MLA/2025/00263 – Report of the Investigation of the Sediment Quality Data of L/2015/00427/7

Representation from North East Marine Research Group (NEMRG)

Author: Dr Simon Gibbon

The document provides the working behind why NEMRG's representation[1] makes the recommendations for restrictions to be imposed as part of the renewal of the River Tees maintenance dredging licence.

NEMRG has 3 major concerns about the information supplied as part of the licence renewal:

1. the River Tees is treated as a clean river which happens to have some areas of contamination, whereas it is sadly the riverbed is made of dirty sediments which happen to have some cleaner patches
2. the interpretation of the sediment quality analyses treats the samples as being homogeneous and coming from a river with predictable sediment quality
3. there is an inherent assumption that as there has not been a catastrophic environmental incident which has been attributed to maintenance dredging, that means the dredging is environmentally good

NEMRG is strongly of the opinion that more transparency and cooperative working around the river would result in major environmental improvement, as proposed in Best Practices for Environmentally Responsible Maintenance Dredging in the River Tees: An Integrated Framework for TSHD Operations[2], more information would have also helped with this investigation.

While this application is for the renewal of the maintenance dredging licence it has few details of the actual dredging processes, which has meant that assumptions have had to be made in this document. While details of the Emerald Duchess carbon reducing environmental credentials are stated, very little is stated about the environmental improvements which impact directly on dredging, which NEMRG assume there are. No specific information is given which would allow the impact of dredging to be localised within the river aside from amounts annually dredged, rates of removal of sediment in different areas are not included, neither are the actual composition of material removed from an area or change over time apart from at an annual level.

NEMRG believes that the 3 yearly sampling of the sediments are not a true indication of the sediments being dredged, as seen by the significant difference often without a trend between different sample sets. NEMRG recommends the investigation of real-time methods that could provide indications of significant differences in the sediments being dredged, combined with regular minimal sediment quality tests which could complement the full sediment quality measurements by providing information on changes between full data sets.

Table of Contents

1 History and Science behind Representation

The representation is based on a detailed analysis of:

- the information from prior reports which have detailed the processes happening in the River Tees
- information provided in the application specifically sediment quality data
- the methods by which dredging is carried out in the River Tees
- the best global environmental dredging practices

1.1 Trailing Suction Hopper Dredgers and Hopper Barges

This section aims to give a quick appreciation of why the overflow which occurs during the standard operation of a trailing suction hopper dredger (TSHD) in the River Tees exposes the river to considerable risk from chemical contamination carried on the small particle released.

The figures used in this section are taken from: Miedema, S.A., "A Sensitivity Analysis Of The Scaling Of TSHD's"[3].

The figure below of a conceptual hopper into which the water and sediment which has been 'vacuumed' from the river bed is being deposited. The bottom is a layer of larger sediment (gravel etc.) while still in suspension is small size particles, given sufficient time these particles would settle.

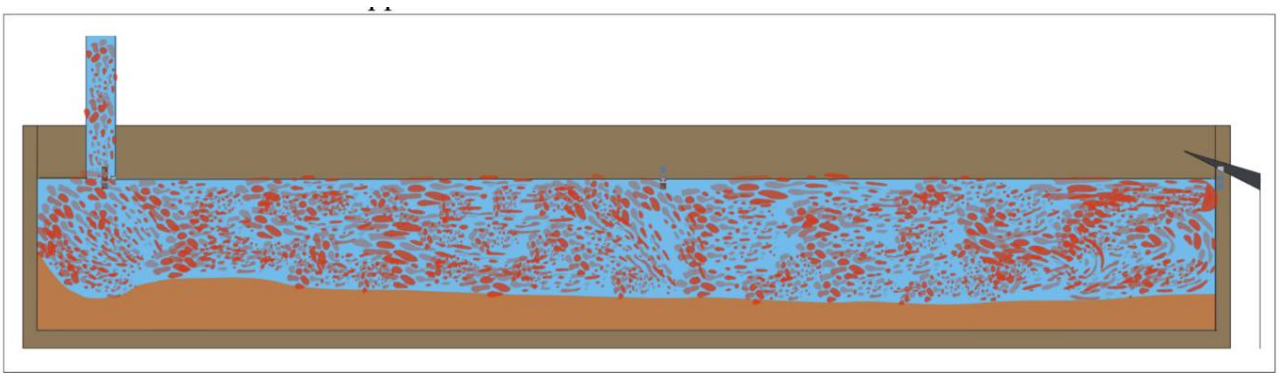


Illustration 1: Phase 5 of the loading cycle of a TSHD

However as they settle more water and sediment is being loaded into the hopper, until the hopper is full of water and sediment. At this point even though settling is occurring small particle size material is being overflowed/overspilled as shown here from a weir over the side of the dredger back into the river or on more modern hopper dredger via a turbidity control valve below the dredger but still being resuspended into the river flow.

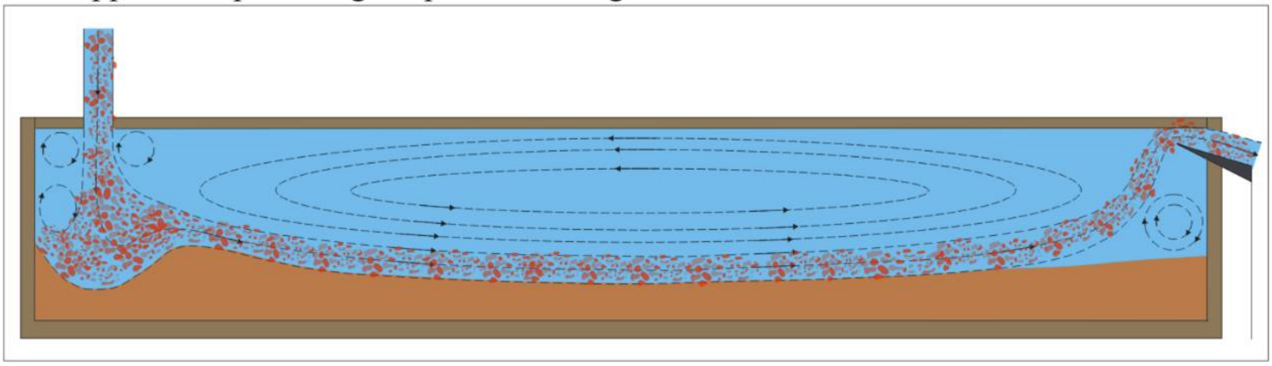


Illustration 2: Phase 6 of the loading cycle of a TSHD

As more materials settles in the hopper filling continues with more material being overflowed.

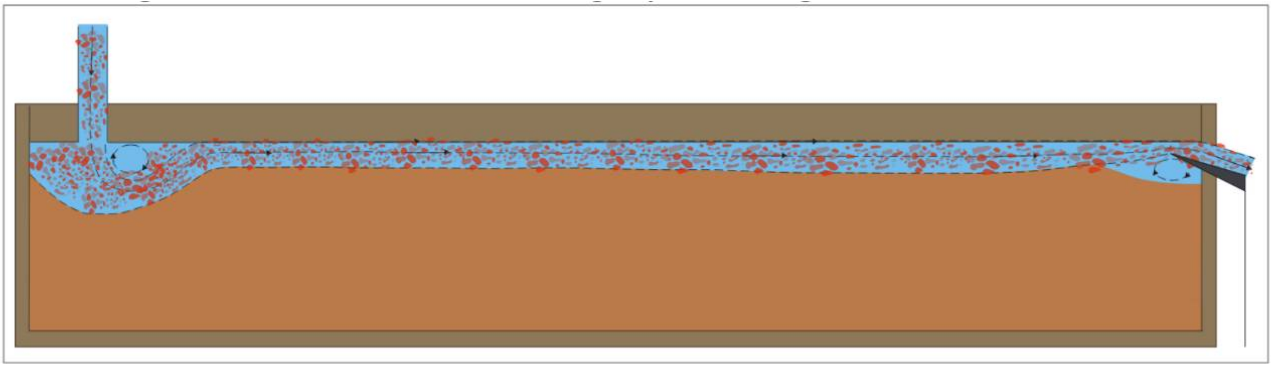


Illustration 3: Phase 8 of the loading cycle of a TSHD

The figure below shows what a loading curve could look like if the aim is to remove as much material as possible without consideration of overflow losses. Here 2111 tonnes of material has been collected in the hopper, but 1564 tonnes of materials has been lost in the overflow.

Trailing suction dredgers normally have the hopper built in, so operate as trailing suction hopper dredgers, however other dredgers often deposit dredged materials into a hopper barge. The barge will be filled and allowed to overflow, so that the hopper barge is now the source of overspilled fine sediment materials.

In the case of the MLA/2025/00263 the overspilling creates a new pathway for release of contaminants from sediment into the water column. The overspilling creates a new discharge with a mixing zone and an assessment should be made following the Environment Agency's surface water pollution risk assessment guidance. It is not obvious that such an assessment has been carried out as part of MLA/2025/00263 and that evidence has been supplied to show that the works are compliant with WFD.

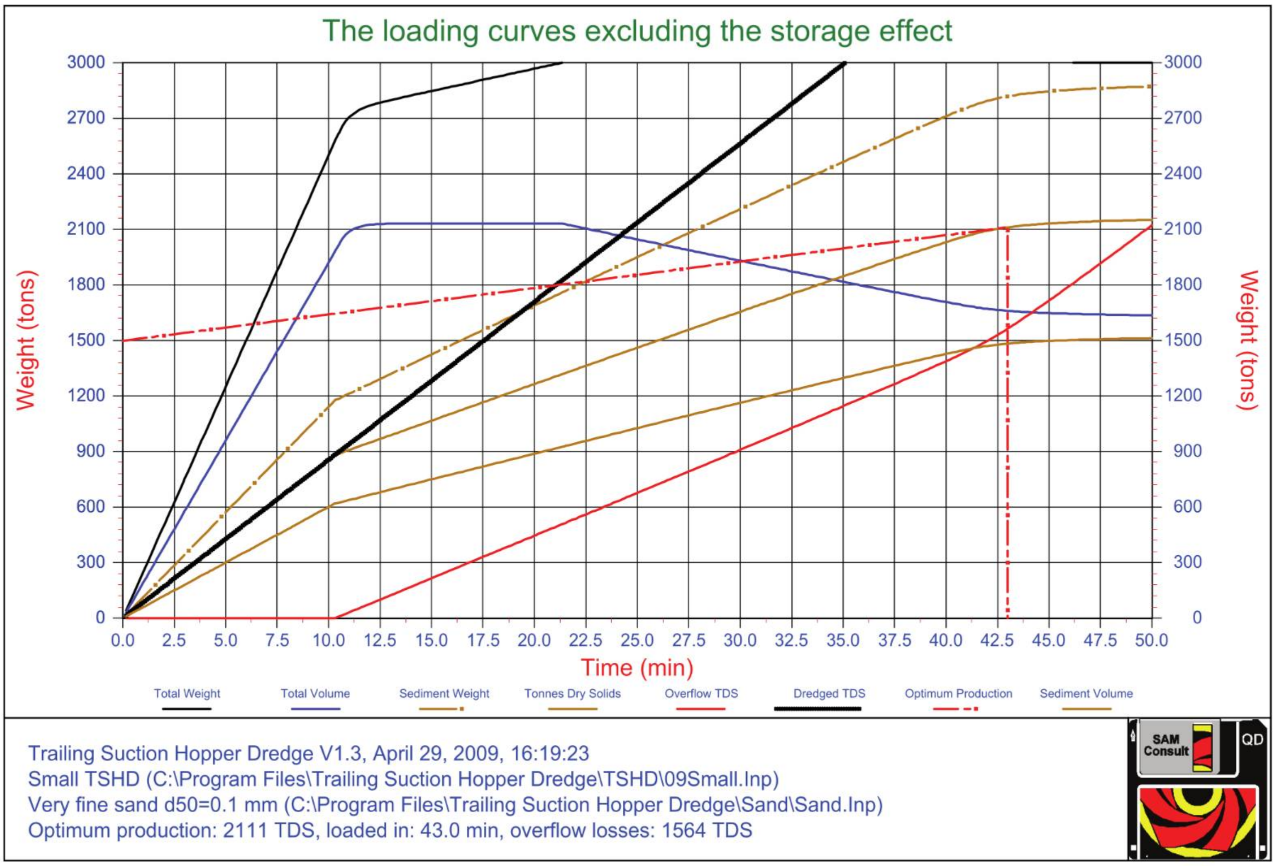


Illustration 4: The loading curves for the Small TSHD

If dredging is being carried out in an enclosed space then 40% overflow would not be acceptable as considerable amounts of the material would redeposit and so require removal by dredging again. However, in a river or estuary where currents are considerable then material below 100µm is expected to be carried out of the dredged area and so allow higher efficiency of operation of dredging. This would be no problem if the small particle dredged material is uncontaminated or if there was evidence that the River Tees would carry material out of the river.

1.2 Processes in the River Tees

While the 2025 MDP Baseline Document[4] provides some background to sediment transport within the River Tees, it does not fully explain within its text how the river works or the role of overspill in dredging operations. However, it references PD Teesport's first Tees Maintenance Dredging Baseline Document dated May 2005[5] which describes the complex processes which drive sediment distribution in the River Tees and unintended effects of dredging, which references a number of reports with more detailed information on sediment transport in the River Tees including the Tees Entrance Channel Study[6,7].

In summary here a number of key insights as explained in the 2005 MDP Baseline Document[5] – pages of 2005 MDP Baseline Document are referenced as (page number):

- **Estuary as a Sediment Trap** The lower Tees Estuary acts as a **trap for both marine and fluvial sediments** (p3.6).
- **Low Flow Speeds** Flow speeds within the channel are generally **low and, for the most part, insufficient to re-erode sediments once they have been deposited**, except during the largest tides or with disturbance or wave action (p3.6).
- **Continuous Settlement and Natural Sorting** Settlement of sediment occurs continuously along the channel. A natural sorting process takes place, with **coarser sediments depositing first in the outer channel**, while finer sediments penetrate further up the estuary (p3.6).
- **Limited Sand Penetration** Sand typically **does not penetrate the estuary in large quantities further than about 2km from the South Gare**, which is near the downstream edge of the Seaton Channel turning circle (p3.7).
- **Middle Estuary as a Siltation Area** The **middle part of the estuary** is described as acting like a typical tidal basin, with an **exponential decrease in the amount of silt in a landward direction where flows are too low to erode**. This strongly indicates a point where sediment will settle and not be carried back out to sea under normal conditions (p3.7).
- **Overall Sediment Supply and Settlement** The general supply of sediment to the main estuary is very low, and **most sediment entering the system will settle out** (p8.1).
- **Impact of Anthropogenic Changes** The considerable historical modification of the Tees Estuary, including training works and the construction of the Tees Barrage, has changed flow patterns, creating a sedimentary environment throughout the estuary where depths need maintaining by dredging (p9.1). The Barrage has provided control in the upper estuary, and flows are now so slow that sand from Tees Bay cannot penetrate far into the estuary without vessel or wave-induced disturbance (p8.1).
- **Siltation in Billingham Reach** A second significant siltation area exists in Billingham Reach. Although this area experiences high bed and surface flows, it has been suggested that disturbance from dredging is the only way sediments can be re-entrained from down estuary to supply this area, implying they would otherwise settle (p3.7).

The 2005 MDP Baseline document also addresses a number of other effects of dredging on the river system beside just deepening the navigation channel – sections of 2005 MDP Baseline Document are referenced as (section number):

- **Agitation and Redistribution of Sediment**: Dredging directly causes the **agitation of material to the water column**, which can lead to increased turbidity and suspended sediment concentrations (3.1.3). This can also result in **smothering** from the deposit of fine sediment (6.4).
- **Redistribution of Contamination**: The disturbance of sediments during dredging has the potential to **redistribute any contamination that adheres to the sediment** both to the water column and to the new location where sediment is re-deposited (6.4).

- **Disturbance to Wildlife**: Dredging operations can cause **disturbance to birds** through noise and the interruption of their lines of sight (8).
- **Creation of a Sedimentary Environment**: Historically, engineering works like training walls helped scour the channel, but the subsequent **over-deepening of the navigational channe** has reduced flow speeds, effectively creating a **sedimentary environment throughout the estuary** where depths constantly need maintaining by dredging (9).
- **Changes in Siltation Patterns**: Post-Tees Barrage construction, there's been a tendency for sediment to **penetrate less distance into the estuary**, causing higher accumulations just down-estuary of the Seaton Channel, which increases dredging requirements in these specific areas (4.3.1).

This highlights how the River Tees is a dynamic system, which is continuously affected by human actions and has been undergoing human induced change for the last 3 centuries.

While the River Tees is obviously not a closed harbour being an active river, the flow patterns within it are such that for fine sediments 2km downstream of South Gare it acts as one. So any overspill of fine material from a trailing suction hopper dredger or a hopper barge operating upstream of 2km from South Gare will redeposit within the river.

Overspilling from trailing suction hopper dredgers or hopper barges will result in contaminants being circulated around the river.

This also means that overspilling while appearing to increase the efficiency of dredging is only a short term benefit, as overspilling will be directly increasing the amount of materials required to be dredged in order to maintain navigation channel depths. So if overspilling upstream of 2km from South Gare was suspended, the increase in dredger time spent travel to the disposal site, over time this would be compensated for by a decrease in the amount of dredging necessary.

Downstream of 2km upstream of South Gare overspilling should only occur on an ebbing tide to ensure that more fine sediment is not trapped within the River Tees sediment trap.

The 2005 MDP Baseline Document[5] and the reports it references are essential reading to understand the current maintenance licence renewal application.

1.3 2021 Crustacean Mortality Event

This was a significant event which happened during the lifetime of previous River Maintenance Dredging Licence as such it should be addressed in a precautionary manner as part of this licence application. The representation mentions some of the conclusions from the previous reports on the mortality event directly, such as “Independent Expert Assessment of Unusual Crustacean Mortality in the North-east of England in 2021 and 2022”[8] as they are mentioned within MLA/2025/00263 licence application documents[2] and quoted as reasons to allow continuation of dredging operations largely unaltered.

This representation is highlighting risks that would be caused if MLA/2025/00263 was granted without the requested restrictions and does not specifically address the crustacean mortality event as that is outside the scope of any future dredging licence.

1.4 2022 - 2023 South Bank Quay Construction - MLA/2020/00506

1.4.1 Learning from South Bank Quay Exclusion Zone Dredge

Sampling prior to construction of the South Bank Quay, the Teesworks site was identified as a highly contaminated area of the river bed, the dredged material from which was to be excluded from being disposed of at sea. Instead the dredge had to be carried out using a closed bucket dredge to ensure none of the highly contaminated sediment was resuspended in the River Tees. Conditions were also included that samples had to be taken from a limited portion of the surrounding river bed both before and after the closed bucket dredge to ensure that any contamination caused by the dredging would be detected.

In fact, the post dredging sampling showed that the river bed around the dredge site had been heavily contaminated by the dredge operation, a subsequent dredging campaign was undertaken to return the river bed to its state prior to the exclusion zone closed bucket dredge.

The volume to be removed from the exclusion zone by dredging was over 120,000m^3 but currently only just over 70,000 m^3 is being stored on the Teesworks site. The unintentional loss of potentially 50,000 m^3 into the River Tees is not surprising if you have ever tried to dig a hole on a beach underwater. Even discounting the material which is resuspended when a bucket is pushed underwater into a sediment, the dredging containment method had a single point of failure, i.e. if the bucket leaked then the highly contaminated material would be continually dispersed into the river as the dredging operation continued. Secondary containment such as a silt curtain should have been installed to ensure contamination could not spread into the wider river or a coffer dam should have been constructed such that the dredging could be carried out by excavation without any contact with the river water.

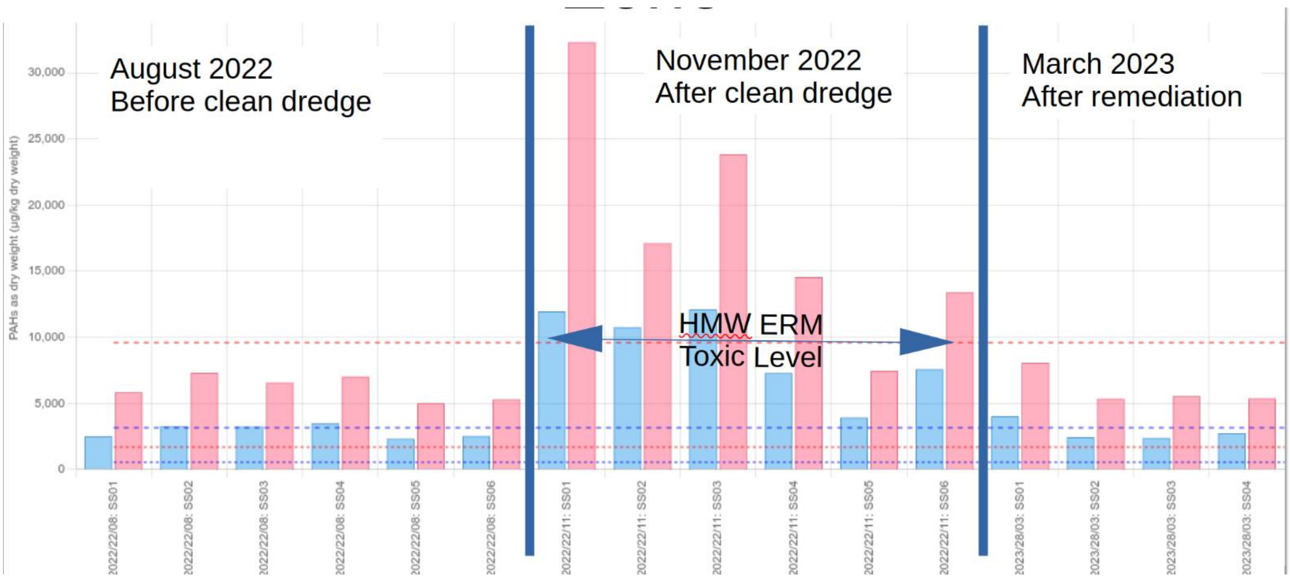


Figure 1: 2022-23 Exclusion zone contamination level before and after dredge plus after remediation

Royal Haskoning DHV detail the analysis of the river bed as part of MLA/2020/00506 Condition 5.2.11 – P03[9].

While the South Bank Quay excluded dredge area was more contaminated than much of the rest of the river, it is not orders of magnitude so and was equivalent to much of the fine particle material which will be overspilled during trailing suction hopper dredger operation. The practice of overspill should be stopped until it can be shown that level of contamination is not significant.

Whereas for the South Bank Quay exclusion dredging sampling was only carried out before and after dredging, which meant that considerable contamination was spread widely over the River Tees river bed, it is essential for the continued maintenance dredging of the River Tees that sampling is also carried out during the dredging operations and limits set on the level of spread of contamination that is allowed before dredging has to be suspended.

In summary to avoid the danger to the environment caused by South Bank Quay exclusion dredging, conditions must be included in any licence to require sampling before, during and after dredging, with specified remediation of any contamination found.

1.4.2 Impact of Cutter Suction Dredge

Once the exclusion zone dredge and the excavation of man made river bank material had been completed the majority of dredge to create phase 1 of the South Bank Quay and deepen the turning circle was completed by the Van Oord's cutter suction dredger Athena. Athena used a cutter head which digs into the sediment with a suction system which captures a portion of the dredged material which is then pumped into hopper barges for transport to Tees Bay C disposal site where the dredged material was disposed of.

Illustration 5: Athena dredging to hopper barge - South Bank Quay - March 2023

The operation of the cutter suction head and the overspill from the hopper barges both result in release of sediment with associated contamination into the river at the site of dredging. The Athena dredged around 2 million tonnes of sediment, so the overspill from the hopper barges will have been between 200,000 tonnes and 400,000 tonnes of sediment. Similar amounts of sediment will have been mobilised at the cutter suction head, much will have settled locally and some portion will have been removed later in the dredge process, however still 10,000s tonnes of sediment will have travelled away from the dredge site.

The whole operation has been summarised Van Oord in a promotional video South Bank Quay Development available to view on YouTube – https://www.youtube.com/watch?v=gGNOGY_vYLE, this clearly shows the impossibility of avoiding large amounts of contaminated material entering the River Tees during the extensive operations using this method of operation.

1.5 2023 Sediment Quality Measurements Show Uniformity of Contamination Along Navigation Channel

No relationship between different sediment surface samples taken in the River Tees should be assumed, as the previous work has shown that the River Tees has a particularly complex set of interacting processes (see above).

The sediment samples taken in 2023 show increased levels of silt and clay as a a progression upstream, excluding Chart 7 sample which is presumed to be due to wash-off from the recently remediated South Bank site at this position. The behaviour could be expected in a normal river and is postulated in this application to be the case for the River Tees, however all other samples set do not show this behaviour.

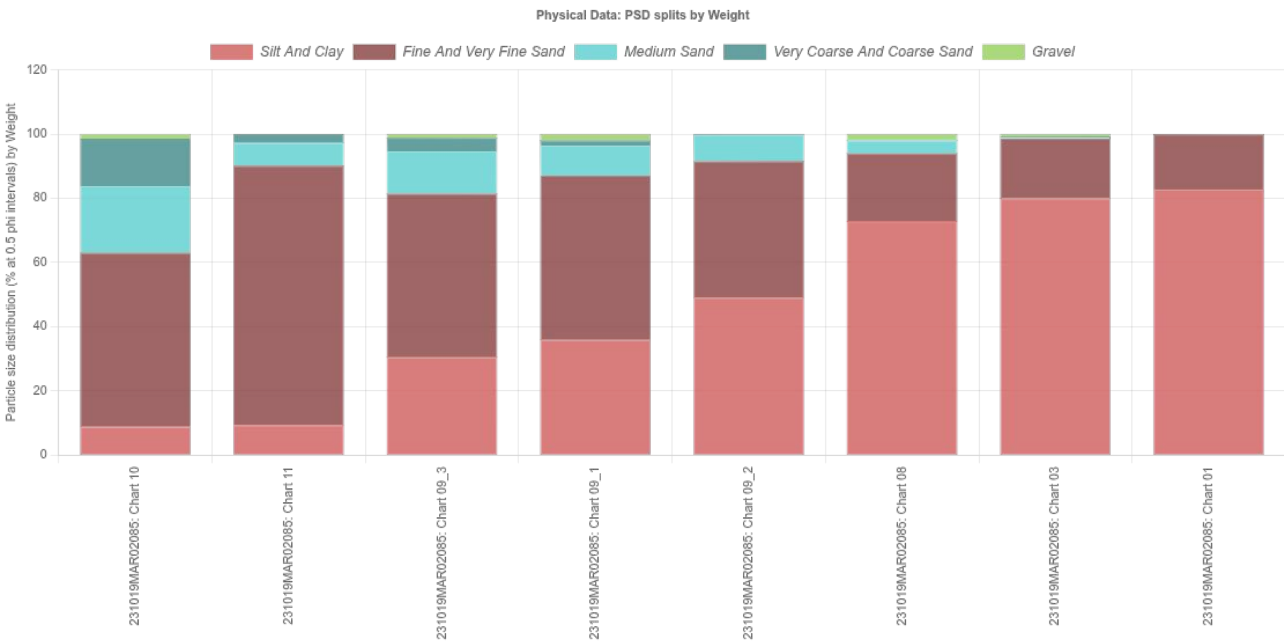


Figure 2: 2023 Sample compositions ordered by silt/clay fraction

The surprising observation is that for the 2023 sample set the contamination by hydrophobic organic contaminants (PCBs, some PAHs, etc.) correlates with increasing levels of silt.

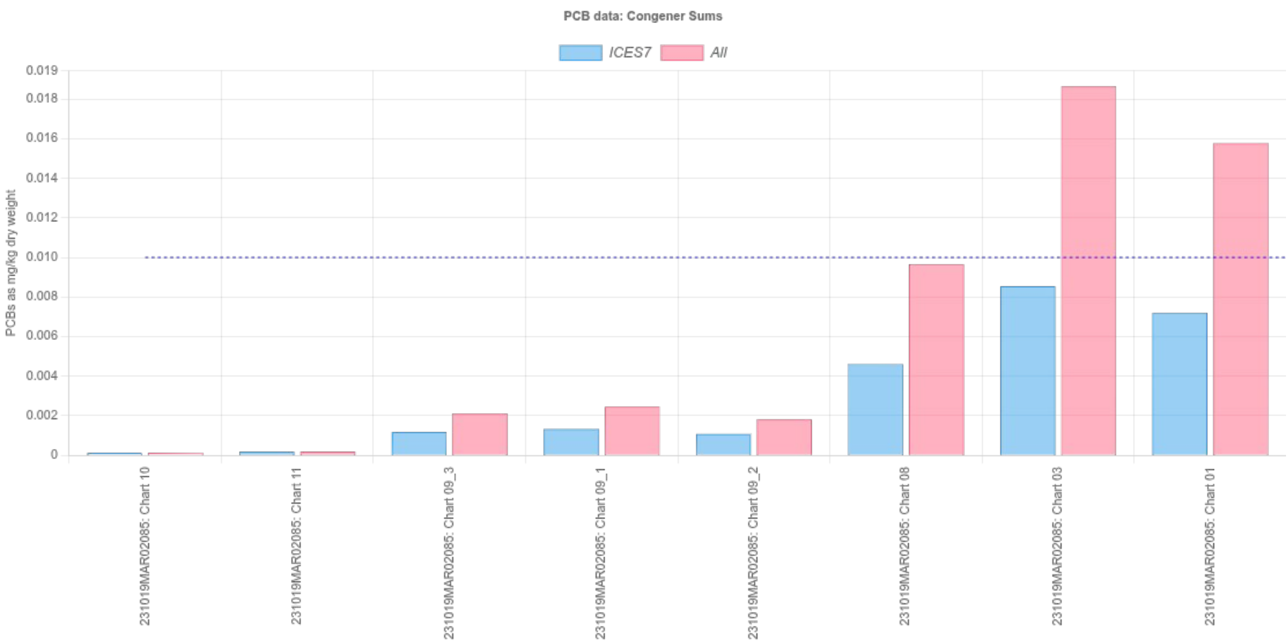


Figure 3: 2023 Samples PCB sums ordered by silt/clay fraction

This will fully explained later using the calculated surface area and the correlation of individual chemicals with surface area.

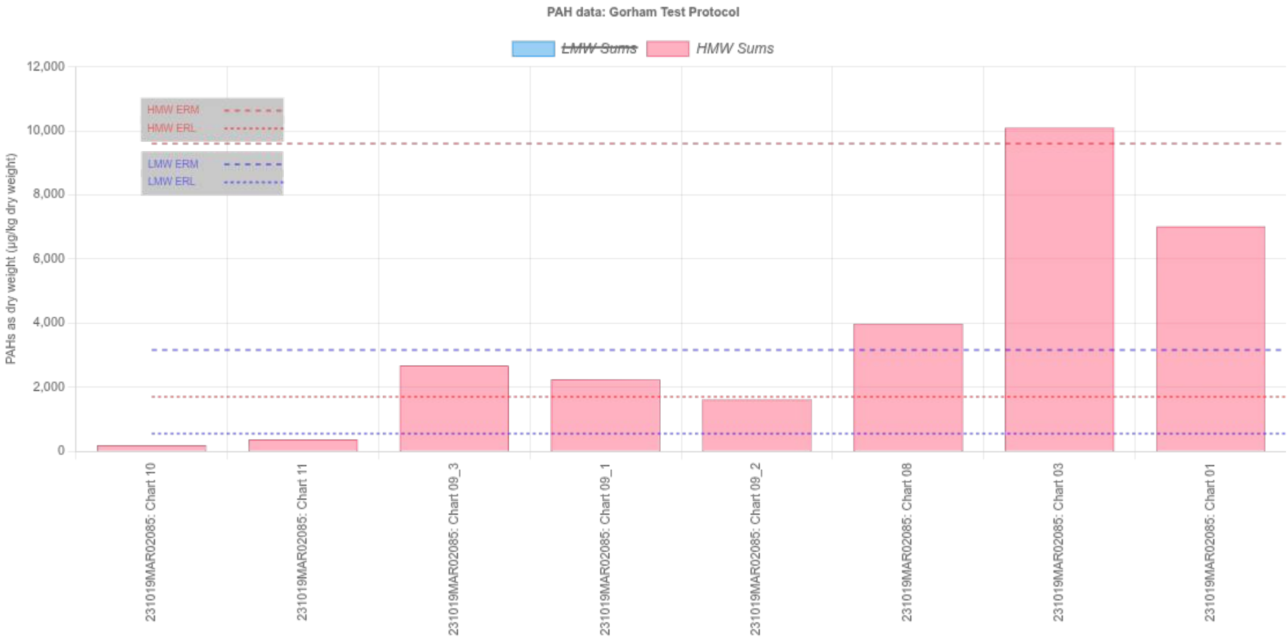


Figure 4: 2023 Samples Gorham Test protocol HMW PAH sums ordered by silt/clay fraction

It is often stated in submission to the MMO that such components are associated with organic mater, however for the 2023 sample set no correlation of hydrophobic contaminants with organic mater (total organic carbon) is seen.

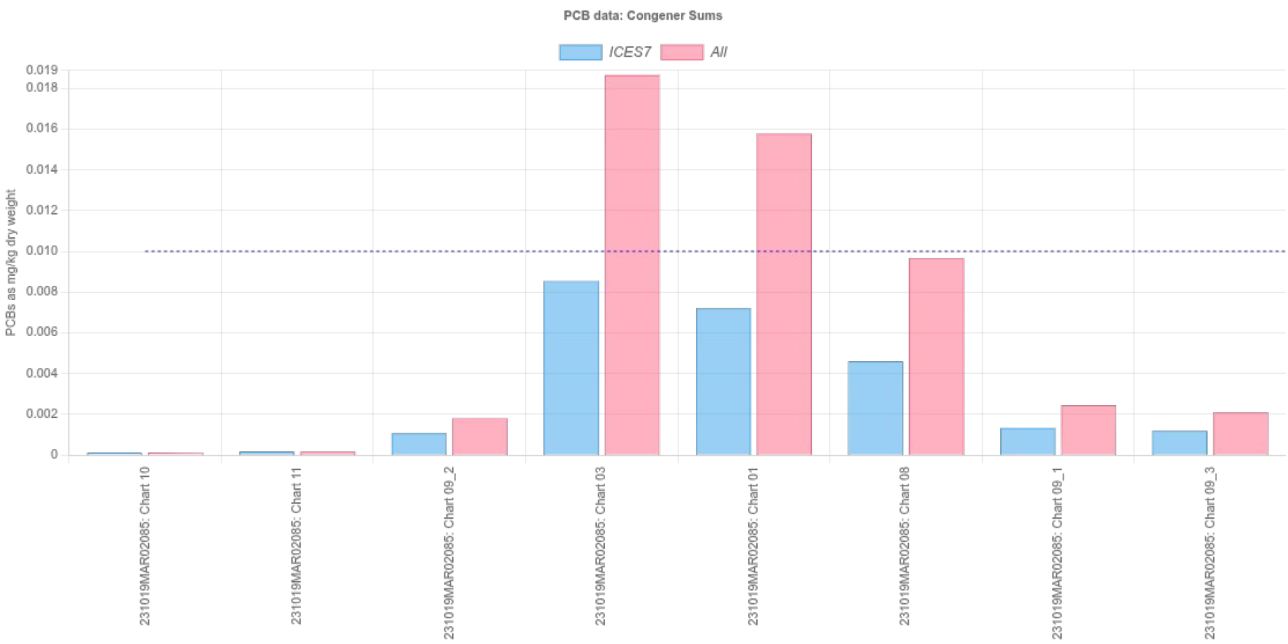


Figure 5: 2023 Samples PCB sums ordered by organic matter

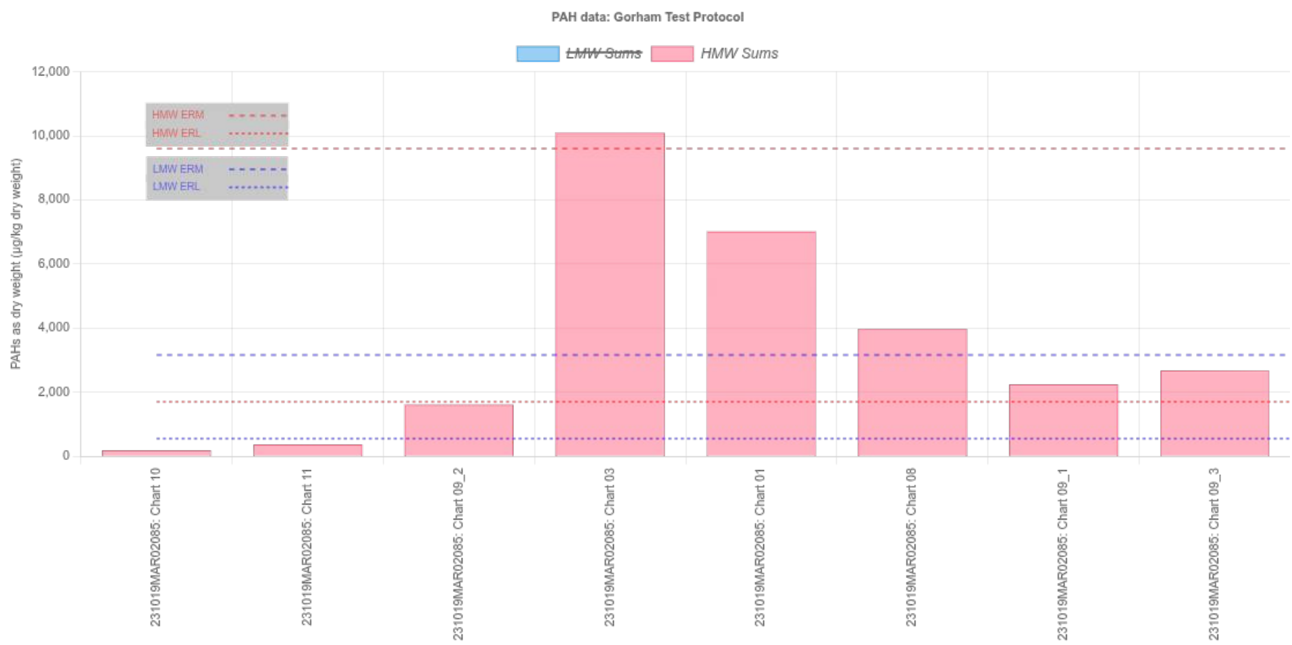


Figure 6: 2023 Samples Gorham Test protocol HMW PAH sums ordered by organic matter

The more silt the more hydrophobic contamination, showing how the hydrophobic contamination is adsorbed onto the particle surfaces. The expected correlation with organic carbon content is not seen.

