Centre for Environment Fisheries & Aquaculture Science

Cefas

World Class Science for the Marine and Freshwater Environment

Welsh Disposal Site Review

C6268U

Author(s): Charlotte Clarke, Jon Rees

Issue Date: 24th March 2020

Cefas Document Control

Submitted to:	Sharon Davies – Welsh Government
Date submitted:	26th March 2020
Project Manager:	Stephanie Eccles
Report compiled by:	Charlotte Clarke
Quality control by:	Jemma Lonsdale
Approved by and date:	Stephanie Eccles 26/03/2020
Version:	5.1

Recommended citation for this report:

Clarke, C., Rees, J. (2020). Welsh Disposal Site Review. Cefas Project Report for Welsh Government. 79pp.

Version Control History

Version	Author	Date	Comment
1.0	Charlotte Clarke, Jon Rees	16/01/2020	First Draft
1.1	Jemma Lonsdale	12/02/2020	QC
2.0	Charlotte Clarke, Jon Rees	13/02/2020	Second Draft – addressed QC comments
2.1	WG	25/02/2020	Welsh Government QC
3.0	Charlotte Clarke, Jon Rees	26/02/2020	Addressed QC comments.
3.1	Jemma Lonsdale	28/02/2020	Technical QC
4.0	Charlotte Clarke, Jon Rees	28/02/2020	Addressed QC comments.
4.1	Charlotte Clarke, Jon Rees	11/03/2020	Addressed final Welsh Government comments
5.0	Jemma Lonsdale	13/03/2020	QC
5.1	Charlotte Clarke, Jon Rees	13/03/2020	Final Version

ISBN 978-1-80391-162-5

Executive Summary

Within the UK, the disposal of dredged material at sea is regulated through the Marine and Coastal Access Act 2009 (MCAA), and equivalent for Devolved Authorities. Under Part 4 of the MCAA, the deposit of any substance or object within the UK marine area is subject to a marine licence. For the purposes of MCAA, the UK marine area is defined as the area of sea, including the seabed and subsoil of the sea, within the seaward limits of the territorial sea adjacent to the UK and within the UK exclusive economic zone (EEZ). This includes any area submerged at mean high water springs, and the waters of any estuary, river, or channel, so far as the tide flows at mean high water springs. A Marine Licence is issued by the appropriate licensing authority following a thorough and robust assessment of marine licence applications, having regard to the need to protect the environment, human health, and the need to prevent interference with legitimate uses of the sea.

Natural Resources Wales (NRW) administers and determines marine licence applications in Wales, acting on behalf of the Welsh Ministers. NRW, assess the suitability of dredged material for disposal at sea in line with relevant legislation and the UK's international obligations. Following consultation on a proposed disposal application, NRW determine the suitability of a suggested disposal site, ensuring that the dredged material disposed does not interfere with other uses of the sea or have adverse impacts on the marine environment or human health.

There are currently 13 open disposal sites designated for the disposal of dredged material under the jurisdiction of NRW (as of end 2017). These sites receive a combined average of 3,008,129 wet tonnes material per annum (across all open sites), which comprises maintenance and capital dredge arisings (e.g. for navigational access to ports and harbours, with an average of 2,842,272 wet tonnes maintenance and 165,857 wet tonnes capital material disposed per annum across all sites) and a small amount (an average of 609 tonnes per annum) of fish waste (in the form of shellfish shells). Although it is worth noting that the fish waste disposal was terminated at the end of 2017, and this is no longer deposited in Welsh waters. With the exception of this fish waste

disposal site, the open disposal sites are still used for on-going disposal operations and considered suitable for disposal following a favourable determination on applications to use the site.

The aim of this project is to review the current open disposal sites in Welsh waters to further inform understanding of how disposal operations interact with the wider marine environment.

Table of Contents

Tables

Figures

1 Introduction

1.1 Regulatory obligations regarding disposal of waste at sea

Within the UK, the disposal of dredged material at sea is regulated through the Marine and Coastal Access Act 2009 (MCAA), and equivalent for the Devolved Authorities. Under Part 4 of the MCAA, the deposit of any substance or object within the UK marine area is subject to a marine licence. For the purposes of MCAA, the UK marine area is defined as the area of sea, including the seabed and subsoil of the sea, within the seaward limits of the territorial sea adjacent to the UK and within the UK exclusive economic zone (EEZ). This includes any area submerged at mean high water springs, and the waters of any estuary, river, or channel, so far as the tide flows at mean high water springs. A Marine Licence is issued by the appropriate licensing authority following consideration of the licence application alongside the need to protect the environment, the need to protect human health, and the need to prevent interference with legitimate uses of the sea.

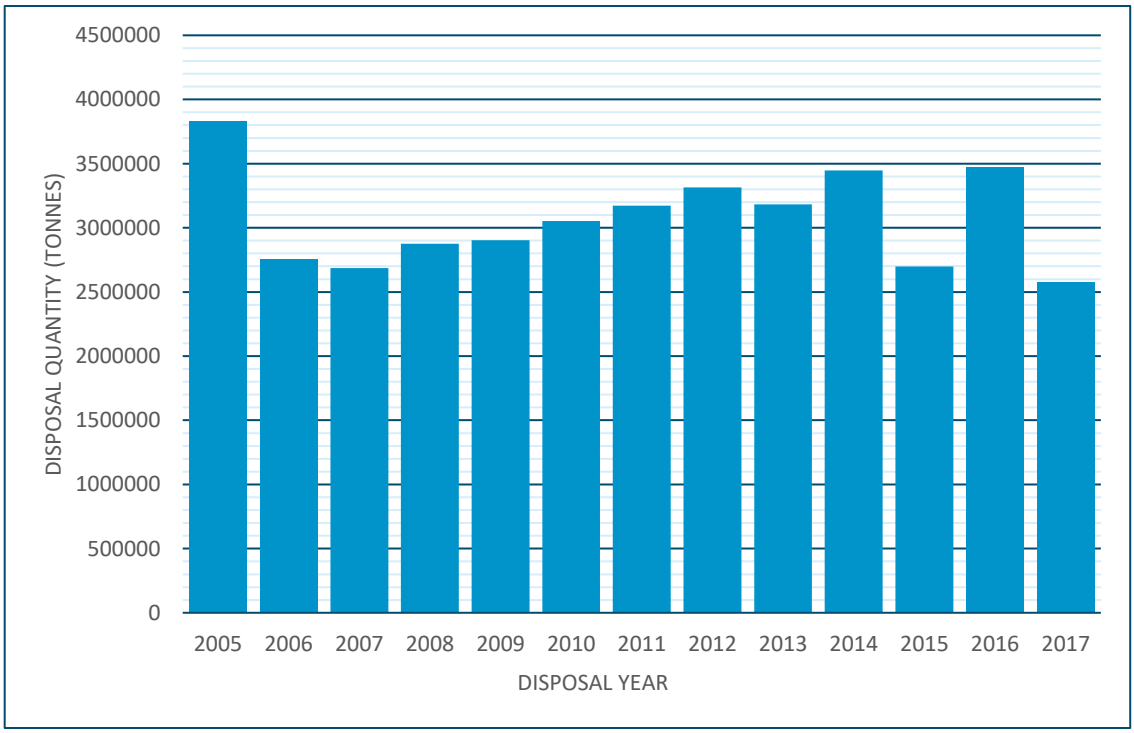
The MCAA also ensures that the UK complies with international obligations as they relate to the disposal of waste at sea, such as those under the OSPAR Convention and the London Convention and London Protocol, to which the UK are a Contracting Party. Under these international conventions only specific types of waste are permitted for disposal at sea[1]. Furthermore, section 71(6) of the MCAA states that licencing authorities must abide by international obligations when issuing marine licences. Since the late 1990s, the only type of material to be routinely licenced for disposal at sea within Welsh waters are dredge arisings (e.g. for navigational access to ports and harbours) and a small amount (an average of 609 tonnes per annum) of fish waste (in

[1] The types of waste that may be permitted for disposal at sea, following the provision of an appropriate licence, are: dredged material; fish waste, or material resulting from industrial fish processing operations; vessels and platforms or other man-made structures at sea; inert, inorganic geological; and, material organic material of natural origin.

the form of shellfish shells). Although it is worth noting that the fish waste disposal was terminated at the end of 2017, and this is no longer deposited in Welsh waters.

1.2 Welsh Disposal Sites

There are currently 13 open sites[2] designated for the disposal of material at sea within Welsh waters (as of end 2017[3]). The amount of dredged material being disposed of to sea within welsh waters has remained relatively constant since 2005 (Figure 1.1), with the total volume of dredge material disposed to open disposal sites in 2017 being 2,576,686 tonnes (although this is not evenly distributed across all sites, as one disposal site (LU130) received over half this material, whereas others received less than 20,000 tonnes).



[2] A new disposal site was designated following the submission of the 2017 data, Tenby, and whilst the first return has been received under the marine licence, the data are currently going through a review/QA process so this site hasn't been included in this review as the review is based on disposal returns up to 2017

[3] Note that only disposal returns up to 2017 have been used to inform this review. Returns after 2017 were not available at the time of this review

Figure 1.1: Bar chart showing the total quantity of dredge material disposed at licenced Welsh disposal sites from 2005 to 2017.

Dredge and disposal operations are essential for the safe passage of vessels to and from ports, harbours and marinas and are often required to support the build of new coastal infrastructure projects. Given the importance of dredging operations and the ongoing need to dredge in Welsh waters, which is likely to continue into the future, dredging and disposal is specifically considered as a sector within the Welsh National Marine Plan (WNMP), with the sector objective listed as: *"To maintain safe and effective navigational access for shipping, fishing and leisure craft and support future growth and increases in port facilities and vessel size whilst promoting the optimal sustainable use of dredged material and ensuring adequate disposal facilities are available"*. Within the WNMP, dredging is considered vital to social and economic development, and therefore has been identified as an area of priority for Welsh Government. In addition, the WNMP notes that whilst there is a requirement to ensure adequate provision for port access and disposal sites, beneficial use of dredged material is to be encouraged. Beneficial use in this case may include, but it not limited to, retaining sediment within the natural sediment system to support sediment-based habitats, shorelines, and infrastructure (known as Sustainable Deposit), as well as habitat restoration, beach nourishment, and shoreline stabilisation/protection. Furthermore, section 314 of the WNMP states that *"disposal site selection should ensure that the deposition of material does not significantly interfere with, or devalue, other legitimate users and uses of the marine environment, or result in significant adverse effects upon ecosystem resilience"*

1.3 Impacts of disposal of dredge material

The disposal of dredged sediment in the marine environment can affect the water column features, the physical and chemical nature of the seabed, and the seabed biota, in both the short- and long-term and at near- and far- field scales (MEMG, 2003). The potential impacts could result in the following:

- A deterioration in the overall health/quality of the marine ecosystem;

- A reduction in the socio-economic aspects of the sea including fishery and amenity interests;
- An interference with the legitimate uses of the sea, such as recreation and navigational aspects; and,
- A reduction in the aesthetic qualities associated with the area (for example "muddying" of the water due to the plume, or deposition of less attractive material on beaches).

Once dredged material is disposed into the water column it results in a mixture of sediment and water that is denser than the surrounding water which descends to the seabed. This creates a dispersion plume which is often described in two phases, the dynamic and passive plume. The dynamic plume descends rapidly (within minutes) to the seabed where material will settle. Some of this may be re-suspended because of the impact as it hits the seabed while large particles are likely to remain on the seabed. As the plume of sediment and water descends through the water column fine material can be entrained (stripped out) from the dynamic plume into the surrounding water column and is dispersed laterally as a passive plume (sometimes referred to as a suspended plume) by currents, wave and tide action (Bray, 2008).

The distance to which the suspended sediments disperse, and settle will depend on the oceanographic conditions of the area and the material that is being disposed. Generally, where the currents, tides and wave action are relatively low, sediments will not travel as far as in highly dynamic areas. Also, the finer the material being disposed, the more potential it has to disperse before settling (although this is not the case with highly cohesive muds or mudstone).

It is worth noting that sediment that is deposited on the seabed has the potential to be re-suspended through tidal currents alone, wind and wave action and through storm events. This will be dependent on the location and the depth of the disposal sites but if the storm waves can penetrate through the water-column and reach the seabed the material will be re-suspended (Uncles et al., 2015). Storms are a large-scale effect and will raise levels over the whole area, with even higher concentrations inshore. There

can also be a significant difference between wintertime and summertime suspended sediment concentrations given the changing climatic conditions.

The main effects resulting from disposal activities are temporary increases in suspended sediments, causing increased turbidity, and the deposition of the sediment onto the seabed. As historically most disposal sites have been selected to disperse material over the long term, significant accumulation at the disposal site is not likely over the long term. However, this also suggests that areas outside of the disposal site may be impacted by disposal operations following the dispersal and/or resuspension of material. Therefore, considering the fate of disposed material at the time of disposal and in the following tidal windows is important when discerning its impact.

High turbidity results in low levels of transmitted light and therefore can negatively affect the functioning of light-dependant organisms such as phytoplankton, eelgrass and visual predators, for example fish (Essink, 1999). However, it is also important to note that increased turbidity can be caused by natural processes, such as storm events and spring tides.

Enhanced sediment deposition is probably the most cited impact of dredged material disposal (OSPAR, 2009). Deposition of dredged sediments can adversely affect benthic communities through burial and smothering of benthos (Zimmerman, 2003) and it can affect the feeding/ spawning behaviour of sensitive species such as filter feeders (Sullivan, 2000). Sediment deposition may also alter habitats due to a change in sediment structure, this can result in habitats being altered outside the tolerance threshold species can survive in (Cooper, 2013). Therefore, sediment deposition has the potential to impact on the condition of features of conservation interest. Seabed sediments can also represent a sink for any contaminants (e.g. trace metals, organotins, polyaromatic hydrocarbons, polycyclic biphenyls and pesticides) in the dredged material disposed to sea. Generally, most impacts from contaminants on the seabed are confined to the disposal site or within a few kilometres of it (OSPAR, 2008) but these contaminants are assessed against the Cefas Action Levels prior to the material being deemed suitable for disposal to sea (See Appendix A).

The disposal of dredged material can also act as a pathway for the spread of invasive non-native species (INNS), as species can be contained within the ballast water of ships carrying out disposal operations, or residual spores and larvae could be within the dredge sediment and then spread further upon disposal, particularly with dispersive disposal sites where material travels long distances upon disposal. However, the majority of dredging operations utilise disposal sites in close proximity to the dredge area in order to minimise costs. Therefore, the risk of spreading INNS from disposal operations can be considered low.

1.4 Disposal Site Management

Given the potential impacts that can arise from the disposal of sediment at sea (see Section 1.3), it is important that all applications for disposal at sea are thoroughly and robustly assessed to ensure disposal operations do not impact the environment, human health or other legitimate uses of the sea and that only designated disposal sites are used for the disposal of dredged material.

NRW, as the regulator for marine licencing in Wales, assess the suitability of dredged material for disposal at sea in line with relevant legislation and the UK's international obligations. In order to make a thorough assessment, NRW consult with technical consultees and key stakeholders on disposal to sea applications. This includes Cefas, who are NRW's main scientific and technical advisor on dredge and disposal operations. Cefas undertake a detailed evaluation of the impacts of the proposed disposal activity on the marine ecosystem which includes consideration of:

- The level of contamination of the material to be dredged and disposed of to the site;
- the amounts that the disposal site has previously received (based on yearly basis and if needed on a monthly basis);
- the applied for licensed tonnage (i.e. can the disposal site accommodate the tonnage applied for, based on expert judgement and records of previous disposal operations at the site?)

- if there are multiple users of the site, the number of licences and current total licensed tonnage for a disposal to ensure the site can accommodate all licensed tonnage; and,
- the type of material to be deposited i.e. if the material is consolidated it could build up and cause an issue for navigation through the shallowing of a site.

In order to assist with such assessments, Cefas often produce a sampling and analysis plan on behalf of NRW to advise applicants on the location, method, and number of samples, and the types of chemical and physical analysis required to ensure the material will be suitable for disposal at sea. These sample plans are provided with consideration for the UK's international obligations, and therefore utilise the OSPAR guidelines for the management of dredged material (OSPAR, 2014).

Following consultation, NRW determine the suitability of a proposed disposal site, ensuring that the dredged material disposed does not interfere with other uses of the sea or have adverse impacts on the marine environment or human health. The disposal site has usually been suggested by the applicant in their licence application, however it is the responsibility of NRW to determine whether this disposal site is appropriate or not. If an appropriate disposal site cannot be identified, then a new disposal site would need to be characterised and designated, or the license refused. This need would normally be identified during the marine licence pre-application phase and reasons may include:

- there are no existing disposal sites that the project can logistically use;
- existing disposal sites cannot take the type of material that will be dredged; and/or
- capacity at an existing disposal site has been reached.

The responsibility for undertaking the process of characterising a new disposal site would normally lie with the applicant who requires a marine licence for dredging and disposal. The principal factors to be considered when selecting a disposal site are listed in the Revised Specific Guidelines for Assessment of Dredged Material (IMO, 2014) that supplement Annex 2 of the 1996 Protocol (London Protocol) (IMO, 2003), these are:

- there are no existing disposal sites that the project can logistically use;
- location of amenities, protected areas, and other uses of the sea in the area;
- characteristics of the water-column and the sea-bed at potential disposal sites;
- economic and operational feasibility of marine transport of the material to the site;
- size of the disposal site: large enough to accommodate the anticipated ongoing volumes of waste without unacceptable degradation of the marine environment or interference with other uses of the sea, but small enough for practical monitoring;
- characteristics of the material to be dumped, including the presence and mobility of contaminants; and
- the presence of other disposal sites in the vicinity

The findings of a disposal site characterisation are presented in a disposal site characterisation report. Once NRW has received a characterisation report and undertaken a consultation with interested parties it then makes an evaluation of the report. If that evaluation is favourable, then NRW designates the site as open. However, the designation of a disposal site only defines an area where disposal may be allowed to take place it does not guarantee that a specific disposal project will necessarily be allowed to proceed. In addition, the characterisations are undertaken and evaluated on a risk-led basis, and therefore some sites may require more information than others before designation is permitted.

2 Aims and Objectives

2.1 Project aims

The aim of this project is to review the current open disposal sites in Welsh waters to further inform understanding of how the disposal sites are interacting with the wider marine environment. The project is being carried out through a high-level desk based review to provide an overview of the potential dispersal of sediment from disposal sites, and the related potential for the disposal operations to act as pressures to nearby features .

2.2 Objectives

1. Review current open disposal sites within Welsh waters, and detail current status of these disposal sites to include, but not limited to:
    a. Disposal site name;
    b. Disposal site code;
    c. Type of material disposed;
    d. Location;
    e. Frequency of use; and,
    f. Annual disposal volumes.
2. Detail any sensitive receptors (including features) in the vicinity of each disposal site identified under objective 1. This should include, but not be limited to:
    a. Environmental receptors (e.g. SPA (special protected area), SAC (special area of conservation), Ramsar, SSSI (site of special scientific interest), MCZ (marine conservation zones), fisheries);
    b. Navigational receptors (shipping density and major shipping routes);
    c. Other socio-economic receptors that may be in the vicinity of disposal sites identified under objective 1 (e.g. Tourism, offshore installations, protected wrecks).
3. Consider the likely spread of sediment disposed at each disposal site identified under objective 1 and the potential pathways of interaction between the disposed sediment and sensitive receptors (features) identified under objective 2.

4. Review, evaluate and make recommendations to the Welsh Government for ongoing management if Welsh disposal sites.

3 Methods

3.1 Identification of disposal sites

This review has focused solely on the current open disposal sites under NRW's jurisdiction, and therefore any sites that have previously been designated but are currently classified as "closed" or "disused" have not been included in the review. For the purposes of marine licencing a disposal site is classified as "disused" after a period of 5 years without use and is classified as "closed" after a period of 10 years without use.

The disposal sites classified as "open" have been identified using the disposal returns data that NRW send to Cefas, which currently includes data on active marine licences and designated disposal sites until the end of 2017. Disposal returns data is supplied annually from licencing authorities as a requirement under the OSPAR convention and the London Convention and London Protocol. The data includes information on the volume and type of material that has been disposed of to each disposal site in a given year, any new marine licences that have been granted for disposal at sea, and information on the composition of licenced disposal material. This data is held by the Centre for Environment, Fisheries and Aquaculture Science (Cefas) for reporting purposes.

3.2 Collection of sensitive receptor data

A variety of suitable data sources were identified and utilised for the collection of data under objective 2, with the primary focus of data collection being on geographic data of sensitive receptors. Information on the data sources used is included in Appendix B of this report. Please note, environmentally monitored beaches were determined to be an appropriate proxy for the location of beaches with notable tourism and amenity value under objective 2c.

3.3 Modelling

Modelling was undertaken to determine the likely spread of disposed material and the dispersive nature of disposal sites as detailed in Objective 3 (Section 2.2). The Cefas Plume model (AE0910) was chosen as an appropriate model with which to explore transport pathways from disposal sites. The model uses a database of tidal constituents (M2, S2 etc) to create the flow fields over a wide grid of around the Welsh coastline, expressed as tidal ellipses in Figure 3.1. This shows the changes in ellipse, from strong almost recta-linear around the NW of Anglesey, to open ellipses with weak flows on the Sellafield Mud Patch (only every tenth point shown to aid clarity). Each of these points includes a residual flow.

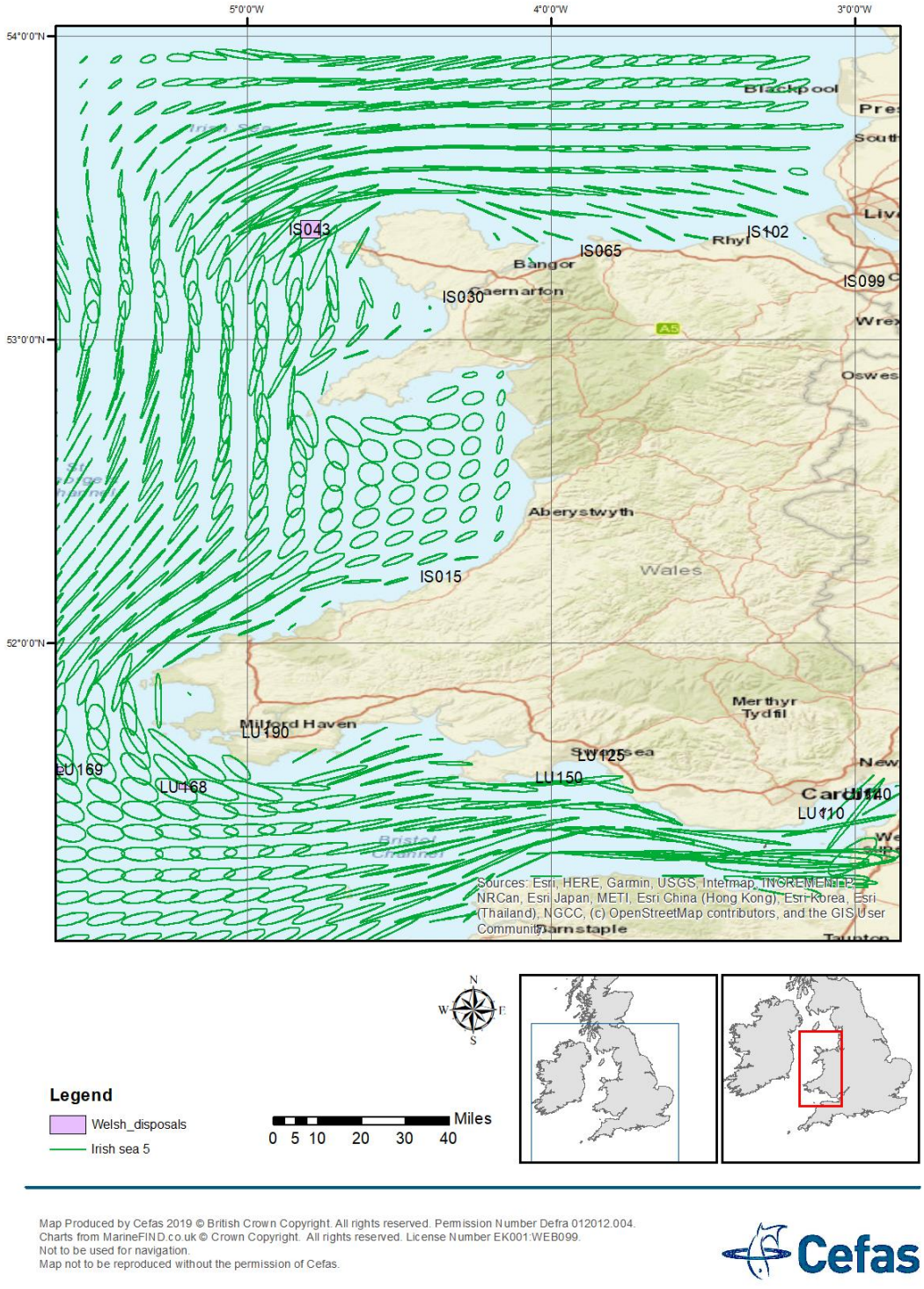


Figure 3.1: Tidal ellipses from the Cefas Plume model (every 5th grid point shown).

