



**Vattenfall Wind Power Ltd**

**Thanet Extension Offshore Wind Farm**

**Annex 5-1: Export Cable Route Intertidal  
Report**

June, 2018, Revision A

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Vattenfall Wind Power Ltd

Thanet Extension Offshore Wind Farm

Annex 5-1: Export Cable Route Intertidal Survey

June, 2018

Drafted By:	Marine Ecological Surveys Limited
Approved By:	Helen Jameson
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# THANET EXTENSION OFFSHORE WINDFARM

## *Export Cable Route Intertidal Report*

*September 2017*



Prepared for

**GoBe Consultants Ltd**

By

**Marine Ecological Surveys Limited**



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## Non-technical Summary

Marine Ecological Surveys Limited (MESL) was commissioned by GoBe Consultants Ltd. on behalf of Vattenfall Wind Power Ltd., to undertake an intertidal survey of three potential landfall sites for a cable extension for the Thanet Extension Offshore Wind Farm. Two potential cable route sites were located at Pegwell Bay and one at Sandwich Bay, Kent. The area as a whole is of importance as a feeding area for wading birds and for the fauna and flora of the surrounding salt-marshes and coastal fringe habitats, including wave-cut platforms and associated communities. The site is therefore subject to a number of conservation designations, including a Special Protection Area (SPA), a Special Area of Conservation (SAC), a Ramsar Site, a Site of Special Scientific Interest (SSSI) and a National Nature Reserve (NNR).

An intertidal survey was required to provide a robust characterisation of the proposed cable landing sites. The data from the survey will provide supporting information to inform the wider Environmental Impact Assessment (EIA) being undertaken for the development.

The survey was undertaken by MESL on the 11<sup>th</sup> – 12<sup>th</sup> July, 2017 and involved Phase I mapping and Phase II sampling of the intertidal mud and sand flats found throughout the proposed cable route sites.

The key findings of this report are as follow:

- The characteristics of Pegwell Bay and Sandwich Bay are highly contrasting in terms of formation, sediment composition and benthic infauna.
- Faunal abundance was higher at Pegwell Bay than at Sandwich Bay and communities demonstrated increased taxa diversity and biomass by comparison.
- Particle Size Analysis (PSA) of the intertidal sediments sampled across Pegwell Bay showed that the sediment composition of the site was dominated by sandy substrates, although a number of stations also contained small fractions of gravel and silt.
- In contrast to Pegwell Bay, PSA of the intertidal sediments sampled across Sandwich Bay showed that the sediment composition of the site was dominated by gravelly substrates, although a number of stations also contained small fractions of sand.
- A total of 35 taxa and 1,070 individuals were sampled from the 15 intertidal core samples collected during the Pegwell Bay survey. The mean number of taxa recorded per sample was 10 and the mean number of organisms per sample was 71.
- A total of 10 taxa and 20 individuals were sampled from the nine intertidal core samples collected from Sandwich Bay. The mean number of taxa recorded per sample was 2 and the mean number of organisms per sample was 2.
- At Pegwell Bay, Crustacea was the dominant faunal group, accounting for 58% of the total abundance and 34% of the diversity of the site. The remainder of the abundance was predominantly contributed by the major group Annelida accounting for 25%, with 17% split between the groups Mollusca and Miscellaneous.
- At Sandwich Bay, Miscellaneous was the dominant faunal group, accounting for approximately 60% of the total abundance. The remainder of the abundance was predominantly contributed by the major group Annelida accounting for 25%, with the remaining abundance attributed to

Crustacea. No Mollusca were recorded at any of the Sandwich Bay stations. Highlighting the sparse nature of the infaunal communities of Sandwich Bay.

- A total of four biotope complexes were assigned to the intertidal habitats of Pegwell Bay. The most common in terms of total area mapped was the biotope complex A2.242 (*Cerastoderma edule* and polychaetes in littoral muddy sand) which was located across the mid and lower shore and was found to be representative of 53.7% of the total mapped area. This was followed by A2.24 (Polychaete/bivalve-dominated muddy sand shores) which represented 30% of the mapped area.
- A single biotope complex (A2.111 – Barren littoral shingle) was identified within the Sandwich Bay survey area. The presence of a single biotope at Pegwell Bay illustrates the homogeneous nature of the bay.

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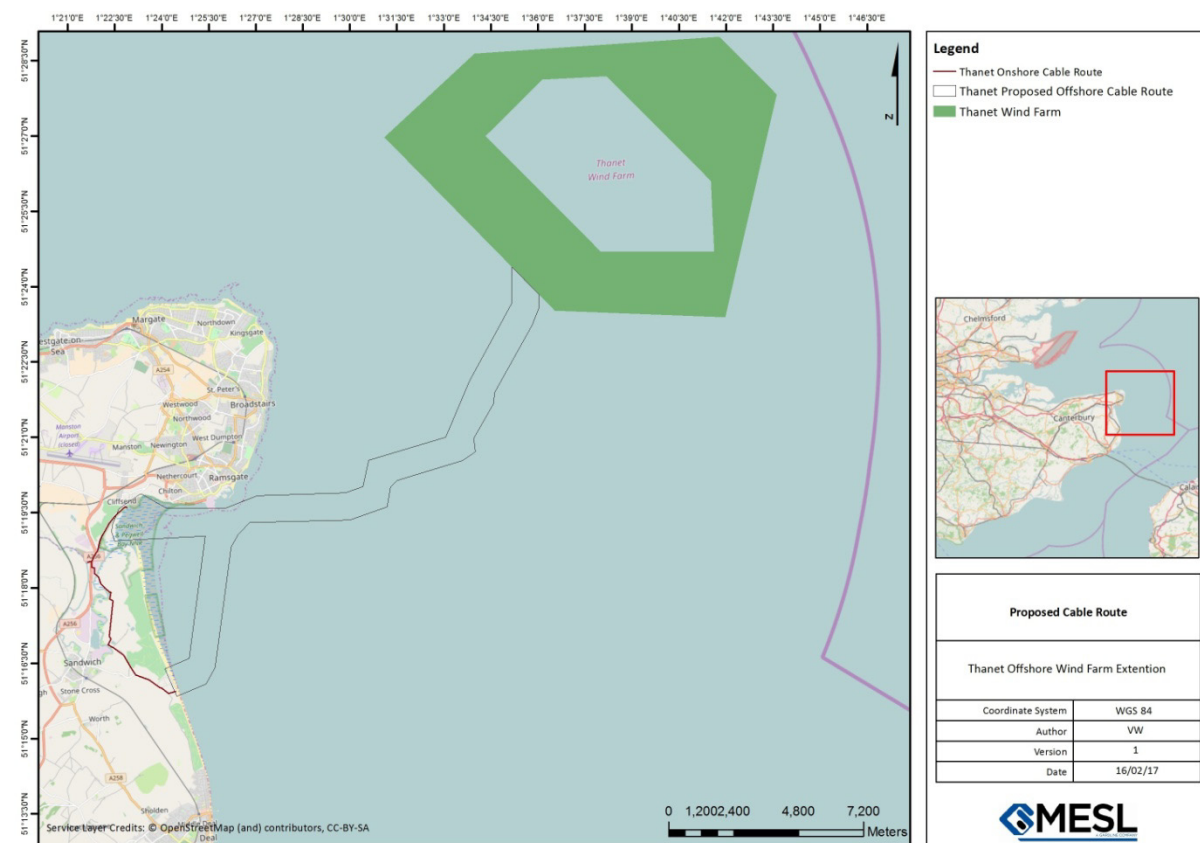
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# 1. Introduction

## 1.1. Project Background

Marine Ecological Surveys Limited (MESL) was commissioned by GoBe Consultants Ltd. on behalf of Vattenfall Wind Power Ltd. to undertake an intertidal survey of three potential landfall sites for a cable extension for Thanet Extension.

The development is expected to comprise of a maximum of 34 x 9MW wind turbine generators that will encircle the current Thanet Offshore Wind Farm, yielding a potential energy generation of up to 285MW. It is anticipated that the export cable route from the Thanet development site will come ashore at either Pegwell or Sandwich Bay on the Kent coastline. There are two proposed cable landing options at Pegwell Bay (one in the northern and one in the southern section of the Bay) and a single option at Sandwich Bay. The proposed landfall locations are shown in Figure 1.



**Figure 1.** The location of the Thanet Wind Farm Extension and the proposed cable landfall sites at Pegwell Bay (northern-most landing sites) and Sandwich Bay (southern-most landing site).

The key elements of the survey undertaken by MESL involved Phase I mapping and Phase II sampling of the intertidal habitats found across each site. The study was designed to characterise the infaunal communities and biotopes of the intertidal sediments of the sites, to identify a suitable cable route and to quantify changes resulting from the installation of the new infrastructure.

The data from this survey will provide supporting information to inform the wider Environmental Impact Assessment (EIA) being undertaken for the proposed development.



## 1.2. Site Description

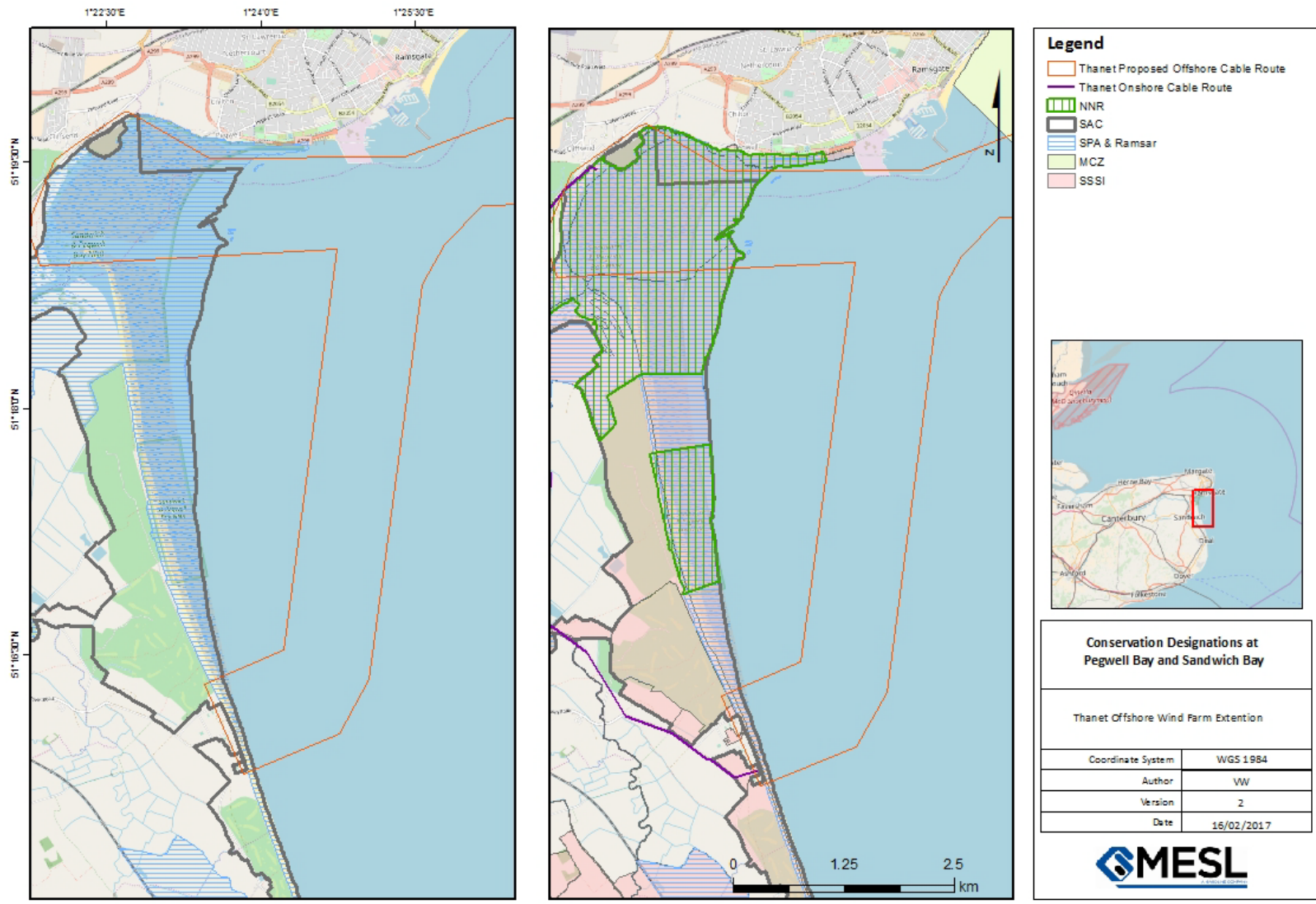
Pegwell Bay and Sandwich Bay in Kent have been selected as possible locations for a new cable landfall site for Thanet Extension. Pegwell Bay is a shallow enclosed inlet of muddy sand found at the eastern edge of the English Channel coastline that straddles the estuary of the River Stour to the north of Sandwich Bay which is a steep, shingle dominated stretch of the coastline.

The ecological character of Pegwell Bay includes intertidal sand and mud flats that are exposed over a wide expanse during low tide. It is bounded by low chalk cliffs that form the southern and eastern side of Ramsgate and Cliffs End, and extends westwards into low-lying marshland that borders the lower estuary of the River Stour inland towards the port of Sandwich. The southern part of Pegwell Bay is known as Sandwich Bay, which is a long stretch of steeply shelved shingle beach and is separated from the main northern mudflats by the approach channel of the Stour estuary to the port of Sandwich (Pound, 2001).

