KEEPING BRITAIN TRADING

IMMINGHAM EASTERN RO-RO TERMINAL

Environmental Statement: Volume 3
Appendix 8.1: Water Framework Directive Compliance Assessment
Document Reference: 8.4.8

APFP Regulations 2009 – Regulation 5(2)(a) and 5(2)(e)
PINS Reference – TR030007

February 2023

Associated British Ports

Immingham Eastern Ro-Ro Terminal

Environment Statement:
Appendix 8.1: Water Framework Directive Compliance Assessment

February 2023





Innovative Thinking - Sustainable Solutions

Page intentionally left blank

Immingham Eastern Ro-Ro Terminal

Environment Statement:
Appendix 8.1: Water Framework Directive Compliance Assessment

February 2023

Document Information

Document History and Authorisation	
Title	Immingham Eastern Ro-Ro Terminal
	Environment Statement: Appendix 8.1: Water Framework Directive Compliance Assessment
Commissioned by	Associated British Ports
Issue date	February 2023
Document ref	R.3890 (Appendix 8.1))
Project no	R/5035/8

Date	Version	Revision Details
10/02/2023	1	

Suggested Citation

ABPmer, (2023). Immingham Eastern Ro-Ro Terminal, Environment Statement: Appendix 8.1: Water Framework Directive Compliance Assessment, ABPmer Report No. R.3890 (Appendix 8.1). A report produced by ABPmer for Associated British Ports, February 2023.

Authors

ABPmer

ABPmer
Quayside Suite, Medina Chambers, Town Quay, Southampton, Hampshire SO14 2AQ
T: +44 (0) 2380 711844 W: http://www.abpmer.co.uk/

Contents

Figure

Tables

1 Introduction

1.1 Introduction

1.1.1 ABPmer was commissioned by Associated British Ports (ABP) to undertake a Water Framework Directive (WFD) compliance assessment to determine whether the proposed Immingham Eastern Ro-Ro Terminal (IERRT) complies with the objectives of the WFD. The information presented in this appendix, together with the Environmental Statement (ES) provided in Volume 1 (Application Document Reference number 8.2), will support the application for a Development Consent Order (DCO). Figure 1 shows the location of the proposed works and surrounding WFD water bodies.

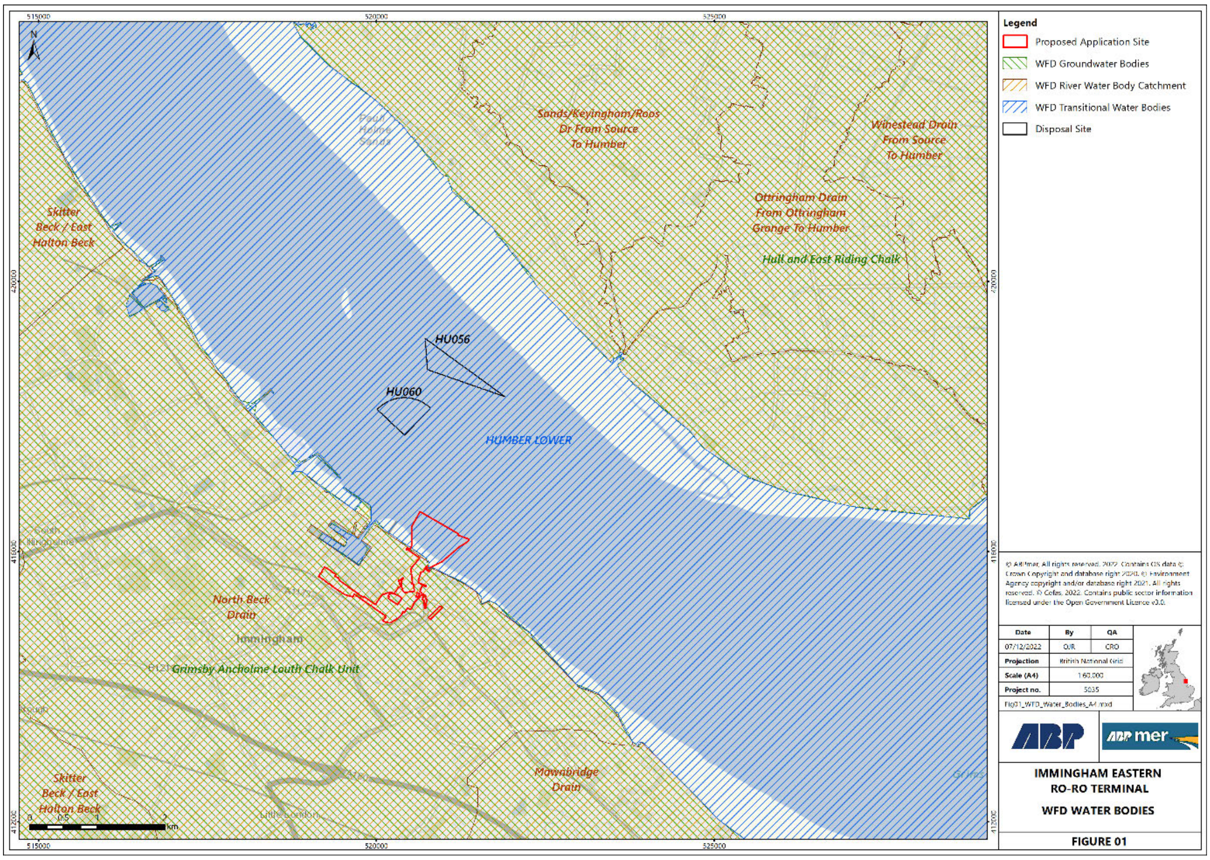

Figure 1. Location of the proposed development and surrounding WFD water bodies

1.2 Water Framework Directive

1.2.1 The WFD (2000/60/EC) came into force in 2000 and establishes a framework for the management and protection of Europe's water resources. It was implemented in England and Wales through the Water Environment (WFD) (England and Wales) Regulations 2003 (the Water Framework Regulations). These Regulations were revoked and replaced in

April 2017 by the Water Environment (WFD) (England and Wales) Regulations 2017[1].

1.2.2 The overall objective of the WFD is to achieve good status (GS) in all inland, transitional, coastal and ground waters by 2021, unless alternative objectives are set and there are appropriate reasons for time limited derogation.

1.2.3 The WFD divides rivers, lakes, lagoons, estuaries, coastal waters (out to one nautical mile from the low water mark), man-made docks and canals into a series of discrete surface water bodies. It sets ecological as well as chemical targets (objectives) for each surface water body. For a surface water body to be at overall GS, the water body must be achieving good ecological status (GES) and good chemical status (GCS). Ecological status is measured on a scale of high, good, moderate, poor or bad, while chemical status is measured as good or fail (i.e., failing to achieve good).

1.2.4 Each surface water body has a hydromorphological designation that describes how modified a water body is from its natural state. Water bodies are either undesignated (i.e., natural, unchanged), designated as a heavily modified water body (HMWB) or designated as an artificial water body (AWB). HMWBs are defined as bodies of water which, as a result of physical alteration by human use activities (such as flood protection and navigation) are substantially changed in character and cannot, therefore, meet GES. AWBs are artificially created through human activity. The default target for HMWBs and AWBs under the WFD is to achieve good ecological potential (GEP), a status recognising the importance of their human use while ensuring ecology is protected as far as possible.

1.2.5 The ecological status/potential of surface waters is classified using information on the biological (e.g., fish, benthic invertebrates, phytoplankton, angiosperms and macroalgae), physico-chemical (e.g., dissolved oxygen and dissolved inorganic nitrogen) and hydromorphological (e.g., hydrological regime) quality of the water body, as well as several specific pollutants (e.g., copper and zinc). Compliance with chemical status objectives is assessed in relation to environmental quality standards (EQS) for a specified list of ‘priority’ and ‘priority hazardous’ substances. These substances were first established by the Priority Substances Directive (PSD) (2008/105/EC) which came into force in January 2009.

1.2.6 The PSD sets objectives, amongst other things, for the reduction of these substances through the cessation of discharges or emissions. As required by the WFD and PSD, a proposal to revise the list of priority (hazardous) substances was submitted by the European Commission in 2012.

1 Following the UK leaving the EU, the main provisions of the WFD have been retained in English law through the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019. Available at: https://www.legislation.gov.uk/uksi/2019/558/contents/made (accessed January 2021).

Subsequently, an updated PSD (2013/39/EU) was published in 2013[2], identifying new priority substances, setting EQSs for those newly identified substances, revising the EQS for some existing substances in line with scientific progress and setting biota EQSs for some existing and newly identified priority substances. The updated PSD is transposed into UK legislation through the Water Environment (WFD) (England and Wales) (Amendment) Regulations 2015, which entered into force in September 2015, and explained in the WFD (Standards and Classification) Directions (England and Wales) 2015.

1.2.7 In addition to surface water bodies, the WFD also incorporates groundwater water bodies. Groundwaters are assessed against different criteria compared to surface water bodies since they do not support ecological communities (i.e., it is not appropriate to consider ecological status of a groundwater). Therefore, groundwater water bodies are classified as good or poor quantitative status in terms of their quantity (groundwater levels and flow directions) and quality (pollutant concentrations and conductivity), along with chemical (groundwater) status.

1.2.8 River Basin Management Plans (RBMPs) are a requirement of the WFD, setting out measures for each river basin district to maintain and improve quality in surface and groundwater water bodies where necessary. In 2009, the Environment Agency published the first cycle (2009 to 2015) of RBMPs for England and Wales, reporting the status and objectives of each individual water body. The Environment Agency subsequently published updated RBMPs for England as part of the second cycle (2015 to 2021), as well as providing water body classification results from 2015 and interim classifications via the Catchment Data Explorer[3]. The latest updates to RBMPs took place in December 2022[4].

1.2.9 The IERRT project is located within the Humber Lower transitional water body and North Beck Drain river body water catchment (see Figure 1). It is also located within the Grimsby Ancholme Louth Chalk Unit groundwater water body. These water bodies are located within the Humber River Basin District which is reported in the Humber RBMP (Environment Agency, 2016a).

1.2.10 Consideration of WFD requirements is necessary for works which have the potential to cause deterioration in ecological, quantitative and/or chemical status of a water body or to compromise improvements which might otherwise lead to a water body meeting its WFD objectives. Therefore, it is necessary to consider the potential for the proposed development to impact WFD water bodies, specifically referring to the following environmental objectives of the WFD:

2 Official Journal of the European Union (2013). Directive 2013/39/EU of the European Parliament and of the Council of 12 August 2013 amending Directives 2000/60/EC and 2008/105/EC as regards priority substances in the field of water policy.

3 https://environment.data.gov.uk/catchment-planning (Accessed April 2022)

4 https://www.gov.uk/guidance/river-basin-management-plans-updated-2022 (Accessed December 2022)

- Prevent deterioration in status of all surface water bodies (Article 4.1 (a)(i));
- Protect, enhance and restore all surface water bodies with the aim of achieving good surface water status by 2015 or later assuming grounds for time limited derogation (Article 4.1 (a)(ii));
- Protect and enhance all HMWBs/AWBs, with the aim of achieving GEP and GCS by 2015 or later assuming grounds for time limited derogation (Article 4.1 (a)(iii));
- Reduce pollution from priority substances and cease or phase out emissions, discharges and losses of priority hazardous substances (Article 4.1 (a)(iv));
- Prevent or limit the input of pollutants into groundwater and prevent deterioration of the status of all groundwater water bodies (Article 4.1 (b)(i));
- Protect, enhance and restore all groundwater water bodies and ensure a balance between abstraction and recharge of groundwater (Article 4.1 (b)(ii));
- Ensure the achievement of objectives in other water bodies is not compromised (Article 4.8); and
- Ensure compliance with other community environmental legislation (Article 4.9).

1.2.11 The Environment Agency (2016b) has published guidance ("Clearing the Waters for All") regarding how to assess the impact of activities in transitional and coastal waters for the WFD. The guidance sets out the following three discrete stages to WFD assessments:

- **Screening**: excludes any activities that do not need to go through the scoping or impact assessment stages;
- **Scoping**: identifies the receptors that are potentially at risk from an activity and need impact assessment; and
- **Impact Assessment**: considers the potential impacts of an activity, identifies ways to avoid or minimise impacts, and indicates if an activity may cause deterioration or jeopardise the water body achieving GS.

1.2.12 Advice Note Eighteen (Planning Inspectorate, 2017) also explains the information that the Inspectorate considers an Applicant must provide with their Nationally Significant Infrastructure Project (NSIP) application in order to clearly demonstrate that the WFD and the Water Environment (WFD) (England and Wales) Regulations 2017 have been appropriately considered.

1.2.13 The Advice Note also refers to Environment Agency guidance (as described above) in terms of the WFD process and the information required.

1.2.14 Both sets of guidance have been followed in this WFD Compliance Assessment.

2 Screening

2.1 Project description

2.1.1 The following paragraphs summarise the marine and landside infrastructure of the proposed IERRT project. Full details are provided in Chapters 2 and 3 in Volume 1 of the ES (Application Document Reference number 8.2).

Marine infrastructure works

2.1.2 The marine works will comprise a number of distinct components. In brief, these include:

- An approach jetty from the shore;
- A linkspan with bankseat to provide a solid foundation;
- Two secured floating pontoons;
- Two finger piers to provide three berths (one on either side of the northern-most outer finger pier furthest from the shore, and one on the northern side of the southern-most inner finger pier) thereby enabling the vessels to berth alongside with their stern ramps resting on a floating pontoon which will match the rising and falling of the tide;
- Possible inclusion of vessel impact protection measures to provide protection in the unlikely event of an errant vessel contacting the Immingham Oil Terminal (IOT) jetty (ABP does not believe that such measures will actually be required, but it has been decided to make provision for them in the DCO application so as to ensure that the infrastructure is consented as part of the IERRT DCO should it be determined at some future date that they are required);
- A capital dredge of the new berth pocket; and
- Disposal of dredged material at sea on the basis that no beneficial alternative use for the material has been identified (see Waste Hierarchy Assessment in Appendix 2.1 in Volume 3 of this ES (Application Document Reference number 8.4)).

Landside infrastructure works

2.1.3 In summary, the landside works consist of the following:

- The demolition of four existing commercial buildings (and a 'lean-to' on one of the buildings). Two of the buildings, used by Malcolm West Forklifts, will be replaced within the existing site boundary but their relocation will facilitate the construction of the internal bridge (see below);
- The improvement of the surface of the development site so to enable it to accommodate the cargo which is either awaiting embarkation on to one of the Ro-Ro vessels or awaiting collection after disembarkation - together with a small vehicular passenger waiting area. These works will include resurfacing and the provision of new pavements and associated infrastructure across the site;

- The construction of a new terminal building and a small welfare building to provide facilities for terminal operational and administration staff, lorry drivers and passengers, together with a small workshop;
- The construction of a UK Border Force building with check in area;
- The provision of necessary infrastructure such as substations and frequency converters;
- An internal vehicle access bridge linking the North and Central Storage Areas which will cross over Robinson Road (an existing port road) and ABP controlled railway track;
- Improvements to the internal road layout within the Port together with improvements to East Gate comprising the widening of the existing entrance; and
- Off-site environmental enhancements involving the improvement of an existing area of woodland and the provision of intertidal habitat.

2.2 Potentially affected water bodies

2.2.1 To determine which water bodies could potentially be affected by the IERRT project, all surface and groundwater water bodies located within the Zone of Influence (ZoI) of the proposed development were recorded (see Figure 1). The ZoI in relation to water and sediment quality impacts is considered to be the wider Humber Estuary from the mouth to up estuary of the Hull Bend (see Water and Sediment Quality chapter (Chapter 8) of the ES), and the ZoI relating to ground conditions including land quality is considered to be 1 km from the proposed development (see Ground Conditions including Land Quality chapter (Chapter 12) of the ES). Therefore, the following water bodies were initially screened in:

- Humber Lower transitional water body (ID: GB530402609201);
- North Beck Drain river body water catchment (ID: GB104029067575); and
- Grimsby Ancholme Louth Chalk Unit (ID: GB40401G401500).

2.2.2 The Humber Lower and North Beck Drain water bodies overlap with the proposed works. The proposed disposal sites also fall within the Humber Lower transitional water body.

2.2.3 Based on the scale and nature of the IERRT project, it is considered unlikely that the proposed development would cause a significant non-temporary effect on the Grimsby Ancholme Louth Chalk Unit groundwater water body. It is noted that this groundwater water body covers a large proportion of the Humber River Basin District (905 km^2), and thus the IERRT project is considered unlikely to cause deterioration in status at the water body level. Furthermore, the IERRT project is not within a Drinking Water Safeguard Zone. It should also be noted that there is a significant thickness of superficial deposits, including low permeability clays, overlying the Flamborough Chalk and Burnham Chalk Formations (see Chapter 12 (Ground Conditions including Land Quality) of the ES). Therefore, the Grimsby Ancholme Louth Chalk Unit groundwater water body has been screened out of the assessment and will not be discussed further.

2.2.4 Table 1 provides a summary of the Humber Lower transitional water body, including current water body status (overall, ecological and chemical) and parameters currently failing to achieve good status. This body of water is a HMWB and in 2019 (the latest interim classification) has a moderate ecological potential and failing chemical status (i.e., failing to achieve good) (Environment Agency, 2022a). The overall, ecological and chemical status/potential is determined by the "one-out, all-out" principle, whereby the poorest individual parameter classification defines the assessment level. Therefore, if any parameter is assessed as less than good (e.g., moderate), then the status for that water body is reported at that level. Moderate ecological potential of the Humber Lower transitional water body is due to the biological quality elements 'angiosperms' (moderate) and 'invertebrates' (moderate), the physico-chemical quality element 'dissolved inorganic nitrogen' (moderate) and supporting element 'Mitigation Measures Assessment' (moderate or less). The failing chemical status is due to the priority substances cypermethrin and dichlorvos, and priority hazardous substances polybrominated diphenyl ethers (PBDE), perfluorooctane sulphonate (PFOS), benzo(b)fluoranthene, benzo(g-h-i)perylene, mercury and its compounds, and tributyltin compounds.

Table 1. Humber Lower transitional water body summary

Water Body Name	Humber Lower
Water Body ID	ID: GB530402609201
Water Body Type	Transitional
Water Body Area	246.455 km²
Hydromorphological Designation (Reasons for Designation)	HMWB (coastal protection, flood protection, navigation, ports and harbours)
Protected Area Designations	Conservation of Wild Birds Directive (Special Protection Area, SPA), Habitats and Species Directive (Special Area of Conservation, SAC), Urban Waste Water Treatment Directive, Bathing Water Directive
Ecological Potential (2019)	Moderate
Chemical Status (2019)	Fail
Parameters Not At Good Status	Angiosperms, Invertebrates, Dissolved Inorganic Nitrate, Mitigation Measures Assessment, Cypermethrin, Dichlorvos, Polybrominated Diphenyl Ethers (PBDE), Perfluorooctane Sulphonate (PFOS), Benzo(b)fluoranthene, Benzo(g-h-i)perylene, Mercury and its Compounds, and Tributyltin Compounds.
Higher Sensitivity Habitats	Chalk reef (689.36 ha) Saltmarsh (1072.31 ha)
Lower Sensitivity Habitats	Cobbles, gravel and shingle (280.54 ha) Intertidal soft sediment (8788.69 ha) Subtidal soft sediments (11286.66 ha)
Phytoplankton Status	High
History of Harmful Algae	No

2.2.5 Table 2 provides a summary of the North Beck Drain river water body. This is a HMWB due to use for coastal protection, flood protection and navigation use. It has a moderate ecological potential and failing chemical status (Environment Agency, 2022a). Moderate ecological potential is due to the and supporting element 'Mitigation Measures Assessment' (moderate or less) and 'hydrological regime' (does not support good). The chemical status of the water body is designated as 'fail' due to PBDEs and Mercury and its Compounds.

