AQUIND Limited

AQUIND INTERCONNECTOR

Environmental Statement – Volume 3 – Appendix 7.3 Contaminated Sediment Survey Report

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(a)

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

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1 CONTAMINATED SEDIMENT SURVEY

1.1 INTRODUCTION

1.1.1. This document presents the results of the contaminated sediment survey and analysis undertaken for the UK marine sector of the AQUIND Interconnector (the 'Proposed Development').

BACKGROUND

1.1.2. Chemicals released into the marine environment as a result of human activities can be persistent, toxic to flora and fauna, and can bioaccumulate up the food chain. Due to the vast array of substances it is highly probable that ecosystems are impacted simultaneously by more than one chemical. The effects on biota can be sub-lethal or lethal and can act through a variety of pathways including endocrine disruption and interfering with metabolic activity.

1.1.3. A variety of harmful substances, including heavy metals, poly-aromatic hydrocarbons ('PAHs'), poly-chlorinated biphenyls ('PCBs') and organotins (e.g. Tributyltin ('TBT') and Dibutyltin ('DBT')), can be retained in sea floor sediments over long time periods. Disturbance of the seabed can release these contaminants into the water column increasing the likelihood of them impacting on biological communities. The degree of contamination and impact will depend on the type and degree of contamination already present and the level of disturbance to the sea floor.

METALS

1.1.4. Contamination of the marine environment with metals can have lethal and sub-lethal effects on fauna depending on concentrations present. Measurement of environmental levels of metals in the sediments is not sufficient to determine toxicity to fauna although metals have been shown to reduce the faunal diversity in sedimentary habitats and adversely affect community structure (Hall *et al.*, 1996).

1.1.5. Some metals such as copper are known to be acutely toxic to invertebrate groups e.g. crustaceans, and as such are used in anti-fouling paints replacing TBTs. Some taxa such as the polychaete *Capitella capitata* and oligochaete *Tubificoides benedii* can show tolerance to metal contamination, and in some cases heritable tolerance has been demonstrated (Grant *et al*., 1989).

POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)

1.1.6. PAHs are persistent organic compounds which are both stable and toxic in the marine environment. PAHs are potential mutagens and carcinogens in marine organisms and humans. They can also bioaccumulate in marine organisms, particularly invertebrates such as bivalves which provide a prey source for fish, birds, marine mammals and humans. Fish can excrete PAH faster than other organisms such as bivalves, and as such, do not bioaccumulate them in the same way (OSPAR, 2004a). However, sub-lethal toxic effects have been observed such as growth reduction, chronic diseases and reproductive impairment (OSPAR, 2004a).

POLY-CHLORINATED BIPHENYLS (PCBS)

1.1.7. PCBs have been present as contaminants in the marine environment for over 60 years. Although the manufacture of materials containing PCBs was banned in 1986, they are persistent chemicals which occur in nearly all marine habitats and organisms and due to their persistence and lipid solubility they can bioaccumulate. Sources of PCBs to the marine environment during the height of their manufacture and use included aerial deposition, ocean dumping, wastewater discharge, vessel coatings, rainfall, and surface runoff (Parnell *et al.,* 2008). Due to the hydrophobic nature of these compounds huge amounts have sedimented to the sea floor adsorbed to organic particles (Magnusson *et al.,* 2006). Marine sediments will therefore continue to serve as secondary sources of these contaminants, both to the benthic communities inhabiting them and to other organisms through food web transfer (Magnusson *et al.,* 2006). For PCBs entering the marine environment, bottom sediments are the ultimate repository where they may become a source for uptake by marine organisms through direct or indirect contact or, for filter-feeders, by ingestion; however, information about their impact on benthic species is relatively scarce (Danis *et al.,* 2003).

1.1.8. PCBs act as endocrine disrupting chemicals in marine organisms and can cause disruption to reproduction and immunodeficiency in marine mammals. PCBs have been shown to be lethally toxic to fish in laboratory studies and can cause lesions, reproductive problems and liver damage in humans (OSPAR, 2004b).

ORGANOTINS

1.1.9. Organotins, such as the biocide TBT, were used to reduce fouling on marine structures and vessels. Their use was banned on vessels under 25 m in 1987 and on all vessels in 2008. Restrictions on the use of TBT were brought in as the toxic effects it had on target organisms were beginning to be detected in non-target organisms. One of the effects of TBT is imposex, the development of male sex organs in female marine invertebrates. To date, imposex due to TBTs has been reported in 150 species and toxicity can occur at very low concentrations (Smith *et al.,* 2006).

1.2 SAMPLE COLLECTION

1.2.1. A total of ten sampling stations were used for the contaminated sediment survey, as part of the benthic survey (see Appendix 8.1 for further details). These were spaced along the benthic survey area (Figure 1), which is defined as 500 m either side of the marine cable corridor.

1.2.2. It should be noted that sample collection was undertaken during earlier design iterations of the Project and at the time, the marine cable corridor followed a slightly different route, and an East Wittering landfall option was being considered. Stations 5 – 7 were selected in order to sample this landfall option (Figure 2), which has since been dropped from the design.

1.2.3. Surface samples were collected using a 0.1 m^2 day grab. After a visual assessment of the sediment was made (Annex 1), samples from the day grab were taken from the surface of the sediment in the grab; avoiding the edges of the grab and any anoxic layer (a note of the sample depth was made). Samples were transferred to containers provided by the laboratory. Samples were frozen as soon as possible after being taken and remained frozen until analysis.