The area as a whole is of importance as a feeding area for wading birds, and for the fauna and flora of the surrounding salt-marshes and coastal fringe habitats, including wave-cut platforms and associated communities. The site is therefore subject to numerous conservation designations, including:

- Special Protection Area (SPA)
- Special Area of Conservation (SAC)
- Ramsar Site
- Site of Special Scientific Interest (SSSI)
- National Nature Reserve (NNR)

Figure 2 shows the location of the various conservation designations in the vicinity of the cable landing sites. The SSSI is notified under the Wildlife and Countryside Act (1981), and represents areas that are of national importance, whilst the NNR is the land declared under the National Parks and Access to the Countryside Act 1949 or Wildlife and Countryside Act (1981) and represents areas that are of national importance. The SPA and SAC are of European importance and were created under the EC Birds Directive and Habitats Directive respectively, forming part of a larger European network known as Natura 2000. The Ramsar site is land listed as a wetland of international importance especially as waterfowl habitat listed under the Ramsar Convention, 1973.



**Figure 2.** The location of the proposed cable landing sites at Pegwell Bay and Sandwich Bay with reference to the various conservation designations in the area, including the SSSI, SPA and SAC and nearby MCZ.

### 1.3. Aims & Objectives

The overarching aim of the 2017 intertidal survey for the Thanet Extension cable landing sites was to obtain robust data on the intertidal communities of each site along the intertidal areas of the proposed cable routes to allow a characterisation of the areas to be undertaken.

In order to meet the projects aim a series of intertidal surveys will be undertaken to the methodologies outlined in this document to provide statistically robust data needed for analysis. The specific objectives of the survey are as follows:

- To characterise the intertidal environment at each of the sites;
- To identifying any species or habitats of conservation importance; and
- To identify the presence of any invasive or non-native species.

The characterisation will provide supporting information to inform the wider Environmental Impact Assessment (EIA) being undertaken for the development.

## 2. Methodology

All intertidal survey work was carried out in accordance with the technical methods outlined in the CSM Guidance, Marine Monitoring Handbook (JNCC, 2004) and the CCW Handbook for Marine Intertidal Phase I Survey and Mapping (Wyn *et al.*, 2006).

### 2.1. Sampling Methodology

The sampling methodology and array for the 2017 intertidal survey, presented below, were approved and signed off by the MMO, the Crown Estate, the Wildlife Trust and GoBe following consultation prior to mobilising the survey following the production of a full Terms of Reference by MESL (MESL, 2017).

The survey had two distinct elements, Phase I mapping and Phase II sampling. Phase I comprises the basic walkover section of the survey, characterising the biotopes present of the site and identifying any conspicuous boundaries or features across the foreshore, whilst Phase II comprises the collection of the infaunal and Particle Size Analysis (PSA) samples to provide greater insight into the ecology of the site. A list of station locations for the intertidal surveys is given in Table 1.

#### 2.1.1. Phase I Methodology

Phase I biotope mapping of the intertidal habitats across Pegwell Bay and Sandwich Bay was carried out alongside the Phase II sampling between the 11<sup>th</sup> - 12<sup>th</sup> July, 2017. Prior to the start of the survey, wherever possible, detailed aerial photography that covered the site was obtained. The imagery was used in conjunction with OS mapping to produce basic wire maps, which were annotated in the field by the survey team.

A map of the sampling array for Pegwell Bay and Sandwich Bay is shown in Figure 3 and Figure 4 below. The orange line delineates the individual transects and the coloured circles represent the actual station locations. Please note that some stations deviate from the transect slightly where it was necessary to relocate them due to dangerous conditions such as the presence of deep mud at Pegwell Bay or due to tidal flow at Sandwich Bay where the beach was short and steep.

Annotations on the wire maps during the survey included:-

- The extent of intertidal features;
- The extent of saltmarsh features;
- The distribution and extent of characteristic biotopes; and
- The sediment character.

As part of the Phase I survey a total of 72 x 1m<sup>2</sup> quadrats were also sampled along the eight pre-designated transects (three quadrats at each upper, mid and low shore station) across the foreshore of Pegwell Bay and Sandwich Bay. The quadrats were primarily used to determine the densities of *Arenicola marina* casts, *Lanice conchilega* tubes and the presence of *Cerastoderma edule* across the site. Quadrats were laid at random at each Phase II sampling station where a photo was taken, along with counts of key conspicuous species and notes on flora present.

Biotopes assigned during the Phase I survey used the EUNIS classification to the highest possible level (minimum level 3). Where necessary, sediment was dug out to a minimum depth of 25cm and sieved in the field using a 1mm sieve to identify conspicuous fauna that may help verify the biotopes present and to provide additional ecological information. Where conspicuous boundaries between biotopes existed between sample points, these locations were fixed on the GPS unit and marked on the wire/aerial imagery maps.

During the walk-over survey any Ecological Network Guidance (JNCC & Natural England, 2010) intertidal features of interest identified by field staff were recorded with georeferenced photographs and reported upon where applicable.

Furthermore, it is the standard practice for field staff to geo-reference, measure and photograph any evidence of anthropogenic disturbance to identified features during the walk-over survey.

### **2.1.2. Phase II Methodology**

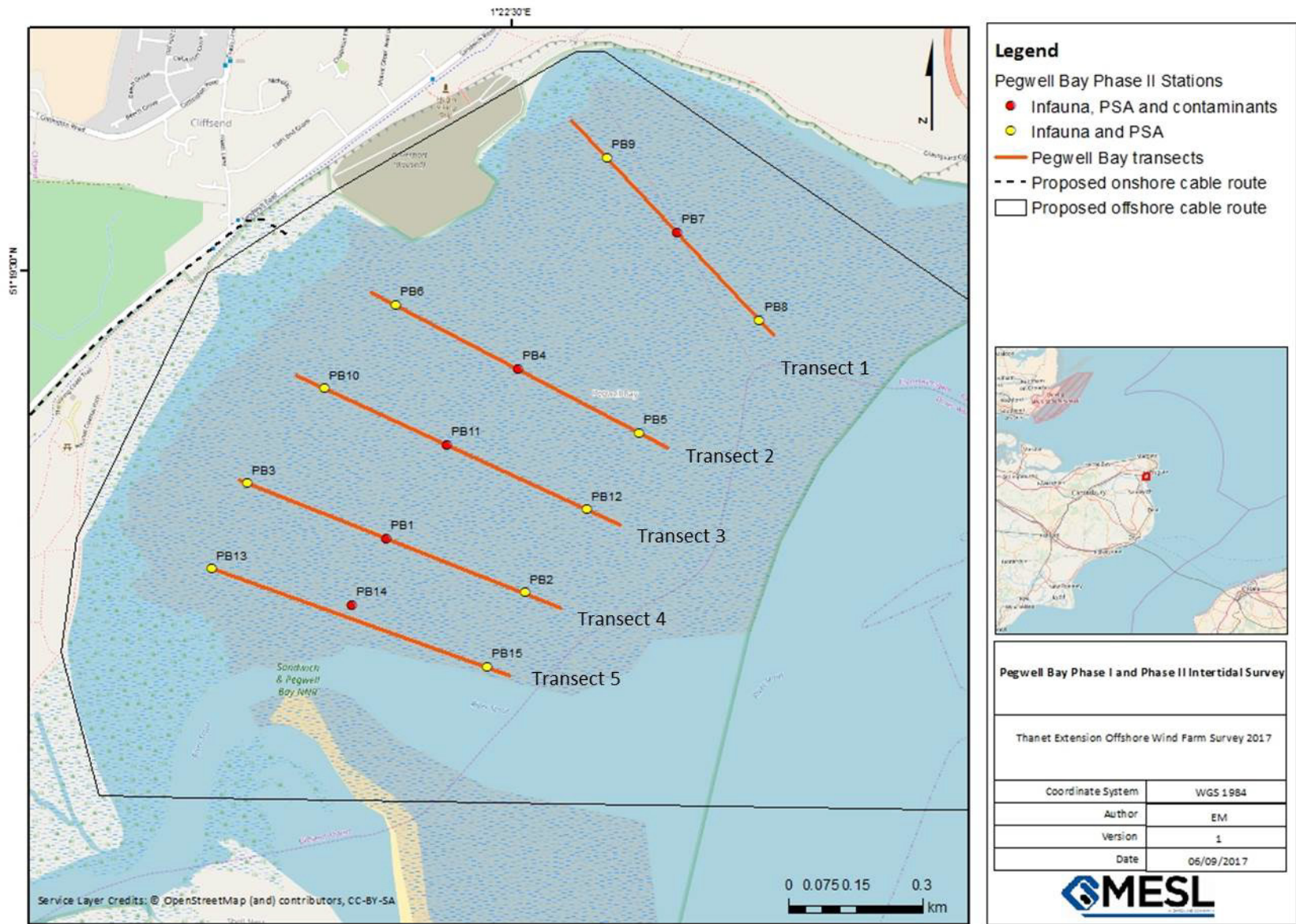
A total of 24 Phase II stations were sampled as part of the 2017 surveys, of which 15 Phase II stations were sampled across Pegwell Bay and 9 across Sandwich Bay (Figure 3 and Figure 4) running vertically up the beach from low to high shore. The stations were allocated proportionately to the proposed cable routes at Pegwell Bay and Sandwich Bay. At all Phase II stations, a single infaunal and PSA sample were collected using a handheld core (0.01m<sup>2</sup> core, 15cm deep).

Infaunal samples were stored in labelled and sealed plastic buckets and preserved using a solution of 4% formalin and seawater. A single PSA sample was collected from all Phase II stations by transferring approximately 0.5L of sediment (taken from immediately next to where the cores were taken) to an externally and internally labelled PSA bag secured with a cable tie. Hence, a total of 24 samples were also collected for PSA.

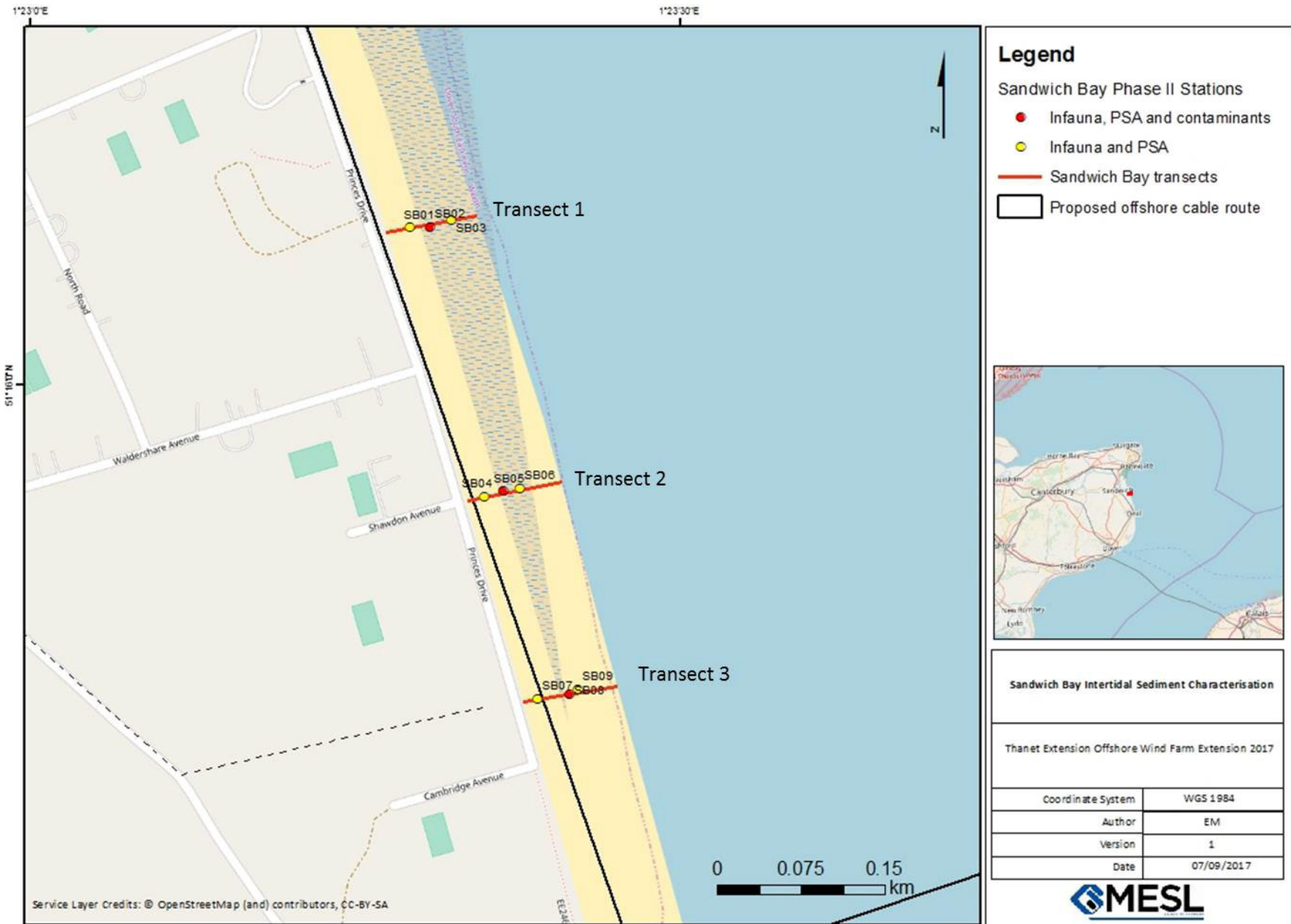
At each sampling point the following details were recorded:

- Sample code, date & time (GMT)
- Latitude & Longitude
- Interstitial salinity
- Texture and presence of surface features (accretions, algae, fauna)
- The anoxic layer depth (RPD layer)
- Depth relative to CD (+/-m) at time of sampling
- Digital image of sediment in sediment surface (image ID code = transect point code and date), include 'survey ruler' in image.

In addition to the PSA and infaunal sample collection, sediment samples were also collected for chemical contaminant analysis from the mid-shore station of each transect at Pegwell Bay and Sandwich Bay. Samples were collected in accordance with the instructions of the analytical lab and were stored in containers provided by the ALS Environmental, to identify levels of TBT, heavy metals, and PAHs in the areas of interest.



