The London Resort Development Consent Order

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Environmental Statement
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Appendix 13.4 – Intertidal Benthic Ecology Survey

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Executive Summary

APEM Ltd was commissioned by the Environmental Dimension Partnership Ltd (EDP) on behalf of the London Resort Holding Company to undertake a series of marine ecology surveys to inform an Ecological Impact Assessment (EIA) for the London Resort Proposed Development. This report presents intertidal benthic ecological data and sediment particle size data from a survey conducted in August 2020. Intertidal surveys consisted of Phase I habitat mapping, Phase II intertidal coring and wall scrapes of man-made structures.

Intertidal core stations were located in the upper and mid intertidal zone along eight transects, two of which also included stations on the lower intertidal zone (total of 18 stations). Stations were located on the western side of Swanscombe Peninsula (Transects 1 to 4 were west of White's Jetty and Transects 5 to 8 were east of White's Jetty). Wall scrape stations were located on Bell Wharf and White's Jetty (total of 5 stations).

Three replicate 0.01 m^2 core samples were collected at each intertidal sampling station for biotic analysis, and a further sample was collected at each intertidal core station for Particle Size Analysis (PSA). At each wall scrape station, biotic samples were collected using a 0.01 m^2 sampling device in accordance with the methodologies described by Worsfold (1988).

The sediment type within the majority of the intertidal zone was found to be fairly homogenous throughout the survey area and was classified as Sandy Mud. The remaining areas were classified as either Muddy Gravel, Muddy Sandy Gravel, Mud, Slightly Gravelly Sandy Mud or Sand (from six stations). All stations except two were classified as 'Very Poorly' sorted.

No benthic invertebrate species of conservation importance were recorded within any of the samples. Four non-native species were recorded during the intertidal Phase I survey (the Chinese mitten crab *Eriocheir sinensis*, the pacific oyster *Magallana gigas*, Australian tube worm *Ficopomatus enigmaticus* and the bay barnacle *Amphibalanus improvisus*) and two non-native species were recorded during the Phase II intertidal coring survey (the barnacle *Austrominius modestus* and the crustacean *Sinelobus vanhaareni*). *Streblospio* sp., Sessilia and Chironomidae were also recorded in samples and at least one species in each of these taxa is considered non-native in the UK. Five species recorded in samples were considered to be cryptogenic (*Alitta succinea, Polydora cornuta, Tubificoides galiciensis, Tubificoides heterochaetus* and *Amphibalanus improvisus*).

The amphipod *Corophium volutator* was the most abundant taxon across the intertidal core samples and crustaceans were the most abundant major taxon group followed by annelids. The non-native crustacean *Sinelobus vanhaareni* was the most abundant taxon across the wall scrape samples. Density of invertebrates was highly variable across stations in the intertidal zone and biomass of intertidal invertebrates was dominated by annelids in the western section of the survey area (west of White's Jetty at Transects 1 to 4) with a greater proportional biomass of crustaceans at the more easterly stations (east of White's Jetty at Transects 5 to 8).

Intertidal core stations were seen to have broadly overlapping species composition, with main differences between cluster groups resulting from differences in sediment composition and taxon abundance. A total of six SIMPROF cluster groups were identified and assigned to one of four habitats. These were *Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud (EUNIS Code: A2.3221) (10 stations), *Hediste diversicolor* and *Corophium volutator* in littoral mud (A2.4115) (6 stations), *Hediste diversicolor* and oligochaetes in littoral mud (A3.3223) (1 station) and *Hediste diversicolor* and *Streblospio shrubsolii* in littoral gravelly sandy mud (A2.4113).

During the Phase I survey, several habitats were assigned to the rest of the intertidal area. Much of the intertidal area consisted of firm sandy mud with a surface veneer of 2-3 inches of softer silty mud, assigned to the habitat *Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud (A2.3221). Either side of White's Jetty and between transects 7 and 8, sediment was dominated by *Corophium volutator* with visible surface burrows and was assigned to *Hediste diversicolor* and *Corophium volutat*or in littoral mud (A2.4115). *Fucus vesiculosus* colonised areas where sea defences were present at the top of the shore or larger artificial boulders or historical fish traps were present and these areas were assigned the habitat *Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata (A1.323). On the lower shore of Transects 1 and 2, around the base of White's Jetty and around artificial boulders on the lower shore to the west of Transect 7, large pebbles, cobbles and boulders were present with the invasive barnacles *A. improvisus* and *A. modestus*. The area was classified as an impoverished variant of Barnacles and *Littorina* spp. on unstable eulittoral mixed substrata (A2.431) with *A. improvisus* replacing the native barnacle *Semibalanus balanoides*.

Several anthropogenic impacts were identified at all coring locations. The most common impact was the presence of litter and debris which was noted at 15 of the 18 coring stations and seven of the eight transects.

Overall, the intertidal assemblages were typical of those found along this stretch of the tidal Thames and are consistent with the assemblages recorded during previous surveys in the area (Aquatonics 2016).

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Glossary

AQC	Analytical Quality Control
CCW	Countryside Council for Wales
CSEMP	Clean Seas Environmental Monitoring Programme
EcIA	Ecological Impact Assessment
EDP	Environmental Dimension Partnership Ltd.
EIA	Environmental Impact Assessment
GPS	Global Positioning System
INNS	Invasive Non-Native Species
JNCC	Joint Nature Conservation Committee
MDS	Multidimensional Scaling
MMO	Marine management Organisation
NMBAQC	North-East Atlantic Marine Biological Analytical Quality Control
PRP	Processing Requirement Protocol
PSA	Particle Size Analysis
TDP	Taxonomic Discrimination Protocol
WFD	Water Framework Directive
WoRMS	World Register of Marine Species

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Chapter One ◆ Introduction

INTRODUCTION

1.1 APEM was commissioned by EDP Ltd to undertake an intertidal benthic ecology survey for the London Resort Proposed Development. The survey area included the intertidal habitat within the Kent Project Site except for the saltmarsh areas which were sampled during a separate saltmarsh survey and presented in Appendix 13.3: *Saltmarsh Survey Report* (document reference 6.2.13.3). Intertidal sampling was not conducted at the Essex Project Site at effects on the intertidal area were considered likely to be negligible and some data were available from previous studies which have been summarised in ES Appendix 13.2 *Marine Ecology and Biodiversity Baseline Conditions* (document reference 6.2.13.2). The survey was conducted a part of a survey programme to provide site characterisation data to inform the marine ecology assessment for the Proposed Development. The overall survey programme has provided site-specific data for intertidal fish, benthos (intertidal and subtidal), saltmarsh and sediment chemistry.

1.2 This report provides the results of the intertidal benthic ecology survey which comprised of Phase I habitat mapping of the intertidal zone and Phase II core sampling of soft sediment, quadrat sampling of hard substrates and wall scrapes of hard structures. Data were collected in August 2020.

SURVEY OBJECTIVES

1.3 The objective of the survey was to characterise the intertidal benthic assemblages present within the survey area in August 2020. Samples were analysed to provide data for biota and sediment/habitat type. The information obtained was to inform Ecological Impact Assessment (EcIA) for the Proposed Development.

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Chapter Two ◆ Methodology

SURVEY AREA

2.1 The intertidal benthic ecology survey was undertaken at the Kent Project Site of the London Resort the intertidal area on the Swanscombe Peninsula (see ES Figure 13.1: Order Limits; figure reference 6.3.13.1).

SURVEY TIMINGS

2.2 The intertidal survey was conducted between the 5th and 8th August 2020. High and low tides for these dates are provided in Table 2-1.

Table 2-1: Date and tidal information for the intertidal and wall scrape survey days.

Survey	Date	Low tide		High tide	
		Time (BST)	Height (m)	Time (BST)	Height (m)
Intertidal Survey	05/08/2020	8:48	0.8	15:07	6.2
	06/08/2020	9:24	0.8	15:42	6.2
	07/08/2020	9:58	0.8	16:14	6.1
	08/08/2020	10:31	0.9	16:46	6.1
Wall scrape survey	06/08/2020	9:24	0.8	15:42	6.2

SURVEY DESIGN

2.3 The following stations were sampled:

- 18 core sampling stations (two transects with stations on upper, mid and lower shore and 8 transects with stations on upper and mid shore); and
- 5 wall scrapes.

2.4 Intertidal survey stations were sampled on both the upper and mid shore after it was determined via an initial walkover that the intertidal did not extend out far enough to have lower, mid and upper shore stations[1]. The only exceptions to this were Transects T02 and T06, in which the lower shore was also sampled. Additionally, the lower shore of Transect T06 was sampled to attempt to sample the 'peat forest' habitat that was recorded by Aquatonics Ltd. in 2015 (Aquatonics 2016). Intertidal core station locations are indicated

[1] Due to this observation and the short distance between mid and lower shore areas it was considered that data obtained for the mid shore would be sufficient to effectively characterise assemblages in the mid and lower intertidal zone.

in Figure 13.4.1 with coordinates provided in Appendix 2.0. Samples for Particle Size Analysis (PSA) were collected at all of the intertidal stations and the locations of wall scrape samples are indicated in Figure 13.4.1.

Intertidal Phase I

2.5 The Phase I survey recorded the range and extent of habitats present in the intertidal area by assigning them *in situ* according to the Countryside Council for Wales (CCW) Handbook for Marine Intertidal Phase I mapping surveys (Wyn *et al*. 2006) and the Marine Monitoring Handbook (Wyn & Brazier 2001). Aerial imagery of survey transects was taken into the field and annotated *in situ* and boundaries of habitat types along the transect were sketched and co-ordinates recorded. Focus was on noting any conspicuous sediment types, biota and features that were evident and the Phase II survey cores were used to obtain community composition data. Habitats were allocated in accordance with EUNIS guidance (EEA 2017). To optimise accuracy of site location a hand-held (Global Positioning System) GPS was used to locate sampling points in the field. The range and extent of habitats was recorded on wireframe maps prepared in advance for the survey. The presence of any non-native species was recorded and appropriate biosecurity measures were employed to prevent further spread. Other notes were made at each station on a proforma and for each habitat surveyors recorded the following:

- Notes relating to the biotic assemblage including key taxa present when applicable;
- Substrate type;
- Anthropogenic pressures;
- Key features of interest;
- Presence of Invasive Non-Native Species (INNS); and
- Presence of macroalgal mats.

2.6 Photographs were taken of habitats, biota and features of interest.

Intertidal Phase II

2.7 Intertidal core samples were taken following guidance within the Marine Monitoring Handbook (Dalkin & Barnett 2001) and UKTAG Water Framework Directive (WFD) guidance (WFD-UKTAG 2014).

2.8 Quantitative core samples were collected at each core station using a 0.01 m^2 handheld core pushed into the sediment to a depth of 15 cm (Dalkin & Barnett 2001). To ensure the data collected were WFD compatible, three replicate cores were taken at each core sample station. Each sample was placed into a robust plastic bag and labelled before being transported to APEM's Marine Biolabs for analysis. Following the methods outlined in the Marine Monitoring Handbook (Davies *et al*. 2001) all biota samples were sieved through a BS410 standard 0.5 mm mesh sieve and subsequently fixed in 4-10% formaldehyde within 24 hours of collection.

2.9 Additional core samples were taken at each sample station for PSA following WFD guidance (WFD-UKTAG 2014) and these samples were kept cool and transported to a third party laboratory for analysis within 24 hours.

2.10 Notes were made at each station of the presence and extent of macroalgae, presence of surface features (e.g. casts, burrows), depth of anoxic layer and sediment characteristics (stability, firmness, surface relief). Anthropogenic impacts were also recorded where evident.

Sampling of man-made structures

2.11 At each wall scrape sampling station, a single sample was taken at approximately the mid tide level using a 0.01 m^2 sampling device in accordance with the methodologies described by Worsfold (1998), (Figure 13.4.2). Using this device, marine growth was then scraped into a bag. Samples were not sieved in the field but instead were transferred to an appropriate container and fixed with 4% buffered formaldehyde solution in seawater. They were later sieved in the laboratory over a 0.5 mm sieve. In addition to wall scrape samples, the general community on the wall was visually described and large, easily identified animals and algae were recorded.

Licences and Permissions

2.12 A Temporary River Works Licence was acquired from the Port of London Authority (issued: 21/08/2020).

2.13 A Wildlife Licence was sought and provided by the Marine Management Organisation (MMO) due to the possible presence of the lagoon sea slug *Tenellia adspersa* and tentacled lagoon worm *Alkmaria romijni*. An exemption notice was submitted to the MMO to inform the organisation that the survey was exempt from needing a marine licence (issued: 30/07/2020).

2.14 The survey design for the intertidal benthic ecology survey was approved by the Environment Agency prior to deployment (approved: 24/06/2020).

Laboratory Processed

Macrobiota

2.15 Sample analysis was conducted according APEM's standard operating procedure for marine benthic sample analysis which is fully compliant with the North-East Atlantic Marine Biological Analytical Quality Control (NMBAQC) Scheme's Processing Requirement Protocol (PRP) (Worsfold *et al*. 2010).

2.16 To standardise the sizes of organisms and improve sorting efficiency, samples were sieved through a stack of sieves of 4.0, 2.0, 1.0 and 0.5 mm meshes in a fume cupboard following

UKTAG guidance for benthic invertebrate sample analysis for transitional waters (WFD-UKTAG 2014). All biota retained in the sieves were then extracted under low power microscopes, identified and enumerated, where applicable.

2.17 Several samples required subsampling due to either large amounts of material or a high abundance of certain taxa. Where subsampling was undertaken it was conducted using the methodology outlined in the NMBAQC Scheme PRP (Worsfold *et al*. 2010) using a Quarteriser (Proudfoot *et al*. 2003). Abundance figures were corrected as required to account for any subsampling undertaken.

2.18 Taxa were identified to the lowest practicable taxonomic level (usually species), using appropriate taxonomic literature. For certain taxonomic groups (e.g. nemerteans, nematodes, and certain oligochaetes), higher taxonomic levels were used due to the widely acknowledged lack of appropriate identification tools for these groups. The NMBAQC Scheme's Taxonomic Discrimination Protocol (TDP) (Worsfold *et al*. 2010), which gives guidance on the most appropriate level to which different marine taxa should be identified, was adhered to for the laboratory analysis. Where required, specimens were also compared with material maintained within the laboratory reference collection. Nomenclature followed the World Register of Marine Species (WoRMS; WoRMS Editorial Board 2017), except where more recent published literature that had not yet been incorporated into the WoRMS list was known to exist.

2.19 All samples were subject to internal quality assurance procedures and, following analysis, 10% of samples were subject to formal Analytical Quality Control (AQC). For archiving purposes, all samples were stored in 70% industrial denatured alcohol (IDA) solution. At least one example of each taxon recorded from the surveys was set aside for inclusion in APEM's in-house reference collection. This collection acts as a permanent record of the biota recorded.