Table 2. North Beck Drain river water body summary

Water Body Name	North Beck Drain
Water Body ID	ID: GB104029067575
Water Body Type	River
Catchment Area	56.647 km²
Hydromorphological Designation (Reasons for Designation)	HMWB (coastal protection, flood protection, navigation, ports and harbours)
Protected Area Designations	Nitrates Directive
Ecological Potential (2019)	Moderate
Chemical Status (2019)	Fail
Parameters Not At Good Status	Mitigation Measures Assessment, Hydrological Regime, Polybrominated Diphenyl Ethers (PBDE), Mercury and its Compounds.

2.3 Protected areas

2.3.1 The WFD requires that activities are also in compliance with other relevant legislation, such as the Habitats Directive (92/43/EEC as amended), Birds Directive (2009/147/EC), Ramsar Convention, Bathing Water Directive (2006/7/EC), Nitrates Directive (91/676/EEC), Urban Waste Water Treatment Directive (91/271/EEC) and the provisions of the Shellfish Waters Directive (2006/113/EC) (now repealed and integrated into the WFD).

Nature conservation designations

2.3.2 The Conservation of Habitats and Species Regulations 2017 (as amended) (the Habitats Regulations) transpose the Habitats Directive (Directive 92/43/EEC) and the Birds Directive (2009/147/EC) into English law. Article 3 of the Habitats Directive (92/43/EEC as amended) requires the establishment of a European network of important high-quality conservation sites known as Special Areas of Conservation (SAC) that will contribute to conserving habitats and species identified in Annexes I and II of the Directive. The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds). In accordance with Article 4 of the Birds Directive (2009/147/EC), Special Protection Areas (SPA) are strictly protected sites classified for rare and vulnerable birds (Annex I of the Directive), and for regularly occurring migratory species. Ramsar sites are wetlands of international importance designated under the Ramsar

Convention (adopted in 1971 and came into force in 1975), providing a framework for the conservation and wise use of wetlands and their resources.

2.3.3 The IERRT falls within the boundaries of the Humber Estuary SAC, SPA and Ramsar site (collectively forming the Humber European Marine Site (EMS)). These sites are shown in Figure 2.

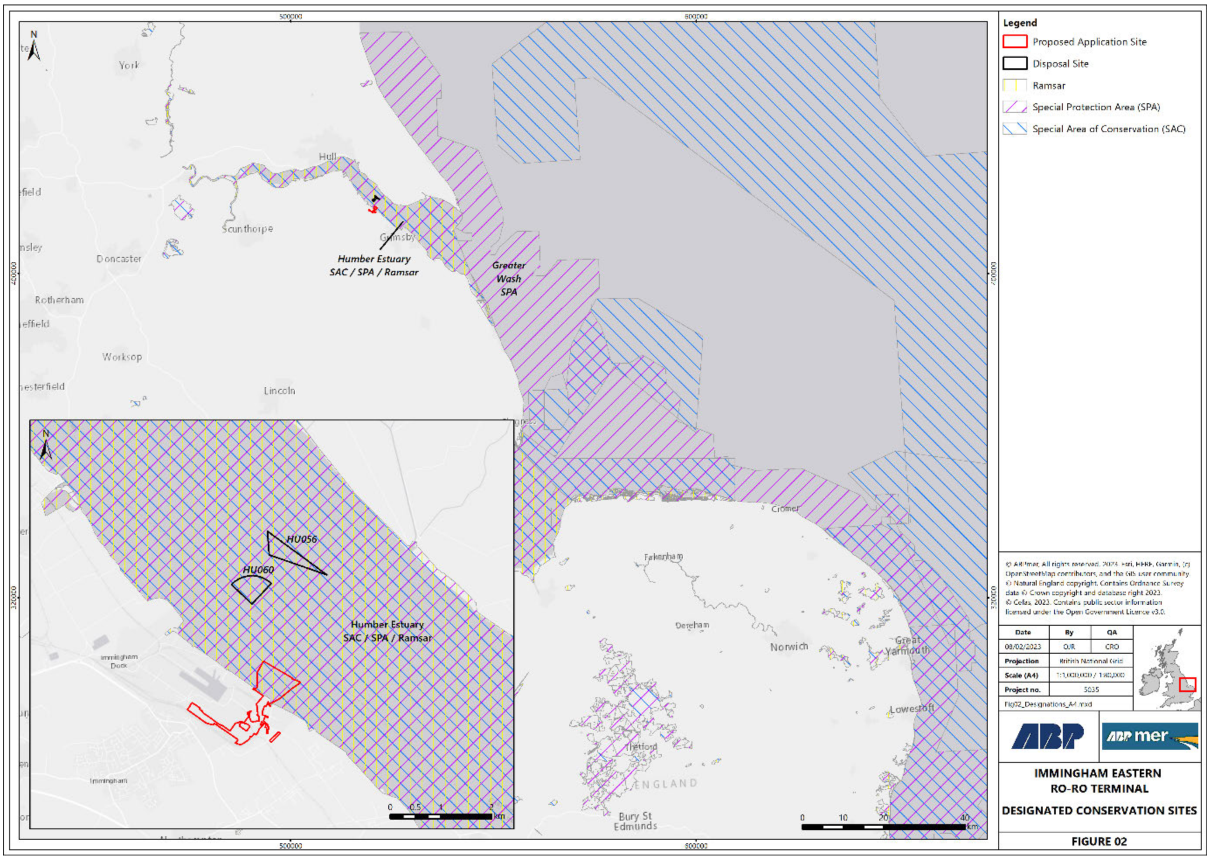

Figure 2. Location of proposed development and surrounding international nature conservation designations

Bathing Water Directive

2.3.4 The revised Bathing Water Directive (2006/7/EC) came into force in 2006, updating the microbiological and physico-chemical standards set by the original Bathing Water Directive (76/160/EEC) and the process used to measure/monitor water quality at identified bathing waters. It is implemented in England and Wales under the Bathing Water Regulations 2013 (as amended). The revised Bathing Water Directive focuses on fewer microbiological indicators, whilst setting higher standards, compared to those of the Bathing Water Directive. Bathing waters under the revised Bathing Water Directive are classified as excellent, good, sufficient or poor according to the levels of certain types of bacteria (intestinal enterococci and *Escherichia coli*) in samples obtained during the bathing season (May to September).

2.3.5 The original Bathing Water Directive was repealed at the end of 2014 and the UK Government's target under the revised Bathing Water Directive was to achieve a classification of 'sufficient' for all bathing waters by 2015, as described under the Bathing Water Regulations 2013[5] (as amended). Monitoring of bathing water quality has been reported against revised Bathing Water Directive indicators since 2015. The new classification system considers all samples obtained during the previous four years and, therefore, data has been collected for revised Bathing Water Directive indicators since 2012.

2.3.6 Cleethorpes designated bathing waters is located approximately 11.5 km south east of the IERRT project, and Humberston Fitties is located approximately 15 km south east (Figure 3). Cleethorpes was assessed as having 'good' bathing water quality in 2021 (Environment Agency, 2022b), declining from an 'excellent' classification in 2019. Humberston Fitties was assessed as having 'good' bathing water quality in 2021 (Environment Agency, 2022b), remaining steady from a 'good' classification in 2019.

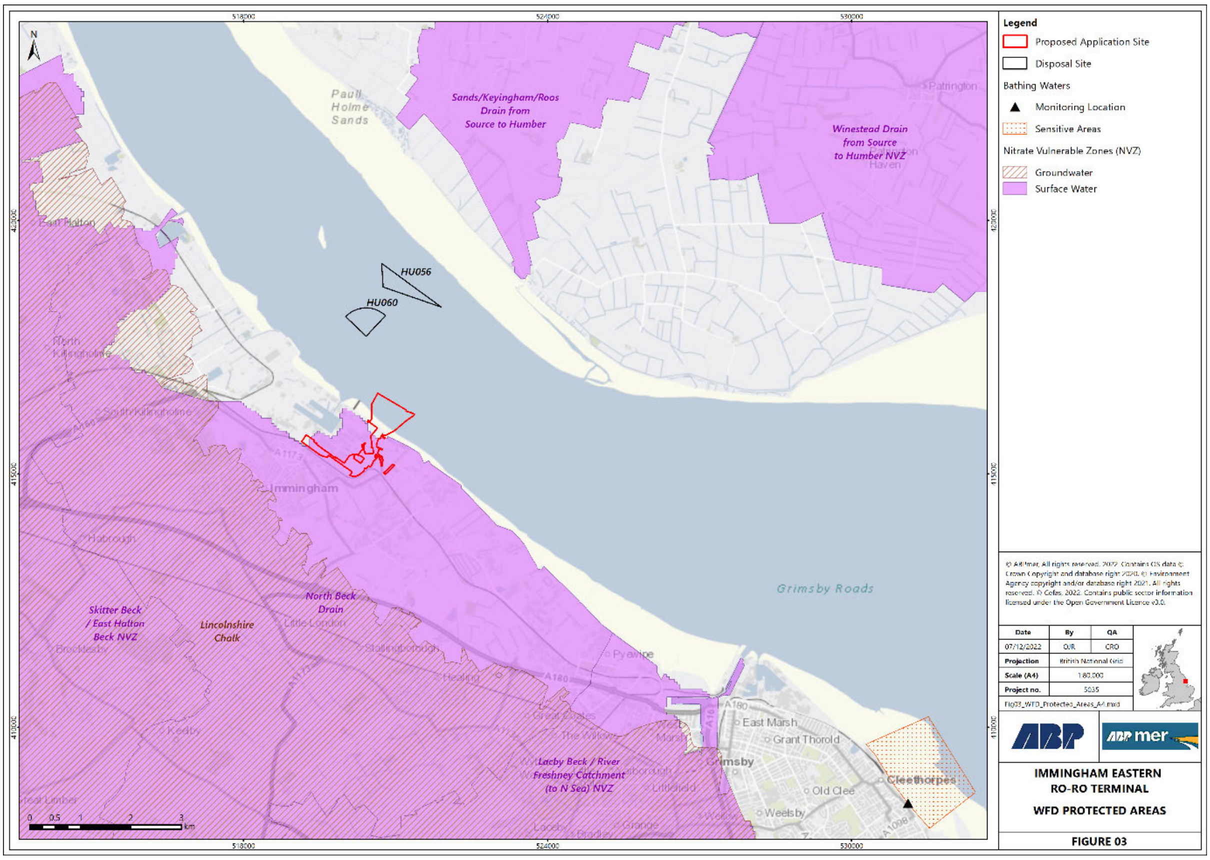

Figure 3. Location of the proposed development and surrounding WFD protected areas

Shellfish Waters Directive

2.3.7 The Shellfish Waters Directive (2006/113/EC) was repealed in December 2013 and subsumed within the WFD. However, the Shellfish Water Protected Areas (England and Wales) Directions 2016 require the Environment Agency

5 From 31 January 2020, this is replaced by The Floods and Water (Amendment etc.) (EU Exit) Regulations 2019.

(in England) to endeavour to observe a microbial standard in all 'shellfish water protected areas'. The microbial standard is 300 or fewer colony forming units of *E. coli* per 100 ml of shellfish flesh and intravalvular liquid.

2.3.8 The Directions also require the Environment Agency to assess compliance against this standard to monitor microbial pollution (75% of samples taken within any period of 12 months below the microbial standard and sampling/analysis in accordance with the Directions).

2.3.9 There are no Shellfish Water Protected Areas in the vicinity of the IERRT project (Defra, 2016). The nearest is the West Wash Shellfish Water Protected Area, located over 65 km south.

Nitrates Directive

2.3.10 The Nitrates Directive (91/676/EEC) is implemented in England under the Nitrate Pollution Prevention Regulations 2015 (as amended). It aims to reduce water pollution from agricultural sources and to prevent such pollution occurring in the future (nitrogen is one of the nutrients that can affect plant growth). Under the Nitrates Directive, surface waters are identified if too much nitrogen has caused a change in plant growth which affects existing plants and animals and the use of the water body.

2.3.11 The landside extent of the IERRT project is located on land included in the North Beck Drain Nitrate Vulnerable Zone (NVZ), covering Immingham as well as South Killingholme and Healing, as designated under the Nitrates Directive (Environment Agency, 2022c) (Figure 3).

Urban Waste Water Directive

2.3.12 The Urban Waste Water Treatment Directive (91/271/EEC) is implemented in England and Wales through the Urban Waste Water Treatment (England and Wales) Regulations 1994 (as amended). It aims to protect the environment from the adverse effects of the collection, treatment, and discharge of urban waste water. It sets treatment levels on the basis of sizes of sewage discharges and the sensitivity of waters receiving the discharges. In general, the Urban Waste Water Treatment Directive requires that collected waste water is treated to at least secondary treatment standards for significant discharges. Secondary treatment is a biological treatment process where bacteria are used to break down the biodegradable matter (already much reduced by primary treatment) in waste water. Sensitive areas under the Urban Waste Water Treatment Directive are water bodies affected by eutrophication due to elevated nitrate concentrations and act as an indication that action is required to prevent further pollution caused by nutrients.

2.3.13 There are no sensitive areas designated under the Urban Waste Water Treatment Directive (91/271/EEC) in the vicinity of the IERRT project (Defra, 2019).

3 Scoping

3.1 Introduction

3.1.1 The "Clearing the Water for All" guidance provides a scoping template to record findings and consider potential risks for several key receptors, specifically:

- Hydromorphology;
- Biology (habitats);
- Biology (fish);
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

3.1.2 Each receptor is considered in the following sections and summarised in a table. Potential risks that have been scoped into the assessment are highlighted in red and considered within the impact assessment stage, while those scoped out of the assessment are highlighted in green.

3.2 Hydromorphology

3.2.1 Hydromorphology is the physical characteristics of estuaries and coasts, including the size, shape and structure of the water body and the flow and quantity of water and sediment. Table 3 presents a summary of hydromorphological considerations and associated risk issues for the proposed development.

Table 3. Hydromorphology scoping summary

Hydromorphology Considerations	Hydromorphology Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity could impact on the hydromorphology (for example morphology or tidal patterns) of a water body at high status?	No (morphology status 'not assessed'). Impact assessment not required.	No (hydrological regime status 'does not support good'). Impact assessment not required.
Consider if your activity could significantly impact the hydromorphology of any water body?	Yes (potential changes to hydromorphology as a result of proposed development). Requires impact assessment.	No (activity not within water body and negligible changes to hydrodynamics and morphology). Impact assessment not required.
Consider if your activity is in a water body that is heavily modified for the same use as your activity?	Yes (reason for hydromorphological designation is 'Navigation, ports and harbours'). Requires impact assessment.	No (activity not within water body). Impact assessment not required.

3.2.2 As at least one hydromorphological consideration indicates that a risk could be associated with the proposed development, this receptor has been scoped into the impact assessment (see Section 4).

3.3 Biology

Habitats

3.3.1 It is necessary to consider the impact of the physical footprint of an activity on nearby marine and coastal habitats. This specifically refers to habitats of higher sensitivity (e.g., intertidal seagrass, maerl and saltmarsh) and lower sensitivity (e.g., cobbles, gravel and shingle, subtidal rock reef and intertidal soft sediments like sand and mud). Table 4 presents a summary of biology (habitat) considerations and associated risk issues for the proposed development. As the biology (habitats) considerations indicate that it is unlikely a risk could be associated with these works, this receptor has been scoped out of the assessment.

Table 4. Biology (habitat) scoping summary

Biology (Habitat) Considerations	Biology (Habitat) Risk Issue(s)	
	Humber Lower	North Beck Drain
Is the footprint of the activity 0.5 km² or larger?	No (marine works < 0.5 km² within water body). Impact assessment not required.	No (landside works < 0.5 km²). Impact assessment not required.
Is the footprint of the activity 1% or more of the water body's area?	No (marine works comprise < 1% of water body). Impact assessment not required.	No (landside works comprise < 1% of water body). Impact assessment not required.
Is the footprint of the activity within 500 m of any higher sensitivity habitat?	No (nearest higher sensitivity habitat > 500 m from the proposed development). Impact assessment not required.	No (nearest higher sensitivity habitat > 500 m from the proposed development). Impact assessment not required.
Is the footprint of the activity 1% or more of any lower sensitivity habitat?	No (< 1% lower sensitivity habitats). Impact assessment not required.	No (< 1% lower sensitivity habitat). Impact assessment not required.

Fish

3.3.2 Activities occurring within an estuary could impact on normal fish behaviour such as movement, migration or spawning. Table 5 presents a summary of biology (fish) considerations and associated risk issues for the proposed development. As at least one biology (fish) consideration indicates that a risk could be associated with the activity, this receptor has been scoped into the assessment (see Section 4).

Table 5. Biology (fish) scoping summary

Biology (Fish) Considerations	Biology (Fish) Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity is in an estuary and could affect fish in the estuary, outside the estuary but could delay or prevent fish entering it or could affect fish migrating through the estuary?	Yes. "Continue with questions".	Yes. "Continue with questions".
Consider if your activity could impact on normal fish behaviour like movement, migration or spawning (for example creating a physical barrier, noise, chemical change or a change in depth or flow)?	Yes. Requires impact assessment.	No (proposed works do not occur within this water body). Impact assessment not required.
Consider if your activity could cause entrainment or impingement of fish?	Yes. Requires impact assessment.	No (proposed works do not occur within this water body). Impact assessment not required.

3.4 Water quality

3.4.1 Consideration should be made regarding whether phytoplankton status and harmful algae could be affected by the proposed development, as well as identifying the potential risks of using, releasing or disturbing chemicals. Table 6 presents a summary of water quality considerations and associated risk issues of the proposed development. As at least one water quality consideration indicates that a risk could be associated with the proposed development, this receptor has been scoped into the impact assessment (see Section 4).

Table 6. Water quality (physical parameters) scoping summary

Water Quality Considerations	Water Quality Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity could affect water clarity, temperature, salinity, oxygen levels, nutrients or microbial patterns continuously for longer than a spring neap tidal cycle (about 14 days)?	No (while the project duration exceeds 14 days, the potential to affect water quality is intermittent and unlikely to persist continuously for greater than 14 days). Impact assessment not required.	No (while the project duration exceeds 14 days, the potential to affect water quality is intermittent and unlikely to persist continuously for greater than 14 days). Impact assessment not required.

Water Quality Considerations	Water Quality Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity is in a water body with a phytoplankton status of moderate, poor or bad?	No (phytoplankton status is high). Impact assessment not required.	No (phytoplankton status not assessed). Impact assessment not required.
Consider if your activity is in a water body with a history of harmful algae?	No (no history of harmful algae). Impact assessment not required.	No (not monitored). Impact assessment not required.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if the chemicals are on the Environmental Quality Standards Directive (EQSD) list?	Yes (potential for sediment-bound chemicals above Cefas AL1 to be disturbed and dispersed during dredging and piling). Requires impact assessment.	Yes (potential for migration of contamination during landside works). Requires impact assessment.
If your activity uses or releases chemicals (for example through sediment disturbance or building works) consider if it disturbs sediment with contaminants above Cefas Action Level 1?		
If your activity has a mixing zone (like a discharge pipeline or outfall) consider if the chemicals released are on the Environmental Quality Standards Directive (EQSD) list?	No (not applicable). Impact assessment not required.	No (not applicable). Impact assessment not required.

3.5 Protected areas

3.5.1 Consideration should be made regarding whether WFD protected areas are at risk from the proposed development, including SACs and SPAs (European sites), as well as bathing waters, shellfish waters and nutrient sensitive areas. Table 7 presents a summary of protected area considerations and associated risk issues of the proposed works. As the protected areas considerations indicate that a risk could be associated with the proposed works, this receptor has been scoped into the impact assessment (see Section 4.