1.3 SAMPLE ANALYSIS

1.3.1. Sample analysis was conducted by Socotech UK Limited, within a laboratory validated by the MMO (2018a)[1] for analysis of inorganics (including Trace Metals), organotins (Tributyltin and dibutylin), polychlorinated biphenyls (PCBs), total hydrocarbon content ('THC'), polycyclic aromatic hydrocarbons (PAHs), organochlorine pesticides ('OCP's) and Total Organic Carbon ('TOC').

1.3.2. Analysis conformed to MMO guidance for the analysis of chemical determinands (MMO, 2018b)[2]. Upon completion of the survey, samples were stored frozen in glass containers for 22 days, and were presented to the Socotech lab on the 30th of August 2018 in satisfactory condition for analysis, as determined by Socotech. Consultation queries on this analysis is presented in Appendix 7.2 (Marine Water and Sediment Quality Consultation Responses) of the ES Volume 3 document reference 6.3.7.2 and the Consultation Report, document reference 5.1.

1.3.3. Samples were analysed for contaminants as listed in Table 1. In line with Cefas guidance (Marine Assessment and Review Group ('MARG'), 2010), analysis was performed on whole samples, rather than the lowest fraction, and the methods of analysis followed the procedures outlined in the Green Book (MARG, 2010), and included the relevant Certified Reference Material ('CRM') 2702 and Quality Control (blank) samples.

Table 1: Contaminants that the sediment samples were tested for in line with Cefas guidelines

Matrix	Determinant	Sample and Fraction Size	Method Summary
Metals (Sieving <63 µm)	Arsenics, Cadmium, Chromium, Copper, Mercury, Nickle, Lead, Zinc	Air dried and sieved	Aqua Regia acid extraction followed by ICP analysis.
Organotins	DBT and TBT	Wet Sediment	Solvent extraction and clean up followed by GC-MS analysis.

[1] https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans
[2] https://www.gov.uk/government/publications/marine-licensing-physical-and-chemical-determinands-for-sediment-sampling/chemical-determinands

Matrix	Determinant	Sample and Fraction Size	Method Summary
PAHs	PDTI2-6 ring aromatics + EPA 16	Wet Sediment	Solvent extraction and clean up followed by GC-FID analysis.
Hydrocarbon	Total content incl. saturates	Wet Sediment	Solvent extraction and derivatisation followed by GC-MS analysis.
PCBs	ICES 7 (28, 52, 101, 118, 138, 153, 180)	Air dried and sieved to <2mm	Solvent extraction and clean up followed by GC-MS-MS analysis.

1.3.4. Contamination levels in sediments were compared against the Cefas Action Levels and OSPAR Quality Guidelines to determine the likelihood of biological impact.

1.3.5. Cefas Action levels are defined below:

- Action Level 1 ('AL1') - contaminants in the sediments below this level are generally of no concern and are unlikely to influence the licensing decision about sea disposal.
- Action Levels 1 and 2 ('ALs 1 and 2') **-** contamination in sediments between levels requires further consideration and testing before a decision can be made about sea disposal.
- Above Action Level 2 ('AL2') - contamination above this level is generally considered unsuitable for sea disposal.

1.3.6. For the OSPAR guidelines two assessment criteria are used to assess the status for metal concentrations in the sediment:

- Background Assessment Concentration ('BAC')
- Effects Range Low ('ERL')

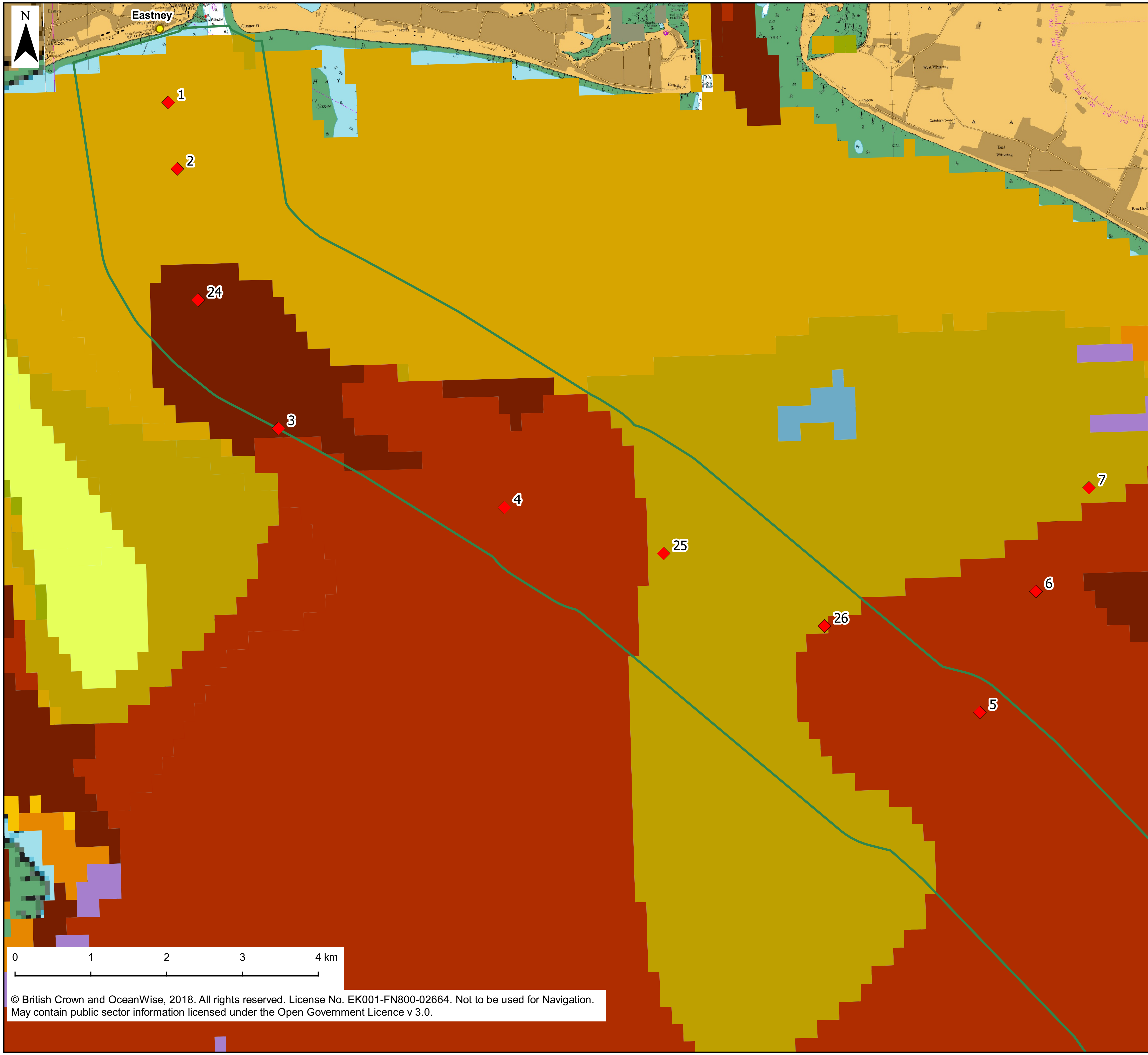
1.3.7. When the mean concentrations are slightly below the BAC level they are said to be near background levels, while concentrations that are below the ERL level are found to rarely cause adverse effects on marine organisms.