**Figure 3.** Intertidal survey station and transect locations for the northern and southern Pegwell Bay cable route options



**Figure 4.** Intertidal survey station and transect locations for the Sandwich Bay cable route option

The coordinates for the Phase II sample stations (WGS 1984) are given in Table 1:

**Table 1.** Coordinates of the proposed sampling stations across Pegwell Bay and Sandwich Bay, 2017

Pegwell Bay				
Transect	Station	Zone	Latitude	Longitude
T1	PB7	Mid	51.32606	1.38045
T1	PB8	Lower	51.32434	1.38313
T1	PB9	Upper	51.32753	1.37815
T2	PB4	Mid	51.32325	1.37545
T2	PB5	Lower	51.32203	1.37935
T2	PB6	Upper	51.32449	1.37147
T3	PB10	Upper	51.32278	1.36929
T3	PB11	Mid	51.32170	1.37323
T3	PB12	Lower	51.32047	1.37775
T4	PB1	Mid	51.31980	1.37136
T4	PB2	Lower	51.31877	1.37582
T4	PB3	Upper	51.32084	1.36688
T5	PB13	Upper	51.31911	1.36580
T5	PB14	Mid	51.31845	1.37031
T5	PB15	Lower	51.31727	1.37468

Sandwich Bay				
Transect	Station	Zone	Latitude	Longitude
T1	SB01	Upper	51.26800	1.38826
T1	SB02	Mid	51.26801	1.38852
T1	SB03	Lower	51.26807	1.38879
T2	SB04	Upper	51.26585	1.38930
T2	SB05	Mid	51.26590	1.38954
T2	SB06	Lower	51.26592	1.38974
T3	SB07	Upper	51.26423	1.39003
T3	SB08	Mid	51.26428	1.39044
T3	SB09	Lower	51.26432	1.39055

## 2.2. Health & Safety

Intertidal areas are inherently dangerous due to the dynamic nature of the environment and therefore are a key concern for MESL. A complete risk assessment was undertaken for all activities, with methods for minimising the risks identified. Due to the potential for unforeseen problems, risk assessments were dynamic, with a continual assessment of potential dangers and actions taken where necessary by surveyors to reduce risk throughout sampling.

A Toolbox talk was given prior to survey operations. This included provisions to ensure that Emergency Response Plans were available, suitable PPE for the task was worn and that the survey team was fully briefed on the tasks and health and safety issues. Two staff were present at all times



on survey operations. MESL has standard risk assessments and SOPs in place for working on intertidal mud flats which are strictly enforced and adhered to.

All surveyors were equipped with suitable PPE which was worn throughout the survey. Communication between the survey teams and the Designated Person Ashore (DPA) was maintained throughout the survey programme, with messages sent at both the commencement of work and successful completion of the survey day.

All of the survey work was successfully completed safely though station PB14 at Pegwell Bay was relocated slightly due to the presence of deep mud at the original target location.

### **2.3. Infaunal Sample Analysis**

On arrival at the MESL analytical laboratory the samples were checked against the field notes (Appendix Table 1) in accordance with standard operating procedures and signed against the list of samples collected. The excess formalin was poured through a 0.5mm mesh sieve and collected for licensed disposal. Each sample was gently eluted with tap water through a 0.5mm mesh sieve to extract the low-density components (Crustacea and Polychaeta) and combined with the floating material initially separated from the formalin in the sample. The larger macrofauna were removed from the eluted material and preserved for analysis. This stage in the initial sorting process was carried out in the open air to reduce the effects of residual formalin used to fix the sample in the field.

The sediments were sorted under a stereomicroscope with the aim of extracting the fauna. The entire sample of separated fauna was then preserved in industrial methylated spirit (IMS) for subsequent analysis. Each of the extracted samples was sorted into major faunal groups before being analysed to species level, where practicable, by experienced taxonomists who sign a log sheet on completion of the analysis of each individual sample. Species identification was recorded in a standard format using species codes from Howson & Picton (1997).

Taxonomic identification was checked throughout the process by our senior analysts and against a reference collection held for ease of use in the analytical laboratory. MESL is a leading participant in the National Marine Biological Analytical Quality Control (NMBAQC) scheme and applies strict QA measures to sample processing.

### **2.4. Particle Size Analysis**

The sediment samples were subjected to PSA carried out by Gardline Geosurvey Limited. PSA samples were obtained from all 24 sample stations; details of the sampling are presented in Appendix Table 2 along with supplementary information obtained during the survey.

The sediments were sieved at  $\frac{1}{2}$  phi<sup>1</sup> intervals over a particle size range of 64mm-0.063mm on the Wentworth scale. The PSA values are summarised in Appendix Table 3 into higher groupings of % silt (<0.063mm), % sand (0.063-2mm) and % gravel (>2mm), for ease of broad-scale substrate assessment. These data were used for the description and classification of sediments.

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<sup>1</sup> Phi =  $-\log_2 D/D_0$  (D is the diameter of the particle,  $D_0$  is a reference diameter, equal to 1mm).

### 3. Phase I Results

#### 3.1. Site Description – Pegwell Bay

Pegwell Bay is dominated by a large expanse of intertidal muddy sand that is bounded by low chalk cliffs that form the southern side of Ramsgate to the north. Saltmarsh hems the western fringes at the high shore and low-lying marshland borders the lower estuary of the River Stour inland towards the port of Sandwich. The southernmost part of Pegwell Bay, known as Sandwich Flats, is separated from the main northern mudflats by the approach channel of the Stour estuary. There was evidence of the presence of the polychaete *Arenicola marina* in the form of casts across much of the shore as well as evidence of burrowing bivalves.



**Plate 1.** Top (left to right): Chalk cliffs and saltmarsh bordering muddy sands at the northern edge of the site; sands with *Arenicola marina* casts along the high shore. Bottom (left to right): Expanse of muddy sand running mid to lower shore; edge of the river Stour along the south western edge of the bay

#### 3.2. Site Description – Sandwich Bay

Sandwich Bay is a long, relatively featureless beach located between Ramsgate and Deal. The beach itself is narrow composed of freely draining shingle and sand. There are several steep shelves carved in to the shingle along the upper and mid shore. Little evidence was present of any intertidal macrofauna during the walkover element of the survey though there were empty *Mytilus* and *Crepidula fornicata* shells littering the foreshore as well as pieces of washed up *Flustra foliacea*, a

colonial bryozoan. Anthropogenic litter was also recorded across the area of interest and included household plastic, food packaging and fishing net waste.



**Plate 2.** (Left to right): Shingle banks and sand looking north towards Pegwell Bay; Shingle and sand at lower shore looking south

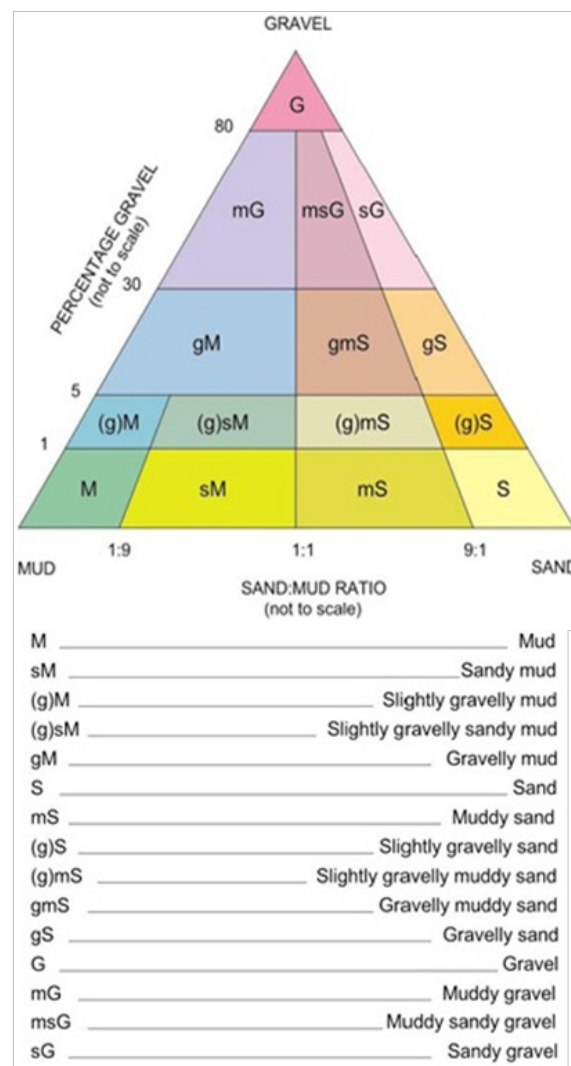
## 4. Phase II Results

### 4.1. Composition of the Intertidal Sediments at Pegwell Bay and Sandwich Bay

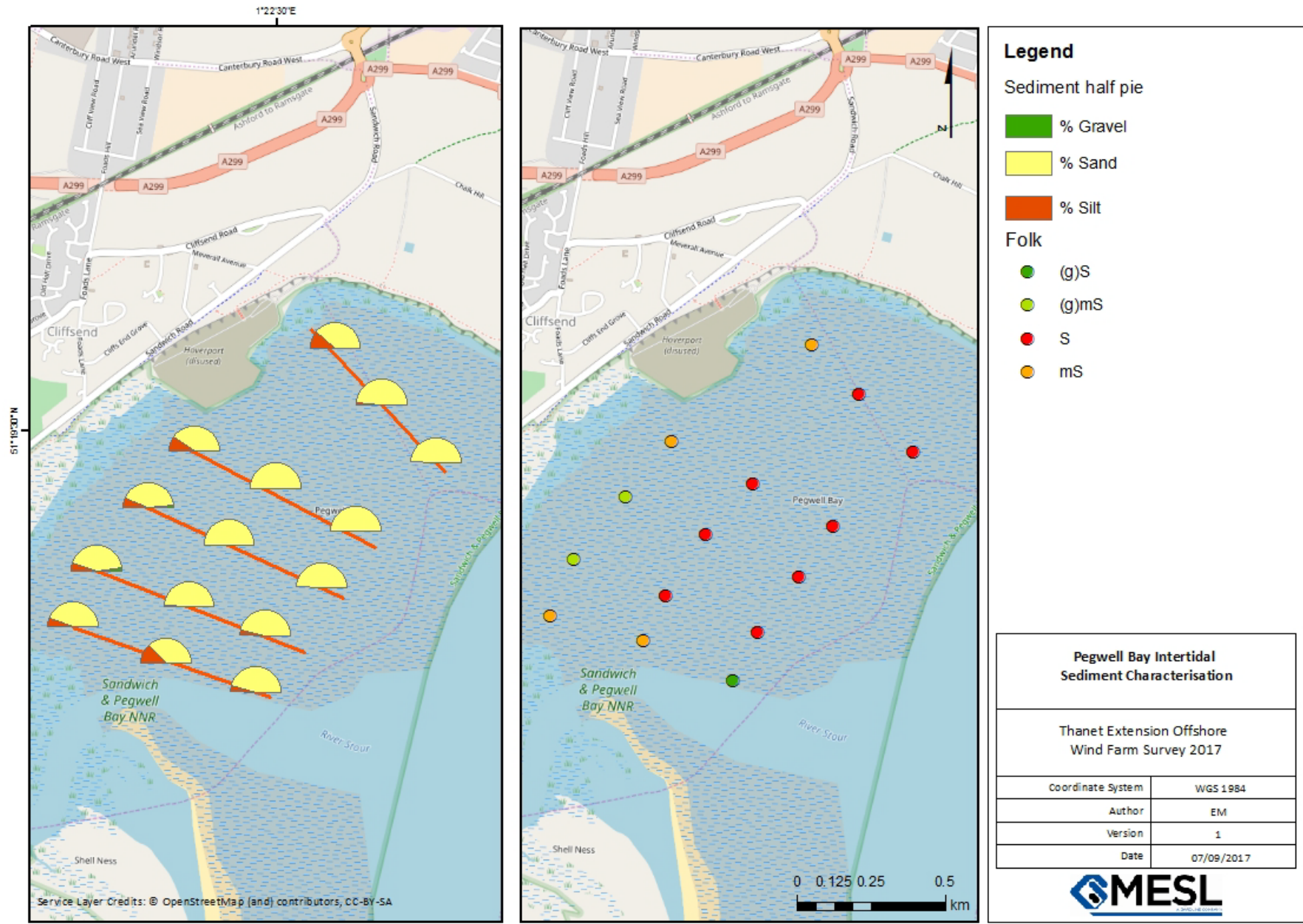
The half-pie diagrams of Figure 6 illustrates that the sediment composition of Pegwell Bay was dominated by Sand, although a number of stations also contained small fractions of silt and gravel, particularly the high shore stations and those adjacent to the River Stour where higher levels of silt were recorded.

In contrast to the sediments of Pegwell Bay, the half-pie diagrams of Figure 7 illustrate that the sediment composition of Sandwich Bay was dominated by gravel, although the mid shore stations also contained small fractions of sand. No silt fraction was recorded at any of the stations.

In order to further describe the substrate types recorded across the study area, sediment samples have been classified according to the Folk classification system (Folk, 1954). These Folk classifications are shown in Figure 6 and Figure 7, with definitions of sediment types presented in Figure 5.



**Figure 5.** Folk triangle used to classify sediments at Pegwell and Sandwich Bay



**Figure 6.** (left) The relative proportions of gravel, sand and silt in the PSA samples obtained across Pegwell Bay. The location of the diagrams represents approximate station positions. (Right) PSA samples classified using the Folk classification system



**Figure 7.** (left) The relative proportions of gravel, sand and silt in the PSA samples obtained across Pegwell Bay. The location of the diagrams represents approximate station positions. (Right) PSA samples classified using the Folk classification system

#### 4.1.1. Pegwell Bay

A total of four different Folk categories were sampled across the site, which were Sand (S), slightly gravelly Sand ((g)S), slightly gravelly muddy Sand ((g)mS) and muddy Sand (mS). Figure 6 demonstrates that the predominant Folk category sampled across Pegwell Bay was Sand which was sampled at eight of the 15 stations.