Table 7. Protected area risk issues in the study area water bodies

Protected Area Considerations	Protected Area Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity is within 2 km of any WFD protected area?	Yes (overlap with SPAs, SACs). Impact assessment required.	Yes (overlap with NVZ). Impact assessment required.

3.6 Invasive non-native species

3.6.1 Consideration should be made regarding whether there is a risk the proposed development could introduce or spread INNS. Risks of introducing or spreading INNS include materials or equipment that have come from, had use in or travelled through other water bodies, as well as activities that help spread existing INNS, either within the immediate water body or other water bodies. Table 8 presents a summary of INNS considerations and associated risk issues for the proposed works. As the INNS considerations indicate that a risk could be associated with these ongoing works, this receptor has been scoped into the impact assessment (see Section 4).

Table 8. Invasive non-native species (INNS) risk issues in the study area water bodies

INNS Considerations	INNS Risk Issue(s)	
	Humber Lower	North Beck Drain
Consider if your activity could introduce or spread INNS?	Yes (potential for introduction or spread of INNS). Requires impact assessment.	Yes (potential for introduction or spread of INNS). Requires impact assessment.

4 Impact Assessment

4.1 Introduction

4.1.1 An impact assessment should be conducted for each receptor identified during the scoping stage as being at risk from an activity. The following receptors have been scoped into the impact assessment:

- Hydromorphology;
- Biology (fish);
- Water quality;
- Protected areas; and
- Invasive non-native species (INNS).

4.1.2 Each of these WFD parameters has been evaluated in order to determine whether the proposed activities might cause deterioration in the status of the relevant water body (defined as a non-temporary effect on status at water body level), or an effect that prevents the water body from meeting its WFD objectives.

4.2 Hydromorphology

4.2.1 Changes in hydromorphology may occur as a result of the capital and maintenance dredge, piling and disposal of material during construction, as well as the presence of the marine facilities and dredge pocket. A detailed physical processes assessment has been undertaken for the proposed development (Chapter 7 (Physical Processes) of the ES) and is briefly summarised here.

4.2.2 The greatest increase in suspended sediment concentrations (SSC) from the piling, dredging and disposal activities will occur during the barge depositing material at the licensed disposal site. Material within the passive plume will be dispersed throughout the water column as the load drops to the bed, with the potential to be transported up- and down-estuary through the full tidal excursion (dependent on tidal state at the point of release). Initial SSC values within the dynamic plume will be very high but, given the very high natural levels within the estuary, excess levels are likely to be reduced to below natural storm disturbance conditions very quickly (and before the next disposal operation commences four hours later). This is typically the same scenario that occurs for the existing maintenance dredging of the local Immingham berths, which has been undertaken frequently (multiple times during the year) since the berths were first implemented.

4.2.3 At the disposal site, the effect of deposition of capital dredge arisings will be similar to that which already occurs as a result of ongoing maintenance dredging and disposal. Local changes to the bathymetry (as a result of material disposal to the bed) within the disposal site will be small in the context of the existing depths. As is currently the practice, disposal activity will be targeted to the deeper areas within the site, ensuring that bed level changes are not excessive in any one area, thus minimising the overall change. As a result, associated changes to the local hydrodynamics (and sediment transport pathways) will be negligible. Ongoing monitoring of depths within the disposal site (an activity already undertaken to assess bed level changes as a result of existing dredge disposal activities) will continue into the future. Consequently, the impact of the disposal from both capital and future maintenance dredging of the proposed IERRT berth will be monitored.

4.2.4 Marginal changes to hydrodynamics (local flow speed) are likely to result from the IERRT within, and adjacent to, the proposed berth pocket. Slight changes in flow speed are predicted to extend up-estuary to Immingham Outer Harbour (IOH) and down-estuary past the Immingham Oil Terminal (IOT) jetty. The largest predicted magnitude of change is anticipated within the berth pocket itself (particularly towards the landward edge, as a result of the larger proposed dredge depths). Given the relatively stable nature of the estuary morphology across the near-field study area (described in Section 7.6 of Chapter 7 of the ES), it is further considered that the changes arising from

IERRT will not vary with the longer-term cyclic patterns in the estuary banks and channels.

4.2.5 Hydrodynamic forcing within (and adjacent to) the proposed IERRT will only be marginally altered and, therefore, changes in the sediment pathways will be small. Predicted changes to future sediment transport are greatest within the proposed dredge pocket itself, which will require future maintenance dredging to ensure sufficient underkeel clearance for vessels on berth. The rate of infill is likely to be similar to that already experienced within the existing Immingham berths. Outside the proposed berth pocket, the proposed scheme has limited impact on the baseline sedimentation and erosion rates.

4.2.6 Marginal changes to significant wave height (Hs) are likely to result from the IERRT within, and adjacent to, the proposed berth pocket. For the various wave events assessed, slight changes in wave height (typically less than ±5 % of baseline values) are predicted to extend up-estuary as far as the Immingham Western Jetty (for a wave event approaching from the southeast). The largest predicted magnitude of change is anticipated in close proximity to the berth pocket itself.

4.2.7 As a result of a less intensive dredge programme (and an overall lower predicted dredge volume), future maintenance dredging will result in smaller changes in SSC and sedimentation (within the dredge plumes and at the disposal site) compared to the capital dredge (as described above). Furthermore, the predicted impacts from future maintenance dredging will be similar to that which already arises from the ongoing maintenance of the existing Immingham berths.

4.2.8 Overall, the proposed works will, therefore, not result in any changes in hydromorphology. The proposed works are, therefore, not expected to lead to a deterioration of the assessed hydromorphological elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

4.3 Biology (fish)

4.3.1 Elevated underwater noise and vibration levels during construction activities can potentially disturb fish by causing physiological damage and/or inducing adverse behavioural reactions. A detailed underwater noise assessment has been undertaken for the proposed development (Appendix 9.2 to this ES) and is briefly summarised here.

4.3.2 For most piling activities, the main source of noise and vibration relates to where piles are hammered or vibrated into the ground. Percussive piling involves hammering the pile into the seabed resulting in an impact blow and high levels of noise. Vibro-piling produces lower levels of noise as piles are vibrated into the seabed.

4.3.3 The dredging process involves a variety of sound generating activities which can be broadly divided into sediment excavation, transport and placement of the dredged material at the disposal site (CEDA, 2011; WODA, 2013; Jones and Marten, 2016). For most dredging activities, the main source of sound relates to the vessel engine noise.

4.3.4 There is a wide diversity in hearing structures in fish which leads to different auditory capabilities across species (Webb *et al*., 2008). All fish can sense the particle motion[6] component of an acoustic field via the inner ear as a result of whole-body accelerations (Radford *et al*., 2012), and noise detection ('hearing') becomes more specialised with the addition of further hearing structures. Particle motion is especially important for locating sound sources through directional hearing (Popper *et al.,* 2014; Hawkins *et al.,* 2015; Nedelec *et al.,* 2016). Although many fish are also likely to detect sound pressure[7], particle motion is considered equally or potentially more important (Hawkins and Popper, 2017).

4.3.5 From the few studies of hearing capabilities in fish that have been conducted, it is evident that there are potentially substantial differences in auditory capabilities from one fish species to another (Hawkins and Popper, 2017). Popper *et al.* (2014) proposed the following three categories of fish which are described below:

- Fish with a swim bladder or air cavities that aid hearing;
- Fish with a swim bladder that does not aid hearing; and
- Fish with no swim bladder.

4.3.6 The first category comprises fish that have special structures mechanically linking the swim bladder to the ear. Fish species in the study area that fall within this first category include herring (*Clupea harengus*) and shads.

4.3.7 The second category comprises fish with a swim bladder where the organ does not appear to play a role in hearing. Fish species in the study area that fall within this second category include Atlantic cod (*Gadus morhua*), Atlantic salmon (*Salmo salar*), European eel (*Anguilla anguilla*), European seabass (*Dicentrarchus labrax*), Atlantic mackerel (*Scomber scombrus*), smelt (*Osmerus eperlanus*) and whiting (*Merlangius merlangus*).

4.3.8 The third category comprises fish lacking swim bladders that are sensitive only to sound particle motion and show sensitivity to only a narrow band of frequencies (e.g., flatfishes, sharks, skates and rays). Fish species in the study area that fall within this third category include plaice (*Pleuronectes platessa*), sea lamprey (*Petronmyzon marinus*), sole (*Solea solea*) and thornback ray (*Raja clavata*).

6 Particle motion is a back-and-forth motion of the medium in a particular direction; it is a vector quantity that can only be fully described by specifying both the magnitude and direction of the motion, as well as its magnitude, temporal, and frequency characteristics.

7 Pressure fluctuations in the medium above and below the local hydrostatic pressure; it acts in all directions and is a scalar quantity that can be described in terms of its magnitude and its temporal and frequency characteristics.

Piling

4.3.9 The predicted range (R) at which the Popper *et al.* (2014) quantitative instantaneous peak Sound Pressure Level (SPL) thresholds for pile driving are reached indicates that there is a risk of mortality, potential mortal injury or recoverable injury within 22 m from the source of impact piling in fish with a swim bladder (such as herring, Atlantic salmon and European eel) and within 10 m in fish with no swim bladder (such as lamprey and flatfish). For vibro-piling, there is a risk of mortality, potential mortal injury or recoverable injury within 3 m from the source in fish with a swim bladder and within 1 m in fish with no swim bladder.

4.3.10 The calculator developed by the United States National Marine Fisheries Service (NMFS) (NMFS, 2021) as a tool for assessing the potential effects to fish exposed to elevated levels of underwater sound produced during pile driving was used to calculate the range at which the cumulative Sound Exposure Levels (SEL) thresholds for pile driving (Popper *et al*., 2014) are reached. Based on the assumptions highlighted in Appendix 9.2 to this ES, there is predicted to be a risk of mortality and potential mortal injury within 72 m from the source of impact piling in fish with a swim bladder involved in hearing (such as herring), within 49 m from the source in fish with a swim bladder not involved in hearing (such as European eel) and within 15 m in fish with no swim bladder (such as sole). The distance at which the received level of noise is within the limits of the recoverable injury threshold is within 121 m in fish with a swim bladder and 23 m in fish without a swim bladder. For vibro-piling, there is predicted to be a risk of mortality and potential mortal injury within 38 m from the source in fish with a swim bladder involved in hearing, within 26 m from the source in fish with a swim bladder not involved in hearing and within 8 m in fish with no swim bladder. The distance at which the received level of noise is within the limits of the recoverable injury threshold is within 64 m in fish with a swim bladder and 12 m in fish without a swim bladder.

4.3.11 Given the mobility of fish, any individuals that might be present within the localised areas associated with potential mortality/injury during pile driving activities would be expected to easily move away and avoid harm. Furthermore, the area local to the proposed development is not considered a key foraging, spawning or nursery habitat for fish and, therefore, this localised zone of injury is unlikely to result in any significant effects on fish.

4.3.12 The range at which the Hawkins *et al*. (2014) quantitative instantaneous peak SPL behaviour thresholds for percussive pile driving are reached indicates that there is a risk of a behavioural response in fish within around 1.6 km from the impact piling. Behavioural reactions during impact piling are, therefore, anticipated to occur across 67% width of the Humber Estuary at low water and 46% of the estuary width at high water, potentially creating a partial temporary barrier to fish movements. For vibro-piling, there is a risk of a behavioural response in fish within around 1.1 km from the source which equates to 48% of the width of the Humber Estuary at low water and 33% of the estuary width at high water.

4.3.13 The scale of the behavioural response is partly dependent on the hearing sensitivity of the species. The key fish in the study area include species across the range of Popper *et al.* (2014) fish hearing groups. Fish with a swim bladder involved in hearing (e.g., herring) may exhibit a moderate behavioural reaction within distance in which a behavioural response is predicted (e.g., a sudden change in swimming direction, speed or depth). Fish with a swim bladder that is not involved in hearing (e.g., European eel) are likely to display a milder behavioural reaction. Fish without a swim bladder (e.g., river lamprey) are anticipated to only show very subtle changes in behaviour in this zone.

4.3.14 The scale of the behavioural effect is also dependent on the size of fish (which affects maximum swimming speed). Smaller fish, juveniles and fish larvae swim at slower speeds and are likely to move passively with the prevailing current. Larger fish are more likely to actively swim and, therefore, may be able to move out of the behavioural effects zone in less time, although it is recognised that the movement of fish is very complex and not possible to define with a high degree of certainty.

4.3.15 The effects of piling noise on fish also need to be considered in terms of the duration of exposure. It is anticipated that piling noise will take place over a period of approximately 24 or 37 weeks (depending on whether a sequenced construction is employed). However, piling will not take place continuously as there will be periods of downtime, pile positioning and set up.

4.3.16 The piling works will be undertaken Monday to Sunday. The maximum impact piling scenario is for 4 tubular piles to be installed each day from either front (i.e., the land and water), involving approximately 180 minutes of impact piling per day and 20 minutes of vibro piling per day in a 12-hour shift. There will, therefore, be significant periods over a 24-hour period when fish will not be disturbed by any piling noise. The actual proportion of piling is estimated to be at worst around 14% (based on 180 minutes of impact piling and 20 minutes of vibro piling each working day) over any given construction week. In other words, any fish that remain within the predicted behavioural effects zone at the time of piling will be exposed a maximum of up to 14% of the time.

4.3.17 It is also important to consider the noise from piling against existing background or ambient noise conditions. The area in which the construction will take place already experiences regular vessel operations and ongoing maintenance dredging, and, therefore, fish are likely to be habituated to a certain level of anthropogenic background noise.

4.3.18 The construction of the IERRT project may be completed as a single activity, or it may be sequenced with operation of the northernmost pier occurring at the same time as construction of the southernmost pier. In the case of a sequenced construction, the duration of piling will be extended but it will not increase the magnitude of change. Therefore, the above assessment is considered the worst case and will not be altered by a sequenced construction period.

4.3.19 In conclusion, the proposed piling activity is not expected to lead to a deterioration of the assessed fish elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

Dredging and disposal

4.3.20 The worst-case source level (SL) generated by dredging and vessels is below the Popper *et al*. (2014) quantitative instantaneous peak SPL and cumulative SEL thresholds for pile driving, which indicates that there is no risk of mortality, potential mortal injury or recoverable injury in all categories of fish even at the very source of the dredger or vessel noise. This appears to correlate with the Popper *et al*. (2014) recommended qualitative guidelines for continuous noise sources which consider that the risk of mortality and potential mortal injury in all fish is low in the near, intermediate and far-field.

4.3.21 According to Popper *et al.* (2014), the risk of recoverable injury is also considered low for fish with no swim bladder and fish with a swim bladder that is not involved in hearing. There is a greater risk of recoverable injury in fish where the swim bladder is involved in hearing (e.g., herring) whereby a cumulative noise exposure threshold is recommended (170 dB rms for 48 h). The distance at which recoverable injury is predicted in these fish as a result of the dredging and vessel movements is 10 m.

4.3.22 Popper *et al.* (2014) advises that there is a moderate risk of temporary threshold shifts (TTS) occurring in the nearfield (i.e., tens of metres from the source) in fish with no swim bladder and fish with a swim bladder that is not involved in hearing and a low risk in the intermediate and far-field. There is a greater risk of TTS in fish where the swim bladder is involved in hearing (e.g., herring) whereby a cumulative noise exposure threshold is recommended (158 dB rms for 12 h). The distance at which TTS is predicted in these fish as a result of the dredging and vessel movements is 46 m.

4.3.23 Popper *et al*. (2014) guidelines suggest that there is considered to be a high risk of potential behavioural responses occurring in the nearfield (i.e., tens of metres from the source) for fish species with a swim bladder involved in hearing and a moderate risk in other fish species. At intermediate distances (i.e., hundreds of metres from the source), there is considered to be a moderate risk of potential behavioural responses in all fish and in the farfield (i.e., thousands of metres from the source) there is considered to be a low risk of a response in all fish.

4.3.24 Overall, there is considered to be a low risk of any injury in fish as a result of the underwater noise generated by dredging and vessel movements. The level of exposure will depend on the position of the fish with respect to the source, the propagation conditions, and the individual’s behaviour over time. However, it is unlikely that a fish would remain in the vicinity of a dredger for extended periods given the distances at which recoverable injury or TTS are predicted in fish as a result of the dredging and vessel movements, as explained above. Behavioural responses are anticipated to be spatially negligible in scale and fish will be able to move away and avoid the source of the noise as required. Furthermore, the period of dredging will be short term (approximately 80 days (11 weeks) in total).

4.3.25 It is noted that there is potential for fish to become entrained during the use of trailer suction hopper dredger (TSHD) (if required). However, the scale of such impacts is considered negligible given the regular maintenance dredging activity that is already undertaken at the Port of Immingham.

4.3.26 The construction of the IERRT project may be completed as a single activity, or it may be sequenced with operation of the northernmost pier occurring at the same time as construction of the southernmost pier. However, in any case, all capital dredging will be undertaken in one construction activity before operation of the northernmost pier. Furthermore, construction of the southernmost pier will not occur at the same time as maintenance dredging and disposal during operation. Therefore, the above assessment is considered the worst case and will not be altered by a sequenced construction period.

4.3.27 In conclusion, the proposed dredging and disposal activity is not expected to lead to a deterioration of the assessed fish elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

4.4 Water quality

4.4.1 Changes in water quality may occur as a result of the capital and maintenance dredge, piling and disposal of material during construction, as well as from surface water run-off during construction and operation. A detailed assessment has been undertaken for the proposed development in the Water and Sediment Quality chapter (Chapter 8) of the ES and the Ground Conditions including Land Quality chapter (Chapter 12) of the ES and is briefly summarised here.

Baseline

4.4.2 The UK has not adopted formal quantitative EQS for sediments. In the absence of any quantified UK standards, therefore, common practice for characterising baseline sediment quality conditions is to compare against the Cefas Guideline Action Levels for the disposal of dredged material (MMO, 2014).

4.4.3 Cefas Guideline Action Levels are used as part of a ‘weight of evidence’ approach to assessing material suitability for disposal at sea. Cefas guidance indicates that, in general, contaminant levels below Action Level 1 (AL1) are of no concern. Material with contaminant levels above Action Level 2 (AL2), however, is generally considered unsuitable for disposal at sea whilst dredged material with contaminant levels between AL1 and AL2 requires further consideration before a decision can be made as to disposal. As a consequence, the Action Levels should not be viewed as pass/fail thresholds, and it is also recognised that these guidelines are not statutory requirements.

4.4.4 In September 2021, a sample plan (SAM/2021/00053) was provided by the MMO, prepared in consultation with Cefas. In October 2021, sediment samples were collected from ten stations (1 to 10) across the proposed dredge area comprising the proposed development, including subsurface samples[8] (Figure 4).