1.3.8. Table 2 sets out the relevant thresholds for each contaminant tested.

Table 2: Summarised combination of Cefas Action levels for Metals, PAH, Organotins and PCBs in Sediments (MMO, 2015)

Contaminant Group	Contaminant	Units	Action Level 1 (AL1)	Action Level 2 (AL2)	Background Assessment Concentration (BAC)	Effects Range Low (ERL)
Metals	Arsenic	mg/kg	20	100	25	8.2
	Cadmium	mg/kg	0.4	5	0.31	1.2
	Chromium	mg/kg	40	400	81	81
	Copper	mg/kg	40	400	27	34
	Mercury	mg/kg	0.3	3	0.07	0.15
	Nickel	mg/kg	20	200	36	21
	Lead	mg/kg	50	500	38	47
	Zinc	mg/kg	130	800	122	150
Organotin	TBT	µg/kg	100	1000	***	***
PCBs	PCBs ∑ICES7	µg/kg	10			
Hydrocarbons	∑16PAH	µg/kg	3712	12760		
	Lindane	µg/kg				
	Dieldrin	µg/kg	5			

***As yet levels not agreed upon



AQUIND Interconnector
- Landfall location
- Benthic survey area
- Contaminated sediment sampling station

EMODnet (2016) habitats - EUNIS code and description
- A3.1 - High energy infralittoral rock
- A3.2 - Moderate energy infralittoral rock
- A4.1 - High energy circalittoral rock
- A5.13 - Infralittoral coarse sediment
- A5.14 - Circalittoral coarse sediment
- A5.23 or A5.24 - Infralittoral fine sand or infralittoral muddy sand
- A5.25 or A5.26 - Circalittoral fine sand or circalittoral muddy sand
- A5.33 - Infralittoral sandy mud
- A5.33 or A5.34 - Infralittoral sandy mud or infralittoral fine mud
- A5.35 - Circalittoral sandy mud
- A5.44 - Circalittoral mixed sediments

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.

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01	20/11/2018	GR	FIRST DRAFT	SM	AW

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CLIENT: AQUIND

PROJECT: AQUIND Interconnector

TITLE: Figure 1 Contaminated Sediment Sampling Stations within the Benthic Survey Area

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PROJECT NO: EN020022	DESIGNED: MG	DRAWN: GR	DATE: 03/12/2018