Biomass estimations

2.20 Biomass analysis was conducted for the intertidal core samples to determine the biomass of different groups. The estimation of biomass was undertaken according to APEM's standard operating procedure and the NMBAQC Scheme guidance and TDP (Worsfold *et al*. 2010). APEM used a non-destructive biomass procedure that is fully compliant with the methods outlined in the Clean Seas Environmental Monitoring Programme (CSEMP) Green Book (CSEMP 2012). Animals were blotted dry before transfer to a tared analytical balance. Biomass values were recorded as blotted wet-weight, +/- 0.0001 g. Taxa weighing less than 0.0001 g were given a nominal weight of 0.0001 g. Barnacles, ascidians, cnidarians and non-countable taxa were not weighed.

2.21 Biomass was determined at major taxonomic group level and specimens set aside for inclusion in the reference collection were weighed separately with their weight being added to the relevant group. The major groups were defined as Annelida, Crustacea, Mollusca, Echinodermata and Others.

Particle size analysis

2.22 PSA was performed in accordance with NMBAQC Scheme best practice guidance for PSA for supporting biological analysis (Mason 2016), with the modification that the wet separation was performed at 2.0 mm rather than 1.0 mm, to determine the 'gravel' to 'sand and mud' proportions by weight. A combination of dry sieving and laser diffraction was used due to the range of particle sizes present in the samples.

Data analysis

2.23 Before analysis, all data were checked for errors. Summary statistics were calculated and outlying values investigated to identify possible data transcription errors. As is standard practice, truncation of the biological data was undertaken before calculation of summary statistics and other statistical analyses (see Table 2-2). Univariate and multivariate analyses were undertaken using the PRIMER software package (Clarke & Warwick 2001).

2.24 For analyses based on numbers of individuals, any non-countable taxa and fragments of individuals were also omitted from analysis.

Table 2-2: Details of data truncation performed prior to statistical analysis.

Taxon / Records	Details of truncation performed
Baltidrilus costatus	Fragments removed from sample Transect 3 Mid (Rep A)
Tubificoides benedii	Fragments removed from sample Transect 3 Mid (Rep B)
Crangon	Fragments removed from sample Transect 2 Upper (Rep A)
Chironomidae	Larva and pupa records combined
Sessila	Adult and juvenile records combined
Scrobicularia plana	Adult and juvenile records combined

2.25 Biological diversity within a community was assessed based on taxon richness (total number of taxa present) and evenness (considers relative abundances of different taxa). The following metrics were calculated:

- **Taxon richness**: The total number of taxa in a sample.
- **Density**: The number of individuals per unit area (e.g. per square metre).
- **Margalef's species richness (d):** A measure of the number of species present for a given number of individuals.
- **Pielou's Evenness Index (J'):** Represents the uniformity in distribution of individuals spread between species in a sample. The output range is from 0 to 1 with higher values indicating more evenness or more uniform distribution of individuals.
- **Shannon-Wiener Diversity Index (H'(loge):** A widely used measure of diversity accounting for both the number of taxa present and the evenness of distribution of

the taxa (Clarke & Warwick 2001).

- **Simpson's Dominance Index (1-λ):** A dominance index derived from the probability of picking two individuals from a community at random that are from the same species. Simpson's dominance index ranges from 0 to 1 with higher values representing a more diverse community without dominant taxa.

2.26 Data for all replicates from a single station were summed to provide total values. Where total values were calculated per station for a given metric, the standard deviation (SD) has been provided.

2.27 Multivariate analyses were conducted using resemblance (similarity) matrices with replicate data first pooled for each station (total number of individuals across replicates). Sample similarity calculations using raw abundance data can easily be dominated by a few highly abundant taxa (Clarke & Warwick 2001), masking the influence of less abundant species. Consequently, a square root transformation was applied to the data prior to the calculation of Bray-Curtis similarity to reduce the influence of the most numerically dominant taxa, following the recommendations in Clarke & Gorley (2006).

2.28 A two-stage analysis of the resemblance matrices for different transformation options was conducted based on consideration of no transformation, square root transformation, 4th root transformation, log (x + 1) transformation and 'presence/absence', in order of increasing strength of the transformation. Spearman rank correlations of 4^{th} root and Log (x+1) transformation resemblance matrices with the square root transformation resemblance matrix were very close to 1 (0.928 and 0.962 respectively, Appendix 6.0). The strong correlation indicates square root transformation is a robust choice and more severe transformations would correlate more closely with a 'presence/absence' transformation of data.

Cluster Analysis

2.29 Cluster analysis was utilised to provide a visual representation of sample similarity in the form of a dendrogram. Cluster analysis was conducted in conjunction with a SIMPROF (similarity profile) test to determine whether groups of samples were statistically indistinguishable at the 5% significance level, or whether any trends in groupings were apparent. Black lines on the dendrogram indicate statistical distinctions between sampling stations, whilst red lines indicate that the samples were statistically inseparable.

Ordination Analysis using non-Metric Multidimensional Scaling

2.30 Non-metric multidimensional scaling (MDS) is a type of ordination method which creates a 2- or 3-dimensional 'map' or plot of the samples from the PRIMER resemblance matrix. The plot generated is a representation of the dissimilarity of the samples (or replicates), with distances between the replicates indicating the extent of the dissimilarity. For example, replicates that are more dissimilar are further apart on the MDS plot. No axes are present on the MDS plots as the scales and orientations of the plots are arbitrary in nature.

2.31 Each MDS plot provides a stress value which is a broad-scale indication of the usefulness of plots, with a general guide indicated below (Clarke & Warwick 2001):

- <0.05 Almost perfect representation of rank similarities;
- 0.05 to <0.1 Good representation;
- 0.1 to <0.2 Still useful;
- 0.2 to <0.3 Should be treated with caution; and
- >0.3 Little better than random points.

SIMPER

2.32 Where differences between groups of samples were found, SIMPER analysis (in PRIMER) was used to determine which taxa were principally responsible for the differences between the statistically distinct groups of stations.

Particle size analysis

2.33 The PSA data were entered into GRADISTAT (Blott & Pye 2001) to produce sediment classifications, following Folk (1954), (Figure 13.4.2). Summary statistics were also calculated including mean particle size, sorting, skewness and kurtosis (following Blott & Pye 2001).

Habitat allocation

2.34 The invertebrate count data and PSA results, and outputs of the cluster analysis, SIMPROF and SIMPER analysis, were interpreted to allocate habitats to each replicate sample. Habitats were allocated following the EUNIS habitat classification system (EEA 2017). Equivalent codes based on JNCC's National Marine Habitat Classification for Britain and Ireland: Version 04.05 (Connor *et al*. 2004) have also been provided.

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Chapter Three ◆ Results

3.1 Photographs of the shoreline at each transect are provided in Appendix 5.0 with photographs of intertidal core and wall scrape sampling locations in Appendices 3.0 and 4.0 respectively. Full PSA data for the subtidal and intertidal sediments are presented in Appendix 7.0 and summary data are provided in Table 3-1. Records of the presence of macroalgae, sediment characteristics, surface features and anthropogenic impacts at each station are provided in Appendix 8.0.

PARTICLE SIZE ANALYSIS

3.2 Sediment at most of the intertidal core stations was classified as Sandy Mud with the exception of Stations 1 Upper (UP) and 3 UP (Muddy Gravel), Station 1 Middle (MID) (Muddy Sandy Gravel), Station 2 MID (Mud), Station 2 Lower (LOW) (Slightly Gravelly Sandy Mud) and Station 8 UP (Sand). All sediments were considered to be 'very poorly' sorted with the exception of Stations 1 UP and 3 UP ('Extremely Poorly' sorted), and Station 8 UP ('Poorly' sorted).

Table 3-1: Summary particle size data from each intertidal and subtidal sample station. U=Upper shore; M = Mid shore; L = Lower shore.

Stations	Mean particle diameter (µm)	Gravel (%)	Sand (%)	Mud (%)	Folk classification	Sorting
T01-U	1707.5	61.7	10.1	28.3	Muddy Gravel	Extremely Poorly Sorted
T01-M	7122.2	75.4	14.8	9.9	Muddy Sandy Gravel	Very Poorly Sorted
T02-U	10.3	0.0	13.3	86.7	Sandy Mud	Very Poorly Sorted
T02-M	8.2	0.0	6.9	93.1	Mud	Very Poorly Sorted
T02-L	36.0	0.2	43.1	56.7	Slightly Gravelly Sandy Mud	Very Poorly Sorted
T03-U	364.8	34.3	28.8	37.0	Muddy Gravel	Extremely Poorly Sorted

Stations	Mean particle diameter (µm)	Gravel (%)	Sand (%)	Mud (%)	Folk classification	Sorting
T03-M	15.6	0.0	19.1	80.9	Sandy Mud	Very Poorly Sorted
T04-U	10.0	0.0	10.1	89.9	Sandy Mud	Very Poorly Sorted
T04-M	10.6	0.0	13.4	86.6	Sandy Mud	Very Poorly Sorted
T05-U	17.7	0.0	29.5	70.5	Sandy Mud	Very Poorly Sorted
T05-M	13.8	0.0	22.6	77.4	Sandy Mud	Very Poorly Sorted
T06-U	12.2	0.0	18.8	81.2	Sandy Mud	Very Poorly Sorted
T06-M	29.5	0.0	37.3	62.7	Sandy Mud	Very Poorly Sorted
T06-L	37.2	0.0	42.8	57.2	Sandy Mud	Very Poorly Sorted
T07-U	16.4	0.0	23.1	76.9	Sandy Mud	Very Poorly Sorted
T07-M	23.1	0.0	36.8	63.2	Sandy Mud	Very Poorly Sorted
T08-U	156.7	0.0	90.5	9.5	Sand	Poorly Sorted
T08-M	9.1	0.0	16.9	83.1	Sandy Mud	Very Poorly Sorted

BIOTIC DATA

Community summary statistics for microbenthic assemblages structure

3.3 The complete benthic dataset for the intertidal core and wall scrape samples are provided in Appendices 9.0 and 10.0 respectively.

Core samples

3.4 A total of 43 benthic taxa were identified from the 18 stations (54 intertidal core samples) of which two were non-countable (e.g. colonial organisms). A total of 9,264 individuals were recorded for the countable taxa. One taxon (*Crangon crangon*) was not included in summary statistics due to the presence of fragments only in core samples. The mud shrimp *Corophium volutator* was the most abundant taxon recorded at every station and was present in almost all of the samples. This taxon had a total abundance of 5,676 individuals (61.2% of the total number of countable organisms recorded for the intertidal cores) and a mean density of 10,511 ± 16,477 individuals m^{-2}. Abundant taxa other than *C. volutator* were the oligochaete *Baltidrilus costatus* (926 individuals; mean density of 1,715 ± 6,127 individuals m^{-2}), the ragworm *Hediste diversicolor* which was found at all but two stations (591 individuals; mean density of 1,094 ± 1,289 individuals m^{-2}), Enchytraeidae spp. (502 individuals; mean density of 927 ± 2,398 individuals m^{-2}), Nematoda spp. (497 individuals; mean density of 920 ± 2,658 individuals m^{-2}), *Streblospio* sp. (467 individuals; mean density of 865 ± 1,671 individuals m^{-2}) and the crustacean *Cyathura carinata* (302 individuals; mean density of 559 ± 1,685 individuals m^{-2}).

The lowest number of taxa was found at Station 2 MID (5 taxa) and 1 MID had the highest number of taxa (16 taxa), (see Biomass analysis

3.5 The complete benthic biomass dataset for the intertidal core and wall scrape samples are provided in Appendices 11.0 and 12.0 respectively.

Core samples

3.6 Faunal biomass in the intertidal cores was dominated by annelids at most stations from Transects 1 to 3 (Stations 1 MID, 2 UP, 2 MID and 3 UP), with an increase in the relative biomass of crustaceans from Transects 5 to 7 (Figure 13.4.4). Particularly high values for annelids were recorded at Stations 1 MID, 2 UP, 3 UP and 6 UP which was largely influenced by high numbers of *H. diversicolor*, *Baltridus costatus* and *Streblospio* sp. at these stations. At Stations 6 MID, 6 LOW and 7 UP crustaceans dominated the biomass. This was primarily influenced by the large numbers of *C. volutator* at these sites but the particularly high value at Station 6 MID was due to a large number of *Cyathura carinata* and very few annelids being recorded. High biomass values for mollusca were recorded at Stations 1 UP and 5 MID. At Station 1 UP biomass was similar to that of annelids whilst at Station 5 MID faunal biomass was dominated by molluscs. High biomass values for molluscs were a result of two large peppery furrow shells *Scrobicularia plana* in one of the replicates at each station. The highest total biomass was recorded at station 1 UP (3.058 g) whilst 8 UP had the lowest total biomass (0.003 g).

Wall scrapes

3.7 Faunal biomass from the wall scrape samples were dominated by crustaceans at the majority of stations (WS 1, WS 2, WS 4 and WS 5). High biomass values for crustaceans at these stations were largely influenced by the presence of several taxa including *S. vanhaareni*, *Lekanesphaera hookeri* and Talitridae. The only exception to this was at station WS 3 which was dominated by molluscs. This was due to the recording of a Pacific oyster *M. gigas* individual. The highest total biomass was recorded at station WS 3 (4.132 g) whilst station WS 2 had the lowest total biomass (0.005 g).

3.8 Table 3-2). The greatest density of individuals was found at Station 6 MID with 78,067 individuals m^{-2} whilst Station 8 UP had the lowest density with 367 individuals m^{-2}. Margalef's species richness varied from 0.62 at Station 2 MID to 2.73 at Station 1 MID. Pielou's Evenness varied from 0.17 at Station 5 MID (low evenness primarily influenced by large numbers of *C. volutator*) to 0.91 at Station 8 UP (high evenness due to low or similarly high numbers of most taxa). The Shannon Weiner Diversity index also indicated low diversity at Station 5 MID (value of 0.36), while the highest value was recorded at Station 6 LOW (value of 1.79). Simpson's dominance varied from 0.14 at Station 5 MID to 0.87 at Station 8 UP. The lower Simpson's dominance values were largely influenced by low numbers of individuals for most taxa and high numbers of *C. volutator* relative to other taxa.