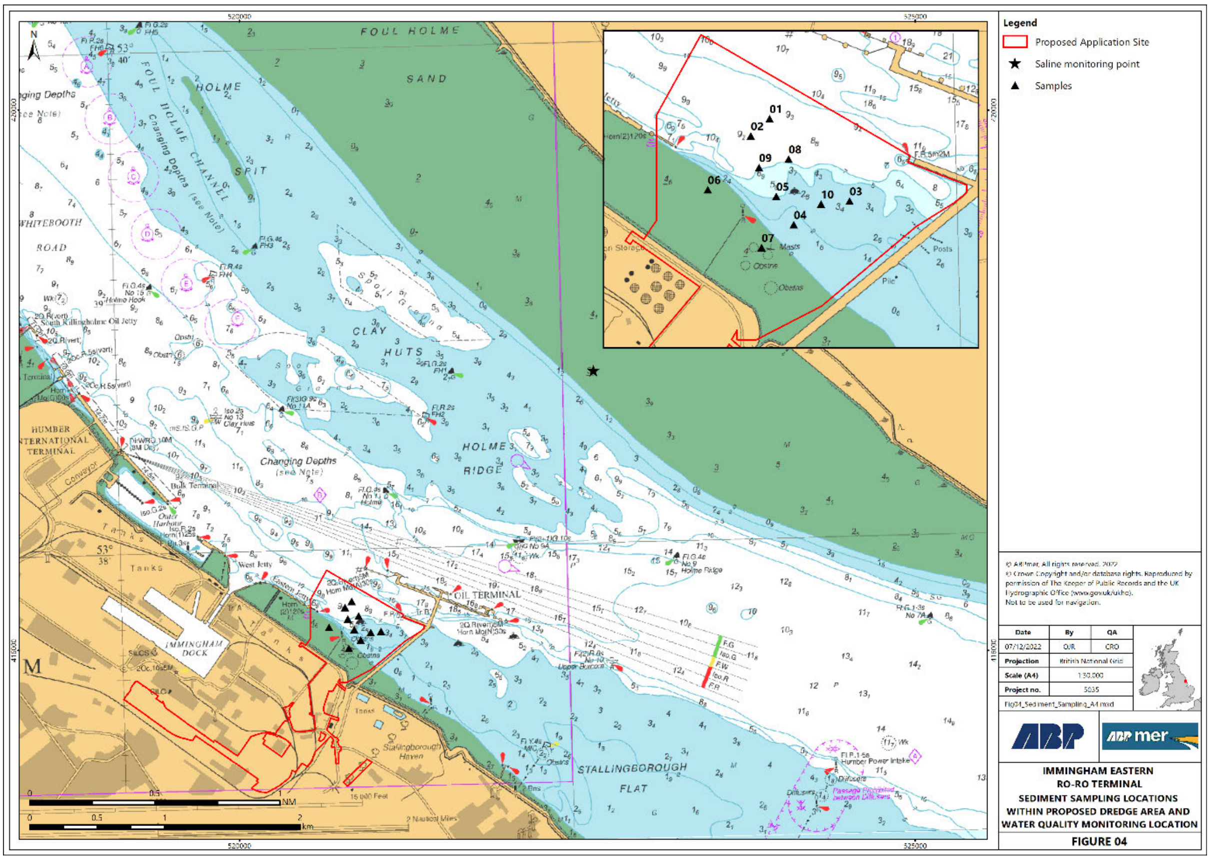

Figure 4. Sediment sampling locations within proposed dredge area and water quality monitoring location

4.4.5 The sampling regime and analysis was undertaken in accordance with the sample plan. The sediment samples were analysed by an MMO-approved laboratory for the following physical and chemical parameters:

8 The sample plan from the MMO advised that sampling should be undertaken a 1 m depth intervals down to the maximum dredge depth for each proposed dredge area. However, the corer used during sampling was unable to retrieve samples from the full dredge depths due to the very stiff nature of the material encountered at depth. One sample was, therefore, retrieved at 1 m depth intervals down to the maximum depth the corer could penetrate. This is considered adequate in this case given these areas have not been dredged beyond this depth historically and the contaminant analysis results indicate contamination generally does not increase with depth. Furthermore, the maximum depths that were possible to sample from the dredge area were into the geological stiff sandy clay material (i.e., virgin material that was laid down prior to the existence of humans) and, therefore, unlikely to be contaminated (as supported by the contaminant analysis results).

- Particle size analysis (PSA);
- Trace metals;
- Organotins;
- Polycyclic aromatic hydrocarbons (PAHs);
- Polychlorinated biphenyls (PCBs);
- Total hydrocarbon content (THC);
- Polybrominated diphenyl ethers (PBDEs); and
- Organochlorine pesticides (OCPs).

4.4.6 The PSA results are presented in Table 9. Sediments from most sampling locations were dominated by silt material. Samples from Sample 2 (3.8 m), Sample 3 (1 m), Sample 4 (2 m), Sample 5 (2 m), Sample 6 (4.10 m), and Sample 8 (1 m) predominantly comprised sand. With the exception of Sample 4 (2 m and 2.70 m), Sample 5 (4.70 m), Sample 9 (3 m), and Sample 10 (2.60 m), gravel comprised less than 10% of samples collected.

4.4.7 Sediment samples have also been analysed for total organic carbon (TOC) (Table 9). Values typically ranged from about 0.5% to 6%, with a minimum of 0.15% and a maximum of 18.8%. The average organic carbon content across all samples was 2.16%. Generally, samples with higher proportions of sand and gravel had lower TOC as organic matter tends to accumulate in finer grained sediments.

4.4.8 A summary of sediment quality (chemical analysis) of samples from the dredge areas is provided in Table 10 to Table 19. Concentrations above or below Cefas Guideline Action Levels are highlighted to provide an indication of sediment quality. In general, concentrations were typically higher in surface samples compared to those obtained at depth. Contaminant concentrations were generally low, with most values below the respective AL1 or marginally exceeding AL1. There were no instances where the concentration exceeded the respective AL2 (or a sample concentration was close to exceeding this threshold).

4.4.9 Trace metal concentrations were typically below AL1 in most samples, with some minor exceedances of AL1 for some metals (mainly in Sample 1 and Sample 6). Organotins were consistently below the respective AL1, as were PCBs in most samples (with the exception of some sub-samples in Sample 1, Sample 2, Sample 6, and Sample 7). Numerous individual PAHs were found to be above AL1 (there is currently no AL2 for individual or total PAHs), particularly in Sample 1, Sample 6, Sample 7, and Sample 9. OCP concentrations were often below the limit of detection (LOD) in most samples. Dieldrin and p,p'-Dichlorodiphenyltrichloroethane (DDT) were mostly below or marginally exceeding AL1. PBDE concentrations also appeared to be low in general with most below the LOD. Currently, no ALs apply to PBDEs, however, Cefas and Defra are proposing to introduce AL1s for these contaminants. A small proportion of surface samples are above the proposed AL1 for BDE 99, BDE 100 and BDE 209 noting that these ALs are still subject to review and are not yet implemented. These values are considered typical of surface concentrations of PBDEs in the Humber Estuary.

Table 9. Particle size analysis (PSA) results from sediment samples collected in October 2021

Sample	Depth (m)	Visual Appearance	Total organic carbon (TOC) M/M %	Particle Size Distribution (%)		
				Gravel (>2 mm)	Sand (2 mm – 63 µm)	Silt (<63 µm)
1	0	Odourless Brown Mud.	1.89	0.00	7.28	92.71
	1	Odourless Brown Mud.	2.07	0.00	5.29	94.68
	2	Odourless Brown Mud.	2.24	0.00	16.57	83.42
	3	Odourless Brown Mud.	2.74	0.00	16.60	83.41
	4	Brown Sandy Mud with an Earthy Odour.	2.32	0.00	13.64	86.34
	4.70	Brown Sandy Mud with an Earthy Odour.	2.06	0.00	17.31	82.70
2	0	Odourless Brown Mud.	2.07	0.00	9.19	90.82
	1	Odourless Brown Mud.	2.26	0.00	18.04	81.97
	2	Brown Mud with an Earthy Odour.	1.01	0.00	0.00	100.00
	3	Brown Mud with an Earthy Odour.	1.06	0.00	11.56	88.44
	3.80	Odourless Brown Sandy Mud.	0.59	0.00	57.58	42.40
3	0	Odourless Brown Mud.	0.43	0.00	4.01	96.01
	1	Odourless Brown Muddy Sand.	0.15	0.00	93.25	6.74
	2	Odourless Brown Mud.	0.94	0.00	0.93	99.06
	3.10	Odourless Brown Gravelly Mud.	0.69	9.43	25.46	65.10
4	0	Odourless Brown Mud with Organic Matter.	4.37	0.10	27.80	72.09
	1	Odourless Brown Mud with Organic Matter.	6.71	0.05	30.42	69.50
	2	Odourless Brown Muddy Sandy Gravel.	0.66	39.44	41.63	18.94
	2.70	Odourless Brown Gravelly Mud.	0.80	10.37	24.36	65.25
5	0	Odourless Brown Mud.	2.15	0.00	8.80	91.19
	1	Odourless Brown Mud.	2.13	0.00	8.09	91.89
	2	Odourless Brown Muddy Sand.	0.38	0.00	77.00	23.01
	3	Odourless Brown Sandy Mud.	1.15	0.00	0.00	100.00
	4	Odourless Brown Gravelly Mud.	0.88	3.93	23.14	72.92
	4.7	Odourless Brown Gravelly Mud.	0.83	19.80	22.27	57.89
6	0	Odourless Brown Mud.	1.65	0.00	18.07	81.94

Sample	Depth (m)	Visual Appearance	Total organic carbon (TOC) M/M %	Particle Size Distribution (%)		
				Gravel (>2 mm)	Sand (2 mm – 63 µm)	Silt (<63 µm)
	1	Odourless Brown Mud.	1.85	0.00	17.34	82.67
	2	Brown Mud with an Earthy Odour.	1.87	0.00	14.76	85.24
	3	Brown Mud with an Earthy Odour.	3.10	0.00	18.53	81.47
	4.10	Odourless Grey-Brown Gravelly Muddy Sand with Shell Fragments and Organic Matter.	0.29	9.60	70.79	19.61
7	0	Odourless Brown Mud.	1.66	0.00	11.77	88.22
	1	Brown Mud with an Earthy Odour.	1.72	0.00	17.62	82.38
	2	Brown Mud with an Earthy Odour.	2.04	0.00	35.84	64.17
	3	Brown Mud with an Earthy Odour.	4.87	0.00	31.16	68.80
	4	Odourless Brown Mud with Organic Matter.	2.55	0.00	36.24	63.77
	4.80	Odourless Brown Mud with Organic Matter.	2.72	0.00	14.89	85.13
8	0	Odourless Brown Gravelly Mud with Organic Matter.	18.80	4.00	10.91	85.09
	1	Odourless Brown Muddy Sand.	0.42	0.00	68.98	31.02
	2	Odourless Brown Sandy Mud.	0.97	0.00	16.51	83.51
	3	Odourless Brown Sandy Mud.	0.92	0.00	5.98	94.02
	3.65	Odourless Brown Sandy Mud.	1.06	0.00	0.56	99.43
9	0	Odourless Brown Mud.	1.99	0.00	3.16	96.82
	1	Odourless Brown Mud.	2.10	0.00	6.16	93.86
	2	Odourless Brown Mud.	2.14	0.00	5.56	94.47
	3	Odourless Brown Gravelly Mud.	0.88	10.21	8.60	81.18
	4	Odourless Brown Mud.	1.15	0.00	0.00	99.99
	4.60	Odourless Brown Mud.	1.20	0.00	0.00	100.00
10	0	Brown Mud with Organic Matter and an Anoxic Odour.	4.36	0.02	29.80	70.19
	1	Odourless Brown Gravelly Sandy Mud with Organic Matter.	6.03	0.55	62.86	36.60
	2	Odourless Brown Sandy Mud.	0.74	0.00	50.69	49.34
	2.60	Odourless Grey-Brown Muddy Sandy Gravel.	0.55	32.49	46.14	21.35

Table 10. Sediment contamination data for Sample 1 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 1 (0 m)	Sample 1 (1.0 m)	Sample 1 (2.0 m)	Sample 1 (3.0 m)	Sample 1 (4.0 m)	Sample 1 (4.7 m)
Arsenic	mg/kg	20	100	17.8	26.5	41.3	62.0	43.7	34.6
Cadmium	mg/kg	0.4	5	0.37	0.46	0.81	0.87	1.06	1.20
Chromium	mg/kg	40	400	49.4	60.6	73.8	113	98.4	77.9
Copper	mg/kg	40	400	31.3	36.5	55.0	69.6	78.5	71.0
Lead	mg/kg	50	500	58.6	69.3	90.1	140	130	110
Mercury	mg/kg	0.3	3	0.19	0.23	0.40	0.50	0.54	0.47
Nickel	mg/kg	20	200	33.2	35.2	40.6	54.8	49.4	43.0
Zinc	mg/kg	130	800	163	191	228	324	314	279
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	0.013	0.013	0.012	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	0.016	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.0601	0.0543	0.15	0.173	0.235	0.351
Acenaphthylene	mg/kg	0.1	-	0.039	0.0349	0.0718	0.104	0.12	0.139
Anthracene	mg/kg	0.1	-	0.114	0.111	0.255	0.321	0.399	0.516
Benzo[a]anthracene	mg/kg	0.1	-	0.251	0.230	0.588	0.675	0.813	0.977
Benzo[a]pyrene	mg/kg	0.1	-	0.345	0.308	0.695	0.954	1.090	1.200
Benzo[b]fluoranthene	mg/kg	0.1	-	0.312	0.324	0.698	0.908	0.972	1.110
Benzo[e]pyrene	mg/kg	0.1	-	0.321	0.326	0.638	0.841	0.889	0.991
Benzo[ghi]perylene	mg/kg	0.1	-	0.333	0.334	0.615	0.905	0.934	0.93
Benzo[k]fluoranthene	mg/kg	0.1	-	0.173	0.172	0.335	0.469	0.574	0.537
C1-naphthalenes	mg/kg	0.1	-	0.586	0.568	0.981	1.17	0.876	0.937
C1-phenanthrene	mg/kg	0.1	-	0.435	0.337	0.671	0.709	0.672	0.805
C2-naphthalenes	mg/kg	0.1	-	0.484	0.456	0.776	0.91	0.666	0.739
C3-naphthalenes	mg/kg	0.1	-	0.491	0.408	0.692	0.8	0.593	0.67
Chrysene	mg/kg	0.1	-	0.26	0.227	0.573	0.681	0.692	0.913
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.0594	0.0499	0.124	0.137	0.15	0.156
Fluoranthene	mg/kg	0.1	-	0.486	0.437	1.17	1.25	1.49	1.95

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 1 (0 m)	Sample 1 (1.0 m)	Sample 1 (2.0 m)	Sample 1 (3.0 m)	Sample 1 (4.0 m)	Sample 1 (4.7 m)
Fluorene	mg/kg	0.1	-	0.0961	0.083	0.213	0.255	0.305	0.413
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.282	0.296	0.609	0.912	0.948	0.991
Naphthalene	mg/kg	0.1	-	0.22	0.223	0.437	0.565	0.493	0.572
Perylene	mg/kg	0.1	-	0.157	0.167	0.31	0.382	0.444	0.454
Phenanthrene	mg/kg	0.1	-	0.433	0.345	0.778	0.848	0.935	1.11
Pyrene	mg/kg	0.1	-	0.488	0.417	1.07	1.09	1.27	1.63
Total Hydrocarbon Content (THC)	mg/kg	-	-	78.1	98.5	79.1	138.0	202.0	480.0
PCBs – Sum of ICES 7	µg/kg	10	-	5.19	8.82	16.64	35.93	39.10	29.83
PCBs – Sum of 25 Congeners	µg/kg	20	200	11.15	18.76	37.23	76.78	11.15	18.76
AHCH	mg/kg	-	-	<0.0001	<0.0001	0.0002	0.0003	0.0002	0.0002
BHCH	mg/kg	-	-	<0.0001	0.0001	0.0002	0.0003	0.0006	0.0005
GHCH	mg/kg	-	-	0.0003	0.0006	0.0027	0.0010	0.0002	<0.0001
Dieldrin	mg/kg	0.005	-	0.0008	0.0008	0.0026	0.0074	0.0065	0.0066
HCB	mg/kg	-	-	0.0005	0.0009	0.0013	0.0015	0.0005	0.0005
PPTDE	mg/kg	-	-	0.0089	0.0115	0.0170	0.0301	0.0364	0.0392
PPDDE	mg/kg	-	-	0.0013	0.0019	0.0034	0.0082	0.0091	0.0099
PPDDT	mg/kg	0.001	-	0.0070	0.0030	0.0121	0.0077	0.0208	0.0189
PBDE 17	µg/kg	-	-	0.474	1.31	0.148	0.0836	<0.02	<0.02
PBDE 28	µg/kg	-	-	0.348	0.962	0.127	0.144	<0.02	<0.02
PBDE 47	µg/kg	-	-	1.72	4.27	0.277	0.337	<0.02	<0.02
PBDE 66	µg/kg	-	-	0.232	0.534	0.0357	0.0484	<0.02	<0.02
PBDE 85	µg/kg	-	-	0.103	0.277	0.0245	0.0358	<0.02	<0.02
PBDE 99	µg/kg	-	-	1.8	4.39	0.295	0.368	<0.02	<0.02
PBDE 100	µg/kg	-	-	0.199	0.552	0.0299	<0.02	<0.02	<0.02
PBDE 138	µg/kg	-	-	0.0408	0.0858	<0.02	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 1 (0 m)	Sample 1 (1.0 m)	Sample 1 (2.0 m)	Sample 1 (3.0 m)	Sample 1 (4.0 m)	Sample 1 (4.7 m)
PBDE 153	µg/kg	-	-	0.245	0.516	0.0313	0.0327	<0.02	<0.02
PBDE 154	µg/kg	-	-	0.115	0.233	<0.02	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	0.0824	0.127	<0.02	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	81.8	84.3	1.4	0.361	<0.1	0.109
Key	Below AL1								
	Above AL1, Below AL2								
	Above AL2								

Table 11. Sediment contamination data for Sample 2 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 2 (0 m)	Sample 2 (1.0 m)	Sample 2 (2.0 m)	Sample 2 (3.0 m)	Sample 2 (3.8 m)
Arsenic	mg/kg	20	100	30.5	43.4	10.1	9.7	5.0
Cadmium	mg/kg	0.4	5	0.46	0.99	0.21	0.25	0.19
Chromium	mg/kg	40	400	56.7	75.8	37.0	30.1	14.1
Copper	mg/kg	40	400	36.4	56.1	22.2	21.8	13.3
Lead	mg/kg	50	500	70.9	94.7	19.4	16.5	9.7
Mercury	mg/kg	0.3	3	0.26	0.44	0.04	0.01	<0.01
Nickel	mg/kg	20	200	34.4	39.9	42.1	38.2	20.8
Zinc	mg/kg	130	800	186	250	70.5	65.8	40.8
Dibutyltin (DBT)	mg/kg	0.1	1	0.013	0.012	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.101	0.144	0.0214	0.0178	0.0124
Acenaphthylene	mg/kg	0.1	-	0.0616	0.068	0.00833	0.00557	0.00447
Anthracene	mg/kg	0.1	-	0.194	0.275	0.0208	0.0176	0.0139
Benzo[a]anthracene	mg/kg	0.1	-	0.384	0.551	0.0622	0.0547	0.0472
Benzo[a]pyrene	mg/kg	0.1	-	0.487	0.736	0.087	0.0714	0.0609
Benzo[b]fluoranthene	mg/kg	0.1	-	0.513	0.69	0.101	0.0941	0.0956
Benzo[e]pyrene	mg/kg	0.1	-	0.498	0.641	0.169	0.168	0.168
Benzo[ghi]perylene	mg/kg	0.1	-	0.487	0.687	0.216	0.197	0.16
Benzo[k]fluoranthene	mg/kg	0.1	-	0.193	0.301	0.036	0.0194	0.019
C1-naphthalenes	mg/kg	0.1	-	0.889	1.06	0.574	0.365	0.394
C1-phenanthrene	mg/kg	0.1	-	0.596	0.711	0.386	0.309	0.32
C2-naphthalenes	mg/kg	0.1	-	0.731	0.838	0.401	0.304	0.311
C3-naphthalenes	mg/kg	0.1	-	0.726	0.734	0.362	0.283	0.278
Chrysene	mg/kg	0.1	-	0.384	0.545	0.0911	0.101	0.0897
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.0802	0.103	0.0211	0.0186	0.0181
Fluoranthene	mg/kg	0.1	-	0.677	1.11	0.0926	0.0838	0.061