The average percentage gravel, sand and silt of the site as a whole gives values of 1%, 90.7% and 8.3% respectively. These average values placed the site as Sand within the Folk classification system, highlighting the dominance of the sand fractions.

#### 4.1.2. Sandwich Bay

These Folk classifications for Sandwich Bay are shown in Figure 7. A total of two different Folk categories were sampled across the site, which were Gravel (G) and sandy Gravel (sG). The right hand plot demonstrates that the predominant Folk category sampled across Sandwich Bay was Gravel which was sampled at six of the nine stations.

The average percentage gravel, sand and silt of the site as a whole gives values of 86.5%, 13.5% and 0.0% respectively. These average values placed the site as Gravel within the Folk classification system, highlighting the dominance of the gravel fraction.

### 4.2. Sediment Contaminants at Pegwell Bay and Sandwich Bay

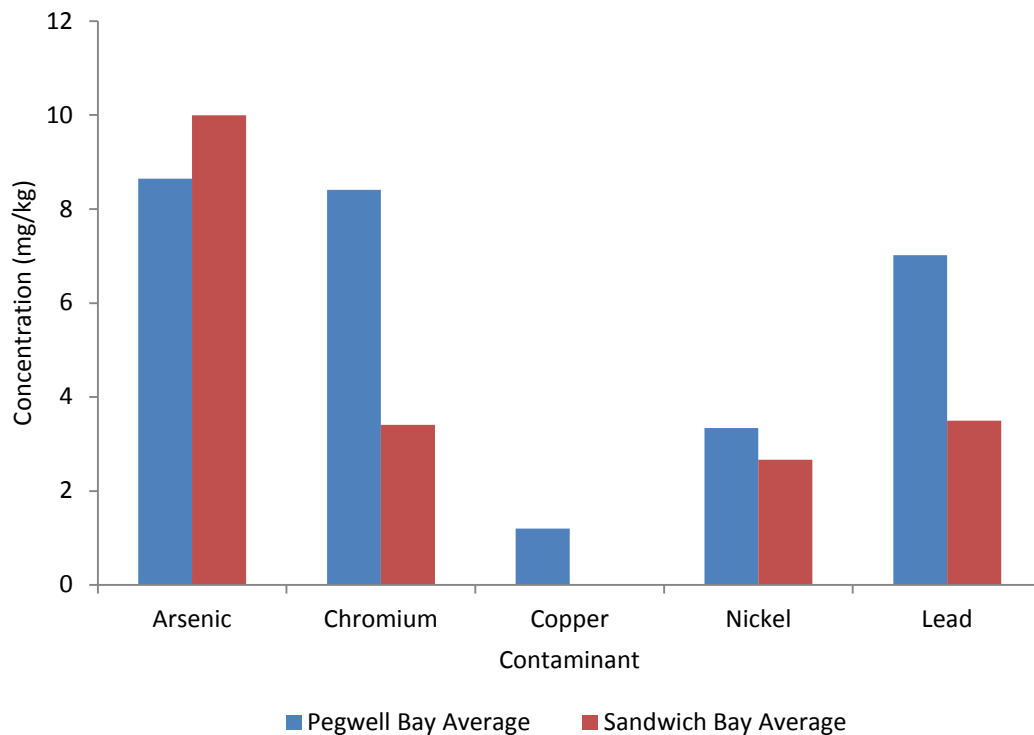
The concentrations of contaminants in terms of TBT, heavy metals and PAHs in sediments obtained across the Pegwell Bay and Sandwich Bay foreshores are presented in Table 2. A full breakdown of all tested substances and their concentrations are presented in Appendix Table 4. Using the Cefas action levels (CAL) outlined in marine licencing sediment analysis and sample plans guidance (MMO, 2016), the selected hazardous substances which were prioritised for action by OSPAR due to their risk for the marine environment, were assessed.

**Table 2.** The results of the contaminant analysis from sediment scrape samples obtained from Phase II sampling stations across the five transects at Pegwell Bay and three transects at Sandwich Bay during the intertidal surveys in July 2017. Contaminants have been assessed within the categories of Cefas action level 1 (CAL1) and Cefas action level 2 (CAL2). All contaminant analyses were carried out by ALS Environmental.

Contaminant	Cefas Action Level 1	Cefas Action Level 2	Average Concentration	Maximum Concentration
<b>Pegwell Bay</b>				
Arsenic	20	100	8.65	9.69
Mercury	0.3	3	<0.20	<0.20
Cadmium	0.4	5	<0.40	<0.40
Chromium	40	400	8.41	10.9
Copper	40	400	1.2	1.4
Nickel	20	200	3.34	4.1
Lead	50	500	7.02	8
Zinc	130	800	-	-
TBT	0.1	1	<0.001	<0.001
Benzo(a)pyrene	-	-	<0.010	<0.010
PAHs	0.1	-	<0.010	<0.010

Contaminant	Cefas Action Level 1	Cefas Action Level 2	Average Concentration	Maximum Concentration
<b>Sandwich Bay</b>				
Arsenic	20	100	10.00	10.90
Mercury	0.3	3	<0.20	<0.20
Cadmium	0.4	5	<0.40	<0.40
Chromium	40	400	3.41	3.83
Copper	40	400	<1.0	<1.0
Nickel	20	200	2.67	3.1
Lead	50	500	3.5	3.8
Zinc	130	800	-	-
TBT	0.1	1	<0.001	<0.001
Benzo(a)pyrene	-	-	<0.010	<0.010
PAHs	0.1	-	<0.010	<0.010

All individual contaminants detected within the sediment samples collected at Pegwell Bay and Sandwich Bay in 2017 were below CAL1 and CAL2 concentrations. The concentrations of the contaminants considered under CAL guidance were higher at Pegwell Bay than those recorded at Sandwich Bay with the exception of arsenic which was higher in Sandwich Bay samples (Figure 8). Please note that only individual contaminants considered within CALs have been included in Figure 8.



**Figure 8.** Comparison of readings for single contaminants present at Pegwell Bay and Sandwich Bay during the intertidal surveys undertaken in 2017



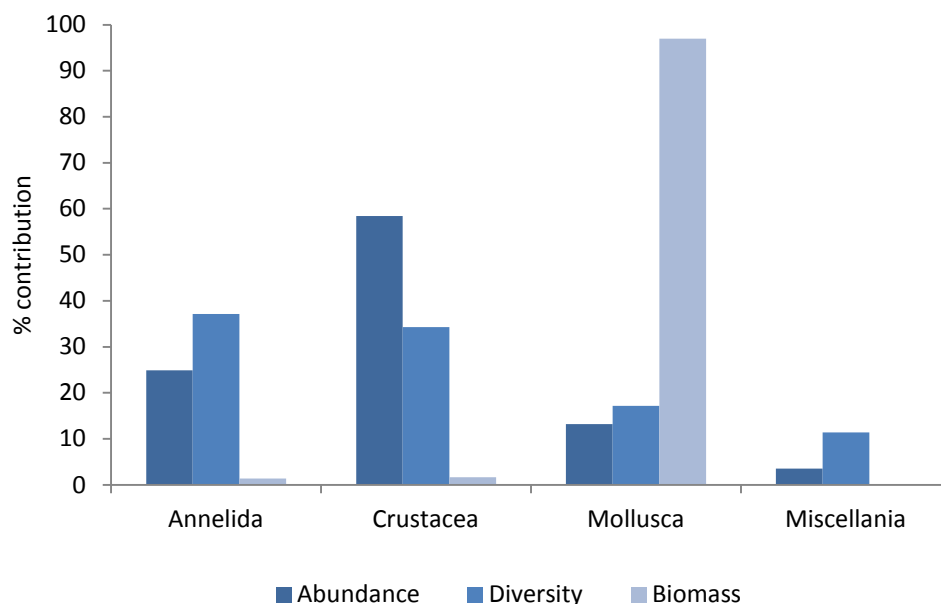
### 4.3. The Nature of Intertidal Fauna at Pegwell Bay and Sandwich Bay

#### 4.3.1. Pegwell Bay

A total of 35 taxa and 1,070 individuals were sampled from the 15 intertidal core samples collected during the Pegwell Bay survey. The full taxonomic list, including the numerical abundance of each taxon by station, is provided in Appendix Table 5 and a contact sheet of each sample station is presented in Appendix Plate 1.

The mean number of taxa recorded per sample was 10 (standard deviation = 3.2) and the mean number of organisms per sample was 71 (standard deviation = 32.6). Samples from this survey were varied, with the abundance ranging between 17 and 136 individuals per sample. A summary of the data by abundance and species diversity per sample is presented in Appendix Table 6.

Figure 9 illustrates the percentage contribution of the major faunal groups to total abundance and diversity recorded during the survey. Crustacea was the dominant faunal group, accounting for 58% of the total abundance and 34% of the diversity of the site. The remainder of the abundance was predominantly contributed by the major group Annelida accounting for 25%, with the remaining 18% split between the groups Mollusca and Miscellanea. Annelida represented the single largest contribution to diversity, representing 37% of the taxa sampled. The groups Mollusca and Miscellanea represented 17% and 11% of the total diversity respectively. Across all stations, Mollusca accounted for 97% of biomass suggesting that numerous small gastropods (*Peringia ulvae*) and several larger bodied bivalves (*C. edule*) represented a substantial portion of the total biomass.



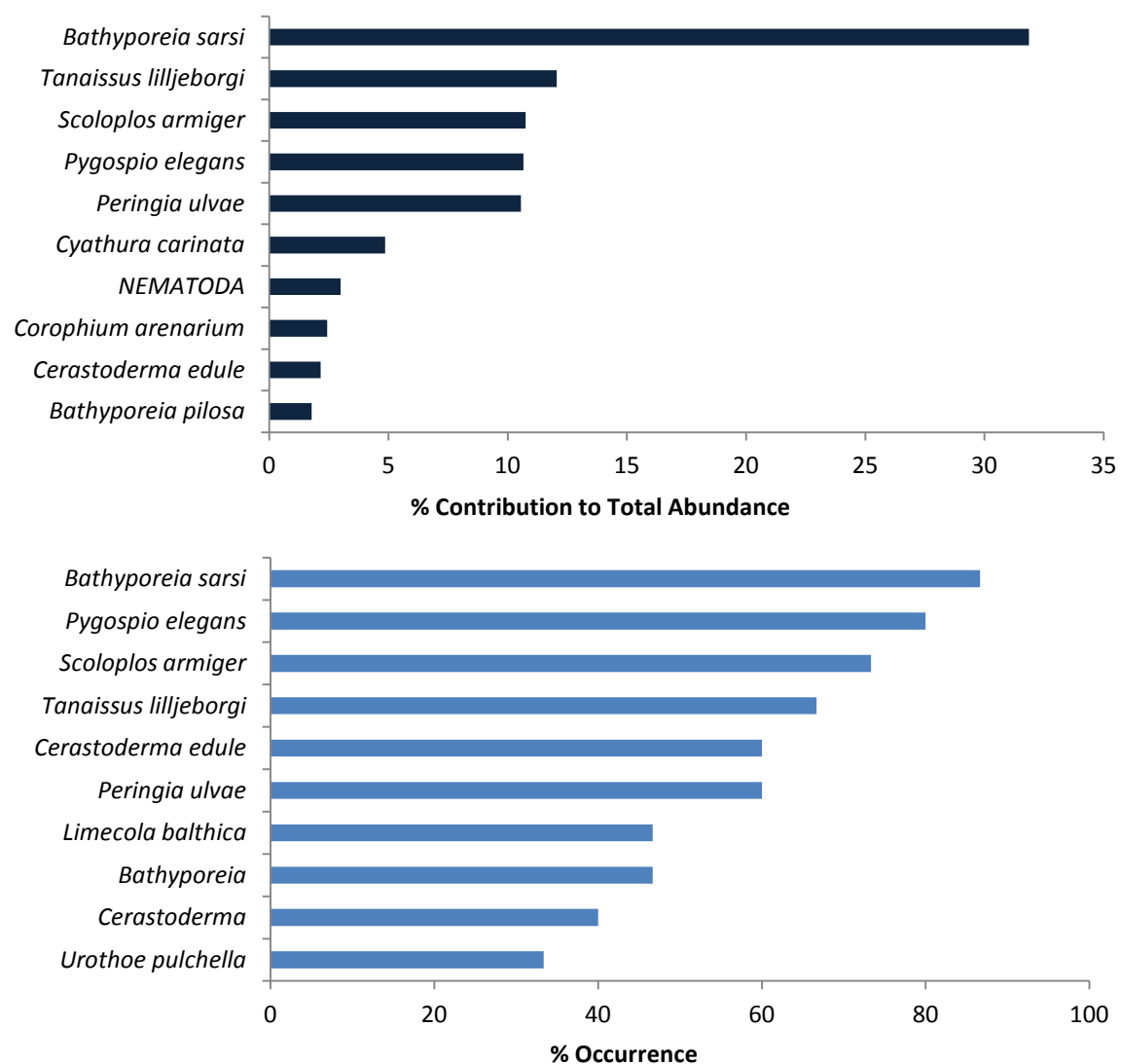
**Figure 9.** The relative contribution of the main faunal groups to the total abundance, diversity and biomass sampled across Pegwell Bay in 2017

Figure 10 depicts the ten taxa which made the greatest contribution to the total abundance of the site and the ten taxa which were the most frequently sampled during the 2017 survey.

The two most abundant taxa sampled across Pegwell Bay were the crustaceans *Bathyporeia sarsi* and *Tanaissus lilljeborgi*, which together contributed approximately 45% of the sampled abundance. The third most abundant taxon was *Scoloplos armiger*, which represented 11% of all individuals sampled. Together the top ten most abundant species contributed 90% of the total abundance sampled.