The model was run for each disposal site, assuming a disposal duration of 1 hour within a circle of 0.1 km radius in the centre of the disposal site. Each model simulation was run for 60 hours, with data points produced showing the location of sediment at the sea surface, water column, and seabed in 6 hourly increments. In order to determine the

relative amounts of material at the sea surface, water column, and seabed at each increment of the model run, a percentage of the total datapoints in each area after each 6-hour period. The currents used within the model were based on the winter period, as this was considered to provide a maximum dispersal scenario, given that tidal currents in winter will likely result in the maximum dispersion of material. Where known, the particle size distribution modelled at each site was based on the sediment previously disposed to that site. Where this information was not known, the particle size distribution used for the modelling was that shown in Table 3.1, which is typical of a muddy estuarine sediment, the source of the majority of Welsh dredging.

Table 3.1: Particle size distribution used for modelling (when the distribution of sediment previously disposed at the site is not known).

% of sample	**9.5**	**16.7**	**16.7**	**16.7**	**16.7**	**9.5**	**7.1**	**2.4**	**2.4**	**1.4**
Size Band (microns)	2	30	60	80	110	140	170	200	220	250

3.3.1 Natural Suspended Sediment Distributions

The Suspended sediment levels in the waters around Wales are controlled by a variety of natural factors. Firstly, the discharges from the major riverine systems like the Severn, secondly resuspension by tides when tidal currents are sufficient to erode the local sediment or by storms (and in combination with tidal currents) when forces acting on the seabed exceed the natural erosion threshold (Soulsby, 1997). Maps of the surface suspended sediment concentration are available (Tiago et al., 2016) and have been published as geodatabases (Tiago, 2016) from satellites using the appropriate calibration algorithms. When resuspended into the water column, the fines will remain in suspension for considerably longer than coarse particles due to the differing sediment fall velocity. Churchill (1989) showed that a sediment settling function could be used to show the typical time scales for material to reach 50 or 10 % of the original starting value using just particle size data. In order to determine an appropriate maximum run-time for the model, considering the principles set out in Churchill (1989),

particle size data from the Holyhead North Site (IS043) (as an example of a typical Welsh disposal) was compared with a typical marine mud and sand (Figure 3.2). Initially, the disposal site IS043, sediment acted as a sand, as the heavy particles fell quickly to the seabed but as the portion of sands increase the behaviour changed to that of a mud. Note times greater than 80 hours should be ignored due to hindered settling of the fine particles. This determined that after 60 hours, the majority of the material (approximately 75%) had settled out of the water column, and therefore this was determined to be an appropriate stopping point for the model The suspended sediment climatology (Figure 3.3) shows the monthly mean surface suspended sediment

concentration. Higher concentration (over 100 mg/l) are associated with turbid estuaries such as the Severn, Morecambe Bay and the Wash estuary.

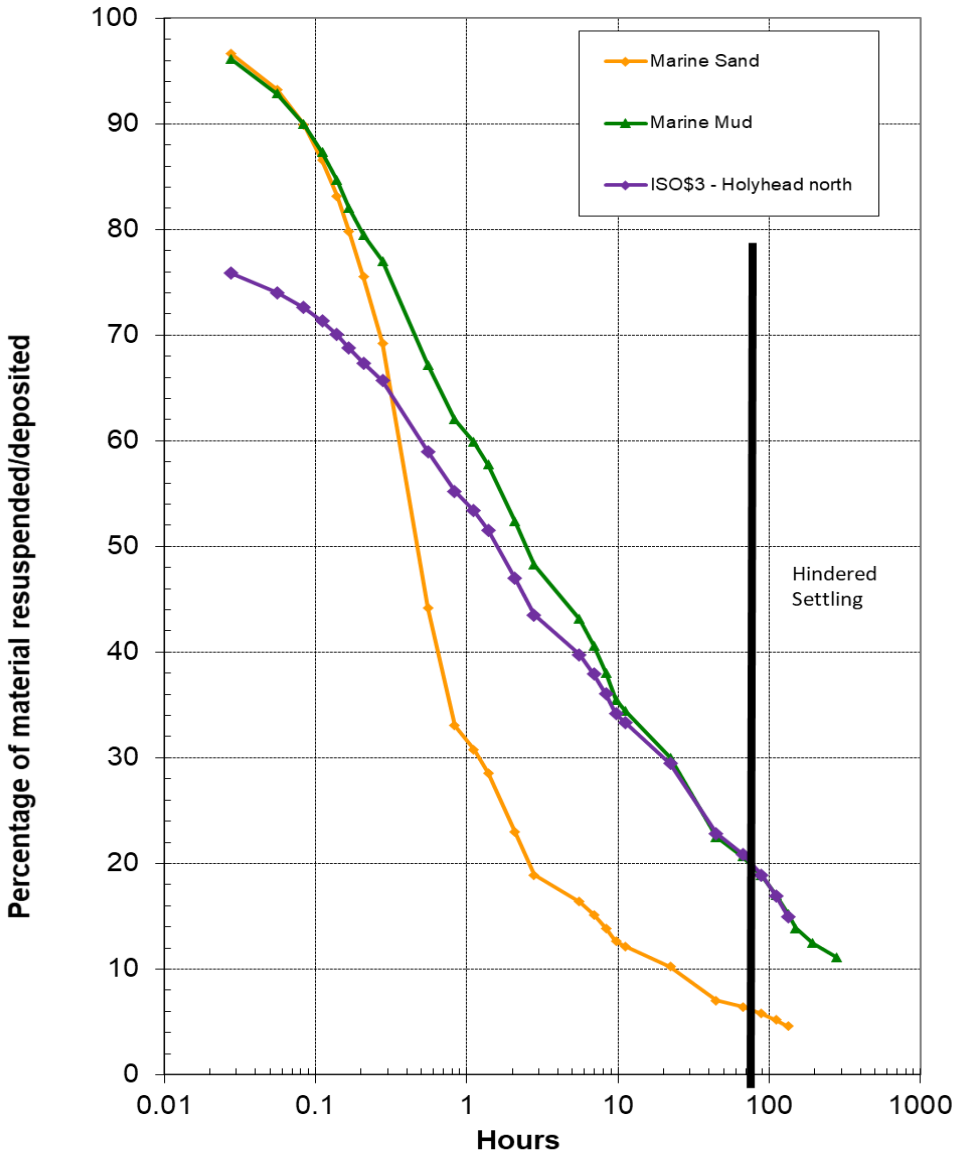


Figure 3.2: Comparison of Sediment Settling Function for Marine Sand, Muds and disposal from Holyhead North (IS043).

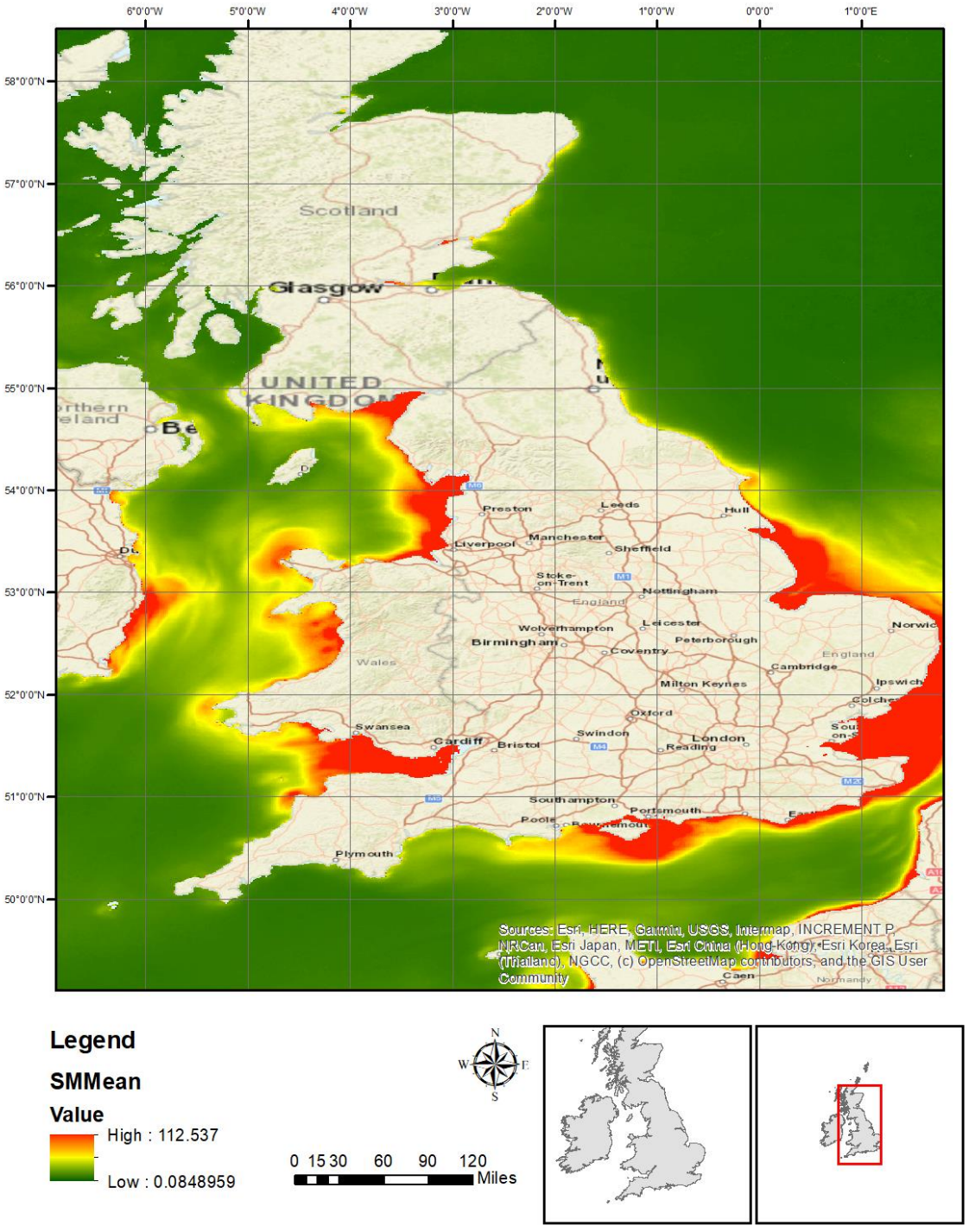


Figure 3.3: Suspended Sediment Climatology (1998-2015) contoured with a stretch algorithm (monthly mean mg/l).

3.3.2 Modelling limitations

In order to undertake this modelling, the Cefas Plume model has been used to explore dispersion of fines from a potential disposals site. It should be noted that this is a desk-based tool and designed to give a first order approximation of the plumes. The limitations to this model include:

- It is assumed that historic dredging record represents the material currently planned to be disposed
- The Cefas Plume Model is a tidal current model – no inclusion of wave dynamics has been included as waves are not a significant physical factor in the majority of sites e.g. sites within the estuary. However, the sites off Anglesey and Swansea will experience annual significant mean waves of approximately 1.50 m and 1.0 m for Anglesey and Swansea respectfully (ABPmer Renewables Atlas). These are not sufficient to erode fresh disposals in the water depths further offshore on a mean basis. Whilst individual storms maybe sufficient to the erode material these will tend to accelerate tidal processes.
- No wind driven circulation is included in the model.
- The resolution of the model is relatively coarse at 2.1 km and some features such as headlands and estuaries will not be resolved. In this instant, the Conwy estuary is not resolved.
- Many of the disposal sites are within potential ROFI (Region of Freshwater influence) zones such as the River Conwy. This potential changes to the density stratification due to the presence of fresh water has not been included. Likewise, the dynamics of freshwater plumes have not been included, this includes relatively dynamic estuaries such as the responsive Conwy, to major estuaries like the Severn which may have large plumes for many months.
- All the scenarios assume that there is no wind. In reality, wind strength and direction can be an important driver of the suspended sediment plume especially in areas of weak residual circulation or where topographic features can steer and moderate the wind regime.
- Due to time limitations, a thorough calibration and validation procedure has not been undertaken. However, over many decades, the size and direction of

the tidal ellipses, the mean flow field and the dynamics of the disposal plume have been found to be correct for a desk-based studies in a variety of locations around the UK.

3.4 Identifying Pathways of Interaction

The overall framework for identifying potential interactions between disposal sites and Marine Protected Areas potential was to use the SPR (Source-Pathway-Receptor) framework. The source material was generally well characterised in terms of tonnages, particle size analysis and locations, which was obtained from the disposal returns database held by Cefas. This database is compiled and managed as part of the UK's international obligations (under OSPAR and the London Convention and Protocol) to keep records and report on the nature and quantities of wastes disposed of at sea, and therefore contains information from all marine licences issued for the disposal of waste at sea. The transport pathway would be determined by the model and the receptor would be characterised as the sensitive features within their zone of interest.

3.4.1 GIS Mapping

The outputs of the modelling for each disposal site were converted into shapefiles using QGIS, which returned three sets of point data shapefiles for each disposal site (circles: the sea surface, diamonds: the water column, and triangles: the seabed). These were then mapped in ArcMap 10.5 alongside sensitive receptor data to carry out an assessment of each site.

4 Results

4.1 Identification of disposal sites

This review has focused on the open disposal sites. The status of sites was determined from the disposal returns data that is held by Cefas[4], and is based on the following criteria:

- Open: A site that is currently available for use
- Disused: A site that has not been used for a period of five years
- Closed: A site that has not been used for a period of ten years.

A total of 13 disposal sites were identified for inclusion in this review and the details of these sites are included in Appendix B.

4.1.1 Summary of sites that were excluded from review

Any sites that were classified as closed or disused have been excluded from this review. 16 disposal sites identified to be excluded from this review based on these criteria. The details of these disposal sites are included in Appendix B.

4.1.2 Summary of sites included in this review

There are currently 13 open sites designated for the disposal of material at sea within Welsh waters. Of these 13 sites, five are classified as "beneficial use" sites, meaning the dredged material is used as part of a scheme to benefit/enhance the surrounding environment (e.g. beach replenishment, managed re-alignment), and one is designated for the disposal of fish waste (shellfish shells) only. It is worth noting that the fish waste disposal was terminated at the end of 2017, and this is no longer deposited in Welsh waters, however has been included within this review as it meets the criteria of an open site (as specified in Section 4.1). With the exception of the fish waste disposal site, the disposal sites primarily receive dredge arisings from the maintenance dredging of

[4] Please note that the data utilised for this review is correct until the end of 2017. Any disposal sites designated, or marine licences issued, after this time have not been included as part of this review.

nearby ports and harbours, as well as occasional capital dredge arisings from new constructions or expansions. The location of all the sites is shown in Figure 4.1, which also highlights whether the sites are designated for beneficial use or not.

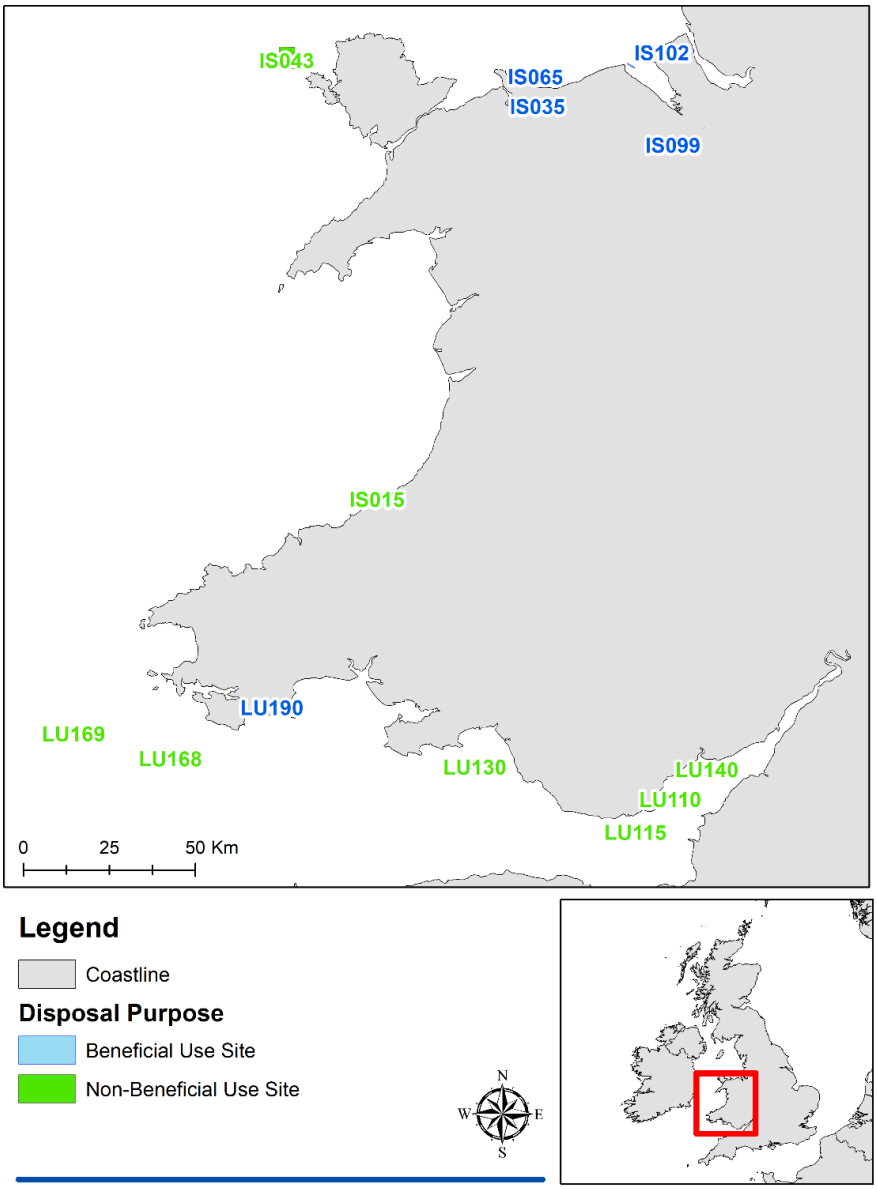


Figure 4.1: Map showing the locations of open disposal sites within NRW's jurisdiction. The labels are colour coded based on the purpose of disposal.

4.2 Sites where the model was unable to be run

Four of the identified disposal sites were outside the plume model domain as they were located too far inshore, and therefore were not able to be assessed based on model results. In this case, expert knowledge of the surrounding area has been applied to

assess the dispersal of disposed material and potential likelihood of impact to surrounding sensitive receptors.

4.2.1 Conwy Estuary: Deganwy (IS035) and Conwy (IS065)

The two beneficial use sites within the Conwy estuary (IS035 (Deganwy) and IS065 (Conwy)) are associated with the maintenance dredging of the nearby marinas. Records of disposal volumes since 2009 show a total of 37,015 tonnes disposed at IS035 with annual averages of 6,169 tonnes (Figure 4.2). Across the estuary, IS065 received 169,216 tonnes between 2009 and 2017 with annual averages of 28,202 tonnes (Figure 4.3). Particle size analysis of IS065 shows a dominance of silts 81% and a smaller proportion of sand (18%). IS035 is likely to be have similar particle size characteristics, however this information was not available in the returns data utilised to inform this review.

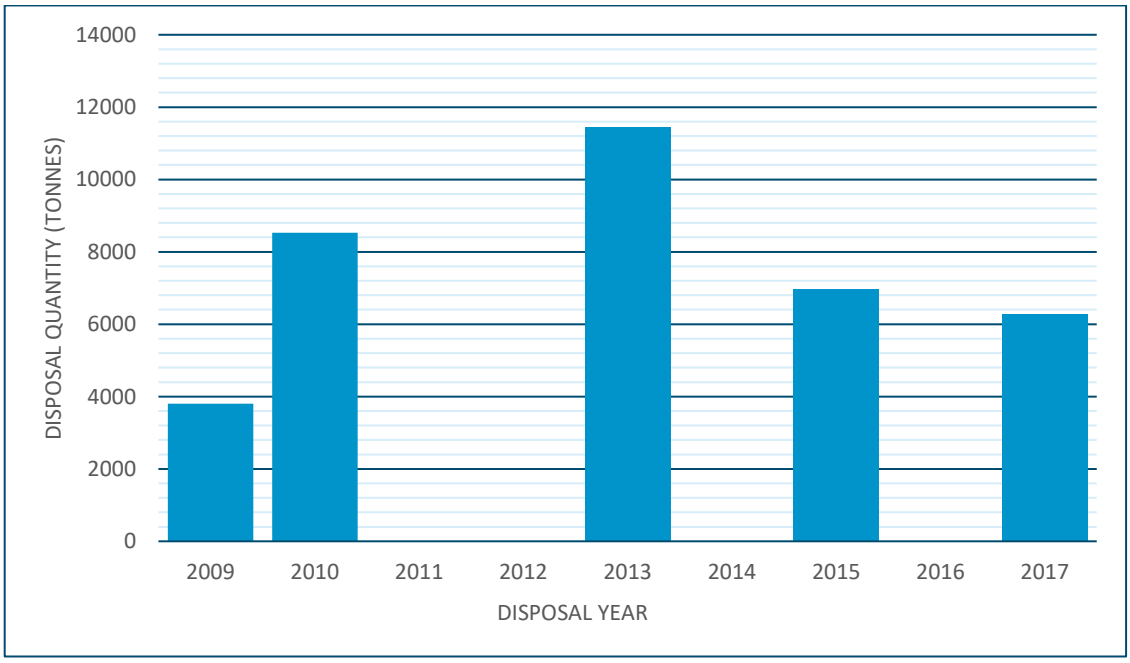


Figure 4.2 Bar chart showing the annual disposal quantities (tonnes) at the Deganwy (IS035) disposal site between 2009 and 2017. All volumes are for disposal of maintenance dredge arisings.

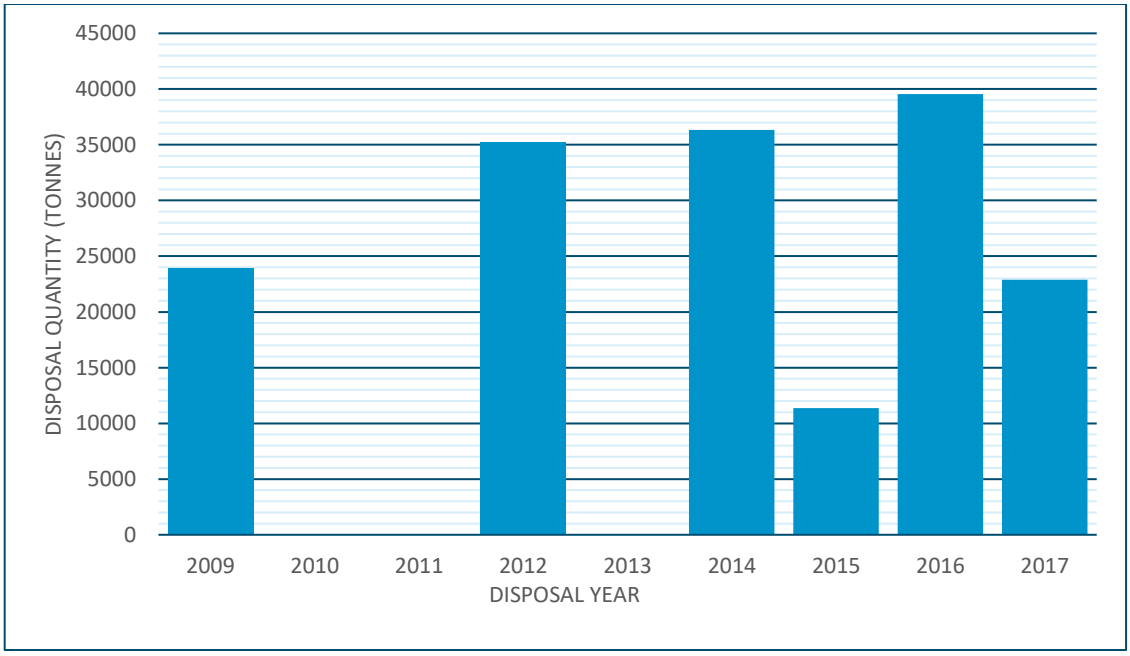


Figure 4.3 Bar chart showing the annual disposal quantities (tonnes) at the Conwy (IS065) disposal site between 2009 and 2017. All volumes are for disposal of maintenance dredge arisings.

Both disposal sites are located close to the marinas that need to be dredged and are located on the flanks of the estuary (IS065) and the intertidal flats (IS035), as shown in Figure 4.4.