The samples taken in 2024 show compositions which do not show the same trend for silt/clay content as can be seen if the samples are ordered by level of silt/clay. Sample 01 is the sample nearest to the barrage and sample 25 is nearest to the sea in the river between South and North Gare.

Figure 7: 2024 Samples compositions ordered by silt/clay fraction

Also no relationship is observed between hydrophobic organic contaminants and silt/clay fraction or with between hydrophobic organic contaminants and organic matter.

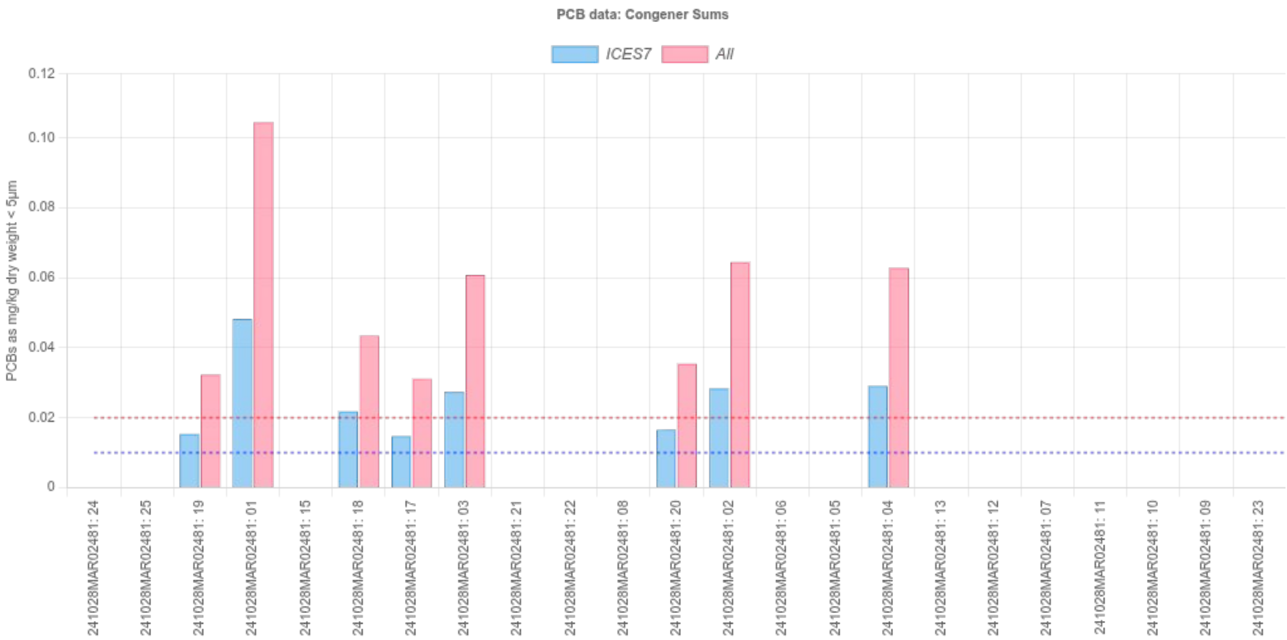


Figure 8: 2024 Samples PCB sums ordered by silt/clay fraction

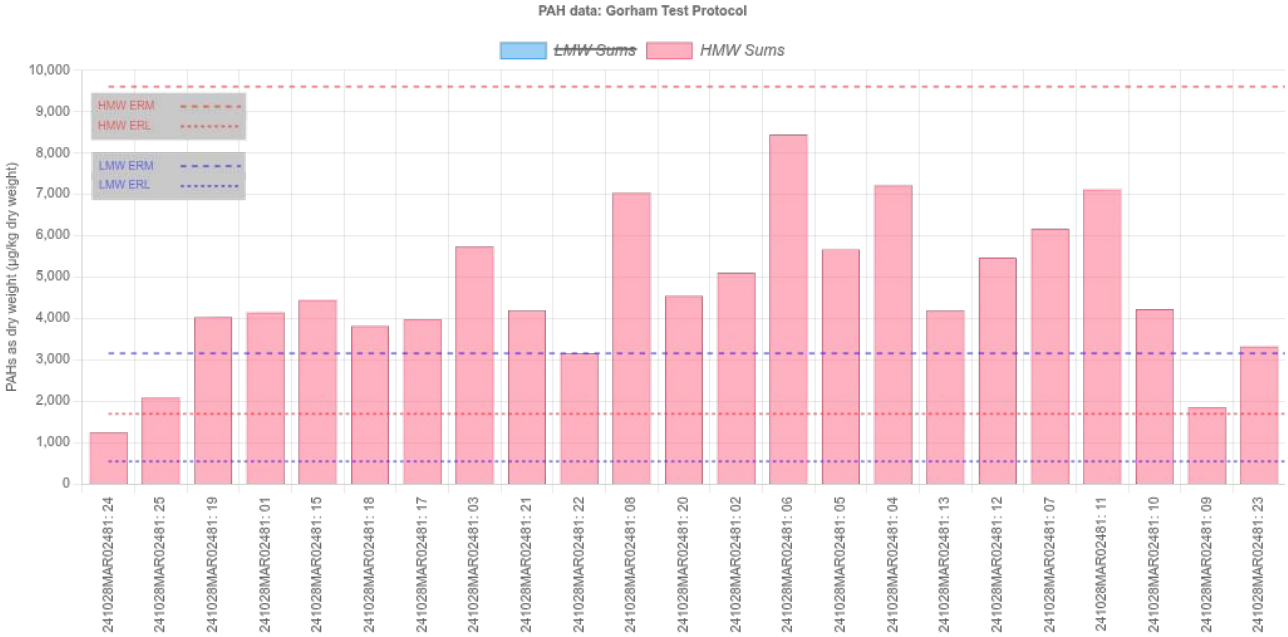


Figure 9: 2024 Samples Gorham Test protocol PAH HMW sums ordered by silt/clay fraction

This simplistic analysis of the particle size distributions, PCB and PAH concentrations shows that in **the lifetime of the previous River Tees Maintenance Dredging Licence L/2021/00333/7 an event occurred which spread contaminated sediment across the whole dredged area**. The most likely event was the capital dredging for the South Bank Quay where release of sediment into the river at the cutter suction dredge head and as overspill from the hopper barges injected a large amount of contaminated sediment onto the river bed at least local to the dredge site. It is possible that natural processes in the River Tees which tend to carry sediment upstream may have be solely responsible for the wide redistribution of the sediment, however it is likely that maintenance dredging of the deposited contaminated sediment resuspended some material at the dredge head and in the overspill, so also spread the contamination around the river system.

1.6 Harbour seal pup morbidity – Tees Estuary Seal Study (TESS)

In 2024 the Tees Estuary Seal Study found morbidity of apparently all harbour seal pups born in 2024[10]. Investigation suggests that the underlying cause of the high morbidity levels in weaned pups in north-east England in 2024 may be poor post-natal growth combined with a weakened immune system, caused by a PCB cocktail ingested in the mother's milk[11]. The pups stranding in the early postweaning period (02–16 Aug) were all well below normal birth weight. Previous studies have shown that such emaciated pups are then highly susceptible to lethal infections by potentially tissue necrotising bacteria.

The possible culpability of PCBs in the seal pup morbidity was suspected from the Tees seal study carried out in 1989–1993, when the three pups that were born died soon after birth and were found to be very underweight with high levels of PCBs in their blubber; pups dying later during their first year also had relatively high levels[12]. However, the analysis at that time only gave a sum of total PCBs, and therefore we are unable to compare the levels of the individual dioxin-like (DL) and non-dioxin-like (NDL) congeners. Since then multiple studies in other parts of the world have found evidence of PCBs being the underlying cause of morbidity of a range of marine mammals[13–15].

The Tees pup morbidity is occurring mainly in the immediate postweaning period. Two principal factors may have combined to make these pups non-viable – their low body weight and hence physical weakness, and their mouth-rot bacterial infection. Both of these principal factors are likely to have an underlying cause of the relatively high PCB contamination of their body tissues, indicated by the blubber analyses for PCBs. PCBs are known to cause poor prenatal and postnatal growth of the newborn seal pup, and they are also known to cause immunosuppression in harbour seals and other marine mammals. The PCB findings do not rule out contributions from other pollutants but may be enough on their own to account for the extraordinarily high postweaning pup mortality, seemingly of most of the Tees 2024 cohort of pups.

Although it is not definitely known if the onset of pup morbidity with low body weight and MR coincides with renewed deep dredging of the River Tees, it is a possibility that historic deposits are being dredged up and returned to circulation in the surface sediments and thence through the Tees food chain to seals. Although potential mitigation may already be too late, with much dredge material having already been dumped offshore in Tees Bay during the past few years, the possibilities and technology for **extracting dredged material without spillage** and **depositing it in lined landfill sites** must be explored urgently rather than the dredge being overspilled and redistributed offshore, where it may be affecting the food chain for crustaceans, fish and marine mammals.

Such mortality of harbour seal pups requires that any future dredging of the River Tees is carried out using a precautionary approach, until the role of dredging has been shown not to be a cause of or to exacerbate the seal pup mortality.

1.7 Sediment Quality Measurement Interpretation

This representation relies heavily on the sediment quality data which has been supplied for MLA/2025/00263 and previous River Tees dredging licence applications both as original sampling programmes and in mid-licence sampling programmes. A method for analysis of the sediment quality measurements has been developed which goes beyond the standard analysis reported in the licence application in order to identify the risks which the sediments pose.

1.7.1 MMO Sediment Template

The Marine Management Organisation explains the sediment sampling and analysis process on the UK Government website[16].

The standard suite of chemicals is set out which has to be sampled for before many types of marine license are granted. The concentration of chemical contaminants is submitted as part of the application in a standard template format Excel macro spreadsheet (xslm). The concentrations are in visible sheets named after the chemical type measured, along with information about the sampling locations and a particle size analysis of each sample. There are also an equal number of hidden sheets with the types of analysis used to assess the data are shown.

Spreadsheets of thousands of concentrations are a useful resource, but comparison and analysis in a spreadsheet format is not possible. The Sediment Data Explorer has been developed to allow both comparison and analysis of multiple sheets across multiple locations and over time periods[17].

While the template is a standard format the completed spreadsheets have many differences. On many occasions dispensations are given based on the history of the site or the application purpose to only measure some of the chemical classes. The quality of completion of the information also varies, from simple differences with information such as digital degree latitudes / longitudes being supplied as northings / eastings instead, to significant differences in the structure of the spreadsheet and missing information such as sampling date.

1.7.2 Particle Size Distributions

Particle size distributions (PSD) are supplied as a by weight basis. The PSD allows sample compositions to be simply examined, both graphically as a distribution and through understanding the split of the sample into standard size ranges silt/clay, fine and very fine sand, medium sand, very coarse and coarse sand, gravel.

The level of variability of the composition of samples taken across the River Tees over time mean it is difficult from a single composition to know where that sample was taken from, as could be expected for a tidal river.

Without a more detailed analysis of the sediments, any further analysis has to make assumptions of the material being dealt with. In general this work makes the assumption that all the sediment particles can be considered to have the same density, as the level of organic matter is below 10%. When considering the distribution of contamination flaws in this assumption can be seen if correlations are seen, for example with “Organic matter (total organic carbon)”. The Sediment Data Explorer provides options to search the data for such correlations (as discussed for 2023 sampling data below).

Contaminants can be[18]:

- components of sediment particles or
- absorbed within sediment particles as organic matter can trap hydrophobic organic contaminants or
- be adsorbed on the surface of sediment particles.

Displaying the particle size distribution by weight only gives an idea of the volume of the particles it does not give any idea of area. Contaminants which are components of sediment particles or absorbed with sediment particles will vary with the volume of material present, but any adsorbed contaminants will vary with the surface area not the volume of material present.

So stating that a trailing suction hopper dredger is operating with a certain percent overspill, does not provide quantitative information about the amount of contamination which has been overspilled.

Contaminants which are adsorbed on sediment particle surface will not follow the volume / weight of sediment, but the surface area. Small particles have a higher area to volume ratio than large particles, so small particles will contain a higher fraction of the total surface adsorbed contamination than larger particles.

The Sediment Data Explorer takes a simplistic approach that the density is uniform and all particles are spherical, then using the supplied PSD by weight this is transformed into a PSD by area, so rather than the fraction of all the sediment particles weights in a size range, the area distribution is the fraction of the all the sediment particles areas in a size range.

These calculations are used to understand how much contamination of adsorbed contaminants are contained in the overspilled fine sediment from trailing suction hopper dredgers. Knowing the fraction of the total dredged material which is overspilling, by using the cumulative weight particle size distribution it is possible to look up the size where all the particles below that size sum to the fraction overspilled, this size is then used on the cumulative area particle size distribution to find the fraction of surface area contained on that weight fraction of the sediment. The fraction of surface area will determine the fraction of adsorbed contaminants which are carried by the overspilled particles.

Looking at two samples from the 2023 sampling programme.

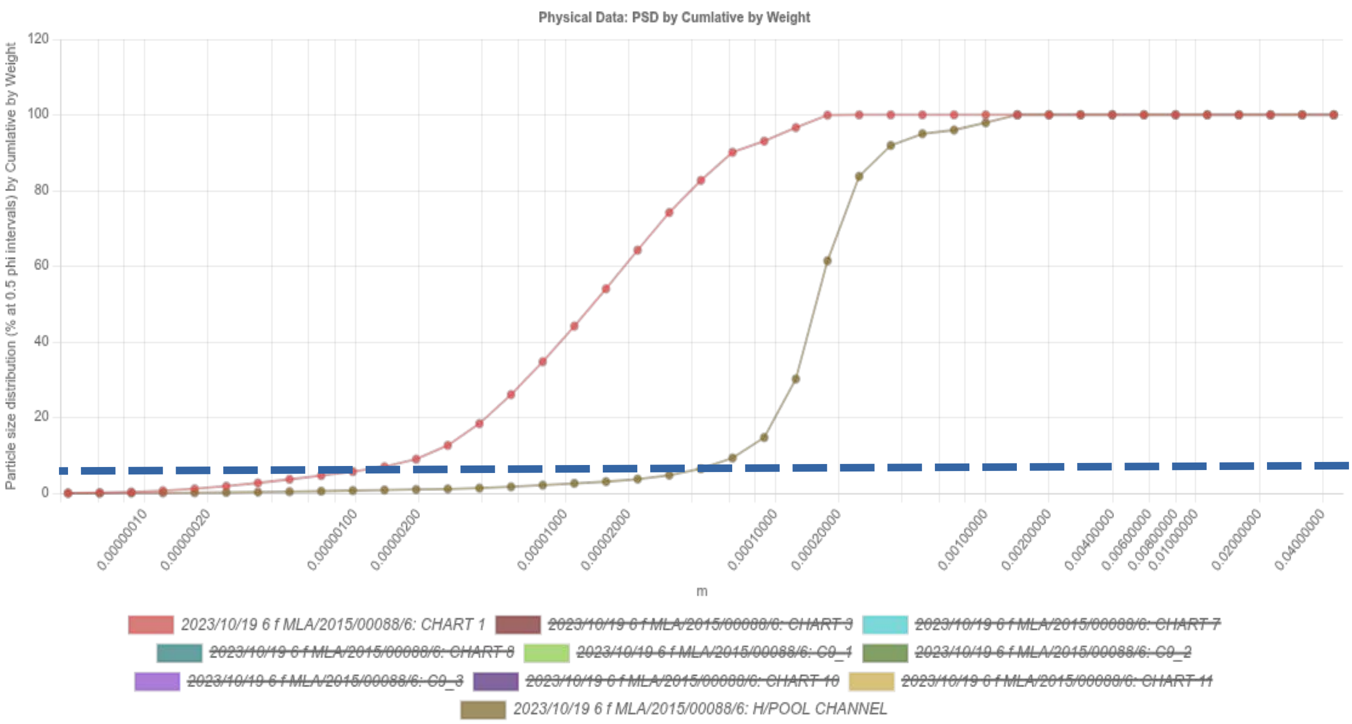


Figure 10: 2023 Samples PSD by cumulative weight

So with 5% overspill for Chart 1 the sediment particles overspilled make up 67% of the surface area, whereas for Hartlepool Channel this is 84%.

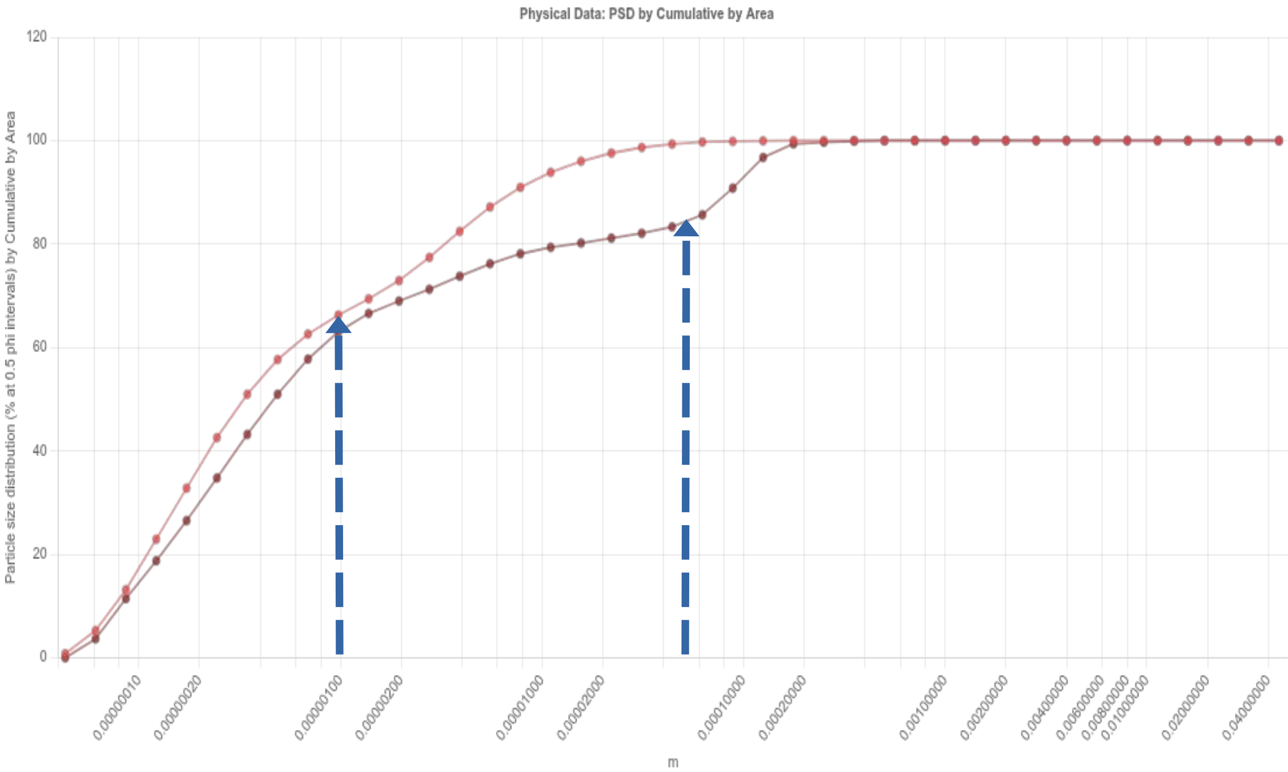


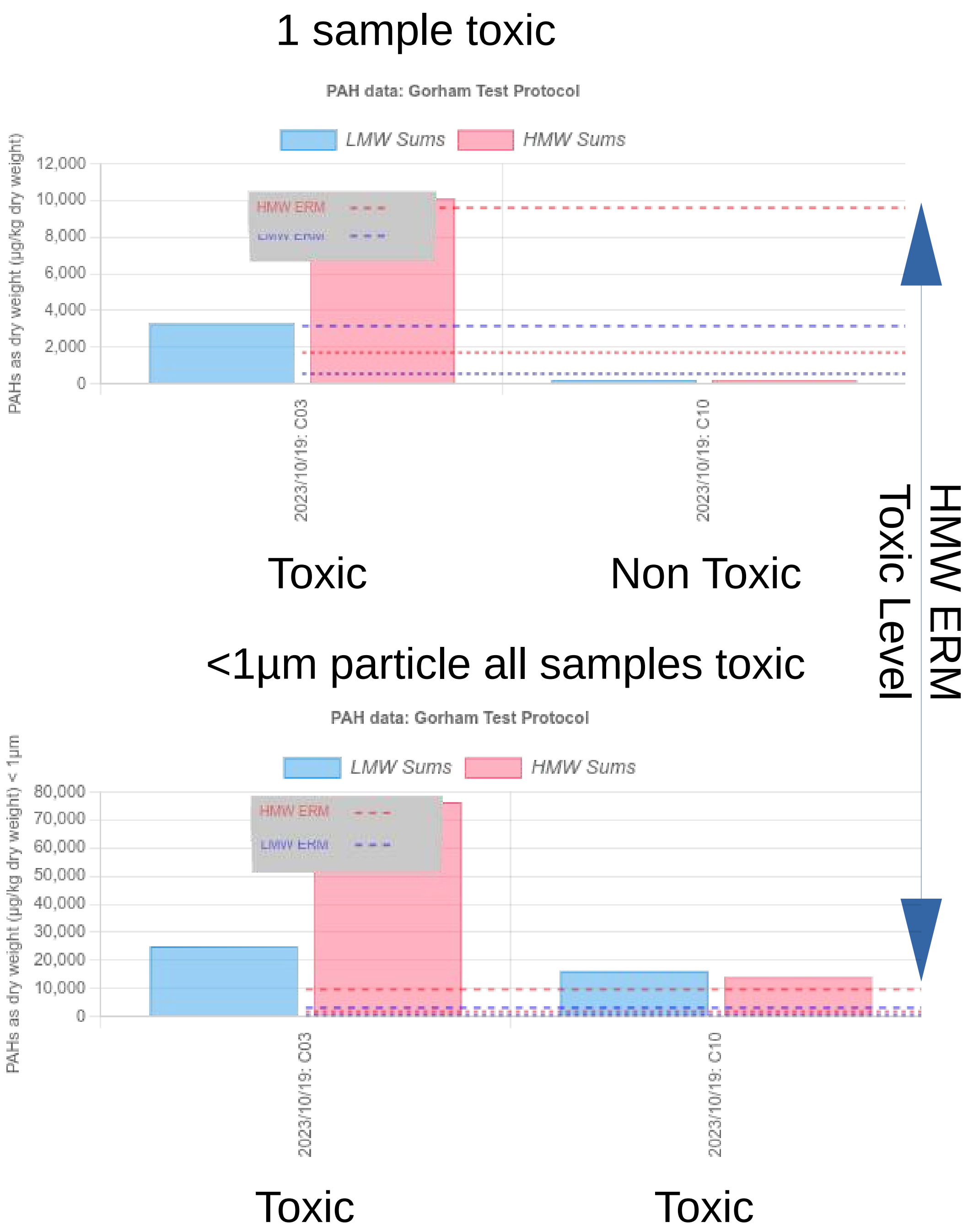
Figure 11: 2023 Samples PSD by cumulative area

This means that if the contaminant is adsorbed on the surface of the sediment particles, than with only 5% weight overspill at Chart 1 67% of the contaminant is being overspilled and at Hartlepool Channel 84% of the contaminant is being overspilled.

The settling rate of the sediment particles once overspilled depends on their size, with the largest particles settling most rapidly and thus spreading least. So when the fraction above 1µm from the Hartlepool channel settles, the sub 1µm fraction will still result in 66% contamination resuspended.

Figure 12: 20023 Samples PSD by cumulative area

This relationship can be used to estimate the toxicity of particles below a certain size. For example for two sample, one exceed the Gorham Test Protocol HMW ERM, but the other is well below it. However, if the fraction of contamination on 1µ is caclulated as a weight contamination level, then both samples fail the Gorham Test Protocol for HMW ERM and LMW ERM.



2 Contamination by Sampling Period

Omission: This application is missing the sample data required for a new licence application, as it only contains sediment sampling which was explicitly taken as mid-licence samples for L/2015/00427/7. MMO stated on 1st April 2025 "*3. MMO remind the applicant that new sampling will be required for any future Marine Licence applications.*" – letter from Conor Godwin, Marine Licensing Case Officer, MMO to Andrew Ridley, PD Ports. Despite confirmation that CEFAS do not now require a new sample set, a further set of samples would provide more confidence that sampling is able to reflect the real contamination state of the River Tees.

Inconsistencies: The licence application relies on 143 samples taken over 10 years to represent over 25 million tonnes of material disposed of at sea, so roughly 5 samples per 1 million tonnes. The data sets are not easily comparable, with very few analysis being present across all 143 samples, for example – the original 2015 data and 2019 data MAR00179 do not contain total organic carbon data, the 2024 sampling MAR02499 and MAR02481 do not contain total hydrocarbon data, Hartlepool samples are compared to River Tees samples, PCBs were not sampled in 2015 and 2018, BDEs were not sampled in 2015, 2018, 2021, organochlorines were not sampled in 2015, 2018. Missing fundamental measurements such as total organic carbon make it impossible to determine whether organic contaminants are following expected distribution behaviour.

This lack of data has a major impact on the ability to understand what is going on in the system and how best any environmental risks can be minimised. For example with the almost complete data supplied from the 2023 sampling no correlation is seen between hydrophobic organic contaminants (including PCBs and some PAHs), but there is a strong correlation across the river with fine particles, suggesting that these materials rather than being associated with organic matter are adsorbed on the surfaces of find particles. Highlighting the importance of limiting or eliminating the practice of overspilled from the trailing suction hopper dredgers.

The inconsistencies make it very difficult to objectively compare samples across both the river and time.

The inconsistencies also make it all the more essential that new samples are taken to support this licence application.

The simplistic approach to purely carry out a chemical analysis on the complete sediment sample while appropriate for disposal, gives no indication as to the hetrogeneous distribution of contaminants between different particles.

2.1 Particle Size Data

River Tees sediments sampled are predominantly composed of silt / clay, as stated by MMO on 31st January 2025 in response to the sample data submitted for the 2024 mid-licence sampling. The predominance of silt / clay means that calculating the concentration of contaminants by weight is appropriate for disposal at sea, assuming the dredged material is disposed of in its entirety. However, the predominance of silt / clay with a considerable fraction of sediment being below 10 microns, means that as much as 90% of the sediment sample area will be on sediment particles which will be released as part of the overflow at the site of dredging. Hydrophobic contaminants when not combined as part of organic carbon matter will adsorb on the particle surfaces and thus be resuspended at the dredge site.

Figure 13 shows the variation in sample consistency purely based on weight of different material

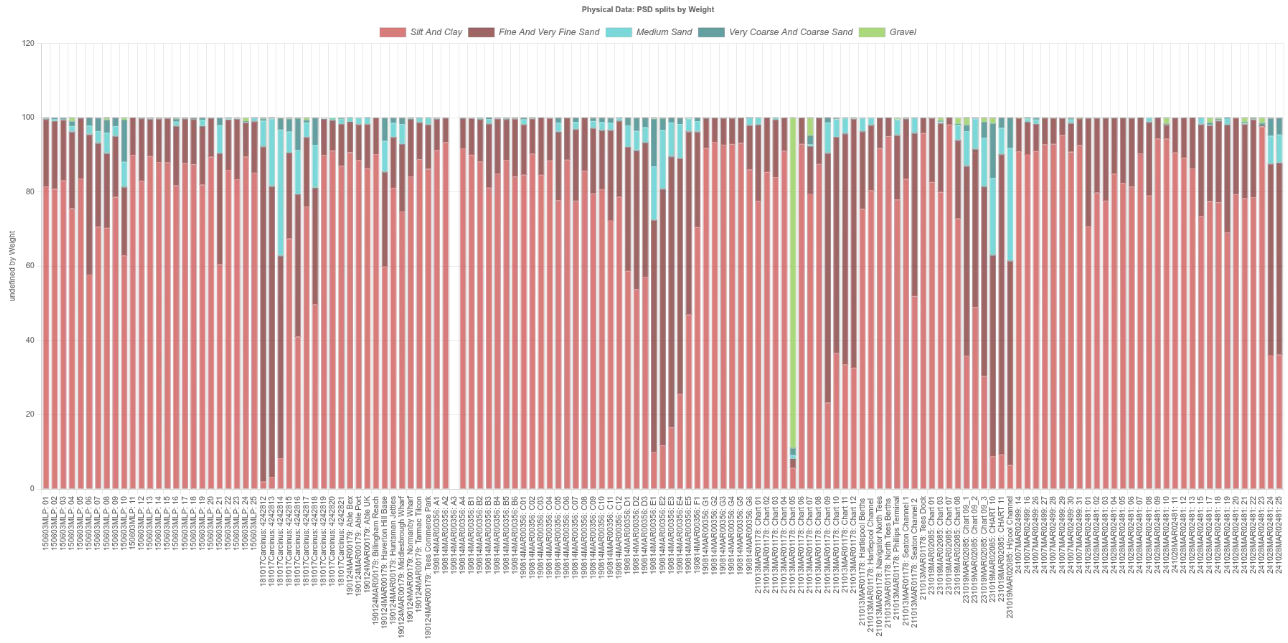


Figure 13: Material composition of all samples from 2015 - 2024
types.

Figure 14 show the particle size distributions reproduced as relative area of the sediment sample instead:

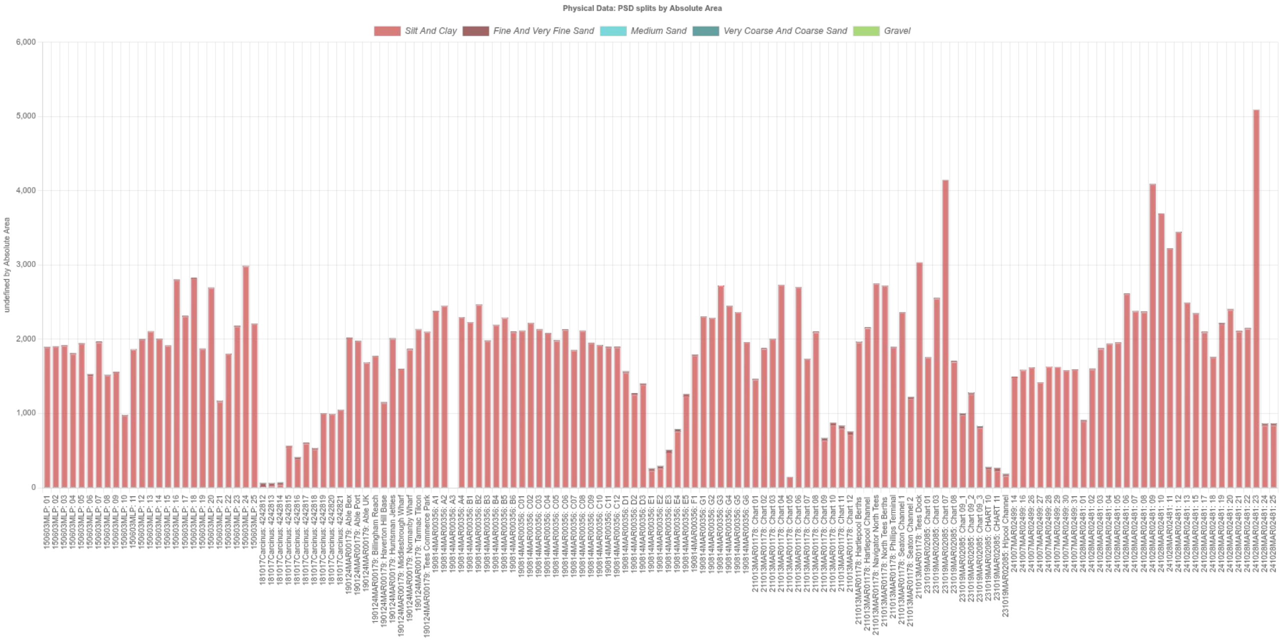


Figure 14: Relative surface area of all sediment samples 2015 - 2024

These variations in surface area complicate the ability to extrapolate from contaminant concentrations of the whole sample to the actual toxic hazard which sediments present and certainly undermines comparisons from year to year.

As shown in section 2 considerable variation is also present across single licence / mid-term sample sets and in section 3 that considerable variation is also seen across time within localised sampling areas.

2.2 Unique Sample Set

Each sample set is examined below, the sampling approach assumes that a sample taken at a specific point in the river is representative of that location over a considerable period of time, 3 years between mid-licence samplings. Samples are taken from the surface of the river bed.

The complex process of River Tees are documented in the Maintenance Dredging Baseline documents and revisions from 2025[4], 2008[19] and 2005[5] Maintenance Dredging Baseline documents, and work they reference on a conceptual model of the Tees Estuary[6,7]. These explain how dynamic the river is in transporting sediment depending on state of tide, weather on land and at sea, dredging operations, shipping operations, anthropogenic changes (both intentional - new structures and unintentional – training wall collapses) and geological changes such as landslips. So at best a complete sample set could be considered to be representative of the whole river, but only if it is assumed that surface sediment sampled is composed of sediment permanently trapped within the tidal river system combined with consistent material flows in from river and sea.

It appears that a sample taken at a location is representative of the surface sediment at that time at that location, as can be seen from comparison of these sample sets taken sometimes only 1 year apart, the variation shows that the river processes dominate and as such it is essential that a precautionary approach is taken to the hazards presented by any contamination.

For this reason, first the 2023 sample set is examined because it is both the most complete (all determinands measured) and the most consistent as will be explained, as such it has lessons for how to interpret the data from other years. The consistency is likely to be due to an unidentified events which had occurred prior to the sampling, distributing the same sediment across the entire River Tees dredging area.