Figure 10 also reveals that *Bathyporeia sarsi* was the most frequently occurring taxon across Pegwell Bay, recorded at 13 of the 15 stations. The annelids *Pygospio elegans* and *Scoloplos armiger* were the second- and third-most commonly occurring taxa, found in 80% and 73% of samples respectively.

No instances of Invasive Non-Native Species (INNS) were recorded throughout the survey, and no species of conservation importance were recorded in the 15 infaunal samples collected at Pegwell Bay.



**Figure 10.** Histograms illustrating the ten most abundant taxa (top) and ten most frequently occurring taxa (bottom) sampled across Pegwell Bay in 2017

It should be noted that *A. marina* casts were observed during the Pegwell Bay survey though none were recorded within the Phase II infaunal samples. This was possibly due to a preference for deeper

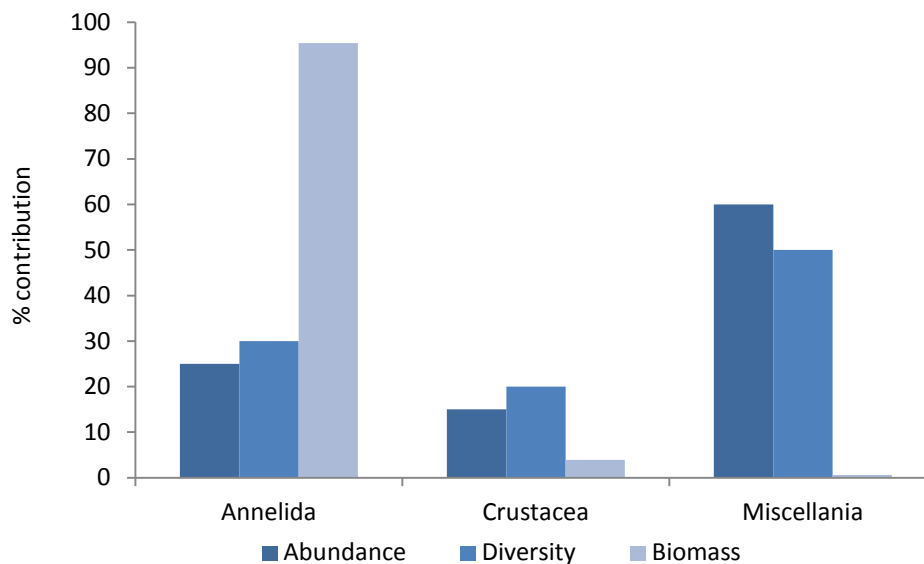
sediments by *A. marina* as they are known to habituate sediments greater than the 15cm – the penetration depth of the corer used for sampling.

#### 4.3.2. Sandwich Bay

A total of 10 taxa and 20 individuals were sampled from the nine intertidal core samples collected during the 2017 survey of Sandwich Bay. The full taxonomic list, including the numerical abundance of each taxon by station, is provided in Appendix Table 7.

The mean number of taxa recorded per sample was 2 (standard deviation = 0.9) and the mean number of organisms per sample was 2 (standard deviation = 1.3). Samples from this survey had relatively low abundance and diversity, with the abundance ranging from 0 to 4 individuals per sample. A summary of the data by abundance and species diversity per sample is presented in Appendix Table 8.

Figure 11 illustrates the percentage contribution of the major faunal groups to total abundance, diversity and biomass recorded during the survey. Miscellaneous was the dominant faunal group, accounting for 60% of the total abundance. The remainder of the abundance was predominantly contributed by the major group Annelida accounting for 25%, with the remaining abundance attributed to Crustacea. No taxa from the major group Mollusca were recorded at any of the Sandwich Bay stations. The major group Miscellaneous also represented the single largest contribution to diversity, representing 50% of the taxa sampled. The groups Annelida and Crustacea represented 30% and 20% of the total diversity respectively. Conversely, Annelida represented the vast majority of the biomass (97%) recorded at the site with Crustacea and Miscellaneous representing 4% and 1% respectively.



**Figure 11.** The relative contribution of the main faunal groups to the total abundance, diversity and biomass sampled across Sandwich Bay in 2017

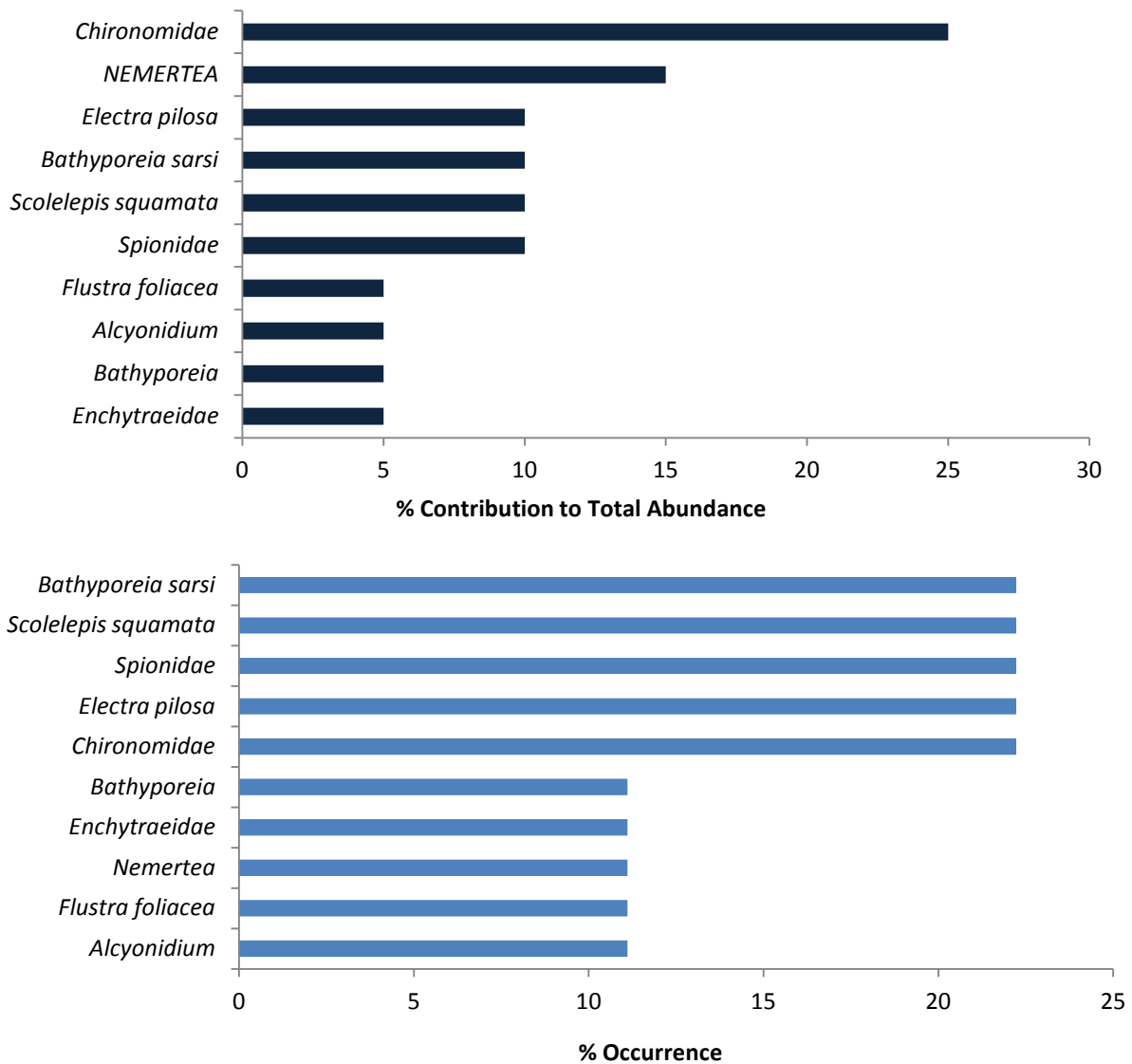
Figure 12 depicts the ten taxa which made the greatest contribution to the total abundance of the site and the ten taxa which were the most frequently sampled during the 2017 survey.

The most abundant taxa sampled across Sandwich Bay were *Chironomidae* which contributed to 25% of the sampled abundance. Nemertea were the second most abundant taxon contributing 15% to

abundance sampled across the site. Together the top ten most abundant species contributed 100% of the total abundance sampled.

Figure 12 also reveals that *Bathyporeia sarsi* was the most frequently occurring taxon across sandwich Bay, along with *Scolelepis squamata*, *Spionidae*, *Electra pilosa* and *Chironomidae*, all of which occurred within two of the nine stations.

No instances of Invasive Non-Native Species (INNS) were recorded throughout the survey, and no species of conservation importance were recorded in the nine infaunal samples collected from Sandwich Bay.

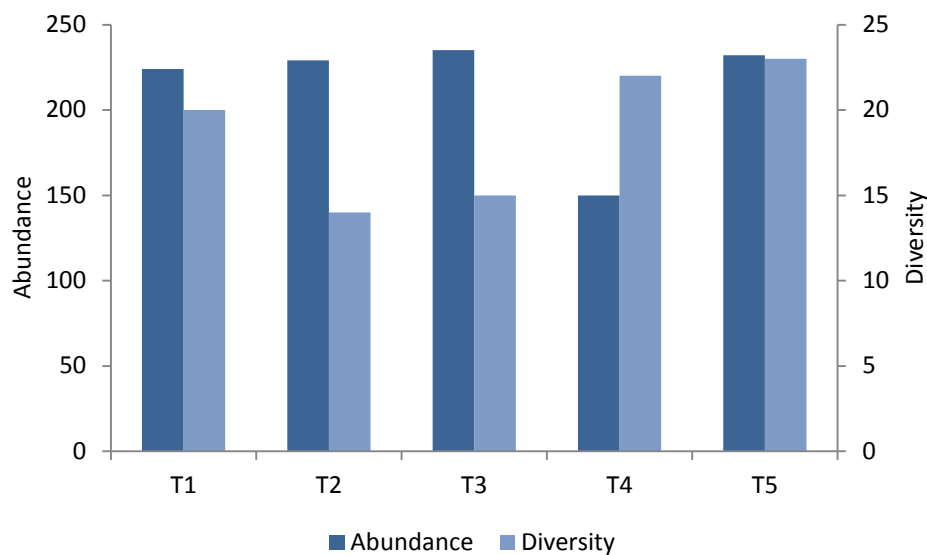


**Figure 12.** Histograms illustrating the ten most abundant taxa (top) and ten most frequently occurring taxa (bottom) sampled across Sandwich Bay in 2017

## 4.4. The Spatial Distribution of Infaunal Communities at Pegwell Bay and Sandwich Bay

### 4.4.1. Pegwell Bay

Figure 13 illustrates the abundance and diversity of species recorded within each transect at Pegwell Bay during the 2017 survey. The average abundance of individuals across all transects taken at Pegwell Bay was 214. The highest abundance was recorded within Transect 3, the most central transect at Pegwell Bay. The lowest abundance was recorded at Transect 4, towards the southern side of Pegwell Bay with 150 individuals recorded. An average of 19 taxa were recorded across the transects at Pegwell Bay, with the lowest diversity seen at Transects 2, one of the more northern transects, with 14 taxa recorded.



**Figure 13.** The total abundance and diversity of species recorded at each transect during the 2017 survey of Pegwell Bay

Figure 14 illustrates the distribution of total abundance (number of individuals) and diversity (number of taxa) and biomass (mg AFDW) of the intertidal sediments sampled at each station across Pegwell Bay in 2017.

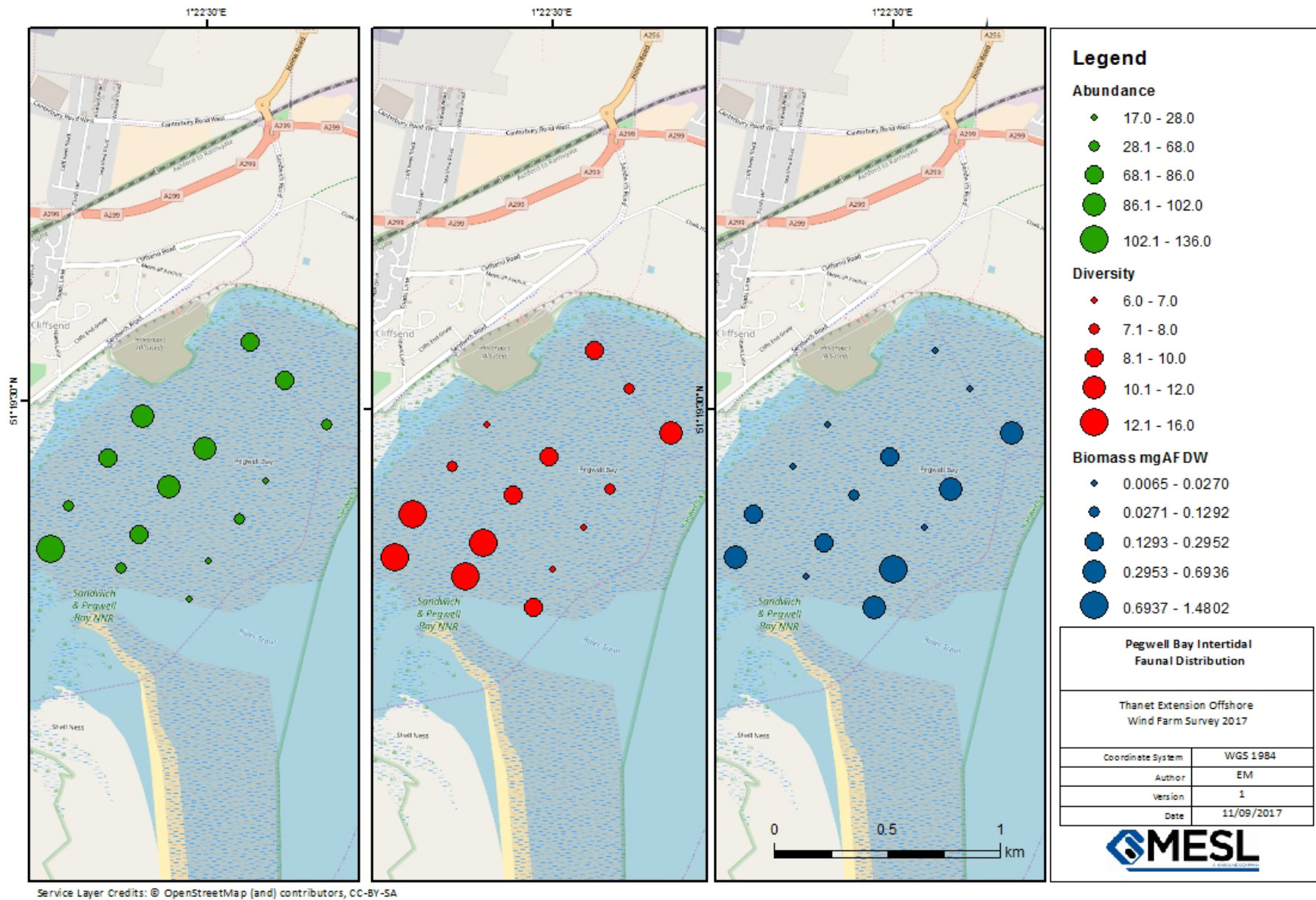
Infaunal abundance recorded across the different shore heights of Pegwell Bay was variable, with higher abundance values predominately found across the mid and high shore. The single highest abundance was recorded at the high-shore station PB13 (Transect 5), with the amphipod *Bathyporeia* accounting for 18.4% of the abundance of the station, closely followed by Corophiidae which accounted for 17.6% abundance. The station with the lowest abundance was station PB15, also in Transect 5, highlighting the presence of zonation across shore height.