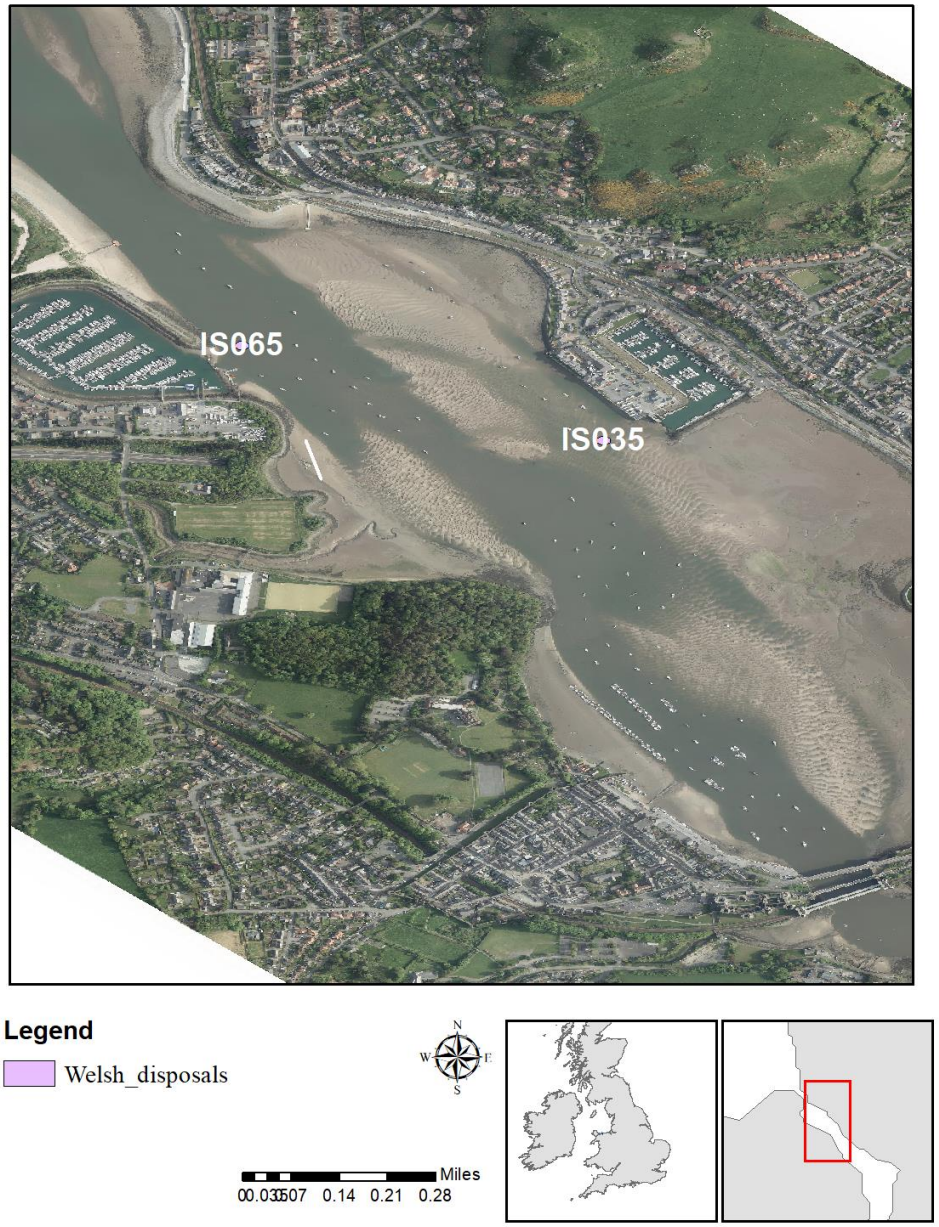


Figure 4.4: Arial imagery of Conwy, showing disposal sites Conwy (IS065) and Deganwy (IS035), taken from an overflight survey May 2018 (source: COO)

Comparison of the 2012 and 2018 overflights (Figure 4.5) shows sediment features on the seabed orientated North West (i.e. ebb dominated). It is noted that the Conwy is a highly responsive estuary (pers comm Peter Robins) as the catchment is relatively large and estuary short resulting in a very "flashy" or responsive estuary with strong ebb events over a few days (see River flow timeseries: Fig 2b from Robins et al (2019)). Estuaries such as the Conwy are complex with strong lateral and longitudinal gradients in temperatures, salinity and suspended concentration that vary over the neap-spring

cycles and the volume of freshwater input within the catchment. Therefore, model predictions from these estuaries can only be undertaken when the there is strong confidence that the model includes all the appropriate physical processes and is well calibrated/validated.

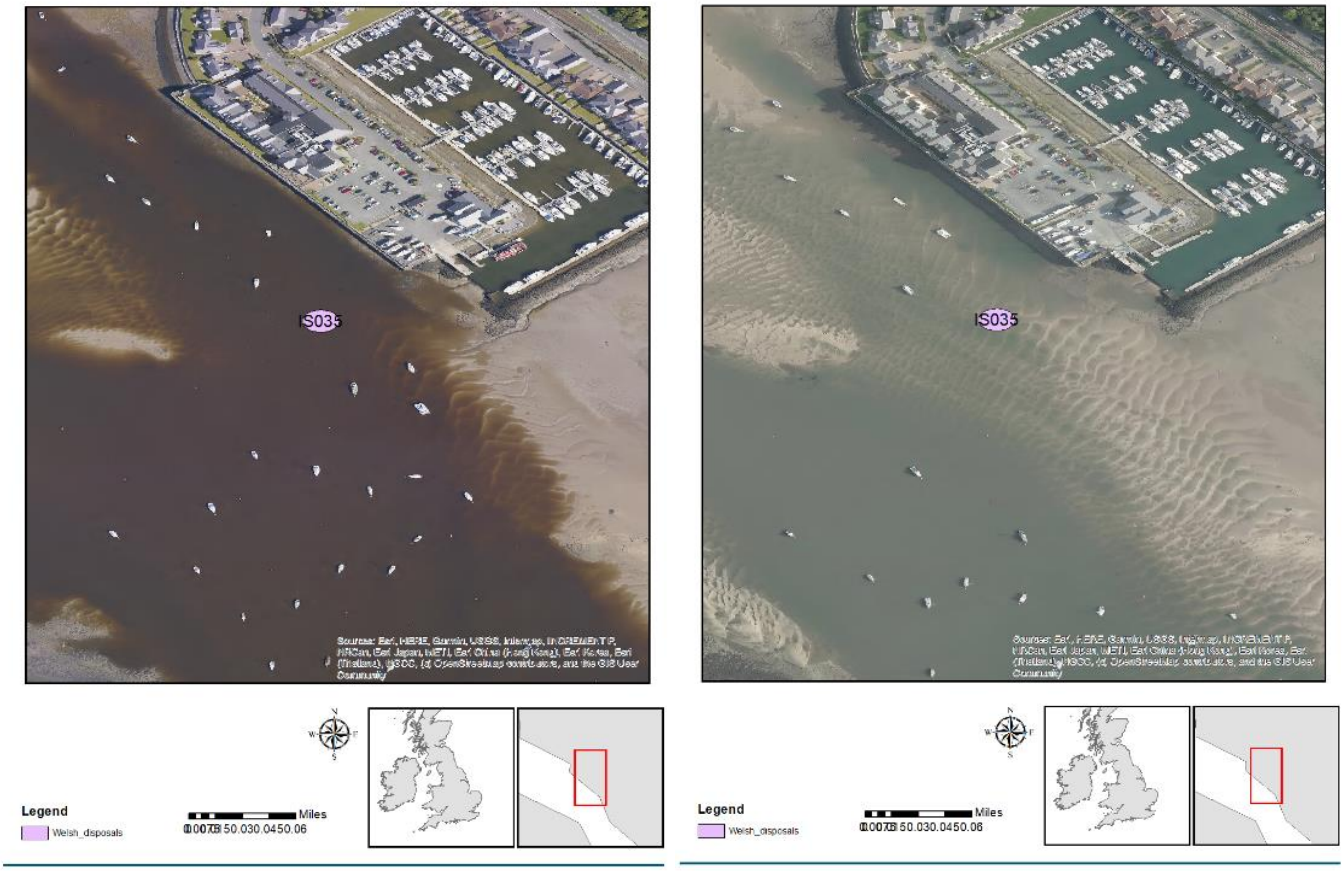


Figure 4.5: The IS035 Deganwy disposal site in 2012 (left) and 2018 (right) using overflight Imagery (source: CCO).

The majority of the material being deposited will take two or three days to reach the seabed assuming a still environment (Figure 3.2). Sediments from disposal will be driven by the predominantly ebb-ward out of the estuary. Sands will tend to be deposited first with silts taking potentially several days to reach the seabed. Furthermore, as the tidal gates only open after the tidal level exceeds 3.5m above chart datum at Conwy and 4.0m at Deganwy Quay (https://www.deganwymarina.co.uk/pilotage), this implies there are more disposals at the end for the flood and the ebb.

However, there are instances such as the Conwy where sediment can be effectively stored within the estuary due to multiple factors. Robins et al (2012) showed using a

realistic and well calibrated model of the Conwy that where environmental fronts converge i.e. salinity changes, or thermoclines, these could create a mechanism for retaining larvae, and by inference, suspended sediments. The Conwy experiences a variety of physical process that can impact the short term and long-term trajectory of suspended sediment particles both horizontally (distance) and vertically (depth/suspended) and on varying timescales. Only a validated numerical model can get a full understanding of the relative strengths of these processes on various length and timescales.

As no direct models of disposals in the Conwy are publicly available, the nearest analogue is that of viruses which whilst neutrally buoyant, will mimic the properties of suspended sediment concentration as they die over time. Whilst, the time scales of decreasing concentrations of suspended sediments and virus may be different, the approximation will give an indication of the suspended front print to a first order approximation.

Figure 4.6 shows the results from Robins et al (2019) modelling of viruses in the Conwy. The total run was for 15 days whereas sediments are more likely to remain in suspension for a 2 – 3 days and thus the first contour line between Orme Head and Llanfairfechan will be used for the maximum dispersal scenario for the disposal of sediment at Conwy (IS065) and Deganwy (IS035) sites simultaneously on the ebb tide.

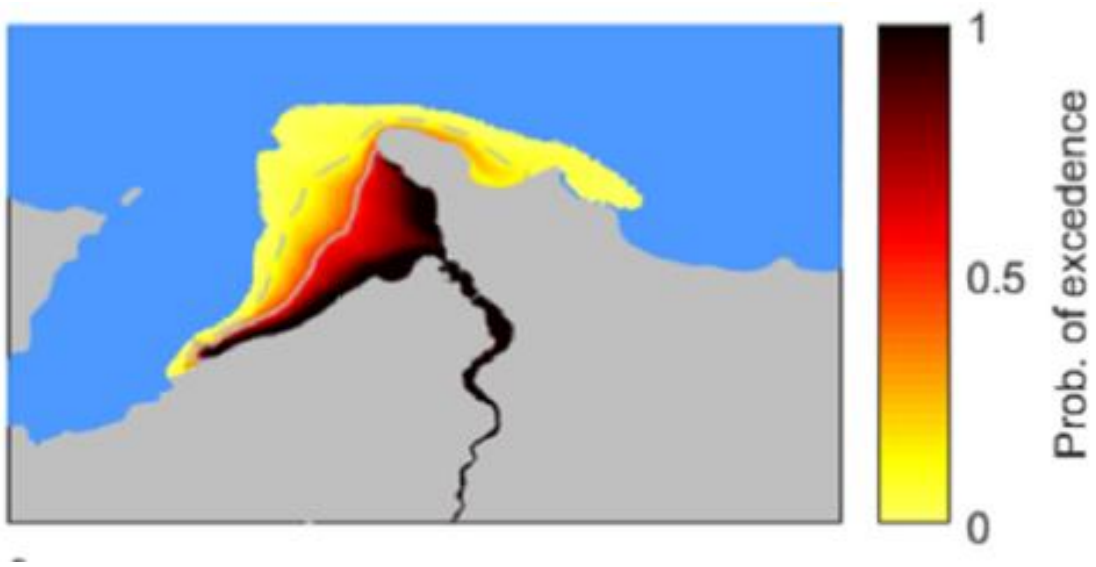


Figure 4.6: Map showing virus concentration with a decay rate in the Conwy (T_{90}=1d)(adapted from Robins et al , 2019 Figure 2d).

The Deganwy disposal site (IS035) is located wholly within the Aber Afon Conwy SSSI, which was designated for the protection of the intertidal communities and habitats. The Conwy disposal site (IS065) is located adjacent to this SSSI. In addition, if material disposed of to these sites is transported out of the estuary and follows a similar dispersal pattern to that displayed in Figure 4.6, it has the potential to interact with the Menai Strait and Conwy Bay SAC, which was primarily designated for the protection of the following Annex I habitats: Sandbanks; Mudflats and sandflats; and Reefs.

With relation to socio-economic receptors, both Deganwy and Conwy disposal sites are located within close proximity (less than 1km) to the shoreline and the active Deganwy and Conwy marinas. In addition, the sites are both located less than 1km (both upstream and downstream) of the M44 shellfish areas, which are designated for *Mytilus* spp.

4.2.2 Broughton (IS099)

The Broughton (IS099) disposal site is located between Chester and the Dee estuary in the Canalised section of the Afon Dyfrdwy. It received approximately 780, 875 tonnes over the years 2010 to 2017. This was dominated by a single disposal of 722,778 tonnes

in 2012 (Figure 4.7). The site, on average, annually receives 9,682 tonnes (excluding the 2012 disposal). Disposals are dominated by sands (95%) with some silts (5%).

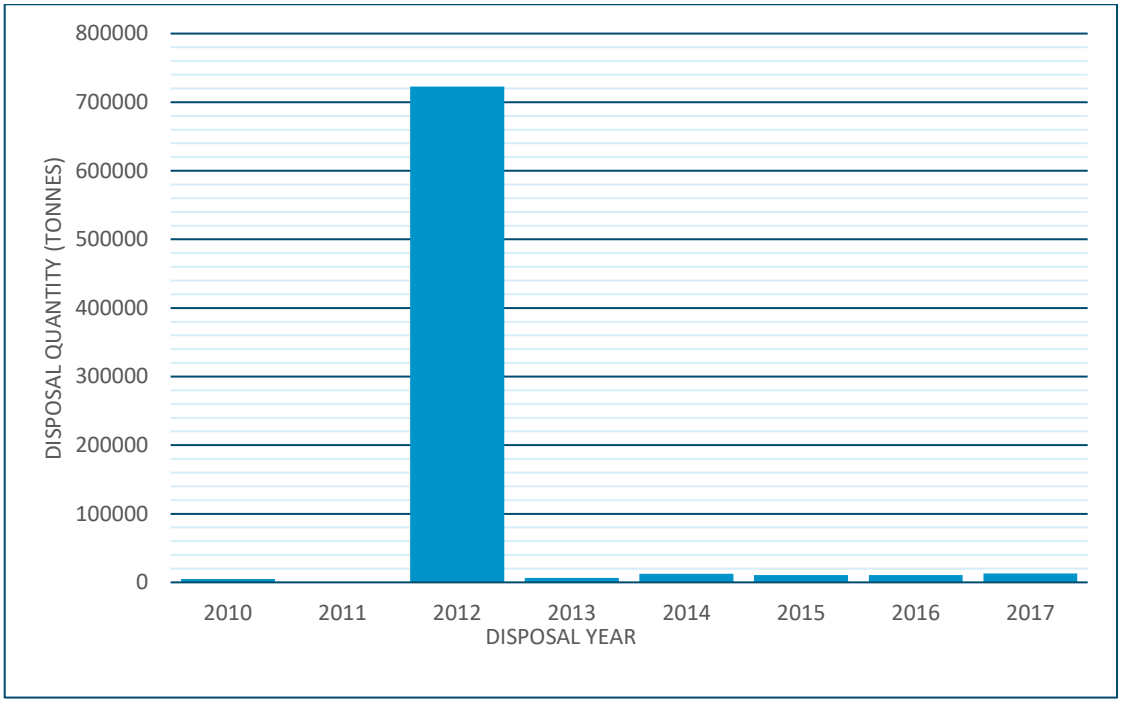


Figure 4.7 Bar chart showing the annual disposal quantities (tonnes) at the Broughton (IS099) disposal site between 2010 and 2017. All volumes are for disposal of maintenance dredge arisings.

The disposal site is located within the River Dee and Bala Lake SAC, which is designated primarily for the protection of the Annex II species Atlantic salmon (*Salmo salar)* and Floating water-plantain (*Luronium natans)*. The site is also located within the River Dee SSSI, which is designated for the protection of Atlantic salmon, Otter (*Lutra lutra*), and Club-tailed dragonfly (*Gomphus vulgatissimus)*, as well as Fluvial Geomorphology and river-supporting habitat.

No modelling of the canalised section or the Dee estuary has been undertaken. Flow rates in the Dyfrdwy river are also unknown but must be sufficient to prevent overloading the disposal site. As the material being deposited is sands, they will fall relatively quickly to the seabed. Anecdotal evidence (pers comm with Mostyn Harbourmaster) suggests that the area between Connah's Quay and the Dee estuary is accreting, and this the likely fate of the material from IS099 (Figure 4.8).

Figure 4.8: Satellite imagery showing the location of Broughton (IS099) and the location of a suggested sink for sediment.

4.2.3 Neyland (Off Milford Haven) (LU190)

The Neyland (LU190) disposal site is situated just below the Cleddau road bridge and receives relatively low volumes of sediment, averaging 3,483 tonnes per annum over the period 2001 to 2017 with disposal in only six of those years (Figure 4.9). No information of particle size distribution of the disposed material is available. Situated

within the Milford Haven Ria, the site is relatively deep at 20m (Carey et al., 2015) with moderate currents but occasional strong episodic fresh-water run-off events.

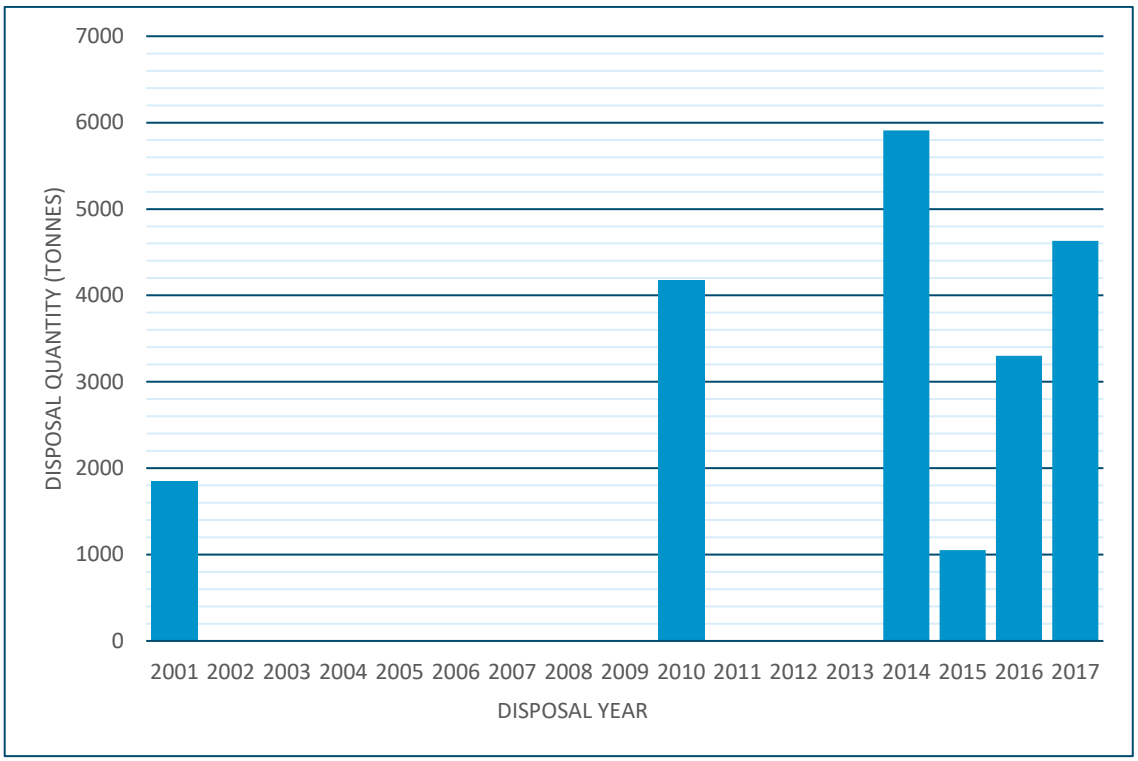


Figure 4.9 Bar chart showing the annual disposal quantities (tonnes) at the Neyland (Off Milford Haven) (LU190) disposal site between 2001 and 2017. All volumes are for disposal of maintenance dredge arisings.

The disposal site is located wholly within the Pembrokeshire Marine SAC (described in section 4.3.8) and is also in close proximity to the Milford Haven Waterway SSSI. However, observations of sediments nearby the disposal site (see Figure 4.10 – Station 441) from an extensive Habitat mapping survey in 2012 show no features associated with impacts of disposal even within the disposal site. Whilst this survey was undertaken two years after any disposal in 2010 (4,169 tonnes) any impacts appear to be within the disposal site and temporary.

With relation to socio-economic receptors, the site is located within the M039 shellfish area, which is designated for *Ostrea edulis*, and is also within a medium-density shipping area due to the nearby Pembroke Port. However, given the lack of impact from the mapping survey discussed above (and in Figure 4.10), the impact to these receptors can be considered low risk.

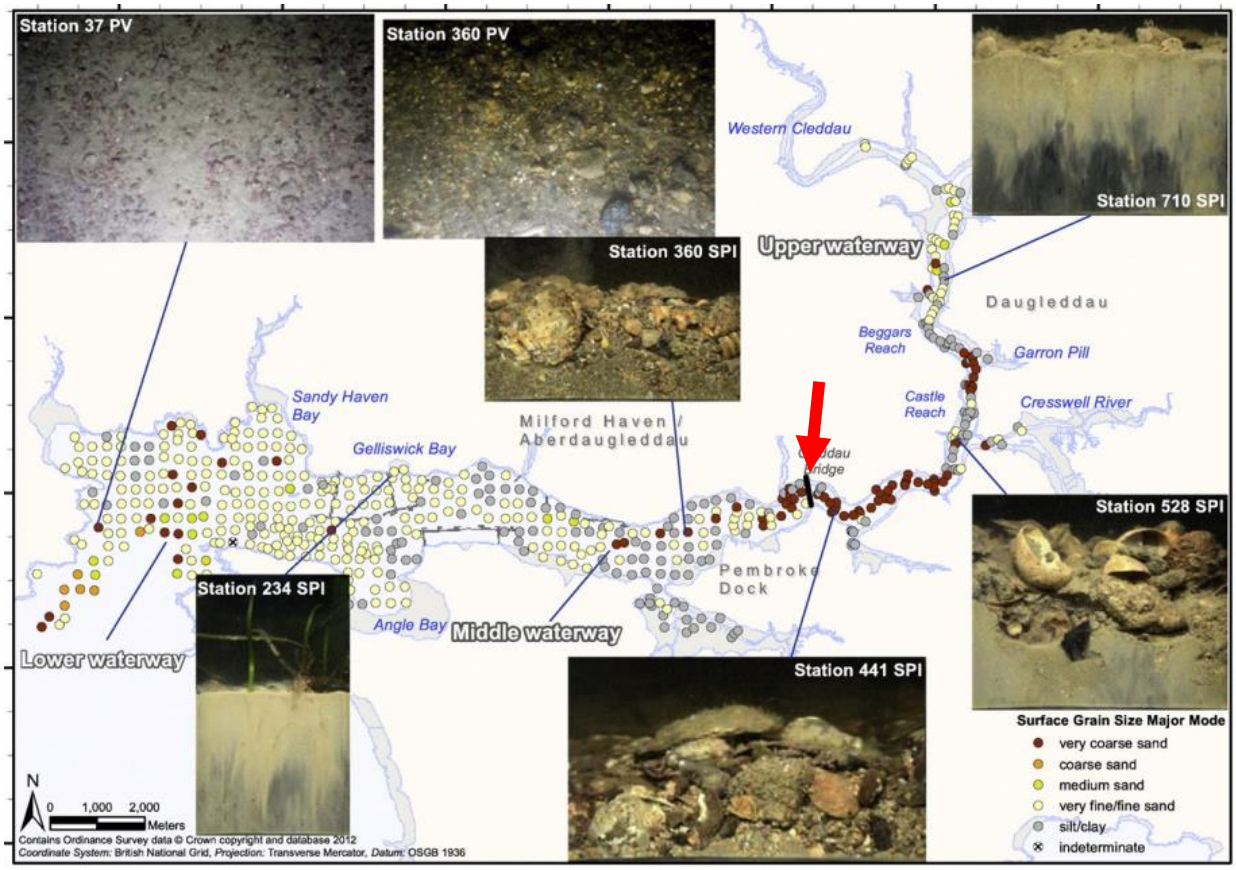


Figure 4.10: Schematic map showing key habitat types from the Milford Haven estuary station 441 is just upstream of the disposal site shown with red arrow (Based on figure 3a from Carey et al, 2015)

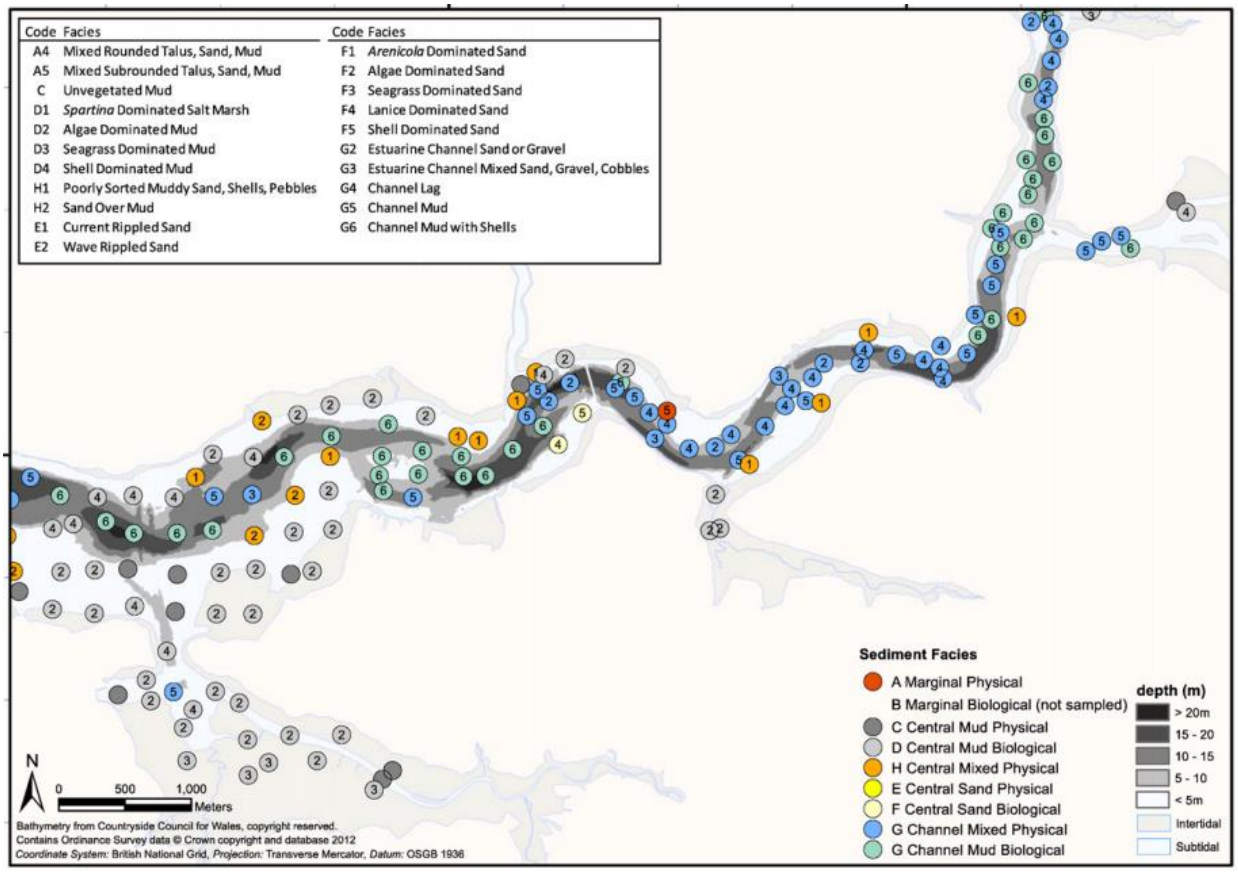


Figure 4.11: Surface sediment data from the region around the Cleddau road bridge(From 3b from Carey et al,2015)

4.3 Sites where modelling results are available

A table summarising the potential pathways of interaction as identified by the model results and the sensitive receptor data obtained to fulfil Objective 2 of this review is provided in Appendix D. However, the observed pathways of interaction at each disposal site are discussed in more detail below.