The most significant events prior to the sampling were the opening of the barrage in April 2023[20] and the capital dredging of the South Bank Quay using a cutter suction dredger combined with hopper barges in early 2023[21]. The barrage event was of limited time and it would be expected that the amount of additional fluvial sediment would be relatively small. However, the cutter suction dredger removed over 1 million tonnes of sediment, with possibly as much as 300,000 tonnes of fine sediment overspilling from the hopper barges.

2.3 Section 3.2.3 Additional mid licence results - 2023

For this sample set the relative surface area of the samples shows the assumed pattern that upstream samples are mainly slit / clay and downstream samples are mainly sand. Chart position 7 is surprisingly the sample with the largest surface area.

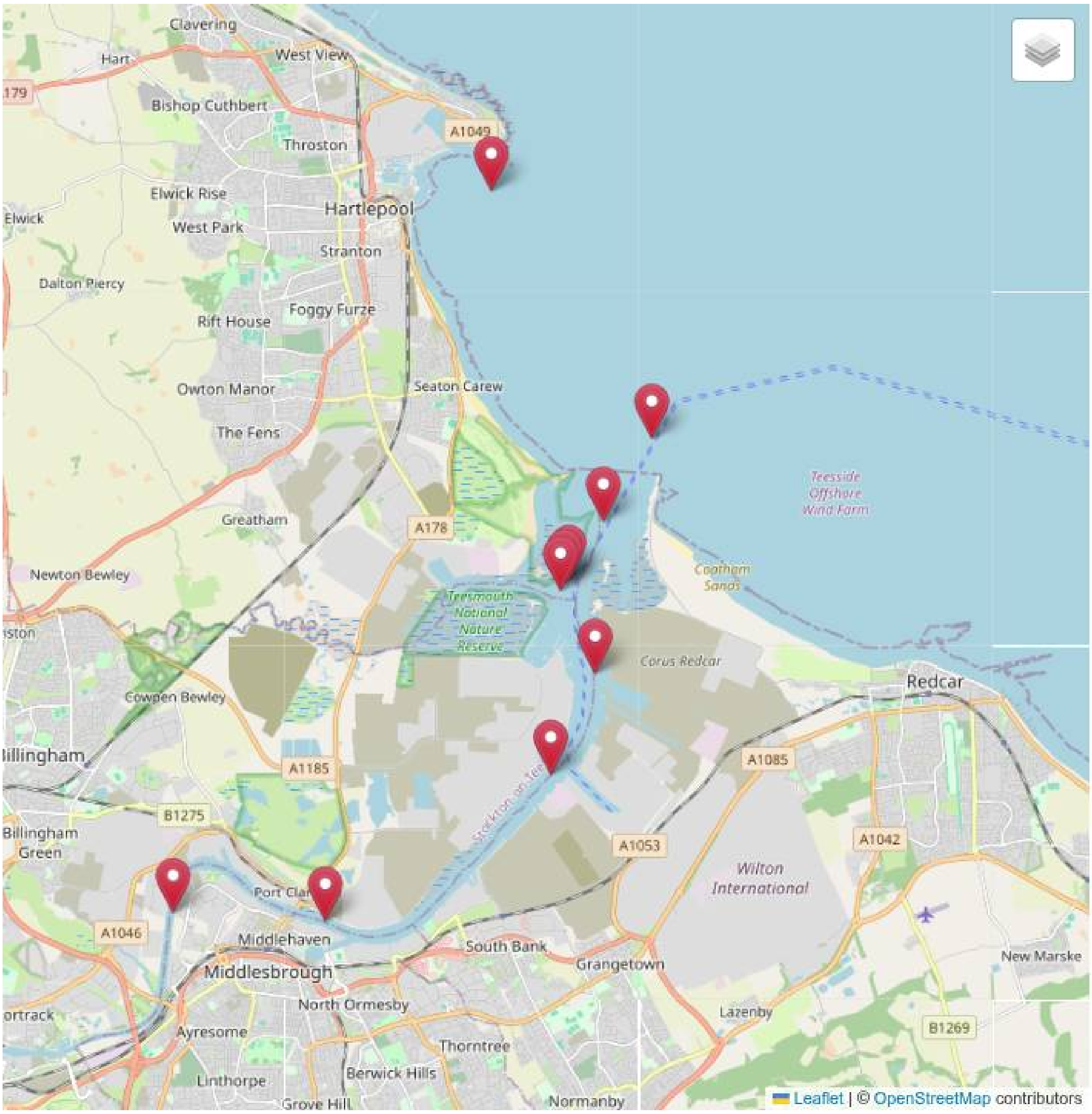


Illustration 6: 2023 Sampling locations

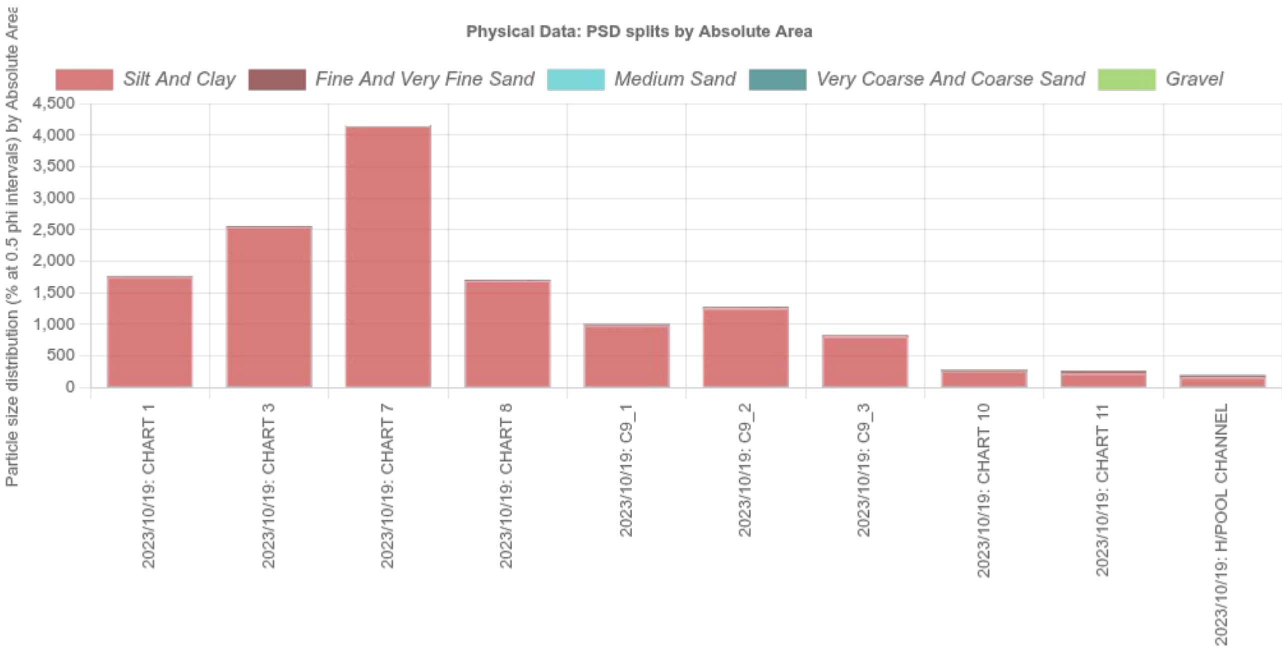


Figure 15: 2023 Samples relative surface area

High molecular weight PAHs show a similar trend with upstream samples being more contaminated. Suggesting that the HMW more hydrphobic PAHs are adsorbing onto the higher surface area of the smaller particles.

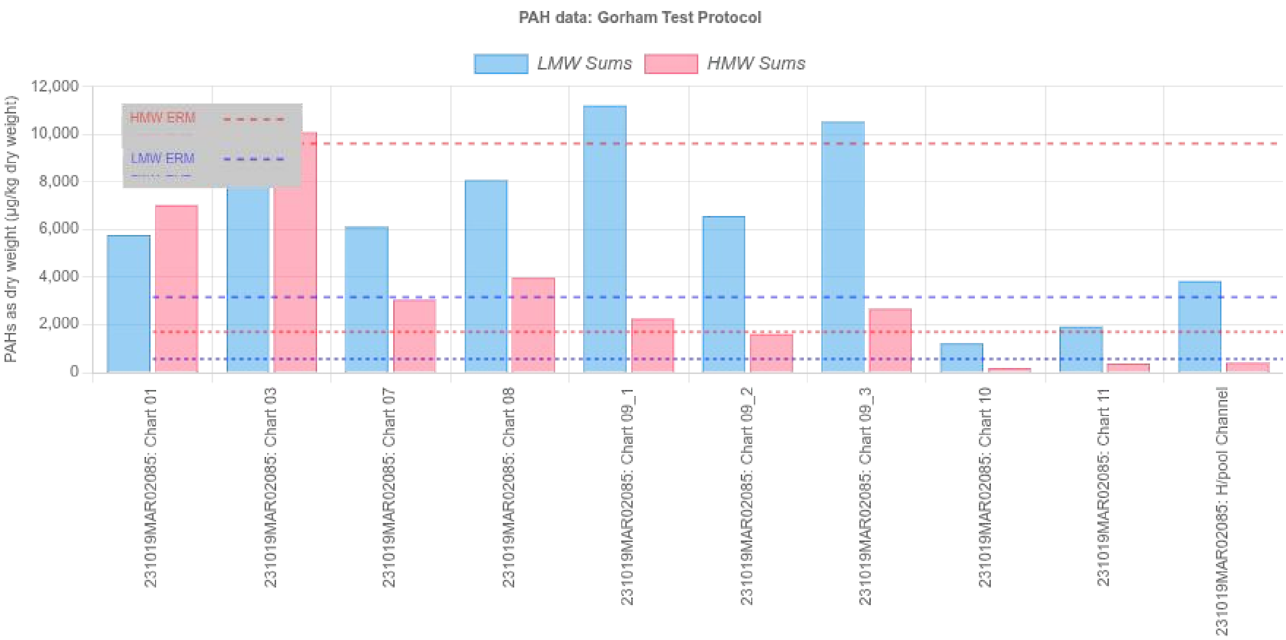


Figure 16: 2023 PAHs Gorham Test protocol

The PCB sums show a similar trend which is to be expected as they are also hydrophobic.

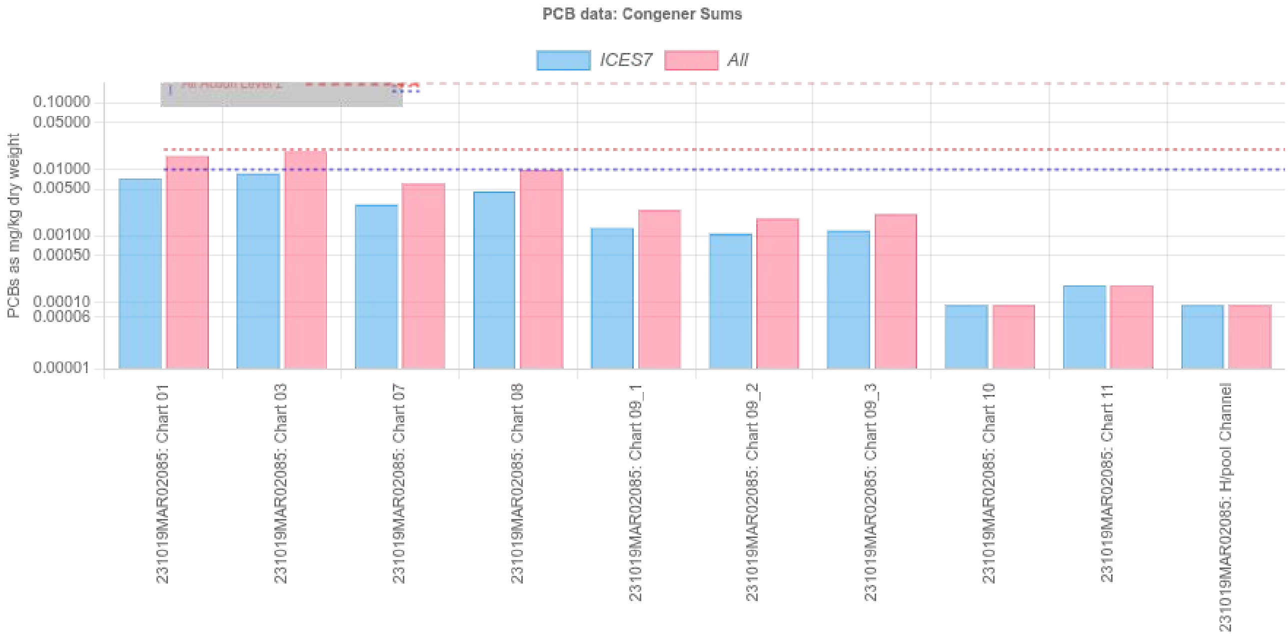


Figure 17: 2023 PCB congener sums

BDEs show less variation.

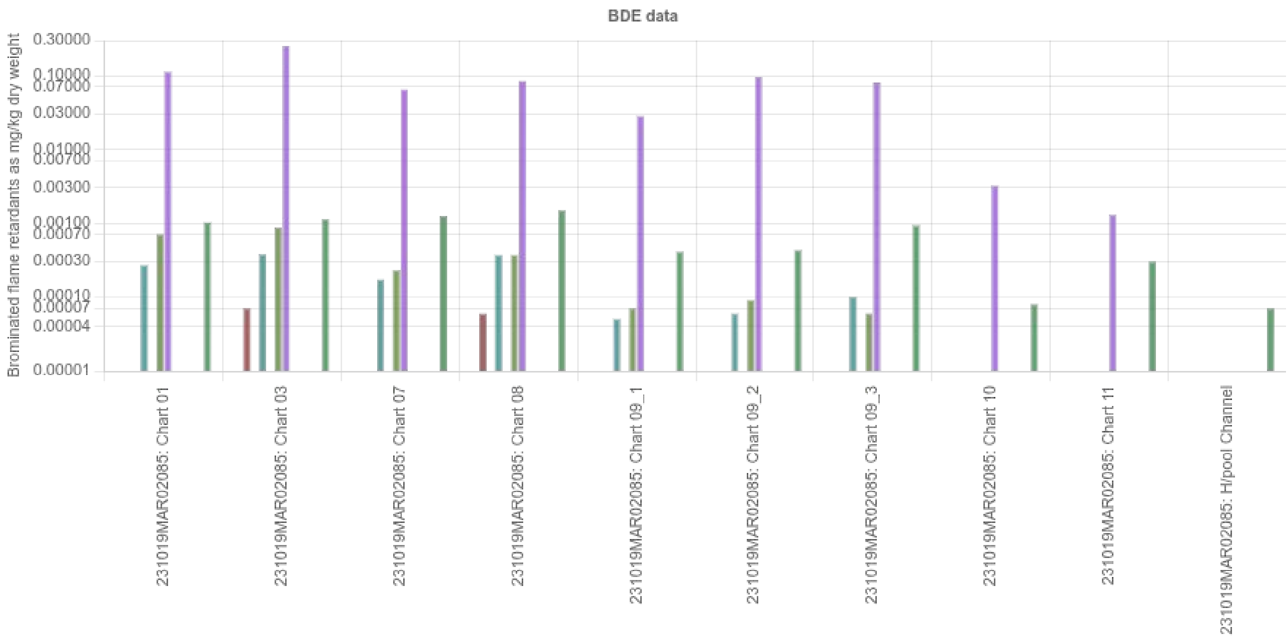


Figure 18: 2023 BDE concentrations

The Hartlepool sample is discarded as there is no hydrogeological connection between Hartlepool and the River Tees channel, so its inclusion would hinder attempting to understand what is happening in the River Tees.

The Chart 7 sample is also discarded as it does not fit with the other samples being almost entirely silt/clay which is not to be expected in this part of the downstream River Tees. This is postulated to be due to wash-off of the laid soil placed on the South Bank site in 2023 as part of the remediation of the site.

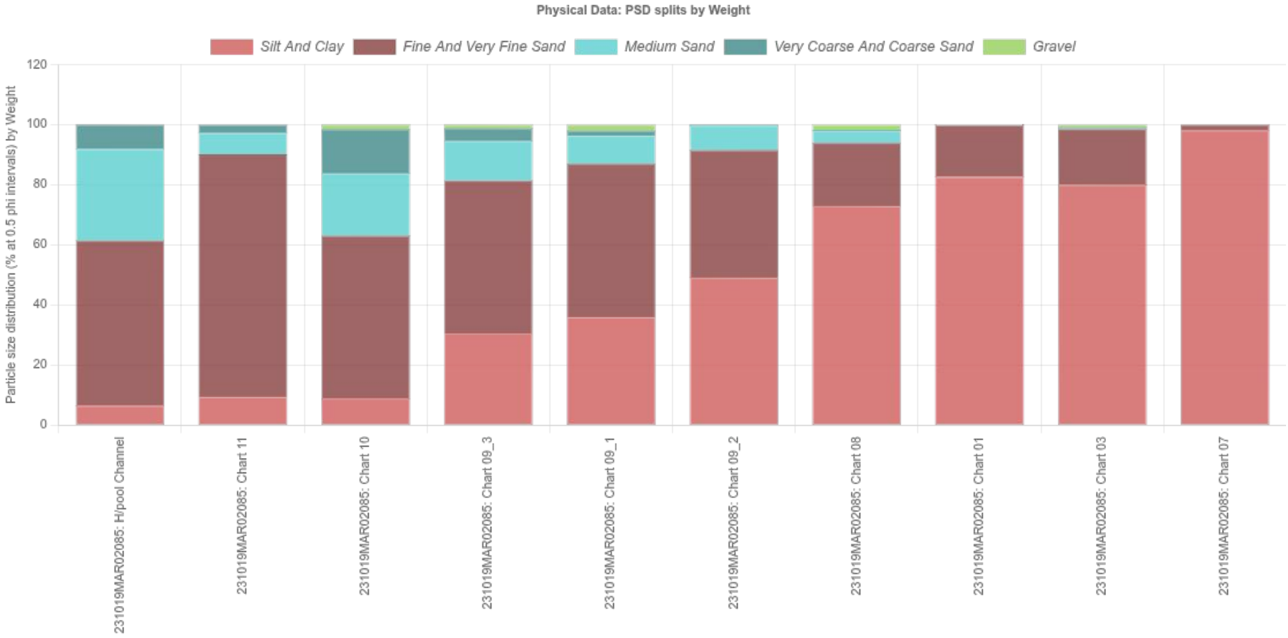


Figure 19: 2023 Sample composition

In order to calculate a relative surface area for sediment samples a number of assumption have to be made, the particles can be approximated as spherical and the majority of the particles have similar densities, or at least the organic component of only 1-7% will not distort the relative area too much. These these assumption are shown to be acceptable by a comparison of weight fraction of silt/clay to relative surface area.

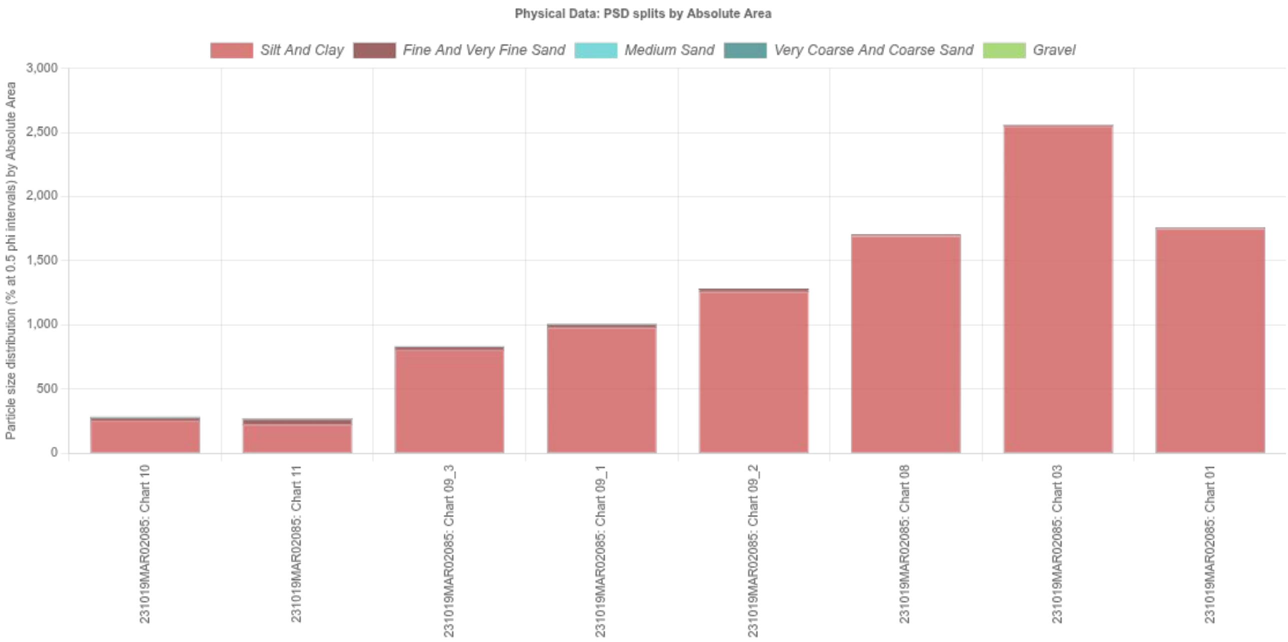


Figure 20: 2023 Surface area vs silt/clay fraction

Looking at the role of silt/clay fraction on higher molecular weight PAHs, an overall effect of increasing silt/clay fraction increasing HMW PAHs.

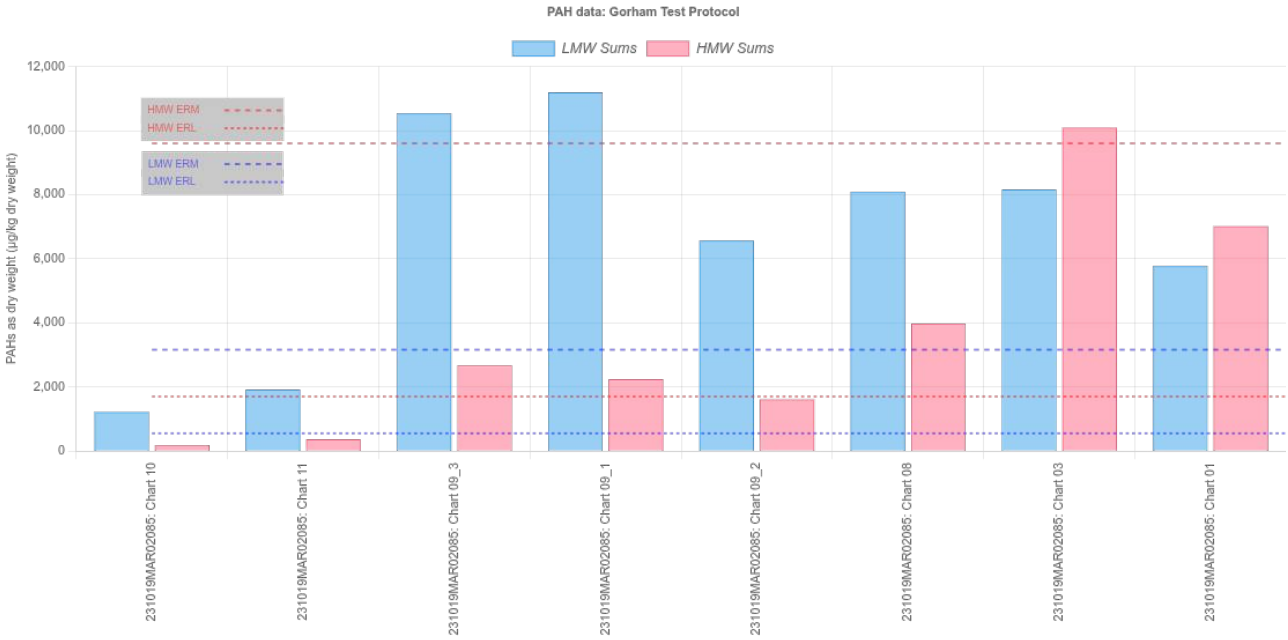


Figure 21: 2023 PAHs Gorham Test protocol ordered with fraction slit/clay

However, repeating the comparison with surface area instead of silt/clay fraction shows an improved correlation (see later for quantitative correlations). This is not surprising as the particle size distribution is continuous so very fine sand also contributes surface area, whereas the silt/clay fraction is an arbitrary cut.

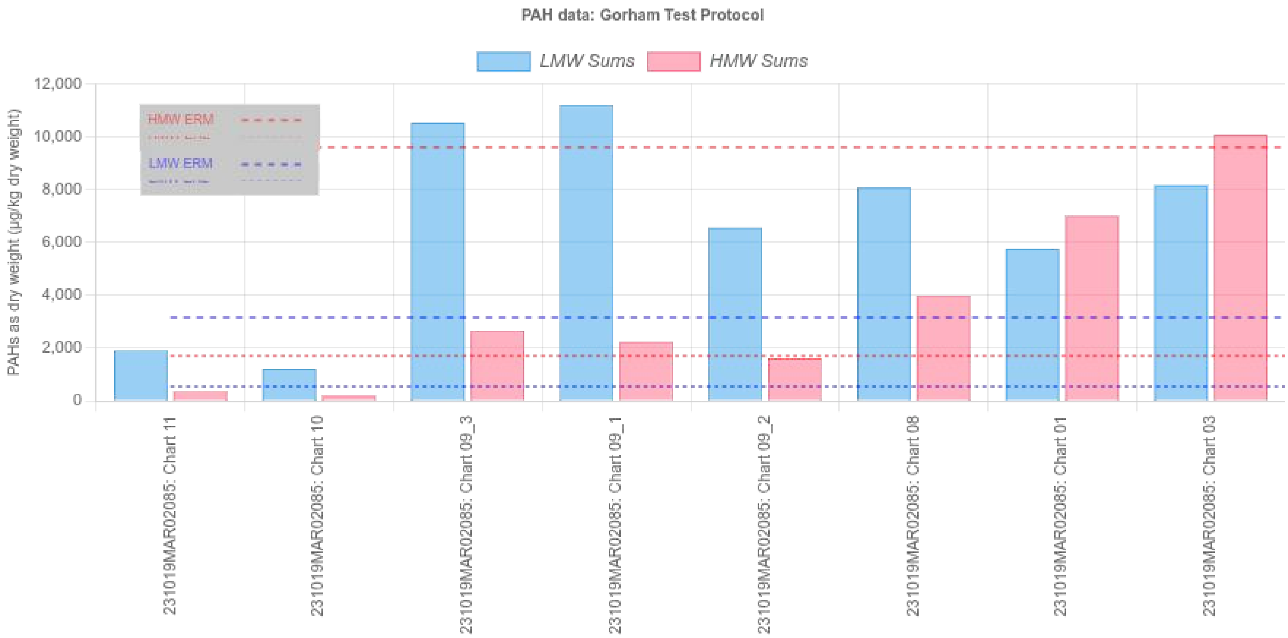


Figure 22: PAHs Gorham Test protocol ordered with relative surface area

The MMO required PAHs are a set of 22 different chemicals, all with different physical properties, so each will have different adsorption properties partly reflected in their variations in hydrophobicity, but also strength of adsorption will influence the partitioning with the sediment. Marine planning document normally state that these hydrophobic contaminants are largely associated with organic matter, so this correlation with particle surface area suggests this may not be a universal truth. The figure below shows plots of the concentrations of each of the 22 PAHs versus sample total area. Each individual plot states the name of the PAH followed by the R^2 correlation coefficient, and below that the minimum and maximum concentration.

Figure 23: 2023 PAHs vs relative total surface area

Taking R^2 values greater than 0.8 shows that a subset of PAHs are strongly associated with surface area - Acenapthene, Acenapthylene, Anthracene, Benz[a]anthracene, Benzo[a]pyrene, Benzo[b]fluoranthene, Benzo[g,h,i]perylene, Benzo[e]pyrene, Benzo[k]fluoranthene, Chrysene, Dibenz[a,h]anthracene, Fluoranthene, Fluorene, Indeno[123-c,d]pyrene, Pyrene. In general higher molecular weight and/or hydrophobic PAHs.

Doing the same analysis looking for the effect of organic carbon on PAH concentration, taking R^2 values greater than 0.6 show that a subset of PAHs are associated with organic carbon - C1-Napthalenes, C1-Phenanthrenes, C2-Napthalenes, C3-Napthalenes, Napthalene, Phenanthrene. In general lower molecular weight and/or less hydrophobic PAHs.

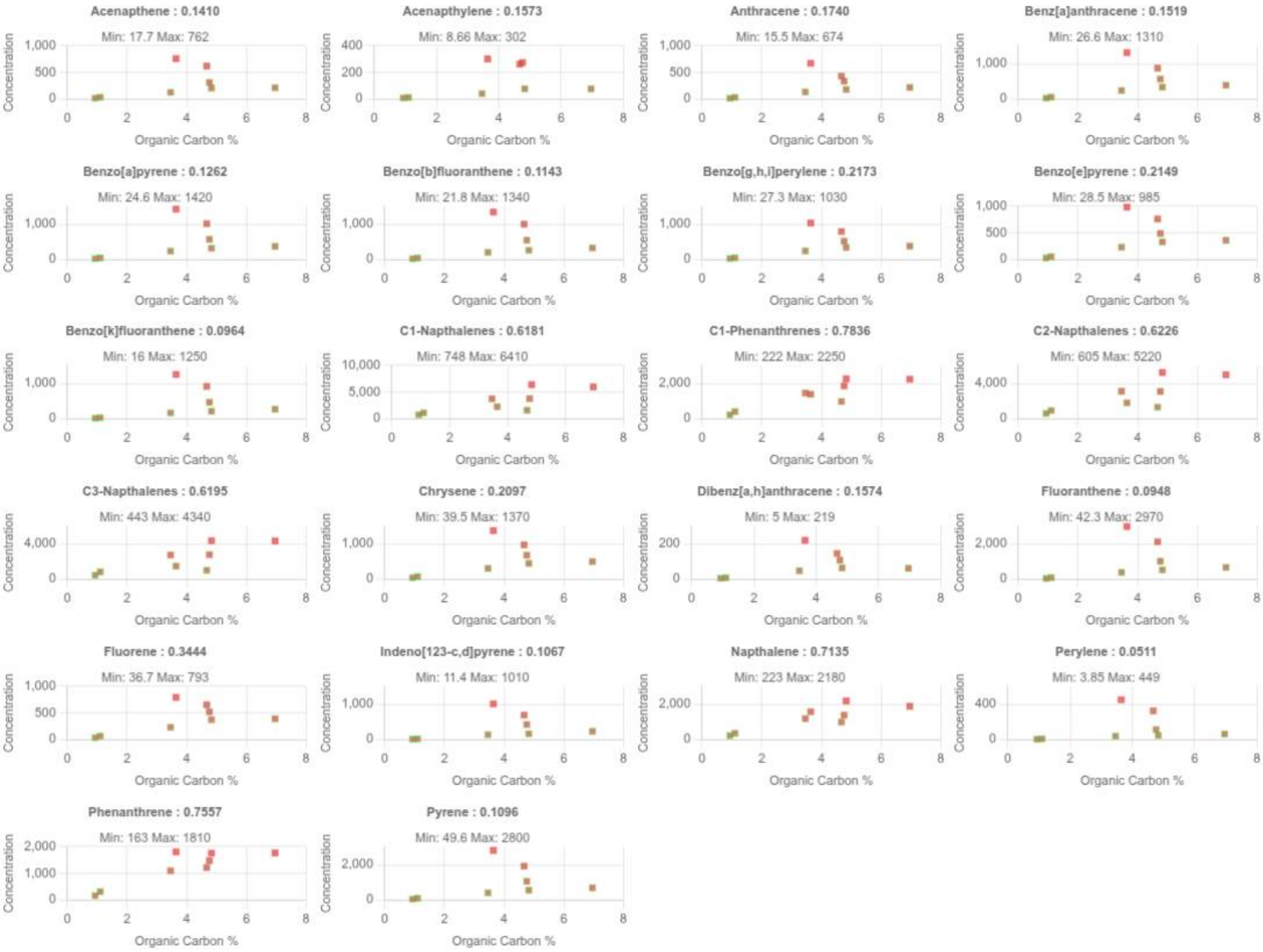


Figure 24: 2023 PAHs vs. organic carbon content

Ordering the Gorham Test protocol HMW PAH concentrations by relative surface area, shows the confirming behaviour.

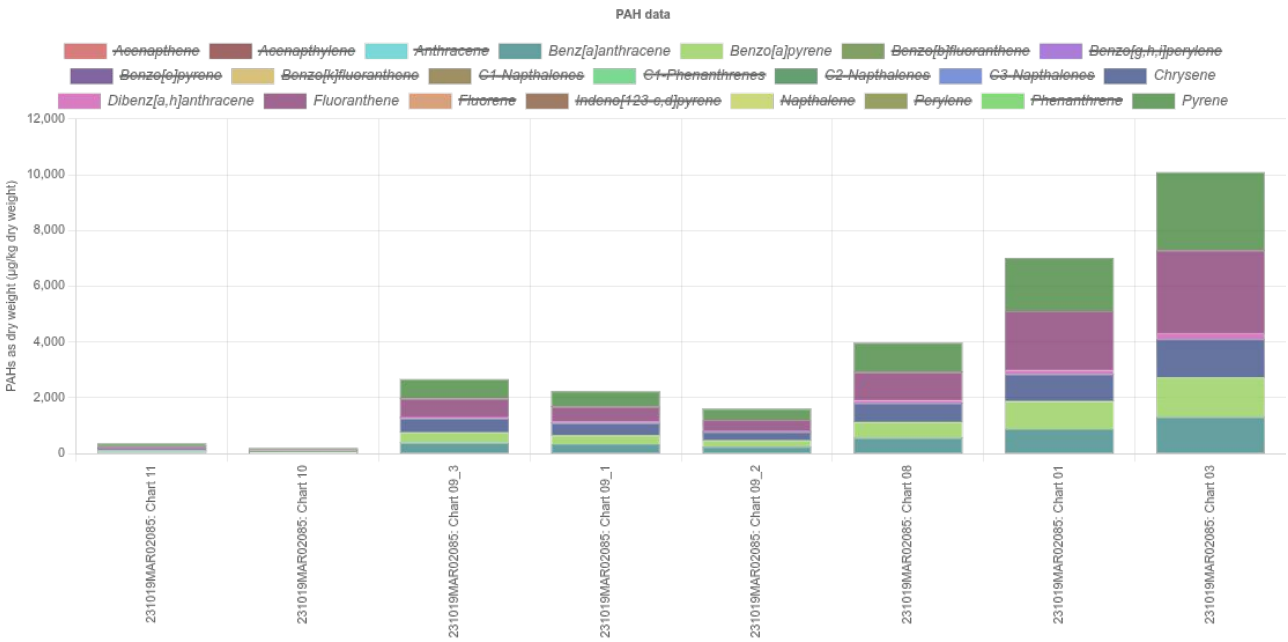


Figure 25: 2023 PAHs Gorham Test protocol - HMW ordered by relative surface area

Doing the same with the complete set of LMW PAHs shows no relationship with relative surface area.