Wall scrapes

3.9 A total of 397 individuals belonging to 15 taxa were identified from the five wall scrape stations, of which five taxa were non-countable. The crustacean *Sinelobus vanhaareni* was the most abundant taxon recorded within wall scrape samples, having a total abundance of 104 individuals (26.2% of the total number of countable organisms recorded for the wall scrapes) and a mean density of 3,467 ± 3,403 individuals m^{-2}. The next most abundant taxon other than *S. vanhaareni* was the acorn barnacle *Austrominius modestus* (92 individuals; mean density of 4,600 ± 6,223 individuals m^{-2}). Other notable taxa included Chironomidae which was the only taxon recorded in samples from all five wall scrape stations (69 individuals; mean density of 1,380 ± 1,715 individuals m^{-2}). Of the five non-countable taxa, the green alga *Blidingia minima* was the most abundant across all stations, and was observed at 80% of wall scrapes stations.

Notable microbenthic taxa

3.10 None of the intertidal infaunal species recorded were of conservation importance (e.g. protected under the Wildlife and Countryside Act 1981 (as amended), Habitats Directive or a Species of Principal Importance in England under Section 41 list of the NERC Act) and none were considered to be rare (i.e. those listed by Bratton 1991; Sanderson 1996; Betts 2001; Chadd & Extence 2004).

3.11 Four non-native species were recorded during the intertidal Phase I survey (the Chinese mitten crab *Eriocheir sinensis*, the Pacific oyster *Magallana gigas*, Australian tube worm *Ficopomatus enigmaticus* and the bay barnacle *Amphibalanus improvisus*) and two non-native species were recorded in the Phase II intertidal samples (the barnacle *A. modestus* and *S. vanhaareni*), (Appendix 9.0). *A. modestus* was recorded at T01 MID and Wall Scrape Stations 3 and 4; whilst *S. vanhaareni* was found at Wall Scrape Stations 1, 3 and 4.

3.12 *Streblospio* sp. was found in 26 of the core samples, Sessilia was found in one of the core samples and two of the wall scrape samples; and Chironomidae was found in all five of the wall scrape samples. At least one species of these taxa are considered non-native in the UK, however, *Streblospio*, Sessilia and Chironomidae are taxonomically problematic and individuals were not identified to species in this study.

3.13 Five species considered to be cryptogenic (i.e. that are neither demonstrably native nor non-native) were recorded (*Alitta succinea, Polydora cornuta, T. galiciensis, T. heterochaetus* and *A. improvisus*).

Biomass analysis

3.14 The complete benthic biomass dataset for the intertidal core and wall scrape samples are provided in Appendices 11.0 and 12.0 respectively.

Core samples

3.15 Faunal biomass in the intertidal cores was dominated by annelids at most stations from Transects 1 to 3 (Stations 1 MID, 2 UP, 2 MID and 3 UP), with an increase in the relative biomass of crustaceans from Transects 5 to 7 (Figure 13.4.4). Particularly high values for annelids were recorded at Stations 1 MID, 2 UP, 3 UP and 6 UP which was largely influenced by high numbers of *H. diversicolor*, *Baltridus costatus* and *Streblospio* sp. at these stations. At Stations 6 MID, 6 LOW and 7 UP crustaceans dominated the biomass. This was primarily influenced by the large numbers of *C. volutator* at these sites but the particularly high value at Station 6 MID was due to a large number of *Cyathura carinata* and very few annelids being recorded. High biomass values for mollusca were recorded at Stations 1 UP and 5 MID. At Station 1 UP biomass was similar to that of annelids whilst at Station 5 MID faunal biomass was dominated by molluscs. High biomass values for molluscs were a result of two large peppery furrow shells *Scrobicularia plana* in one of the replicates at each station. The highest total biomass was recorded at station 1 UP (3.058 g) whilst 8 UP had the lowest total biomass (0.003 g).

Wall scrapes

3.16 Faunal biomass from the wall scrape samples were dominated by crustaceans at the majority of stations (WS 1, WS 2, WS 4 and WS 5). High biomass values for crustaceans at these stations were largely influenced by the presence of several taxa including *S. vanhaareni*, *Lekanesphaera hookeri* and Talitridae. The only exception to this was at station WS 3 which was dominated by molluscs. This was due to the recording of a Pacific oyster *M. gigas* individual. The highest total biomass was recorded at station WS 3 (4.132 g) whilst station WS 2 had the lowest total biomass (0.005 g).

Table 3-2: Summary statistics for the intertidal core stations.

Station	Total no. taxa (per station)	Total no. individuals (per m^2)	Margalef's species richness (*d*)	Pielou's Evenness (*J'*)	Shannon Wiener Diversity (*H'*(log$_e$))	Simpson's Dominance (1-λ)
1 UP	13	36,800	1.71	0.47	1.22	0.62
1 MID	16	8,133	2.73	0.59	1.64	0.69
2 UP	12	8,467	1.63	0.47	1.09	0.54
2 MID	5	20,433	0.62	0.25	0.40	0.18
2 LOW	9	8,133	1.46	0.70	1.53	0.70
3 UP	6	4,500	1.02	0.66	1.19	0.68
3 MID	7	1,367	1.62	0.85	1.66	0.80
4 UP	6	3,000	1.11	0.65	1.17	0.58
4 MID	6	533	1.80	0.80	1.44	0.73
5 UP	10	25,067	1.36	0.51	1.17	0.51
5 MID	8	17,700	1.12	0.17	0.36	0.14
6 UP	11	23,767	1.52	0.52	1.25	0.64
6 MID	7	78,067	0.77	0.51	0.99	0.47
6 LOW	9	21,467	1.24	0.81	1.79	0.81
7 UP	8	40,333	0.99	0.19	0.40	0.16
7 MID	8	7,000	1.31	0.73	1.52	0.73
8 UP	7	367	2.50	0.91	1.77	0.87
8 MID	10	3,667	1.91	0.48	1.10	0.45
Min	**5**	**367**	**0.62**	**0.17**	**0.36**	**0.14**
Max	**16**	**78,067**	**2.73**	**0.91**	**1.79**	**0.87**

Multivariate analysis

3.17 The results of SIMPROF cluster analysis on the macrobenthic data for each station are presented in Figure 13.4.5. Black lines denote significant structure within the group to that point and red lines connect samples that cannot be significantly differentiated at the 95% confidence interval. The SIMPROF test identified six groups (Group a-f) that can be considered statistically distinct from one-another at the 95% confidence level, three of which consisted of a single station. These are differentiated on the cluster dendrogram (Figure 13.4.5) and MDS plot (Figure 13.4.6) with different symbols and colours. The stress value of the MDS plot is low (0.13), indicating a good two-dimensional representation of the higher dimensional relationships between samples with no real prospect of a misleading interpretation (Clarke & Warwick, 2001). The results of SIMPER analysis presenting percentage contributions of different taxa to within-group similarity and between group dissimilarity are provided in Appendix 13.0.

3.18 **Group a** consisted of one station (Transect 7 MID) which was separated from groups b to e on the cluster dendrogram at just under 28% similarity (Figure 13.4.5). Within-group similarity cannot be calculated for a single station, however, this station was characterised by relatively high abundances of nematodes and the oligochaetes *T. benedii* and Enchytraeidae compared to the other sampling stations.

3.19 **Group b** also included only a single station (Transect 1 MID), separating from groups c to e at just under 32% similarity (Figure 13.4.5). This group was characterised by the polychaete *Streblospio* sp., the isopod crustacean *Cyathura carinata* and the ragworm *H. diversicolor*. The sediment at this station included coarser material than many of the other stations and was the only coring station at which the barnacles *A. improvisus* and *A. modestus* were recorded.

3.20 **Group c** was comprised of the single station Transect 8 MID and separated from group d at just under 47%. This group was characterised by relatively high abundance of *C. volutator* and low abundance of the spionid polychaete *Pygospio elegans* and the oligochaetes *T. benedii* and Enchytraeidae.

3.21 **Group d** consisted of two stations (Transect 3 UP and Transect 4 UP). This group had high within-group similarity (70.69%) and was characterised primarily by *C. volutator*, which contributed 44.37% to within-group similarity; along with the oligochaete *Baltidrilus costatus* and the ragworm *H. diversicolor*, which contributed a further 26.76% and 22.18% to within-group similarity, respectively.

3.22 **Group e** was the largest SIMPROF group, comprising ten stations spread across the survey area (Transects 1 UP; 2 UP, MID & LOW; 5 UP & MID; 6 UP, MID & LOW; and 7 UP). This group was separated from groups c and d at approximately 39% similarity on the cluster dendrogram (Figure 13.4.5) and had a within group similarity of 55.42%. This group was characterised by a very high relative abundance of *C. volutator* (contributing 53.48% to within-group similarity), along with the polychaetes *H. diversicolor* and *Streblospio* sp., contributing a further 17.18% and 7.09% to within-group similarity respectively.

3.23 **Group f** was comprised of three stations (Transect 3 MID; Transect 4 MID and Transect 8 UP). This group had the widest separation from the other stations (see Figure 13.4.5), separating at 21.29% similarity. Within-group similarity was low (35.94%) with abundance of *C. volutator* contributing to 58.08% to the within-group similarity.

Habitat allocation

3.24 The intertidal core samples had broadly overlapping species composition with the main differences between cluster groups resulting from differences in sediment composition or relative abundances of individual taxa. The six SIMPROF cluster groups were assigned to one of four habitats (Table 3-3). The majority of the samples were either assigned to the habitat *Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud (EUNIS code: A2.3221) (10 stations) or *Hediste diversicolor* and C*orophium volutator* in littoral mud (A2.4115) (6 stations), although four of the stations assigned to the latter habitat deviated from the standard description (Connor *et al*. 2004). Station 8 MID deviated from the standard description due to the absence of *H. diversicolor* and Stations 3 MID, 4 MID and 8 UP had lower abundances than would be expected for this habitat. Station 7 MID had low diversity and much lower abundance of *H. diversicolor* than the other stations and was assigned to the habitat *Hediste diversicolor* and oligochaetes in littoral mud (A3.3223). Station 1 MID had a generally higher proportion of coarse sediment than the other stations and was therefore assigned to the habitat *Hediste diversicolor* and *Streblospio shrubsolii* in littoral gravelly sandy mud (A2.4113).

3.25 The habitats assigned to the rest of the intertidal survey area during the Phase I survey are indicated in Figure 13.4.7. Much of the intertidal area consisted of firm sandy mud with a surface veneer of 2-3 inches of softer silty mud, assigned to the habitat *Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud (A2.3221). Either side of White's Jetty and between Transects 7 and 8 the sediment was dominated by *C. volutator* with visible surface burrows; these areas were assigned to *Hediste diversicolor* and *C. volutator* in littoral mud (A2.4115). Where sea defences were present at the top of the shore or larger artificial boulders or historical fish traps were present, these were colonised by *Fucus vesiculosus* and these areas were assigned the habitat type *Fucus vesiculosus* on variable salinity mid eulittoral boulders and stable mixed substrata (A1.323). There were large pebbles, cobbles and boulders with the non-native barnacles *A. improvisus* and *A. modestus* at the lower shore of Transects 1 and 2, around the base of White's Jetty and around the lower shore artificial boulders around the beacon to the west of Transect 7. Whilst this does not match any standard habitat descriptions (Connor *et al*. 2004), the closest habitat would be an impoverished variant of Barnacles and *Littorina* spp. on unstable eulittoral mixed substrata (A2.431) with *A. improvisus* replacing the native barnacle *Semibalanus balanoides*.

Table 3-3: Habitats recorded at core stations. cf denotes variant to standard description.

Cluster Group	Description	EUNIS code	JNCC code	Replicates
A	*Hediste diversicolor* and oligochaetes in littoral mud	A3.3223	LS.LMu.UEst.Hed.Ol	7 MID
B	Hediste diversicolor and Streblospio shrubsolii in littoral gravelly sandy mud	A2.4113	LS.LMx.GvMu.HedMx.Str	1 MID
C	*Hediste diversicolor* and *Corophium volutator* in littoral mud	A2.4115	cf. LS.LMu.UEst.Hed.Cvol	8 MID
D	*Hediste diversicolor* and *Corophium volutator* in littoral mud	A2.4115	LS.LMu.UEst.Hed.Cvol	3 UP, 4 UP
E	*Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud	A2.3221	LS.LMu.UEst.Hed.Str	1 UP, 2 LOW, 2 MID, 2 UP, 5 MID, 5 UP, 6 LOW, 6 MID, 6 UP, 7 UP
F	*Hediste diversicolor* and *Corophium volutator* in littoral mud	A2.4115	cf. LS.LMu.UEst.Hed.Cvol	3 MID, 4 MID, 8 UP

Anthropogenic impacts

3.26 Anthropogenic impacts were noted at all of the coring locations. The most common impact noted was the presence of litter and debris which was noted at 15 of the 18 coring stations and seven of the eight transects (Appendix 8.0).

Chapter Four ◆ Summary and Discussion

4.1 An intertidal benthic ecology and wall scrape survey was conducted in August 2020 with samples collected for biotic analysis and PSA. A total of 18 stations were sampled for the intertidal core survey and 5 stations were sampled for the wall scrape survey.

4.2 The dominance of Sandy Mud was noted for the intertidal stations, with 6 of the 18 stations classified as either Muddy Gravel, Muddy Sandy Gravel, Mud, Slightly Gravelly Sandy Mud, Sand. The dominance of sandy mud is consistent with PSA data recorded for other surveys in the area (e.g. APEM 2018). All sediment samples except three were considered to be 'very poorly' sorted.

4.3 A total of 43 taxa were recorded in the intertidal core samples, with 15 recorded in the wall scrape samples. Density of invertebrates at each station was highly variable ranging from 367 ± 78,067 individuals m^{-2} for the intertidal core samples. In these samples, the mud shrimp *C. volutator* was the most abundant taxon, and this taxon was recorded at every station and accounted for 61.2% of the total number of countable organisms across the intertidal cores. The most abundant taxon found in the wall scrape samples was the crustacean *S. vanhaareni*. Biomass data for intertidal core stations indicated that annelids and crustacea dominated biomass at stations across the survey area. Annelids dominated biomass within stations on Transects 1 to 4 to the west of the survey area (west of White's Jetty), whilst crustaceans were found to have greater biomass east of the survey area (east of White's Jetty). Molluscs were found to have the greatest biomass at Stations 1 UP and 5 MID, however, this was due to two *S. plana* individuals in one of the replicates at each station.

4.4 Intertidal core stations had broadly overlapping species composition, with main differences between cluster groups resulting from differences in sediment composition and taxon abundance. A total of six SIMPROF cluster groups were identified and assigned to one of four habitats. These were *Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud (A2.3221) (10 stations), *Hediste diversicolor* and *Corophium volutator* in littoral mud (A2.4115) (6 stations), *Hediste diversicolor* and oligochaetes in littoral mud (A3.3223) (1 station) and *Hediste diversicolor* and *Streblospio shrubsolii* in littoral gravely sandy mud (A2.4113). During the Phase I survey several habitats were assigned to the rest of the intertidal area.