The distribution of the diversity of the infaunal communities also varied across the foreshore, with no clear distinction between areas of either high or low diversity values. The highest diversity value (16 taxa) was found at station PB13 (Transect 5) along the high shore, where the highest abundance was also recorded. The single lowest diversity value was recorded at station PB12 (Transect 4) on the lower shore where a total of just six taxa were recorded.

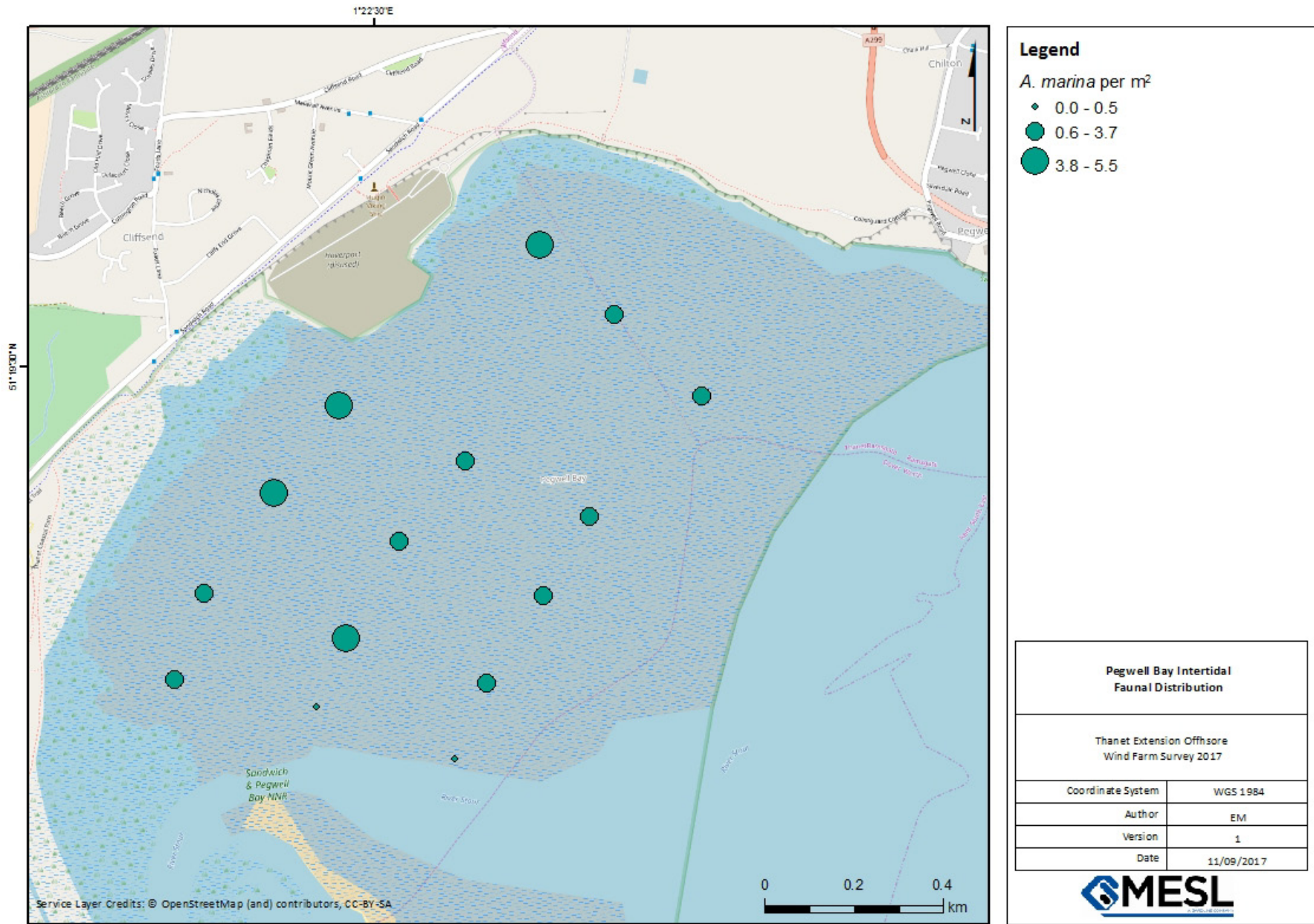
Biomass values was also variable across Pegwell Bay (Figure 14) though was generally highest along the lower shoreline stations with the exception of PB12, the lower shore station of Transect 3. The

single highest biomass was recorded at the lower shore station PB02 (Transect 4) which was largely attributable to the presence of several large *Cerastoderma edule* bivalves.

Figure 15 illustrates the distribution and density of *Arenicola marina* identified within the Phase I quadrats sampled across Pegwell Bay. It is apparent *A. marina* were observed across the majority of the foreshore with the exception of the mid and low shore stations in Transect 5, adjacent to the River Stour where higher levels of silt were recorded. The highest average densities of *A. marina* were recorded at the upper shore stations PB06 and PB09 (Transects 1 and 2) where an average of 5.3 casts/m<sup>2</sup>.



**Figure 14.** The distribution of average abundance (individuals per sample) (left), species diversity (taxa per sample) (middle) and biomass (mgAFDW) (right) per 0.01m<sup>2</sup> core sampled across Pegwell Bay in 2017

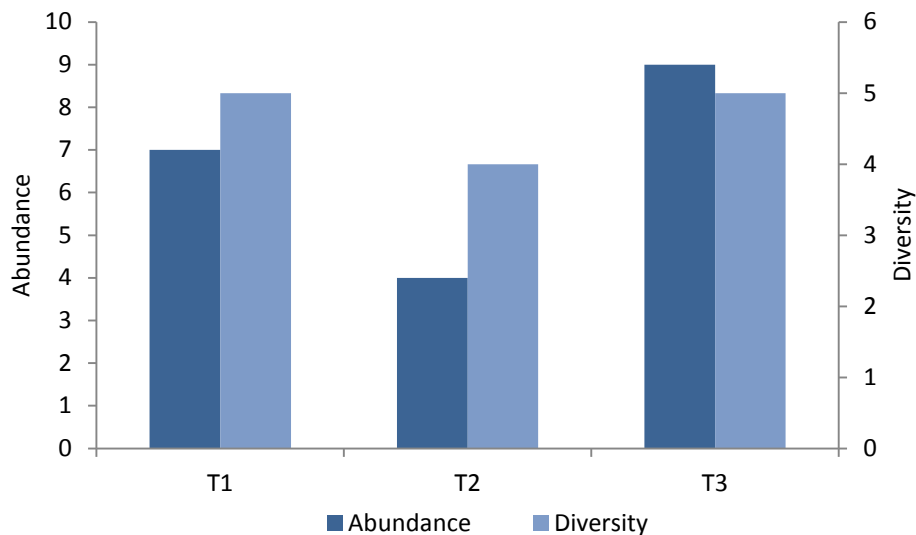


**Figure 15.** The distribution of average *Arenicola marina* casts recorded within Phase I quadrats sampled at Pegwell Bay in 2017 (average count per station)



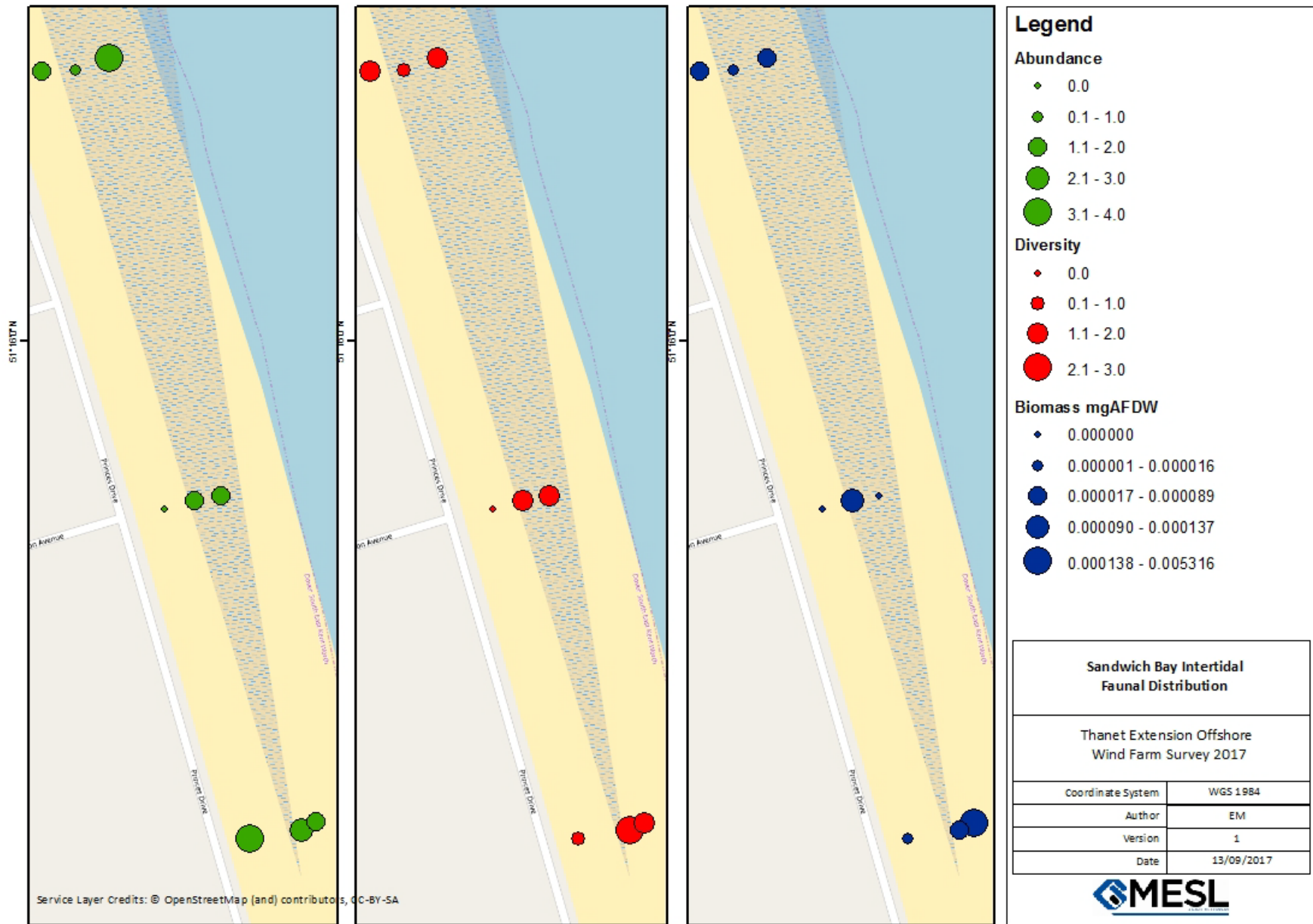
#### 4.4.2. Sandwich Bay

Figure 16 shows the total abundance and diversity of species recorded within each transect at Sandwich Bay during the 2017 survey. The average species abundance recorded across all transects was seven. The highest abundance was recorded along Transect 3, the southernmost transect at Sandwich Bay. The lowest abundance was recorded at Transect 2, the mid shore transect, with four species recorded. An average of five taxa were recorded across all transects at Sandwich Bay, with the lowest diversity seen at Transect 2 where just four taxa were recorded.



**Figure 16.** The total abundance and diversity of species recorded at each transect during the 2017 survey of Sandwich Bay

Figure 17 illustrates the distribution of the abundance (number of individuals) and diversity (number of taxa) and biomass (mg AFDW) of the intertidal sediments sampled at each station across Sandwich Bay in 2017. It should be noted that spatially, there was little distance between the upper, mid and lower shore stations at Sandwich Bay due to its steeply shelving nature of the foreshore though there were notable differences in elevation between the intertidal zones along each transect.