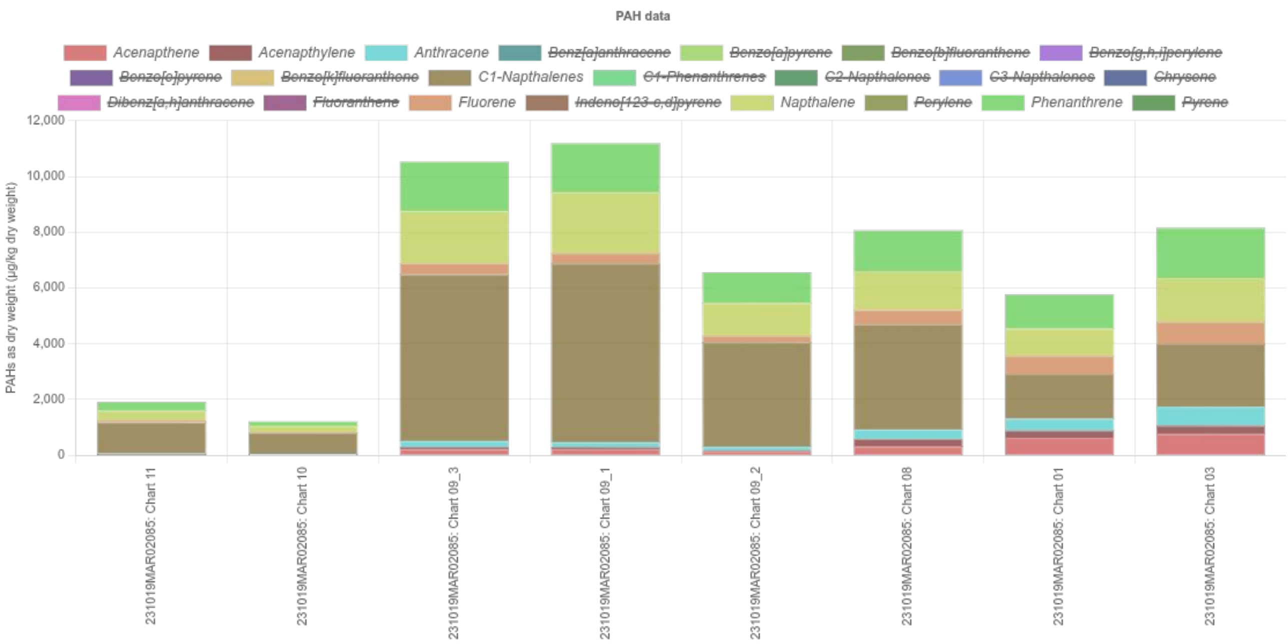


Figure 26: 2023 PAHs Gorham Test protocol LMW ordered by relative surface area

However removing the LMW PAHs which showed correlation with organic carbon, leaves just 4 PAHs whose concentration correlate well with relative surface area.

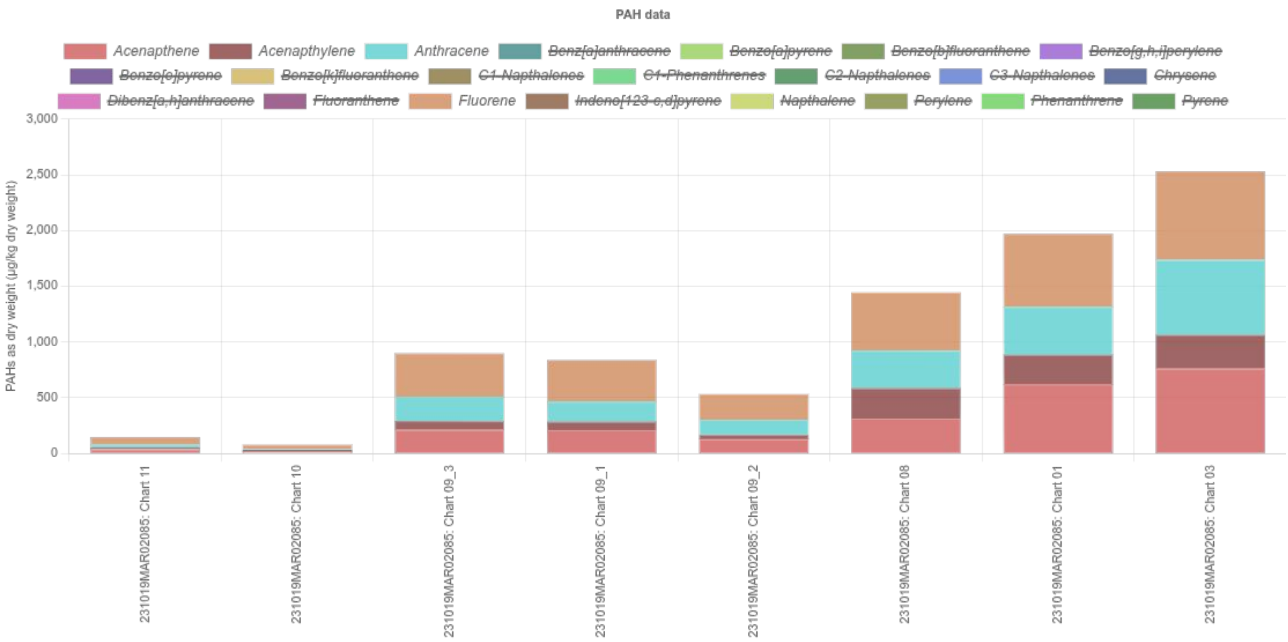


Figure 27: 2023 PAHs Gorham Test Protocol - LMW only adsorbed PAHs

Removing C1-Napthalenes, Napthalene and Phenanthrene left Acenapthene, Acenapthylene, Anthracene and Fluorene, as the LMW PAHs which correlate with surface area.

Taking the whole set of PAHs both HMW and LMW which correlate with surface area, shows the expected relationship.

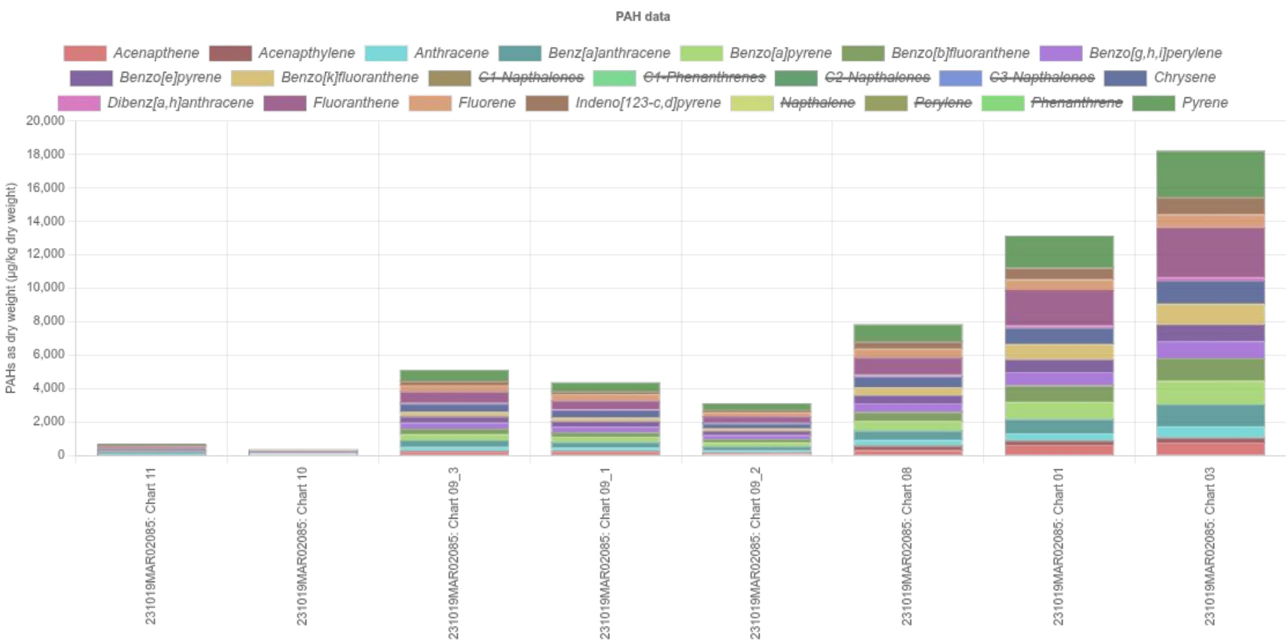


Figure 28: 2023 Adsorbing PAH concentrations

PAHs were investigated first as they were measured in all the MLA/2015/00088 original and mid-licence sample sets. However for PCBs the relationship jumps out due to there uniformly hydrophobic nature.

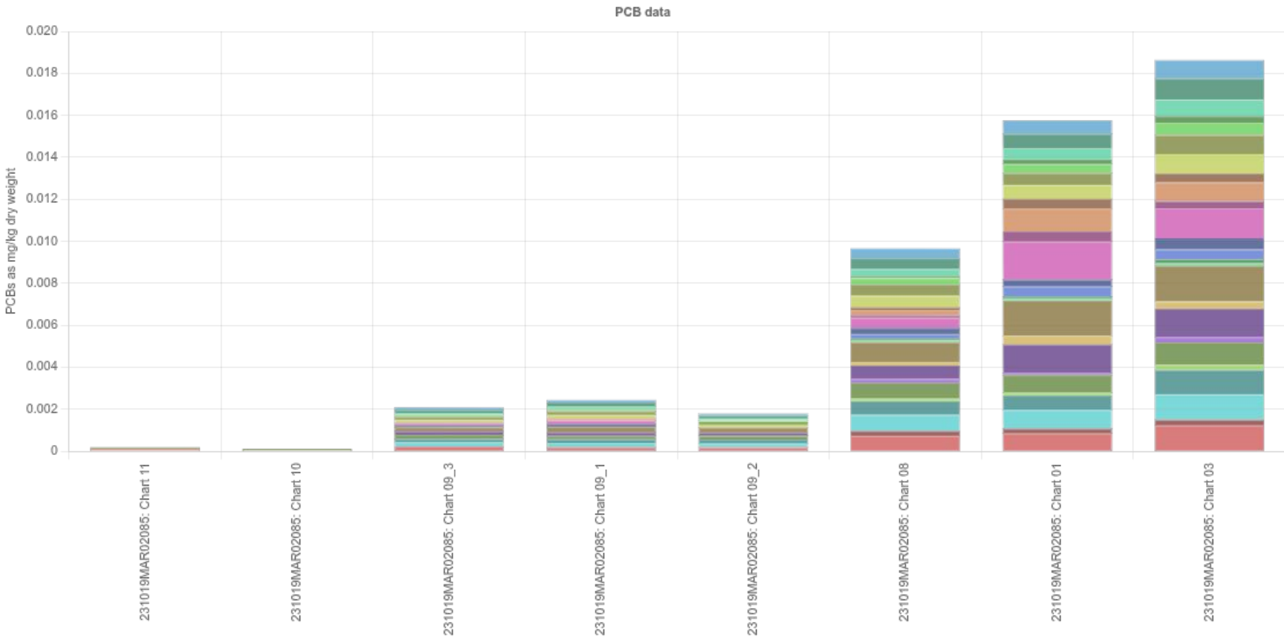


Figure 29: 2023 PCBs concentrations ordered by relative area

Quantitatively, 6 PCBs have R^2 greater than 0.9, 8 have R^2 between 0.9 and 0.8, 6 have R^2 between 0.8 and 0.7, 4 have R^2 between 0.7 and 0.6 and only 1 between 0.6 and 0.5, so all the PCBs show some correlation with surface area.

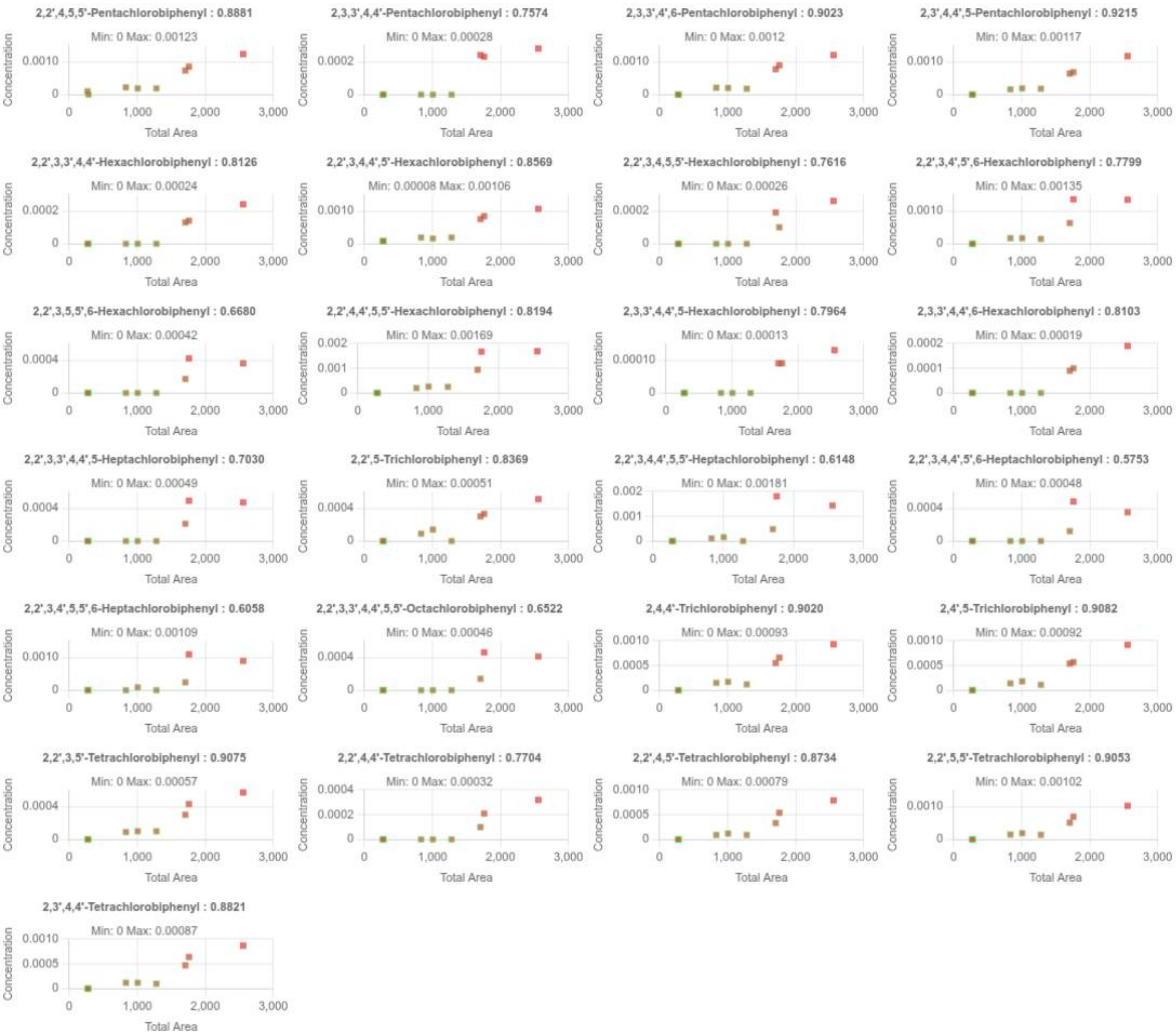


Figure 30: 2023 PCBs vs relative total surface area

The PCBs show far less correlation with organic carbon, with no R^2 greater than 0.54, so there may be a small portion of the PCBs which are associated with organic matter in the samples.

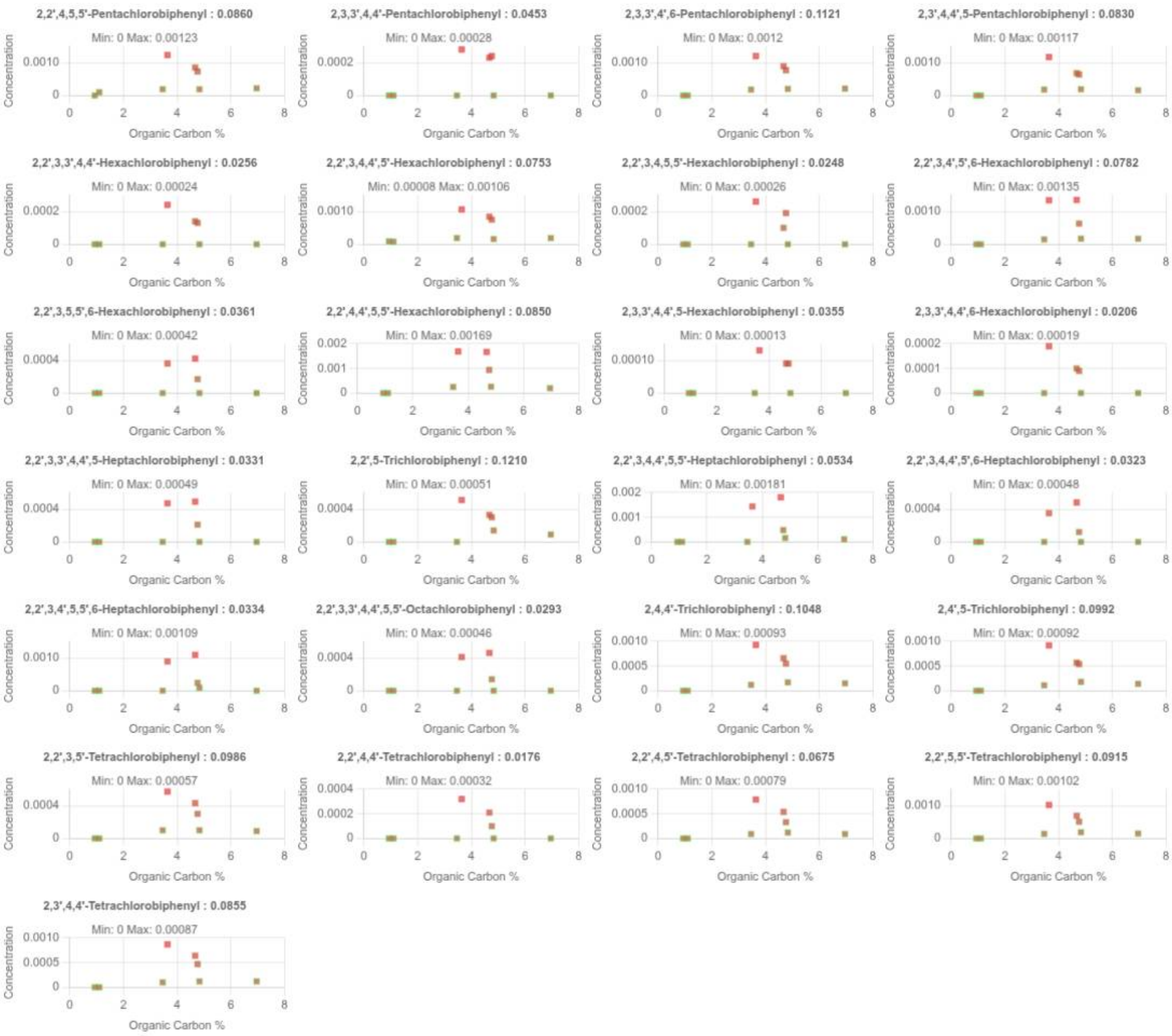


Figure 31: 2023 PCBs vs organic carbon

2.3.1 2023 Overspill

The overspill from a trailing suction hopper dredger (or a hopper barge) will contain a fraction of the sediment dredged consisting of the particles which settle most slowly, these are the finer particles. So where it has been shown that contamination is associated with surface area it is possible to calculate how much of the contamination is carried out of the hopper on the overspill, using the cumulative weight and area particle size distribution.

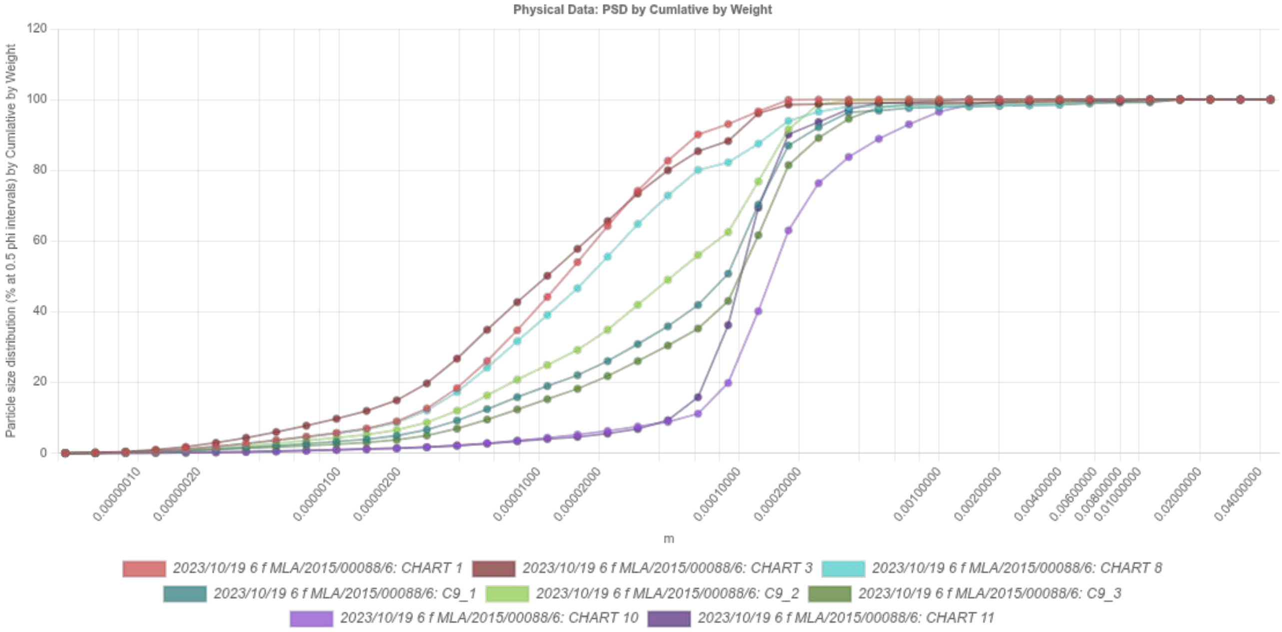


Figure 32: 2023 Cumulative weight sample particle size distributions

If the amount of overspill is known then it is possible to see the maximum size of particles which are going to be overspilled from the cumulative weight particle size distribution. For the Chart 1 sample with 25% overspill the maximum size particle would be approximately 5µm.

Then using the cumulative area particle size distribution the fraction of surface area can be determine, here for Chart 1 approximately 90% of the surface area is on particle less than 5µm.

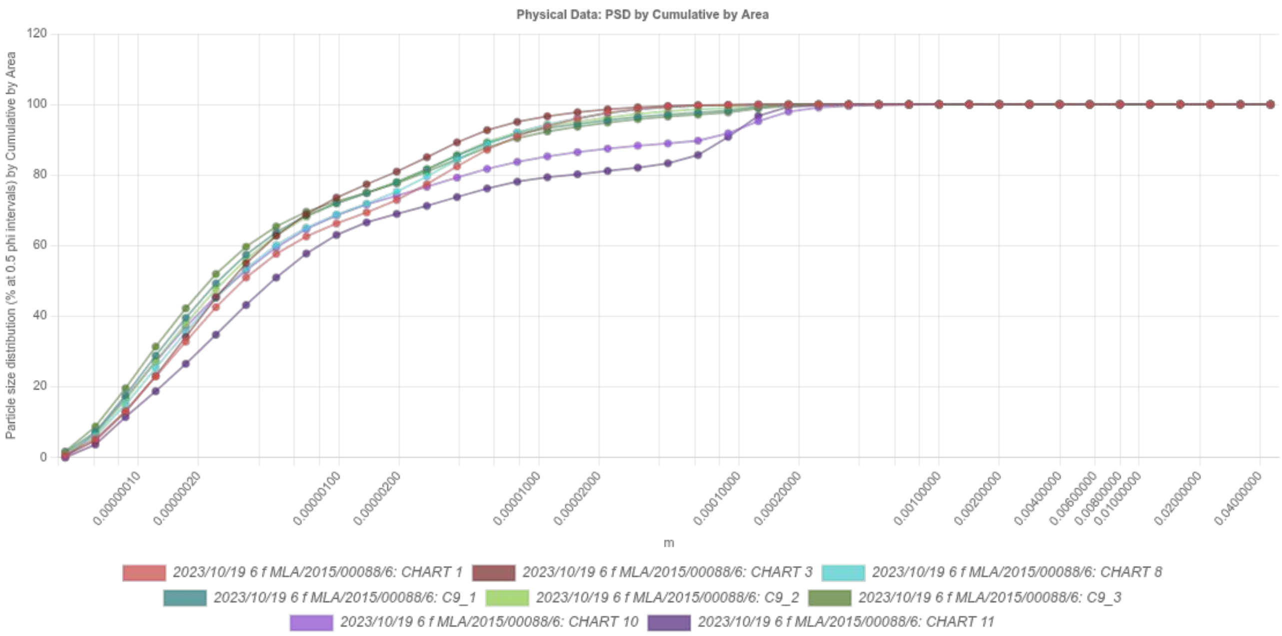
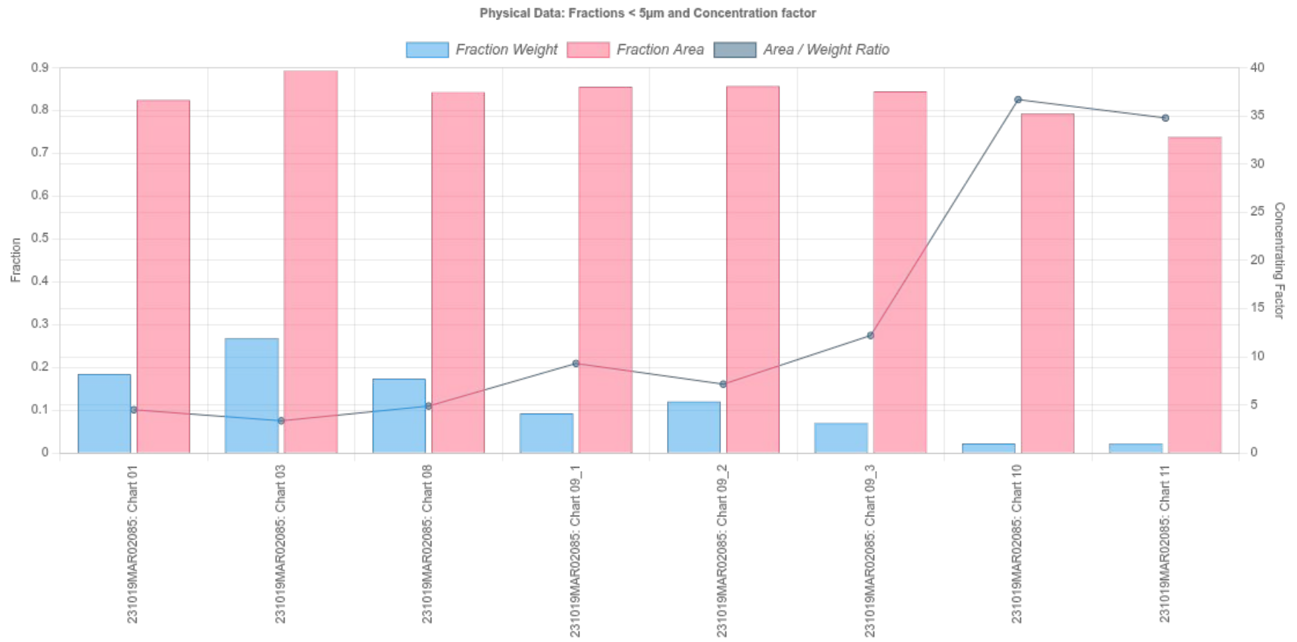


Figure 33: 2023 Cumulative area sample particle size distribution

This means that 90% of the HMW / hydrophobic PAH and PCB contamination will be associated with the 25% of dredged material which is overspilled. The corollary is that only 10% of this contamination will be retained in the hopper and disposed off correctly at sea.

The graph below shows the actual amounts of material below 5µm, and a concentrating factor, i.e. the ratio between the fraction area below 5µm and the fraction weight below 5µm. Using this factor it is possible to show the toxicity of the material overspilled.



2.3.1.1 2023 Overspilled PAHs

Recalculating the Gorham Test protocol based on 5µm being overspilled, shows how all the samples exceed the LMW ERM for LMW and for all but one of the HMW PAHs.

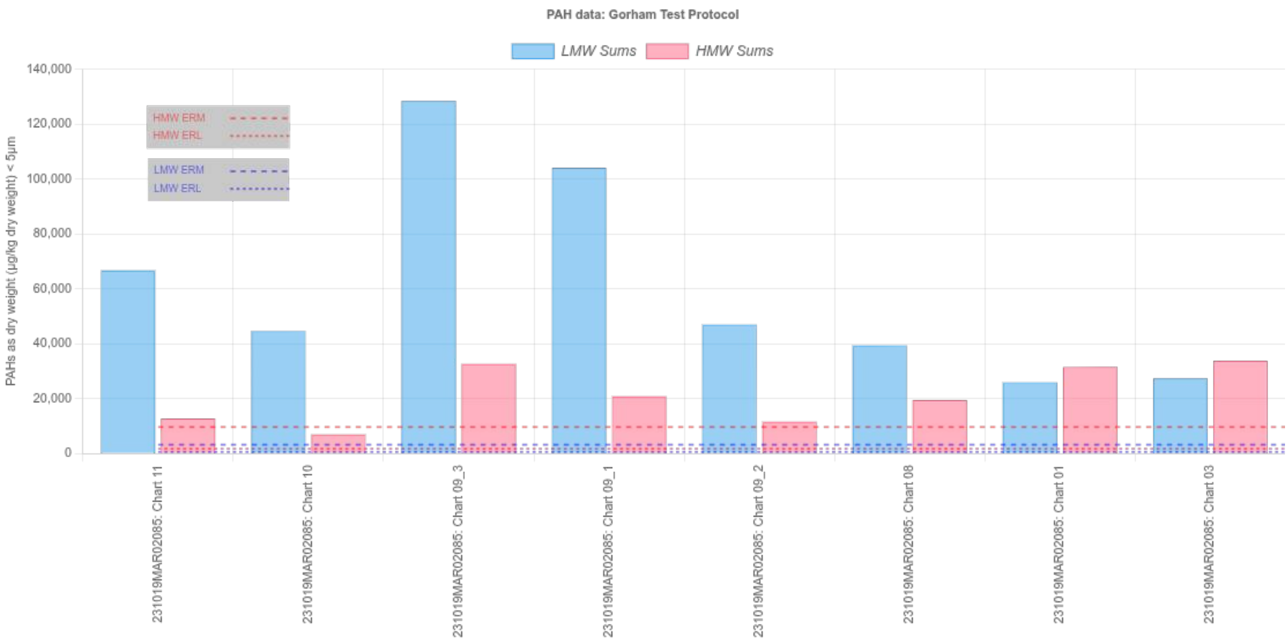


Figure 34: 2023 Sub 5µm fraction - PAHs Gorham Test protocol

Similar high levels are seen looking at all the PAHs which showed correlation with surface area.

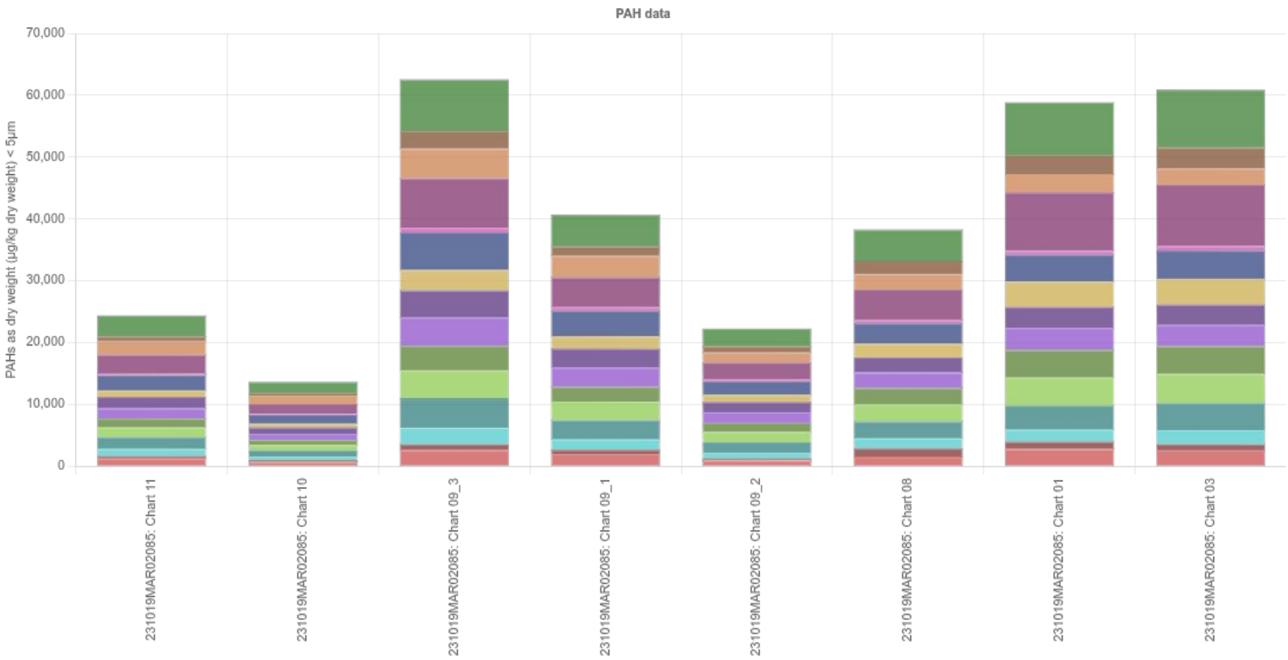


Figure 35: 2023 Sub 5µm fraction – HMW and hydrophobic PAH concentrations

Of this material about half is the HMW PAHs considered by the Gorham Test protocol.

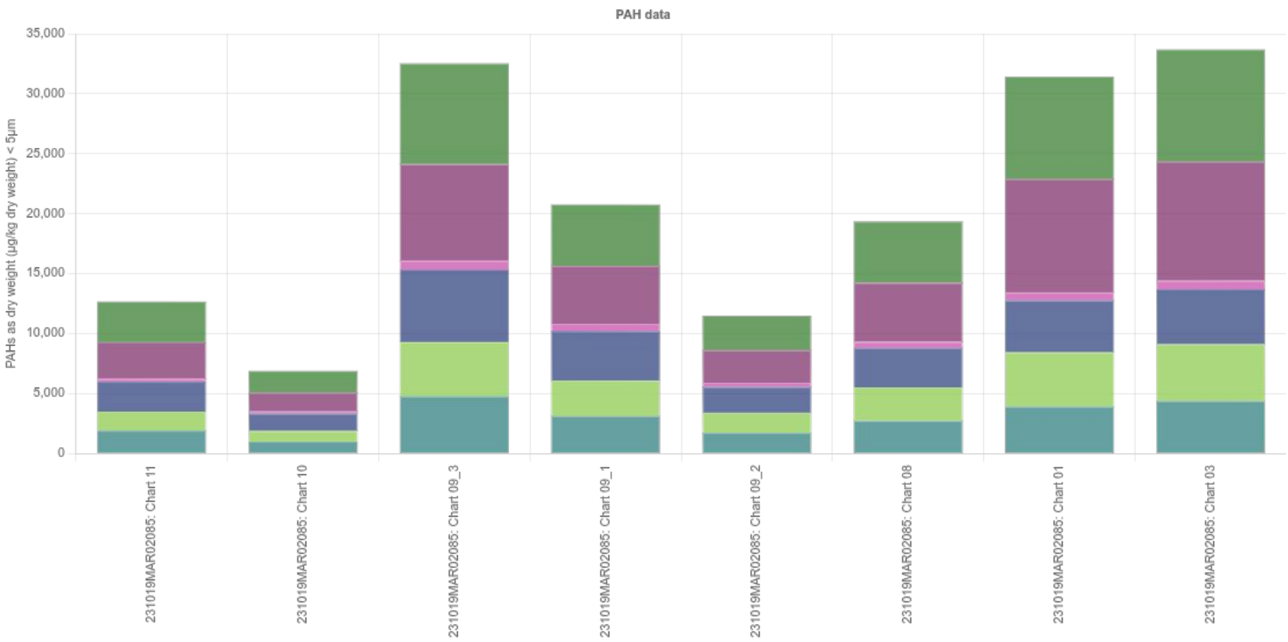


Figure 36: 2023 Sub 5µm fraction – Gorham Test protocol HMW PAH concentrations

A similar analysis of sub 1 µm shows higher levels of contamination on each particle, but this only represents 6% of the total contamination, however these particles will be a far slower to settle and thus travel far further from the site of release.