4.5 Much of the intertidal area consisted of firm sandy mud with a surface veneer of 2-3 inches of softer silty mud, assigned to the habitat *Hediste diversicolor* and *Streblospio shrubsolii* in littoral sandy mud (A2.3221). Either side of White's Jetty and between Transects 7 and 8, sediment was dominated by *C. volutator* with visible surface burrows and was assigned to *Hediste diversicolor* and *Corophium volutator* in littoral mud (A2.4115). *F. vesiculosus* colonised areas where sea defences were present at the top of the shore or larger artificial boulders or historical fish traps were present and these areas were assigned the habitat

Fucus vesiculosus on variable salinity mid eulittoral boulders and stable mixed substrata (A1.323).

4.6 No benthic invertebrate species of conservation importance were recorded across all samples. Four non-native species were recorded during the intertidal Phase I survey (the Chinese mitten crab *E. sinensis*, the Pacific oyster *M. gigas*, Australian tube worm *F. enigmaticus* and the bay barnacle *A. improvisus*) and two non-native species were recorded during the Phase II intertidal coring survey (the barnacle *A. modestus* and *S. vanhaareni*). *Streblospio* sp. was also recorded in the intertidal core samples, whilst Sessilia and Chironomidae were recorded in wall scrape samples. At least one species of each of these taxa are considered non-native in the UK. Five species considered to be to be cryptogenic were recorded (*A. succinea, P. cornuta, T. galiciensis, T. heterochaetus* and *A. improvisus*).

4.7 A. *modestus, E. sinensis* and *F. enigmaticus* are considered to be invasive (i.e. a non-native species that has the ability to spread causing damage to the environment, the economy and our health (GBNNSS 2018)).

4.8 The Phase I intertidal survey identified several anthropogenic impacts at all coring locations. The most common impact noted was the presence of litter and debris which was noted at 15 of the 18 coring stations and seven of the eight transects (Appendix 8.0).

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Appendices

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Appendix 1.0 Figures & Data

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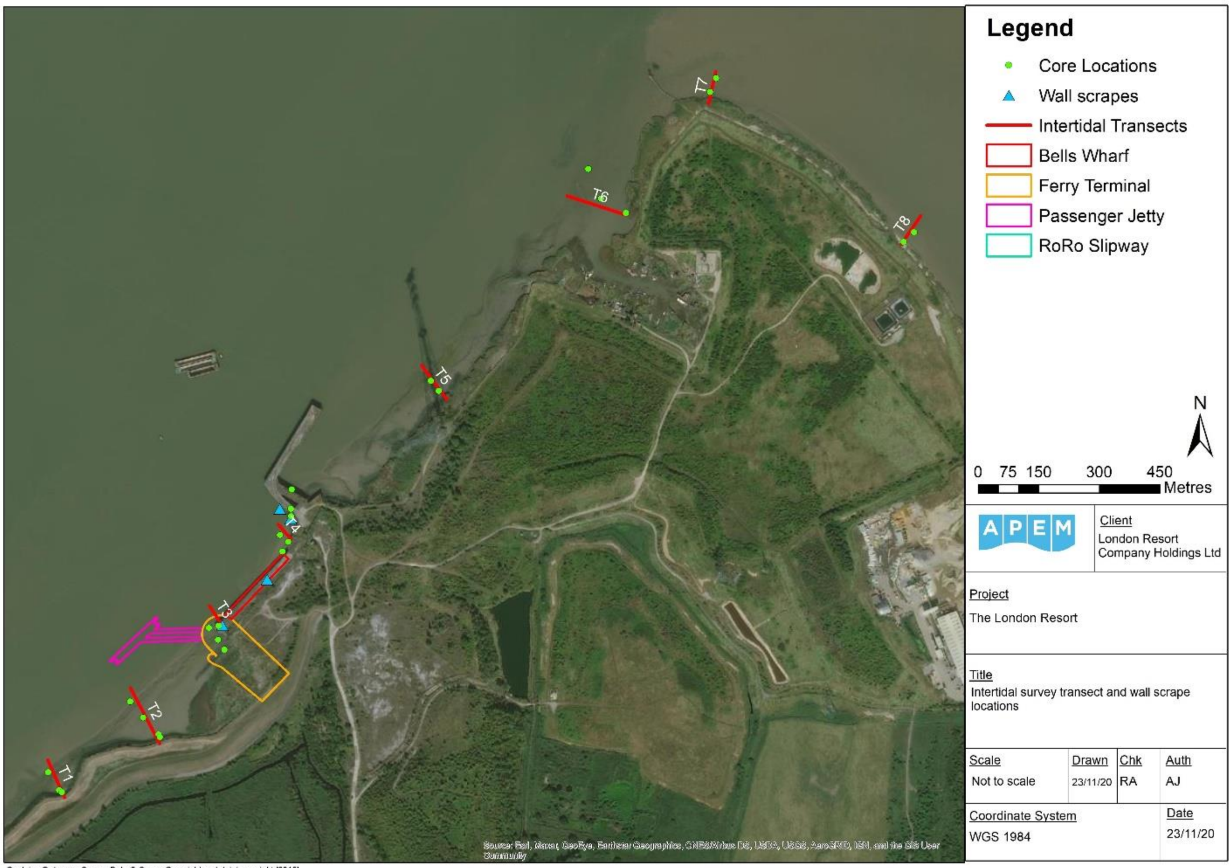
Figure 13.4.1: Intertidal survey transect and wall scrape location.



Contains Ordnance Survey Data © Crown Copyright and database right [2015]

Figure 13.4.2: Wall scrape sampling device.

Figure 13.4.3: Folk sediment classification pyramid (Folk, 1954).

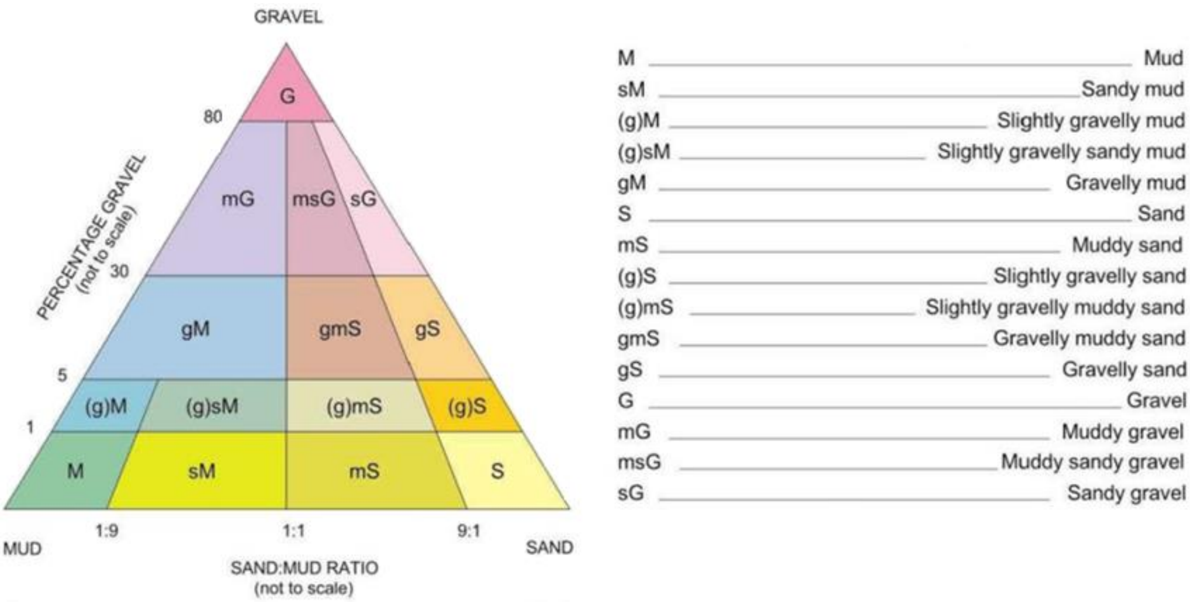


Figure 13.4.4: Average wet weight biomass in grams per replicate at each intertidal core station. UP = Upper shore, MID = Mid shore and LOW = Lower shore.

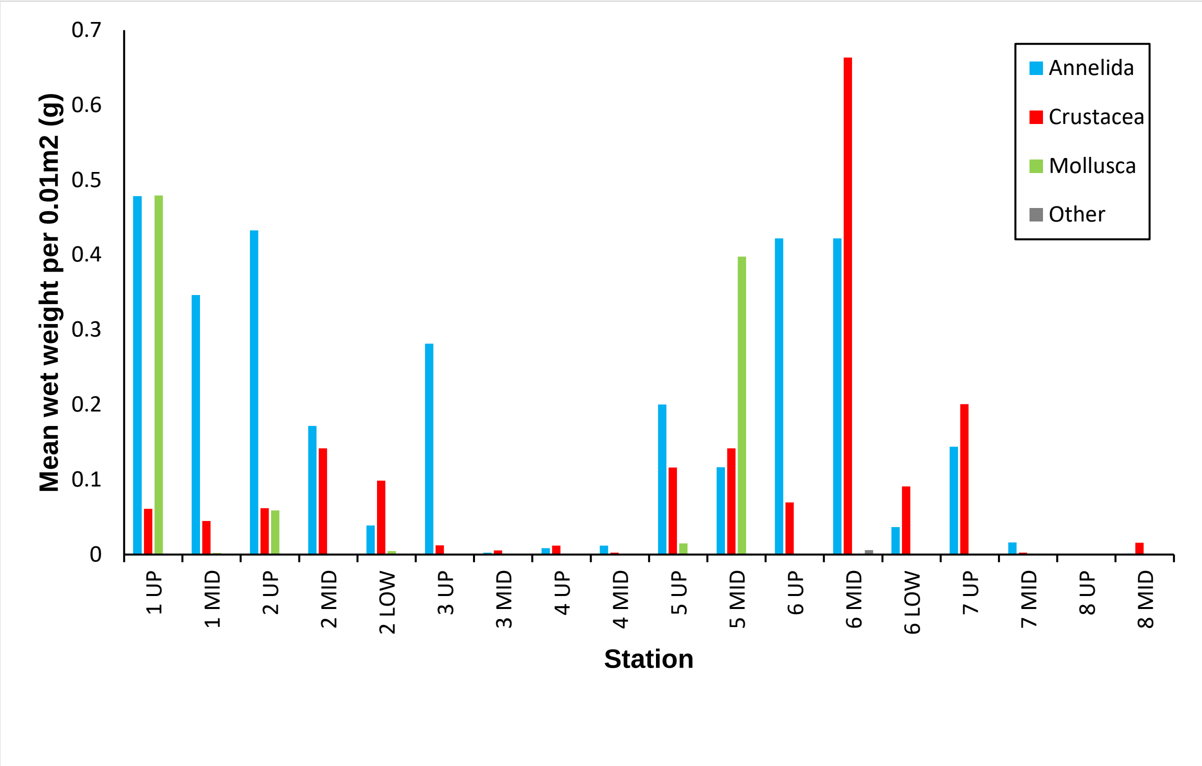


Figure 13.4.5: Cluster analyses dendrogram with SIMPROF for intertidal core invertebrate abundance. Black lines show groupings at ≥5%..

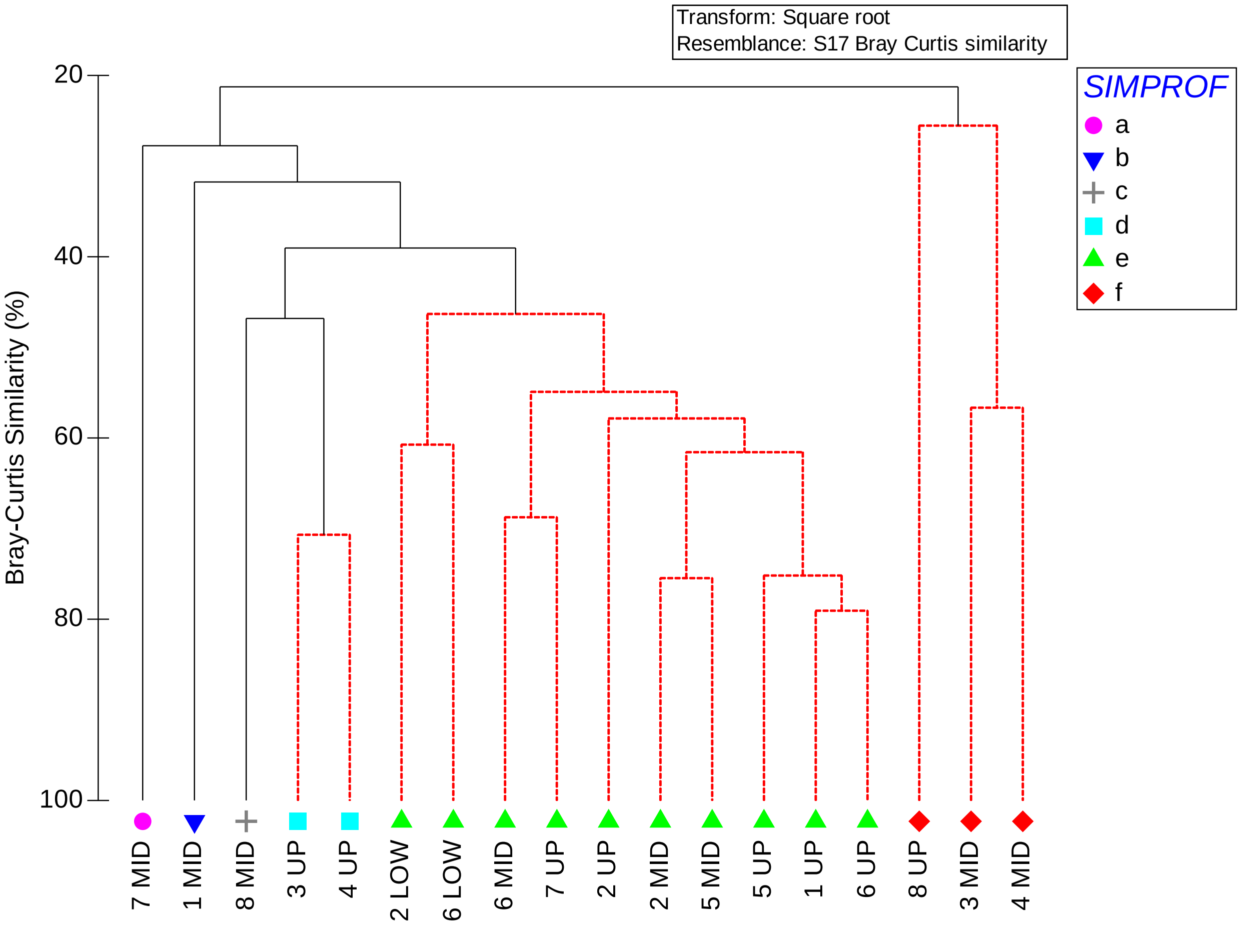


Figure 13.4.6: Multidimensional Scaling ordination plot for intertidal core invertebrate abundance.