4.3.1 New Quay Track (IS015)

New Quay Track (IS015) disposal site is located on the West coast of Wales (Figure 4.1) and was licenced solely for the disposal of small volumes of fish waste, in the form of clean shellfish shells. Disposal returns data indicated that the site has been used annually between 2013 and 2017, with an average disposal of 609 tonnes per annum over this period (Figure 4.12). However, this licence under which this fish waste was disposed at IS015 was terminated at the end of 2017, and fish waste is no longer deposited in Welsh waters.

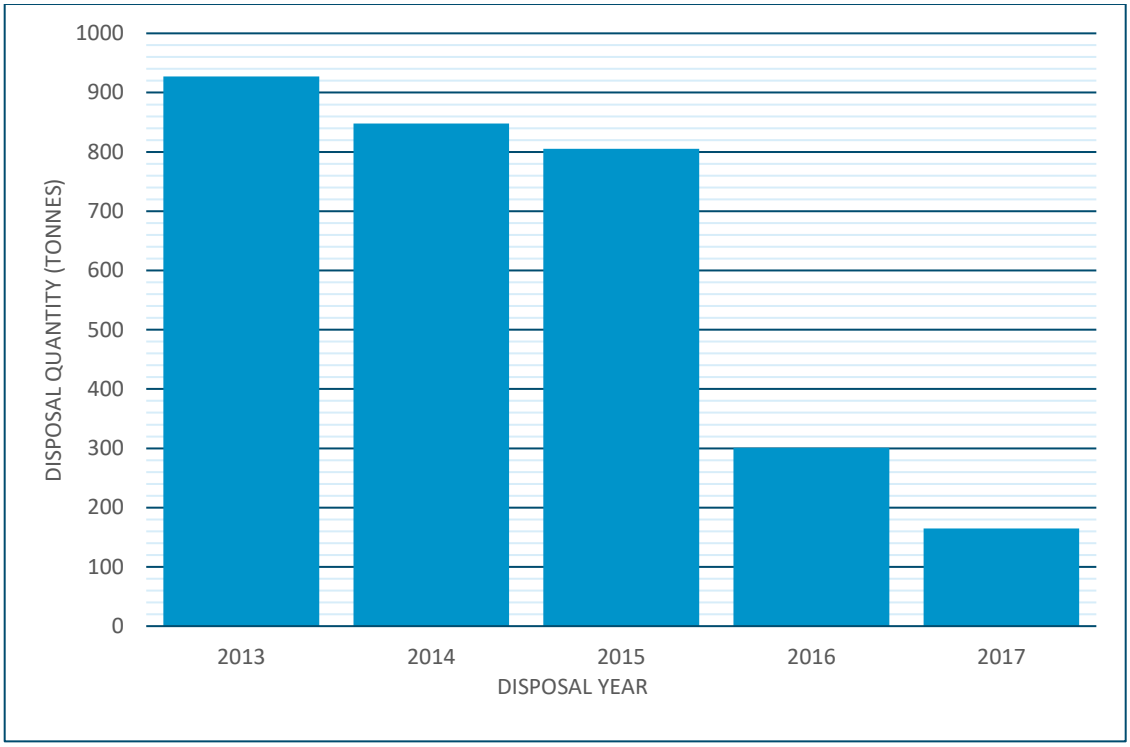


Figure 4.12: Bar chart showing the annual disposal quantities (tonnes) at the New Quay Track IS015) disposal site between 2013 and 2017.

Modelling results, as shown in Figure 4.13, indicate that upon disposal, material remains relatively local to the disposal site, and therefore does not disperse too far up the shoreline. However, as the disposal site itself is located close to the coast (approximately 0.2 km), the disposed material has the potential to wash ashore within the vicinity of the site. The disposal site itself is located within the Cardigan Bay SAC, and Aberarth SSSI, and therefore the disposal plume observed in the modelling also overlaps with these areas.

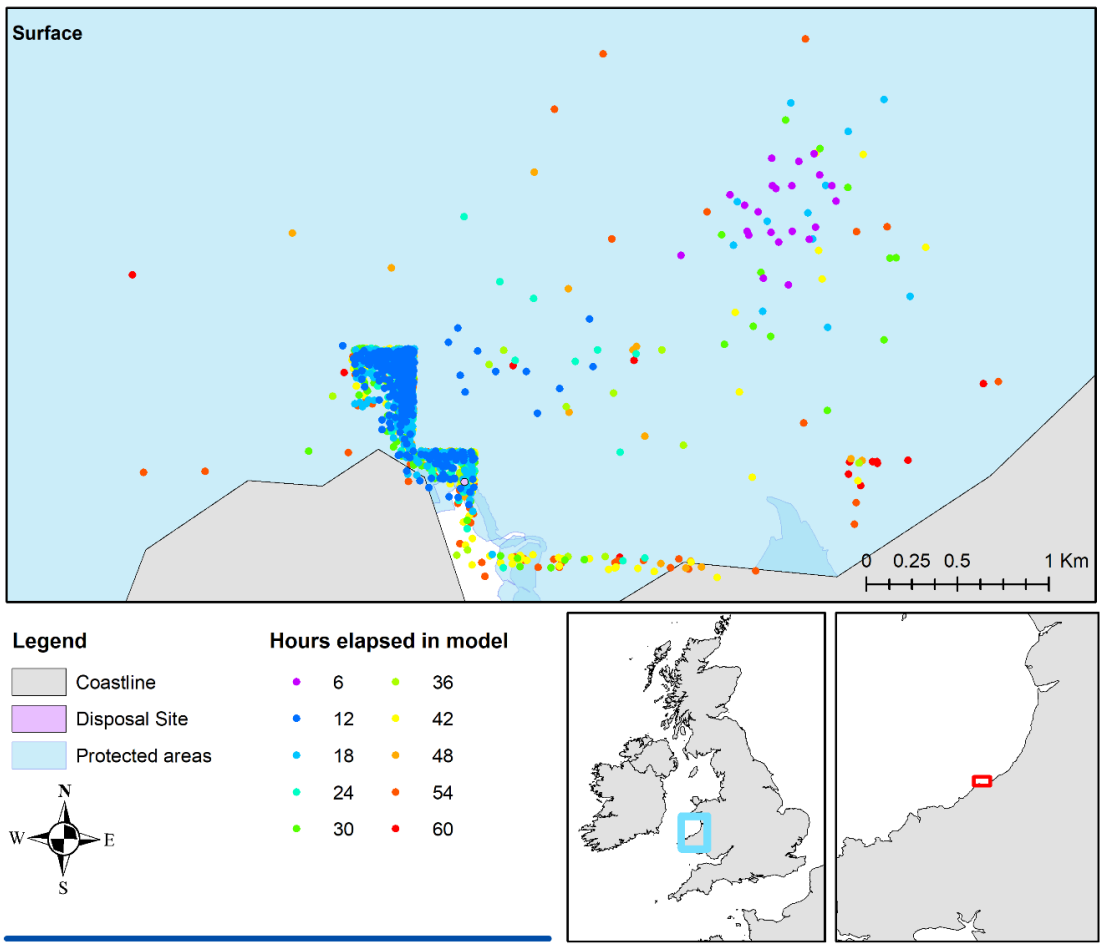


Figure 4.13: Map showing the modelling results for disposal site IS015 (New Quay Track), including any overlap with the disposal site / plume and protected areas. Data points show the location of disposal material at the surface after 6 hour increments of the model run. Note that resolution of the model can be seen as the "steps" in the particle fields.

The Cardigan Bay SAC was designated primarily to protect the Annex II species *Tursiops truncatus* (bottlenosed dolphin), with the JNCC website stating that the dolphin population (which is estimated to consist of 125 individuals) appears to use the inshore waters of Cardigan Bay for both feeding and reproduction, and in the summer months calves and juveniles are often observed with adult individuals or groups. The SAC also protects the qualifiying annex II species *Petromyzon marinus* (sea lamprey), *Lampetra fluviatilis* (river lamprey), and *Halichoerus grypus* (grey seal), and qualifying annex I habitats of "reefs", "sandbanks which are slightly covered by sea water all the time", and "submerged or partially submerged sea caves".

Similarly, the Aberarth SSSI has been designated to protect the bottlenose dolphin and grey seal, as well as the habitats of caves and overhangs, exposed rock, moderately exposed rocks, rockpools, and sand influenced biogenic reefs. Given the nature of these protected species and habitats, it is likely that the majority of these would not be negatively impacted by the disposal operations (Tillin et al., 2010). The protected feature that is most likely to be impacted by disposal operations is the reef habitat, which could be smothered by large volumes of material. However, as the New Quay Track disposal site has only received clean shellfish shells and receives small volumes (an average of 609 tonnes per annum between 2013 and 2017), it is unlikely that these disposals will have a significant impact on the reef habitats.

The limits of the model in this case only allowed results to be provided for the surface movement of the disposed material, however given the nature of the disposed material (shellfish shells) it is likely that this would settle to the seabed within a relatively short time period. This is also indicated in the model results, as the majority of datapoints suggest material is no longer at the surface after a period of 12 hours from disposal.

With relation to other sensitive receptors, the disposal site is located within close proximity to two environmentally monitored beaches (New Quay North, and New Quay Harbour), so there is the possibility of the disposed material interacting with these.

4.3.2 Holyhead North (IS043)

Holyhead North (IS043) disposal site is located approximately 5 km off the West coast of Anglesey in the North of Wales. The site was designated in 2017, although was originally part of the larger Holyhead Deep (IS040) disposal site, which was closed in 2017 but had previously received an average of 422,460 tonnes of material per annum since its initial returns in 1993. No disposals have been undertaken at IS043 site to date, however a licence application was received in 2017 (under reference WN-112017-001) to utilise this site for the disposal of 352,000 tonnes of soft sediment, and 709,714 tonnes of rock material from a nearby capital dredge. It is worth noting that this large volume of rock would not follow the model results indicated here. This material would likely settle in a short time frame, having not dispersed a great distance from the disposal

location. However, this will have been assessed as part of the licence application process (see section 1.4).

The disposal site is located partially within the Anglesey Terns SPA, which is an extension to the previous SPA designated to protect breeding Tern colonies, and therefore there is a potential that material disposed of within this site will interact with the SPA. However, modelling results indicate that material will generally disperse to the South of the disposal site (Figure 4.14) and away from the protected area. Therefore, any interaction with protected areas is considered to be unlikely and/or limited. In addition, the disposal site is located approximately 5km from the nearest shoreline, and 13km from the nearest environmentally monitored beach, with the plume spreading further offshore rather than towards the coast. Therefore, the likelihood of interaction with tourism/recreation in the area can be considered low.

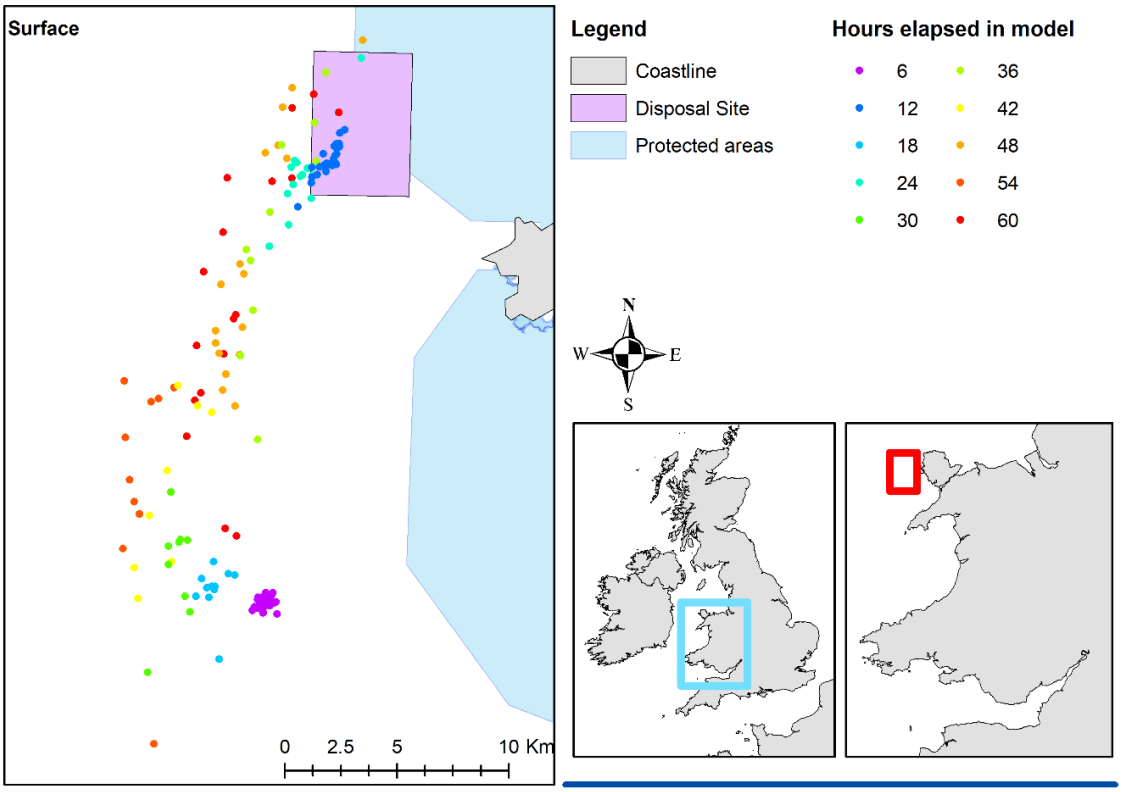


Figure 4.14: Map showing the modelling results for disposal site IS043 (Holyhead North), including any overlap with the disposal site / plume and protected areas. Data points show the location of disposal material at the surface after 6 hour increments of the model run.

The disposal site and plume are not within close proximity to any major ports; however, they are located within a high-density shipping area based on ships travelling into and out of Holyhead Port, which is located >10km from the disposal site. It is unlikely that disposed material will negatively impact shipping activities, however if large disposal operations are to be undertaken at this site, the movement of disposal vessels may cause an obstruction to these shipping routes.

Holyhead marina is known to contain the INNS *Didemnum vexillum* (carpet sea squirt). Given that this disposal site is highly dispersive, and the plume is shown to travel a long distance down the length of the Welsh coast, disposal operations at this site have the potential to act as a pathway for non-native species such as this to spread further along the coast. However, given that the plume remains a considerable distance from the shore, and does not interact with any man-made structures, it is unlikely that disposal operations will act as a significant pathway for this species.

4.3.3 Mostyn Deep (Maintenance) (IS102)

Mostyn Deep (IS102) disposal site is located approximately 0.8km from the North Wales coastline. The first documented disposal at this site took place in 2005, and the site has received an average of 253,677 tonnes of maintenance dredge material per annum between 2005 and 2017 (Figure 4.15).

The site is located wholly within the Dee Estuary SAC, SPA, SSSI and Ramsar site. These protected areas are designated primarily for the protection of coastal habitats, including the Annex I habitats “mudflats and sandflats not covered by seawater at low tide”, “*Salicornia* and other annuals colonizing mud and sand”, “Atlantic salt meadows”, as well as foraging seabirds, primarily Little Tern.

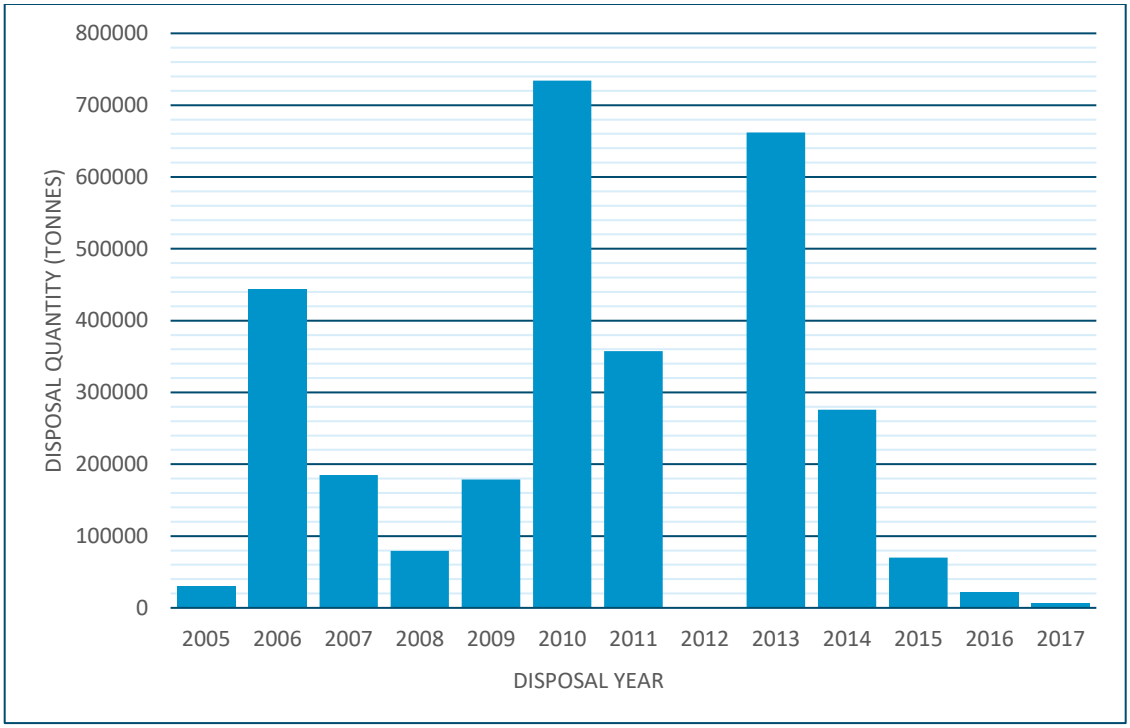


Figure 4.15: Bar chart showing the annual disposal quantities (tonnes) at the Mostyn Deep (maintenance) (IS102) disposal site between 2013 and 2017.

The modelling results indicate that the disposal plume will spread to the West and East of the disposal site in an elliptical fashion (Figure 4.16) and will therefore also interact with the Liverpool Bay SPA, which is designated for the protection of common tern, little tern, and little gull. The proposal for the SPA states that the area is particularly important for the terns as much of the sea surrounding their breeding colonies is the ideal habitat for plunge diving for food. An increase in suspended sediment concentration from disposal at this site could impact the foraging behaviour of these diving birds, as it would reduce the visibility within the water. Given that the model indicates that material remains generally within the water column or at the sea surface, this is likely to be a greater concern than if the material settled to the seabed.

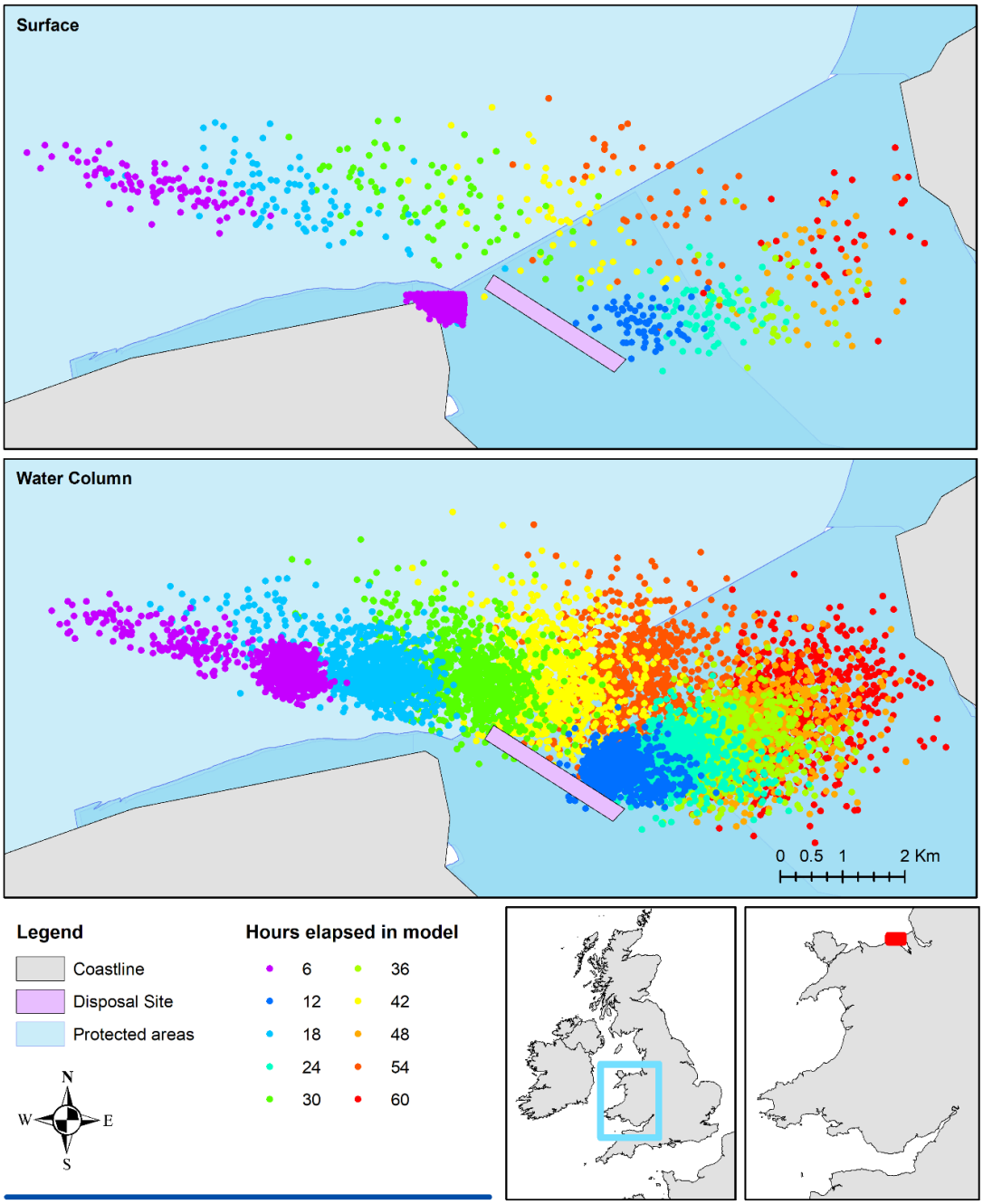


Figure 4.16: Map showing the modelling results for disposal site IS102 (Mostyn Deep), including any overlap with the disposal site / plume and protected areas. Data points show the location of disposal material at the surface and water column after 6 hour increments of the model run.

In addition, the plume from a disposal at Mostyn Deep (Maintenance) (IS102) is shown to have the potential to interact with the M045 shellfish area, which is designated for the common cockle (*Cerastoderma edule)*. Given that shellfish are filter feeders, an

increased suspended sediment concentration has the potential to negatively impact the shellfish populations in this area, particularly as the model results indicate approximately 30-40% of disposed material will remain in the water column throughout the 60 hour model run (Figure 4.17). However, given that the area already exhibits high background levels of suspended sediment concentrations (Figure 3.3), it is unlikely that any impact from the disposal plume will be significant.