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 2 (0 m)	Sample 2 (1.0 m)	Sample 2 (2.0 m)	Sample 2 (3.0 m)	Sample 2 (3.8 m)
Fluorene	mg/kg	0.1	-	0.138	0.213	0.0693	0.0477	0.0474
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.44	0.691	0.0668	0.0539	0.0395
Naphthalene	mg/kg	0.1	-	0.337	0.441	0.19	0.0769	0.0915
Perylene	mg/kg	0.1	-	0.217	0.291	0.0268	0.0234	0.0143
Phenanthrene	mg/kg	0.1	-	0.562	0.855	0.309	0.235	0.25
Pyrene	mg/kg	0.1	-	0.651	0.99	0.118	0.128	0.104
Total Hydrocarbon Content (THC)	mg/kg	-	-	26.3	87.8	10.8	8.37	42.4
PCBs – Sum of ICES 7	ug/kg	10	-	8.84	20.58	0.59	<0.56	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	19.48	47.80	2.03	<2.00	<2.00
AHCH	mg/kg	-	-	<0.0001	0.0003	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	0.0002	0.0008	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	0.0003	0.0017	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0019	0.0035	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	0.0010	0.0018	<0.0001	<0.0001	<0.0001
PPTDE	mg/kg	-	-	0.0127	0.0283	0.0007	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0022	0.0053	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0018	0.0214	0.0004	<0.0001	<0.0001
PBDE 17	µg/kg	-	-	0.543	0.212	<0.02	<0.02	<0.02
PBDE 28	µg/kg	-	-	0.448	0.104	<0.02	<0.02	<0.02
PBDE 47	µg/kg	-	-	1.97	0.241	0.0371	<0.02	<0.02
PBDE 66	µg/kg	-	-	0.208	0.033	<0.02	<0.02	<0.02
PBDE 85	µg/kg	-	-	0.12	<0.02	<0.02	<0.02	<0.02
PBDE 99	µg/kg	-	-	1.83	0.26	0.0289	<0.02	<0.02
PBDE 100	µg/kg	-	-	0.134	0.024	<0.02	<0.02	<0.02
PBDE 138	µg/kg	-	-	0.0494	<0.02	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 2 (0 m)	Sample 2 (1.0 m)	Sample 2 (2.0 m)	Sample 2 (3.0 m)	Sample 2 (3.8 m)
PBDE 153	µg/kg	-	-	0.241	0.0272	<0.02	<0.02	<0.02
PBDE 154	µg/kg	-	-	0.0803	<0.02	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	0.0654	<0.02	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	45.5	0.556	0.687	0.137	0.148
Key	Below AL1							
	Above AL1, Below AL2							
	Above AL2							

Table 12. Sediment contamination data for Sample 3 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 3 (0 m)	Sample 3 (1.0 m)	Sample 3 (2.0 m)	Sample 3 (3.1 m)
Arsenic	mg/kg	20	100	5.6	2.4	5.2	6.4
Cadmium	mg/kg	0.4	5	0.13	0.08	0.20	0.24
Chromium	mg/kg	40	400	16.4	8.4	20.4	22.1
Copper	mg/kg	40	400	14.9	10.1	19.2	13.8
Lead	mg/kg	50	500	16.3	6.1	15.0	10.4
Mercury	mg/kg	0.3	3	0.03	<0.01	0.01	0.04
Nickel	mg/kg	20	200	17.4	14.6	28.4	26.9
Zinc	mg/kg	130	800	52.0	31.1	57.5	48.8
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.0239	0.00107	0.0108	0.00809
Acenaphthylene	mg/kg	0.1	-	0.0156	<0.001	0.00427	0.00291
Anthracene	mg/kg	0.1	-	0.0448	0.00174	0.0128	0.0113
Benzo[a]anthracene	mg/kg	0.1	-	0.125	0.0042	0.0619	0.0312
Benzo[a]pyrene	mg/kg	0.1	-	0.158	0.00295	0.0534	0.0368
Benzo[b]fluoranthene	mg/kg	0.1	-	0.194	0.0058	0.158	0.0501
Benzo[e]pyrene	mg/kg	0.1	-	0.206	0.00989	0.243	0.0747
Benzo[ghi]perylene	mg/kg	0.1	-	0.196	0.00943	0.182	0.0985
Benzo[k]fluoranthene	mg/kg	0.1	-	0.0812	0.00206	0.0241	0.0145
C1-naphthalenes	mg/kg	0.1	-	0.325	0.0122	0.487	0.18
C1-phenanthrene	mg/kg	0.1	-	0.242	0.0126	0.354	0.185
C2-naphthalenes	mg/kg	0.1	-	0.253	0.0106	0.326	0.158
C3-naphthalenes	mg/kg	0.1	-	0.238	0.00934	0.237	0.173
Chrysene	mg/kg	0.1	-	0.152	0.00604	0.187	0.0477
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.0322	0.00179	0.0317	0.00964
Fluoranthene	mg/kg	0.1	-	0.207	0.00525	0.0865	0.0514

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 3 (0 m)	Sample 3 (1.0 m)	Sample 3 (2.0 m)	Sample 3 (3.1 m)
Fluorene	mg/kg	0.1	-	0.0435	0.00138	0.0425	0.0217
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.164	0.00191	0.057	0.0267
Naphthalene	mg/kg	0.1	-	0.135	0.00524	0.119	0.0477
Perylene	mg/kg	0.1	-	0.127	0.0702	0.00684	0.0192
Phenanthrene	mg/kg	0.1	-	0.219	0.00986	0.324	0.139
Pyrene	mg/kg	0.1	-	0.221	0.00812	0.11	0.0637
Total Hydrocarbon Content (THC)	mg/kg	-	-	36.8	6.7	96.7	26.7
PCBs – Sum of ICES 7	ug/kg	10	-	<0.56	<0.56	0.57	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	2.58	<2.00	<2.00	2.01
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPTDE	mg/kg	-	-	0.0014	0.0002	<0.0001	0.0007
PPDDE	mg/kg	-	-	0.0001	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0002	<0.0001	<0.0001	0.0002
PBDE 17	µg/kg	-	-	0.0645	<0.02	<0.02	<0.02
PBDE 28	µg/kg	-	-	0.0488	<0.02	<0.02	<0.02
PBDE 47	µg/kg	-	-	0.204	<0.02	<0.02	<0.02
PBDE 66	µg/kg	-	-	0.0311	<0.02	<0.02	<0.02
PBDE 85	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 99	µg/kg	-	-	0.199	<0.02	<0.02	<0.02
PBDE 100	µg/kg	-	-	0.0297	<0.02	<0.02	<0.02
PBDE 138	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 153	µg/kg	-	-	0.035	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 3 (0 m)	Sample 3 (1.0 m)	Sample 3 (2.0 m)	Sample 3 (3.1 m)
PBDE 154	µg/kg	-	-	0.0206	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	12.9	0.143	0.195	0.102
Key	Below AL1						
	Above AL1, Below AL2						
	Above AL2						

Table 13. Sediment contamination data for Sample 4 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 4 (0 m)	Sample 4 (1.0 m)	Sample 4 (2.0 m)	Sample 4 (2.7 m)
Arsenic	mg/kg	20	100	13.8	16.8	6.6	6.5
Cadmium	mg/kg	0.4	5	0.33	0.37	0.23	0.21
Chromium	mg/kg	40	400	37.5	35.2	14.2	19.0
Copper	mg/kg	40	400	18.9	18.6	21.5	13.7
Lead	mg/kg	50	500	19.7	18.1	9.0	9.3
Mercury	mg/kg	0.3	3	0.03	0.03	0.02	0.02
Nickel	mg/kg	20	200	41.3	41.7	24.7	22.0
Zinc	mg/kg	130	800	93.2	99.7	60.0	44.2
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.00760	0.00522	0.0106	0.0105
Acenaphthylene	mg/kg	0.1	-	0.00199	0.00103	0.00358	0.00262
Anthracene	mg/kg	0.1	-	0.00732	0.00433	0.0123	0.0125
Benzo[a]anthracene	mg/kg	0.1	-	0.01460	0.00869	0.032	0.0323
Benzo[a]pyrene	mg/kg	0.1	-	0.02110	0.01160	0.038	0.0379
Benzo[b]fluoranthene	mg/kg	0.1	-	0.03950	0.02550	0.0499	0.0455
Benzo[e]pyrene	mg/kg	0.1	-	0.0596	0.0375	0.0905	0.0750
Benzo[ghi]perylene	mg/kg	0.1	-	0.0705	0.0469	0.0869	0.0925
Benzo[k]fluoranthene	mg/kg	0.1	-	0.00897	0.00484	0.0168	0.0138
C1-naphthalenes	mg/kg	0.1	-	0.14300	0.07840	0.214	0.146
C1-phenanthrene	mg/kg	0.1	-	0.12600	0.07570	0.229	0.192
C2-naphthalenes	mg/kg	0.1	-	0.11700	0.07280	0.202	0.14
C3-naphthalenes	mg/kg	0.1	-	0.10900	0.06030	0.21	0.155
Chrysene	mg/kg	0.1	-	0.02720	0.02220	0.0535	0.0485
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.00736	0.00527	0.00909	0.0102
Fluoranthene	mg/kg	0.1	-	0.02660	0.01600	0.0464	0.0511

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 4 (0 m)	Sample 4 (1.0 m)	Sample 4 (2.0 m)	Sample 4 (2.7 m)
Fluorene	mg/kg	0.1	-	0.01860	0.01260	0.0281	0.0216
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.01990	0.01220	0.0192	0.0241
Naphthalene	mg/kg	0.1	-	0.03800	0.02030	0.0494	0.0313
Perylene	mg/kg	0.1	-	0.16000	2.40000	0.0174	0.0181
Phenanthrene	mg/kg	0.1	-	0.09300	0.06140	0.173	0.137
Pyrene	mg/kg	0.1	-	0.03480	0.02220	0.0693	0.0673
Total Hydrocarbon Content (THC)	mg/kg	-	-	4.98	9.35	156	5.31
PCBs – Sum of ICES 7	ug/kg	10	-	<0.56	<0.56	<0.56	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	<2.00	<2.00	<2.00	<2.00
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPTDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPDDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	<0.0001	<0.0001	<0.0001	<0.0001
PBDE 17	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 28	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 47	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 66	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 85	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 99	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 100	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 138	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 153	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 4 (0 m)	Sample 4 (1.0 m)	Sample 4 (2.0 m)	Sample 4 (2.7 m)
PBDE 154	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	<0.1	0.139	<0.1	<0.1
Key	Below AL1						
	Above AL1, Below AL2						
	Above AL2						

Table 14. Sediment contamination data for Sample 5 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 5 (0 m)	Sample 5 (1.0 m)	Sample 5 (2.0 m)	Sample 5 (3 m)	Sample 5 (4 m)	Sample 5 (4.7 m)
Arsenic	mg/kg	20	100	17.7	19.1	4.0	12	7.8	13.6
Cadmium	mg/kg	0.4	5	0.38	0.42	0.17	0.24	0.18	0.22
Chromium	mg/kg	40	400	49.7	58.5	9.0	28.6	19.2	19.7
Copper	mg/kg	40	400	32.7	33.0	9.7	22.6	14.9	17.0
Lead	mg/kg	50	500	62.8	67.6	6.9	18.0	13.3	10.5
Mercury	mg/kg	0.3	3	0.13	0.14	0.01	0.02	0.03	0.03
Nickel	mg/kg	20	200	35.2	38.2	11.6	36.3	24.0	25.8
Zinc	mg/kg	130	800	167	178	35.2	66.8	45.8	49.5
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.04640	0.05990	0.00316	0.03170	0.01410	0.01030
Acenaphthylene	mg/kg	0.1	-	0.02890	0.03630	0.00113	0.01060	0.00375	0.00321
Anthracene	mg/kg	0.1	-	0.22400	0.09480	0.00418	0.02460	0.01250	0.00938
Benzo[a]anthracene	mg/kg	0.1	-	0.23000	0.24200	0.01110	0.08670	0.02940	0.02450
Benzo[a]pyrene	mg/kg	0.1	-	0.30600	0.33700	0.01270	0.12800	0.03500	0.03090
Benzo[b]fluoranthene	mg/kg	0.1	-	0.31600	0.36200	0.01850	0.17100	0.04270	0.03800
Benzo[e]pyrene	mg/kg	0.1	-	0.322	0.355	0.0302	0.3350	0.0779	0.0633
Benzo[ghi]perylene	mg/kg	0.1	-	0.3270	0.3730	0.0304	0.3230	0.0924	0.0848
Benzo[k]fluoranthene	mg/kg	0.1	-	0.1640	0.1780	0.0054	0.0423	0.0173	0.0109
C1-naphthalenes	mg/kg	0.1	-	0.5650	0.6410	0.0671	1.14	0.201	0.183
C1-phenanthrene	mg/kg	0.1	-	0.3790	0.4270	0.0763	0.725	0.243	0.172
C2-naphthalenes	mg/kg	0.1	-	0.4550	0.5450	0.064	0.782	0.227	0.185
C3-naphthalenes	mg/kg	0.1	-	0.3910	0.5150	0.0649	0.567	0.252	0.195
Chrysene	mg/kg	0.1	-	0.3070	0.2410	0.0195	0.181	0.0416	0.0381
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.0494	0.0507	0.00294	0.0409	0.0102	0.0065
Fluoranthene	mg/kg	0.1	-	0.3740	0.4280	0.0162	0.134	0.0488	0.0383

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 5 (0 m)	Sample 5 (1.0 m)	Sample 5 (2.0 m)	Sample 5 (3 m)	Sample 5 (4 m)	Sample 5 (4.7 m)
Fluorene	mg/kg	0.1	-	0.0746	0.0914	0.00802	0.175	0.0297	0.0222
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.2800	0.3240	0.00809	0.0826	0.0223	0.0193
Naphthalene	mg/kg	0.1	-	0.2210	0.2460	0.0149	0.236	0.0284	0.0378
Perylene	mg/kg	0.1	-	0.1340	0.1660	0.00422	0.0241	0.015	0.0151
Phenanthrene	mg/kg	0.1	-	0.3580	0.3790	0.0515	0.66	0.182	0.126
Pyrene	mg/kg	0.1	-	0.3880	0.4440	0.0267	0.192	0.0645	0.056
Total Hydrocarbon Content (THC)	mg/kg	-	-	269	120	21.0	22.7	11.9	25.2
PCBs – Sum of ICES 7	ug/kg	10	-	4.48	5.53	<0.56	<0.56	<0.56	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	10.00	12.00	<2.00	<2.00	<2.00	<2.00
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0008	0.0011	<0.0001	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	0.0005	0.0005	<0.0001	<0.0001	<0.0001	<0.0001
PPTDE	mg/kg	-	-	0.0079	0.0086	0.0002	<0.0001	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0015	0.0016	<0.0001	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0019	0.0020	<0.0001	<0.0001	<0.0001	<0.0001
PBDE 17	µg/kg	-	-	0.397	0.406	<0.02	<0.02	<0.02	<0.02
PBDE 28	µg/kg	-	-	0.27	0.317	<0.02	<0.02	<0.02	<0.02
PBDE 47	µg/kg	-	-	1.5	1.64	<0.02	<0.02	<0.02	<0.02
PBDE 66	µg/kg	-	-	0.174	0.179	<0.02	<0.02	<0.02	<0.02
PBDE 85	µg/kg	-	-	0.0954	0.217	<0.02	<0.02	<0.02	<0.02
PBDE 99	µg/kg	-	-	1.77	3.75	<0.02	<0.02	<0.02	<0.02
PBDE 100	µg/kg	-	-	0.267	0.543	<0.02	<0.02	<0.02	<0.02
PBDE 138	µg/kg	-	-	0.0538	0.141	<0.02	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 5 (0 m)	Sample 5 (1.0 m)	Sample 5 (2.0 m)	Sample 5 (3 m)	Sample 5 (4 m)	Sample 5 (4.7 m)
PBDE 153	µg/kg	-	-	0.327	0.705	<0.02	<0.02	<0.02	<0.02
PBDE 154	µg/kg	-	-	0.174	0.342	<0.02	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	0.0861	0.0813	<0.02	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	62	79.5	0.364	0.203	0.109	0.129
Key	Below AL1								
	Above AL1, Below AL2								
	Above AL2								

Table 15. Sediment contamination data for Sample 6 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 6 (0 m)	Sample 6 (1.0 m)	Sample 6 (2.0 m)	Sample 6 (3 m)	Sample 6 (4.1 m)
Arsenic	mg/kg	20	100	16.4	27.0	37.8	24.9	7.0
Cadmium	mg/kg	0.4	5	0.30	0.53	1.04	0.70	0.36
Chromium	mg/kg	40	400	43.8	55.6	79.6	72.1	11.3
Copper	mg/kg	40	400	29.0	34.5	55.0	48.9	9.4
Lead	mg/kg	50	500	48.7	59.6	86.8	102	9.1
Mercury	mg/kg	0.3	3	0.14	0.20	0.42	0.32	0.04
Nickel	mg/kg	20	200	30.0	29.7	36.1	43.7	15.9
Zinc	mg/kg	130	800	129	176	221	214	43.8
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	0.013	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	0.012	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.04650	0.06050	0.18100	0.01410	<0.001
Acenaphthylene	mg/kg	0.1	-	0.03320	0.03860	0.09780	0.00527	<0.001
Anthracene	mg/kg	0.1	-	0.09380	0.13300	0.34400	0.01580	<0.001
Benzo[a]anthracene	mg/kg	0.1	-	0.23600	0.28700	0.75500	0.03460	0.00473
Benzo[a]pyrene	mg/kg	0.1	-	0.32800	0.42000	1.07000	0.04640	0.00249
Benzo[b]fluoranthene	mg/kg	0.1	-	0.31900	0.40500	0.93900	0.06300	0.00956
Benzo[e]pyrene	mg/kg	0.1	-	0.3230	0.3940	0.8520	0.0847	0.0153
Benzo[ghi]perylene	mg/kg	0.1	-	0.34000	0.41600	0.90000	0.09580	0.00985
Benzo[k]fluoranthene	mg/kg	0.1	-	0.14000	0.18300	0.57200	0.02110	0.00226
C1-naphthalenes	mg/kg	0.1	-	0.59000	0.74700	1.25000	0.17800	0.00897
C1-phenanthrene	mg/kg	0.1	-	0.40000	0.43300	0.78900	0.14200	0.01470
C2-naphthalenes	mg/kg	0.1	-	0.46800	0.60800	0.97600	0.14300	0.00456
C3-naphthalenes	mg/kg	0.1	-	0.44000	0.53800	0.84900	0.13600	0.00400
Chrysene	mg/kg	0.1	-	0.22100	0.28000	0.67400	0.04860	0.01150
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.06170	0.06460	0.18200	0.01260	0.00210
Fluoranthene	mg/kg	0.1	-	0.40400	0.51900	1.51000	0.06910	0.00617