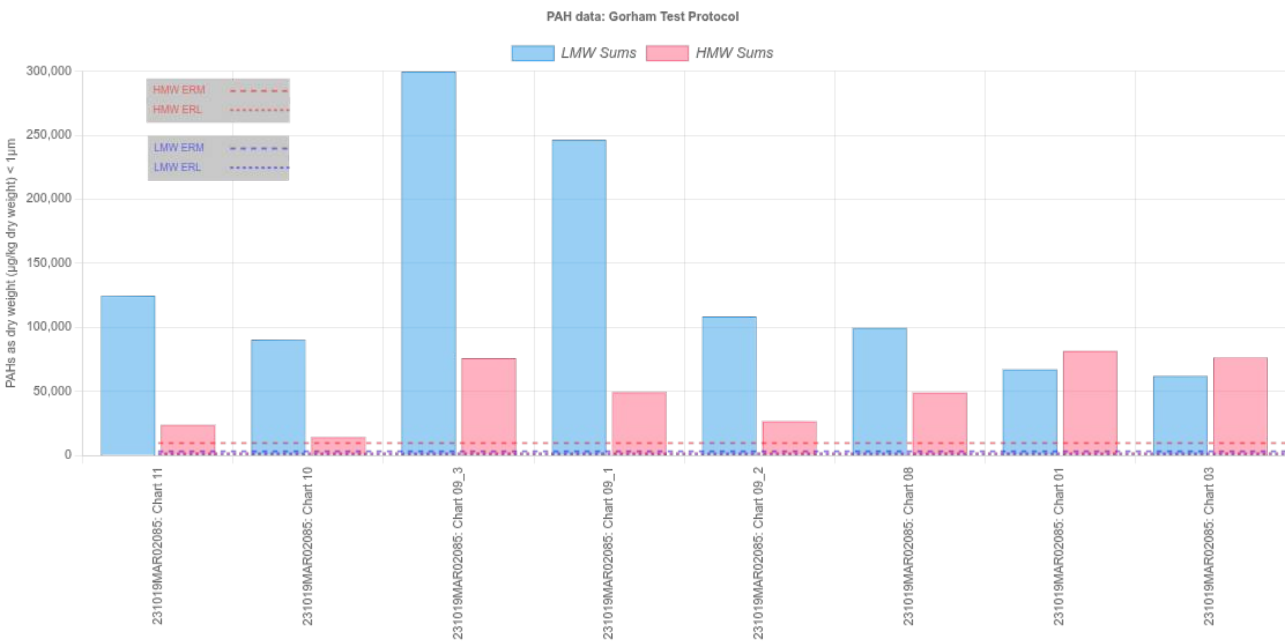


Figure 37: 2023 Sub 1µm fraction - PAHs Gorham Test protocol

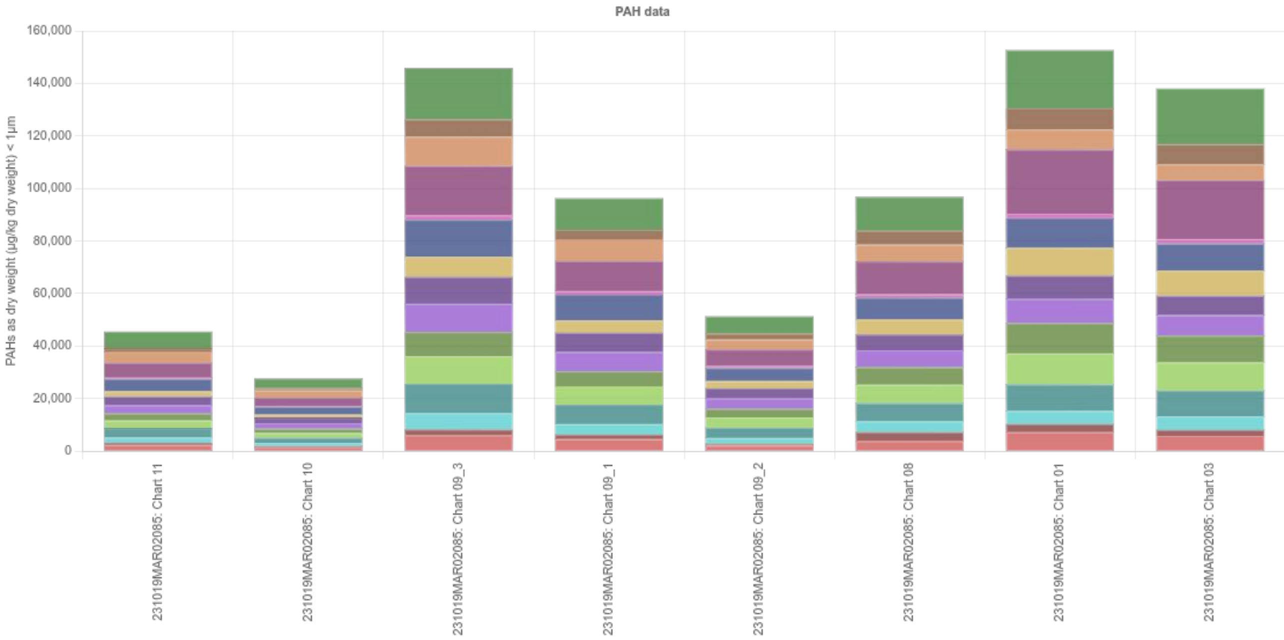


Figure 38: 2023 Sub 1µm fraction – HMW and hydrophobic PAH concentrations

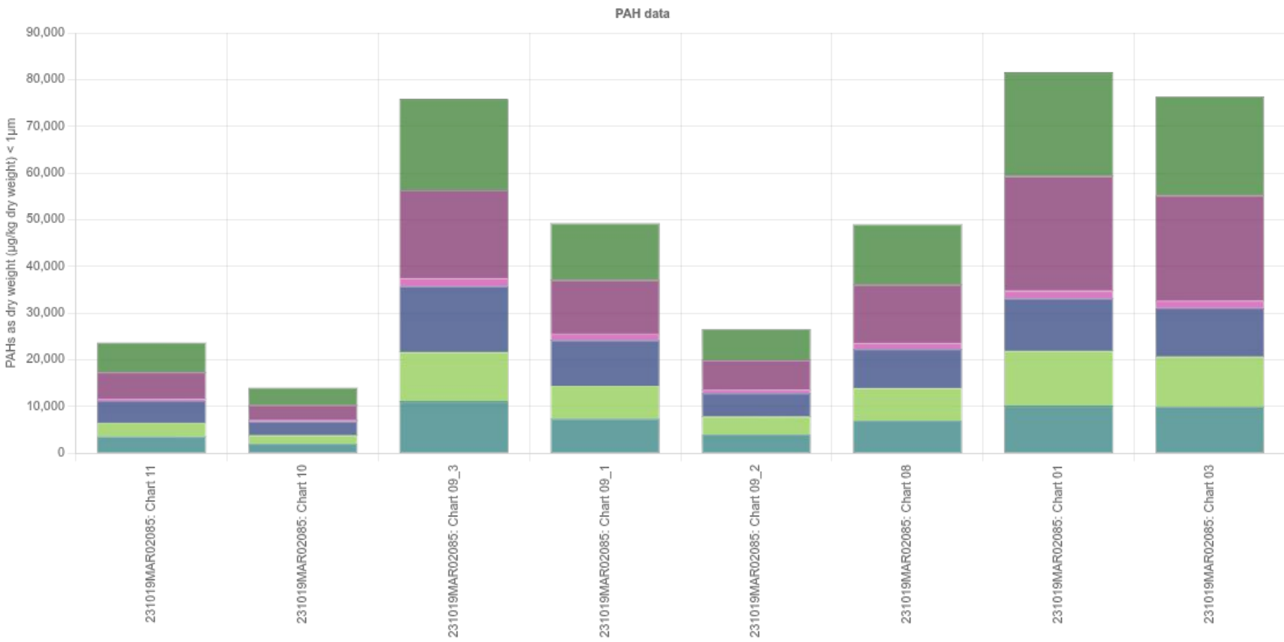


Figure 39: Sub 1µm fraction - HMW PAH concentrations

2.3.1.2 2023 Overspilled PCBs

The same analysis for PCBs is even more clearcut as all the PCBs strong an association with surface area, thus for sub 1µm particles all but 2 samples exceed the lower levels for ICES7 and All PCB sums with 1 being close to the all sum level 2. Sub 5µm particles the results are similar but the levels are a lot lower.

Sub 1µm

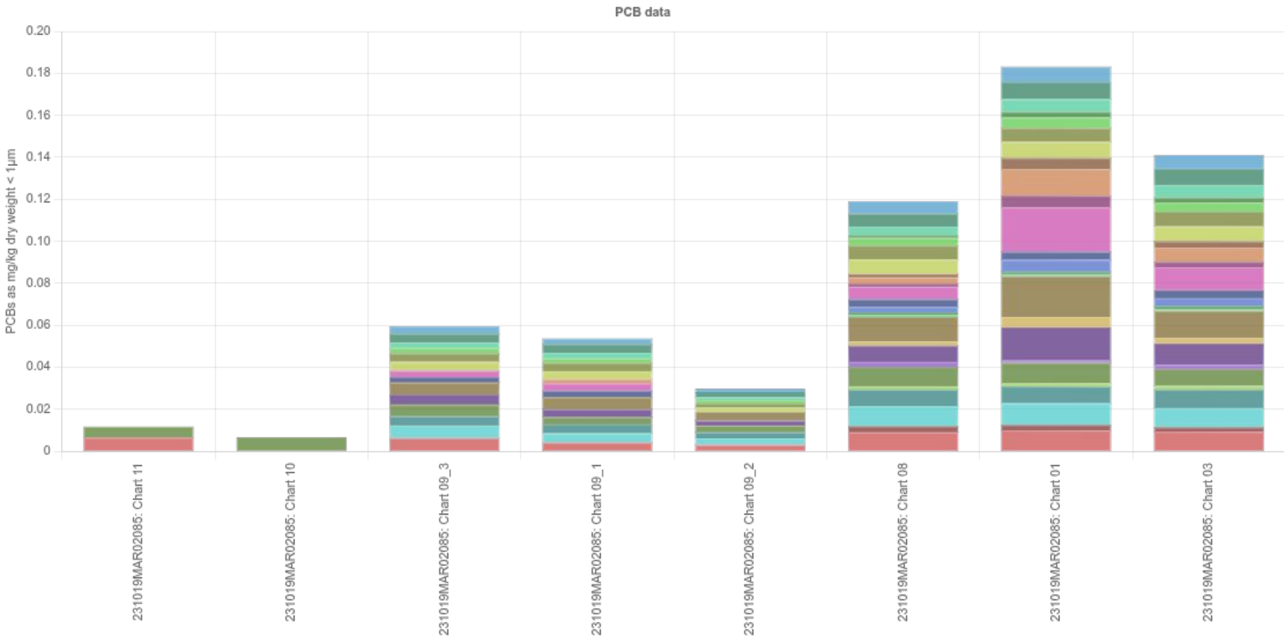


Figure 40: 2023 Sub 1µm fraction - PCB concentrations

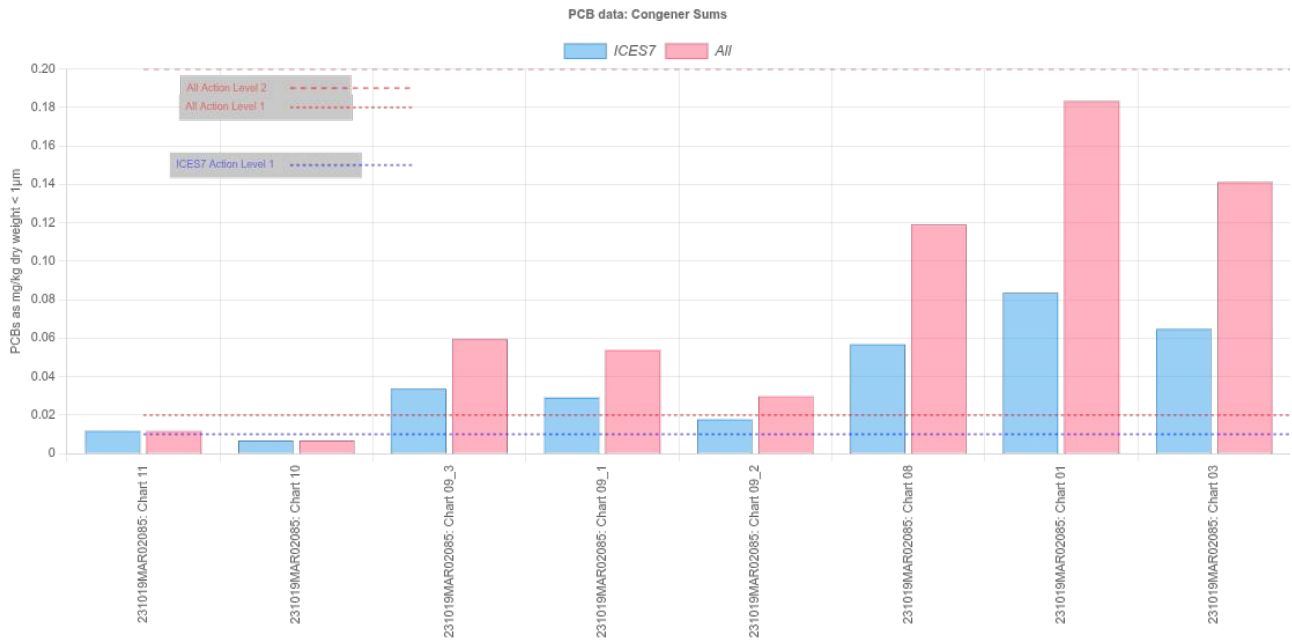


Figure 41: 2023 Sub 1µm fraction - PCB congener sums

Sub 5µm

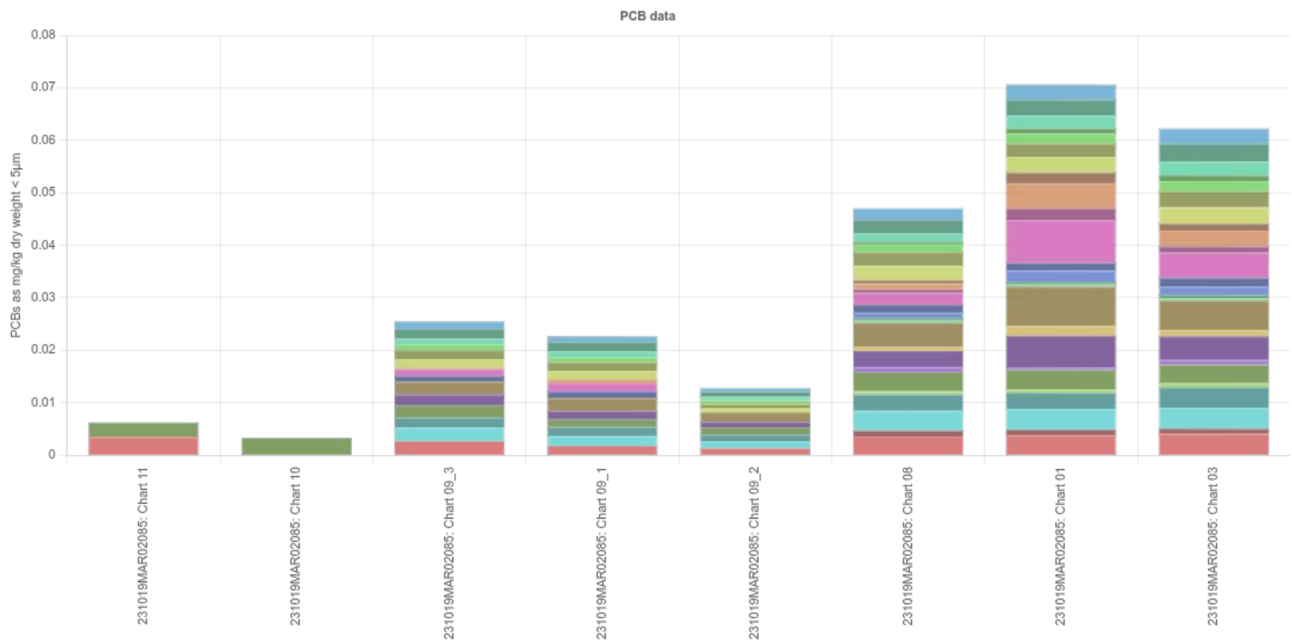


Figure 42: 2023 Sub 5µm fraction - PCB concentrations

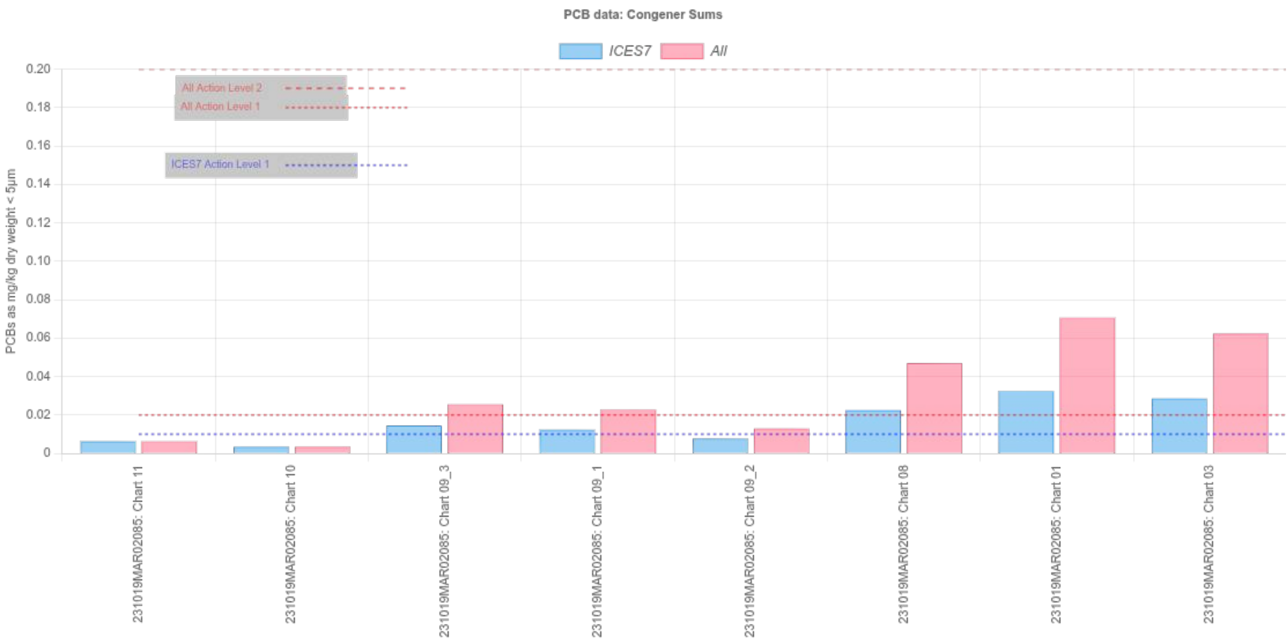


Figure 43: 2023 Sub 5µm fraction - PCB congener sums

The overspilled PCBs are particularly interesting and particularly relevant at the current time, as while PCBs levels across the UK are reported to be decreasing rapidly, at least locally in the River Tees there is still high seal mortality[10]. While the immediate cause of death is often put down to a common bacteria which causes mouth rot, on post mortem the seal pups have very high levels of PCBs in their organs. It seems likely that seal mothers eating in the overspill from dredgers are ingesting PCBs, which is then expelled through their milk concentrating in the seal pups internal organs, making the pups susceptible to the common mouth rot bacteria and in a poor state of health due to the presence of PCBs unable to recover from the infection. Previous studies have shown that PCBs cause seals to loose resistance to common deceases and are unable to gain weight[22].

2.4 Section 2.3.0 (missing) 2015 MLA/2015/00088 Sample set

For completeness the original MLA/2015/00088 sample set is analysed here. It should be noted that this data set was extremely sparse with 25 samples with only particle size, PAH and organotin measurements and no samples were presented for Hartlepool.

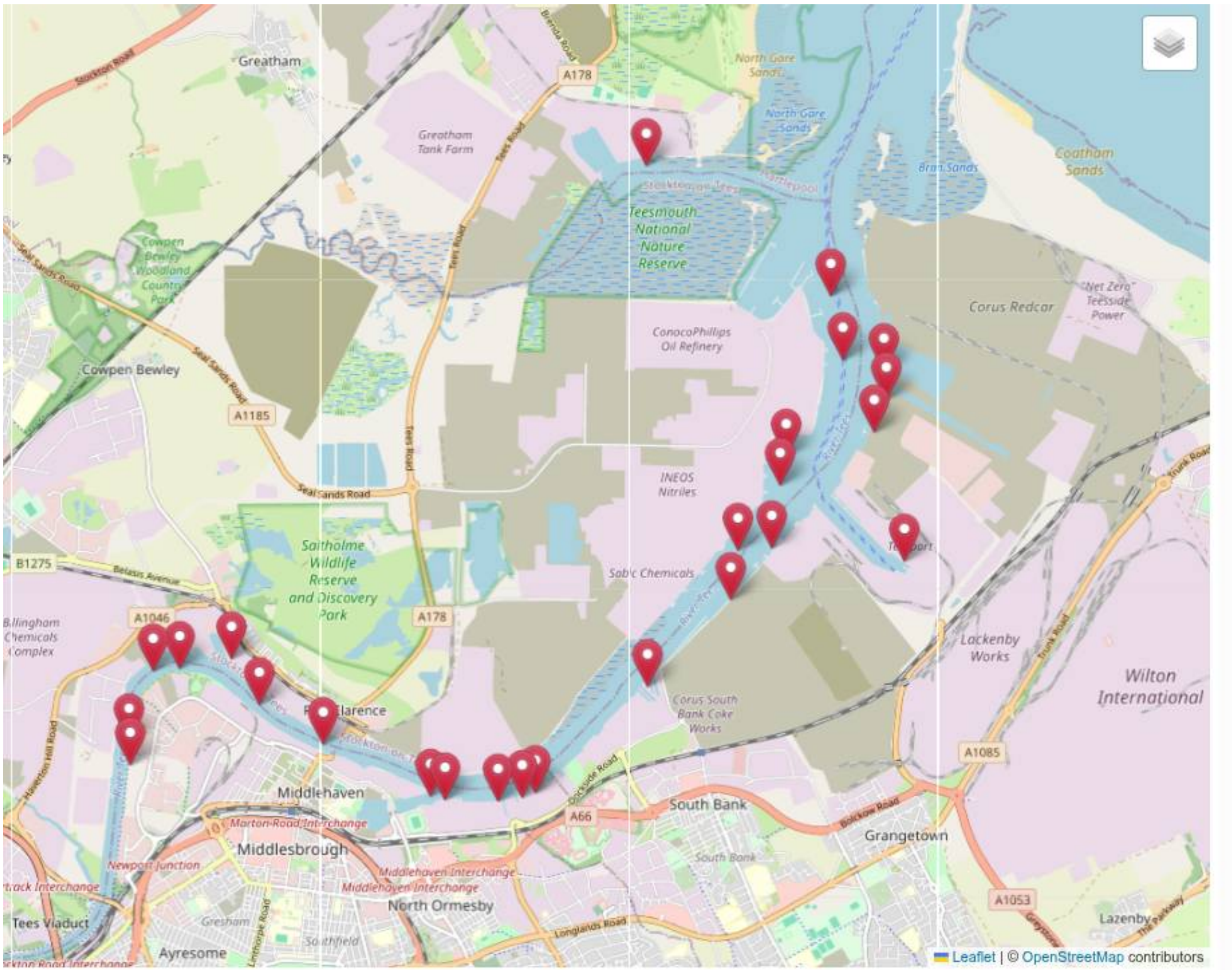


Illustration 7: 2015 Sampling locations

The 2015 samples do not show the trend mentioned in the report of being more sandy downstream, this is shown both by ordering of the composition and relative surface area by latitude or longitude (samples 02 upstream and sample 12 downstream).

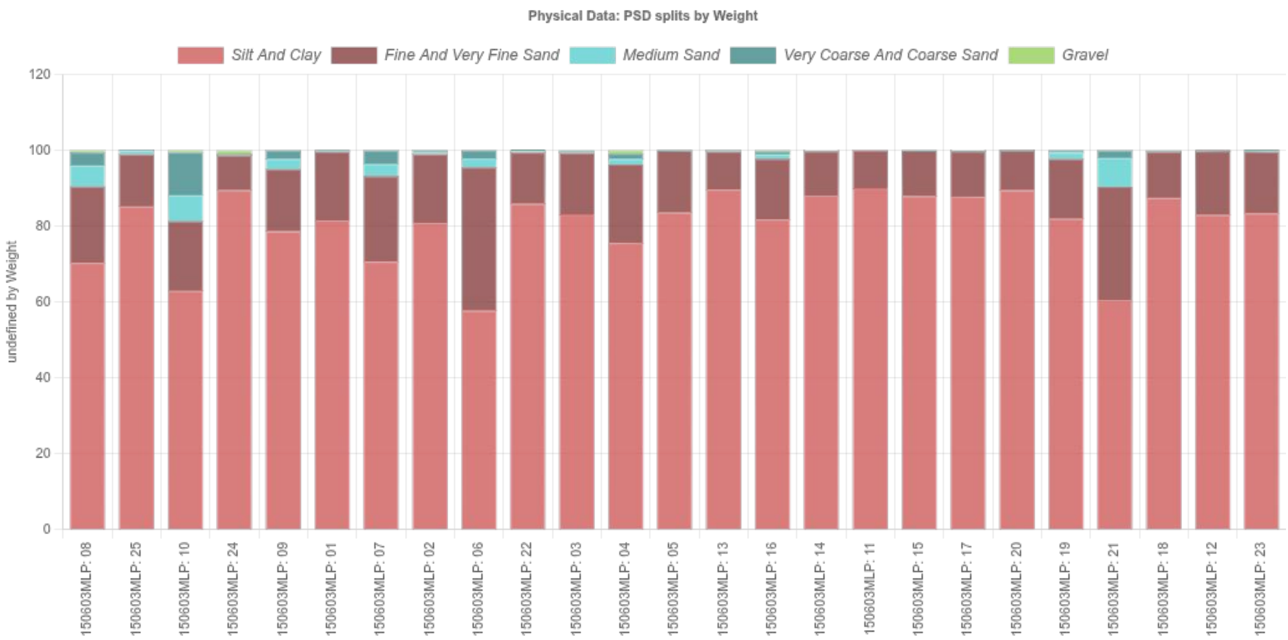


Figure 44: Sample composition ordered by latitude

The lack of this trend is similar to that seen in figure 6.1 of the 2025 MDP for samples taken in 2025.

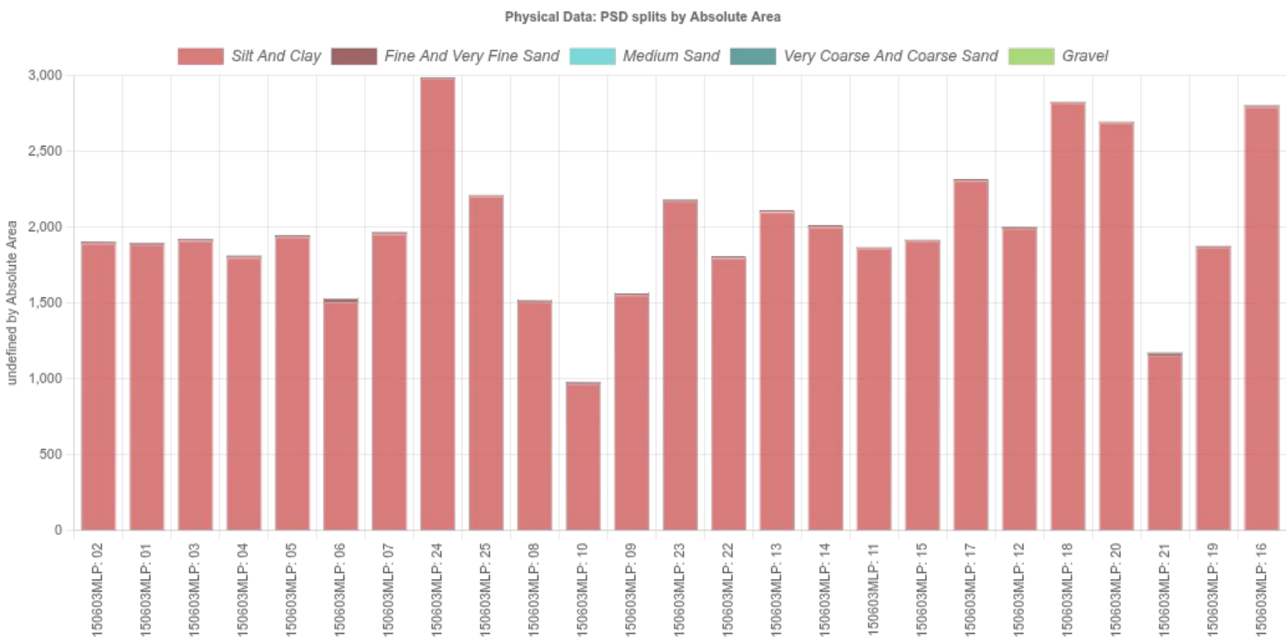


Figure 45: 2015 Samples relative surface areas in longitude order

In 2015 4 samples exceeded the HMW ERM level in the Gorham Test protocol and all 25 samples exceeded the LMW ERM level.

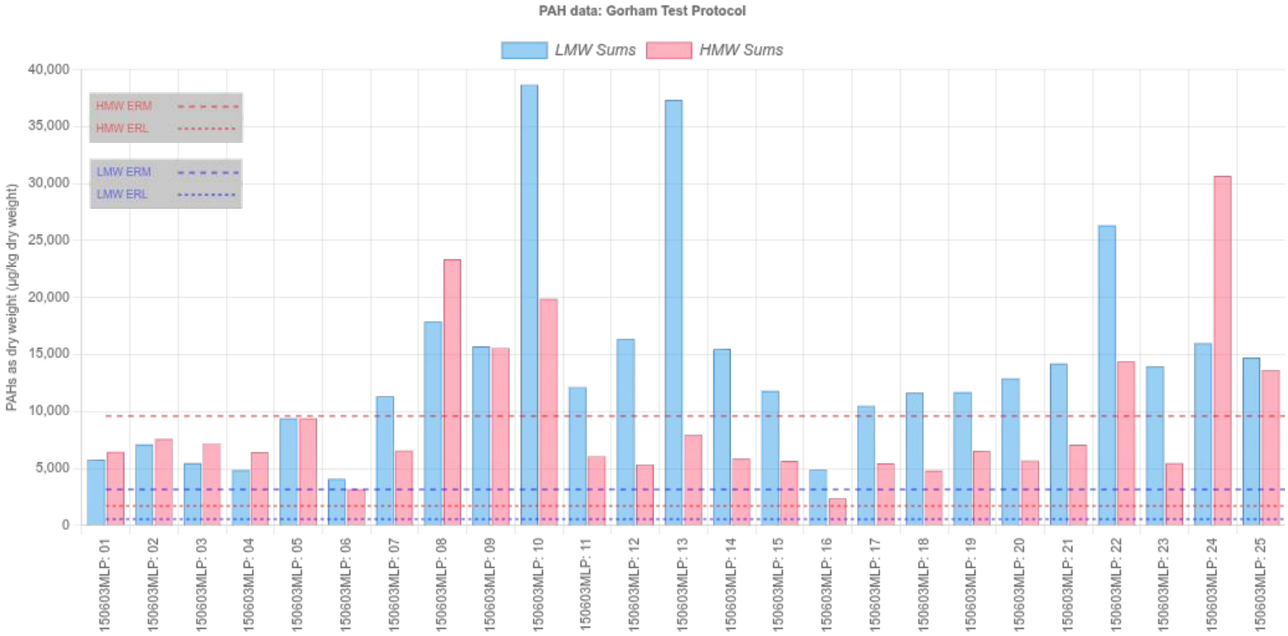


Figure 46: 2015 PAHs Gorham Test protocol

2.5 Section 3.2.1 Mid licence year 3 results – 2018/19

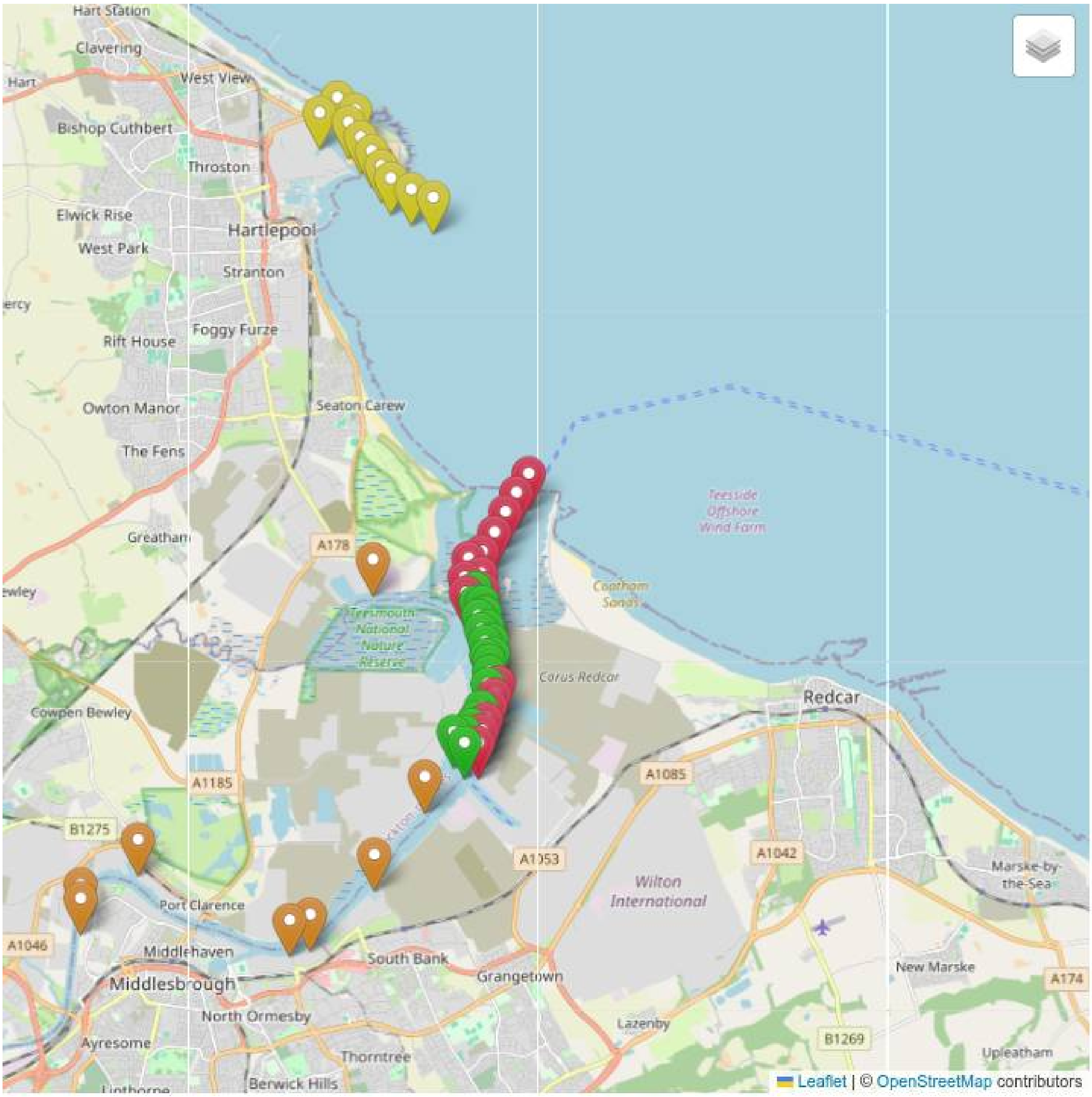


Illustration 8: 2018/19 Sampling locations
T

The samples had a wide range of particle size distributions, as shown by the surface areas of the samples. The samples between the Gares and in Tees bay were dominated by sand.