Mostyn Deep (Maintenance) (IS102) used to be a part of the larger Mostyn Deep (IS101) disposal site, which is now classified as "disused", but has previously received disposal. As far as we are aware there have been no reported impacts from disposal at this larger site, and therefore the disposal at smaller Mostyn Deep (Maintenance) (IS102) can be considered low risk.

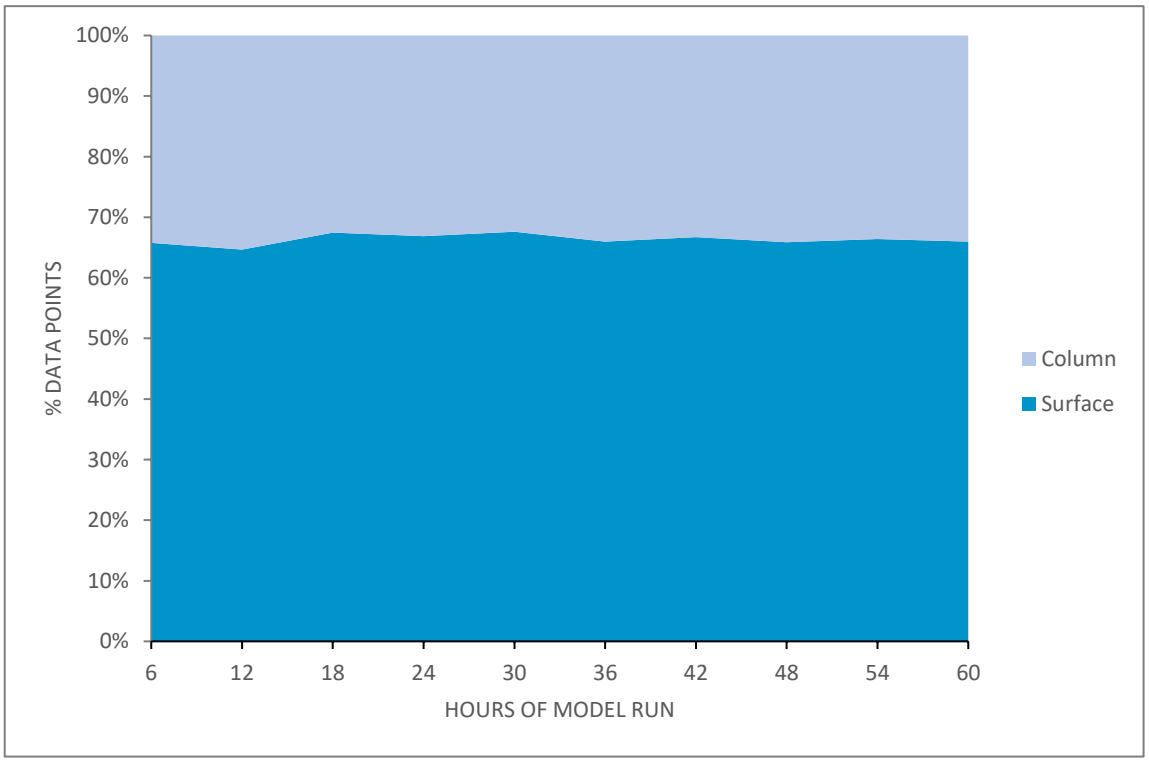


Figure 4.17: Stacked area chart showing the percentage of model data points that were in the water column, and surface, throughout the model run for disposal site IS102 (Mostyn Deep) .

4.3.4 Cardiff Grounds (LU110)

Cardiff Grounds (LU110) disposal site is located within the Severn Estuary, approximately 3 km off the South coast of Wales. The site is one of the largest disposal sites within the scope of this review (in terms of disposed volume), having received an average of 302,091 tonnes maintenance dredge material per annum between 1988 and 2017, with an observed maximum disposal of 1,022,874 tonnes in 2011 (Figure 4.18)

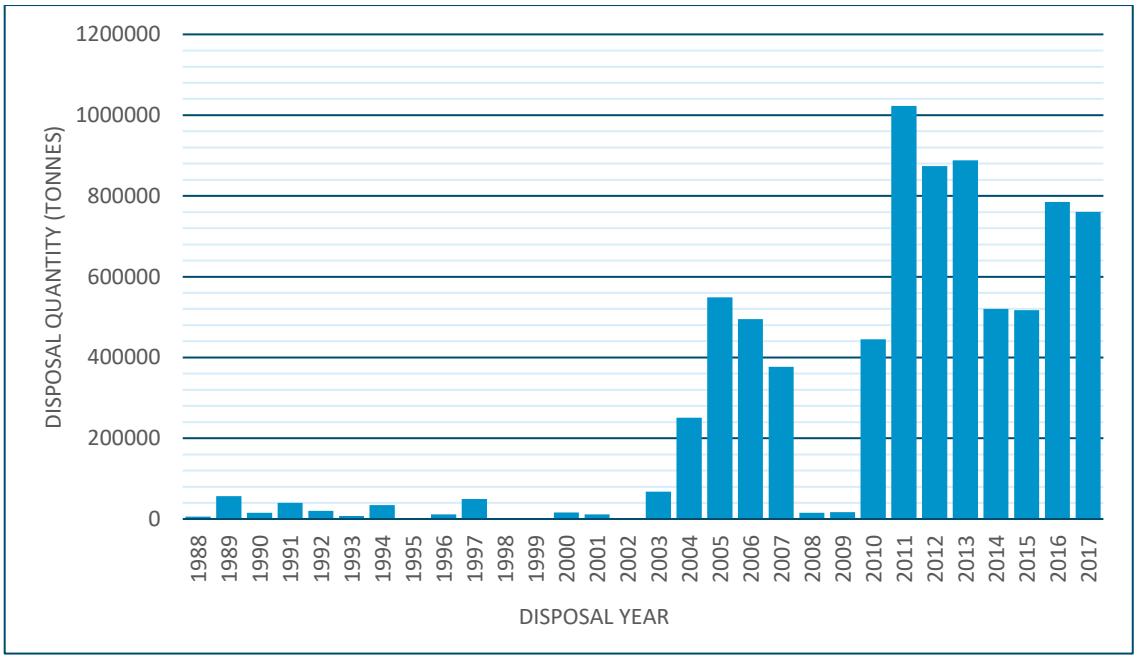


Figure 4.18: Bar chart showing the annual disposal quantities (tonnes) at the Cardiff Grounds (LU110) disposal site between 1988 and 2017.

The site is located wholly within the Severn Estuary SAC, which is primarily designated to protect the Annex I habitats of "estuaries", "mudflats and sandflats not covered by seawater at low tide", and "Atlantic salt meadows", and the Annex II species of sea lamprey, river lamprey, and *Alosa fallax* (Twaite shad). The modelling results show that, although sediment is retained within 10km of the disposal site over the 60 hour model runs, the site is dispersive as the Severn Estuary is naturally highly dynamic. The plume generally spreads in a North Easterly direction (Figure 4.19) and therefore also overlaps with the boundaries of the Severn Estuary SPA, SSSI, and Ramsar site. The Severn Estuary SPA is designated for the protection of the following qualifying species: Bewick's swan; Common shelduck; Gadwall; Dunlin (Non-breeding); Common redshank; and, Greater white-fronted goose. The SSSI and Ramsar site protect similar habitats and

species to those covered by the SPA and SAC, as well as several other waterfowl and additional habitats, such as rockpools and sand-influenced biogenic reefs.

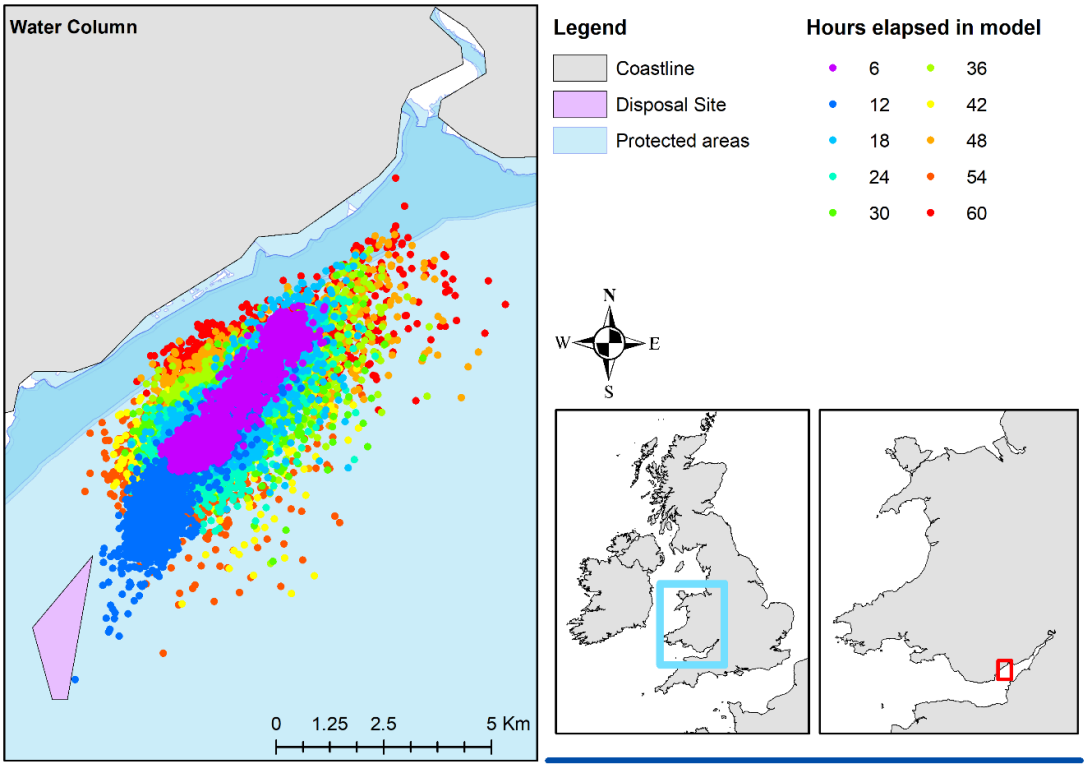


Figure 4.19: Map showing the modelling results for disposal site LU110 (Cardiff Grounds), including any overlap with the disposal site / plume and protected areas. Data points show the location of disposal material in the water column after 6 hour increments of the model run.

The model results indicate that material remained largely within the water column throughout 60-hour model run, as the model returned no datapoints in the seabed or water column. Therefore, the risk of smothering benthic features, such as the protected reefs, can be considered low. The increased suspended sediment concentration from disposal activities could be disruptive to the foraging behaviour of some of the protected seabirds in the area as the visibility of prey would be reduced. However, as the majority of protected seabirds in the area are waders, and therefore do not rely on diving or visual predation techniques, the risk to these seabirds can be considered low.

Given that the material largely remains in the water column, and does not disperse a great distance from the disposal site, it is possible that the continued disposal seen at

this site will lead to an accumulation of suspended sediment in the water column within the plume area. However, the background suspended sediment concentrations in this area are already very high (Figure 3.3) and therefore this is unlikely to create a significant impact, but it may be an area that is worth further investigation through the use of a more detailed model of this area, as well as a sensitivity analysis based on the features of the designated areas..

The modelling results also indicate that disposed material may approach the coastline, with the closest model data point reaching a distance of approximately 0.3 km from the coastline after 60 hours and the majority of the plume remaining approximately 1 – 5km away from the coast. However, the material appears to be unlikely to wash ashore as it generally remains within the water column and the model plume did not interact with / overlap with the coastline over the 60 hour model period (Figure 4.19). In addition, there are no environmentally monitored beaches in the vicinity of the disposal site or plume, and therefore any risk of impact to tourism and recreation within the area is considered minimal.

A number of major ports are located within vicinity of the disposal site, including Newport, Penarth, and Cardiff. As a result of this, the sediment plume from disposal is located within a high-density shipping area. It is unlikely that disposed material will negatively impact shipping activities, however if large disposal operations are to be undertaken at this site, the movement of disposal vessels may cause an obstruction to these shipping routes.

4.3.5 Merkur Buoy (LU115)

Merkur Buoy (LU115) disposal site is located approximately 4 km off the South coast of Wales and was first used for disposal in 1993. The site is one of the smallest disposal sites within the scope of this review, covering an area of 0.02km^2. However, it still receives a moderate amount of material, having historically received an average of 42,197 tonnes maintenance dredged material per annum between 1993 and 2017 (Figure 4.20).

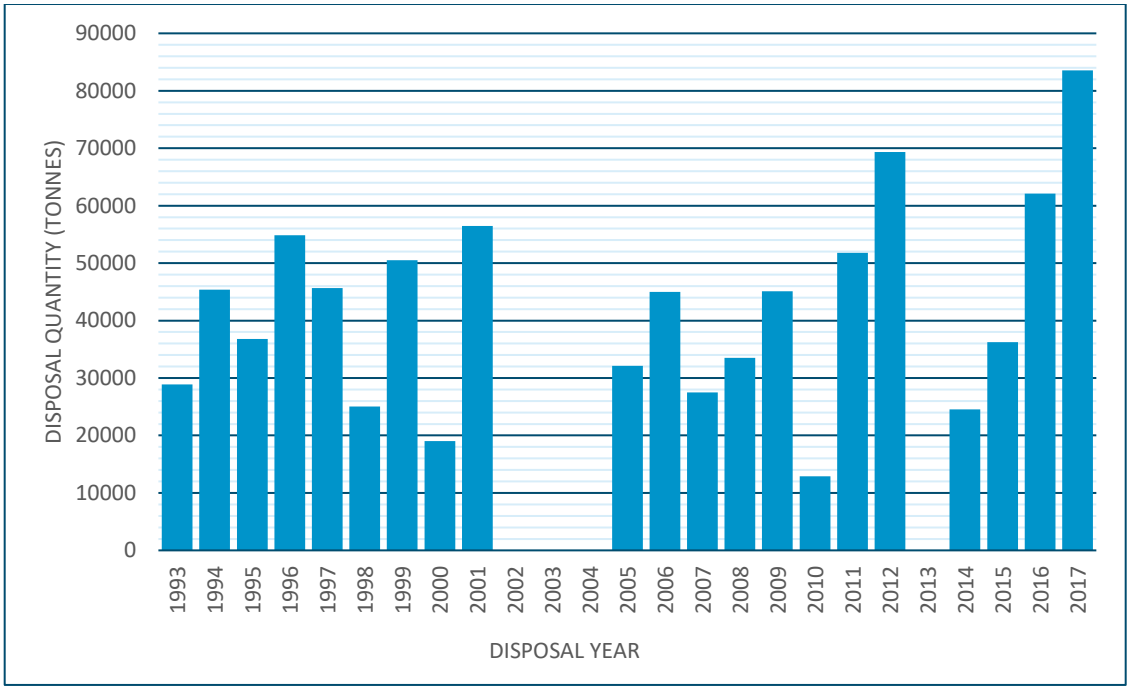


Figure 4.20: Bar chart showing the annual disposal quantities (tonnes) at the Merkur Buoy (LU115) disposal site between 1993 and 2017.

Modelling results show that it is highly dispersive with material potentially spreading to a large area of the Severn Estuary and remaining largely within the water column throughout the model duration (Figure 4.21). Due to this dispersive nature, material disposed of to this disposal site, has the potential to interact with a number of protected areas including the Severn Estuary SAC, SPA, and Ramsar Site (described in section 4.3.4), the East Aberthaw Coast SSSI, and the Flat Holm SSSI (Figure 4.22).

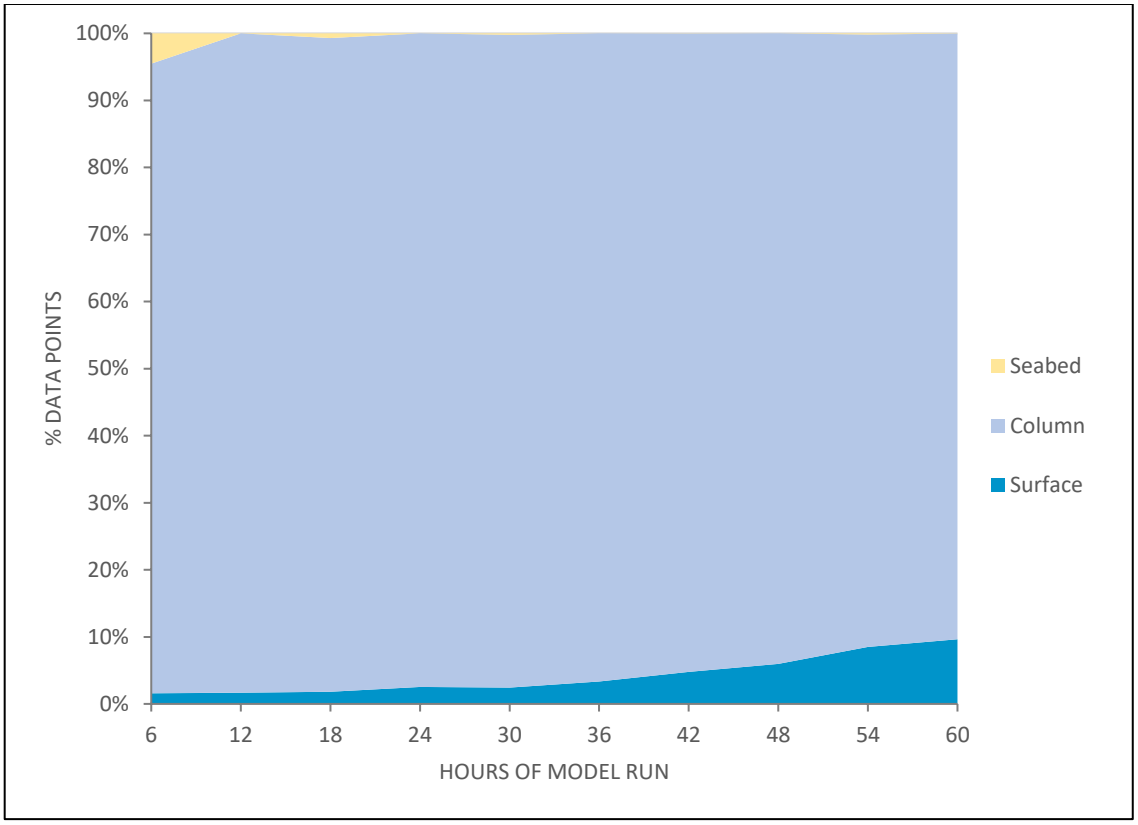


Figure 4.21: Stacked area chart showing the percentage of model data points that were in the water column, seabed and surface, throughout the model run for disposal site LU115 (Merkur Buoy).

The East Aberthaw Coast SSSI is designated for the protection of rockpools, under boulders, and the flatworm *Convoluta roscoffensis.* The Flat Holm SSSI is designated for the protection of sand-influenced biogenic reefs. As all of these features can be considered as benthic features, and the model results indicate that material will not settle on the seabed within the protected area, the likelihood of interaction between disposed material and the protected features can be considered to be low.

In addition, the plume model suggests that material has the potential to interact with a number of environmentally monitored beaches: Jackson's Bay Barry Island, Whitmore Bay Barry Island, Cols Knap Barry, Burnham Jetty North, Berrow North of Unity Farm, Brean, Minehead Terminus, Dunster North West, and Blue Anchor West. However, given the highly dispersive nature of the plume, particularly in the surface and water column, it is unlikely that the material will cause a significant increase in suspended sediment concentrations, and therefore it is unlikely that there will be a significant

impact to these areas. In addition, the model results indicate that the spread of material settling on the seabed is much smaller, and away from the shoreline.

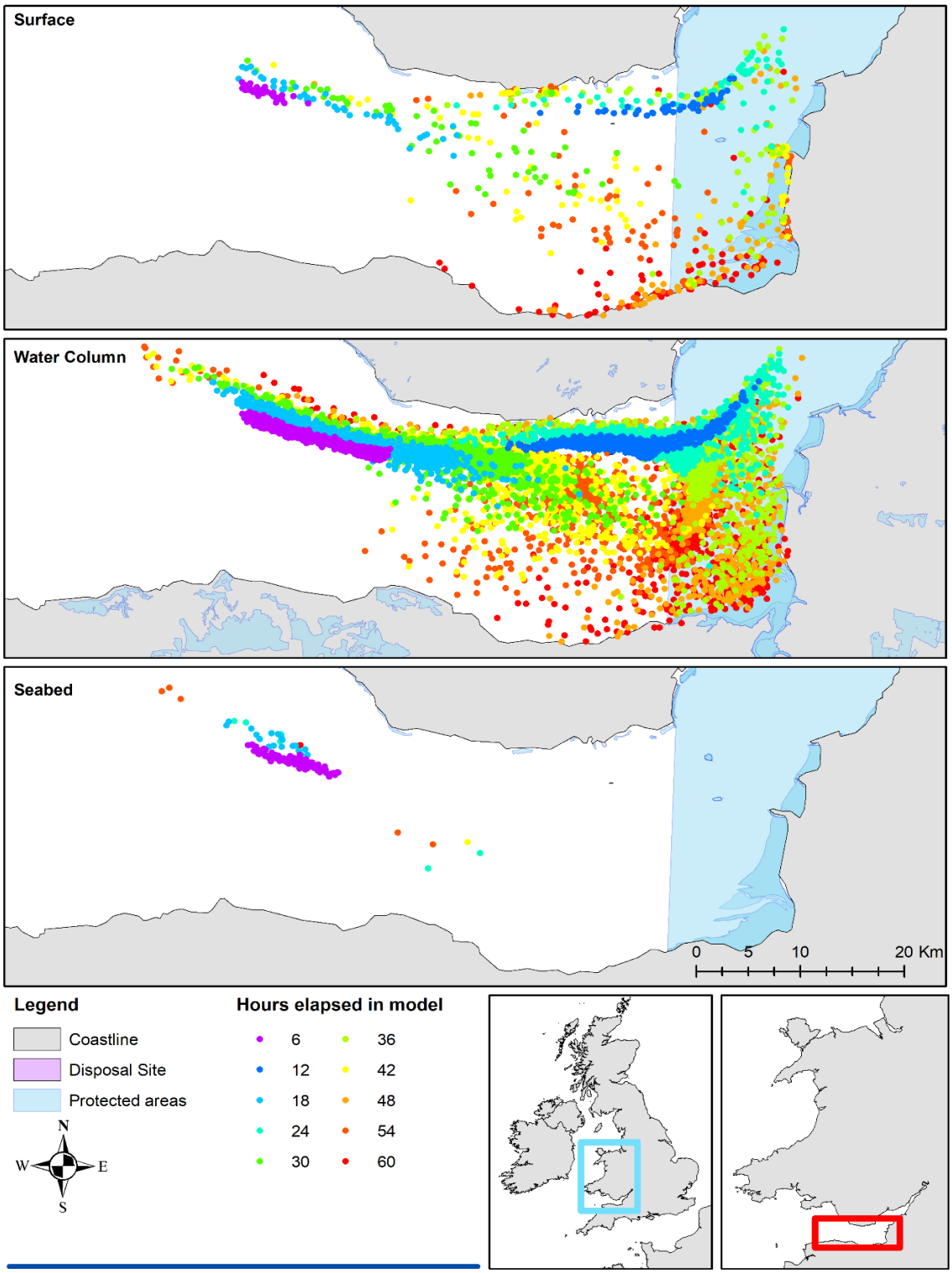


Figure 4.22: Map showing the modelling results for disposal site LU115 (Merkur Buoy), including any overlap with the disposal site / plume and protected areas. Data points show the location of disposal material at the surface, water column, and seabed after 6 hour increments of the model run.

4.3.6 Swansea Bay (Outer) (LU130)

Swansea Bay (Outer) (LU130) first received disposal material in 1988 and to date has received the most material of any disposal site within the scope of this review, having received an average 1,834,499 tonnes maintenance material per annum between 2004 and 2017, as well as a number of capital dredge disposals with an average volume of 131,398 tonnes. The largest annual disposal to this site was of 3,188,920 tonnes in 2005 (Figure 4.23).

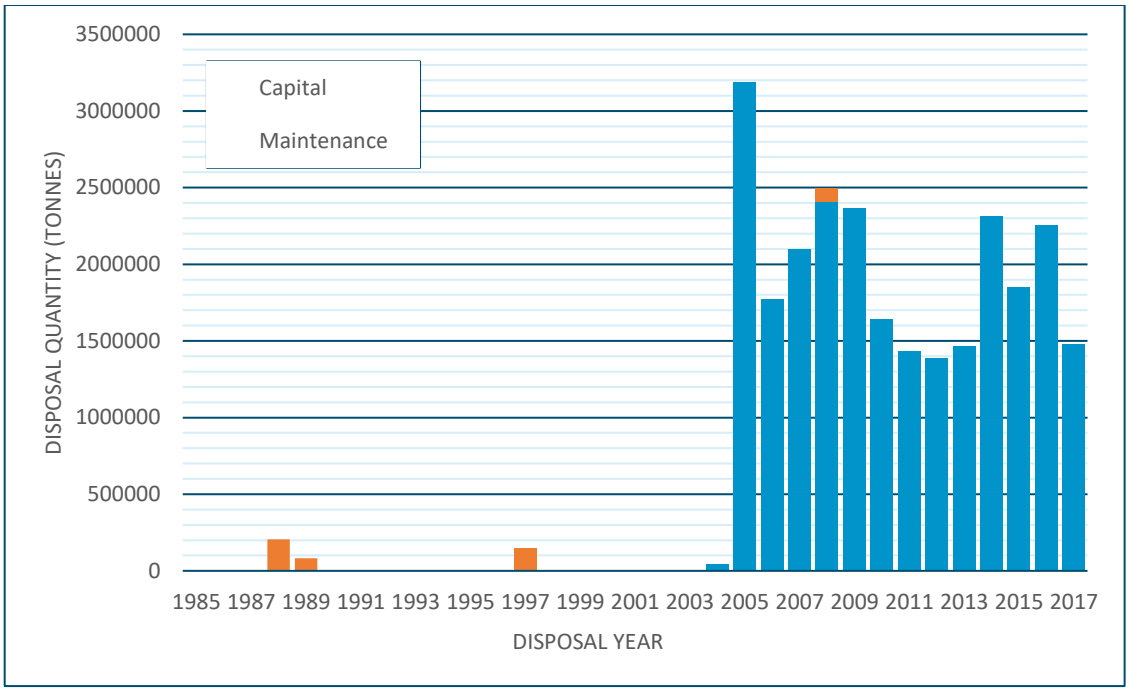


Figure 4.23: Stacked bar chart showing the annual disposal quantities (tonnes) at the Swansea Bay (Outer) (LU130) disposal site between 1985 and 2017. The quantities of maintenance dredge material disposed are displayed in blue, and the quantities of capital dredge material disposed are displayed in orange.