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 6 (0 m)	Sample 6 (1.0 m)	Sample 6 (2.0 m)	Sample 6 (3 m)	Sample 6 (4.1 m)
Fluorene	mg/kg	0.1	-	0.08060	0.09070	0.23000	0.02600	<0.001
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.30000	0.38300	0.94600	0.04670	0.00336
Naphthalene	mg/kg	0.1	-	0.24800	0.29300	0.55400	0.06150	0.00715
Perylene	mg/kg	0.1	-	0.14500	0.17500	0.36000	0.26800	0.27500
Phenanthrene	mg/kg	0.1	-	0.38000	0.43200	0.95900	0.11400	0.01330
Pyrene	mg/kg	0.1	-	0.41600	0.53100	1.32000	0.07270	0.00880
Total Hydrocarbon Content (THC)	mg/kg	-	-	28.00	135.00	142.00	12.10	2.86
PCBs – Sum of ICES 7	ug/kg	10	-	4.47	7.33	31.18	11.74	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	9.60	16.00	70.00	25.00	<2.00
AHCH	mg/kg	-	-	<0.0001	0.0002	0.0002	0.0002	<0.0001
BHCH	mg/kg	-	-	<0.0001	0.0002	0.0004	0.0006	<0.0001
GHCH	mg/kg	-	-	0.0001	0.0005	0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0007	0.0016	0.0079	0.0116	<0.0001
HCB	mg/kg	-	-	0.0005	0.0010	0.0022	0.0006	0.0001
PPTDE	mg/kg	-	-	0.0080	0.0104	0.0246	0.0296	0.0003
PPDDE	mg/kg	-	-	0.0011	0.0016	0.0045	0.0061	0.0001
PPDDT	mg/kg	0.001	-	0.0006	0.0012	0.0106	0.0068	0.0002
PBDE 17	µg/kg	-	-	0.487	2.17	0.113	<0.02	<0.02
PBDE 28	µg/kg	-	-	0.33	1.12	0.0737	<0.02	<0.02
PBDE 47	µg/kg	-	-	1.61	5.23	0.412	<0.02	<0.02
PBDE 66	µg/kg	-	-	0.197	0.546	0.0412	<0.02	<0.02
PBDE 85	µg/kg	-	-	0.0986	0.516	0.034	<0.02	<0.02
PBDE 99	µg/kg	-	-	1.69	8.2	0.475	<0.02	<0.02
PBDE 100	µg/kg	-	-	0.265	0.819	0.0472	<0.02	<0.02
PBDE 138	µg/kg	-	-	0.0448	0.305	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 6 (0 m)	Sample 6 (1.0 m)	Sample 6 (2.0 m)	Sample 6 (3 m)	Sample 6 (4.1 m)
PBDE 153	µg/kg	-	-	0.276	1.59	0.0615	<0.02	<0.02
PBDE 154	µg/kg	-	-	0.149	0.533	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	0.0725	0.162	<0.02	0.0237	<0.02
PBDE 209	µg/kg	-	-	71.7	68.8	1.42	0.225	<0.1
Key	Below AL1							
	Above AL1, Below AL2							
	Above AL2							

Table 16. Sediment contamination data for Sample 7 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 7 (0 m)	Sample 7 (1.0 m)	Sample 7 (2.0 m)	Sample 7 (3 m)	Sample 7 (4 m)	Sample 7 (4.8 m)
Arsenic	mg/kg	20	100	15.3	30.0	37.0	15.6	16.1	12.9
Cadmium	mg/kg	0.4	5	0.27	0.66	1.01	0.26	0.28	0.32
Chromium	mg/kg	40	400	39.8	64.0	92.7	35.2	35.3	36.8
Copper	mg/kg	40	400	25.2	38.3	75.3	19.5	17.1	17.7
Lead	mg/kg	50	500	49.9	65.2	115	23.1	20.7	20.6
Mercury	mg/kg	0.3	3	0.16	0.25	0.44	0.08	0.06	0.05
Nickel	mg/kg	20	200	27.1	32.7	42.6	40.0	40.4	40.2
Zinc	mg/kg	130	800	131	185	265	103	95.6	91.4
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	0.008	<0.005	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.0583	0.06200	0.30300	0.00917	0.00630	0.00861
Acenaphthylene	mg/kg	0.1	-	0.0534	0.04590	0.12500	0.00395	0.00224	0.00284
Anthracene	mg/kg	0.1	-	0.1140	0.19300	0.45300	0.01220	0.00719	0.00889
Benzo[a]anthracene	mg/kg	0.1	-	0.2810	0.29300	0.87400	0.02970	0.01940	0.02130
Benzo[a]pyrene	mg/kg	0.1	-	0.4530	0.42900	1.25000	0.03510	0.02250	0.02520
Benzo[b]fluoranthene	mg/kg	0.1	-	0.4000	0.37900	1.10000	0.05830	0.04660	0.04480
Benzo[e]pyrene	mg/kg	0.1	-	0.419	0.3760	0.9930	0.0960	0.0724	0.0706
Benzo[ghi]perylene	mg/kg	0.1	-	0.4410	0.4010	1.0500	0.0965	0.0775	0.0808
Benzo[k]fluoranthene	mg/kg	0.1	-	0.2090	0.202	0.601	0.0152	0.00819	0.0112
C1-naphthalenes	mg/kg	0.1	-	0.7640	0.654	1.25	0.242	0.161	0.168
C1-phenanthrene	mg/kg	0.1	-	0.4890	0.407	0.771	0.175	0.134	0.134
C2-naphthalenes	mg/kg	0.1	-	0.6120	0.509	0.921	0.176	0.12	0.137
C3-naphthalenes	mg/kg	0.1	-	0.5460	0.448	0.823	0.137	0.108	0.121
Chrysene	mg/kg	0.1	-	0.2910	0.268	0.815	0.0575	0.0352	0.0376
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.0679	0.074	0.205	0.0143	0.0094	0.00832

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 7 (0 m)	Sample 7 (1.0 m)	Sample 7 (2.0 m)	Sample 7 (3 m)	Sample 7 (4 m)	Sample 7 (4.8 m)
Fluoranthene	mg/kg	0.1	-	0.4880	0.536	1.74	0.0544	0.0314	0.0345
Fluorene	mg/kg	0.1	-	0.0909	0.0982	0.376	0.0267	0.0184	0.0222
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.4050	0.39	1.11	0.0369	0.0229	0.0253
Naphthalene	mg/kg	0.1	-	0.3010	0.268	0.689	0.0713	0.0413	0.051
Perylene	mg/kg	0.1	-	0.1760	0.178	0.439	1.64	0.455	0.4
Phenanthrene	mg/kg	0.1	-	0.4430	0.431	1.03	0.149	0.108	0.106
Pyrene	mg/kg	0.1	-	0.5040	0.552	1.47	0.0663	0.0405	0.0433
Total Hydrocarbon Content (THC)	mg/kg	-	-	21.7	104.00	180.00	6.37	3.06	6.06
PCBs – Sum of ICES 7	ug/kg	10	-	4.63	12.53	28.91	0.62	<0.56	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	9.99	27.88	65.82	2.10	<2.00	<2.00
AHCH	mg/kg	-	-	<0.0001	0.0001	0.0002	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	0.0001	0.0005	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	0.0003	0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0008	0.0029	0.0118	0.0002	<0.0001	<0.0001
HCB	mg/kg	-	-	0.0006	0.0010	0.0006	0.0001	0.0000	<0.0001
PPTDE	mg/kg	-	-	0.0075	0.0169	0.0382	0.0007	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0014	0.0030	0.0096	0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0030	0.0092	0.0092	0.0004	0.0002	<0.0001
PBDE 17	µg/kg	-	-	0.496	0.286	<0.02	<0.02	<0.02	<0.02
PBDE 28	µg/kg	-	-	0.324	0.134	<0.02	<0.02	<0.02	<0.02
PBDE 47	µg/kg	-	-	1.71	0.711	0.0334	<0.02	<0.02	<0.02
PBDE 66	µg/kg	-	-	0.199	0.0825	<0.02	<0.02	<0.02	<0.02
PBDE 85	µg/kg	-	-	0.0971	0.0509	<0.02	<0.02	<0.02	<0.02
PBDE 99	µg/kg	-	-	1.69	0.709	0.0301	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 7 (0 m)	Sample 7 (1.0 m)	Sample 7 (2.0 m)	Sample 7 (3 m)	Sample 7 (4 m)	Sample 7 (4.8 m)
PBDE 100	µg/kg	-	-	0.219	0.0944	<0.02	<0.02	<0.02	<0.02
PBDE 138	µg/kg	-	-	0.044	0.0251	<0.02	<0.02	<0.02	<0.02
PBDE 153	µg/kg	-	-	0.241	0.0955	<0.02	<0.02	<0.02	<0.02
PBDE 154	µg/kg	-	-	0.12	0.0383	<0.02	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	0.089	0.0201	<0.02	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	60.9	7.51	0.337	0.115	<0.1	0.132
Key	Below AL1								
	Above AL1, Below AL2								
	Above AL2								

Table 17. Sediment contamination data for Sample 8 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 8 (0 m)	Sample 8 (1.0 m)	Sample 8 (2.0 m)	Sample 8 (3 m)	Sample 8 (3.65 m)
Arsenic	mg/kg	20	100	20.2	5.4	6.9	8.2	9.2
Cadmium	mg/kg	0.4	5	0.51	0.19	0.15	0.20	0.27
Chromium	mg/kg	40	400	16.8	12.3	16.5	28.1	28.8
Copper	mg/kg	40	400	18.4	13.7	14.8	18.9	20.3
Lead	mg/kg	50	500	14.6	8.9	10.1	15.4	16.8
Mercury	mg/kg	0.3	3	0.04	0.03	0.02	0.02	0.02
Nickel	mg/kg	20	200	23.8	15.6	20.9	33.7	35.6
Zinc	mg/kg	130	800	79.4	38.1	42.9	58.3	62.4
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.00694	0.0049	0.00984	0.0241	0.0157
Acenaphthylene	mg/kg	0.1	-	0.00252	0.00154	0.00313	0.00686	0.00442
Anthracene	mg/kg	0.1	-	0.00736	0.0057	0.0133	0.0234	0.0171
Benzo[a]anthracene	mg/kg	0.1	-	0.0153	0.0152	0.0363	0.0676	0.0489
Benzo[a]pyrene	mg/kg	0.1	-	0.0176	0.0183	0.0408	0.0919	0.0647
Benzo[b]fluoranthene	mg/kg	0.1	-	0.028	0.022	0.0493	0.108	0.0847
Benzo[e]pyrene	mg/kg	0.1	-	0.0321	0.0411	0.0798	0.197	0.141
Benzo[ghi]perylene	mg/kg	0.1	-	0.0369	0.045	0.088	0.238	0.165
Benzo[k]fluoranthene	mg/kg	0.1	-	0.0103	0.00505	0.0192	0.0289	0.0199
C1-naphthalenes	mg/kg	0.1	-	0.0998	0.0854	0.226	0.409	0.31
C1-phenanthrene	mg/kg	0.1	-	0.0659	0.0936	0.221	0.429	0.293
C2-naphthalenes	mg/kg	0.1	-	0.0772	0.0872	0.19	0.391	0.26
C3-naphthalenes	mg/kg	0.1	-	0.0742	0.0968	0.199	0.42	0.251
Chrysene	mg/kg	0.1	-	0.0198	0.0223	0.0484	0.112	0.0742
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.0044	0.00343	0.00786	0.0251	0.018
Fluoranthene	mg/kg	0.1	-	0.0303	0.0224	0.0491	0.106	0.0717

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 8 (0 m)	Sample 8 (1.0 m)	Sample 8 (2.0 m)	Sample 8 (3 m)	Sample 8 (3.65 m)
Fluorene	mg/kg	0.1	-	0.0161	0.0102	0.0218	0.0664	0.0427
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.0189	0.0095	0.0216	0.0548	0.0433
Naphthalene	mg/kg	0.1	-	0.0347	0.0197	0.0544	0.0799	0.0657
Perylene	mg/kg	0.1	-	3.28	0.00736	0.0124	0.0279	0.0184
Phenanthrene	mg/kg	0.1	-	0.0534	0.0713	0.161	0.316	0.224
Pyrene	mg/kg	0.1	-	0.0385	0.0379	0.0761	0.152	0.108
Total Hydrocarbon Content (THC)	mg/kg	-	-	5.47	28.30	36.20	26.50	32.50
PCBs – Sum of ICES 7	ug/kg	10	-	3.68	<0.56	<0.56	<0.56	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	11.59	<2.00	<2.00	<2.00	<2.00
AHCH	mg/kg	-	-	0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	0.0005	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	0.0004	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0012	<0.0001	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	0.0004	<0.0001	<0.0001	<0.0001	<0.0001
PPTDE	mg/kg	-	-	0.0032	<0.0001	<0.0001	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0007	<0.0001	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0004	<0.0001	<0.0001	<0.0001	<0.0001
PBDE 17	µg/kg	-	-	0.123	<0.02	<0.02	<0.02	<0.02
PBDE 28	µg/kg	-	-	0.0892	<0.02	<0.02	<0.02	<0.02
PBDE 47	µg/kg	-	-	0.368	<0.02	<0.02	<0.02	<0.02
PBDE 66	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02	<0.02
PBDE 85	µg/kg	-	-	0.0663	<0.02	<0.02	<0.02	<0.02
PBDE 99	µg/kg	-	-	0.364	<0.02	<0.02	<0.02	<0.02
PBDE 100	µg/kg	-	-	0.0886	<0.02	<0.02	<0.02	<0.02
PBDE 138	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration				
		AL1	AL2	Sample 8 (0 m)	Sample 8 (1.0 m)	Sample 8 (2.0 m)	Sample 8 (3 m)	Sample 8 (3.65 m)
PBDE 153	µg/kg	-	-	0.0501	<0.02	<0.02	<0.02	<0.02
PBDE 154	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	5.76	0.103	<0.1	<0.1	1.5
Key	Below AL1							
	Above AL1, Below AL2							
	Above AL2							

Table 18. Sediment contamination data for Sample 9 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 9 (0 m)	Sample 9 (1.0 m)	Sample 9 (2.0 m)	Sample 9 (3 m)	Sample 9 (4 m)	Sample 9 (4.6 m)
Arsenic	mg/kg	20	100	18.0	24.1	24.6	8.4	9.6	10.3
Cadmium	mg/kg	0.4	5	0.35	0.36	0.43	0.19	0.28	0.23
Chromium	mg/kg	40	400	50.4	58.7	57.6	21.1	32.0	36.9
Copper	mg/kg	40	400	30.5	35.9	35.7	17.5	21.3	23.6
Lead	mg/kg	50	500	63.7	71.4	73.9	13.2	18.3	19.7
Mercury	mg/kg	0.3	3	0.19	0.20	0.22	0.02	0.02	0.02
Nickel	mg/kg	20	200	34.2	37.1	34.6	25.4	40.0	44.3
Zinc	mg/kg	130	800	164	177	177	48.8	69.0	76.6
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	0.012	<0.005	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	0.011	0.014	<0.005	<0.005	<0.005	0.011
Acenaphthene	mg/kg	0.1	-	0.0481	0.0541	0.0609	0.0149	0.0221	0.0211
Acenaphthylene	mg/kg	0.1	-	0.0286	0.0372	0.0364	0.0053	0.00718	0.00729
Anthracene	mg/kg	0.1	-	0.0953	0.121	0.121	0.019	0.0187	0.0183
Benzo[a]anthracene	mg/kg	0.1	-	0.217	0.254	0.256	0.0523	0.0488	0.0556
Benzo[a]pyrene	mg/kg	0.1	-	0.29	0.341	0.323	0.0643	0.0692	0.0742
Benzo[b]fluoranthene	mg/kg	0.1	-	0.28	0.344	0.316	0.076	0.0816	0.0908
Benzo[e]pyrene	mg/kg	0.1	-	0.292	0.359	0.328	0.137	0.152	0.174
Benzo[ghi]perylene	mg/kg	0.1	-	0.303	0.389	0.335	0.159	0.184	0.188
Benzo[k]fluoranthene	mg/kg	0.1	-	0.1450	0.1840	0.1690	0.0223	0.0233	0.0255
C1-naphthalenes	mg/kg	0.1	-	0.5400	0.7380	0.7600	0.3130	0.5540	0.6960
C1-phenanthrene	mg/kg	0.1	-	0.3860	0.4830	0.5060	0.3170	0.4030	0.4590
C2-naphthalenes	mg/kg	0.1	-	0.4240	0.5830	0.6000	0.2720	0.4000	0.4510
C3-naphthalenes	mg/kg	0.1	-	0.3860	0.5290	0.5420	0.2650	0.3920	0.4020
Chrysene	mg/kg	0.1	-	0.2140	0.2380	0.2480	0.0833	0.0901	0.0977
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.0535	0.0684	0.0462	0.0147	0.0199	0.0226
Fluoranthene	mg/kg	0.1	-	0.4360	0.4840	0.5060	0.0796	0.0921	0.0948

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 9 (0 m)	Sample 9 (1.0 m)	Sample 9 (2.0 m)	Sample 9 (3 m)	Sample 9 (4 m)	Sample 9 (4.6 m)
Fluorene	mg/kg	0.1	-	0.0723	0.0963	0.1000	0.0385	0.0666	0.0822
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.2670	0.3350	0.3060	0.0389	0.0431	0.0453
Naphthalene	mg/kg	0.1	-	0.2090	0.2780	0.3000	0.0666	0.1770	0.2520
Perylene	mg/kg	0.1	-	0.1390	0.1980	0.1780	0.0208	0.0222	0.0206
Phenanthrene	mg/kg	0.1	-	0.3620	0.4550	0.4770	0.2360	0.3330	0.3880
Pyrene	mg/kg	0.1	-	0.4330	0.4920	0.4830	0.1210	0.1210	0.1280
Total Hydrocarbon Content (THC)	mg/kg	-	-	27.90	41.40	48.10	22.30	4.36	7.62
PCBs – Sum of ICES 7	ug/kg	10	-	4.85	7.27	7.25	<0.56	<0.56	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	10.61	15.00	15.90	<2.00	<2.00	<2.00
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	0.0001	0.0003	0.0003	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	0.0005	0.0010	0.0011	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	0.0005	0.0007	0.0007	<0.0001	<0.0001	<0.0001
PPTDE	mg/kg	-	-	0.0079	0.0088	0.0116	0.0002	<0.0001	<0.0001
PPDDE	mg/kg	-	-	0.0016	0.0018	0.0020	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	0.0021	0.0005	0.0020	<0.0001	<0.0001	<0.0001
PBDE 17	µg/kg	-	-	0.564	1	0.874	<0.02	<0.02	<0.02
PBDE 28	µg/kg	-	-	0.378	0.681	0.649	<0.02	<0.02	<0.02
PBDE 47	µg/kg	-	-	1.77	3.43	3.16	0.0808	<0.02	<0.02
PBDE 66	µg/kg	-	-	0.218	0.402	0.367	<0.02	<0.02	<0.02
PBDE 85	µg/kg	-	-	0.109	0.218	0.209	<0.02	<0.02	<0.02
PBDE 99	µg/kg	-	-	1.86	3.78	3.58	0.195	<0.02	<0.02
PBDE 100	µg/kg	-	-	0.316	0.538	0.544	0.0364	<0.02	<0.02
PBDE 138	µg/kg	-	-	0.0535	0.0787	0.0906	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration					
		AL1	AL2	Sample 9 (0 m)	Sample 9 (1.0 m)	Sample 9 (2.0 m)	Sample 9 (3 m)	Sample 9 (4 m)	Sample 9 (4.6 m)
PBDE 153	µg/kg	-	-	0.319	0.526	0.531	0.0466	<0.02	<0.02
PBDE 154	µg/kg	-	-	0.198	0.283	0.287	0.0253	<0.02	<0.02
PBDE 183	µg/kg	-	-	0.105	0.208	0.108	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	95.4	90.8	76.8	1.67	0.622	0.219
Key	Below AL1								
	Above AL1, Below AL2								
	Above AL2								