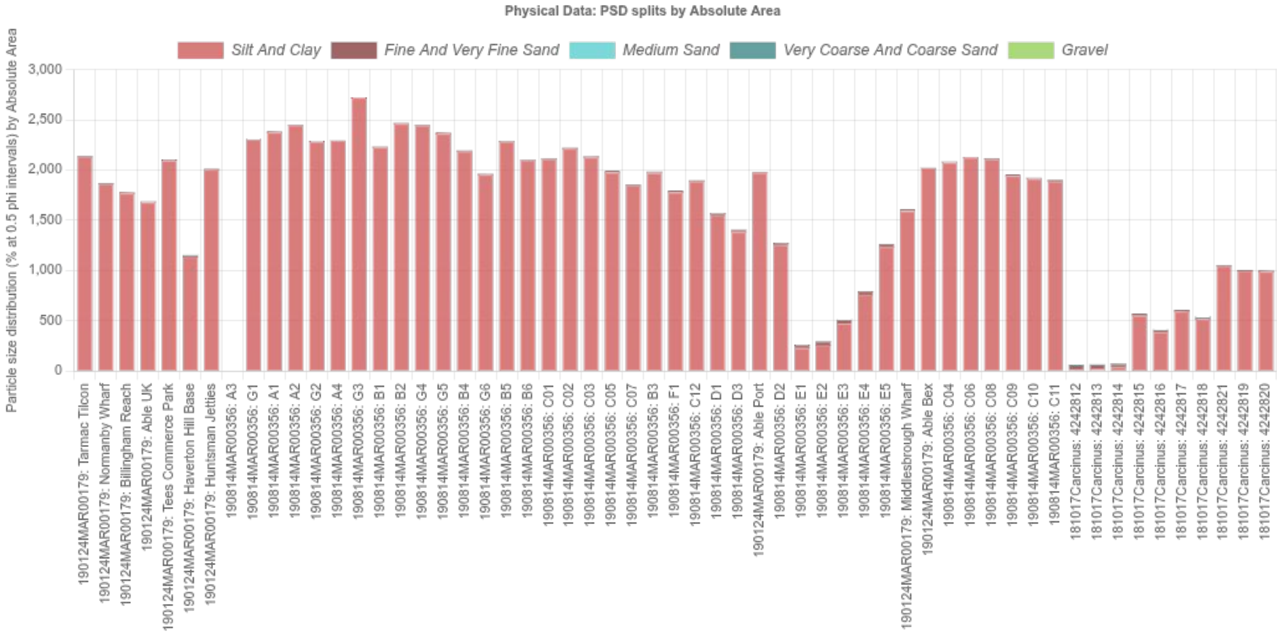


Figure 47: 2018/19 Sample relative surface areas ordered by latitude

Considering the River Tees alone PAHs showed considerable presence, with 5 samples exceeding the HMW ERM and all samples exceeding the LMW ERM. For Hartlepool no samples exceeded the HMW ERM and all samples exceeded the LMW ERM.

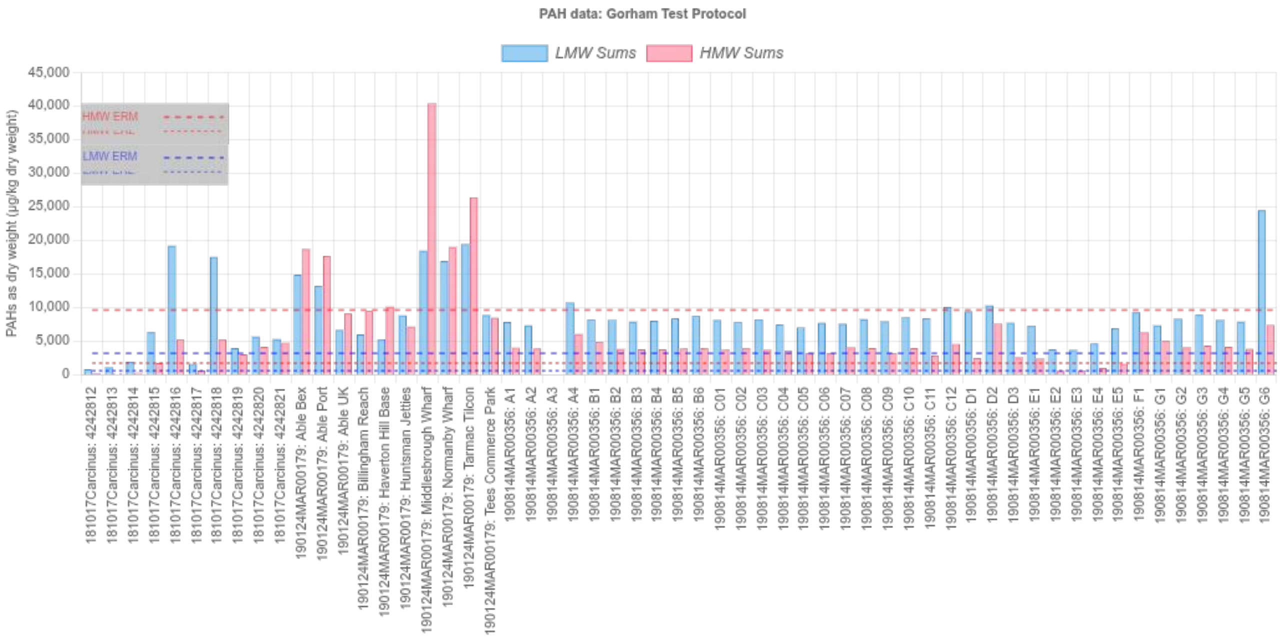


Figure 48: 2018/19 PAHs Gorham Test protocol

Considering the PCB congener sums, for the River Tees 1 sample exceeded the all sum Action Level 2, 9 samples exceeded the all sum Action Level 1 and 7 samples exceeded the ICES7 action level 1. As documented some PCB measurements were repeated and an exclusion zone at Billingham Reaches was removed.

Figure 49: 2018/19 PCBs congener sums

BDEs:

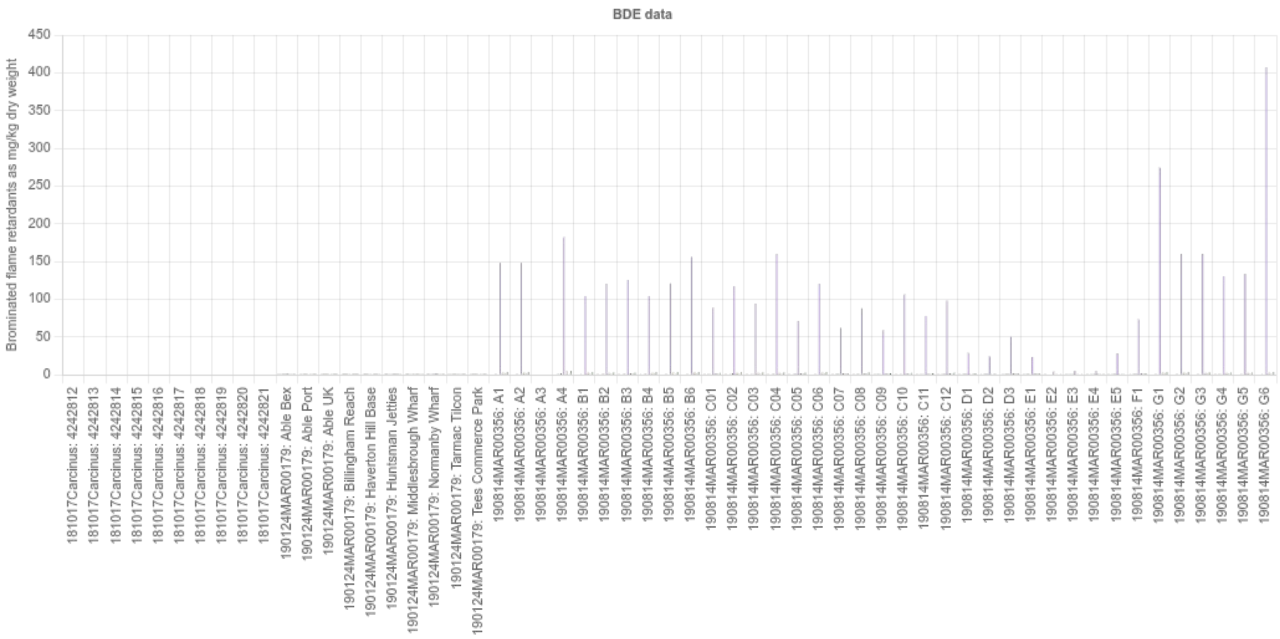


Figure 50: 2018/19 BDEs

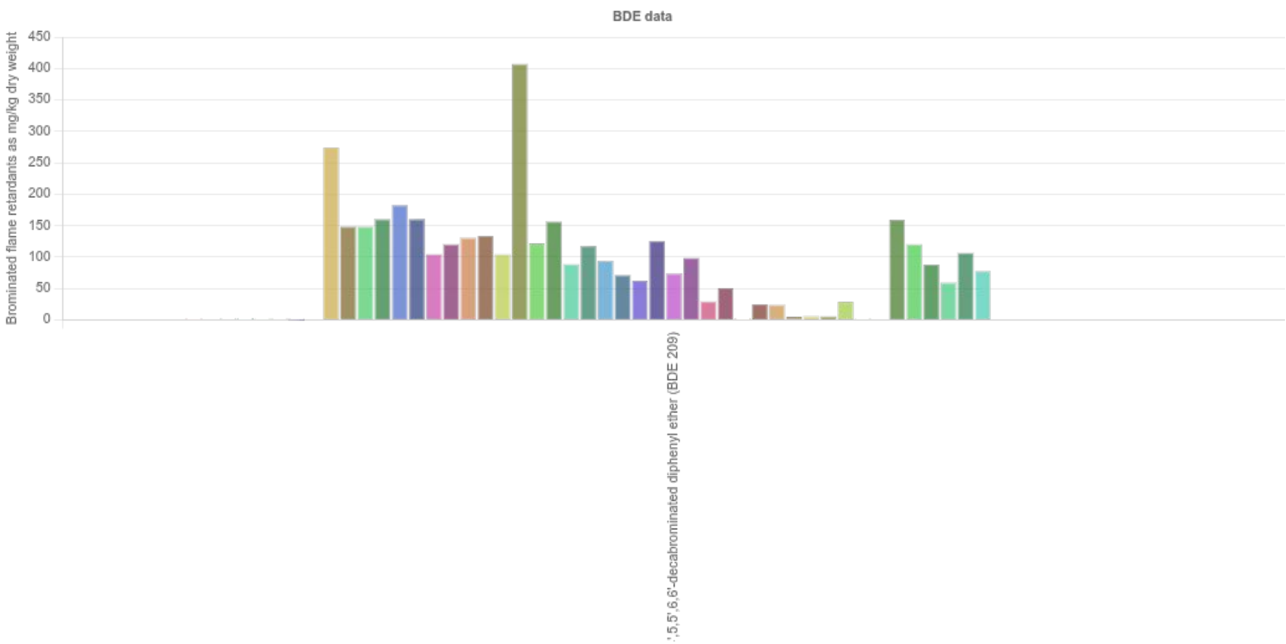


Figure 51: 2018/19 BDE 209 concentrations

Organochlorines

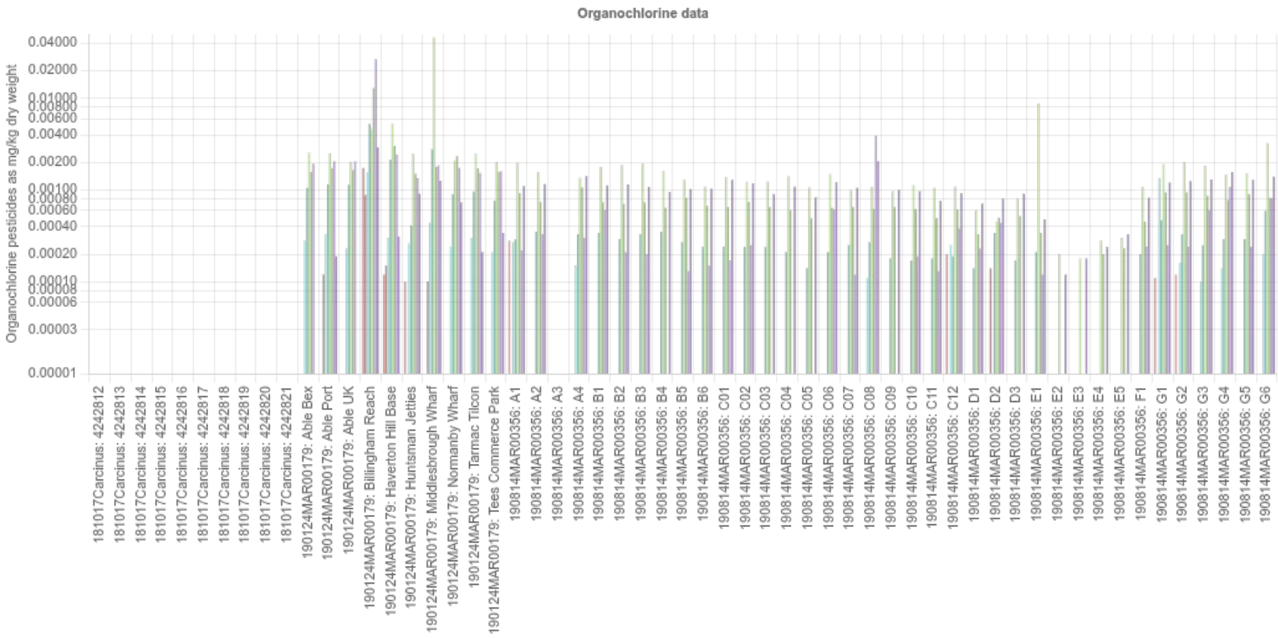


Figure 52: 2018/19 Organochlorines by sample

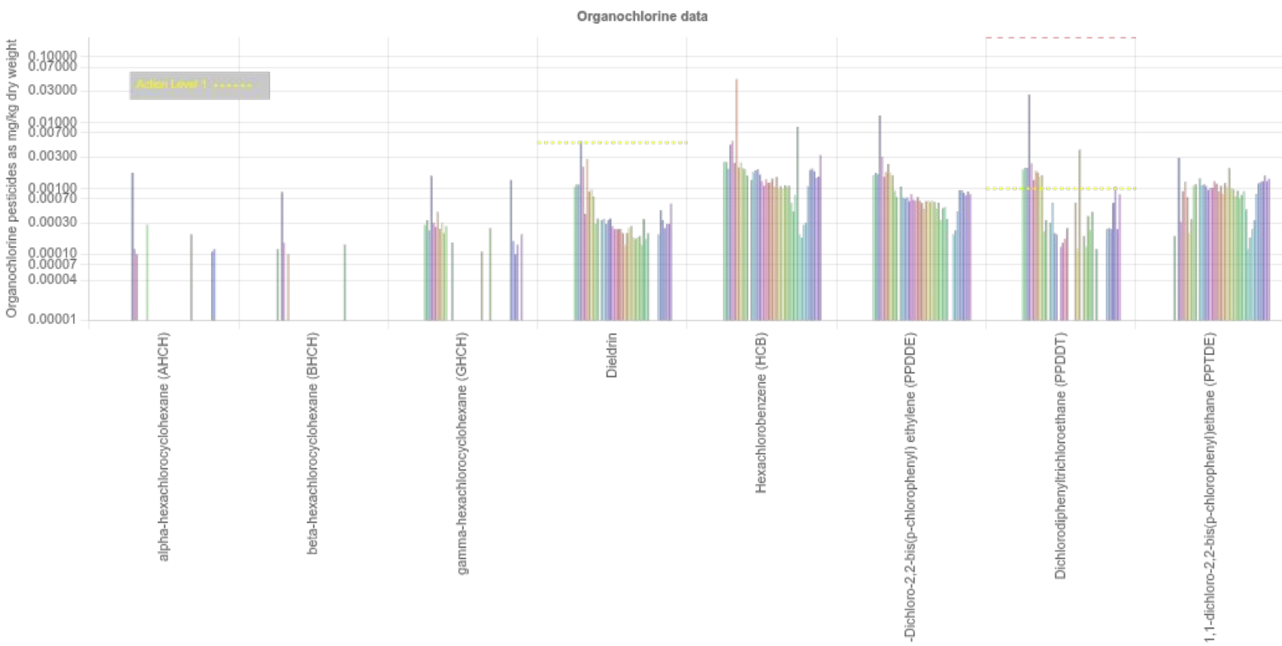


Figure 53: 2018/19 Organochlorines grouped by chemical

2.6 Section 3.2.2 Mid licence year 6 results – 2021

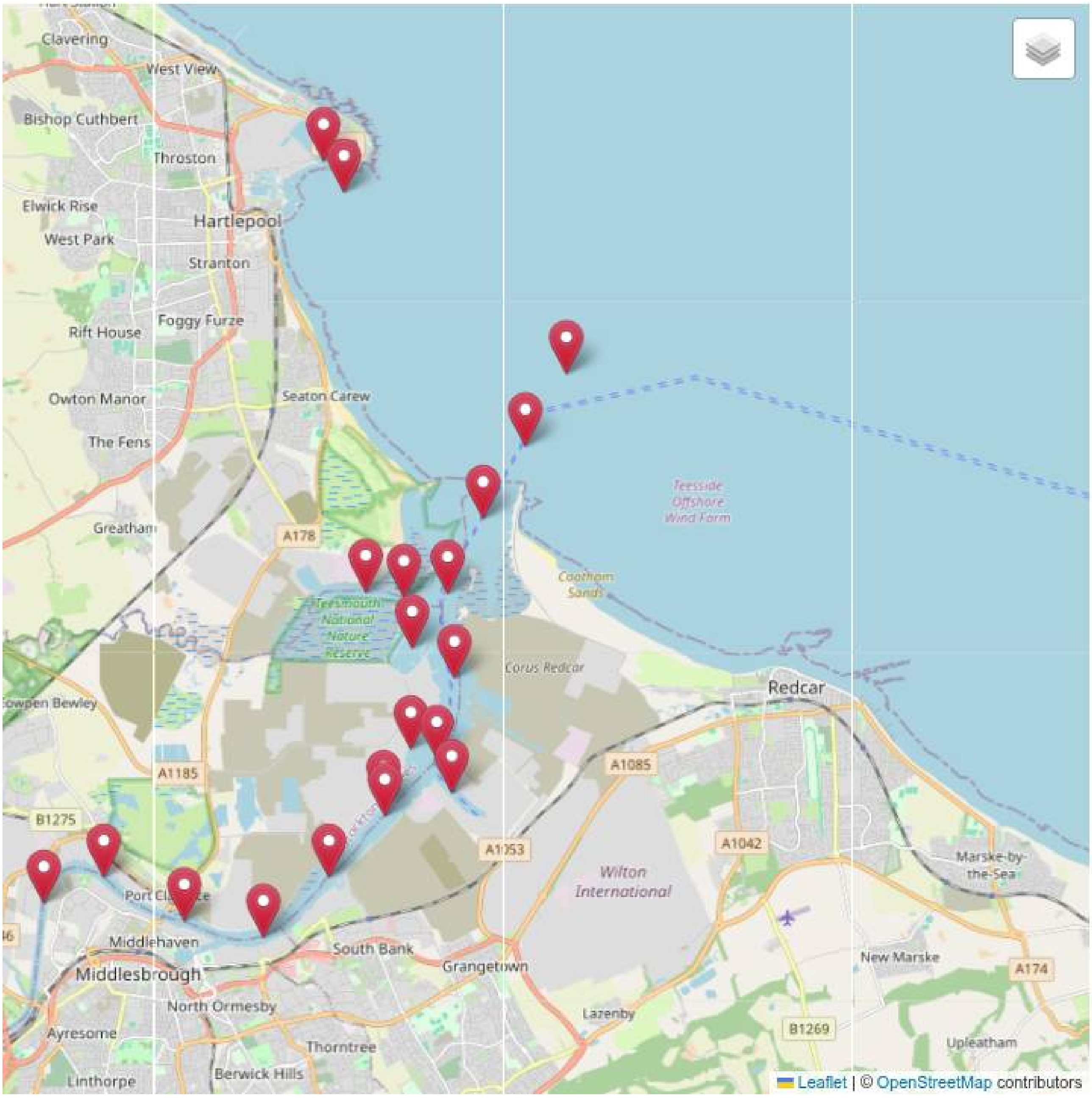


Illustration 9: 2021 Sample locations

The particle size distribution show lower surface areas downstream in general, but considerable variation in surface area is seen along the navigation channel.

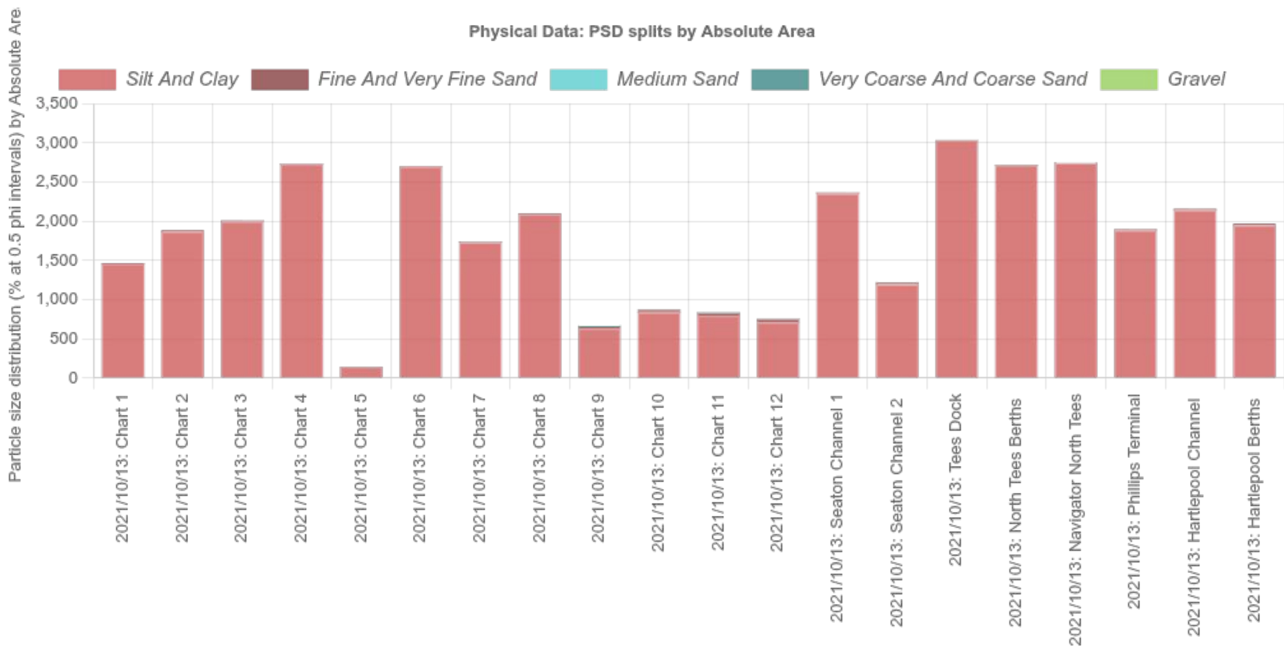


Figure 54: 2021 Sample relative surface areas

Trace metals show levels about Action Level 1, but considerably below action level 2.:

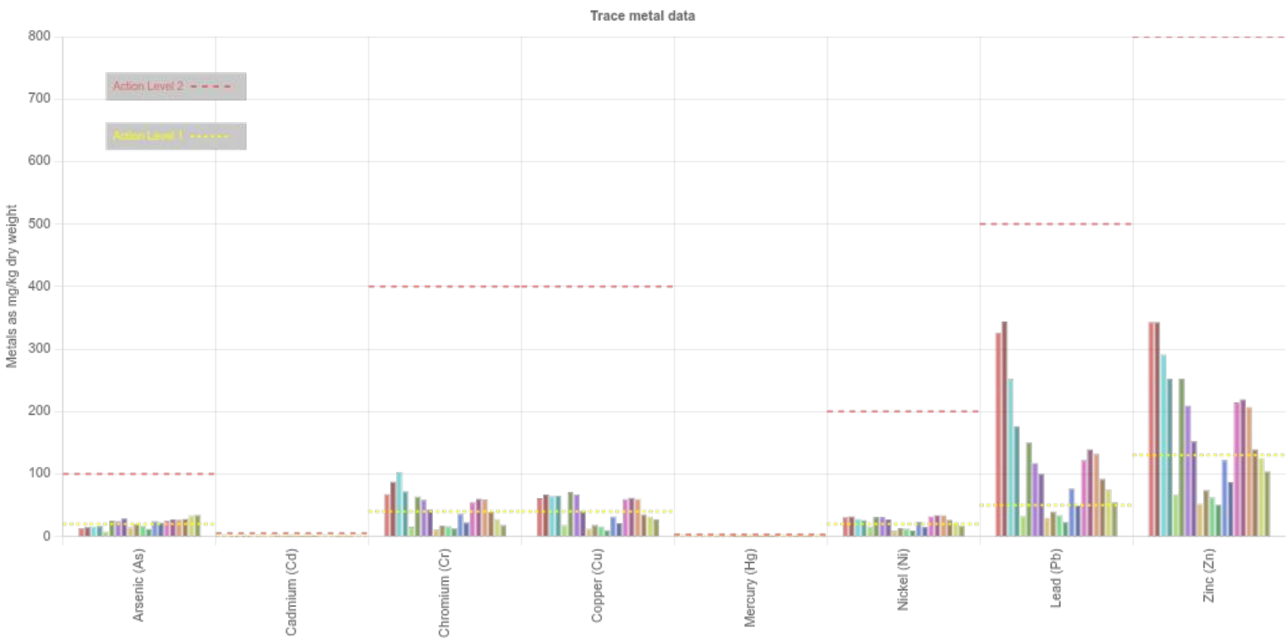


Figure 55: 2021 Trace metal concentrations group by metal

PAHs

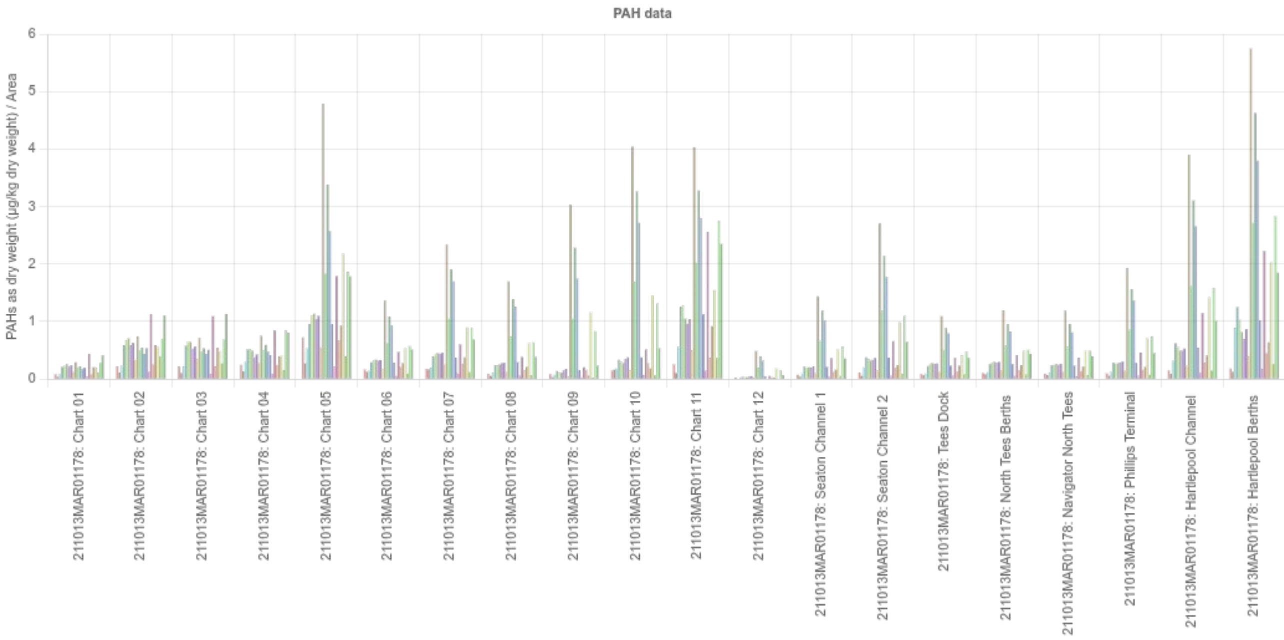


Figure 56: 2021 PAH concentration grouped by sample

For the River Tees no samples exceed the HMW ERM with most sample exceeded the HMW ERL, and most samples exceeding the LMW ERM. The two Hartlepool samples exceed both HMW and LMW ERM.

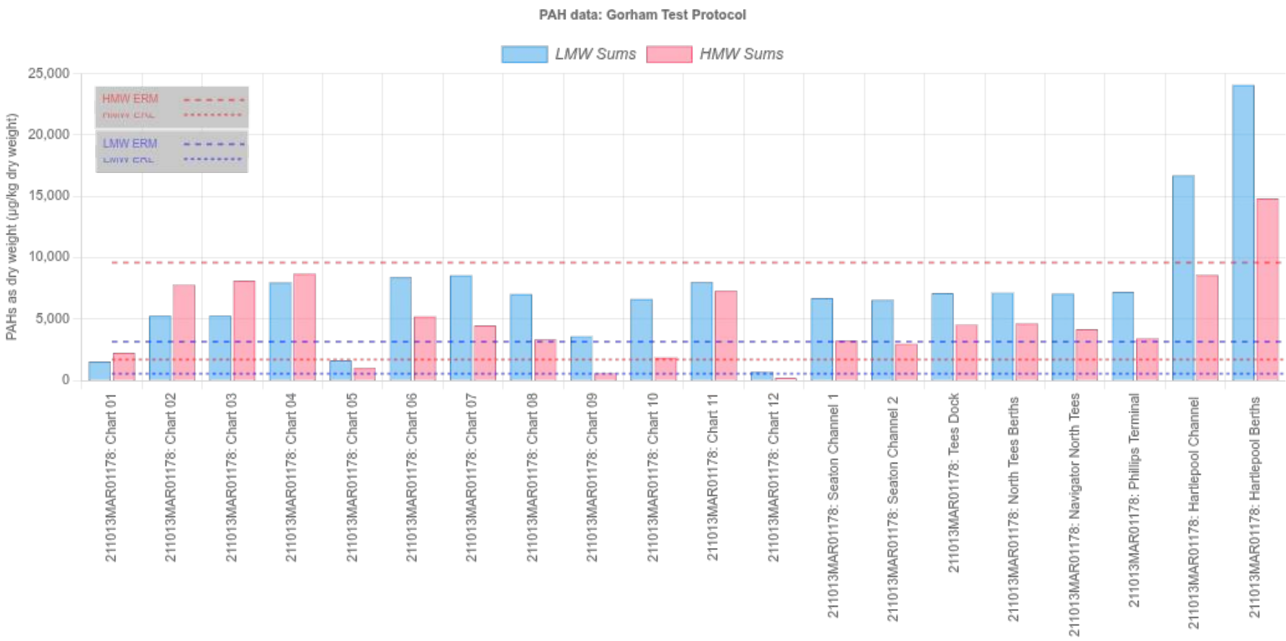


Figure 57: 2021 PAHs Gorham Test protocol

Only 2 samples exceed the PCB All sum Action level 1 being 1.5 and 2.2x it.

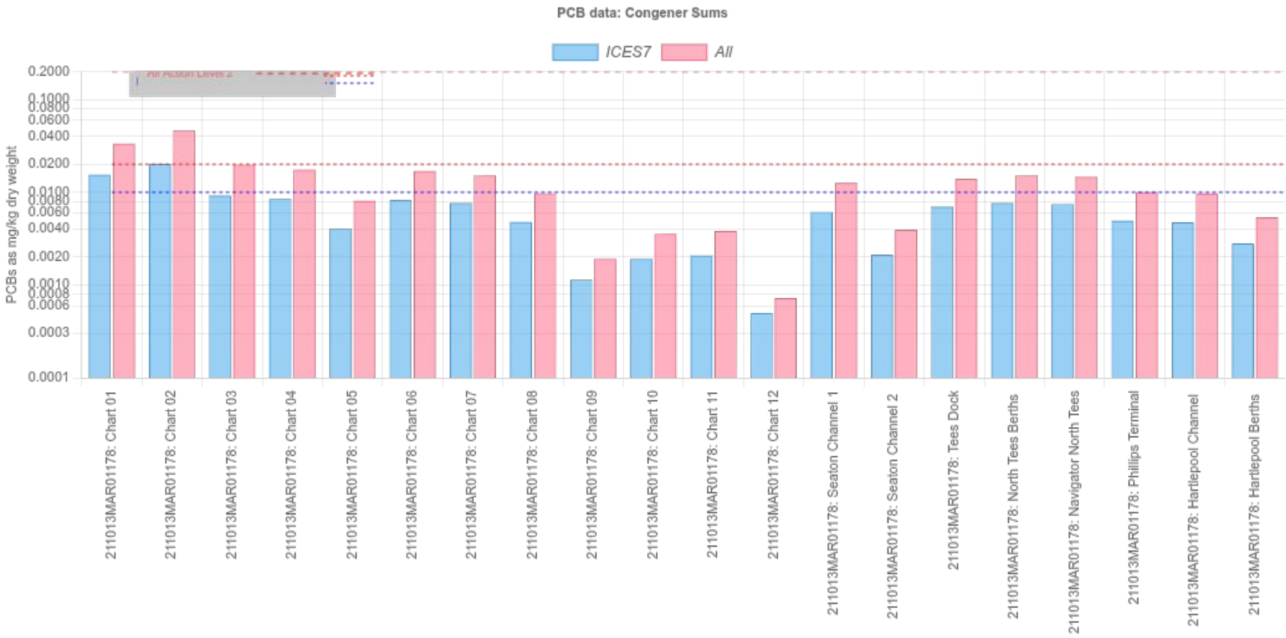


Figure 58: 2021 PCB congener sums

Organochlorines:

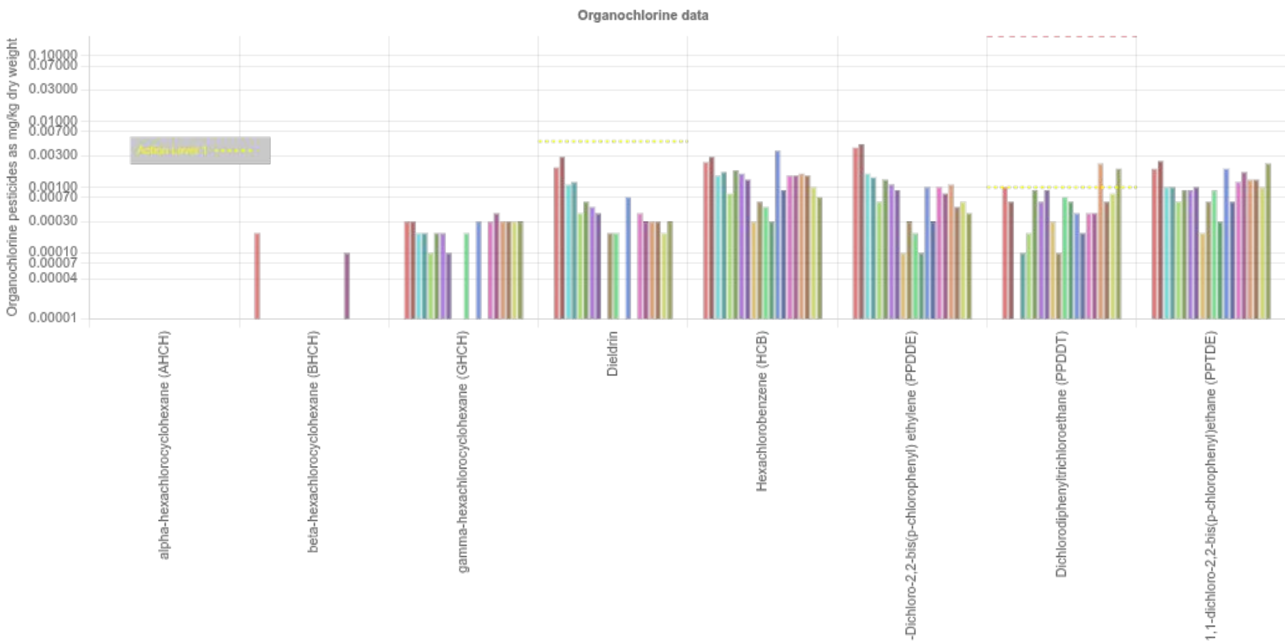


Figure 59: 2021 Organochlorines grouped by chemical

2.6.1 2021 Overspill

Considering the toxicity of the overspill both sub 5µm and sub 1µm fractions exceed the LMW and HMW ERMs for most samples. Meaning that the overspill being released into the sea is breaking the OSPAR convention and the overspill being released into the river is present an ongoing toxic hazard for the river.