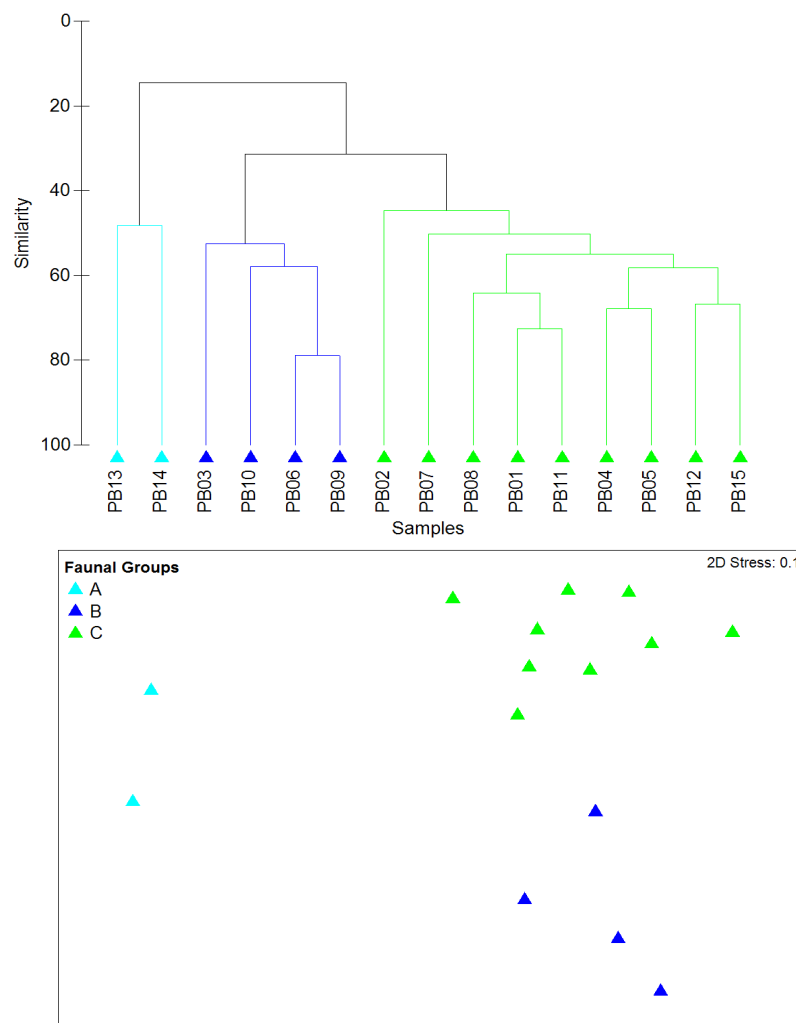
**Figure 17.** The distribution of average abundance (individuals per sample) (left), taxa diversity (taxa per sample) (middle) and biomass (mgAFDW) (right) per 0.01m<sup>2</sup> core sampled across Sandwich Bay in 2017

#### 4.4.3. Multivariate Analysis of Infaunal Community Composition at Pegwell Bay

Multivariate analysis of the intertidal abundance data collected during the 2017 survey at Pegwell Bay has been undertaken to further investigate the patterns present within the infaunal dataset.

A total of three distinct faunal groups were identified within the Pegwell Bay intertidal infaunal abundance dataset, as presented in Figure 18. The figure shows a group average sorting dendrogram based on square-root transformed averaged abundance data (Bray-Curtis similarity), and the corresponding multi-dimensional scaling (MDS) plot, presented in 2D format. The MDS plot has a low 2D stress (0.1), indicating a valuable representation of the data points in multidimensional space and a useful interpretation of the inter-relationships that occur between the communities sampled at the different stations.

The multivariate faunal groups shown in Figure 18 were derived using the SIMPROF routine (described in Appendix Table 9). The composition of each faunal group is described in Table 3, whilst the distribution is illustrated in Figure 19. SIMPER analysis was run on the three multivariate groups to identify the key taxa driving the similarity within the groups.



**Figure 18.** Group average sorting dendrogram (top) based on square root transformed (Bray-Curtis similarity) infaunal abundance data and corresponding 2D multidimensional scaling ordination (bottom).

**Table 3.** Average abundance and diversity of each of the multivariate faunal groups identified across Pegwell Bay in 2017

Faunal Group	Average Abundance (individuals per sample)	Average Diversity (taxa per sample)	Average Biomass (mg FAFDW)
Faunal Group A	102.0	15	0.28
Faunal Group B	76.8	10	0.08
Faunal Group C	62.1	9.2	0.43

**Faunal Group A** (average group similarity: 48.12%) was ascribed to two stations sampled in the upper and mid shore at Transect 5. Group A stations were solely sampled from the Folk sediment group slightly gravelly muddy Sand ((g)mS) and characterised by the crustacean *Urothoe poseidonis* and annelids *Nephtys* and *Glycera*. The group recorded the lowest average diversity and abundance of the three infaunal groups.

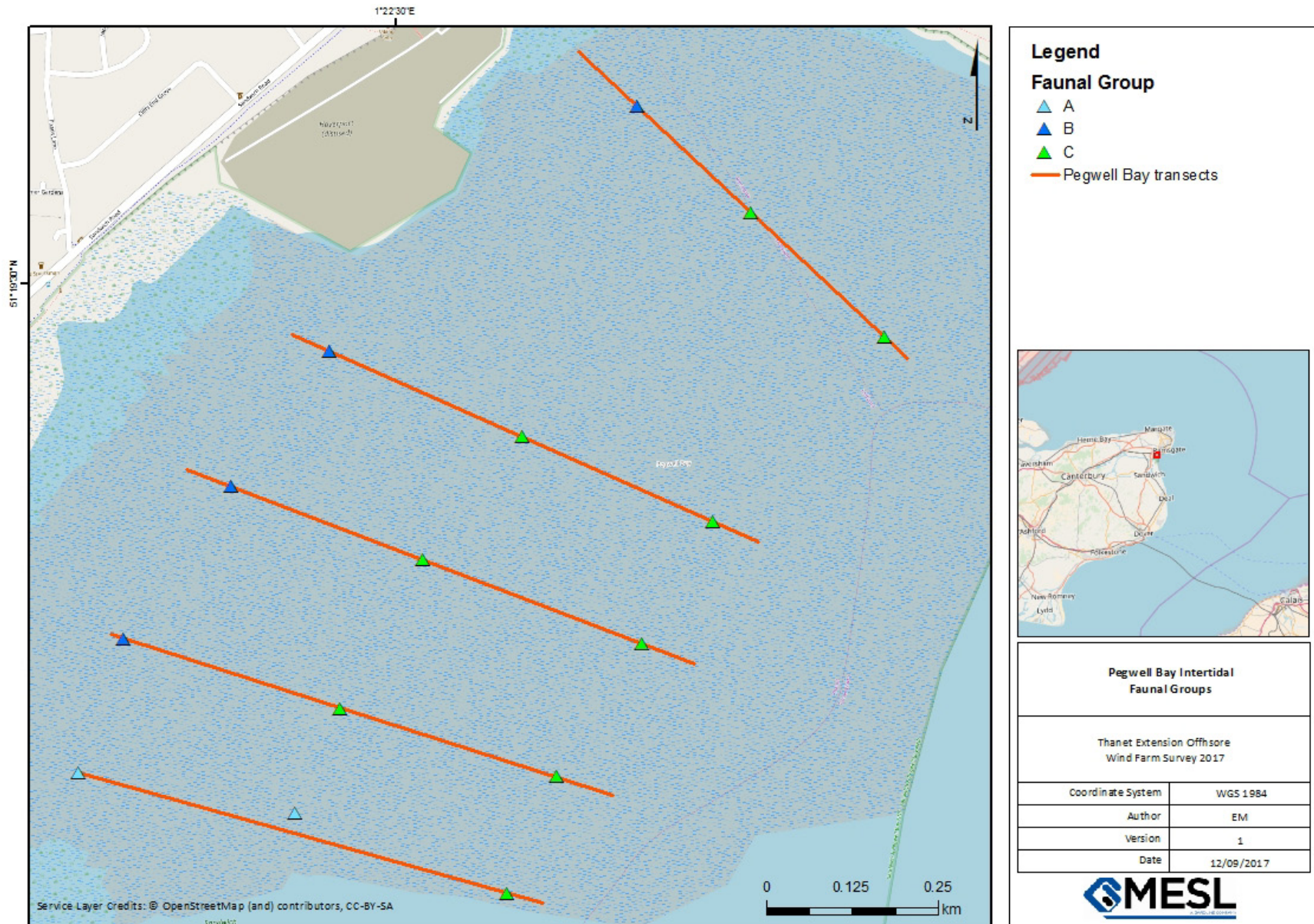
**Faunal Group B** (average group similarity: 58.64%) was assigned to four sample stations found across the high shore of Pegwell Bay. The group was predominately sampled from slightly gravelly muddy Sand ((g)mS) sediments, with key characterising taxa of the group including the mollusc *Peringia ulvae*, the crustacean *Cyathura carinata* and the annelid *Pygospio elegans*.

Group B faunal communities were found to be representative of all of the high shore stations for each transect bar Transect 5.

**Faunal Group C** (average group similarity: 53.72%) was sampled from the mid and low shore of Pegwell Bay from a total of nine stations, the group also recorded the highest average abundance and diversity of the three groups, as shown in Table 2 above. The group was solely sampled from slightly gravelly Sand ((g)S) sediments with *Bathyporeia sarsi* and *Scoloplos armiger* being the dominant taxa of the group.

The fauna present within group C were found to be representative of communities at nine stations along the lower and mid shore.

Multivariate analysis was not conducted on the data collected from Sandwich Bay due to the low abundance and diversity of species present. However, based upon observations of infaunal communities present and PSA data, it is evident that the two sites are highly distinct.



**Figure 19.** The distribution of the infaunal groups determined by multivariate analysis across Pegwell Bay in 2017

## 4.5. Intertidal Biotope Mapping of Pegwell Bay and Sandwich Bay

### 4.5.1. Pegwell Bay

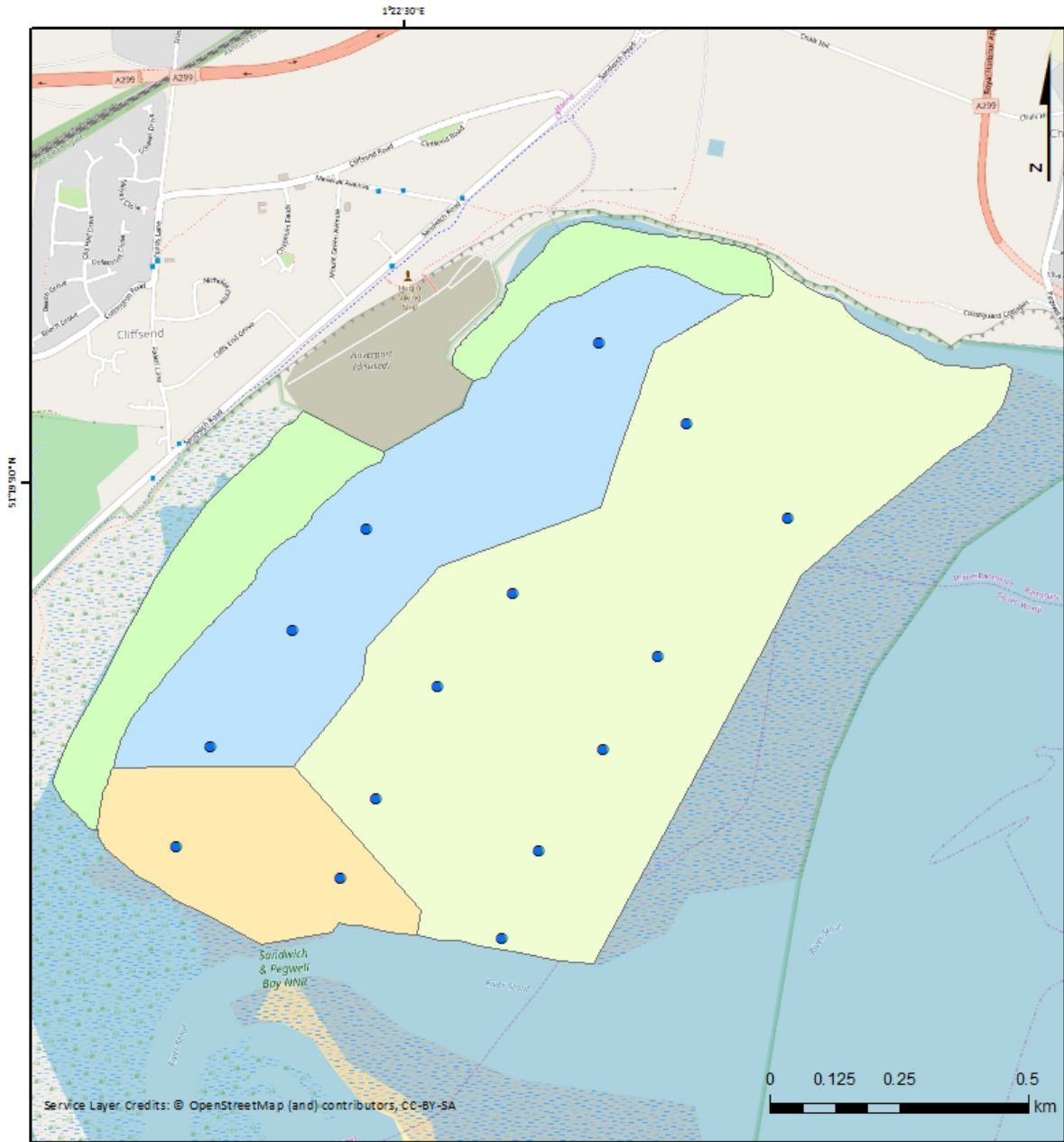
On completion of the intertidal walk-over survey, all the gathered information was transferred to an internal database, whilst photographs and GPS data were downloaded for assessment. Maps of the extent and distribution of the broad-scale habitats of interest across both Pegwell and Sandwich Bay were produced by systematically analysing the survey notes, GPS data and both the Infaunal and PSA data collected as part of the Phase I and II elements of the survey. To delineate the boundaries of the biotopes, Thiessen polygons were used to create boundaries at equidistance's between sample points with conflicting biotopes, where no conspicuous boundaries were identified in the field.