The site is located approximately 5 km off the South coast of Wales in approximately 15-20m water depth, and the modelling results indicate that the majority of disposed material is likely to settle to the seabed relatively quickly (Figure 4.24), and then continue to travel further offshore in a Southerly direction (Figure 4.25). The results indicate that this transport occurs in an elliptical fashion, with data points taken after 6 hours being located to the South West of the disposal site, then after 12 hours the data points are directly south of the site, and after 18 hours they are South West of the site again etc. Overall, the plume is shown to spread a distance of approximately 12 km South of the disposal site, and >20 km West.

Material disposed of to this site will likely be impacted by storms reaching the seabed and resuspending material into the water column. Although the area may be exposed to wave action year-round as it is not in a sheltered location, only storms would have sufficient energy to erode or resuspend and disperse material. Such storms have not been considered within the modelling undertaken with this review, although they will tend to accelerate the tidal processes on which this model is based. However, this site may benefit from further investigation with a model that incorporates wave and storm action (see section 5.2 for further recommendations)

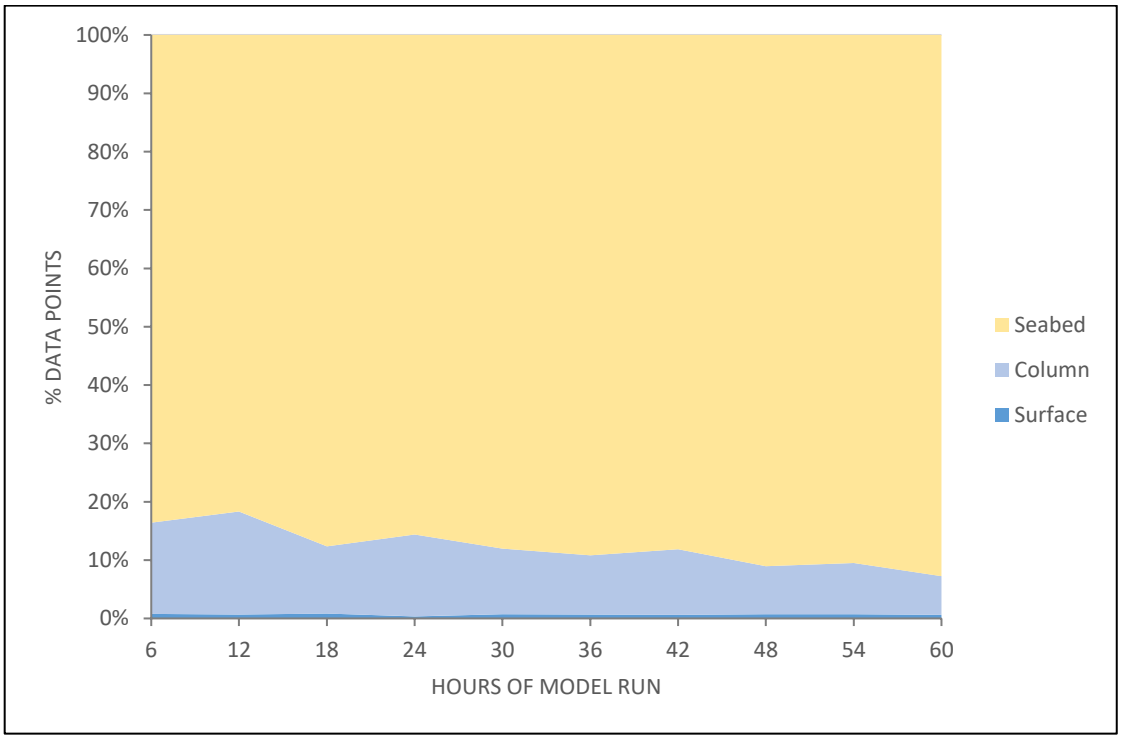


Figure 4.24: Stacked area chart showing the percentage of model data points that were in the water column, seabed and surface, throughout the model run for disposal site LU130 (Swansea Bay (Outer)).

Given the location of the disposal site, and the likely movement of the sediment, it is unlikely that material disposed to Swansea Bay (Outer) will interact with any protected areas, as there is no overlap with the disposal site or the modelled sediment plume. However, the plume does come within 2km of the Carmarthen Bay and Estuaries SAC after 6 hours, although this distance generally increases over time, and therefore there is a potential pathway of interaction over this distance.

The Carmarthen Bay and Estuaries SAC is designated for the primary protection of the following Annex I habitats: sandbanks which are slightly covered by sea water all the time; estuaries; mudflats and sandflats not covered by seawater at low tide; large shallow inlets and bays; salicornia and other annuals colonizing mud and sand; and, Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*).It is also designated for the primary protection of the Annex II species Twaite Shad. However, the majority of these protections are concerned with habitats and features in the inshore area, and the modelling results show that the disposal plume travels further offshore, and the disposal site is already a considerable distance from the shore. Therefore, any impact from the disposal operations at Swansea Bay (Outer) is considered to be low. There are no observed pathways of interaction between any of the other sensitive receptors observed within this review.

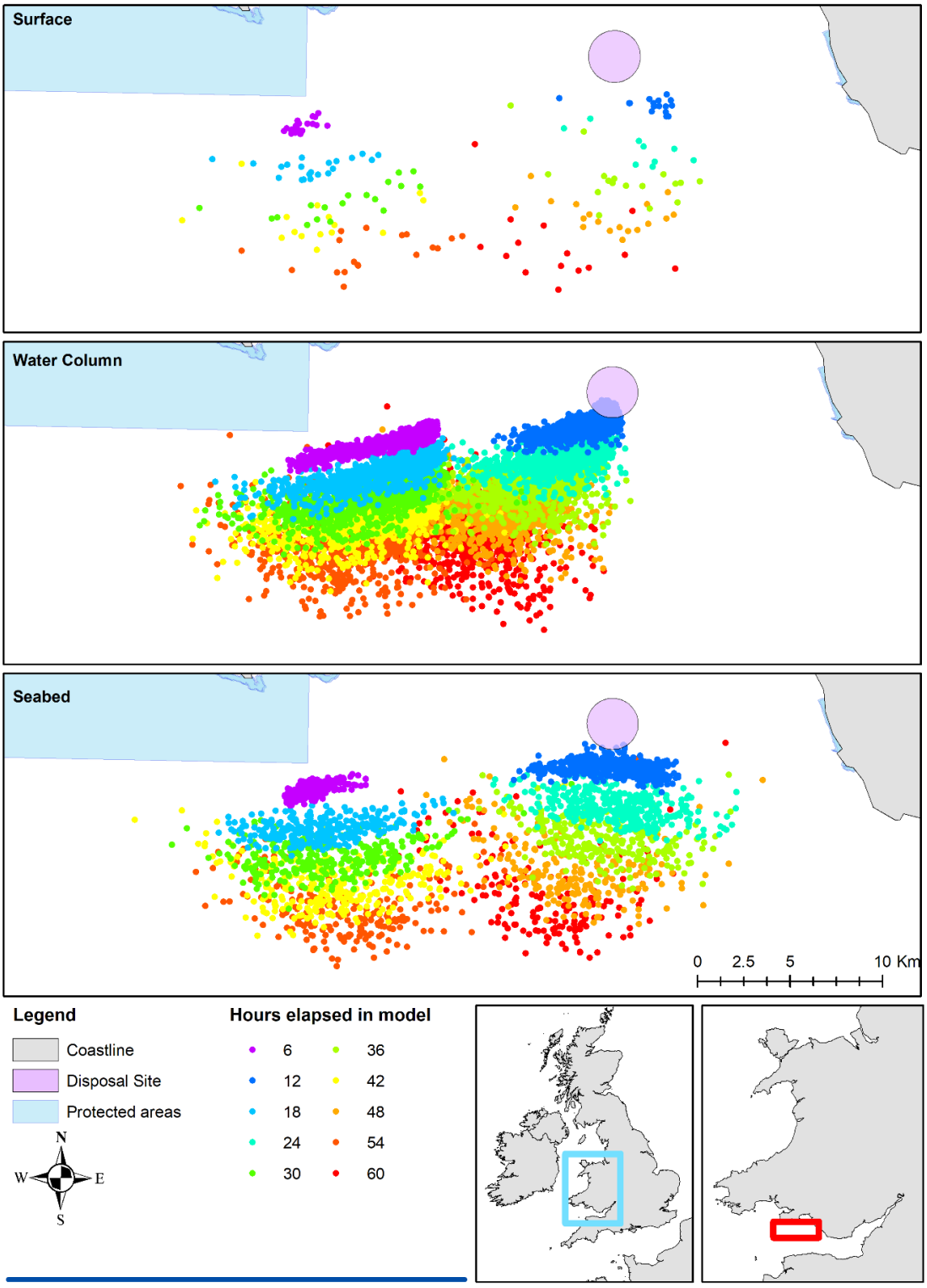


Figure 4.25: Map showing the modelling results for disposal site LU130 (Swansea Bay (Outer)), including any overlap with the disposal site / plume and protected areas. Data points show the location of disposal material at the surface, water column, and seabed after 6 hour increments of the model run.

4.3.7 Newport (LU140)

Newport (LU140) disposal site is located approximately 5 km off the South coast of Wales, within the Severn Estuary. The site has historically received both maintenance and capital dredge material, with an average disposal of 159,004 tonnes maintenance material per annum between 1990 and 2017, and a singular disposal of 1800 tonnes capital dredge material in 2000 (Figure 4.26).

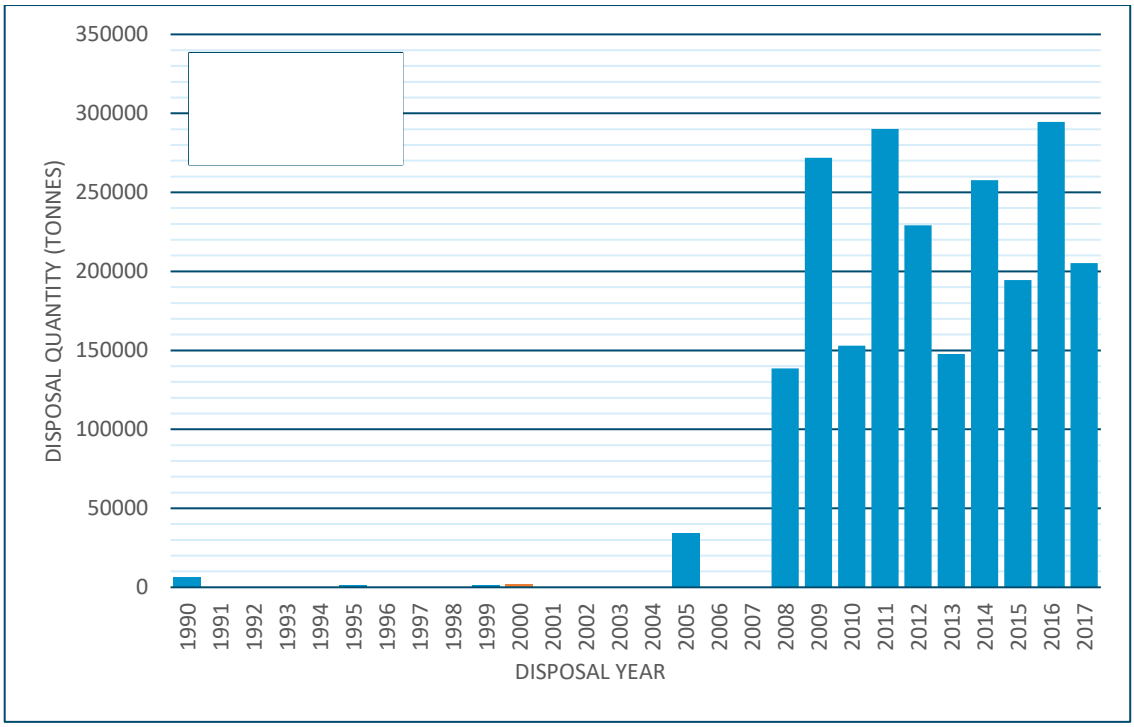


Figure 4.26: Stacked bar chart showing the annual disposal quantities (tonnes) at the Newport (LU140) disposal site between 1985 and 2017. The quantities of maintenance dredge material disposed are displayed in blue, and the quantities of capital dredge material disposed are displayed in orange.

In comparison to the other sites discussed above, the model results indicate that material disposed of to this site is continuously re-suspended before re-settling on the seabed over the 60 hour run time of the model (
Figure 4.27).

The site is located wholly within the Severn Estuary SAC (described in Section 4.3.4). Modelling results indicate that the site is highly dispersive, particularly in terms of sediment at the surface and within the water column, with the plume shown to travel over 25 km South West of the disposal site within the first 6 hours of the model run

(Figure 4.28). This therefore indicates that the plume also has the possibility to overlap with the Severn Estuary SPA, SSSI, and Ramsar site (described in Section 4.3.4).

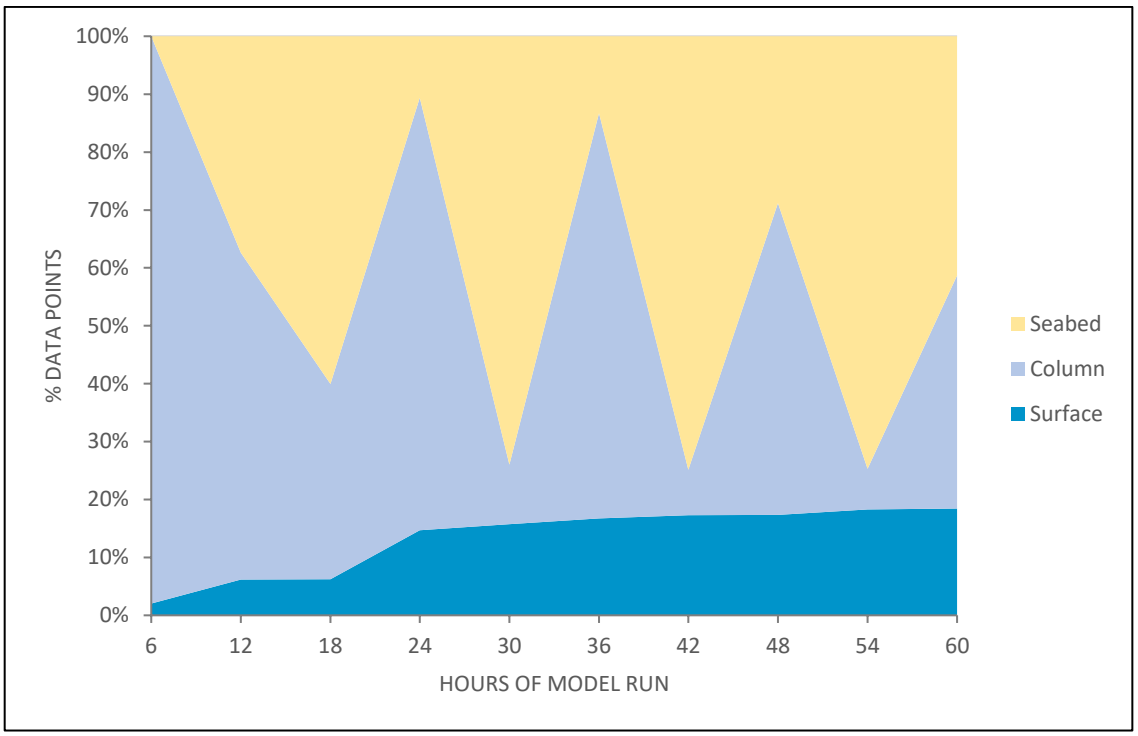


Figure 4.27: Stacked area chart showing the percentage of model data points that were in the water column, seabed and surface, throughout the model run for disposal site LU140 (Newport).

Given the proximity of this site and the Cardiff Grounds disposal site (LU110), there is the potential for overlap of the two disposal plumes. However, the model results indicate that this only exists very slightly after 54 hours of the model run. Therefore, cumulative impacts from the disposal at these two sites is unlikely.

In addition, where part of the plume is shown to spread to the North East of the disposal site, it reaches the coastline of Wales at Newport, and therefore may have an impact on the tourism and recreation in this area, especially as it is shown to reach this area only at the surface and in the water column. However, given that much of the Welsh coastline consists of mudflats and saltmarsh, which is currently depleting, the additional deposition that may occur from this plume could be seen as beneficial, as it would support these habitats. In addition, due to the dispersive nature of this site, and the existing high background suspended concentrations in the area (Figure 3.3), it is unlikely that the impact on tourism will be significant. Similarly, there is a potential pathway of

interaction between the plume and a number of environmentally monitored beaches on the English coastline (Burnham Jetty North, Berrow North of Unity Farm, Brean, Weston Super-Mare Uphill Slipway, Weston Main, and Weston Super Mare Sand Bay), where the plume is seen to spread to after 12 – 24 hours. However, as the material remains in suspension and appears to move away from this area again over time, it is unlikely to cause a significant impact on the tourism in these areas.

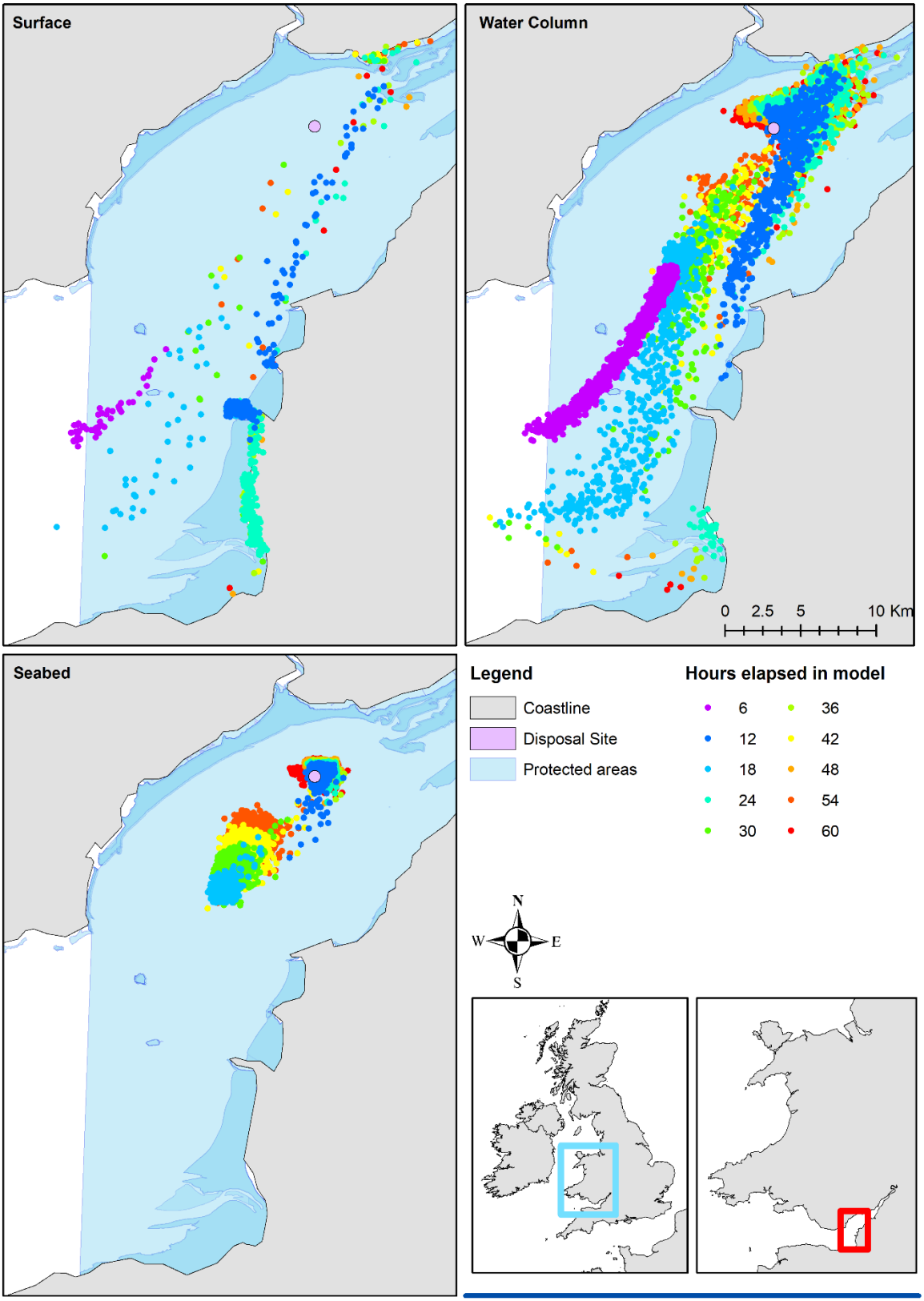


Figure 4.28: Map showing the modelling results for disposal site LU140 (Newport), including any overlap with the disposal site / plume and protected areas. Data points show the location of disposal material at the surface, water column, and seabed after 6 hour increments of the model run.

4.3.8 Milford Haven Two (LU168)

Milford Haven Two (LU168) disposal site has historically only received a small number of disposals of both maintenance and capital dredge material, with the most recent disposal being of 450 tonnes of capital dredge material in 2007 (Figure 4.29). A marine licence was issued in 2017 (DML1646) permitting the disposal of material at this site and the nearby Milford Haven Three (LU169) site (see section 4.3.9), however no disposal has been undertaken under this licence to date.

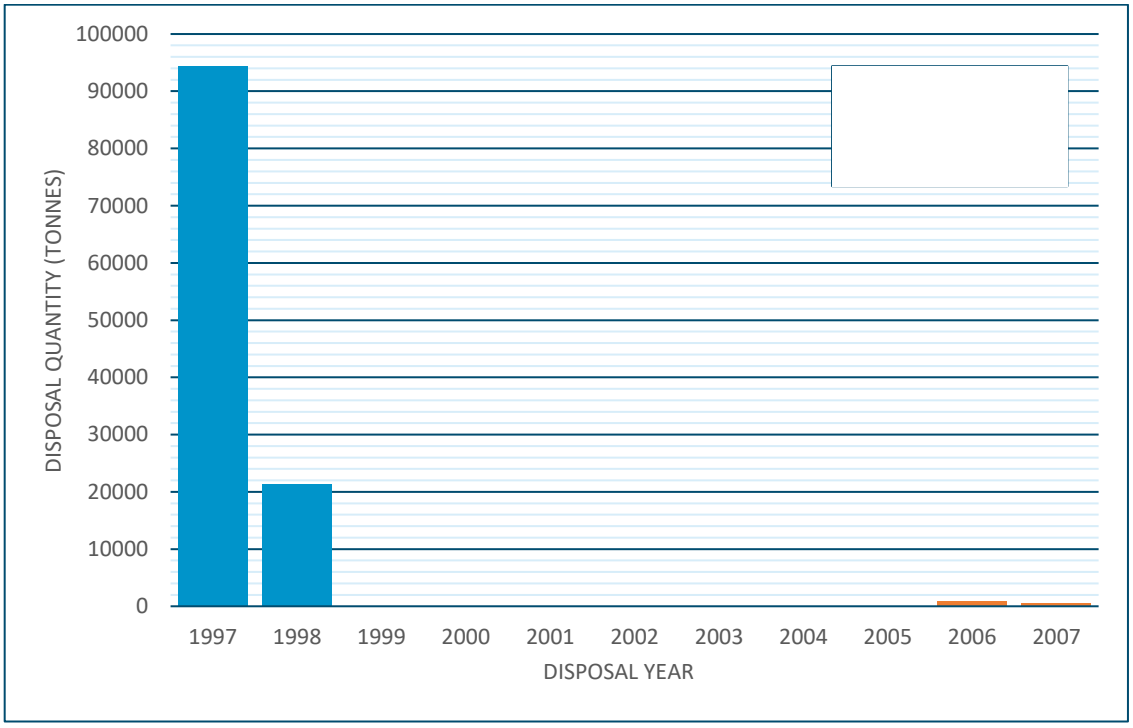


Figure 4.29: Stacked bar chart showing the annual disposal quantities (tonnes) at the Milford Haven Two (LU168) disposal site between 1985 and 2017. The quantities of maintenance dredge material disposed are displayed in blue, and the quantities of capital dredge material disposed are displayed in orange.