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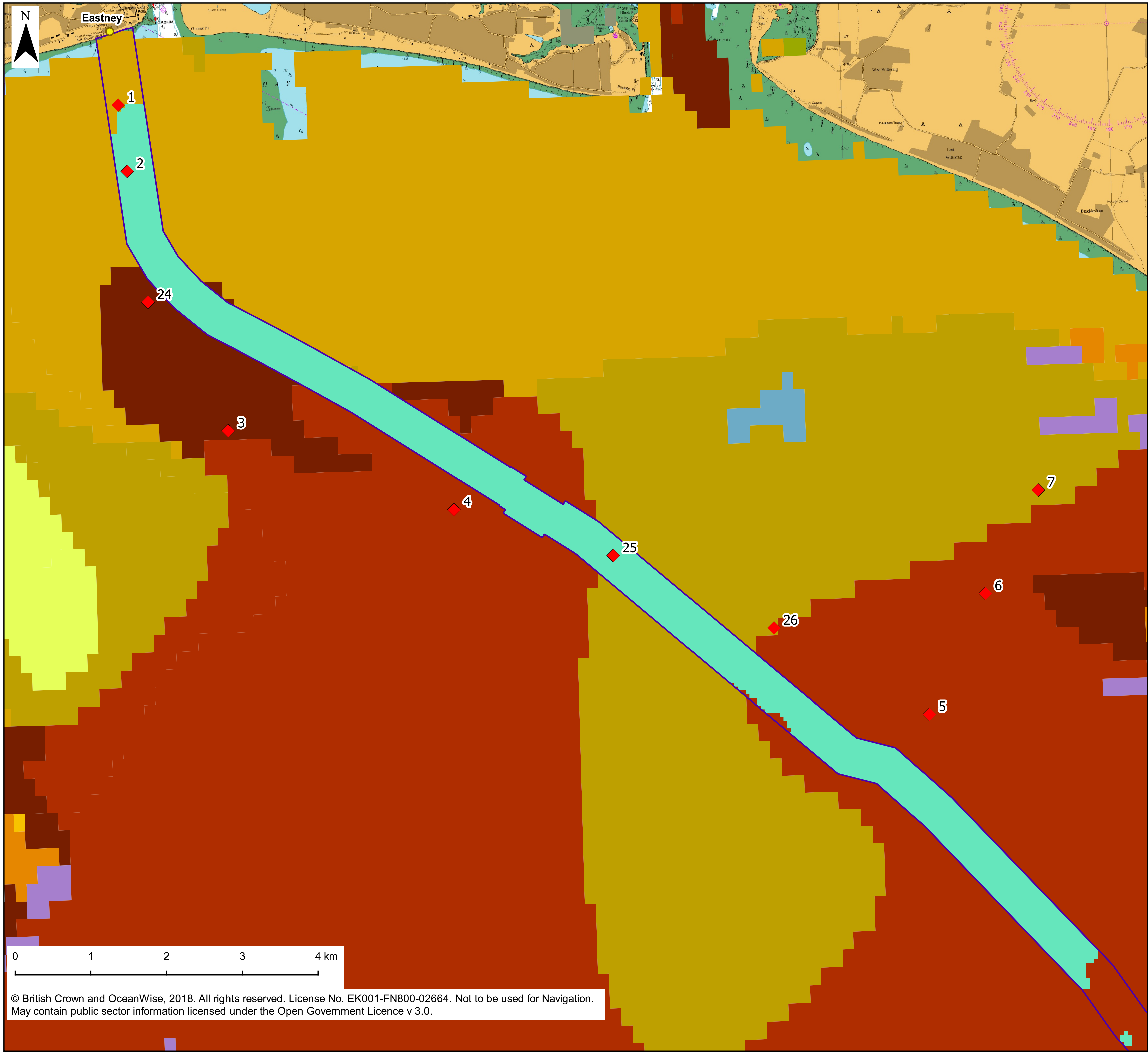
REV.NO. 02



AQUIND Interconnector
- Landfall location
- Marine Cable Corridor*
- Contaminated sediment sampling station

Geophysical interpretation - EUNIS code and description
- A5.14 - Circalittoral coarse sediment
- A5.23 - Infralittoral fine sediment
- A5.43 - Infralittoral mixed sediment

EMODnet (2016) habitats - EUNIS code and description
- A3.1 - High energy infralittoral rock
- A3.2 - Moderate energy infralittoral rock
- A4.1 - High energy circalittoral rock
- A5.13 - Infralittoral coarse sediment
- A5.14 - Circalittoral coarse sediment
- A5.23 or A5.24 - Infralittoral fine sand or infralittoral muddy sand
- A5.25 or A5.26 - Circalittoral fine sand or circalittoral muddy sand
- A5.33 - Infralittoral sandy mud
- A5.33 or A5.34 - Infralittoral sandy mud or infralittoral fine mud
- A5.35 - Circalittoral sandy mud
- A5.44 - Circalittoral mixed sediments

*Marine Cable Corridor clipped to MHWS

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PROJECT: AQUIND Interconnector

TITLE: Figure 2 Contaminated Sediment Sampling Stations and the Marine Cable Corridor

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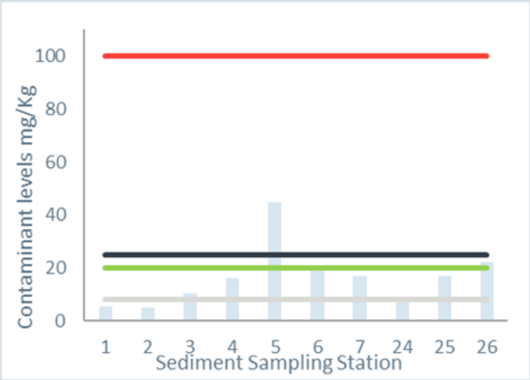
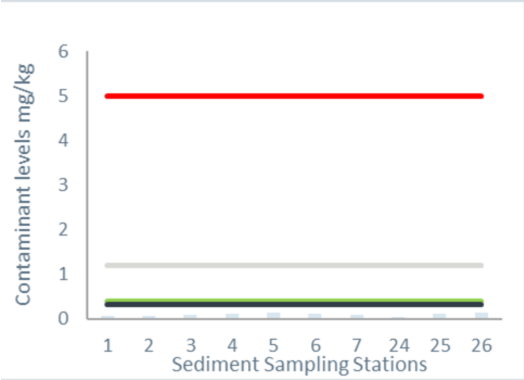
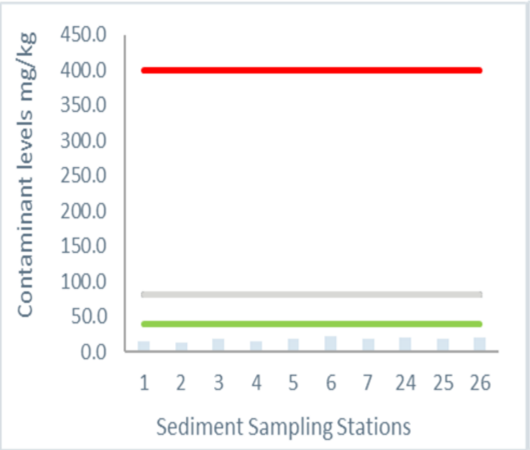
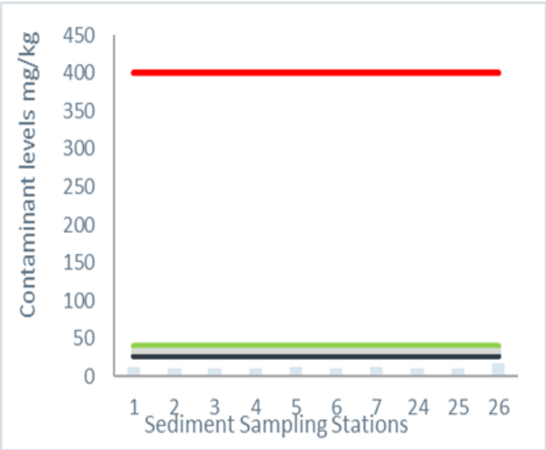
1.4 RESULTS