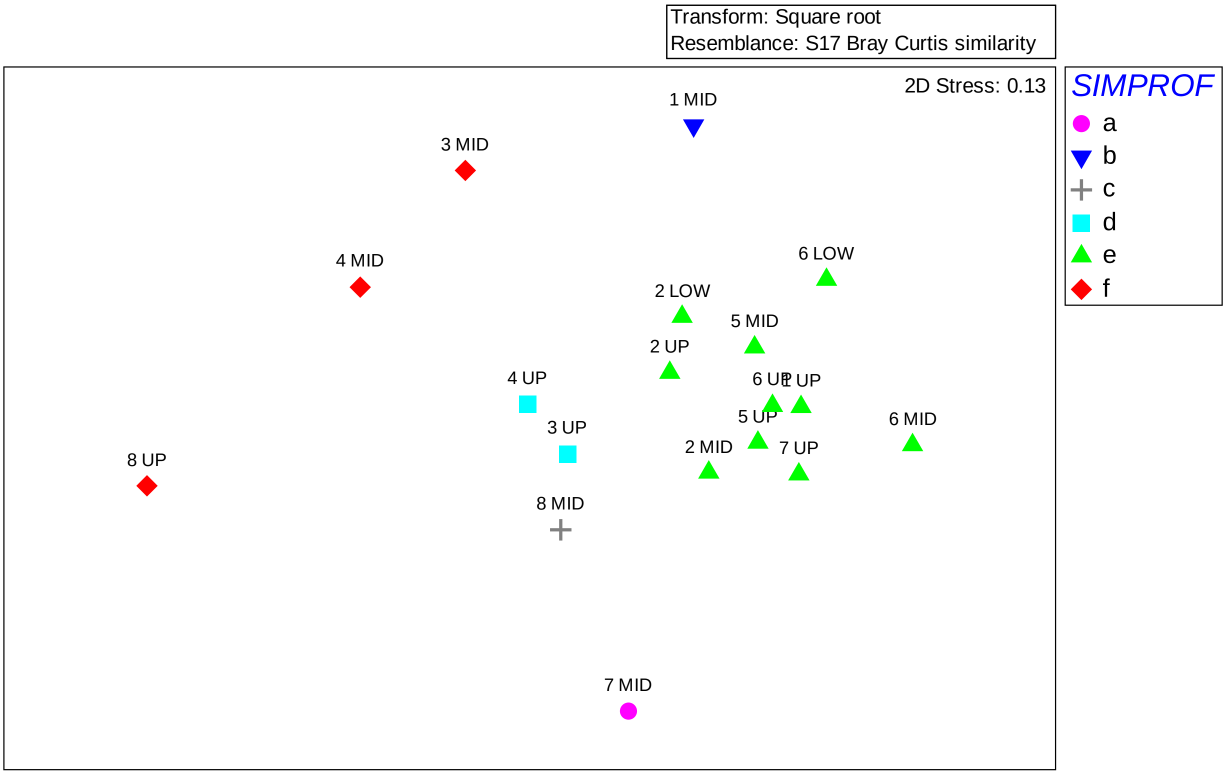


Figure 13.4.7: Habitats mapped during the intertidal survey (EUNIS habitat codes indicated).

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Appendix 2.0 Station Coordinates

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Station	Sample Date	Sampling positions (decimal degrees, WGS84)		Sampling positions (NGR)	
		Latitude	Longitude	Easting	Northing
Intertidal Cores					
1 Upper	05/08/20	51.457187	0.296882	559674	175636
1 Mid	05/08/20	51.457438	0.296642	559656	175663
2 Upper	05/08/20	51.457962	0.299094	559825	175727
2 Mid	05/08/20	51.458196	0.29875	559800	175752
2 Lower	05/08/20	51.45842	0.298463	559780	175777
3 Upper	06/08/20	51.459277	0.300415	559912	175876
3 Mid	06/08/20	51.459443	0.300215	559898	175894
4 Upper	06/08/20	51.460504	0.301848	560007	176016
4 Mid	06/08/20	51.460733	0.301791	560003	176041
5 Upper	08/08/20	51.462731	0.305323	560241	176271
5 Mid	07/08/20	51.462873	0.305144	560228	176286
6 Upper	07/08/20	51.4652	0.309483	560521	176555
6 Mid	07/08/20	51.465403	0.308929	560482	176576
6 Lower	07/08/20	51.465813	0.308648	560461	176621
7 Upper	08/08/20	51.466882	0.31135	560645	176746
7 Mid	08/08/20	51.467075	0.311487	560654	176767
8 Upper	08/08/20	51.464802	0.315657	560951	176524
8 Mid	08/08/20	51.464934	0.315885	560967	176539
Wall Scrapes					
WS1	06/08/2020	51.459471	0.300425	559912	175898
WS2	06/08/2020	51.460638	0.301971	560015	176031
WS3	06/08/2020	51.461363	0.302051	560018	176112
WS4	06/08/2020	51.461095	0.302035	560018	176082
WS5	06/08/2020	51.46099	0.302039	560019	176070

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Appendix 3.0 Intertidal sampling station photographs

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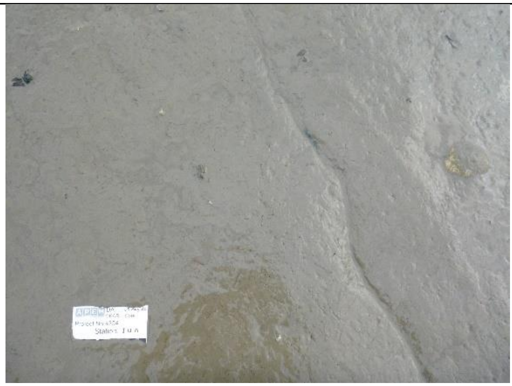
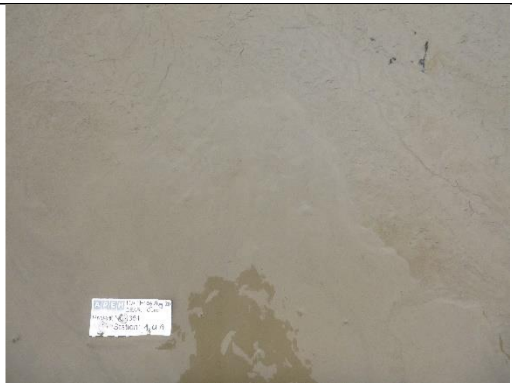
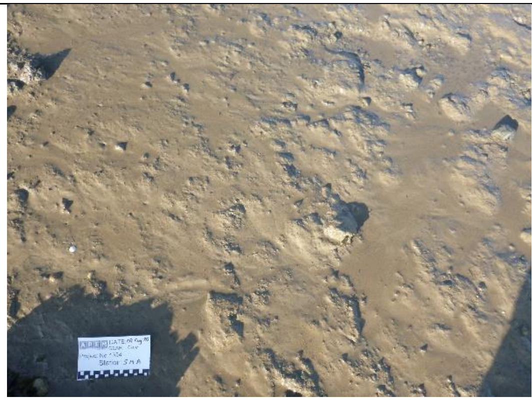
Station	Upper	Middle	Lower
T1			Sample not deemed necessary
T2			

Station	Upper	Middle	Lower
T3			Sample not deemed necessary
T4			Sample not deemed necessary

Station	Upper	Middle	Lower
T5			Sample not deemed necessary
T6			

Station	Upper	Middle	Lower
T7			Sample not deemed necessary
T8			Sample not deemed necessary

Appendix 4.0 Wall scrape sample photographs

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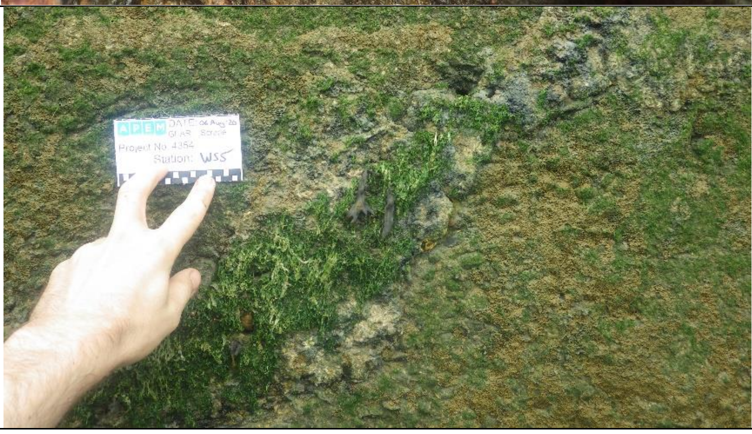
Station	Surface
WS1	
WS2	
WS3	

Station	Surface
WS4	
WS5	

Appendix 5.0 Transect station photographs

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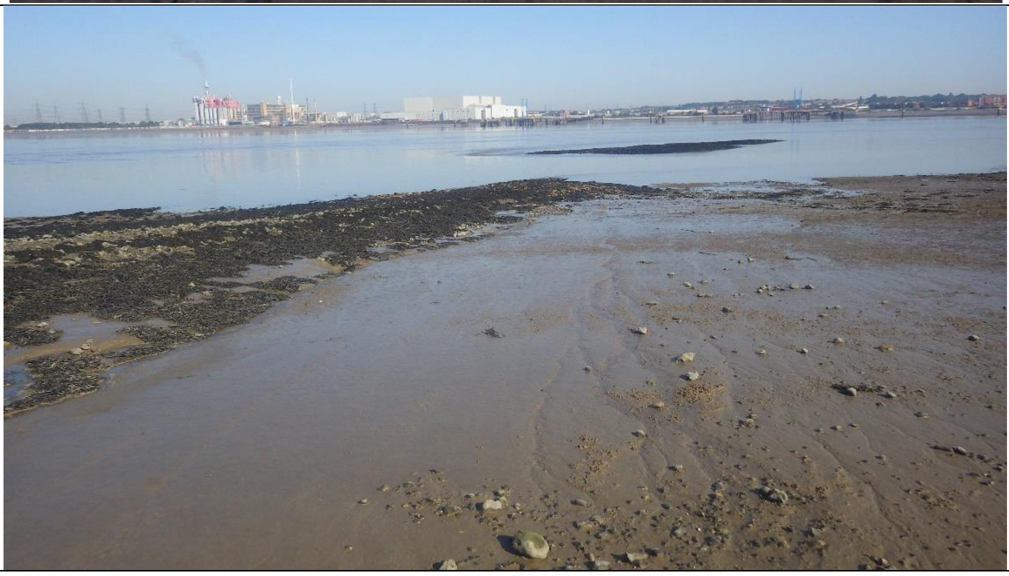
Transect	Shoreline
T1	
T2	
T3	

Transect	Shoreline
T4	
T5	
T6	

Transect	Shoreline
T7	
T8	

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Appendix 6.0 Data transformation analysis

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Two stage analysis of transformations

Correlation (-1 - 1)

	Resem No	**Resem PA**	**Resem SqRoot**	**Resem4thRot**
Untrans_B-C				
SqRt_B-C	0.9447			
4thRT_B-C	0.78856	0.92873		
Log(X+1)_B-C	0.83417	0.96158	0.96533	
PA-B-C	0.40727	0.58074	0.81602	0.67458

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Appendix 7.0 Particle size data for intertidal core stations

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Station ID	Sampled	Visual description pre-analysis	Blott & Pye (2012) classification	Folk (1954) classification	Statistics calculated using Folk and Ward (1957) formulae							
					Mean		Sorting		Skewness		Kurtosis	
					(µm)	(description)	(phi)	(description)	(phi)	(description)	(phi)	(description)
1 Upper	05/08/2020	Gravelly mud	Slightly sandy muddy gravel	Muddy Gravel	1707.5	Very Coarse Sand	5.112	Extremely Poorly Sorted	0.749	Very Fine Skewed	0.585	Very Platykurtic
1 Middle	05/08/2020	Gravelly mud	Slightly sandy slightly muddy gravel	Muddy Sandy Gravel	7122.2	Fine Gravel	3.503	Very Poorly Sorted	0.794	Very Fine Skewed	1.259	Leptokurtic
2 Upper	05/08/2020	Mud	Slightly sandy mud	Sandy Mud	10.3	Medium Silt	2.514	Very Poorly Sorted	0.118	Fine Skewed	1.094	Mesokurtic
2 Middle	05/08/2020	Mud	Slightly sandy mud	Mud	8.2	Medium Silt	2.251	Very Poorly Sorted	0.171	Fine Skewed	1.097	Mesokurtic
2 Lower	05/08/2020	Mud, some organic fragments	Sandy mud	Slightly Gravelly Sandy Mud	36.0	Very Coarse Silt	3.154	Very Poorly Sorted	0.098	Symmetrical	0.914	Mesokurtic
3 Upper	06/08/2020	Gravelly mud	Gravelly sandy mud	Muddy Gravel	364.8	Medium Sand	4.756	Extremely Poorly Sorted	0.225	Fine Skewed	0.673	Platykurtic
3 Middle	06/08/2020	Mud	Slightly sandy mud	Sandy Mud	15.6	Coarse Silt	2.385	Very Poorly Sorted	0.107	Fine Skewed	1.131	Leptokurtic
4 Upper	06/08/2020	Mud	Slightly sandy mud	Sandy Mud	10.0	Medium Silt	2.228	Very Poorly Sorted	0.119	Fine Skewed	1.277	Leptokurtic
4 Middle	06/08/2020	Mud	Slightly sandy mud	Sandy Mud	10.6	Medium Silt	2.448	Very Poorly Sorted	0.121	Fine Skewed	1.160	Leptokurtic
5 Upper	07/08/2020	Mud	Sandy mud	Sandy Mud	17.7	Coarse Silt	3.213	Very Poorly Sorted	-0.006	Symmetrical	0.982	Mesokurtic
5 Middle	07/08/2020	Mud	Sandy mud	Sandy Mud	13.8	Medium Silt	3.077	Very Poorly Sorted	0.019	Symmetrical	1.125	Leptokurtic
6 Upper	07/08/2020	Mud, some organic fragments	Slightly sandy mud	Sandy Mud	12.2	Medium Silt	2.703	Very Poorly Sorted	0.100	Fine Skewed	1.075	Mesokurtic
6 Middle	07/08/2020	Mud, some organic fragments	Sandy mud	Sandy Mud	29.5	Coarse Silt	3.063	Very Poorly Sorted	0.050	Symmetrical	0.958	Mesokurtic
6 Lower	07/08/2020	Mud, some organic fragments	Sandy mud	Sandy Mud	37.2	Very Coarse Silt	3.027	Very Poorly Sorted	0.092	Symmetrical	0.938	Mesokurtic
7 Upper	08/08/2020	Mud	Sandy mud	Sandy Mud	16.4	Coarse Silt	2.792	Very Poorly Sorted	-0.029	Symmetrical	1.147	Leptokurtic
7 Middle	08/08/2020	Mud, some organic fragments	Sandy mud	Sandy Mud	23.1	Coarse Silt	3.388	Very Poorly Sorted	0.031	Symmetrical	0.872	Platykurtic
8 Upper	08/08/2020	Muddy sand	Slightly muddy sand	Sand	156.7	Fine Sand	1.065	Poorly Sorted	0.413	Very Fine Skewed	2.460	Very Leptokurtic
8 Middle	08/08/2020	Mud	Slightly sandy mud	Sandy Mud	9.1	Medium Silt	2.925	Very Poorly Sorted	0.126	Fine Skewed	1.037	Mesokurtic