Table 19. Sediment contamination data for Sample 10 collected in October 2021

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 10 (0 m)	Sample 10 (1.0 m)	Sample 10 (2.0 m)	Sample 10 (2.6 m)
Arsenic	mg/kg	20	100	14.9	10.4	3.3	15.1
Cadmium	mg/kg	0.4	5	0.38	0.18	0.17	0.39
Chromium	mg/kg	40	400	36.9	11.3	13.0	14.8
Copper	mg/kg	40	400	19.2	10.4	13.9	16.8
Lead	mg/kg	50	500	19.4	6.9	10.1	12.9
Mercury	mg/kg	0.3	3	0.02	0.02	0.02	0.03
Nickel	mg/kg	20	200	39.3	13.2	17.3	30.8
Zinc	mg/kg	130	800	97.7	37.7	39.8	90.9
Dibutyltin (DBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005
Tributyltin (TBT)	mg/kg	0.1	1	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	0.1	-	0.008	0.002	0.005	0.003
Acenaphthylene	mg/kg	0.1	-	0.003	<0.001	0.002	0.001
Anthracene	mg/kg	0.1	-	0.008	0.001	0.006	0.004
Benzo[a]anthracene	mg/kg	0.1	-	0.014	0.002	0.020	0.008
Benzo[a]pyrene	mg/kg	0.1	-	0.019	0.002	0.019	0.011
Benzo[b]fluoranthene	mg/kg	0.1	-	0.034	0.003	0.093	0.014
Benzo[e]pyrene	mg/kg	0.1	-	0.0533	0.0058	0.1250	0.0276
Benzo[ghi]perylene	mg/kg	0.1	-	0.061	0.006	0.065	0.034
Benzo[k]fluoranthene	mg/kg	0.1	-	0.00754	0.00150	0.01380	0.00423
C1-naphthalenes	mg/kg	0.1	-	0.12200	0.01060	0.19000	0.05070
C1-phenanthrene	mg/kg	0.1	-	0.12200	0.01220	0.15900	0.05370
C2-naphthalenes	mg/kg	0.1	-	0.10700	0.00874	0.12700	0.04490
C3-naphthalenes	mg/kg	0.1	-	0.09590	0.00797	0.11000	0.04550
Chrysene	mg/kg	0.1	-	0.02530	0.00455	0.08300	0.01430
Dibenzo[ah]anthracene	mg/kg	0.1	-	0.00620	<0.001	0.01190	0.00258
Fluoranthene	mg/kg	0.1	-	0.02770	0.00585	0.03990	0.01400

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 10 (0 m)	Sample 10 (1.0 m)	Sample 10 (2.0 m)	Sample 10 (2.6 m)
Fluorene	mg/kg	0.1	-	0.01850	0.00344	0.00916	0.00725
Indeno[1,2,3-cd]pyrene	mg/kg	0.1	-	0.01680	0.00177	0.01970	0.00499
Naphthalene	mg/kg	0.1	-	0.02940	0.00458	0.05760	0.01310
Perylene	mg/kg	0.1	-	0.23300	2.28000	0.00473	0.00623
Phenanthrene	mg/kg	0.1	-	0.09010	0.00932	0.14200	0.03930
Pyrene	mg/kg	0.1	-	0.03530	0.00705	0.04950	0.02910
Total Hydrocarbon Content (THC)	mg/kg	-	-	2.08	3.85	7.85	57.80
PCBs – Sum of ICES 7	ug/kg	10	-	<0.56	<0.56	<0.56	<0.56
PCBs – Sum of 25 Congeners	ug/kg	20	200	<2.00	<2.00	<2.00	<2.00
AHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
BHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
GHCH	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
Dieldrin	mg/kg	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001
HCB	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPTDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPDDE	mg/kg	-	-	<0.0001	<0.0001	<0.0001	<0.0001
PPDDT	mg/kg	0.001	-	<0.0001	<0.0001	<0.0001	<0.0001
PBDE 17	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 28	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 47	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 66	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 85	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 99	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 100	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 138	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 153	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02

Contaminant	Units	Cefas Action Level		Sample Concentration			
		AL1	AL2	Sample 10 (0 m)	Sample 10 (1.0 m)	Sample 10 (2.0 m)	Sample 10 (2.6 m)
PBDE 154	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 183	µg/kg	-	-	<0.02	<0.02	<0.02	<0.02
PBDE 209	µg/kg	-	-	<0.1	0.211	<0.1	0.192
Key	Below AL1						
	Above AL1, Below AL2						
	Above AL2						

4.4.10 The Environment Agency's 'Water Quality Archive' (accessible on their website) provides data on water quality measurements taken at sampling points around England. These can be from coastal or estuarine waters, rivers, lakes, ponds, canals or groundwaters. They are taken for a number of purposes including compliance assessment against discharge permits, investigation of pollution incidents or environmental monitoring.

4.4.11 The nearest saline water sampling point to the proposed development (with adequate temporal coverage and a reasonable amount of determinands measured) is Clean Site - Ti02 Monitoring Point, 1985 (sampling ID: AN-CLNMON1). This is shown on Figure 4. Contaminant concentrations measured in the water at this location are shown in Table 20. These are compared against EQS as described under the WFD (Standards and Classification) Directions (England and Wales) 2015, specifically annual average (AA) concentrations and/or maximum allowable concentrations (MAC)) to provide an indication of the water quality measured at the sampling point.

4.4.12 As indicated in Table 20, metal concentrations reported between 2015 and 2022 were typically below respective EQSs. There were some exceedances related to the AA EQS for tributyl tin (TBT) and the Humber Estuary transitional water body was failing chemical status due to excessive concentrations of TBT in 2019. Benzo(a)pyrene and benzo(g,h,i)perylene were failing their respective MAC EQSs between 2015 and 2021. Benzo(b)fluoranthene was also failing its MAC EQSs in 2015 to 2021 (with the exception 2019), and benzo(k)fluoranthene was failing its MAC EQS in 2016 to 2018. The Humber Lower transitional water body was failing chemical status due to benzo(b)fluoranthene and benzo(g-h-i)perylene in 2019.

Table 20. Concentration range, mean and number of water samples collected between 2015 and 2022 by the Environment Agency for contaminants measured near the proposed development

Parameter	Unit	EQS	2015	2016	2017	2018	2019	2020	2021	2022
Arsenic	µg/l	25 (AA)	1.9 – 2.39 $\bar{x}$ = 2.10 (n = 3)	2.32 (n = 1)	-	1.94 – 2.59 $\bar{x}$ = 2.276667 (n = 3)	1.95 (n = 1)	-	-	-
Cadmium	µg/l	0.2 (AA)	0.044 – 0.101 $\bar{x}$ = 0.077 (n = 9)	0.041 – 0.066 $\bar{x}$ = 0.04875 (n = 4)	0.062 – 0.063 $\bar{x}$ = 0.063 (n = 2)	0.046 – 0.14 $\bar{x}$ = 0.089 (n = 9)	0.0408 – 0.0706 $\bar{x}$ = 0.055433 (n = 3)	-	0.058 – 0.12 $\bar{x}$ = 0.084 (n = 8)	0.051 – 0.079 $\bar{x}$ = 0.066 (n = 8)
Chromium (VI)	µg/l	0.6 (AA); 32 (MAC)	<0.3 (n = 1)	<0.3 (n = 1)	-	<0.3 (n = 3)	<0.3 (n = 1)	-	-	-
Copper	µg/l	3.76 (AA)	1.7 – 2.62 $\bar{x}$ = 2.01 (n	2.35 – 2.96 $\bar{x}$ = 2.85 (n = 2)	2.35 – 2.96 $\bar{x}$ = 2.66 (n = 2)	1.99 – 2.52 $\bar{x}$ = 2.2 (n = 3)	1.59 (n = 1)	-	1.7 – 3.2 $\bar{x}$ = 2.19 (n = 8)	1.7 – 2.3 $\bar{x}$ = 1.96 (n = 8)
Lead	µg/l	1.3 (AA); 14 (MAC)	<0.04 – 0.074 $\bar{x}$ = 0.056 (n = 9)	0.04 – 0.098 $\bar{x}$ = 0.07 (n = 3)	-	<0.04 – 0.088 $\bar{x}$ = 0.053189 (n = 9)	0.0656 – 0.108 $\bar{x}$ = 0.0798 (n = 3)	-	0.046 – 0.12 $\bar{x}$ = 0.069 (n = 8)	0.04 – 0.084 $\bar{x}$ = 0.065 (n = 8)
Mercury	µg/l	0.07 (MAC)	<0.01 (n = 9)	<0.01 (n = 3)	-	<0.01 (n = 9)	<0.01 (n = 3)	-	-	-
Nickel	µg/l	8.6 (AA); 34 (MAC)	1.25 – 2.29 $\bar{x}$ = 1.69 (n = 9)	1.14 – 2.11 $\bar{x}$ = 1.61 (n = 4)	1.79 – 2.11 $\bar{x}$ = 1.95 (n = 2.11)	1.4 – 2.00 $\bar{x}$ = 1.71 (n = 8)	1.35 – 1.8 $\bar{x}$ = 1.54 (n = 3)	-	1.4 – 7.8 $\bar{x}$ = 2.43 (n = 8)	1.3 – 1.6 $\bar{x}$ = 1.41 (n = 8)
Zinc	µg/l	7.9 (AA)	2.2 – 4.7 $\bar{x}$ = 3.79 (n = 3)	3.47 – 4.86 $\bar{x}$ = 4.165 (n = 2)	4.22 – 4.86 $\bar{x}$ = 4.54 (n = 2)	2.21 – 4.32 $\bar{x}$ = 3.15 (n = 3)	4.05 (n = 1)	-	1.9 – 5.7 $\bar{x}$ = 3.29 (n = 8)	1.9 – 3.4 $\bar{x}$ = 2.93 (n = 8)
Tributyltin (TBT)	µg/l	0.0002 (AA); 0.0015 (MAC)	0.00021 – 0.00096 $\bar{x}$ = 0.00044 (n = 9)	<0.0002 – 0.0008 $\bar{x}$ = 0.00041 (n = 12)	0.00029 – 0.00092 $\bar{x}$ = 0.00052 (n = 3)	<0.0002 – 0.00081 $\bar{x}$ = 0.00030 (n = 10)	0.00025 – 0.00032 $\bar{x}$ = 0.00029 (n = 2)	-	0.0002 – 0.00023 $\bar{x}$ = 0.0002 (n = 8)	0.0002 – 0.00036 $\bar{x}$ = 0.00023 (n = 8)

Parameter	Unit	EQS	2015	2016	2017	2018	2019	2020	2021	2022
Benzo(a)-pyrene	µg/l	0.00017 (AA); 0.0027 (MAC)	>0.002 - <0.01 $\bar{x}$ = 0.0087 (n = 12)	>0.002 – 0.22 $\bar{x}$ = 0.042 (n = 12)	0.00055 – >0.05 $\bar{x}$ = 0.026 (n = 0.026)	<0.0004 – 0.0874 $\bar{x}$ = 0.033 (n = 8)	0.015 – 4.05 $\bar{x}$ = 1.02 (n = 4)	-	0.0004 – 0.033 $\bar{x}$ = 0.013 (n = 8)	0.0005 – 0.026 $\bar{x}$ = 0.007 (n = 8)
Benzo(g,h,i)-perylene	µg/l	0.00082 (MAC)	>0.002 – <0.01 $\bar{x}$ = 0.0087 (n = 12)	>0.002 – 0.24 $\bar{x}$ = 0.042 (n = 12)	0.00063 – >0.05 $\bar{x}$ = 0.025 (n = 3)	0.00057 – 0.091 $\bar{x}$ = 0.026 (n = 8)	0.015 – 0.018 $\bar{x}$ = 0.017 (n = 2)	-	0.0004 – 0.03 $\bar{x}$ = 0.011 (n = 8)	0.0005 – 0.024 $\bar{x}$ = 0.006 (n = 8)
Benzo(b)-fluoranthene	µg/l	0.017 (MAC)	>0.002 – 0.20 $\bar{x}$ = 0.038 (n = 12)	>0.002 – 0.20 $\bar{x}$ = 0.038 (n = 12)	0.00056 - >0.05 $\bar{x}$ = 0.024 (n = 3)	0.00045 – 0.074 $\bar{x}$ = 0.028 (n = 8)	0.013 – 0.014 $\bar{x}$ = 0.013 (n = 2)	-	0.0005 – 0.03 $\bar{x}$ = 0.011 (n = 8)	0.0005 – 0.021 $\bar{x}$ = 0.006 (n = 8)
Benzo(k)-fluoranthene	µg/l	0.0063 (AA); 0.017 (MAC)	>0.002 – <0.01 $\bar{x}$ = 0.0087 (n = 12)	>0.002 – 0.11 $\bar{x}$ = 0.024 (n = 12)	<0.0004 – >0.05 $\bar{x}$ = 0.021 (n = 3)	<0.0004 – 0.038 $\bar{x}$ = 0.015 (n = 8)	0.0070 – 0.0075 $\bar{x}$ = 0.0072 (n = 2)	-	0.0004 – 0.016 $\bar{x}$ = 0.006 (n = 8)	0.0004 – 0.012 $\bar{x}$ = 0.004 (n = 8)
Fluoranthene	µg/l	0.12 (MAC)	>0.002 - <0.01 $\bar{x}$ = 0.0087 (n = 12)	>0.002 – 0.14 $\bar{x}$ = 0.036 (n = 12)	0.00103 - >0.05 $\bar{x}$ = 0.027 (n = 3)	<0.0004 – 0.095 $\bar{x}$ = 0.031 (n = 8)	0.016 – 0.019 $\bar{x}$ = 0.018 (n = 3)	-	0.0015 – 0.026 $\bar{x}$ = 0.012 (n = 8)	0.0012 – 0.023 $\bar{x}$ = 0.009 (n = 8)
Hexachloro-benzene	µg/l	0.05 (MAC)	<0.001 (n = 12)	<0.0001 – 0.001 $\bar{x}$ = 0.00049 (n = 7)	<0.0001 – 0.005 $\bar{x}$ = 0.0020 (n = 3)	-	-	-	-	-
Hexachloro-butadiene	µg/l	0.6 (MAC)	<0.003 (n = 12)	<0.0001 – <0.001 $\bar{x}$ = 0.00049 (n = 7)	<0.0001 – <0.005 $\bar{x}$ = 0.0020 (n = 3)	-	-	-	-	-
BDE 28	µg/l	-	<0.0006 (n = 7)	<0.0006 (n = 7)	<0.0006 (n = 3)	-	-	-	-	-
BDE 47	µg/l	-	<0.0006 - 0.0001 $\bar{x}$ = 0.000065 (n = 7)	<0.0006 (n = 7)	<0.0006 (n = 3)	-	-	-	-	-

Parameter	Unit	EQS	2015	2016	2017	2018	2019	2020	2021	2022
BDE 99	µg/l	-	<0.0006 – 0.00017 $\bar{x}$ = 0.000076 (n = 7)	<0.0006 (n = 7)	<0.0006 (n = 3)	-	-	-	-	-
BDE 100	µg/l	-	<0.0006 – 0.00017 $\bar{x}$ = 0.000076 (n = 7)	<0.0006 (n = 7)	<0.0006 (n = 3)	-	-	-	-	-
BDE 153	µg/l	-	<0.0006 – 0.0007 $\bar{x}$ = 0.000061 (n = 7)	<0.0006 (n = 7)	<0.0006 (n = 3)	-	-	-	-	-
BDE 154	µg/l	-	<0.0006 (n = 7)	<0.0006 (n = 7)	<0.0006 (n = 3)	-	-	-	-	-

$\bar{x}$ = mean
n = number of water samples
Data from sampling point 'Clean Site - Ti02 Monitoring Point, 1985, ID: AN-CLNMON1)' in the Humber Estuary, obtained from the Environment Agency's 'Water Quality Archive' (Environment Agency, 2022d)

Capital and maintenance dredging

4.4.13 As sediment is disturbed and re-distributed into the water column, any sediment-bound contaminants may be partitioned from the solid phase (i.e., bound to sediments or suspended matter), to the dissolved or aqueous phase (i.e., dissolved in pore water or overlying water) (Luoma, 1983). To determine the maximum dissolved fraction of contaminants released into the water column, it is necessary to consider the relative potential for each contaminant to change from one phase to another (i.e., contaminant adsorbed to sediment surfaces to dissolved in the water), referred to as the partition coefficient. Partition coefficients describe the ratio between the freely dissolved concentration in water and another environmental phase (e.g., sediment-bound) at equilibrium. It should be noted that desorption rates of contaminants from suspended sediments into the water column are highly regulated by hydrodynamics, biogeochemical processes, and environmental conditions (redox, pH, salinity, and temperature) (Eggleton and Thomas, 2004). Due to the variability in environmental conditions, a wide range of partition coefficients are reported in the literature.

4.4.14 There is potential for sediment-bound contaminants to be re-mobilised in the water column following an increase in SSC during the proposed capital and maintenance dredging. Sediment disturbance will be caused at the bed by abrasion pressure from the dredging equipment (i.e., bucket or draghead). As noted in the Physical Processes chapter (Chapter 7) of the ES, maximum SSCs are associated with the disposal activities (with relatively small increases in SSC arising from the dredging itself). Peak excess SSC levels resulting from the disposal activities are predicted to be around 600 to 800 mg/l at HU060 licensed disposal site (this site is likely to receive the vast majority of the more unconsolidated dredged material). Increased SSCs arising from the dredge operations will be of lower magnitude and persist for a shorter distance (and time) than that from the disposal. Therefore, while a different activity, the estimated maximum incremental SSC for disposal activities is used in the calculations below on a precautionary basis.

4.4.15 A Microsoft Excel Spreadsheet tool developed by APEM Ltd, referred to as SeDiChem (short for Sediment Disturbance on Chemical status), was provided by the Environment Agency to support consideration of potential uplift in contaminant concentrations following disturbance of contaminated sediments in estuarine and marine waters.

4.4.16 Table 21 provides a summary of the SeDiChem tool outputs, with empirical calculations based on a number of simple assumptions. This includes general site parameters (e.g., net flow rate of 20,736,000 m^3/day based on an average for the Humber of 240 m^3/second (Environment Agency, 2008)), maximum incremental SSC (800 mg/l), worst case (or precautionary) partition coefficients from suggested literature and sediment quality from samples collected within the proposed dredge area. In addition, background water quality concentrations have been inputted based on Environment Agency monitoring data from nearby monitoring station Clean Site - Ti02 Monitoring

Point, 1985 (sampling ID: AN-CLNMON1) (see Table 20), averaged across the most recent five years of data.

4.4.17 Overall, the uplift in contaminant concentrations is anticipated to be minimal, and unlikely to present a significant issue at the water body level. Where contaminants are already reported to be failing within the water bodies (e.g., PBDEs, benzo(b)fluoranthene, benzo(g-h-i)perylene, mercury and its compounds and TBT compounds), any disturbance of sediments during dredging activities will result in an uplift effectively causing a ‘worse failure’. However, the scale of this deterioration is considered to be small and highly localised. As a percentage increase of EQS headroom (i.e., the capacity for the concentration to increase whilst still remaining below the environmental threshold), the increased concentration due to dredging is likely to be less than 1% for mercury, and 35% for TBT. For benzo(b)fluoranthene, the increased concentration due to dredging as a percentage of headroom is likely to be around 6%. The background dissolved concentration for benzo(g,h,i)perylene is above the EQS, therefore no headroom is available according to the SeDiChem tool. However, as a percentage increase of background concentrations, the increase in concentration of this contaminant is calculated as < 1%. Furthermore, these calculations are based on a maximum sediment concentration and worst-case partition coefficients. It is, therefore, considered unlikely that the proposed dredging activity would cause even a short-term deterioration in water quality with regards to contaminants.