METAL CONTAMINATION

1.4.1. Sample analysis indicated that for a single metal (arsenic), two sampling stations slightly exceeded Cefas AL1, with one of these sampling stations exceeding the OSPAR BAC level (Figure 3A). While these samples are within the Benthic Survey Area (Figure 1), neither is within the marine cable corridor (Figure 2). The levels for all the remaining metals were generally low, falling below OSPAR and Cefas levels, and no metal concentrations in any sample exceeded AL2. (Figure 3B-H).

Key: CEFAS AL1 | CEFAS AL2 | OSAPR BAC | OSPAR ERL

A) Arsenic	B) Cadmium
	
C) Chromium	**D) Copper**
	

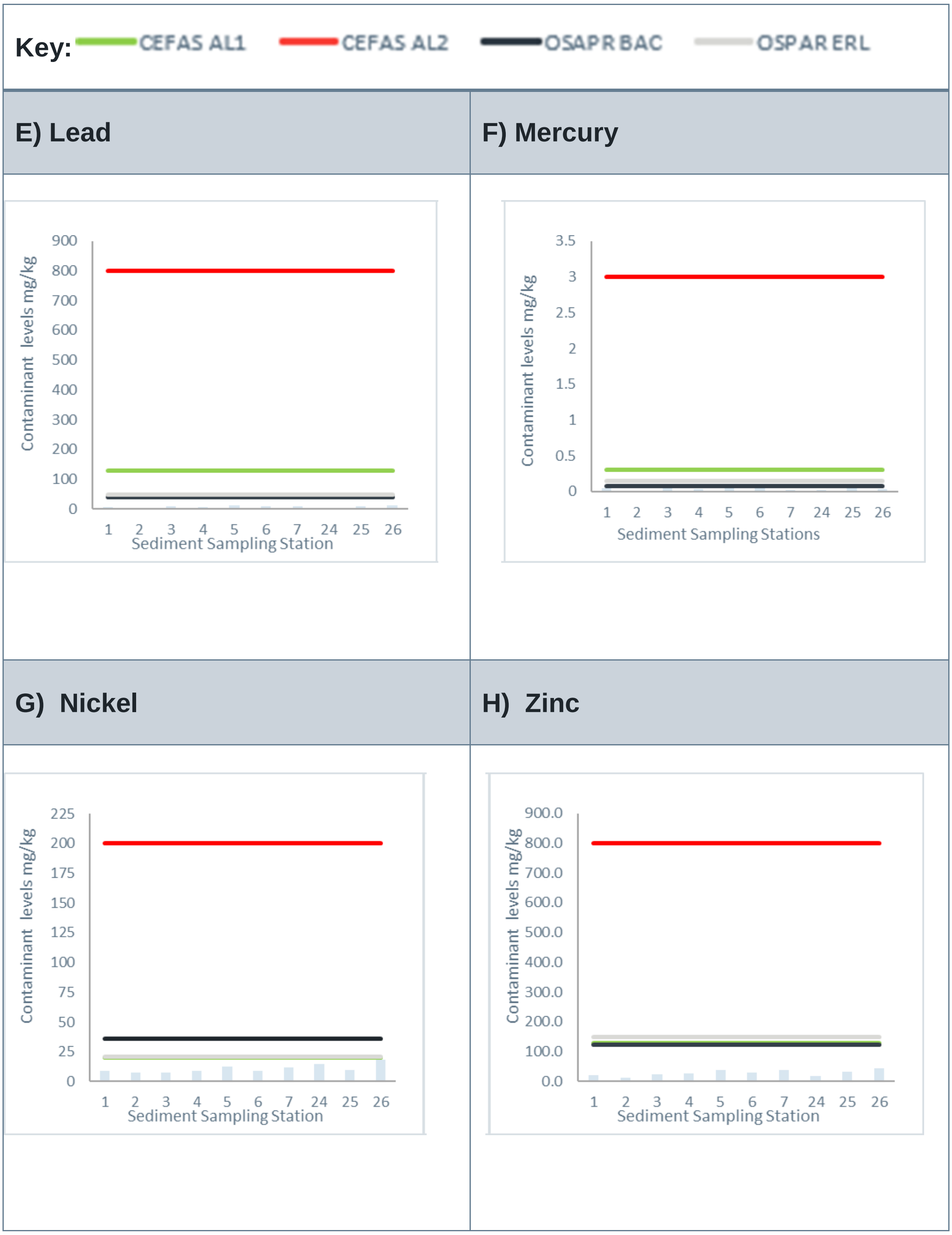
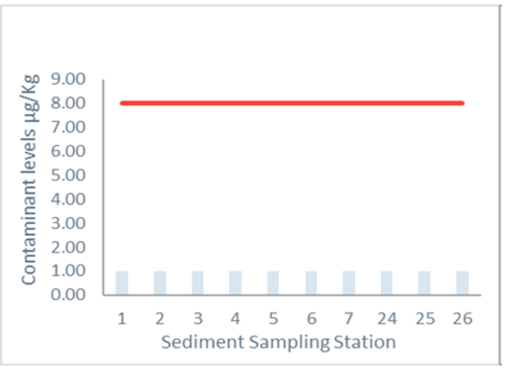
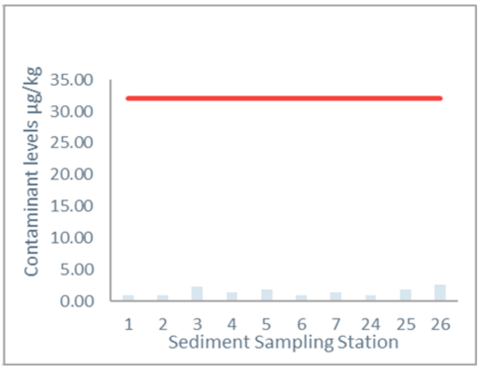
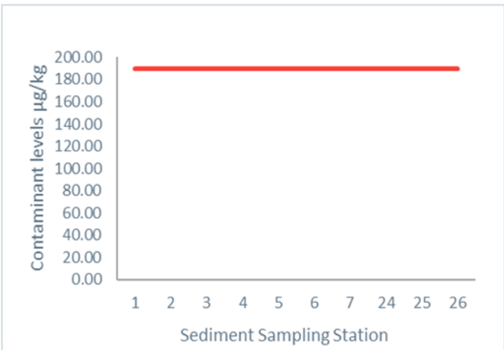
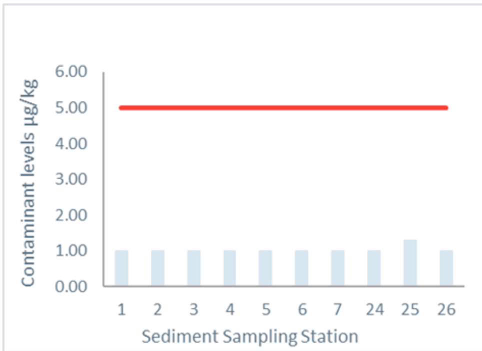