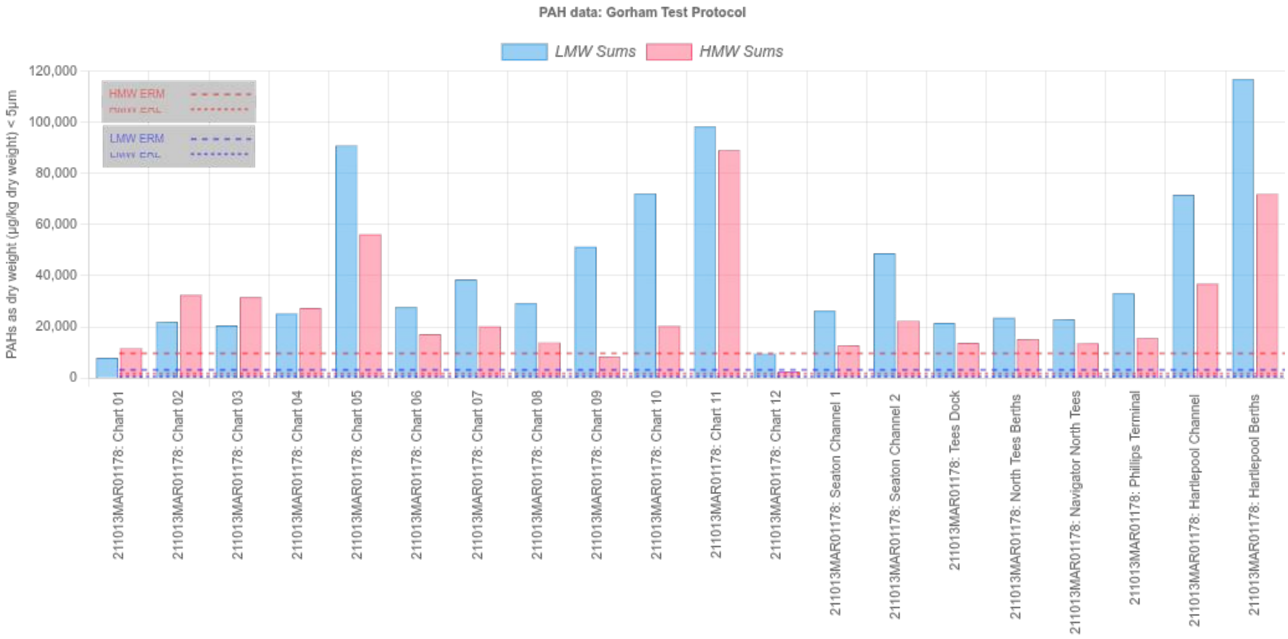


Figure 60: 2021 Sub 5µm fraction - PAHs Gorham Test protocol

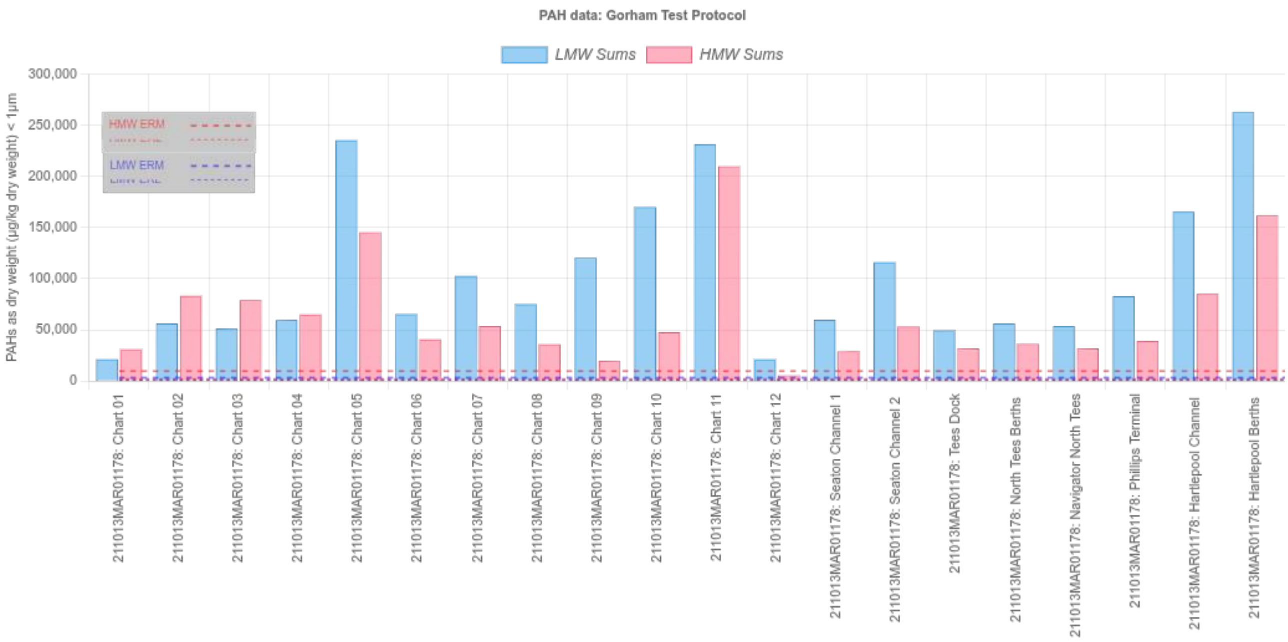


Figure 61: 2021 Sub 1µm fraction - PAHs Gorham Test protocol

The overspilled PCBs show fewer samples exceeding the current Action Level 2 than the PAHs exceeding the ERM levels.

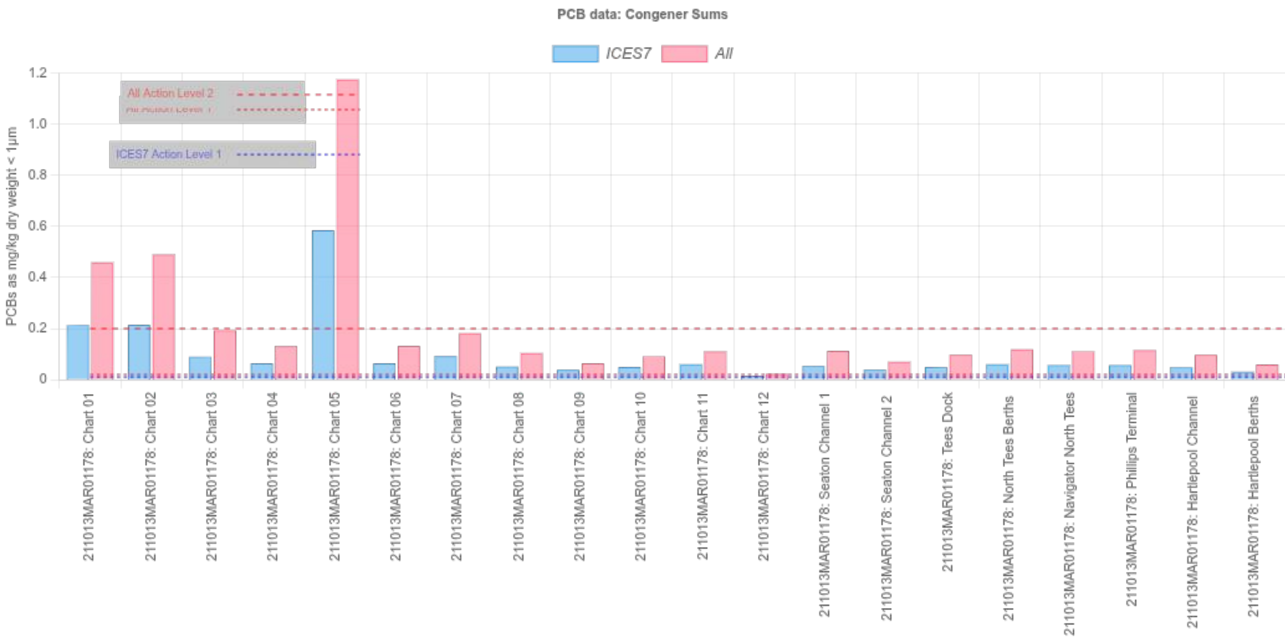


Figure 63: 2021 Sub 1µm fraction - PCB congener sums

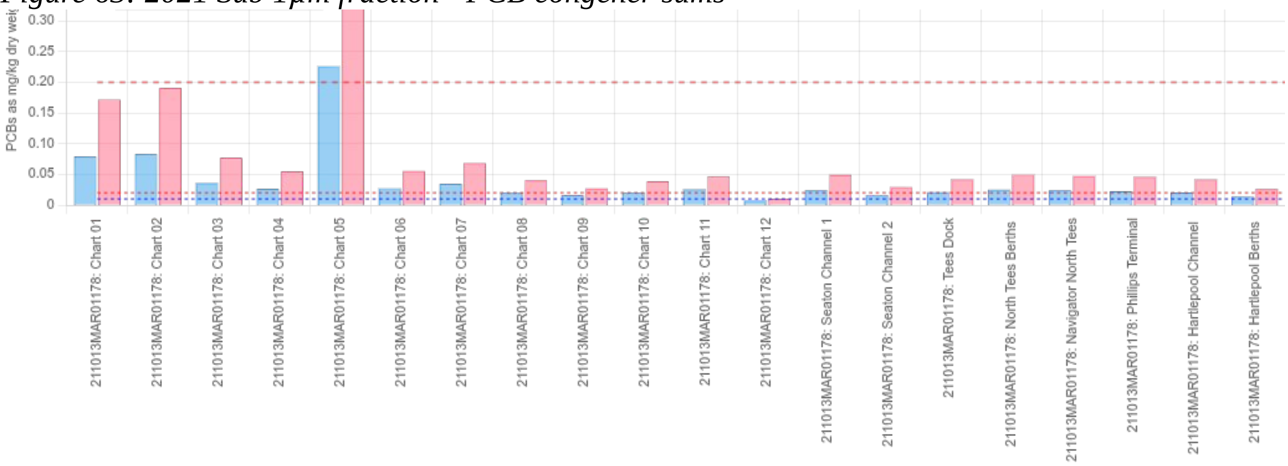


Figure 62: 2021 Sub 5µm fraction - PCB congener sums

2.7 Section 3.2.4 Mid licence year 9 results - 2024

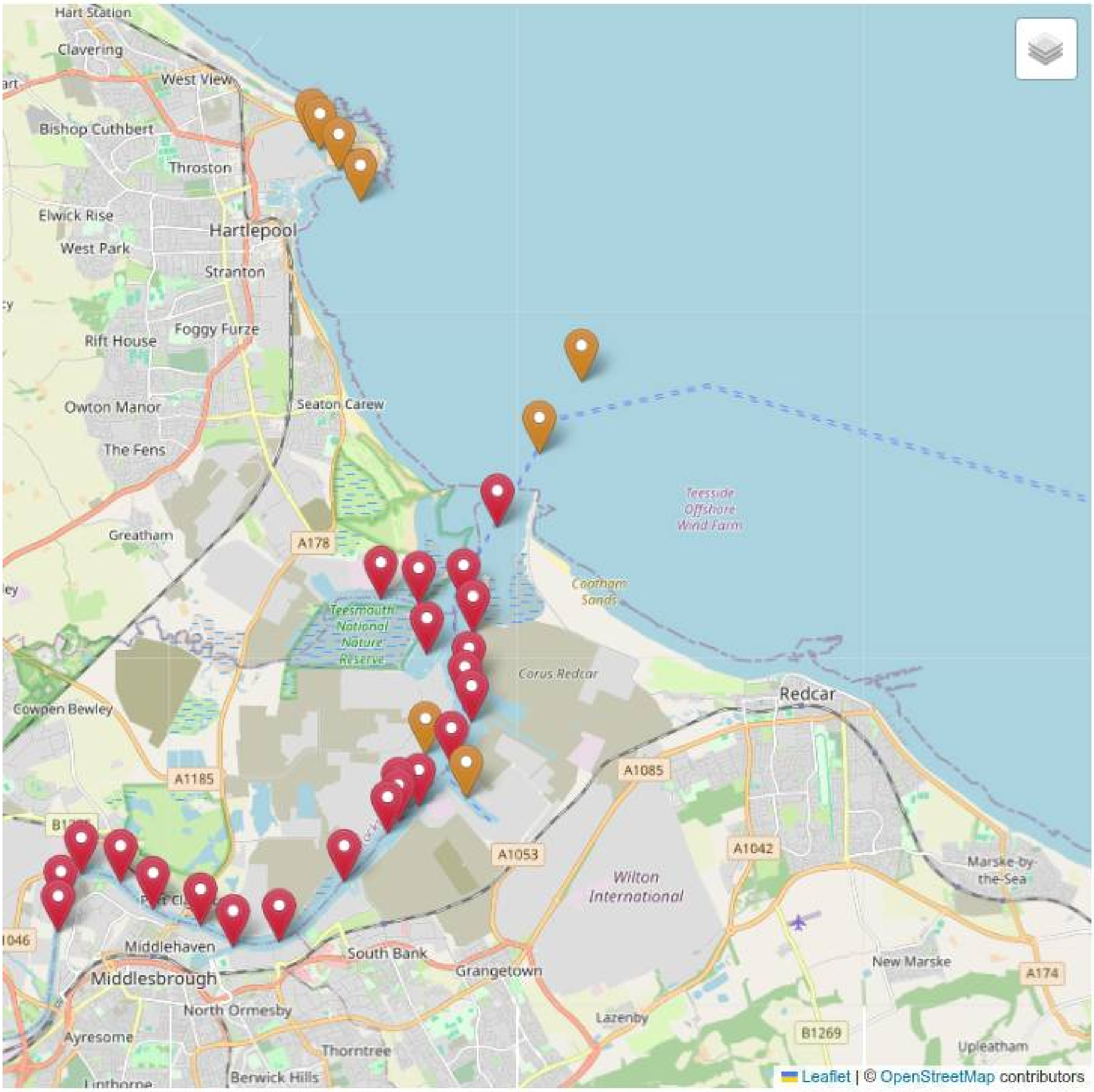


Figure 64: 2024 Sampling locations

The sample relative surface area plot reflects figure 6.1 in the 2025 baseline document, there is a large degree of variation in the sample composition across the dredging area with no trend visible.

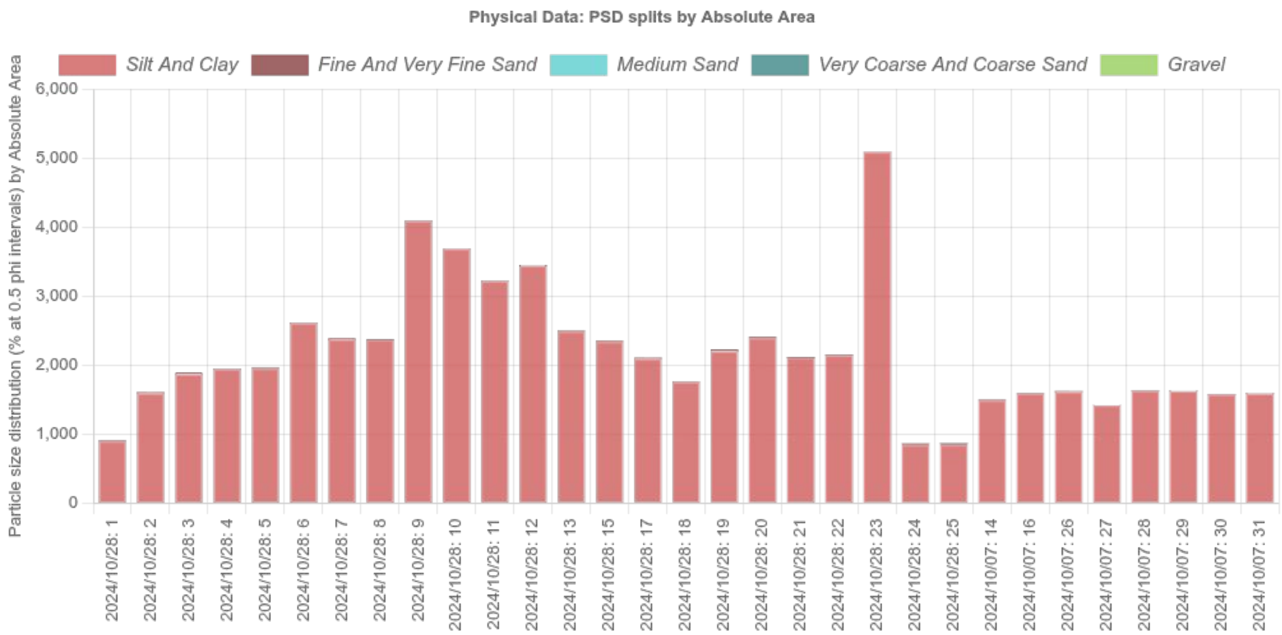


Figure 65: 2024 Sample relative surface areas

No sample exceed the PAH HMW ERM level but only one sample is significantly less than the LMW ERM level.

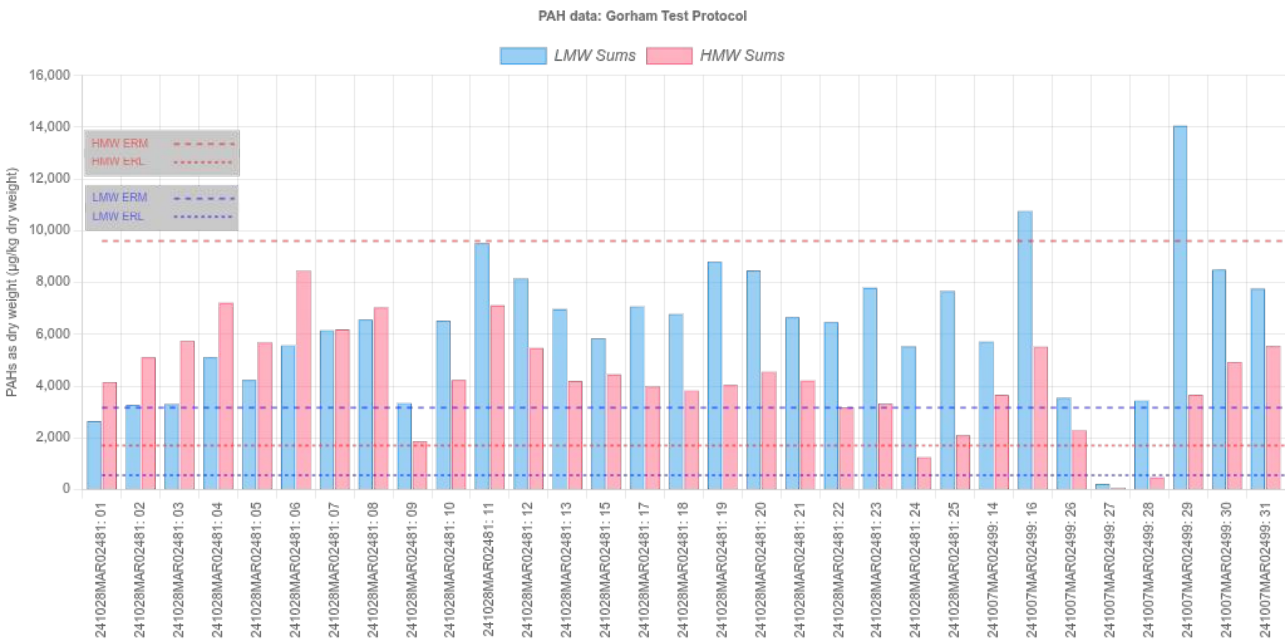


Figure 66: 2024 PAHs Gorham Test protocol

Limited PCB measurement were made and no sample exceed the accepted levels.

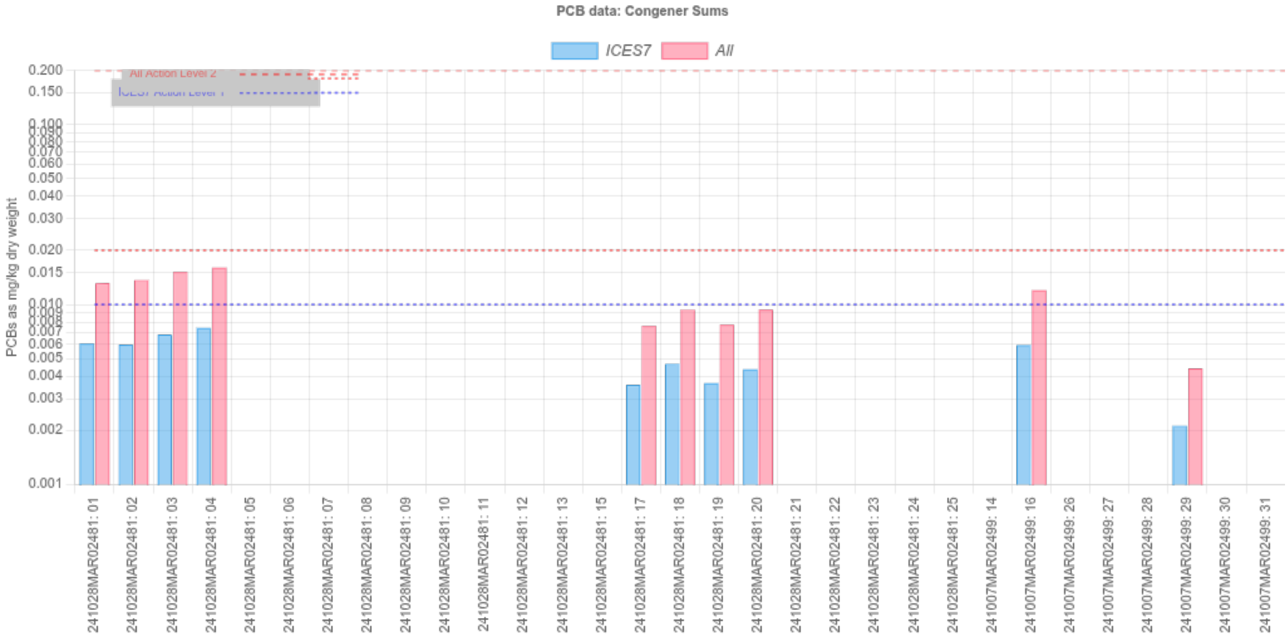


Figure 67: 2024 PCB congener sums

BDEs

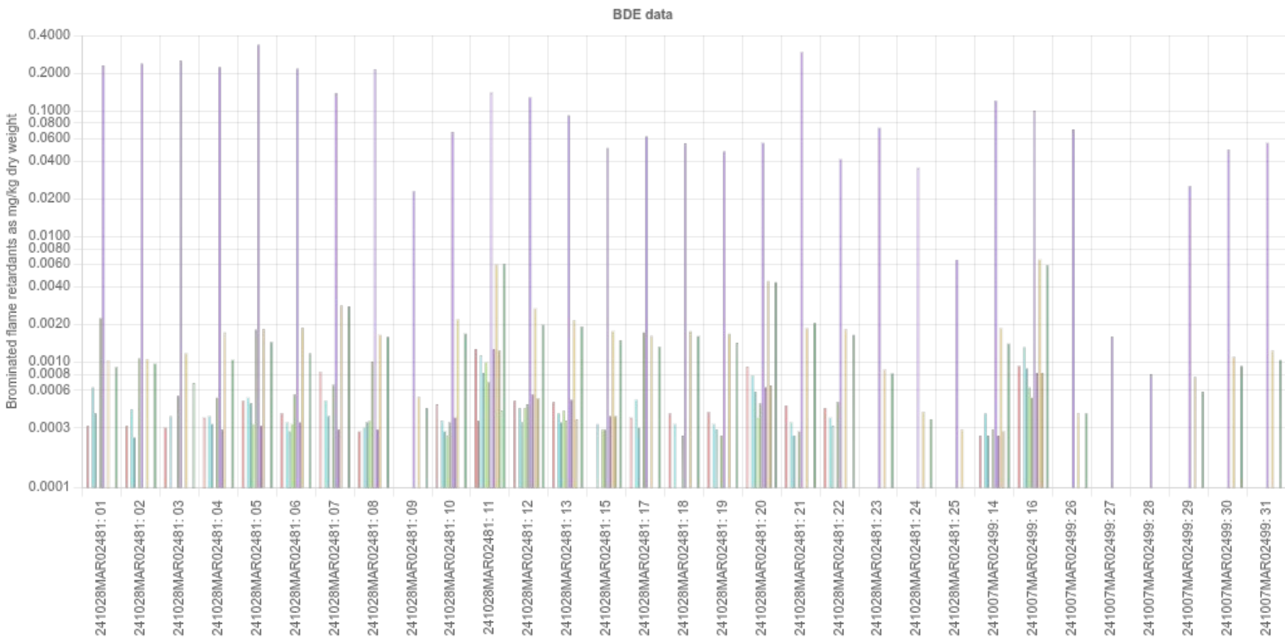
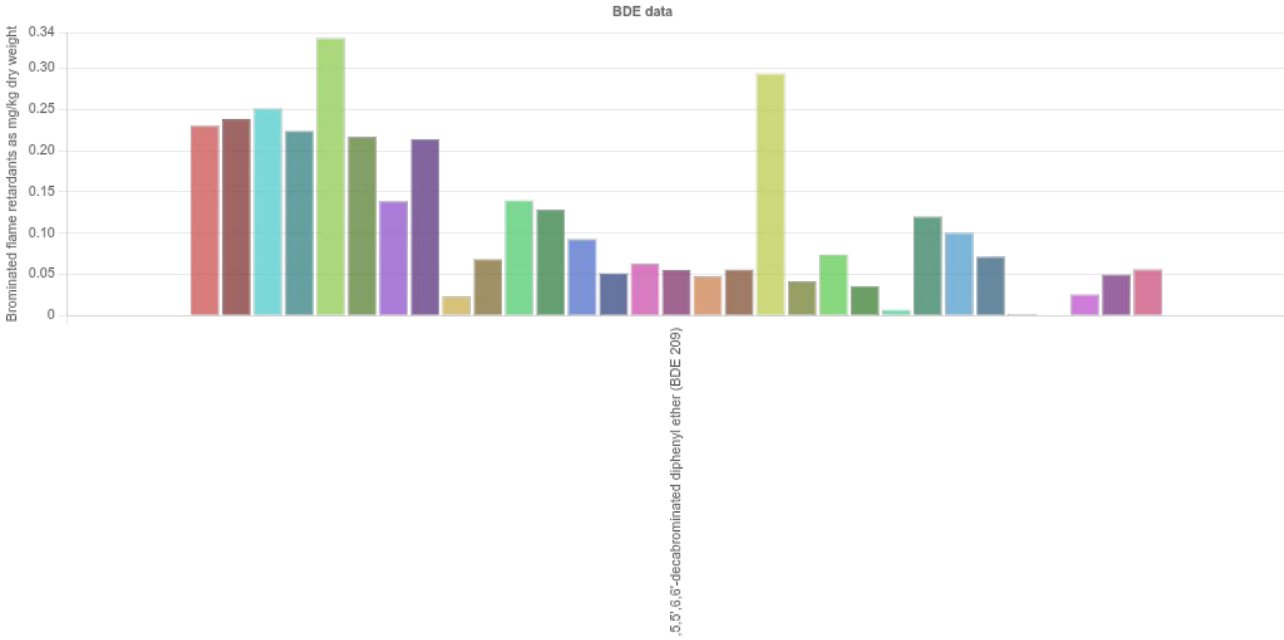


Figure 68: 2024 BDE concentrations



Organochlorines

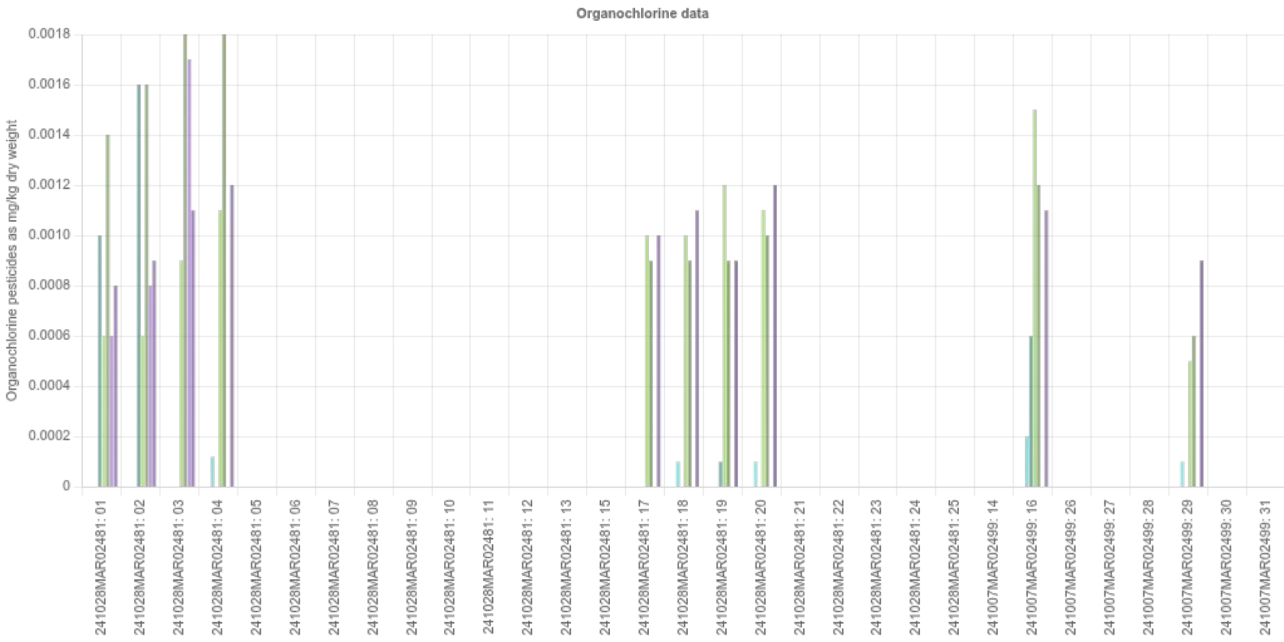


Figure 69: 2024 Organochlorines grouped by sample

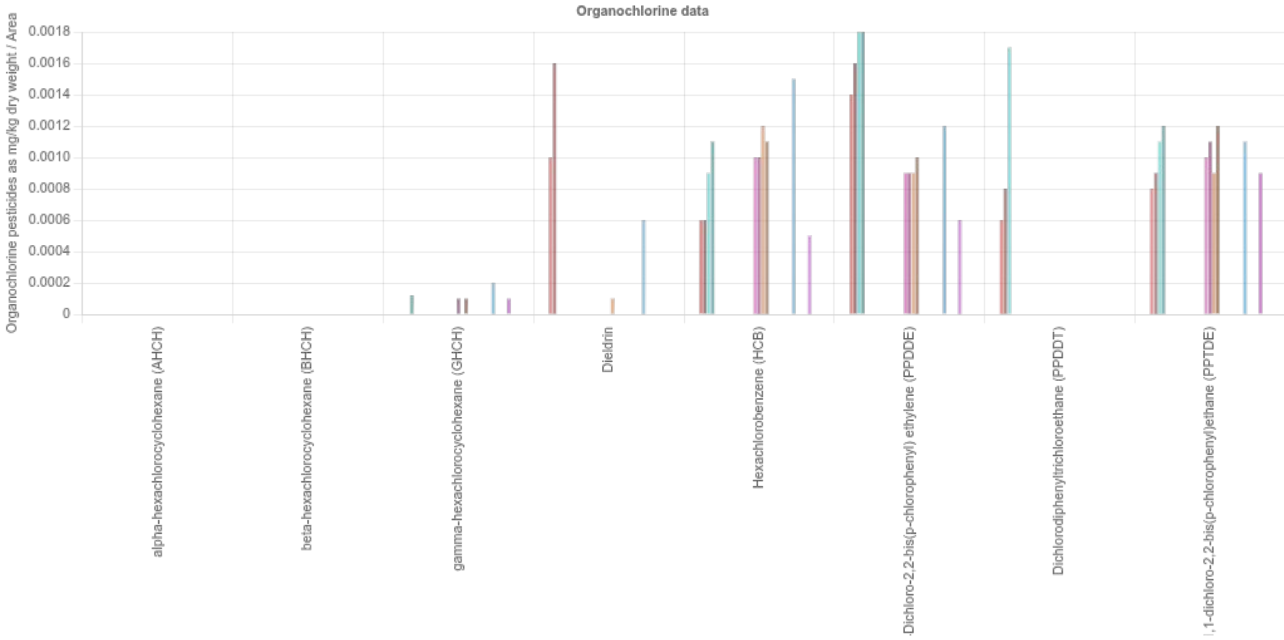


Figure 70: 2024 Organochlorines grouped by chemical

2.7.1 2024 Overspill

Once again for both sub 5µm and sub 1µm fraction show most samples exceed the internationally accepted levels at which material is safe to be disposed of at sea and as such if the overspilled sediment was considered it would still not be acceptable under the OSPAR convention.

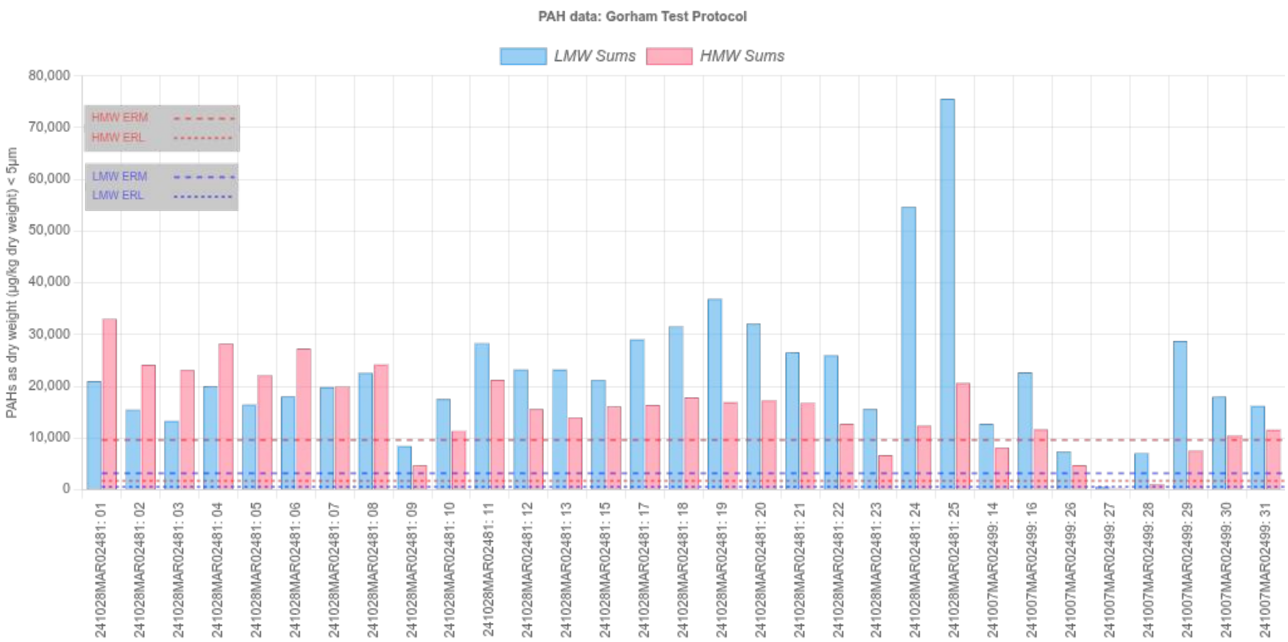


Figure 71: 2024 Sub 5µm fraction - PAHs Gorham Test protocol

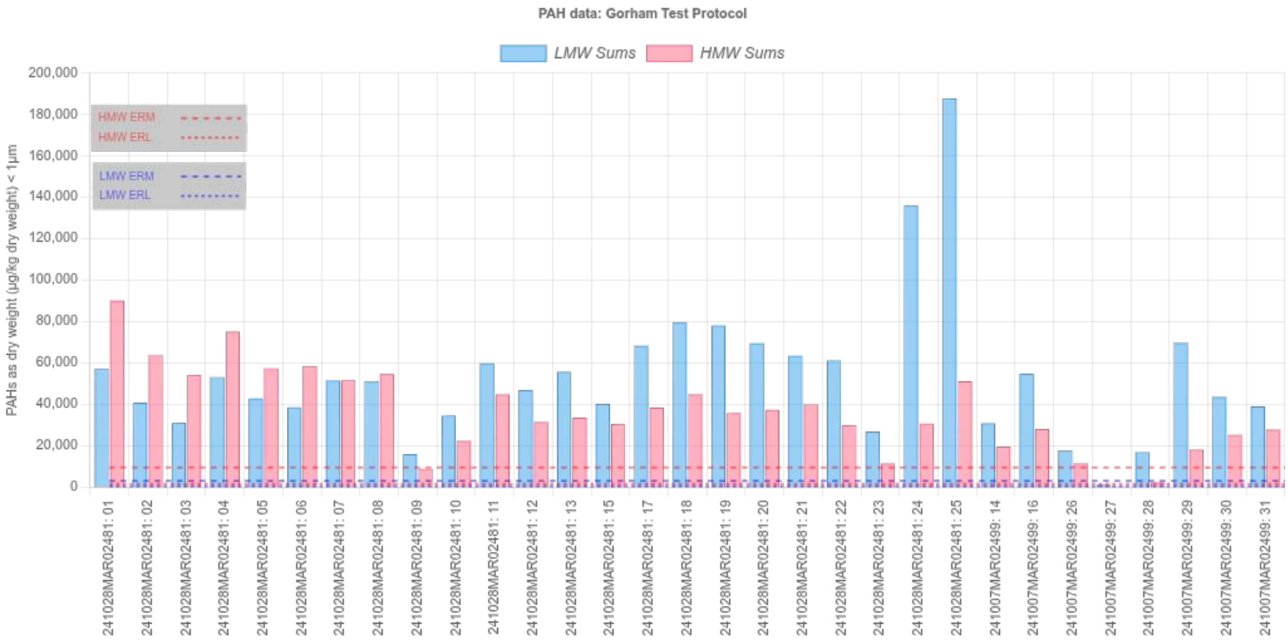


Figure 72: 2024 Sub 1µm fraction - PAHs Gorham Test protocol

2.8 Contamination Insights

The level of variation seen between and within the different sets of sampling means that while there appear to be some trends in the level of contamination over time, this needs to be treated in a precautionary not providential way. Specifically it needs to be rigorously questioned not purely excepted as it would be so convenient. There are so many factors which undermine the robustness of any trends stated about contamination: the limited number of samples taken; the lack of multiple samples taken in the same location under the same conditions; the lack of continuous sampling of all the determinands - organic carbon, PCBs, BDEs, organochlorines, etc.; full consideration of the complex process happening in the River Tees and their implications for samples taken.