4.4.18 Furthermore, the proposed works will not directly introduce contaminants to the marine environment and good practice measures (Defra and Environment Agency, 2019), will be used to prevent/reduce the potential for accidental spillages throughout the dredging process.

4.4.19 The construction of the IERRT project may be completed as a single activity, or it may be sequenced with operation of the northernmost pier occurring at the same time as construction of the southernmost pier. However, in any case, all capital dredging will be undertaken in one construction activity before operation of the northernmost pier. Therefore, the above assessment is considered the worst case and will not be altered by a sequenced construction period.

4.4.20 In conclusion, dredging activities are not expected to lead to a deterioration of the assessed water quality elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

Table 21. Potential contaminant concentrations as a result of the proposed development in the Humber Lower transitional water body based on SeDiChem tool outputs

Parameter	Max. Sediment Concentration (mg/kg)	Current WFD Status	Partition Coefficient (l/kg)	EQS (µg/l)	Dissolved Concentration (Background* and Dredging) (µg/l)	Concentration Increase due to Dredging (% of Background)	Concentration Increase as % of EQS Headroom
Arsenic	62.00	High	40	25 (dissolved)	4.216	97.43%	9.10%
Cadmium	1.20	Good	100	0.2 (dissolved)	0.093	21.69%	13.40%
Chromium	113.00	High	79	32 (dissolved)	12.057	18.21%	8.52%
Copper	78.50	High	3,162	3.76 (dissolved)	2.156	1.578%	2.06%
Lead	140.00	Good	35,481	14 (dissolved)	0.069	8.31%	0.04%
Mercury	0.54	Fail	6,310	0.07 (dissolved)	0.010	1.14%	0.19%
Nickel	54.80	Good	500	34 (dissolved)	1.969	7.87%	0.45%
Zinc	324.00	High	12,589	8.8 (dissolved)	3.32	1.05%	0.75%
Benzo(a)pyrene	1.25	Good	9,120	0.027 (total)	0.018	0.99%	2.05%
Benzo(b) fluoranthene	1.11	Fail	20,795	0.017 (total)	0.016	0.45%	5.60%
Benzo(g,h,i) perylene	1.05	Fail	18,904	0.00082 (total)	0.016	0.46%	No headroom
Benzo(k) fluoranthene	0.60	Good	19,859	0.017 (total)	0.009	0.43%	0.51%
Fluoranthene	1.95	Good	1,396	0.12 (total)	0.02	10.23%	1.84%
Tributyltin (TBT)	0.02	Fail	49	0.0015 (total)	0.001	150.84%	34.52%
Congener: BDE-28	0.00112	N/A	4,136	N/A	0.000	0.59%	N/A
Congener: BDE-47	0.00523	N/A	17,793	N/A	0.000	0.62%	N/A

Parameter	Max. Sediment Concentration (mg/kg)	Current WFD Status	Partition Coefficient (l/kg)	EQS (µg/l)	Dissolved Concentration (Background* and Dredging) (µg/l)	Concentration Increase due to Dredging (% of Background)	Concentration Increase as % of EQS Headroom
Congener: BDE-99	0.0082	N/A	45,631	N/A	0.000	0.36%	N/A
Congener: BDE-100	0.000819	N/A	27,325	N/A	0.000	0.059%	N/A
Congener: BDE-153	0.00159	N/A	71,871	N/A	0.000	0.048%	N/A
Congener: BDE-154	0.000533	N/A	58,419	N/A	0.000	0.020%	N/A
Hexachloro-benzene	0.0022	Good	5,978	0.05 (total)	0.001	0.049%	0.00%
* Averaged for the five most recent years of data							

Piling

4.4.21 As discussed for dredging above, maximum SSCs are associated with the disposal activities. Peak excess SSC levels resulting from the disposal activities are around 600-800 mg/l at the HU060 licensed disposal site. Increased SSCs arising from the dredge operations will be of lower magnitude and persist for a shorter distance (and time) than that from the disposal. The anticipated increased SSC concentration related to piling will be less than that that of dredging and disposal, as compaction will occur in the sediment rather than complete disturbance. Table 21 calculates the potential for sediment-bound contaminants to increase the concentration of in-water contaminants and, even when applying SSCs of 800 mg/l, the proposed piling works are considered unlikely to result in significant water quality impacts.

4.4.22 The construction of the IERRT project may be completed as a single activity, or it may be sequenced with operation of the northernmost pier occurring at the same time as construction of the southernmost pier. In the case of a sequenced construction, the duration of piling will be extended but it will not increase the magnitude of change. Furthermore, any sediment disturbance during construction of the southernmost pier will not occur at the same time as maintenance dredging and disposal during operation. Therefore, the above assessment is considered the worst case and will not be altered by a sequenced construction period.

4.4.23 In conclusion, piling is not expected to lead to a deterioration of the assessed water quality elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

Disposal

4.4.24 As discussed for dredging above, maximum SSCs are associated with the disposal activities. Peak excess SSC levels resulting from the disposal activities are around 600-800 mg/l at the HU060 licensed disposal site. Table 21 calculates the potential for sediment-bound contaminants to increase the concentration of in-water contaminants and, when applying SSCs of 800 mg/l, the proposed disposal activities are considered unlikely to result in significant water quality impacts.

4.4.25 The construction of the IERRT project may be completed as a single activity, or it may be sequenced with operation of the northernmost pier occurring at the same time as construction of the southernmost pier. However, in any case, the disposal of the capital dredge arisings will be completed in one construction activity before the operation of the northernmost pier. Therefore, the above assessment is considered the worst case and will not be altered by a sequenced construction period.

4.4.26 In conclusion, disposal activities are not expected to lead to a deterioration of the assessed water quality elements within the Humber Lower transitional water body, nor prevent this water body from meeting its WFD objectives.

Surface water run-off

4.4.27 Potential effects could arise from migration, caused by site works, of potential contaminants into the Humber Estuary or North Beck Drain.

4.4.28 Accidental leaks of fuels and oils from vehicular plant equipment, stored liquids, and other polluting materials have the potential to be mobilised to groundwaters and surface water via vertical and lateral migration or surface run-off. These risks will be mitigated, however, by the adoption of good practice as set in the guidance document Construction Industry Research and Information Association (CIRIA) C741 and the implementation of the site-specific Construction Environmental Management Plan (CEMP) (Application Document Reference 9.2).

4.4.29 Disturbance and/ or removal of ground materials could potentially remove, relocate or mobilise potential contaminants, e.g., during foundation construction, earthworks and excavations. Soil samples from Made Ground recorded exceedances of the human health Generic Assessment Criteria (GAC) for Commercial Land Use indicating potential sources of contamination within Made Ground. Exceedances were also identified in leachate samples from Made Ground and reworked natural strata, indicating further sources of contamination that could be mobilised during foundation works, earthworks and excavations. These exceedances are the same, or within one order of magnitude of the GAC, EQS Freshwater and Drinking Water Standards (DWS) criteria and hence are considered to present a low risk. However, exceedances of chromium (VI), thiocyanate and ammoniacal nitrogen were two orders of magnitude above the DWS and EQS Freshwater criteria.

4.4.30 There is potential for creation of new Source-Pathway-Receptor linkages (e.g., pile foundation construction through existing Made Ground into underlying natural soils or bedrock) into an aquifer (comprised of coarse or sandy soils (superficial deposits) or chalk (bedrock)).

4.4.31 The creation of new potential contaminant linkages or mobilisation of existing contaminants may result from exposure of soils/ increases in rainwater infiltration through changes in ground cover/ in excavations or bulk earthworks. Leachate exceedances of ammoniacal nitrogen, copper and nickel were identified in Made Ground and reworked natural deposits within the same exploratory hole location, indicating a potential pathway from Made Ground to reworked natural deposits.

4.4.32 A Remediation Strategy will be put in place for the proposed development which will set out the measures required to mitigate any significant/ unacceptable contaminant linkages (risks) and how the earthworks stage of construction will be undertaken during the landside works (see the Ground Conditions, including Land Quality chapter (Chapter 12) of the ES for further detail).

4.4.33 Impacts to water quality could also potentially occur during operation as a result of accidental spills from the handling or leakage of fuels, lubricants, stored chemicals and process liquids. Standard industry practices will be adopted to mitigate these potential impacts.

4.4.34 In conclusion, surface-water run-off is not expected to lead to a deterioration of the assessed water quality elements within the Humber Lower transitional water body and/or the North Beck Drain river water body, nor prevent these water bodies from meeting their WFD objectives.

4.5 Protected areas

4.5.1 The proposed development, specifically the marine element of the works and the dredge disposal sites, overlaps with the Humber Estuary SAC, SPA and Ramsar site (collectively forming the Humber EMS). As the proposed development is neither directly connected with nor necessary to the management of these sites, it is considered to have the potential to result in a likely significant effect (LSE) on these European sites.

4.5.2 The potential impact pathways on these sites and interest features have been assessed in the Habitat Regulations Assessment (Application Document Reference number 9.6) in the context of the nature and scale of the construction and operational activities associated with the proposed development. The geographic location of the project activities relative to the interest features and the sensitivities of the interest features to these environmental pressures/changes have also been taken into account. Based on available evidence and suggested mitigation measures outlined in the HRA and Chapter 9 of the ES, there is considered to be no potential for an adverse effect on integrity (AEOI) of the interest features or conservation objectives of European sites either alone and/or in-combination with other plans and projects.

4.5.3 The proposed development will not introduce nitrates to the marine environment (such inputs are typically associated with wastewater discharges and agricultural activities) and, therefore, will not impact nearby surface and groundwater NVZs.

4.5.4 In conclusion, the proposed development is not expected to lead to a deterioration of the assessed protected area designations within the Humber Lower transitional water body and/or North Beck Drain river water body, nor prevent these water bodies from meeting respective WFD objectives.

4.6 Invasive non-native species

4.6.1 As with most activities which occur in the marine environment, there is potential risk that the proposed development could result in the introduction or spread of INNS. Non-native species have the potential to be transported into the local area on the hulls of the vessels if they have operated in other water bodies, as well as ballast water which can transfer organisms from one water body to another. Nevertheless, given the nature of the proposed development, the ballast water exchange requirements expected to have been carried out as described under the Ballast Water Management

Convention[9] and the fact that potential biosecurity risks are managed through ABP's existing biosecurity management procedures, the risk in terms of introducing or transferring INNS is considered to be insignificant. Biosecurity control measures during construction have also been detailed within the CEMP (Application Document Reference number 9.2). It is noted that the installation of piles will introduce a new hard surface which could be colonised by INNS, although this does not present a new opportunity for introduction/spread of INNS given the abundance of similar habitat types/surfaces at the Port of Immingham.

4.6.2 Consequently, the probability of the introduction and spread of INNS from the proposed development is considered low and it is not expected to lead to a deterioration in status of the Humber Lower transitional water body and/or North Beck Drain river water body, nor prevent these water bodies from meeting respective WFD objectives.

5 Conclusion

5.1.1 Based upon the information presented within this WFD compliance assessment, and considering the additional information presented in the main ES (particularly Chapter 7 (Physical Processes), Chapter 8 (Water and Sediment Quality), Chapter 9 (Nature Conservation and Marine Ecology), and Chapter 12 (Ground Conditions, including Land Quality)), it is concluded that the proposed development is not likely to have a permanent (i.e. non-temporary) effect on the status of WFD parameters that are significant at water body level. Therefore, deterioration to the current status of the Humber Lower transitional water body and/or North Beck Drain river water body is not predicted, nor a prevention of these water bodies achieving future WFD status objectives.

6 References

CEDA. (2011). Underwater sound in relation to dredging. CEDA Position Paper - 7 November 2011.

Department for Environment, Food and Rural Affairs. (2019). Urban waste water treatment: updated sensitive areas maps 2019. [Online] Available at: https://www.gov.uk/government/publications/urban-waste-water-treatment-updated-sensitive-areas-maps-2019 (accessed October 2022).

9 Noting, the UK has not yet ratified the Convention; however, the UK regulatory package has been drafted and the Government remains committed to acceding to the Convention and implementing it into UK law. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/949792/Ballast_water_Rev_3._01.21.pdf (Accessed March 2021).

Department for Environment, Food and Rural Affairs. (2016). Water Framework Directive. List of Shellfish Water Protected Areas in England. March 2016. Department for Environment, Food and Rural Affairs. [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/504984/shellfish-waters-list-2016-england.pdf (accessed October 2022).

Department for Environment, Food and Rural Affairs and Environment Agency (2019). Pollution prevention for businesses. Available at: https://www.gov.uk/guidance/pollution-prevention-for-businesses (accessed October 2022).

Eggleton, J. and Thomas, K. V. (2004). A review of factors affecting the release and bioavailability of contaminants during sediment disturbance events. Environmental International, 30, 973-980.

Environment Agency. (2022a). Catchment Data Explorer. Available at: https://environment.data.gov.uk/catchment-planning/RiverBasinDistrict/4 (accessed October 2022).

Environment Agency. (2022b). Find a bathing water. [Online] Available at: http://environment.data.gov.uk/bwq/profiles/ (accessed October 2022).

Environment Agency. (2022c). Check for drinking water safeguard zones and NVZs. [Online] Available at: https://environment.data.gov.uk/farmers/ (accessed October 2022).

Environment Agency. (2016a). Humber river basin district river basin management plan. Updated February 2018. Available online at: https://www.gov.uk/government/publications/humber-river-basin-district-river-basin-management-plan (accessed October 2022).

Environment Agency. (2016b). Water Framework Directive assessment: estuarine and coastal waters. [Online] Available at: https://www.gov.uk/guidance/water-framework-directive-assessment-estuarine-and-coastal-waters (accessed October 2022).

Environment Agency. (2008). Understanding and Managing Morphological Change in Estuaries. [Online] Available at: http://www.estuary-guide.net/pdfs/chapter3_estuary_setting.pdf (accessed October 2022).

Hawkins, A.D., Pembroke, A., and Popper, A. (2015). Information gaps in understanding the effects of noise on fishes and invertebrates. Reviews in Fish Biology and Fisheries, 25, pp. 39–64.

Hawkins A. D., and Popper, A. N. (2017). A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates. ICES Journal of Marine Science, Volume 74, Issue 3, 1 March 2017, Pages 635–651. [Online] Available at: https://doi.org/10.1093/icesjms/fsw205 (accessed October 2022).

Hawkins, A.D., Roberts, L. and Cheesman, S. (2014). Responses of free-living coastal pelagic fish to impulsive sounds. The Journal of the Acoustical Society of America, 135.

Jones, D. and Marten, K. (2016). Dredging sound levels, numerical modelling and EIA. Terra et Aqua, 144, pp.21-29.

Luoma, S. N. (1983). Bioavailability of trace metals to aquatic organisms—a review. Science of the Total Environment, 28, 1-22.

Nedelec, S.L., Campbell, J., Radford, A.N., Simpson, S.D. and Merchant, N.D. (2016). Particle motion: the missing link in underwater acoustic ecology. Methods in Ecology and Evolution, 7, pp.836-842.

Marine Management Organisation. (2014). Marine Licencing: sediment analysis and sample plans. [Online] Available at: https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans###Suitability%20of%20material.

National Marine Fisheries Service (NMFS). (2021). Section 7 Consultation Guidance: Pile Driving Noise Calculator (Excel spreadsheet download). [Online] Available at: https://www.fisheries.noaa.gov/southeast/consultations/section-7-consultation-guidance (accessed October 2021).

Planning Inspectorate. (2017). Advice Note Eighteen: The Water Framework Directive [Online] Available at: https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/ (accessed October 2022).

Popper, A.N., Hawkins, A.D., Fay, R., Mann, D., Bartol, S., Carlson, Th., Coombs, S., Ellison, W.T., Gentry, R., Halvorsen, M.B., Lokkeborg, S., Rogers, P., Southall, B.L., Zeddies, D.G. and Tavolga, W.N. (2014). Sound exposure guidelines for fishes and sea turtles: A technical report prepared by ANSI-Accredited standards committee S3/SC1 and registered with ANSI. Springer, ASA Press. ISBN 2196-1212. (e-book ISBN 978-2-219-06659-2).

Radford, C.A., Montgomery, J.C., Caiger, P. and Higgs, D.M. (2012). Pressure and particle motion detection thresholds in fish: a re-examination of salient auditory cues in teleosts. Journal of Experimental Biology, 215(19), pp.3429-3435.

Webb, J. F., Popper, A. N. and Fay, R. R. (2008). Fish Bioacoustics. New York, NY: Springer.

WODA. (2013). Technical Guidance on: Underwater Sound in Relation to Dredging.

7 Abbreviations/Acronyms

AA	Annual Average
ABP	Associated British Ports
AEOI	Adverse Effect on Integrity
AHCH	alpha-Hexachlorcyclohexane
AL	Action Level
AWB	Artificial Water Body
BDE-##	A Compound/Congener of Polybrominated Diphenyl Ether
BHCH	beta-Hexachlorocyclohexane
CEDA	Centre for Environmental Data Analysis
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research and Information Association
dB	Decibel
DBT	Dibutyltin
DCO	Development Consent Order
DDT	Dichlorodiphenyltrichloroethane
Defra	Department for Environment, Food and Rural Affairs
DWS	Drinking Water Standard
EC	European Community
EEC	European Economic Community
EMS	European Marine Site
EQS	Environmental Quality Standards
EQSD	Environmental Quality Standards Directive
ES	Environmental Statement
EU	European Union
GAC	Generic Assessment Criteria
GCS	Good Chemical Status
GEP	Good Ecological Potential
GES	Good Ecological Status
GHCH	gamma-Hexachlorocyclohexane
GS	Good Status
HCB	Hexachlorobenzene
HMWB	Heavily Modified Water Body
HRA	Habitats Regulations Assessment
ICES	International Council for the Exploration of the Sea
ID	Identity
IERRT	Immingham Eastern Ro-Ro Terminal
INNS	Invasive Non-Native Species
IOH	Immingham Outer Harbour
IOT	Immingham Oil Terminal
LOD	Limit of Detection
LSE	Likely Significant Effect
MAC	Maximum Allowable Concentrations
MMO	Marine Management Organisation
NMFS	National Marine Fisheries Service
NSIP	Nationally Significant Infrastructure Project
NVZ	Nitrate Vulnerable Zone

OCP	Organochlorine Pesticides
PAHs	Polycyclic Aromatic Hydrocarbons
PBDE	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PFOS	Perfluorooctane Sulphonate
PPDDE	p,p'-Dichlorodiphenyldichloroethylene
PPDDT	p,p'-Dichlorodiphenyltrichloroethane
PPTDE	p,p'-Dichlorodiphenyldichloroethane
PSA	Particle Size Analysis
PSD	Priority Substances Directive
RBMP	River Basin Management Plans
SAC	Special Area of Conservation
SeDiChem	Sediment Disturbance effects on Chemical status (Microsoft Excel Spreadsheet Tool by APEM Ltd)
SEL	Sound Exposure Level
SL	Source Level
SPA	Special Protection Area
SPL	Sound Pressure Level
SSC	Suspended Sediment Concentration
TBT	Tributyltin
THC	Total Hydrocarbon Content
TOC	Total Organic carbon
TSHD	Trailing Suction Hopper Dredger
TTS	Temporary Threshold Shift
UK	United Kingdom
WFD	Water Framework Directive
WODA	World Organisation of Dredging Associations
ZoI	Zone of Influence

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Contact Us

ABPmer

Quayside Suite,
Medina Chambers
Town Quay, Southampton
SO14 2AQ

T +44 (0) 23 8071 1840
F +44 (0) 23 8071 1841
E enquiries@abpmer.co.uk

[redacted]