Figure 3: A-H - Metal contaminant levels for all stations sampled

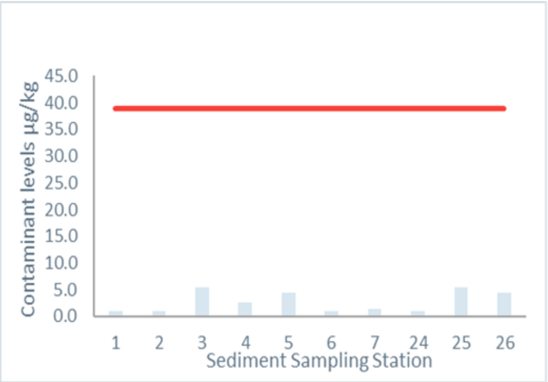
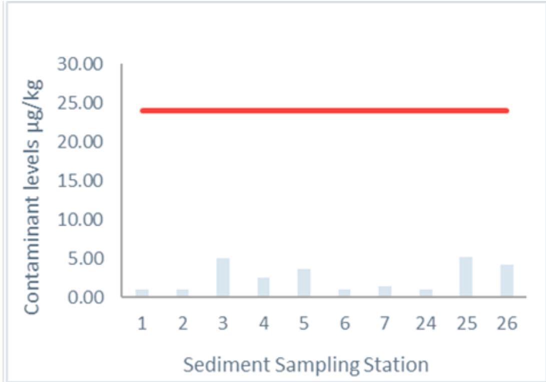
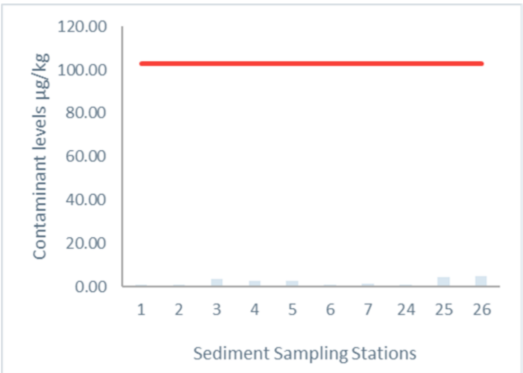
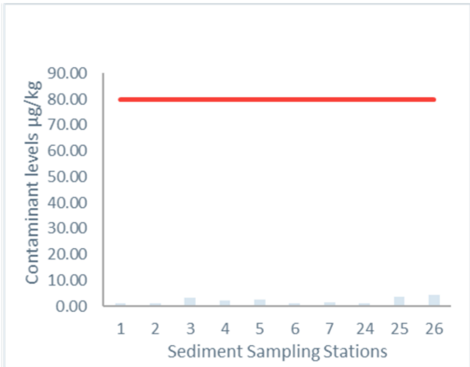
PAH CONTAMINATION