The site is located approximately 14 km off the South West coast of Wales, and sits wholly within the Skomer, Skokholm, and the Seas off Pembrokeshire SPA. The SPA is designated as an extension to the existing Skokholm and Skomer SPA, which was designated to protect breeding populations of a number of species of seabirds, including *Puffinus* (Manx shearwater*), Fratercula arctica* (Atlantic puffin), *Hydrobates pelagicus* (European storm petrel) and *Larus fuscus* (lesser black-backed gull*)*. It also protects the islands' small populations of *Pyrrhocorax pyrrhocorax (*chough) and *Asio flammeus* (short eared owl*).* The modelling results show that the majority of material

(over 80%) falls to the seabed within the first six hours of the model run (Figure 4.30), and the disposal plume generally spreads to approximately 15km to the South East of the disposal site (Figure 4.31), although it seems to be retained in an elliptical fashion over this area.

In addition to the SPA in which the disposal site is located, the modelling shows that the plume is likely to overlap slightly with the Pembrokeshire Marine SAC. This SAC was designated primarily to protect the Annex I habitats of "estuaries" (in particular the Daugleddau estuary due to the species richness of sediment communities), "large shallow inlets and bays" (primarily Milford Haven and the wide, shallow, predominantly sandy embayment of St Brides Bay), and "Reefs" (including the extensive areas of sublittoral rocky reef stretch offshore from the west Pembrokeshire coast, the limestone reefs that occur in the south of the site, and offshore areas of tide-swept kelp and species-rich red algal populations). Another primary reason for the designation of the SAC is the protection of grey seals and shore dock (*Rumex rupestris*). Of the protected features covered by the SPA and SAC, the feature most likely to be impacted by disposal operations is the benthic reefs, which are at risk of smothering from disposal, or abrasion from suspended sediment (Tilin et al., 2010). However, given the disposal volumes observed at this site, and the area of overlap with the protected areas, it is considered unlikely that disposal will cause any significant impact on these areas.

No other pathways of interaction were identified between material disposed of to this site and any other sensitive receptors reviewed as part of this report.

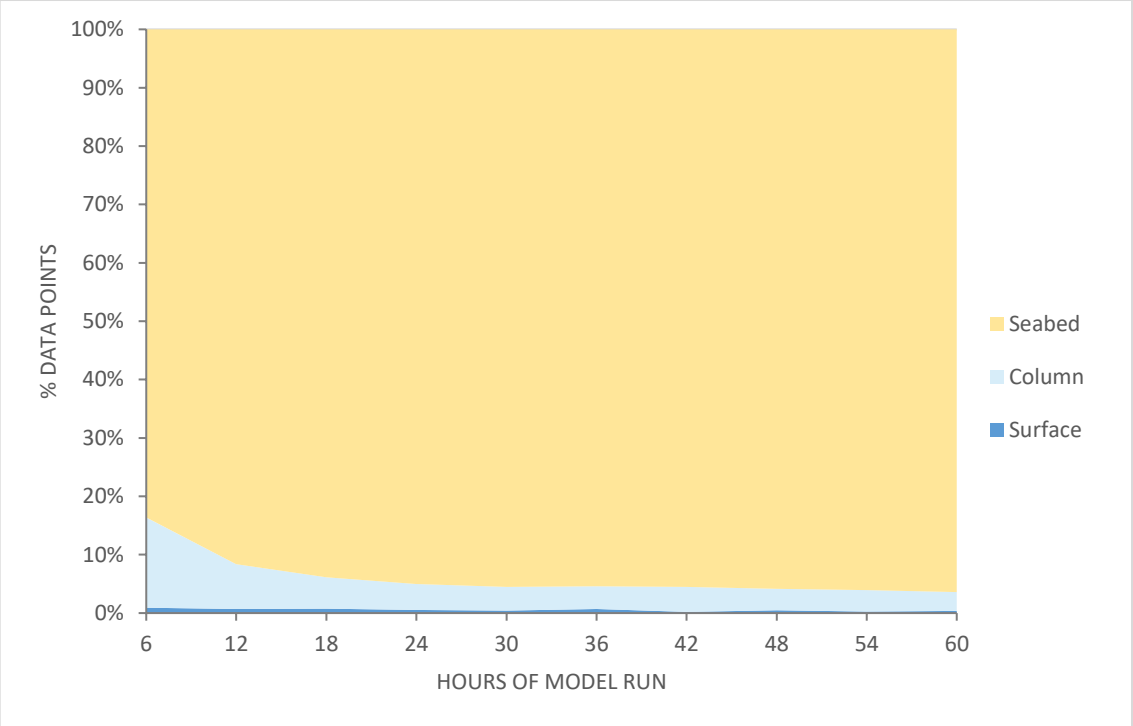


Figure 4.30 Stacked area chart showing the percentage of model data points that were in the water column, seabed and surface, throughout the model run for disposal site LU168 (Milford Haven Two).

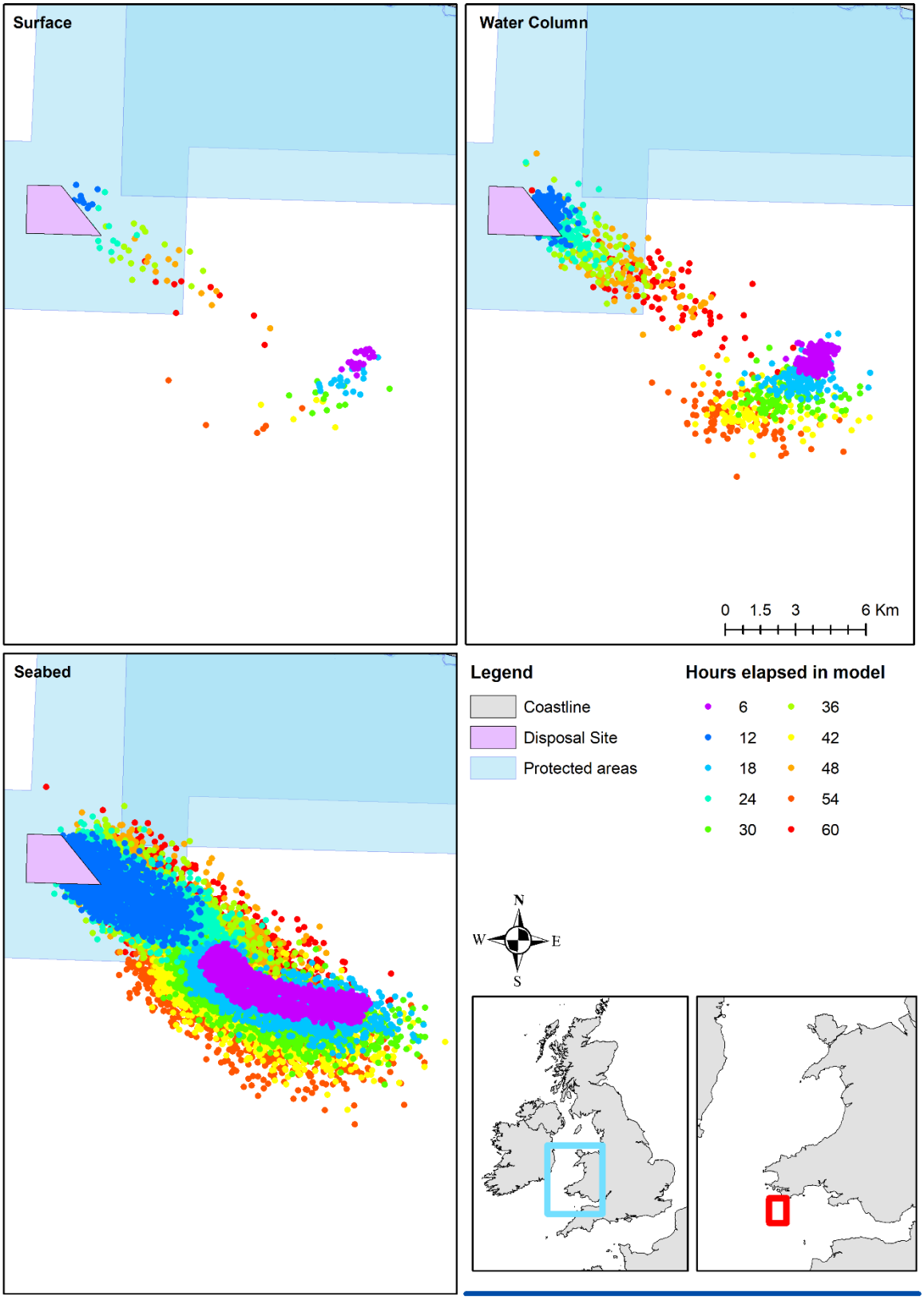


Figure 4.31: Map showing the modelling results for disposal site LU168 (Milford Haven Two), including any overlap with the disposal site / plume and protected areas. Data

points show the location of disposal material at the surface, water column, and seabed after 6 hour increments of the model run.

4.3.9 Milford Haven Three (LU169)

Milford Haven Three (LU169) disposal site is located offshore, over 25km from the South West coast of Wales. The site has historically received both maintenance and capital material, although it is not consistently used annually, with the most recent disposal being 18,425 tonnes of capital material in 2011 (Figure 4.32). A marine licence was issued in 2017 (DML1646) permitting the disposal of material at this site and the nearby Milford Haven Two (LU168) site (see section 4.3.8), however no disposal has been undertaken under this licence to date.

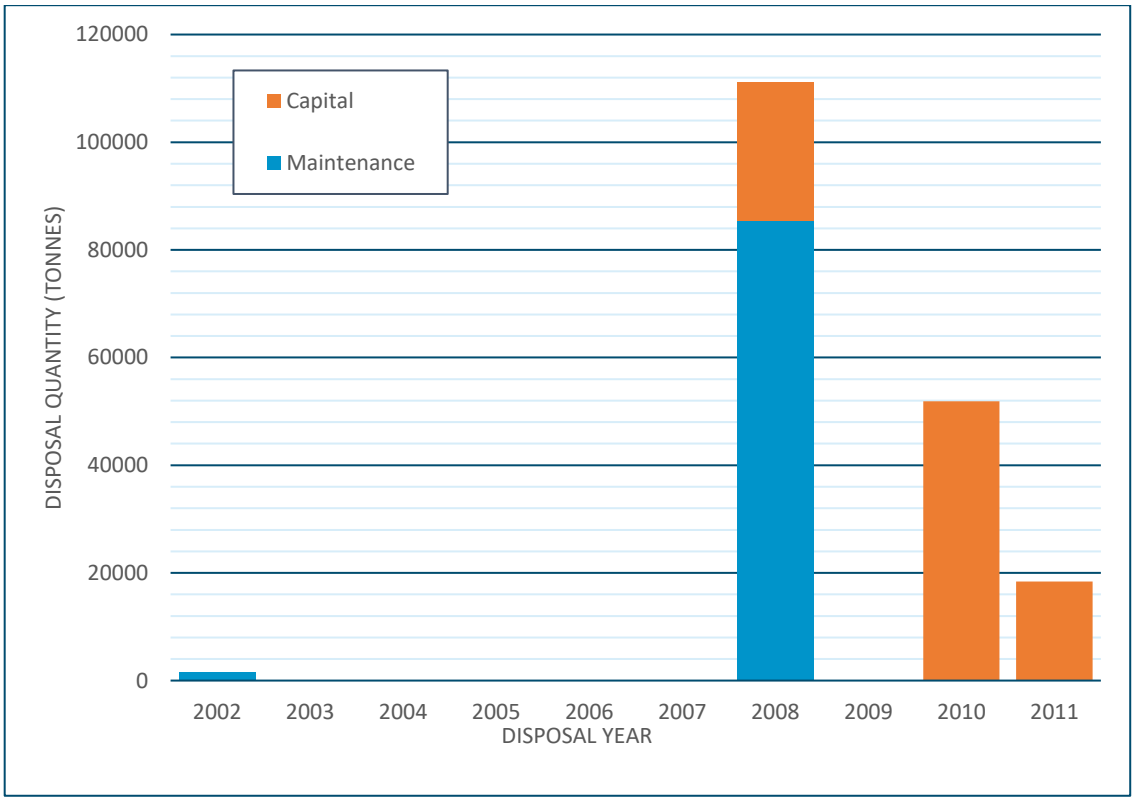


Figure 4.32: Stacked bar chart showing the annual disposal quantities (tonnes) at the Milford Haven Three (LU169) disposal site between 1985 and 2017. The quantities of maintenance dredge material disposed are displayed in blue, and the quantities of capital dredge material disposed are displayed in orange.

Similarly to LU168, Milford Haven Three disposal site sits wholly within the Skomer, Stokholm, and the Seas off Pembrokeshire SPA (see section 4.3.8 for a description of the features protected by this SPA). For the most part the model shows that the disposal

plume remains within this SPA (Figure 4.33), spreading >15km to the South of the disposal site within 6 hours of disposal. As the SPA is primarily designated for the protection of seabird foraging areas, and a number of the protected seabirds are known to dive to capture their prey, there is a possibility that the increased suspended sediment caused by the disposal plume could be disruptive to the foraging behaviour of these birds. However, given small and sporadic nature of disposals at this site, the likelihood of significant impact from disposal operations is reduced.

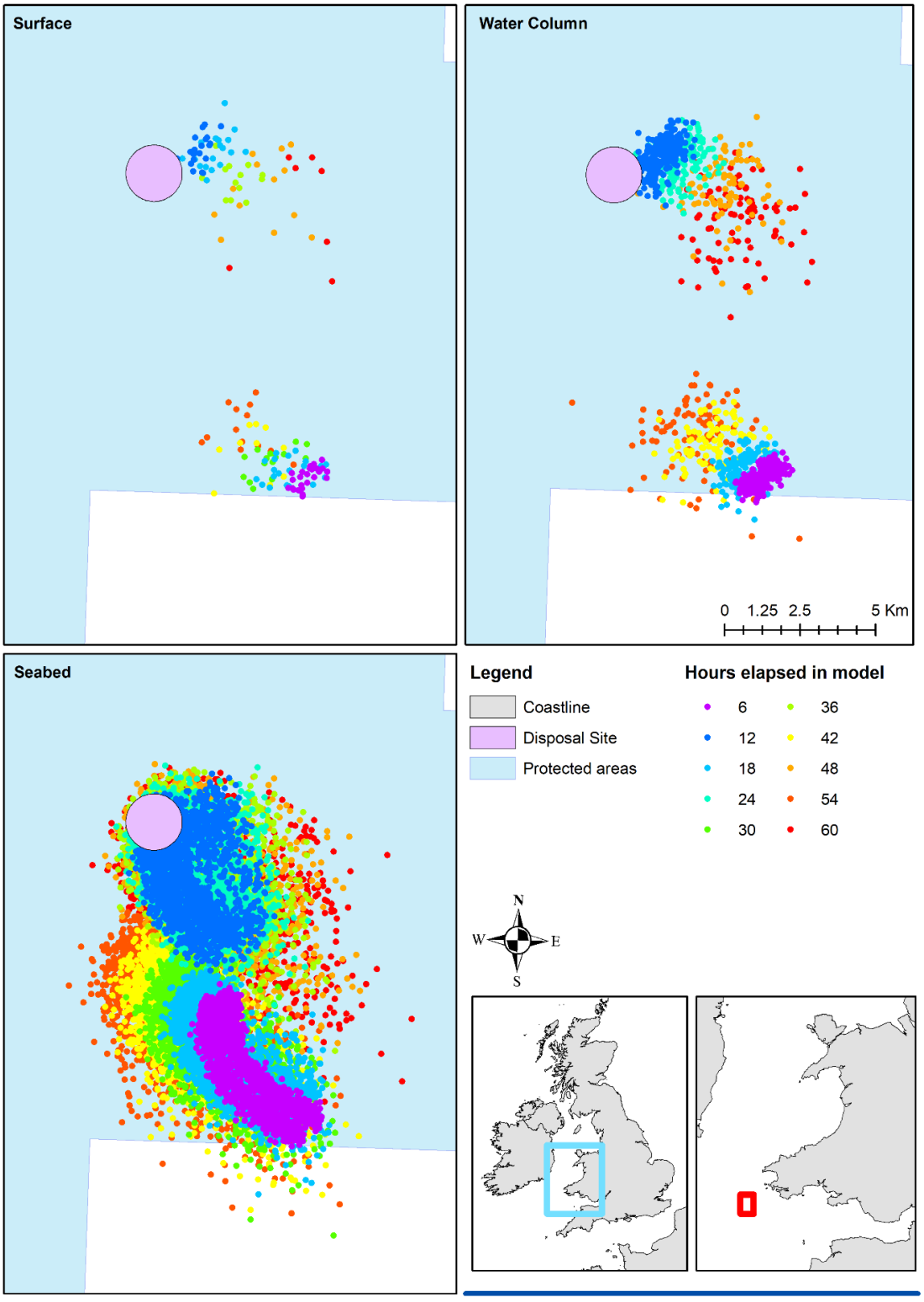


Figure 4.33: Map showing the modelling results for disposal site LU169 (Milford Haven Three), including any overlap with the disposal site / plume and protected areas. Data points show the location of disposal material at the surface, water column, and seabed after 6 hour increments of the model run.

The modelling results indicate that the majority of material deposited at this site is likely to settle to the seabed within 6-12 hours (Figure 4.34), which presents a risk of smothering to benthic species and features. However, the plume does not interact with the Pembrokeshire SAC, which covers the protection of benthic reefs in the area, suggesting the likelihood of the plume interacting with these features is reduced. In addition, the small disposal volumes observed at this site would reduce the likelihood of any significant impact to benthic features in the area.

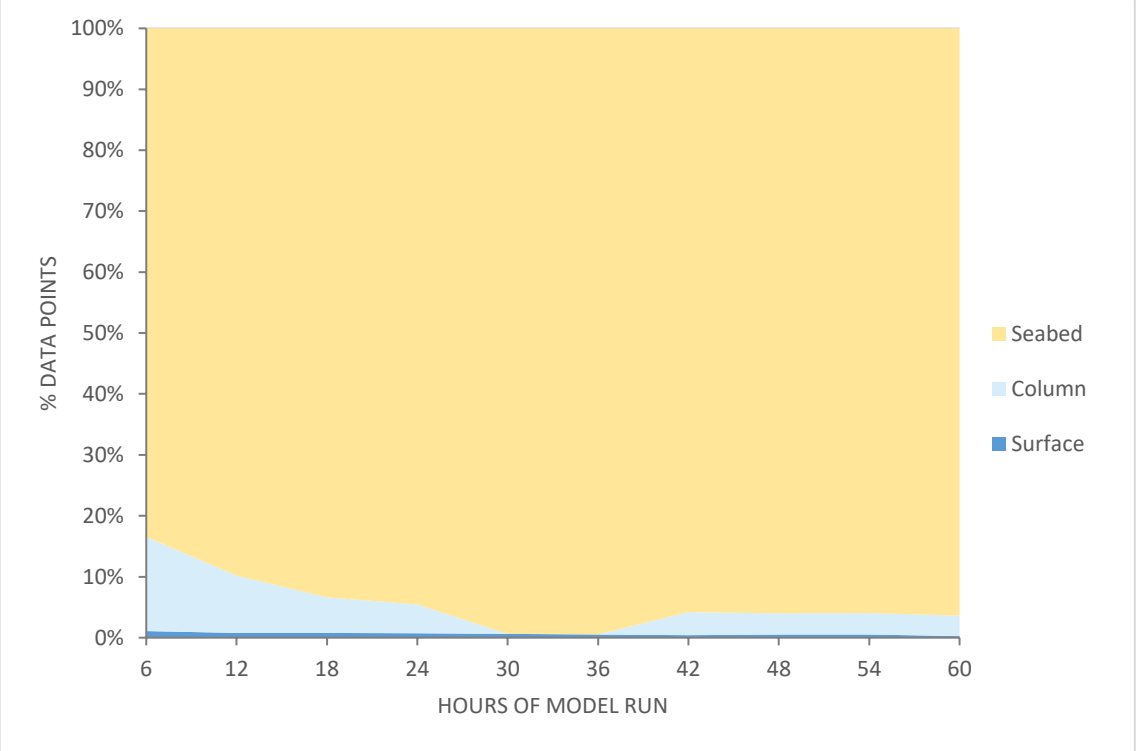


Figure 4.34 Stacked area chart showing the percentage of model data points that were in the water column, seabed and surface, throughout the model run for disposal site LU169 (Milford Haven Three).

5 Discussion

5.1 Summary of Results

Table 5.1 highlights the key points that were identified for each disposal site with relation to pathways of interaction between the disposal operations and sensitive receptors (as outlined in objective 2 (Section 2.2) and Appendix D). The table also discusses the confidence in each of the assessments, as well as any evidence gaps that were identified and may be beneficial for further investigation into these sites (see section 5.2 for further recommendations)

Table 5.1: Summary table showing the key points from each disposal site review alongside the confidence in the assessment and any evidence gaps / suggestions for further investigation.

Site	Key Points	Confidence	Evidence Gaps
IS015	Material remains close to the disposal site. It has the possibility to interact with protected features of the Cardigan Bay SAC as well as nearby beaches. However, given the small volumes of material disposed, it is unlikely to create a significant impact.	Medium. Expert judgement based on the modelling results.	Due to the proximity to the shoreline, this site may be further influenced by factors such as wave dynamics, which were not considered as part of this model.
IS035	The majority of the material will take two or three days to reach the seabed assuming a still environment.	Low. Expert opinion based on existing knowledge of the area.	This site was outside the model domain, so additional modelling of this particular area would be beneficial.
IS043	The disposal site is located within the Anglesey Terns SPA, but material is likely to spread	Medium. Expert judgement based	Further investigation into the sensitivities of the nearby protected

Site	Key Points	Confidence	Evidence Gaps
	South of this location, and away from the shoreline. Disposal operations interact with a high-density shipping area, based on ships travelling into and out of Holyhead Port (although the port itself id >10km away)	on the modelling results.	areas, and dispersive nature of the material (to determine the severity of the impact to navigation)
IS065	The majority of the material will take two or three days to reach the seabed assuming a still environment.	Low. Expert opinion based on existing knowledge of the area.	This site was outside the model domain, so additional modelling of this particular area would be beneficial.
IS099	Flow rates in the Dyfrdwy river (where this site is located) are unknown but must be sufficient to prevent overloading the disposal site. As the material being deposited is sands, it will likely fall relatively quickly to the seabed. Anecdotal evidence suggests that the area between Connah's Quay and the Dee estuary is accreting, and this the likely fate of the material from IS09	Low. Expert opinion based on existing knowledge of the area.	This site was outside the model domain, so additional modelling of this particular area would be beneficial.
IS102	Disposal site located within the Dee Estuary SAC, SPA, SSSI, and Ramsar Site, and the modelled	Medium. Expert judgement based	Further investigation into the sensitivities of the nearby protected

Site	Key Points	Confidence	Evidence Gaps
	plume is likely to interact with the Liverpool Bay SPA. The plume also has the potential to interact with the M045 shellfish area. The site used to be a part of a larger disposal site (IS101), for which there were no reported impacts, and therefore any risk of impact is considered low.	on the modelling results.	areas, and shellfish areas may be beneficial at this site.
LU110	Material remains largely within the water column (any material reaching the seabed is resuspended) and is retained within 10km of the disposal site. Dispersive site due to The disposal site is located within the Severn Estuary SAC, and the plume also overlaps with the Severn Estuary SPA, The disposal site is in close proximity to a number of major ports, and therefore the site and plume are within a high-density shipping area.	judgement based on the modelling results.	Further investigation into the sensitivities of the protected areas' features may be beneficial at this site. Also, due to the proximity to the shoreline, this site may be further influenced by factors such as wave dynamics, which were not considered as part of this model.
LU115	This site is highly dispersive, and material may spread to a large area of the Severn	Medium. Expert judgement based	Further investigation into the sensitivities of the protected areas'

Site	Key Points	Confidence	Evidence Gaps
	Estuary, while remaining in the water column throughout the model duration. Disposed material has the potential to interact with the Severn Estuary SAC, SPA, and Ramsar Site, the East Aberthaw SSSI, and the Flat Holm SSSI. The material also has the potential to interact with monitored beaches, which may impact tourism, but given the highly dispersive nature of the site and existing suspended sediment concentrations in the area, this is unlikely to cause a serious impact.	on the modelling results.	features may be beneficial at this site.
LU130	Modelling results indicate that the majority of disposed material is likely to settle to the seabed relatively quickly, and then continue to travel further offshore in a Southerly direction. Given the location of the disposal site, and the likely movement of the sediment, it is unlikely that material disposed to Swansea Bay (Outer) will interact with any	Medium. Expert judgement based on the modelling results	This site has the potential to be impacted by storms, and their associated wave action, which was not included in the model used.

Site	Key Points	Confidence	Evidence Gaps
	protected areas, as there is no overlap with the disposal site or the modelled sediment plume. However, the plume does come within 2km of the Carmarthen Bay and Estuaries SAC after 6 hours, although this distance generally increases over time, and therefore there is a potential pathway of interaction over this distance.		
LU140	This is a highly dispersive site, particularly in relation to sediment at the surface and water column. The disposal site is located within the Severn Estuary SAC, and the plume also overlaps with the Severn Estuary SPA, SSSI, and Ramsar site. The modelled plume reaches the shoreline in a number of locations (both on the Welsh and English side), although this could potentially be a benefit if material is deposited of mudflat/saltmarsh habitat.	Medium. Expert judgement based on the modelling results.	Further investigation into the sensitivities of the protected areas' features may be beneficial at this site. Further investigation as to the fate of the material when it reaches the shoreline would also be beneficial.