Station ID	Primary Mode (µm)	d10 (µm)	d50 (µm)	d90 (µm)	Gravel (>2 mm) (%)	Sand 3-2000 µr (%)	Mud (<63 µm) (%)	V Coarse Gravel (32-64 mm) (%)	Coarse Gravel (16-32 mm) (%)	Medium Gravel (8-16 mm) (%)	Fine Gravel (4-8 mm) (%)	V Fine Gravel (2-4 mm) (%)	V Coarse Sand (1-2 mm) (%)	Coarse Sand (500-1000 µm) (%)
1 Upper	38250.0	5.2	12898.1	40164.6	61.7	10.1	28.3	30.0	16.5	10.0	3.1	2.0	1.1	0.6
1 Middle	38250.0	64.6	21830.7	41024.2	75.4	14.8	9.9	36.9	22.5	8.0	4.9	3.2	2.5	5.3
2 Upper	13.3	0.8	11.1	77.6	0.0	13.3	86.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 Middle	13.3	0.9	9.4	48.9	0.0	6.9	93.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 Lower	150.9	1.8	36.2	466.1	0.2	43.1	56.7	0.0	0.0	0.0	0.0	0.2	0.1	8.6
3 Upper	19200.0	4.0	599.9	17938.2	34.3	28.8	37.0	0.0	13.2	6.5	7.8	6.8	9.0	8.8
3 Middle	13.3	1.6	16.1	104.8	0.0	19.1	80.9	0.0	0.0	0.0	0.0	0.0	0.0	0.5
4 Upper	13.3	1.1	10.5	62.8	0.0	10.1	89.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Middle	13.3	0.9	11.2	79.8	0.0	13.4	86.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Upper	13.3	0.8	16.0	316.7	0.0	29.5	70.5	0.0	0.0	0.0	0.0	0.0	0.0	5.2
5 Middle	13.3	0.7	13.3	208.3	0.0	22.6	77.4	0.0	0.0	0.0	0.0	0.0	0.0	2.0
6 Upper	13.3	0.8	12.8	112.7	0.0	18.8	81.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6 Middle	13.3	1.7	27.9	388.1	0.0	37.3	62.7	0.0	0.0	0.0	0.0	0.0	0.0	6.5
6 Lower	150.9	2.3	37.0	435.4	0.0	42.8	57.2	0.0	0.0	0.0	0.0	0.0	0.0	7.7
7 Upper	9.4	1.3	14.2	184.9	0.0	23.1	76.9	0.0	0.0	0.0	0.0	0.0	0.0	2.1
7 Middle	13.3	0.8	21.5	418.0	0.0	36.8	63.2	0.0	0.0	0.0	0.0	0.0	0.0	7.6
8 Upper	213.4	65.3	167.4	269.7	0.0	90.5	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5
8 Middle	13.3	0.5	10.7	110.8	0.0	16.9	83.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Medium Silt	Fine Silt	V Fine Silt	Clay	Percentages of the distribution in each 'half-phi' size interval, expressed in µm (sieving for >1mm fraction, laser diffraction for <1mm fraction)									
(8-16 µm)	(4-8 µm)	(2-4 µm)	(<2 µm)	>63000	45000	31500	22400	16000	11200	8000	5600	4000	2800
(%)	(%)	(%)	(%)		to 63000	to 45000	to 31500	to 22400	to 16000	to 11200	to 8000	to 5600	to 4000
6.2	5.7	3.3	4.5	0.0	0.0	31.4	10.7	4.5	5.8	4.2	1.4	1.7	1.2
1.8	1.9	1.2	1.8	0.0	0.0	38.6	10.7	10.1	4.7	3.2	2.5	2.3	1.9
17.9	15.0	9.6	16.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19.0	16.6	11.1	17.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11.9	9.1	5.4	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
8.1	7.4	4.1	5.7	0.0	0.0	0.0	3.8	9.4	3.1	3.4	4.1	3.8	3.4
17.9	13.1	7.1	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22.1	17.4	9.4	13.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18.9	15.6	9.2	15.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14.0	11.7	7.9	15.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.1	12.6	7.9	17.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.0	13.8	8.7	16.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12.9	10.1	6.0	10.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12.3	8.9	5.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16.9	14.7	8.1	12.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12.4	10.5	7.0	15.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.6	1.6	1.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15.6	13.0	8.9	21.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Station ID	2000 to 2800	1400 to 2000	1000 to 1400	710 to 1000	500 to 710	355 to 500	250 to 355	180 to 250	125 to 180	90 to 125	63 to 90	44.19 to 63	31.25 to 44.19	22.097 to 31.25	15.625 to 22.097	11.049 to 15.625	7.813 to 11.049	5.524 to 7.813	3.906 to 5.524	2.762 to 3.906	1.953 to 2.762
1 Upper	0.8	0.7	0.4	0.0	0.6	1.4	1.3	0.9	1.0	1.8	1.9	1.7	2.0	2.2	2.6	3.1	3.2	3.0	2.6	2.0	1.3
1 Middle	1.4	1.3	1.2	2.5	2.8	1.8	0.7	0.5	0.8	1.6	1.5	0.9	0.8	0.7	0.8	0.9	0.9	1.0	0.9	0.7	0.5
2 Upper	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.7	3.3	2.8	5.3	6.6	6.2	6.9	8.0	9.2	8.7	8.0	7.0	5.5	4.1
2 Middle	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.1	2.2	3.2	4.4	6.8	8.4	9.3	9.8	9.2	8.7	7.9	6.3	4.8
2 Lower	0.0	0.0	0.0	3.8	4.8	5.6	5.9	6.6	6.8	5.5	4.0	3.9	4.8	5.3	5.7	6.2	5.8	5.0	4.1	3.1	2.3
3 Upper	3.3	4.3	4.7	4.9	3.9	2.8	1.1	0.9	1.3	2.3	2.6	2.4	2.8	3.0	3.4	4.0	4.1	4.0	3.4	2.5	1.6
3 Middle	0.0	0.0	0.0	0.0	0.5	1.2	0.9	1.9	2.9	5.3	6.5	6.8	7.8	8.3	8.7	9.2	8.7	7.3	5.7	4.1	2.9
4 Upper	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2	1.7	3.3	3.7	4.1	6.1	7.5	9.6	11.2	10.9	9.6	7.8	5.6	3.8
4 Middle	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.7	2.5	4.2	4.8	5.1	6.4	7.3	8.6	9.6	9.3	8.5	7.2	5.4	3.8
5 Upper	0.0	0.0	0.0	0.7	4.5	4.0	2.8	4.0	4.1	5.2	4.4	3.9	4.8	5.8	6.5	7.3	6.7	6.2	5.5	4.4	3.4
5 Middle	0.0	0.0	0.0	0.0	2.0	3.1	3.0	3.5	3.7	3.9	3.2	3.7	5.4	6.7	7.7	8.5	7.6	6.8	5.8	4.5	3.4
6 Upper	0.0	0.0	0.0	0.0	0.0	0.2	2.1	2.8	3.4	4.9	5.4	5.8	6.5	6.9	7.3	8.1	7.9	7.3	6.4	5.0	3.7
6 Middle	0.0	0.0	0.0	2.6	3.9	4.7	4.8	5.2	5.6	5.5	4.8	4.9	5.8	6.0	6.3	6.7	6.2	5.5	4.6	3.5	2.5
6 Lower	0.0	0.0	0.0	3.4	4.4	5.6	5.8	6.4	6.7	5.9	4.7	4.5	5.4	5.8	6.2	6.5	5.8	5.0	4.0	2.9	2.1
7 Upper	0.0	0.0	0.0	0.2	1.8	2.4	2.6	3.3	4.0	4.5	4.1	4.4	5.9	6.9	7.5	8.4	8.6	8.1	6.7	4.8	3.3
7 Middle	0.0	0.0	0.0	2.6	5.0	4.7	5.2	5.5	5.1	4.9	3.8	3.3	4.6	4.8	5.1	6.3	6.1	5.6	4.9	3.9	3.1
8 Upper	0.0	0.0	0.0	0.0	0.5	1.9	9.7	33.2	29.7	11.6	3.8	1.4	0.9	0.7	0.7	0.8	0.8	0.9	0.8	0.6	0.4
8 Middle	0.0	0.0	0.0	0.0	0.0	0.0	1.6	3.5	3.3	4.5	4.0	4.5	5.9	6.7	7.4	8.0	7.5	6.9	6.1	4.9	3.9

Station ID	1.381 to 1.953	0.977 to 1.381	0.691 to 0.977	0.488 to 0.691	0.345 to 0.488	0.244 to 0.345	0.173 to 0.244	0.122 to 0.173	0.086 to 0.122	0.061 to 0.086	0.043 to 0.061	0.01 to 0.043
1 Upper	0.9	0.6	0.5	0.5	0.5	0.5	0.4	0.3	0.2	0.1	0.0	0.0
1 Middle	0.4	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0	0.0
2 Upper	3.2	2.5	2.1	2.0	2.0	1.8	1.4	1.0	0.6	0.2	0.0	0.0
2 Middle	3.7	2.9	2.4	2.0	1.8	1.6	1.2	0.9	0.6	0.2	0.0	0.0
2 Lower	1.7	1.3	1.2	1.3	1.4	1.3	1.0	0.7	0.4	0.1	0.0	0.0
3 Upper	1.1	0.8	0.7	0.7	0.7	0.6	0.5	0.3	0.2	0.1	0.0	0.0
3 Middle	2.2	1.6	1.4	1.3	1.3	1.2	0.9	0.7	0.4	0.2	0.0	0.0
4 Upper	2.6	1.9	1.7	1.7	1.6	1.5	1.2	0.9	0.5	0.2	0.0	0.0
4 Middle	2.8	2.2	1.9	1.9	1.9	1.7	1.4	1.0	0.6	0.2	0.0	0.0
5 Upper	2.7	2.0	1.8	2.0	2.3	2.2	1.5	0.9	0.4	0.1	0.0	0.0
5 Middle	2.7	2.2	2.1	2.3	2.5	2.3	1.6	1.0	0.5	0.2	0.0	0.0
6 Upper	2.8	2.2	1.9	2.0	2.1	1.9	1.5	1.0	0.6	0.2	0.0	0.0
6 Middle	1.8	1.4	1.3	1.4	1.4	1.3	1.0	0.6	0.3	0.1	0.0	0.0
6 Lower	1.5	1.1	1.1	1.2	1.4	1.2	0.8	0.5	0.2	0.1	0.0	0.0
7 Upper	2.2	1.4	1.3	1.6	2.0	1.8	1.2	0.7	0.3	0.1	0.0	0.0
7 Middle	2.5	1.9	1.7	2.1	2.4	2.2	1.5	0.8	0.3	0.1	0.0	0.0
8 Upper	0.4	0.3	0.3	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
8 Middle	3.1	2.5	2.4	2.8	3.2	3.0	2.1	1.2	0.6	0.2	0.0	0.0

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Appendix 8.0 Station feature record notes

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Site Code	*Arenicola marina*	Large siphon	Small siphon	*Scrobicularia plana*	*Lanice conchilega*	Anoxic	Surface	Firmness	Sorting	Stability	Macroalg	Sediment underwater (%)	Surface features	Anthropogenic pressures	Species present / Notes
T01 Upper	0	0	75	0	0	6	2	4 at surface 2 below surface	3	2	<5	0	*Corophium* tracks between holes	Historical finfish aquaculture Coastal defence seawalls Litter/debris Popular recreational beach	Sandy mud with *Corophium* burrows visible on surface. Surface softer and wetter than harder core substrate beneath. 45 degree boulder wall at top of shore. Historic fish traps present further down the shore Litter common - a lot of broken glass bottles and plastic debris.
T01 Mid	0	0	0	0	0	-	3	2	5	4	5	<1	Diatom film on boulders	Historical finfish aquaculture Popular recreational beach - people walking at the top	Boulders and cobbles with muddy sandy gravel beneath Litter - broken glass and plastic, on wall a metal industrial debris present Diatom film

Site Code	*Arenicola marina*	Large siphon	Small siphon	*Scrobicularia plana*	*Lanice conchilega*	Anoxic	Surface	Firmness	Sorting	Stability	Macroalg	Sediment underwater (%)	Surface features	Anthropogenic pressures	Species present / Notes
T02 Upper	0	0	185	1	0	1	2	4	3	2	0	0	*Corophium* on surface of mud	Coastal defence seawall made of boulders and concrete Litter and Debris Popular recreational beach for walkers	Anoxic sandy mud with gravel/cobble beneath A few *Scrobicularia* marks visible on surface
T02 Mid	0	0	250	0	0	1	2	4	2	2	0	0	*Corophium* holes	Litter and debris	*Corophium* 2 m^{-2} Soft mud with clay beneath 5-10 cm Clay not anoxic Occasional boulders with Fucoids Litter - glass bottles and plastic debris - occasional
T02 Lower	0	0	0	0	0	0	3	2	2	1	0	0	Plant material	Litter and debris	*Corophium* 7 m^{-2} Loose cobble and pebbles on lower shore Eroded clay ledge on mid-shore between 2M and 2L (Track 2)

Site Code	*Arenicola marina*	Large siphon	Small siphon	*Scrobicularia plana*	*Lanice conchilega*	Anoxic	Surface	Firmness	Sorting	Stability	Macroalg	Sediment underwater (%)	Surface features	Anthropogenic pressures	Species present / Notes
T03 Upper	0	0	30	0	0	5	2	3	4	3	10	0	Diatom cover 5%	Concrete sea defence behind wharf Disused wharf Litter and debris	Silt top 3 cm with muddy sandy gravel beneath A lot of car parts, plastic and industrial debris
T03 Mid	0	0	170	0	0	0.5	1	5	1	5	0	0	Diatom film	Litter and debris Wharf	*Corophium* holes and tracks on surface Small stone Diatom film in patches Anoxic mud all but the very surface layer
T04 Upper	0	0	6	0	0	1	1	5	1	5	0	0	-	Seawall Wharf	Very soft silty mud Only very thin and spongy diatom film on patches, film of water present Large pieces of litter / debris - industrial metal parts and concrete as well as plastic and glass
T04 Mid	0	0	0	0	0	1	1	5	1	5	0	100	-	Seawall	Tide out, film of water over surface no features visible Very soft throughout core