1.4.3. At no stations were Cefas Action levels for PAH exceeded (Figure 4A-M).

Key: BAC

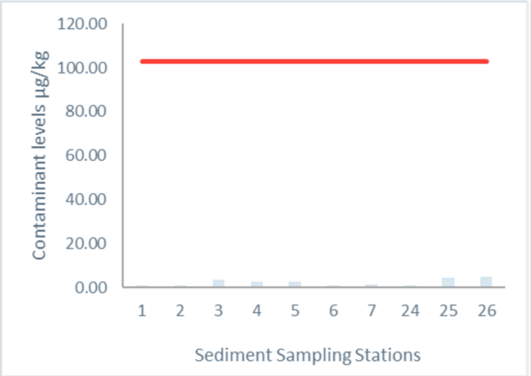
A) Naphthalene	B) Phenethrene
	
C) Dibenzohiophene	**D) Anthracene**
	

Key: BAC

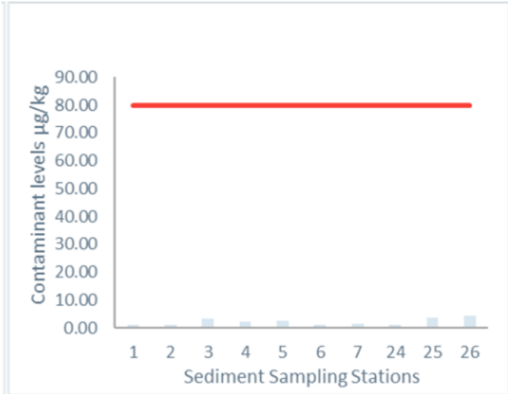
E) Fluoranthene	F) Pyrene
	
G) Indeno[123-cd]pyrene	**H) Benzo[ghi]perylene**
	

Key: BAC

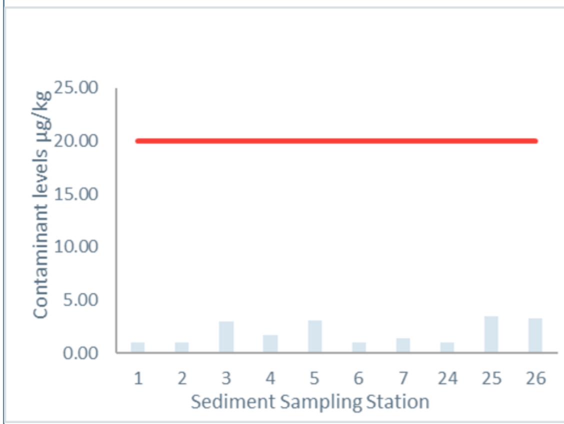
I) Indeno[123-cd]pyrene



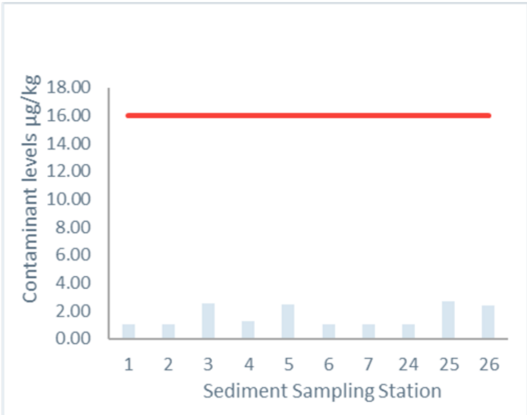
J) Benzo[ghi]perylene



K) Chrysene



L) Benzo[a]anthracene



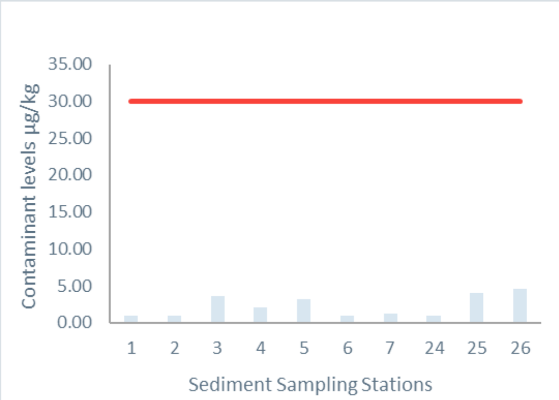
Key: —— BAC	
M) Benzo[o]pyrene	
	

Figure 4: A – M - PAH levels

PCB CONTAMINATION

1.4.4. As yet there are no thresholds or action levels set for individual PCBs. There are standards for total PCBs for the sum of 25 congeners and the sum of ICES 7 PCBs (Figure 5). The majority of the PCBs were below the limit of detection (0.08 µg/kg). At no sampling station were any of the Cefas Action Levels exceeded for total (sum of ICES 7) PCBs.

Table 3: Concentrations of PCBs in sediment samples (µg/kg)

		Sampling station									
		1	2	3	4	5	6	7	24	25	26
PCB	28	0.16	0.11	0.20	0.22	0.19	0.22	0.11	0.26	0.15	0.29
	52	0.13	0.08	0.16	0.22	0.15	0.17	0.09	0.22	0.11	0.27
	101	<0.08	<0.08	<0.08	0.16	<0.08	<0.08	<0.08	0.10	<0.08	0.13
	118	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
	138	<0.08	<0.08	<0.08	0.17	<0.08	<0.08	<0.08	<0.08	<0.08	0.09
	153	<0.08	<0.08	<0.08	0.23	<0.08	<0.08	<0.08	<0.08	<0.08	0.11
	180	<0.08	<0.08	<0.08	0.18	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08