Site	Key Points	Confidence	Evidence Gaps
LU190	Site is located within the Milford Haven Ria, which is subject to moderate currents. Observations of sediments near the disposal site indicate no features associated with the impacts of disposal are within the vicinity of the site. A survey undertaken two years post disposal indicated any impacts appear to be confined within the disposal sites and temporary.	Low. Expert opinion based on existing knowledge of the area.	This site was outside the model domain, so additional modelling of this particular area would be beneficial.
LU168	Site sits wholly within the Skomer, Skokholm, and the Seas off Pembrokeshire SPA, and is likely to overlap with the Pembrokeshire Marine SAC.	Medium. Expert judgement based on the modelling results.	Further investigation into the sensitivities of the protected areas' features may be beneficial at this site.
LU169	Site sits wholly within the Skomer, Stokholm, and the Seas off Pembrokeshire SPA, and for the most part the model shows that the disposal plume remains within this SPA, spreading >15km to the South of the disposal site within 6 hours of disposal.	Medium. Expert judgement based on the modelling results.	Further investigation into the sensitivities of the protected areas' features may be beneficial at this site.

5.2 Further Recommendations

This review has not included a detailed review of the management measures applied to individual sites, and therefore restrictions on the disposal of material at certain time periods (e.g. disposal on only the ebb tide), or other such management measures, have not been considered.

In addition, in order to run the model to determine the potential pathway of interaction from a disposal site to the sensitive receptors, the central point of a disposal site was used however, a disposal operation can occur anywhere within a site. Therefore, it would be prudent to investigate certain disposal sites further with a more complex model (that take into account more environmental factors) to determine if spatial restrictions can be applied to these disposal sites to reduce the likelihood of exposure.

This study has also only looked at the disposal operations of dredged material within the vicinity of designated disposal sites; it has not looked at the dredging operations or any other activity which may have a cumulative impact on the features of a designated site or wider environmental or socio economic receptors. This may be a factor that the Welsh Government wish to look into for certain disposal sites identified to have potential pathways of interactions with sensitive receptors.

Where robust high-resolution models exist such as in the Conwy, it recommended that licence conditions are explored in the model in order to predict residual particle directions for various particle sizes and fluvial conditions i.e. high runoff events, summer droughts. Similarly, The Swansea Site will benefit from model simulations including wave resuspension.

The following disposal sites may benefit from further investigation into the sensitivity of receptors within the area, particularly in the context of protected areas, where potential pathways of interaction have been identified as part of this review:

- Mostyn Deep (IS102)
- Cardiff Grounds (LU110)

- Newport (LU140)
- Deganwy (IS035)
- Conwy (IS065)
- Milford Haven Two (LU168) and Three (LU169)

Further investigation into these sites could include a more comprehensive desk-based review, in particular to look into the specific locations and sensitivities of receptors in relation to the disposal operations and plumes. This would enable a more detailed assessment of any potential impacts arising from the disposal at these locations. In addition, this may highlight sites that would benefit from monitoring activities to determine the impact of disposal over time.

6 References

ABPmer Renewables Atlas, https://www.renewables-atlas.info/explore-the-atlas/, retrieved Feb 2020.

AE0910, A Computer Modelling Tool For Predicting the Dispersion Of Sediment Plumes From Aggregate Extraction Activities, AE0910, 2001, http://randd.defra.gov.uk/Document.aspx?Document=AE0910_1119_FRP.doc

Bray, R.N., (2008). Environmental Aspects of Dredging, CEDA/IADC.Taylor and Francis.

Carey, D.A., Hayn, M., Germano, J.D., Little, D.I., Bullimore B., 2015, Marine Habitat mapping of the Milford Haven Waterway, Wales, UK, Comparison of facies mapping and EUNIS classification for monitoring sediment habitats in and industrial estuary, Journal of Sea Research 100, 99-119 doi:10.1016/j.series.2014.09.012

Churchill, J. H. 1989. The effect of commercial trawling on sediment resuspension and transport over the Middle Atlantic Bight continental shelf. Cont. Shelf Res. 9:841864.

Cooper, K., (2013) Setting limits for acceptable change in sediment particle size composition: TesPages 86-97.

Essink, K. (1999) Ecological effects of dumping dredged sediments: options for management. Journal of Coastal Conservation 5: 69-80.

International Maritime Organisation IMO, (2014). Waste Assessment Guidelines under the London Convention and Protocol: 2014 edition. IMO publication sales number. IA531E

International Maritime Organisation (IMO), (2003). London Convention 1972 and 1996 Protocol, 2003 edition. ISBN 92-801-4155-4, IMO publication sales number IA532E.

MEMG (2003). Group Co-ordinating Sea Disposal Monitoring. Final Report of the Dredging and Dredged Material Disposal Monitoring Task Team. Sci. Ser., Aquat. Environ. Monit. Rep., CEFAS, Lowestoft, (55): 52pp.

OSPAR (2009). JAMP assessment of the environmental impact of dumping wastes at sea. OSPAR Commission 2009: Biodiversity Series.

OSPAR (2008) Literature review on the impacts of dredged sediment disposal at sea. OSPAR Commission 2008: Biodiversity Series

OSPAR (2014) OSPAR Guidelines for the Management of Dredged Material at Sea. OSPAR Commission Agreement 2014-06.

Robins, P.E., Neill, S.P and Gimenez, L., 2012, A numerical study of marine larval dispersal in the presence of an axil convergent front, Estuarine, Coastal and Shelf Science, 100, p172-185.

Robins, P.E., Farkas, K., Cooper, D., Malham, S.K., and Jones, D., 2019, Viral dispersal in the coastal zone : A method to quantify water quality risk, Environment International 126 , p430-442.

Silva, T., Biermann, L. and Rees, J. ,2016, Suspended Sediment Climatologies around the UK,
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584621/CEFAS_2016_Suspended_Sediment_Climatologies_around_the_UK.pdf

Silva (2016). Monthly average non-algal Suspended Particulate Matter concentrations. Cefas, UK. V1. doi: https://doi.org/10.14466/CefasDataHub.31

Sullivan, N. (2000) The use of agitation dredging, water injection dredging and sidecasting: Results of a survey of ports in England and Wales. Terra et Aqua. 78: 11-20.

Tillin, H.M., Hull, S.C., Tyler-Walters, H. 2010. Development of a Sensitivity Matrix (pressures-MCZ/MPA features). Report to the Department of Environment, Food and Rural Affairs from ABPMer, Southampton and the Marine Life Information Network (MarLIN) Plymouth: Marine Biological Association of the UK. Defra Contract No. MB0102 Task 3A, Report No. 22.

Uncles, R.J., Stephens, J.A. and Harris, C. (2015). Physical processes in a coupled bay–estuary coastal system: Whitsand Bay and Plymouth Sound, Progress in Oceanography, Volume 137, Part B, September 2015, Pages 360-384, ISSN 0079-6611, http://dx.doi.org/10.1016/j.pocean.2015.04.019

Zimmerman, L.E., Jutte, P.C. and Van Dolah, R.F. (2003) An environmental assessment of the Charleston Ocean Dredged Material Disposal Site and surrounding areas after partial completion of the Charleston Harbor Deepening Project. Marine Pollution Bulletin 46, 1408-1419.

Appendix A:

Cefas

Use of Action Levels in Dredged Material Assessments

Action Levels are used as part of a 'weight of evidence' approach to assessing dredged material and its suitability for disposal to sea. These values will be used in conjunction with a range of other assessment methods e.g. bioassays, as well as historical data and knowledge regarding the dredging site, the material's physical characteristics, the disposal site characteristics and other relevant data, to make management decisions regarding the fate of dredged material. We are currently in the process of testing sediment bioassays to provide further information on the characteristics of dredged material. This integrated approach is in line with recent discussions regarding weight of evidence approaches to environmental management of sediments. It considers balancing multiple lines of evidence concerning ecological assessment as an aid to decision making.

In general, contaminant levels in dredged material below Action Level 1 are of no concern and are unlikely to influence the licensing decision. However, dredged material with contaminant levels above Action Level 2 is generally considered unsuitable for sea disposal. The latter situation most often applies only to a part of a proposed dredging area and so that area can be excluded from disposal at sea and disposed of by other routes e.g. landfill. Dredged material with contaminant levels between Action Levels 1 and 2 requires further consideration and testing before a decision can be made.

ACTION LEVELS		
Contaminant / Compound	Action Level 1	Action Level 2
	mg/kg Dry Weight (ppm)	
As	20	100
Hg	0.3	3
Cd	0.4	5
Cr	40	400
Cu	40	400
Ni	20	200
Pb	50	500
Zn	130	800
Organotins; TBT DBT MBT	0.1	1
PCB's, sum of ICES 7	0.01	none
PCB's, sum of 25 congeners	0.02	0.2
*DDT	*0.001	
*Dieldrin	*0.005	
	*these levels were set in 1994	

Cefas is an Executive Agency of Defra

Appendix B:

Open disposal sites (included in this review):

Disposal Site Code	Disposal Site Name	First Disposal Returns	Particle Size Distribution (%)		
			Gravel	Sand	Silt
IS015	NEW QUAY TRACK	2013			
IS035	DEGANWY BENEFICIAL USE	2009			
IS043	Holyhead North	2017	11.79	25.08	63.13
IS065	CONWY BENEFICIAL USE	2009	0	19	81
IS099	BROUGHTON	2010	0	95	5
IS102	MOSTYN DEEP (MAINTENANCE)	2005	0	90	10
LU110	CARDIFF GROUNDS	1988			
LU115	MERKUR BUOY	1997	10	35	55
LU130	SWANSEA BAY (OUTER)	1985	15	20	65
LU140	NEWPORT	1990			
LU190	NEYLAND (OFF MILFORD HAVEN)	2001			
LU168	MILFORD HAVEN TWO	1997			
LU169	MILFORD HAVEN THREE	2002	7	39	54

Closed/ Disused disposal site details (not included in this review):

Site Code	Disposal Site Name
IS030	MENAI STRAIT
IS040	HOLYHEAD DEEP
IS041	HOLYHEAD SOUTH
IS042	HOLHEAD EAST
IS050	POINT LYNAS
IS060	PUFFIN ISLAND
IS100	DEE ESTUARY
LU040	MILFORD HAVEN INDUSTRIAL
LU111	CARDIFF OUTFALL TEMPORARY DEPO
LU120	SWANSEA BAY (INNER)
LU150	MUMBLES HEAD
LU160	BRISTOL CHANNEL
LU170	MILFORD HAVEN
LU180	ST ANNS HEAD
LU200	USKMOUTH
MH001	HERBRANDSTON MARINE, MILFORD HAVEN

Annual disposal volumes and types for disposal sites included in this review (continued on next page):

Site Code	Disposal type	Disposal Quantity (wet tonnes) per year										
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
IS015	**FW**											
IS035	**MD**											
IS043	**MD**											
IS065	**MD**											
IS099	**MD**											
IS102	**MD**											
LU110	**MD**				**6240**	56640	15600	39920	20183	7670	34350	-
LU115	**MD**									**2860**	45393	36777
LU130	**MD**											
	CD	**4000**	-	-	205400	82620	-	-	-	-	-	-
LU140	**MD**						**6950**	-	-	-	-	1120
	CD											
LU190	**MD**											
LU168	**MD**											
	CD											
LU169	**MD**											
	CD											

Site Code	Disposal type	Disposal Quantity (wet tonnes) per year										
		1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
IS015	**FW**											
IS035	**MD**											
IS043	**MD**											
IS065	**MD**											
IS099	**MD**											
IS102	**MD**										**29464**	443968
LU110	**MD**	11604	49490	-	-	16428	11233	-	67800	251209	549147	494887
LU115	**MD**	54828	45640	25017	50490	19032	56449	-	-	-	32136	45015
LU130	**MD**									**40763**	3188920	1771653
	CD	-	147889	-	-	-	-	-	-	-	-	-
LU140	**MD**	-	-	-	1520	**-**	-	-	-	-	34468	-
	CD					**1800**	-	-	-	-	-	-
LU190	**MD**						**1842**	-	-	-	-	-
LU168	**MD**		**94444**	21342	-	-	**-**	-	-	-	-	-
	CD											**900**
LU169	**MD**							**1503**	-	-	-	-
	CD											

Site Code	Disposal type	Disposal Quantity (wet tonnes) per year										
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
IS015	**FW**							**927**	848	805	301	165
IS035	**MD**			**3800**	8529	-	-	11441	-	6969	0	6276
IS043	**MD**											**0**
IS065	**MD**			**23900**	10500	-	35188	-	36324	11370	39537	22897
IS099	**MD**				**4884**	-	733778	6920	12423	10523	10853	13124
IS102	**MD**	185180	79508	178950	734250	357332	-	662160	275830	69970	21348	6172
LU110	**MD**	376544	15460	16748	444954	1022874	874282	887999	520103	516954	785318	760730
LU115	**MD**	27468	33496	45091	12883	51785	69347	-	24532	36251	62121	83530
LU130	**MD**	2097350	2407028	2362779	1639550	1431124	1383986	1466431	2313193	1849880	2256269	1471064
	CD	-	90014	-	-	-	-	-	-	-	-	-
LU140	**MD**	-	138656	271811	152956	290046	229236	147702	257705	194412	294577	205263
	CD	-	-	-	-	-	-	-	-	-	-	-
LU190	**MD**	-	-	-	4169	-	-	-	5910	1050	3300	4630
LU168	**MD**	-	-	-	-	-	-	-	-	-	-	-
	CD	450	-	-	-	-	-	-	-	-	-	-
LU169	**MD**	-	85500	-	-	-	-	-	-	-	-	-
	CD		**25660**	-	51865	18425	-	-	-	-	-	-

FW: Fish Waste MD: Maintenance Dredge CD: Capital Dredge

The first record of disposal for each waste type at each site is listed in bold typeface. Blank cells represent years prior to the first disposal return at a site, and "-" is used to represent a year when the site was open, but no returns were received, suggesting that no disposal activity was undertaken at that site, for that waste type, that year.

Appendix C:

Data Layer	Description	Source
Disposal Site Areas	Polygon data showing the location and status of licensed offshore disposal sites within UK waters.	Cefas Data
CADW Designated Wrecks	Polygon data showing the location of a Protected Wreck. The GIS depictions were drawn from the positional information given in the Statutory Instrument under which this site was designated.	lle.gov.wales
AIS Vessel Transit Lines (2015 national dataset)	Line data showing transit lines of vessels, based on Automatic Identification System (AIS) data.	ABPmer
AIS Vessel Density Grid 2015	This dataset contains the average weekly shipping density for the whole of the UK at a 2km grid resolution.	MMO
Offshore Wave Areas	This dataset represents all current live wave agreements in English, Welsh and Northern Irish waters. The boundaries are a true reflection of what has been signed in the Agreements for Lease and Lease documents.	The Crown Estate
Offshore Aggregate Sites	This dataset represents all current marine aggregates sites in English, Welsh and Northern Irish waters. The two types of agreement are 'Production	The Crown Estate

	Agreement' and 'Exploration and Option Areas'. The boundaries are a true reflection of what has been signed in the Agreements for Lease and Lease documents.	
Offshore Wind Areas	This dataset represents all current offshore wind farms in pre-planning, planning, construction and operational phases in English, Welsh and Northern Irish waters. The boundaries are a true reflection of what has been signed in the Agreements for Lease and Lease documents.	The Crown Estate
Offshore Wind Cable Areas	This dataset represents all current export cables for offshore wind farms in pre-planning, planning, construction and operational phases in English, Welsh and Northern Irish waters. The boundaries are a true reflection of what has been signed in the Agreements for Lease and Lease documents.	The Crown Estate
Offshore Tidal Stream Areas	This dataset represents all current live tidal stream agreements in English, Welsh and Northern Irish waters. The boundaries are a true reflection of what has been signed in the Agreements for Lease and Lease documents.	The Crown Estate
Offshore Tidal Stream Cable Areas	This dataset represents all current export cables for live tidal stream agreements in English, Welsh and Northern Irish waters. The boundaries are a true reflection of what has been signed in the Agreements for Lease and Lease documents.	The Crown Estate
Shellfish Areas	Polygon data showing the location of designated shellfish waters in the UK	Cefas Data

Environmentally Monitored Beaches	Point data showing the location of environmentally monitored beaches	Emodnet
Major Ports	Point data showing the location of Major ports around the UK	Emodnet
Protected Areas	Polygon data showing the location of current protected areas around the UK (including MCZ, SAC, SPA, SSSI, Ramsar)	Cefas Data
Fisheries nursery / spawning areas	Polygon data showing the broad nursey and spawning areas of fish around the UK	Cefas Data

Appendix D:

Site Code	Protected Areas	Fisheries		Shellfisheries	Tourism / Recreation	Protected Wrecks	Offshore Installations	Oil and Gas	Shipping
		Nursery	Spawning						
IS015	Disposal site and plume overlaps with Cardigan Bay SAC, and Aberarth SSSI	Anglerfish Plaice Spotted Ray Thornback Ray Whiting	Sandeel Whiting Sole Plaice Cod	None	Near 3 Environmentally monitored beaches: - New Quay North - New Quay Harbour - Traeth Gwyn New Quay	None	None	None	Low density area
IS043	Disposal site located partly within Anglesey Terns SPA. Material generally transported SSW from the disposal location and therefore does not overlap with any protected areas	Tope Shark Anglerfish Spotted Ray Whiting	Ling Mackerel Sandeel Whiting Sole Plaice Cod Sprat	None	~ 13km from nearest Environmentally monitored beach ~ 5 km from nearest coastline No interaction between beaches and plume	>10km from nearest wreck (Royal Yacht Mary) and plume moves away from this.	None	None	High density area (result of Holyhead port, which is >10km away)

Site Code	Protected Areas	Fisheries		Shellfisheries	Tourism / Recreation	Protected Wrecks	Offshore Installations	Oil and Gas	Shipping
		Nursery	Spawning						
IS102	Site within Dee Estuary SAC, SPA, SSSI, and Ramsar site Plume spreads to overlap with Liverpool Bay SPA	Cod Tope Shark Herring Anglerfish Plaice Sandeel Spotted Ray Sole Thornback Ray Whiting	Mackerel Sandeel Whiting Sole Plaice Cod Sprat	Plume overlaps with M045 shellfish area (designated for *C. edule*)	No overlap with monitored beaches. Plume reaches shoreline at surface in one location (at 6 hour point and then moves away again)	None	None	None	Low-Medium density area
LU110	Disposal Site located within Severn Estuary SAC Plume spreads NE into Severn Estuary SPA, SSSI, and Ramsar Site	No data	No data	None	No overlap with monitored beaches. Plume does not reach shoreline	None	None	None	Plume overlaps a high density shipping area, due to number of major ports in vicinity: - Newport - Penarth

Site Code	Protected Areas	Fisheries		Shellfisheries	Tourism / Recreation	Protected Wrecks	Offshore Installations	Oil and Gas	Shipping
		Nursery	Spawning						
									- Cardiff
LU115	Plume overlaps with: Severn Estuary SAC, SPA, and Ramsar site; East Aberthaw Coast SSSI; and, Flat Holm SSSI	No data	No data	No data	Several environmentally monitored beaches in proximity to plume: - Jackson's Bay Barry Island - Whitmore Bay Barry Island - Cols Knap Barry - Burnham Jetty North - Berrow North of Unity Farm - Brean - Minehead Terminus - Dunster North West - Blue Anchor West	None	None	None	Plume within a medium - high density area Two major ports, within proximity of plume: - Barry - Watchet

Site Code	Protected Areas	Fisheries		Shellfisheries	Tourism / Recreation	Protected Wrecks	Offshore Installations	Oil and Gas	Shipping
		Nursery	Spawning						
LU130	No overlap with protected areas, although plume comes within 2km of Carmarthen Bay and Estuaries SAC (distance increases over time)	Tope shark Herring Anglerfish Plaice Sandeel Spotted Ray Sole Thornback Ray Whiting Lemon Sole	Sandeel Sole Lemon Sole	None	No overlap with monitored beaches. Plume remains offshore	None	None	None	Medium density area Nearest major port (Port Talbot) is ~ 9km from the site and plume.
LU140	Site within Severn Estuary SAC Plume spreads to overlap with Severn Estuary SPA, SSSI, and Ramsar Site	Anglerfish Plaice Sole Whiting	No data	None	Site and Plume >10km away from nearest coastline	None	None	None	Low-medium density area

Site Code	Protected Areas	Fisheries		Shellfisheries	Tourism / Recreation	Protected Wrecks	Offshore Installations	Oil and Gas	Shipping
		Nursery	Spawning						
LU168	Site within Skomer, Stokholm and the Seas off Pembrokeshire SPA Plume slightly overlaps with Permbrokeshire Marine SAC, but generally spreads away from the protected areas.	Tope shark European Hake Mackerel Anglerfish Sandeel Spotted Ray Sole Thornback Ray Whiting	Cod Hake Horse Mackerel Ling Mackerel Plaice Sandeel Sole Whiting Sprat	None	Site and Plume >10km away from nearest coastline	None	None	None	Low-medium density area
LU169	Site within Skomer, Stokholm and the Seas off Pembrokeshire SPA	European Hake Mackerel Anglerfish Thornback Ray Whiting	Cod Hake Horse Mackerel Ling Mackerel Sandeel Sole Whiting	None	Plume >20km from nearest coastline Disposal site >25km from nearest coastline	None	None	None	Low density area

Site Code	Protected Areas	Fisheries		Shellfisheries	Tourism / Recreation	Protected Wrecks	Offshore Installations	Oil and Gas	Shipping
		Nursery	Spawning						
			Sprat						
IS035	Site within Aber Afon Conwy SSSI Potential to interact with Menai Strait and Conwy Bay SAC	Cod Tope shark Anglerfish Plaice Sandeel Spotted Ray Sole Thornback Ray Whiting	Mackerel Sandeel Whiting Sole Plaice Cod Sprat	Located close (<1km both upstream and downstream) of the M044 shellfish areas, which are designated for *Mytilus spp.*	Located close (<1km) to coastline and the busy Conwy and Deganwy marinas	None	None	None	Low density area
IS065	Site adjacent to Aber Afon Conwy SSSI Potential to interact with Menai Strait and Conwy Bay SAC	Cod Tope shark Anglerfish Plaice Sandeel Spotted Ray Sole	Mackerel Sandeel Whiting Sole Plaice Cod Sprat	Located close (<1km both upstream and downstream) of the M044 shellfish areas, which are	Located close (<1km) to coastline and the busy Conwy and Deganwy marinas	None	None	None	Low density area

Site Code	Protected Areas	Fisheries		Shellfisheries	Tourism / Recreation	Protected Wrecks	Offshore Installations	Oil and Gas	Shipping
		Nursery	Spawning						
		Thornback Ray Whiting		designated for *Mytilus spp.*					
IS099	Site within the River Dee and Bala Lake SAC, and River Dee SSSI	Herring	Sprat	None	None	None	None	None	Low density area
LU190	Site within the Pembrokeshire Marine SPA and <1km from the Milford Haven Waterway SSSI	Tope Shark Herring Anglerfish Plaice Sandeel Spotted Ray Sole Thornback Ray Whiting	Plaice Sandeel Sole Sprat	Site within the M039 shellfish area, designated for O. Edulis	Located <1km from the shoreline	None	None	None	Medium density area, due to nearby Pembroke Port

Centre for Environment Fisheries & Aquaculture Science

Cefas

About us

We are the Government's marine and freshwater science experts. We help keep our seas, oceans and rivers healthy and productive and our seafood safe and sustainable by providing data and advice to the UK Government and our overseas partners.

We are passionate about what we do because our work helps tackle the serious global problems of climate change, marine litter, over-fishing and pollution in support of the UK's commitments to a better future (for example the UN Sustainable Development Goals and Defra's 25 year Environment Plan).

We work in partnership with our colleagues in Defra and across UK government, and with international governments, business, maritime and fishing industry, non-governmental organisations, research institutes, universities, civil society and schools to collate and share knowledge.

Together we can understand and value our seas to secure a sustainable blue future for us all, and help create a greater place for living.

Head office
Pakefield Road
Lowestoft
Suffolk
NR33 0HT
Tel: +44 (0) 1502 56 2244
Fax: +44 (0) 1502 51 3865

Weymouth office
Barrack Road
The Nothe
Weymouth
DT4 8UB

Tel: +44 (0) 1305 206600
Fax: +44 (0) 1305 206601

Innovative, world-class science is central to our mission. Our scientists use a breadth of surveying, mapping and sampling technologies to collect and analyse data that are reliable and valuable. We use our state-of-the-art Research Vessel Cefas Endeavour, autonomous marine vehicles, remotely piloted aircraft and utilise satellites to monitor and assess the health of our waters.

In our laboratories in Lowestoft and Weymouth we:
- safeguard human and animal health
- enable food security
- support marine economies.

This is supported by monitoring risks and disease in water and seafood; using our data in advanced computer models to advise on how best to manage fish stocks and seafood farming; to reduce the environmental impact of man-made developments; and to respond to serious emergencies such as fish disease outbreaks, and to respond to oil or chemical spills, and radioactivity leaks.

Overseas, our scientists currently work in Commonwealth countries, United Kingdom Overseas Territories, South East Asia and the Middle East.

Our customer base and partnerships are broad, spanning Government, public and private sectors, academia, non-governmental organisations (NGOs), at home and internationally.

disability confident EMPLOYER

www.cefas.co.uk

Printed on paper made from a minimum 75% de-inked post-consumer waste