Site Code	***Arenicola marina***	**Large siphon**	**Small siphon**	***Scrobicularia plana***	***Lanice conchilega***	**Anoxic**	**Surface**	**Firmness**	**Sorting**	**Stability**	**Macroalg**	**Sediment underwater (%)**	**Surface features**	**Anthropogenic pressures**	**Species present / Notes**
T05 Upper	0	0	180	0	0	5	1	2	2	2	0	0	*Corophium* on surface ~5 m^{-2}	Seawall - boulders and concrete Litter and debris - glass and plastic	Anoxic sandy clay with silty mud on surface Fragments of glass, metal and plastic visible on surface of sediment 1-2 m^{-2}
T05 Mid	0	0	~125	0	0	4	1	-	3	2	<5	0	-	Litter and debris Evidence of physical damage - erosion line	Wet surface mud – 3 cm deep with hard clay below ~5% cobbles/pebbles on surface larger ones with few *Fucus vesiculosus* Corophium 4 m^{-2} on surface
T06 Upper	0	0	300	0	0	-	1	4	1	1	0	10	*Corophium* tracks	Nearby marina Some litter/debris in saltmarsh	Soft mud ~8-10 cm with firmer clay beneath Water runoff from saltmarsh above leaving small rivets over surface
T06 Mid	0	0	0	0	0	-	2	-	2	1	0	5 Streams from saltmarsh	5% diatom cover *Corophium* 3 m^{-2} on surface	Litter/debris	Harder sandy clay with 1-2 cm of soft mud on surface *Corophium* tube structures as per ridges as notes elsewhere Metal industrial litter and plastic/glass present on surface

Site Code	***Arenicola marina***	**Large siphon**	**Small siphon**	***Scrobicularia plana***	***Lanice conchilea***	**Anoxic**	**Surface**	**Firmness**	**Sorting**	**Stability**	**Macroalg**	**Sediment underwater (%)**	**Surface features**	**Anthropogenic pressures**	**Species present / Notes**
T06 Lower	0	0	0	0	0	5	2	2	2	2	0	10	90% Brown Film	Litter/debris Marina nearby	Peat/ancient leaflitter evidence of roots and sticks Peat with leaf litter and thin veneer of mud on surface Some cobble/pebble with barnacles on surface <5%
T07 Upper	0	0	150	0	0	2	2	4 in top 2 cm 2 below	1	1	<1	0	Some cobble, pebble and gravel	Litter/debris	Anoxic sandy clay with 1-2 cm veneer of soft mud *Corophium* 5 m^{-2} on surface Many holes visible in core Some metal and glass debris visible on surface and around core location Bricks and industrial debris Transect on approximately boundary between vegetation and rough clay to the west and smooth clay to east
T07 Mid	0	0	0	0	0	-	3	2	1	1	0	0	Diatoms 90%	Litter/debris	Soft mud with diatom cover over hard clay some large pieces of industrial debris and litter visible on surface

Site Code	*Arenicola marina*	Large siphon	Small siphon	*Scrobicularia plana*	*Lanice conchilega*	Anoxic	Surface	Firmness	Sorting	Stability	Macroalg	Sediment underwater (%)	Surface features	Anthropogenic pressures	Species present / Notes
T08 Upper	0	0	0	0	0	4 to 8	1	1	2	2	0	0	-	Litter/ debris	Muddy sand on upper shore Occasional pieces of large plastic debris (bags, crates, drums) Strandline above in saltmarsh
T08 Mid	0	0	100	0	0	3	2	3	2	1	0	0	*Corophium*	Litter/ debris	Sandy mud over clay Similar "rough" surface appearance to T6 and T7 Occasional broken glass

Appendix 9.0 Macrobenthic data for intertidal core samples. N/A = non applicable

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	Station		T01						T02									T03						T04						T05						T06									T07						T08						
	Shore Height		Upper			Mid			Upper			Mid			Lower			Upper			Mid			Upper			Mid			Upper			Mid			Upper			Mid			Lower			Upper			Mid			Upper			Mid			
Code	Replicate		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	Total
-	Animalia	eggs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
HD0001	Nematoda		0	2	5	0	0	0	0	0	0	0	1	0	12	0	0	0	1	0	0	0	0	0	0	0	0	0	0	12	6	15	4	1	0	1	2	3	52	144	108	0	0	16	2	8	5	12	76	6	0	0	0	0	3	0	497
P0118	*Eteone longa*	aggregate	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
P0462	*Hediste diversicolor*		27	17	61	7	15	4	26	19	19	10	11	9	8	0	0	7	10	18	0	2	1	3	4	4	0	2	0	17	27	23	5	10	3	25	40	35	8	37	10	1	16	2	5	29	13	0	0	1	0	0	0	0	0	0	591
P0471	*Alitta succinea*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
P0494	Nephtys	juvenile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
P0753	*Polydora cornuta*		0	0	1	6	10	3	0	0	1	0	0	0	12	4	4	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	20	4	0	0	0	0	0	0	0	0	0	0	0	0	99
P0776	*Pygospio elegans*		0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	9
P0798	Streblospio		0	9	34	27	69	28	1	6	3	0	0	0	4	4	0	0	0	0	1	1	6	0	1	0	0	0	1	8	38	8	0	0	4	4	51	3	0	0	16	48	36	56	0	0	0	0	0	0	0	0	0	0	0	0	467
P0917	*Heteromastus filiformis*		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3
P1294	*Manayunkia aestuarina*		0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
P1479	*Baltidrilus costatus*		96	58	434	2	0	0	0	2	0	9	8	10	0	0	0	2	16	35	0	0	0	3	1	12	0	0	1	22	8	20	0	0	0	27	89	46	0	0	0	0	0	0	0	2	1	0	16	3	1	1	0	0	1	0	926
P1487	Tubificoides galiciensis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
P1490	Tubificoides benedii		0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	0	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	36	1	0	0	0	0	2	4	56
P1494	*Tubificoides diazi*	aggregate	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15
P1495	*Tubificoides heterochaetus*		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
P1500	*Tubificoides swirencoides*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
P1501	Enchytraeidae		0	2	9	0	0	0	1	8	0	0	0	0	52	4	0	0	0	0	1	0	0	0	0	0	0	0	0	8	8	10	0	0	0	0	0	1	36	56	128	96	32	0	0	13	1	0	28	2	0	0	0	0	6	0	502
Q0054	Acari		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R0015	Sessilia		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R0068	*Austrominius modestus*		0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R0078	*Amphibalanus improvisus*		0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
R0142	Copepoda		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	24
R2413	Myodocopida		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
S0076	*Neomysis integer*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
S0228	Talitridae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S0481	*Gammarus salinus*		0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
S0525	*Melita palmata*		0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
S0590	*Leptocheirus pilosus*		0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
S0616	*Corophium volutator*		52	56	224	2	2	5	28	100	32	154	167	233	59	21	39	0	30	14	1	6	5	10	33	12	1	7	0	158	160	195	203	119	171	139	148	93	296	604	754	122	5	17	174	716	220	1	0	3	1	2	1	3	47	31	5676
S0792	Gnathiidae	female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
S0805	*Cyathura carinata*		0	1	0	10	17	16	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	6	2	0	0	1	28	36	25	114	12	6	2	8	9	0	0	0	0	0	0	0	0	1	302
S0869	*Lekanesphaera hookeri*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
S1102	*Sinelobus vanhaareni*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S1385	*Crangon crangon*	juvenile	0	0	0	0	0	0	0	0	frag.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
S1594	*Carcinus maenas*		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
T0002	Coleoptera	larva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
T0002	Chrysomelidae		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
T0002	Curculionidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
T0003	Diptera	larva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T0003	Chironomidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T0003	Dolichopodidae	larva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
T0004	Ephemeroptera	larva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
T0005	Hemiptera	larva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3
T0005	Aphididae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
W0385	*Peringia ulvae*		0	0	0	2	0	1	0	1	0	0	0	0	0	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	22
W1761	*Magallana gigas*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W2029	*Limecola balthica*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
W2068	*Scrobicularia plana*		1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	6
ZM0002	Rhodophyta		0	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZR0002	Phaeophyceae	?	0	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZR0376	Fucus	juvenile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZR0384	*Fucus vesiculosus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZS0068	Urospora		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZS0145	*Blidingia minima*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A

	Station		T05						T06									T07						T08						
	Shore Height		**Upper**			**Mid**			**Upper**			**Mid**			**Lower**			**Upper**			**Mid**			**Upper**			**Mid**			
Code	**Replicate**		**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**Total**
-	Animalia	eggs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
HD0001	Nematoda		12	6	15	4	1	0	1	2	3	52	144	108	0	0	16	2	8	5	12	76	6	0	0	0	0	3	0	497
P0118	*Eteone longa*	aggregate	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
P0462	*Hediste diversicolor*		17	27	23	5	10	3	25	40	35	8	37	10	1	16	2	5	29	13	0	0	1	0	0	0	0	0	0	591
P0471	*Alitta succinea*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
P0494	Nephtys	juvenile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
P0753	*Polydora cornuta*		0	0	0	0	0	0	0	0	0	0	0	0	32	20	4	0	0	0	0	0	0	0	0	0	0	0	0	99
P0776	*Pygospio elegans*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	1	9
P0798	Streblospio		8	38	8	0	0	4	4	51	3	0	0	16	48	36	56	0	0	0	0	0	0	0	0	0	0	0	0	467
P0917	*Heteromastus filiformis*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3
P1294	*Manayunkia aestuarina*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
P1479	*Baltidrilus costatus*		22	8	20	0	0	0	27	89	46	0	0	0	0	0	0	0	2	1	0	16	3	1	1	0	0	1	0	926
P1487	Tubificoides galiciensis		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
P1490	Tubificoides benedii		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	36	1	0	0	0	0	2	4	56
P1494	*Tubificoides diazi*	aggregate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	15
P1495	*Tubificoides heterochaetus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
P1500	*Tubificoides swirencoides*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
P1501	Enchytraeidae		8	8	10	0	0	0	0	0	1	36	56	128	96	32	0	0	13	1	0	28	2	0	0	0	0	6	0	502
Q0054	Acari		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R0015	Sessilia		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R0068	*Austrominius modestus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
R0078	*Amphibalanus improvisus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
R0142	Copepoda		0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	24
R2413	Myodocopida		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
S0076	*Neomysis integer*		0	0	0	1	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
S0228	Talitridae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S0481	*Gammarus salinus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
S0525	*Melita palmata*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
S0590	*Leptocheirus pilosus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
S0616	*Corophium volutator*		158	160	195	203	119	171	139	148	93	296	604	754	122	5	17	174	716	220	1	0	3	1	2	1	3	47	31	5676
S0792	Gnathiidae	female	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
S0805	*Cyathura carinata*		0	0	3	0	6	2	0	0	1	28	36	25	114	12	6	2	8	9	0	0	0	0	0	0	0	0	1	302
S0869	*Lekanesphaera hookeri*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
S1102	*Sinelobus vanhaareni*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S1385	*Crangon crangon*	juvenile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
S1594	*Carcinus maenas*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
T0002	Coleoptera	larva	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
T0002	Chrysomelidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
T0002	Curculionidae		0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
T0003	Diptera	larva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T0003	Chironomidae		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T0003	Dolichopodidae	larva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
T0004	Ephemeroptera	larva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1
T0005	Hemiptera	larva	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3
T0005	Aphididae		0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
W0385	*Peringia ulvae*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	22
W1761	*Magallana gigas*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W2029	*Limecola balthica*		0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
W2068	*Scrobicularia plana*		1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	6
ZM0002	Rhodophyta		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZR0002	Phaeophyceae	?	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZR0376	Fucus	juvenile	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZR0384	*Fucus vesiculosus*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZS0068	Urospora		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A
ZS0145	*Blidingia minima*		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	N/A

Appendix 10.0 Macrobenthic data for wall scrape samples. N/A = non applicable

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Code	Station		WS1	WS2	WS3	WS4	WS5	Total
	Taxa	Notes						
-	Animalia	eggs	0	0	0	0	P	N/A
HD0001	Nematoda		0	0	0	0	0	0
P0118	Eteone longa	aggregate	0	0	0	0	0	0
P0462	Hediste diversicolor		0	0	0	0	0	0
P0471	Alitta succinea		0	0	0	0	0	0
P0494	Nephtys	juvenile	0	0	0	0	0	0
P0753	Polydora cornuta		0	0	0	0	0	0
P0776	Pygospio elegans		0	0	0	0	0	0
P0798	Streblospio		0	0	0	0	0	0
P0917	Heteromastus filiformis		0	0	0	0	0	0
P1294	Manayunkia aestuarina		0	0	0	0	0	0
P1479	Baltidrilus costatus		0	0	0	0	0	0
P1487	Tubificoides galiciensis		0	0	0	0	0	0
P1490	Tubificoides benedii		0	0	0	0	0	0
P1494	Tubificoides diazi	aggregate	0	0	0	0	0	0
P1495	Tubificoides heterochaetus		0	0	0	0	0	0
P1500	Tubificoides swirencoides		0	0	0	0	0	0
P1501	Enchytraeidae		5	0	1	16	0	22
Q0054	Acari		0	0	1	0	1	2
R0015	Sessilia		0	0	9	56	0	65
R0068	Austrominius modestus		0	0	90	2	0	92
R0078	Amphibalanus improvisus		0	0	26	7	0	33
R0142	Copepoda		0	0	0	0	0	0
R2413	Myodocopida		0	0	0	0	0	0
S0076	Neomysis integer		0	0	0	0	0	0