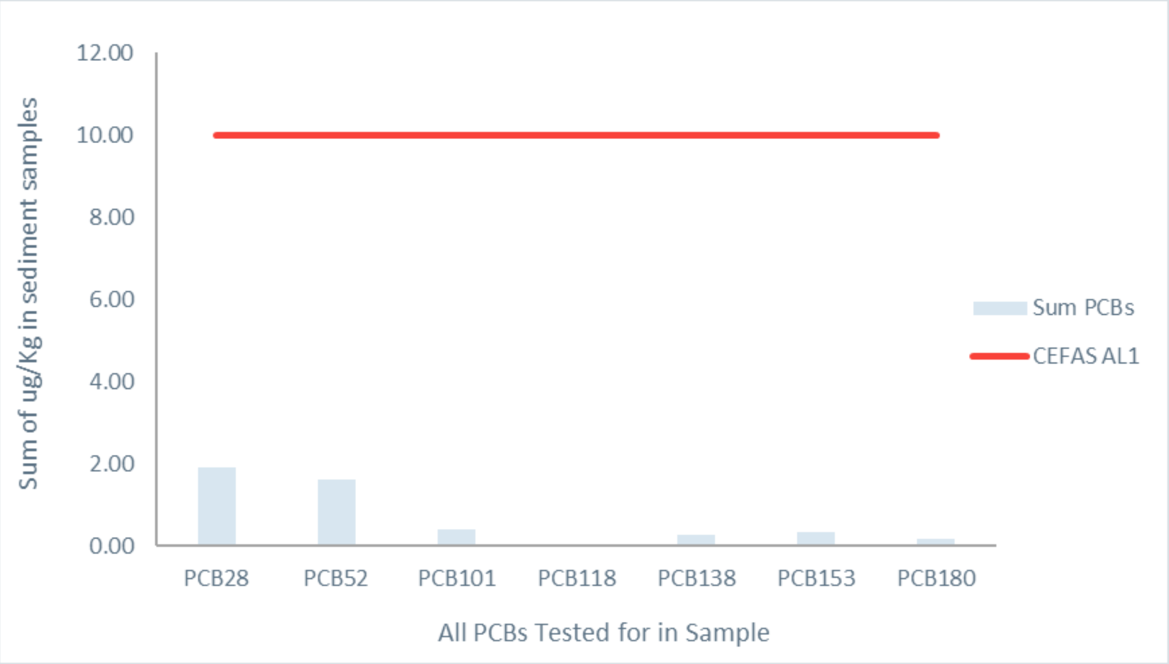


Figure 5: The sum of all PCBs within samples

ORGANOTIN CONTAMINATION

1.4.5. At all sampling stations the organotin compounds (DBT and TBT) were below the limits of detection (i.e. < 1µg/kg) and did not exceed AL1.

1.5 DISCUSSION

1.5.1. Results from the subtidal contaminant survey indicate that none of the locations have contaminant concentrations of concern (i.e. above Cefas AL2). However, two sampling stations (5 and 26) had contaminant levels above Cefas AL1 for Arsenic (Figure 3A). As stated, while these stations were within the Benthic Survey Area (Figure 1), neither is within the marine cable corridor (Figure 2). Therefore, the stations are unlikely to be disturbed during works associated with the Proposed Development. The remaining eight sampling stations had contaminant levels either below the level of detection or below Cefas AL1.

1.5.2. It should also be noted that despite the long history of port, heavy shipping, and military activity in the wider area, evidence from the nearby IFA2 interconnector (IFA2, 2016) suggests that the area is not heavily contaminated. IFA2 is situated at a minimum distance of less than half a km west of the Marine Cable Corridor, and also passes through the Solent. Contaminated sediment surveys undertaken for IFA2 detected arsenic at two sites, located approximately 10 km west of the Marine Cable Corridor, and measurable amounts of DBT and TBT at the mouth of Southampton Water (IFA2, 2016).

1.5.3. Rampion Offshore Wind Farm (E.ON, 2012) is located approximately 9 km to the east, in a similar sediment type to the Proposed Development. No contamination levels exceeded AL2 for any contaminant (E.ON, 2012). Tributyltin and hydrocarbons were all below levels of detection and heavy metals concentrations levels were of no concern apart from one sampling station in the whole array which was deemed to be an isolated contamination event. This station had elevated levels of arsenic, chromium and nickel but again were still well below CEFAS AL2.

1.5.4. Therefore, while both projects recorded instances of slight elevation in certain contaminants, there were no instances of any contaminant exceeding Cefas AL2, i.e. unsafe levels of contamination for the sediment and surrounds. When levels were compared between the survey areas for the three developments (AQUIND Interconnector, IFA2 interconnector and Rampion Offshore Wind Farm) the contaminant levels for the marine cable corridor were found to be significantly lower than either IFA2 or Rampion, which are both located closer to industrial ports/historic dumping grounds.

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ANNEX A

GRAB SAMPLE PHOTOS

(A) Grab Station: 01

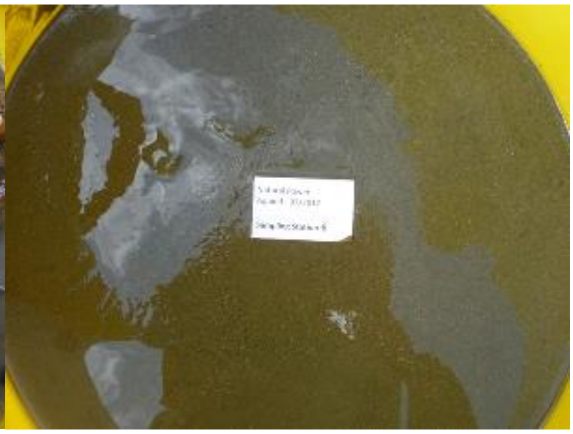
(B) Grab Station: 02

(C) Grab Station: 03

(D) Grab Station: 04

(E) Grab Station: 05

(F) Grab Station: 06



(G) Grab Station: 07

(H) Grab Station: 24

(I) Grab Station: 25

(J) Grab Station: 26 *

*(Label showing RE12-Reviewed Station)

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