A total of four intertidal biotope complexes were identified across the Pegwell Bay foreshore from the 2017 survey data. The distribution of these biotopes is illustrated in Figure 20. The polygons which have been digitised are at EUNIS levels 3, 4 and 5 and provide a valuable visualisation of the distribution of habitat types across the foreshore of the bay. Zonation of the biotopes across the survey area is apparent, with distinctions in the infaunal communities identified during SIMPER analysis reflected in the biotopes present.

Table 4 below shows the total area (hectares - Ha) of each of the mapped EUNIS biotope complexes, highlighting the dominance of the littoral sand-based habitats. The biotope with the single largest area was A2.242 (*Cerastoserma edule* and polychaetes in littoral muddy sand) which was located across the mid and lower shore and was found to be representative of 53.7% of the survey area. The biotope A2.24 (Polychaete/bivalve-dominated muddy sand shores) had the second highest coverage (24.3%) and was found across the upper shore, illustrating a clear zonation in sediment type and faunal communities with shore height. The biotope A2.23 (Polychaete/amphipod-dominated fine sand shores) was only found at the southern part of Pegwell Bay in the muddier sediments adjacent to the Rover Stour and represented 9.8% of the mapped foreshore. Saltmarsh was recorded fringing the upper shore to the north east and south west of the old hoverport and accounted for 12.2% of the mapped foreshore of Pegwell Bay.

**Table 4.** Total area hectares (Ha) of the four habitat types mapped across Pegwell Bay in 2017.

EUNIS Biotope Complex	Habitat Description	Total Area (Ha)
A2.5	Saltmarsh	17.85
A2.23	Polychaete/amphipod-dominated fine sand shores	14.4
A2.24	Polychaete/bivalve-dominated muddy sand shores	35.53
A2.242	<i>Cerastoserma edule</i> and polychaetes in littoral muddy sand	78.66
	Total	<b>146.44</b>



**Legend**

- Phase II stations

EUNIS Biotope code

- A2.23
- A2.24
- A2.242
- A2.5

Pegwell Bay Intertidal Characterisation	
Thanet Extension Offshore Wind Farm Intertidal Survey 2017	
Coordinate System	WGS 1984
Author	EM
Version	1
Date	18/09/2017

**MESL**  
Marine Environmental Services Limited

Figure 20. EUNIS biotope complexes mapped across Pegwell Bay in July 2017

#### 4.5.2. Sandwich Bay

A single biotope complex (A2.111 – Barren littoral shingle) was identified across Sandwich Bay as illustrated in Figure 21. The figure illustrates the homogeneous nature of the habitat type across the bay. Unlike at Pegwell Bay, there is no zonation of the biotopes as there were no distinctions between infaunal communities identified at upper, mid and lower shore stations of Sandwich Bay, largely due to the sparse infaunal communities sampled at the bay. Though the mid-shore stations at Sandwich Bay were classified with higher proportions of sand than those within the upper and lower shore zones, gravel remained the dominant grain size by a large majority across the site.

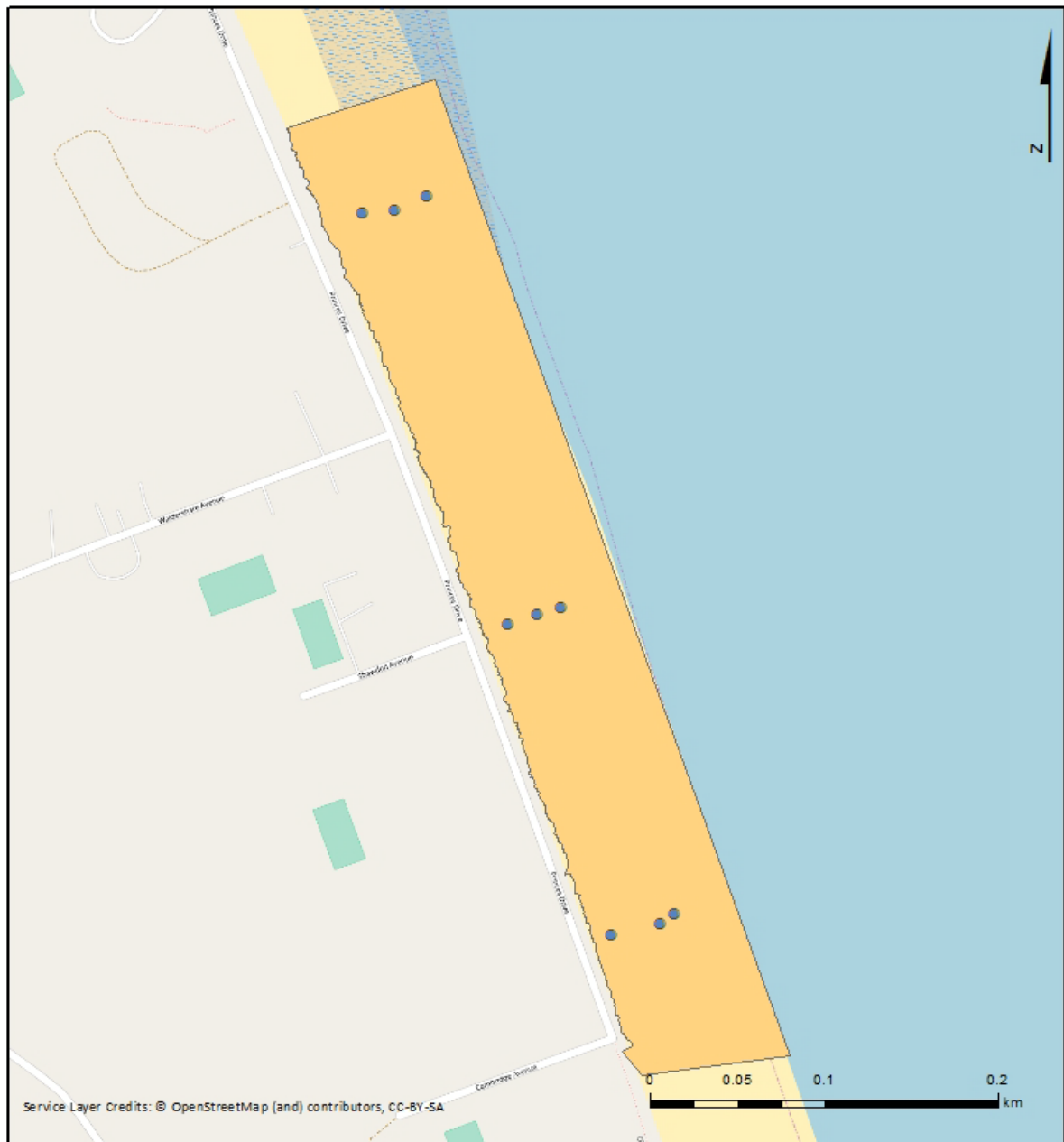
Table 5 below shows the total area hectares (Ha) of the mapped EUNIS biotope complex at Sandwich Bay.

**Table 4.** Total area hectares (Ha) of the single habitat type mapped across Sandwich Bay in 2017.

<b>EUNIS Biotope Complex</b>	<b>Habitat Description</b>	<b>Total Area (Ha)</b>
A2.111	Barren littoral shingle	4.94

It should be noted that the broad-scale habitat mapping-based approach to intertidal surveying produces an illustrated map that defines the presence and extent of the littoral sediment habitats of interest to the project. However, intertidal areas, particularly those that are susceptible to erosion, are dynamic systems and the maps produced represent a 'snap-shot in time'. Habitats may change naturally through physical and biological processes or through anthropogenic disturbance, such as the creation or removal of sea defence structures.





### Legend

- Phase II Stations
- EUNIS Biotope code
- A2.2111

### Sandwich Bay Intertidal Characterisation

Thanet Extension Offshore  
Wind Farm Intertidal Survey 2017

Coordinate System	UTM 31N
Author	EM
Version	1
Date	18/09/2017



**Figure 21.** EUNIS biotope complexes mapped across Sandwich Bay in July 2017

## 5. Conclusions

The overarching aim of this project was to obtain robust data on the intertidal ecology of the potential cable landfall sites for the Thanet Extension: two locations at Pegwell Bay, one at Sandwich Bay, Kent. The data provided by this investigation has established baseline characterisations of the sites that will provide supporting information to inform the wider Environmental Impact Assessment (EIA) being undertaken for the development.

The following conclusions can be drawn from this report:

- The characteristics of Pegwell Bay and Sandwich Bay are highly contrasting in terms of formation, sediment composition and benthic infauna. Faunal abundance was higher at Pegwell Bay than at Sandwich Bay and communities demonstrated increased taxa diversity and biomass by comparison.
- PSA of the intertidal sediments sampled across Pegwell Bay showed that the sediment composition of the site was dominated by sandy substrates, although a number of stations also contained small fractions of gravel and silt. A total of four different Folk categories were sampled across the site, which were Sand (S), slightly gravelly Sand ((g)S), slightly gravelly muddy Sand ((g)mS) and muddy Sand (mS) with Sand (S) being the most frequently sampled category.
- The average percentage gravel, sand and silt of the site as a whole gives values of 1%, 90.7% and 8.3% respectively. These average values placed the site as Sand within the Folk classification system.
- In contrast to Pegwell Bay, PSA of the intertidal sediments sampled across Sandwich Bay showed that the sediment composition of the site was dominated by gravelly substrates, although a number of stations also contained small fractions of sand. A total of two different Folk categories were sampled across the site, which were Gravel (G) and sandy Gravel (sG) with Gravel (G) being the most frequently sampled category.
- The average percentage gravel, sand and silt of Sandwich Bay gives values of 85.9% , 13.5% and 0.0% respectively. These average values placed the site as Gravel within the Folk classification system.
- A total of 35 taxa and 1,070 individuals were sampled from the 15 intertidal core samples collected during the Pegwell Bay survey. The mean number of taxa recorded per sample was 10 and the mean number of organisms per sample was 71.
- A total of 10 taxa and 20 individuals were sampled from the nine intertidal core samples collected during the Sandwich Bay survey. The mean number of taxa recorded per sample was 2 and the mean number of organisms per sample was 2.
- At Pegwell Bay, Crustacea was the dominant faunal group, accounting for 58% of the total abundance and 34% of the diversity of the site. The remainder of the abundance was predominantly contributed by the major group Annelida accounting for 25%, with 18% split between the groups Mollusca and Miscellaneous.
- At Sandwich Bay, Miscellaneous was the dominant faunal group, accounting for 60% of the total abundance. The remainder of the abundance was predominantly contributed by the

major group Annelida accounting for 25%, with the remainder attributed to Crustacea. No Mollusca were recorded at any of the Sandwich Bay stations.

- The two most abundant taxa sampled across Pegwell Bay were the crustaceans *Bathyporeia sarsi* and *Tanaissus lilljeborgi*, which together contributed 44% of the sampled abundance. The third most abundant taxon was *Scoloplos armiger*, which represented 11% of all individuals sampled. Together the top ten most abundant species contributed 90% of the total abundance sampled.
- The most abundant taxa sampled across Sandwich Bay were *Chironomidae* which contributed to 25% of the sampled abundance. Nemertea were the second most abundant taxon contributing 15% to abundance sampled across the site. Together the top ten most abundant species contributed 100% of the total abundance sampled.
- Three distinct faunal groups were identified through multivariate analysis at Pegwell Bay. Faunal Group C was the largest group, sampled at a total of 9 stations from sand dominated sediments. Dominant taxa of this group included the crustacean *Bathyporeia sarsi* and the annelid *Scoloplos armiger*.
- Multivariate analysis was not conducted using the Sandwich Bay faunal data due to the sparse nature of infauna sampled across the site.
- No instances of Invasive non-native species (INNS) were recorded throughout the survey of both Pegwell and Sandwich Bay, and no species of conservation importance were recorded in the 24 infaunal samples.
- A total of four biotope complexes were assigned to the intertidal habitats of the Pegwell Bay. The most common in terms of total area mapped was the biotope complex A2.242 (*Cerastoderma edule* and polychaetes in littoral muddy sand) which was located across the mid and lower shore and was found to be representative of 53.7% of the total mapped area. This was followed by A2.24 (Polychaete/bivalve-dominated muddy sand shores) which represented 30% of the mapped area.
- A single biotope complex (A2.111 – Barren littoral shingle) was identified within the Sandwich Bay survey area, illustrating the homogeneous nature of the bay.

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## 7. Appendices

**Appendix Table 1.** Pegwell Bay and Sandwich Bay intertidal survey field notes from the 2017 survey.

**Appendix Table 2.** Particle size analysis raw data breakdown for stations at Pegwell Bay and Sandwich Bay during the 2017 survey.

**Appendix Table 3.** Particle size analysis higher groupings for stations at Pegwell Bay and Sandwich Bay during the 2017 survey.

**Appendix Table 4.** Intertidal sediment contaminant data for stations at Pegwell and Sandwich Bay in 2017.

**Appendix Table 5.** Abundance matrix for benthic fauna recorded in samples collected at Pegwell Bay in 2017.

**Appendix Table 6.** Abundance, diversity and biomass summary for benthic fauna recorded in samples collected at Pegwell Bay in 2017.

**Appendix Table 7.** Abundance matrix for benthic fauna recorded in samples collected at Sandwich Bay in 2017.

**Appendix Table 8.** Abundance, diversity and biomass summary for benthic fauna recorded in samples collected at Sandwich Bay in 2017.

**Appendix Table 9.** The similarity of multivariate SIMPROF faunal groups for Pegwell Bay derived using the SIMPER function in Primer 6.

**Appendix Table 10.** The dissimilarity between faunal groups derived using the SIMPER function in Primer 6 software.

**Appendix Plate 1.** Pegwell Bay Phase II core stations and quadrats-July 2017.

**Appendix Plate 2.** Appendix Plate 2. Sandwich Bay Phase II core stations and quadrats-July 2017.