Code	Station		WS1	WS2	WS3	WS4	WS5	Total
	Taxa	Notes						
S0228	Talitridae		0	1	0	0	5	6
S0481	Gammarus salinus		0	0	0	0	0	0
S0525	Melita palmata		0	0	0	0	0	0
S0590	Leptocheirus pilosus		0	0	0	0	0	0
S0616	Corophium volutator		0	0	0	0	0	0
S0792	Gnathiidae	female	0	0	0	0	0	0
S0805	Cyathura carinata		0	0	0	0	0	0
S0869	Lekanesphaera hookeri		0	1	0	0	1	2
S1102	Sinelobus vanhaareni		23	0	8	73	0	104
S1385	Crangon crangon	juvenile	0	0	0	0	0	0
S1594	Carcinus maenas		0	0	0	0	0	0
T0002	Coleoptera	larva	0	0	0	0	0	0
T0002	Chrysomelidae		0	0	0	0	0	0
T0002	Curculionidae		0	0	0	0	0	0
T0003	Diptera	larva	0	0	0	0	1	1
T0003	Chironomidae		44	1	8	8	8	69
T0003	Dolichopodidae	larva	0	0	0	0	0	0
T0004	Ephemeroptera	larva	0	0	0	0	0	0
T0005	Hemiptera	larva	0	0	0	0	0	0
T0005	Aphididae		0	0	0	0	0	0
W0385	Peringia ulvae		0	0	0	0	0	0
W1761	Magallana gigas		0	0	1	0	0	1
W2029	Limecola balthica		0	0	0	0	0	0
W2068	Scrobicularia plana		0	0	0	0	0	0
ZM0002	Rhodophyta		0	0	0	0	0	N/A
ZR0002	Phaeophyceae		0	0	0	0	0	N/A

Code	Station		WS1	WS2	WS3	WS4	WS5	Total
	Taxa	**Notes**						
ZR0376	Fucus	juvenile	0	P	P	0	0	N/A
ZR0384	Fucus vesiculosus		P	P	0	0	P	N/A
ZS0068	Urospora		0	0	P	0	0	N/A
ZS0145	Blidingia minima		P	P	P	0	P	N/A

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Appendix 11.0 Biomass data for intertidal core samples

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	Station		T01						T02									T03						T04					
	Shore Hight		Upper			Middle			Upper			Middle			Lower			Upper			Middle			Upper			Middle		
Code	Replicate		A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
C0000	Animalia	eggs																											
1	Nematoda			0.0001	0.0001								0.0001		0.0004				0.0001										
P0118	*Eteone longa*	e	0.0001																										
P0462	*Hediste diversicolor*		0.3836	0.3096	0.5512	0.2708	0.3549	0.3586	0.4412	0.4826	0.3723	0.1892	0.2093	0.1036	0.0558			0.1084	0.2941	0.4244		0.0005	0.0018	0.0098	0.0017	0.0076		0.0346	
P0471	*Alitta succinea*																0.0546												
P0494	Nephtys	juvenile																											
P0753	*Polydora cornuta*				0.0001	0.002	0.0062	0.0028			0.0002				0.0024	0.0008	0.0004						0.0006						
P0776	*Pygospio elegans*					0.0002	0.0001																						
P0798	Streblospio			0.0009	0.0022	0.0059	0.0172	0.0075	0.0001	0.001	0.0002				0.0004	0.0004					0.0001	0.0004	0.0015		0.0001				0.0001
P0917	*Heteromastus filiformis*					0.0126																							
P1294	*Manayunkia aestuarina*				0.0001																								
P1479	*Baltidrilus costatus*		0.0422	0.0181	0.1256	0.0004				0.0001		0.0035	0.0035	0.0051				0.0009	0.0067	0.01	0.0001			0.0002	0.0002	0.0029			0.0001
P1487	Tubificoides galiciensis																												
P1490	Tubificoides benedii													0.0011		0.0004				0.0001		0.0001			0.0018	0.0005			
P1494	*Tubificoides diazi*	e			0.001																			0.0001	0.0011				
P1495	*Tubificoides heterochaetus*						0.0001														0.0005							0.0008	
P1500	*Tubificoides swirencoides*																				0.0018								
P1501	Enchytraeidae			0.0001	0.0001				0.0001	0.0001					0.0004	0.0004					0.0001								
Q0054	Acari																												
R0015	Sessilia																												
R0015	*Austrominius modestus*	juvenile																											
R0068	*Amphibalanus improvisus*																												
R0078	Copepoda																												
R0142	Myodocopida																												
R2413	*Neomysis integer*																												
S0076	Talitridae																												
S0228	*Gammarus salinus*																												
S0481	*Melita palmata*						0.0066	0.0399																					
S0525	*Leptocheirus pilosus*							0.0027																					
S0590	*Corophium volutator*						0.0009																						
S0616	Gnathiidae		0.0352	0.0254	0.1201	0.0067	0.0011	0.0003	0.0219	0.1251	0.027	0.1524	0.0945	0.1788	0.0746	0.039	0.1819		0.0261	0.0113	0.004	0.0042	0.0082	0.0072	0.0159	0.0132	0.0001	0.0011	
S0792	*Cyathura carinata*	female																											
S0805	*Lekanesphaera hookeri*			0.0031		0.0213	0.0223	0.0333	0.0004	0.0061																			0.0061
S0869	*Sinelobus vanhaareni*																			0.0001									
S1102	*Crangon crangon*																												
S1385	*Carcinus maenas*	juvenile									0.0015																		
S1594	Coleoptera									0.0037																			
T0002	Chrysomelidae	larva																											
T0002	Curculionidae			0.0008																									
T0002	Diptera																												
T0003	Chironomidae	larva																											
T0003	Dolichopodidae	large																											
T0003	Ephemeroptera	larva																											
T0003	Hemiptera	pupa																											
T0003	Aphididae	larva																											
T0004	*Peringia ulvae*	larva																											
T0005	*Magallana gigas*	larva																											
T0005	*Limecola balthica*																												
W0385	*Scrobicularia plana*					0.0052		0.0011		0.0001						0.0044	0.0096												
W1761	Rhodophyta																												
W2029	Phaeophyceae																												
W2068	Fucus		1.4382						0.0634		0.1138																		
W2068	*Fucus vesiculosus*	juvenile																											
2	Urospora																												
2	*Blidingia minima*	?																											
6	Fucus	juvenile																											
4	Fucus vesiculosus																												
ZS0068	Urospora																												
ZS0145	Blidingia minima																												

	Station	T05						T06									T07						c					
	Shore Hight	Upper			Middle			Upper			Middle			Lower			Upper			Middle			Upper			Middle		
Code	Replicate	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
C0000	Animalia																											
1	Nematoda	0.0008	0.0005	0.0005	0.0004	0.0001		0.0001	0.0001	0.0001	0.0008	0.004	0.002			0.0016	0.0001	0.0001	0.0001	0.0004	0.002	0.0001					0.0001	
P0118	*Eteone longa*		0.0024						0.0007																			
P0462	*Hediste diversicolor*	0.1616	0.1529	0.2502	0.1591	0.1296	0.0608	0.4197	0.3842	0.3559	0.254	0.5052	0.4969	0.0239	0.0032	0.0559	0.0541	0.2483	0.129			0.035						
P0471	*Alitta succinea*																											
P0494	Nephtys																						0.0009					
P0753	*Polydora cornuta*													0.0064	0.0028	0.002												
P0776	*Pygospio elegans*																										0.0009	0.0008
P0798	Streblospio	0.0024	0.0059	0.0016			0.0008	0.0003	0.0084	0.0006			0.0016	0.0048	0.0032	0.0036												
P0917	*Heteromastus filiformis*																										0.0001	
P1294	*Manayunkia aestuarina*																											
P1479	*Baltidrilus costatus*	0.0064	0.0072	0.0081				0.0167	0.0529	0.0272								0.0006	0.0001		0.0016	0.0002	0.0002	0.0001			0.0001	
P1487	Tubificoides galiciensis																											0.0006
P1490	Tubificoides benedii																			0.0004	0.0084	0.0007					0.0005	0.0009
P1494	*Tubificoides diazi*																											0.0001
P1495	*Tubificoides heterochaetus*																											
P1500	*Tubificoides swirencoides*																											
P1501	Enchytraeidae	0.0008	0.0004	0.0011						0.0001	0.002	0.0048	0.0016	0.0032	0.0016			0.0001	0.0001		0.0024	0.0001					0.0001	
Q0054	Acari																											
R0015	Sessilia																											
R0015	*Austrominius modestus*																											
R0068	*Amphibalanus improvisus*																											
R0078	Copepoda																											
R0142	Myodocopida		0.0004																		0.0004							
R2413	*Neomysis integer*																								0.0001			
S0076	Talitridae				0.0077									0.0512														
S0228	*Gammarus salinus*																											
S0481	*Melita palmata*																											
S0525	*Leptocheirus pilosus*																											
S0590	*Corophium volutator*																											
S0616	Gnathiidae	0.0853	0.1145	0.1401	0.1279	0.1049	0.1508	0.0542	0.0932	0.0581	0.2808	0.4563	0.9427	0.031	0.0039	0.0139	0.0837	0.3818	0.0861	0.0004		0.007	0.0008	0.0001	0.0002	0.0029	0.0306	0.0143
S0792	*Cyathura carinata*																						0.0001					
S0805	*Lekanesphaera hookeri*			0.0086		0.0168	0.017			0.0036	0.0896	0.1579	0.0625	0.0996	0.0594	0.014	0.0042	0.0126	0.0335									0.0001
S0869	*Sinelobus vanhaareni*																											
S1102	*Crangon crangon*																											
S1385	*Carcinus maenas*																											
S1594	Coleoptera																											
T0002	Chrysomelidae										0.0104																	
T0002	Curculionidae																											
T0002	Diptera					0.0009																						
T0003	Chironomidae																											
T0003	Dolichopodidae																											
T0003	Ephemeroptera																											
T0003	Hemiptera																											
T0003	Aphididae																0.0001											
T0004	*Peringia ulvae*															0.0001												
T0005	*Magallana gigas*							0.0026																0.0003				
T0005	*Limecola balthica*									0.0001																		
W0385	*Scrobicularia plana*																	0.0013				0.0007						
W1761	Rhodophyta																											
W2029	Phaeophyceae									0.0025																		
W2068	Fucus	0.0443				1.1926																						
W2068	*Fucus vesiculosus*																							0.0001				
2	Urospora																											
2	*Blidingia minima*																											
6	Fucus																											
4	Fucus vesiculosus																											
ZS0068	Urospora																											
ZS0145	Blidingia minima																											

Appendix 12.0 Biomass data for wall scrape samples

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			Station				
Code	**Taxa**		**WS1**	**WS2**	**WS3**	**WS4**	**WS5**
C0000	Animalia	eggs					
HD0001	Nematoda						
P0118	*Eteone longa*	aggregate					
P0462	*Hediste diversicolor*						
P0471	*Alitta succinea*						
P0494	Nephtys	juvenile					
P0753	*Polydora cornuta*						
P0776	*Pygospio elegans*						
P0798	Streblospio						
P0917	*Heteromastus filiformis*						
P1294	*Manayunkia aestuarina*						
P1479	*Baltidrilus costatus*						
P1487	Tubificoides galiciensis						
P1490	Tubificoides benedii						
P1494	*Tubificoides diazi*	aggregate					
P1495	*Tubificoides heterochaetus*						
P1500	*Tubificoides swirencoides*						
P1501	Enchytraeidae		0.0002		0.0001	0.0007	
Q0054	Acari				0.0001		0.0001
R0015	Sessilia						
R0015	*Austrominius modestus*	juvenile					
R0068	*Amphibalanus improvisus*						
R0078	Copepoda						
R0142	Myodocopida						
R2413	*Neomysis integer*						
S0076	Talitridae						
S0228	*Gammarus salinus*			0.0012			0.0116
S0481	*Melita palmata*						
S0525	*Leptocheirus pilosus*						
S0590	*Corophium volutator*						
S0616	Gnathiidae						
S0792	*Cyathura carinata*	female					
S0805	*Lekanesphaera hookeri*						
S0869	*Sinelobus vanhaareni*			0.0034			0.0014

			Station				
Code	**Taxa**		**WS1**	**WS2**	**WS3**	**WS4**	**WS5**
S1102	*Crangon crangon*		0.0071		0.0011	0.0136	
S1385	*Carcinus maenas*	juvenile					
S1594	Coleoptera						
T0002	Chrysomelidae	larva					
T0002	Curculionidae						
T0002	Diptera						
T0003	Chironomidae	larva					0.002
T0003	Dolichopodidae	large			0.0009		
T0003	Ephemeroptera	larva	0.0031				0.0008
T0003	Hemiptera	pupa	0.0001	0.0001		0.0012	
T0003	Aphididae	larva					
T0004	*Peringia ulvae*	larva					
T0005	*Magallana gigas*	larva					
T0005	*Limecola balthica*						
W0385	*Scrobicularia plana*						
W1761	Rhodophyta				4.1293		
W2029	Phaeophyceae						
W2068	Fucus						
W2068	*Fucus vesiculosus*	juvenile					
ZM0002	Urospora						
ZR0002	*Blidingia minima*	?					
ZR0376	Fucus	juvenile					
ZR0384	Fucus vesiculosus						
ZS0068	Urospora						
ZS0145	Blidingia minima						

Appendix 13.0 SIMPER analysis results

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Intertidal samples: Analysis results

SIMPER
Similarity Percentages - species contributions

One-Way Analysis

Data worksheet
Name: SqRt_Transform
Data type: Abundance
Sample selection: All
Variable selection: All

Parameters
Resemblance: S17 Bray Curtis similarity
Cut off for low contributions: 90.00%

Simprof groups allocated to each station

Sample	SIMPROF
1 UP	e
2 UP	e
2 MID	e
2 LOW	e
5 UP	e
5 MID	e
6 UP	e
6 MID	e
6 LOW	e
7 UP	e
1 MID	b
3 UP	d
4 UP	d
3 MID	f
4 MID	f
8 UP	f
7 MID	a
8 MID	c

Group a
Less than 2 samples in group

Group b
Less than 2 samples in group

Group c
Less than 2 samples in group

Group d
Average similarity: 70.69

Species	Av.Abund	Av.Sim	Sim/SD*	Contrib%	Cum.%
Corophium volutator	7.02	31.37	-	44.37	44.37
Baltidrilus costatus	5.64	18.92	-	26.76	71.13
Hediste diversicolor	4.62	15.68	-	22.18	93.31

*Unable to calculate with only two samples in group

Group e
Average similarity: 55.42

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Corophium volutator	21.56	29.64	2.88	53.48	53.48
Hediste diversicolor	6.76	9.52	2.96	17.18	70.66
Streblospio	4.53	3.93	1.06	7.09	77.75
Enchytraeidae	4.98	3.59	0.91	6.48	84.23
Nematoda	4.28	3.44	1.52	6.2	90.43

Group f
Average similarity: 35.94

Species	Av.Abund	Av.Sim	Sim/SD	Contrib%	Cum.%
Corophium volutator	2.76	20.87	5.68	58.08	58.08
Tubificoides heterochaetus	1.15	4.69	0.58	13.06	71.14
Baltidrilus costatus	0.8	3.83	0.58	10.67	81.8
Hediste diversicolor	1.05	3.83	0.58	10.66	92.46