In terms of contamination for the areas covered, the Tees MDP Baseline Document 2025 takes a providential approach, only telling the good news and not explaining the not so good news, so no mitigation is included. For example Plate 3-1 should have included the ERL and ERM levels for the low molecular weight hydrocarbons, in which case while the levels may be decreasing the 2024 samples show that both the median and mean levels still exceed the low molecular weight ERM level by a factor of 2.

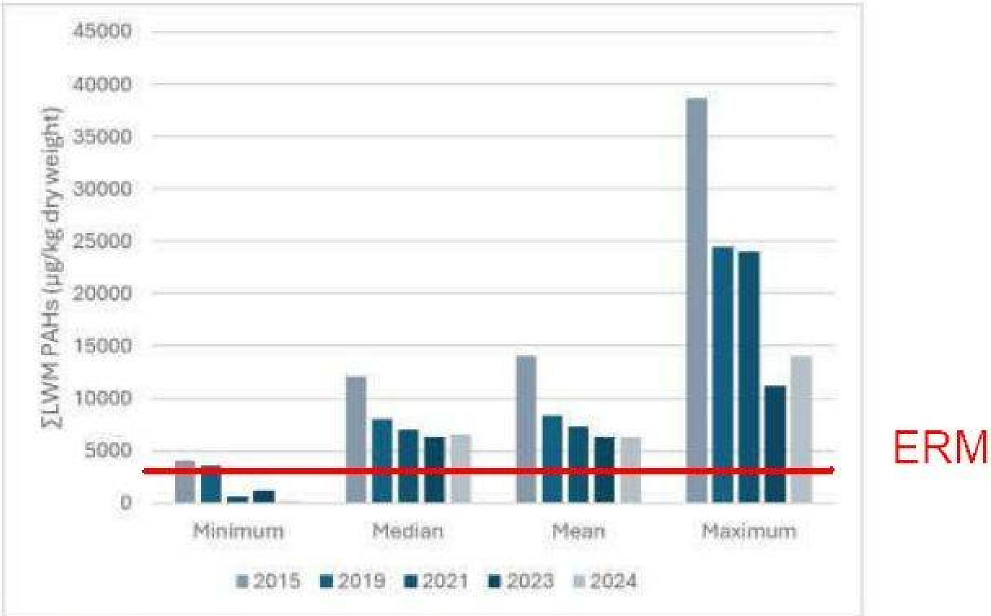


Plate 3-1 Low molecular weight group comparison across the licenced period (reproduced from Cefas sample advice dated 31 January 2025)

Figure 73: Plate 3-1 from Tees MDP Baseline 2025 - with added LMW ERM

So the best that can be said for the PAH state of the River Tees is that it is in a less bad state than it was in the past.

This is particular evident as soon as you compare these results to those from another port such as the sediments from Southampton taken for MLA/2025/00234 in April 2025:

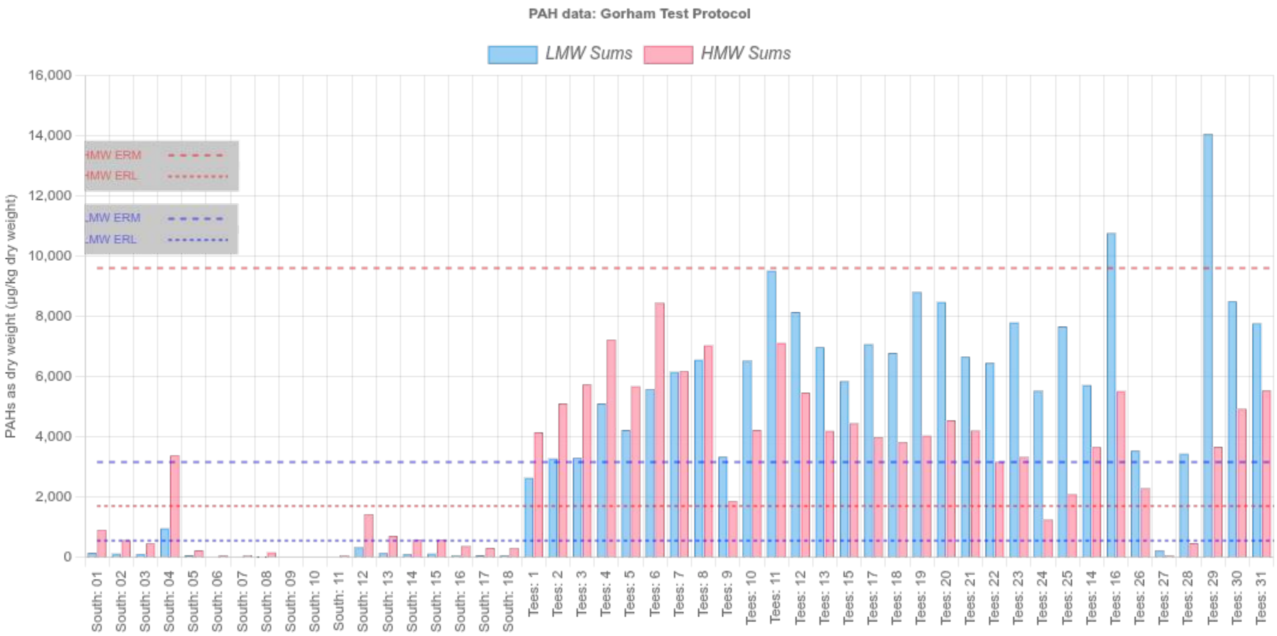


Figure 74: 2025 Southampton compared 2024 Tees/Hartlepool - PAH Gorham Test protocol

Both the Southampton and Tees / Hartlepool samples have a range of different sample compositions as shown by particle size distributions in Figure 75, as such they span a similar range.

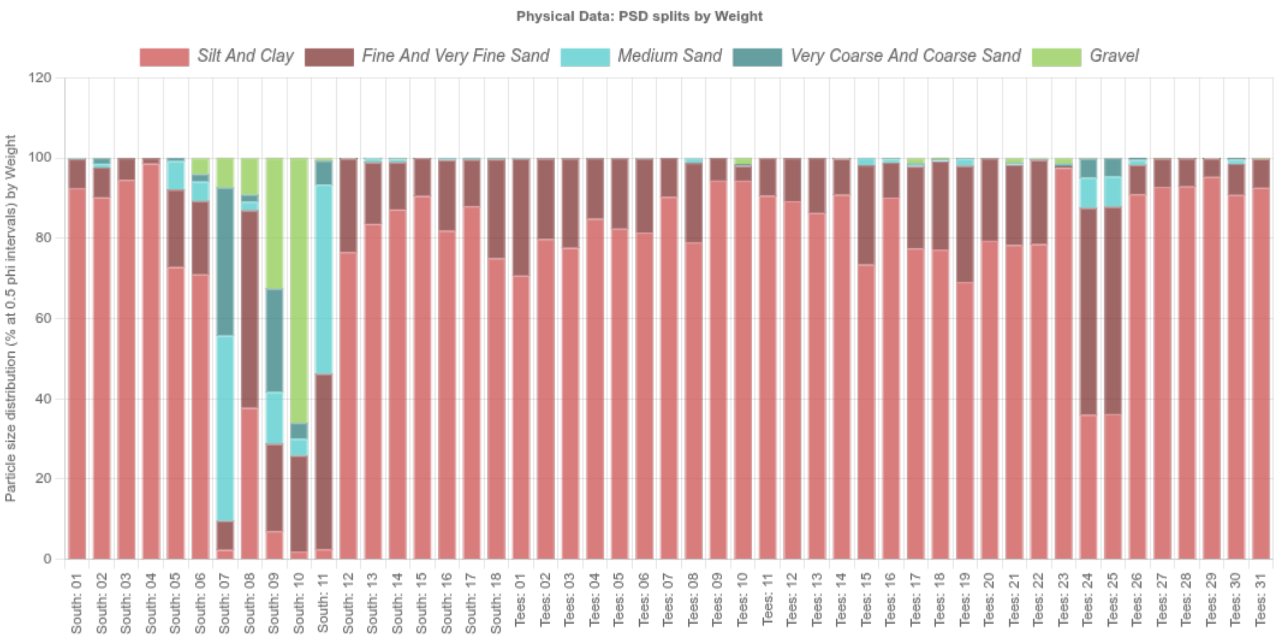


Figure 75: 2025 Southampton compared 2024 Tees/Hartlepool - sample compositions

The relative surface areas compared in Figure 76 show the Tees set does not have the low surface area samples that the Southampton set contains.

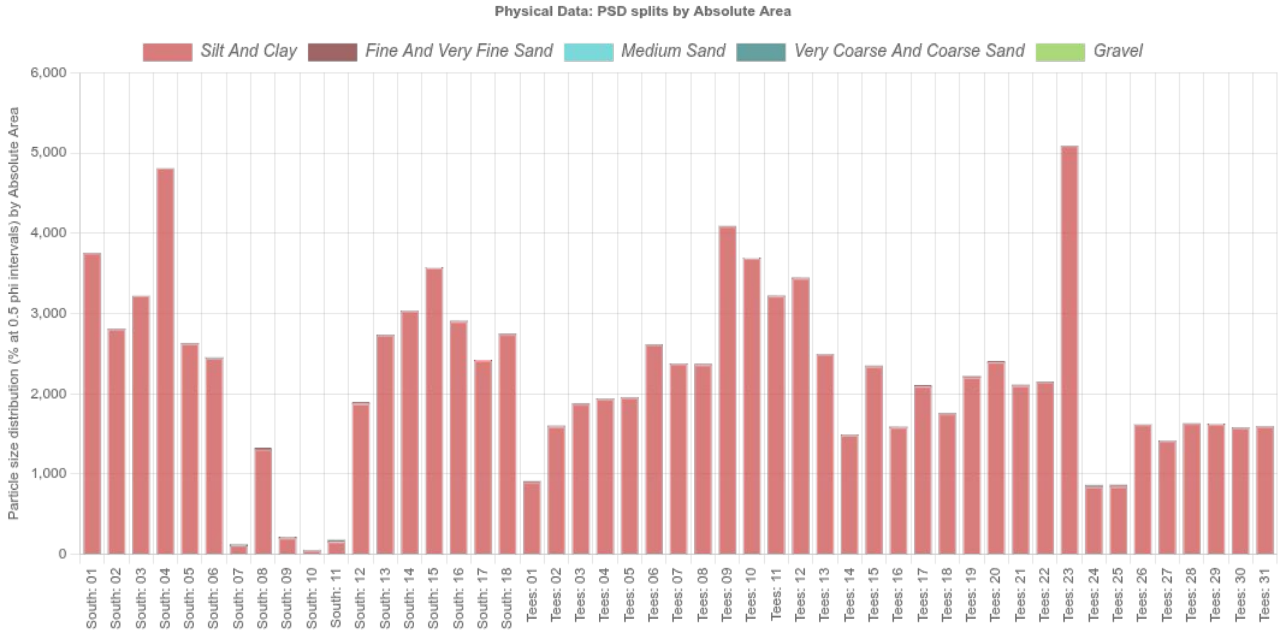


Figure 76: 2025 Southampton compared 2024 Tees/Hartlepool - relative surface area

In terms of PAH contaminants the Southampton samples are far less contaminated than the Tees samples.

The same is true for PCBs sums.

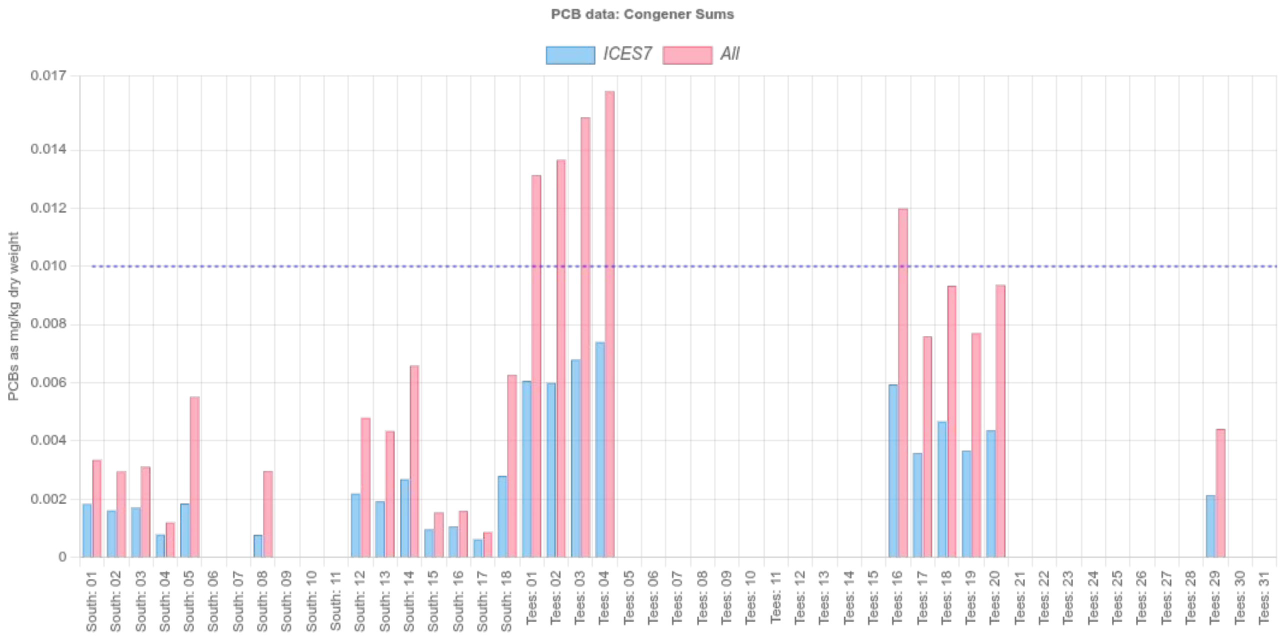


Figure 77: 2025 Southampton compared 2024 Tees/Hartlepool - PCB sums

Sums of all the BDE contaminants detected shows the Tees system contains 10 times as much BDE contamination than the Southampton system.

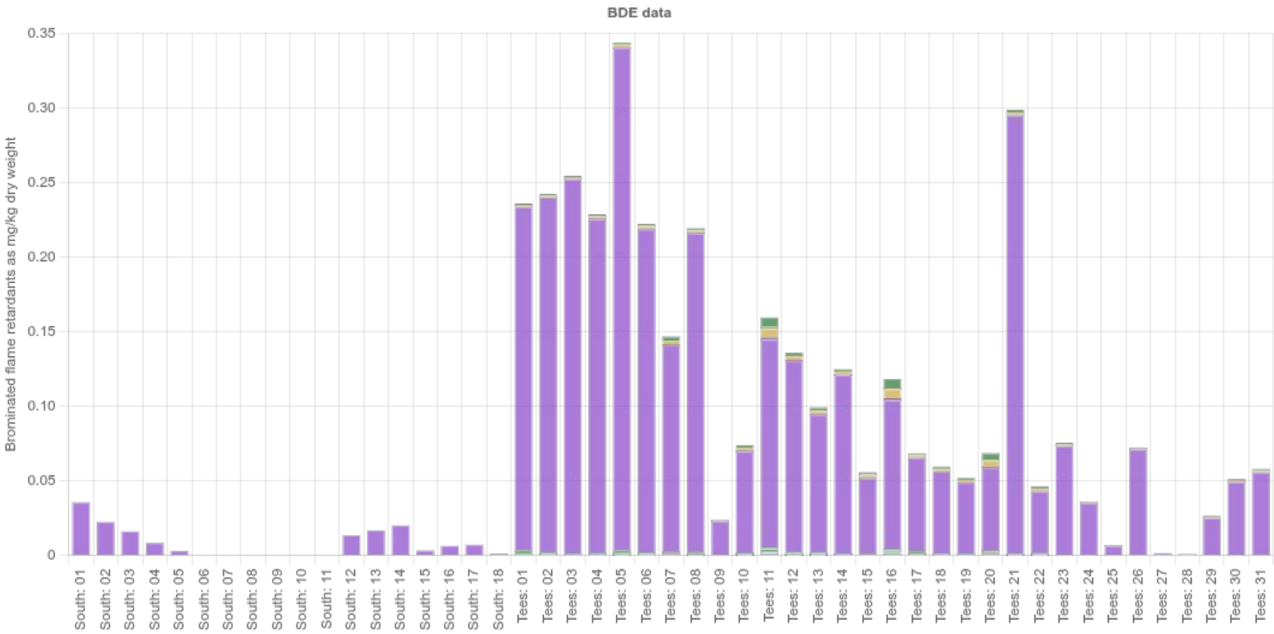
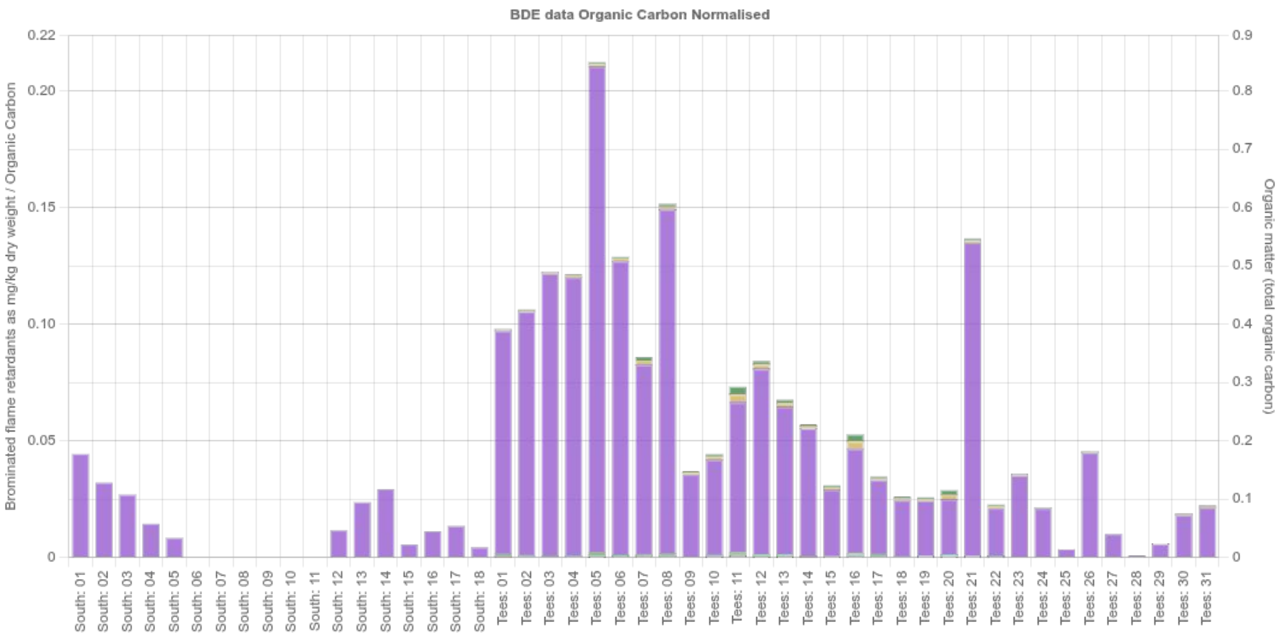


Figure 78: 2025 Southampton compared 2024 Tees/Hartlepool - BDE sum

Cefas asses the risk of BDE by normalise against a standard organic matter content of 2.5%, even normalising the BDE sums still show the Tees samples are many time more contaminated than the Southampton samples.



Cefas have commented on the levels of BDEs in both the Southampton and the Tees samples. In the case of Southampton[23] it is stated in conclusion to the BDE section that "*However, Cefas assess PBDEs as a contaminant group, and as only one congener (BDE209) is observed at levels above the LAC, it is considered that the material is not likely to pose a potentially unacceptable risk to the marine environment thus should not be precluded from disposal at sea.*" In the case of Tees[24] it is stated in conclusion to the BDE section that "*Comparison of the levels of BDE209 and BDE99 was undertaken from 2019 to 2024 and for normalised versus non-normalised data in 2024 which showed mean normalised levels of BDE99 in 2024 to be still above levels in 2023. However, levels of BDE 209 on average were lower than levels from 2019 to 2023. As a result of this assessment the annual resampling requirement was rescinded to every three years.*", with the final conclusions being for the Tees samples "*The material remains acceptable for disposal to sea.*".

NEMRG are concerned that bearing in mind the level of variability seen in the sample sets presented and the level of development activity on going and forecast around the River Tees, that on the basis of a single "good result" the recommendation to reduce the amount of sampling, i.e. not look for issues. The River Tees needs a precautionary approach to risk both because of its history and because of the unresolved environmental issues.

2.9 Section 3.3 Disposal volumes

With the variations in dredged volumes both over location and over time, was decided to look at the variation of the sample results in different areas within the dredge footprint.

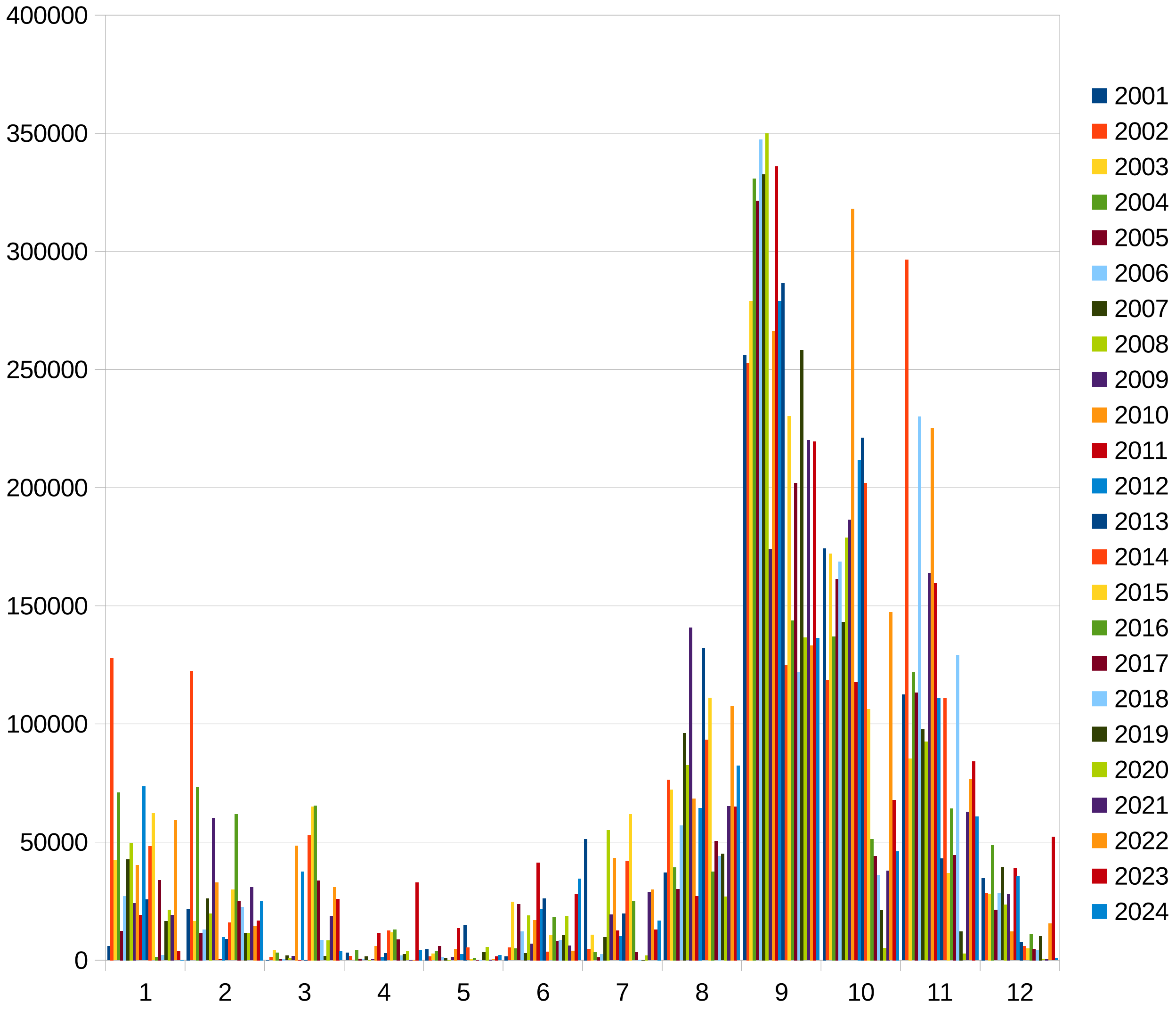


Figure 79: 2001-2024 Dredge volumes by chart (cubic metres)

As stated in the 2025 MDP Baseline Document most of the dredged material is removed from a few chart areas and this pattern has been generally true since 2001. However, as can be seen the total range across the 24 years in any chart area is considerable, as Figure 79 shows.

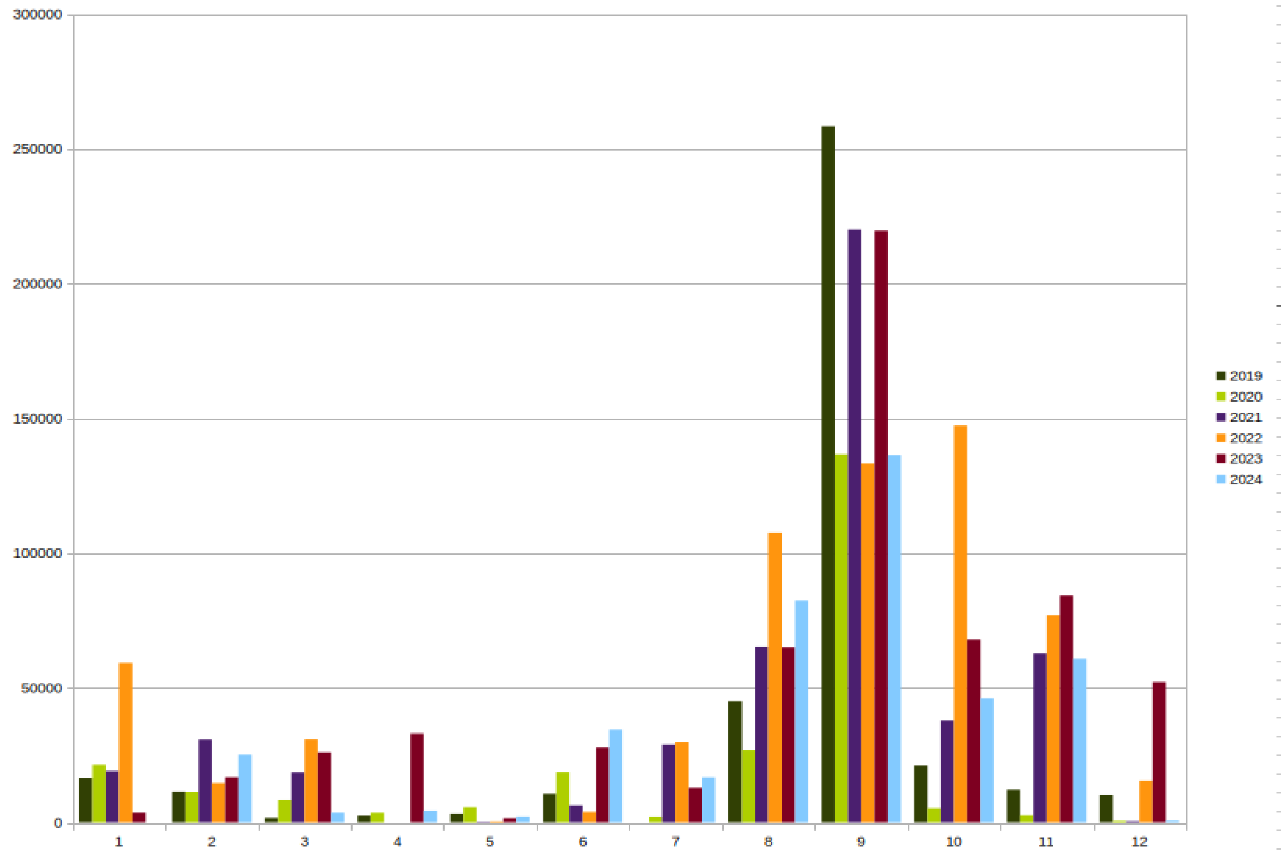


Figure 80: 2019-2024 Dredge volume by chart (cubic metres)

The last 5 years show a similar pattern, with extreme variations in the amount dredged, whereas chart area 9 the maximum is only double the minimum.

Taking the average dredged from each area over the past 10 years (2015-2024), accentuates the differences:

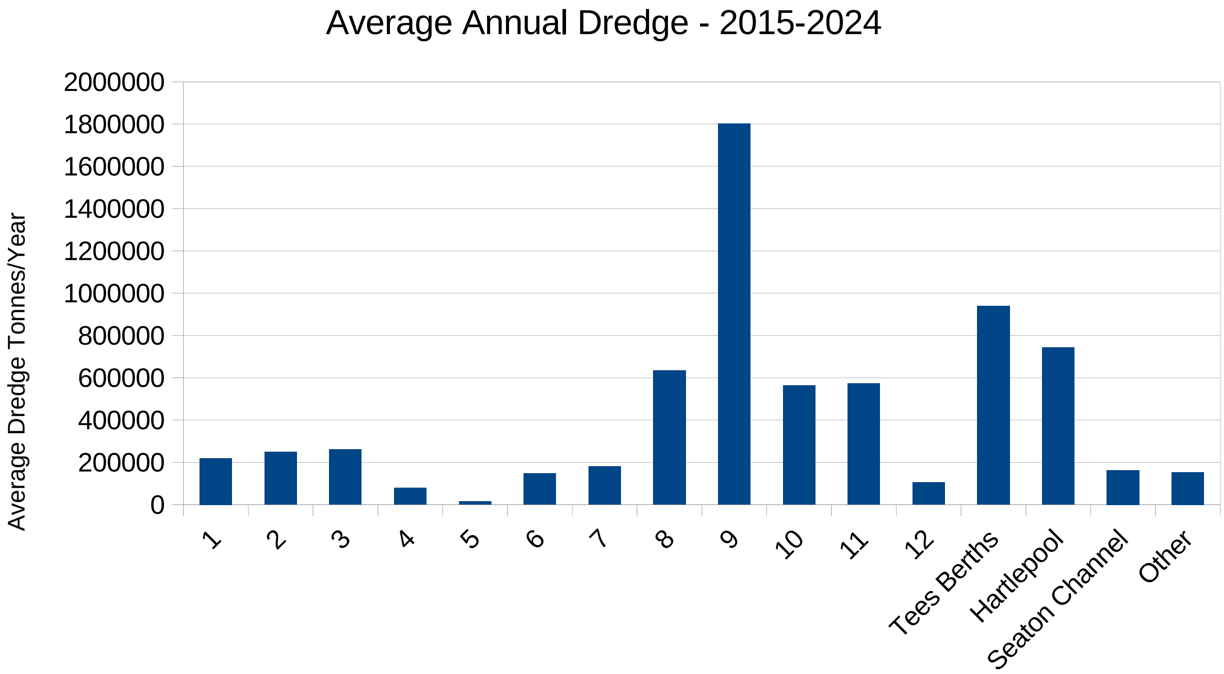


Figure 81: Average annual dredge per area 2015-2024

The average annual dredge in Chart area 9 is greater than the sum of Chart areas 1-7 and is greater than the sum of Chart areas 10-12 with Seaton Channel and Other.

NEMRG considers the number of samples taken each sample set insufficient to comply with the proper application of OSPAR guidelines[25], bearing in mind the geographical spread of the area being dredged, the amount of material being dredged, the non-uniformity across the area and the non-assessment of overspill.

Following the OSPAR guidelines[25] paragraph 5.3 and considering the amounts of material disposed of in the TSHD's hopper then each chart area should be considered separately given a total number of samples between 58 and 78 to capture the sediment quality issues of each char area:

Chart	Average Annual Cubic Metres	OSPAR Samples Minimum	OSPAR Samples Max
1	21970.6	3	3
2	24919.4	3	3
3	26210.2	4	6
4	7896.3	3	3
5	1462.9	3	3
6	14780.3	3	3
7	18064.2	3	3

8	63498.5	4	6
9	180189.8	7	15
10	56316.8	4	6
11	57423.7	4	6
12	10484	3	3
Tees Berths	93906.5	4	6
Hartlepool	74417.7	4	6
Seaton Channel	16303.8	3	3
Other	15387.7	3	3
Total No Samples		58	78

The OSPAR agreements 2014-06[25] and 2002-16[26] both explicitly stress the importance of creating a lower particle size sub-fraction to allow the concentration of contamination to be accounted for (main theme of this document), to NEMRG's knowledge this has never been done with samples in the Tees/Hartlepool maintenance dredged area. NEMRG would recommend that all the 58-78 OSPAR required samples should be fractioned in this way with chemical analysis being repeated for the small fraction samples following the OSPAR guidelines.

Alternatively and more pragmatically NEMRG would consider slightly fewer samples based on the level of material being overspilling, however this may not comply with the full OSPAR guidelines.

Chart	Average Annual Overpsill (20%?) Cubic Metres	OSPAR Samples Overspill Minimum	OSPAR Samples Overspill Max
1	4394.12	3	3
2	4983.88	3	3
3	5242.04	3	3
4	1579.26	3	3
5	292.58	3	3
6	2956.06	3	3
7	3612.84	3	3
8	12699.7	3	3
9	36037.96	4	6
10	11263.36	3	3
11	11484.74	3	3
12	2096.8	3	3
Tees Berths	18781.3	3	3
Hartlepool	14883.54	3	3
Seaton Channel	3260.76	3	3
Other	3077.54	3	3
OSPAR Requirement		49	51

3 Contamination by Chart Area

The sample set have been extensively studied by date of sampling across the river. In order to attempt to better understand variations over time in different areas, analysis of localised areas is carried out.

This analysis focuses on relative surface area to highlight composition differences between samples and PAH contamination levels as PAHs have been measured in all the datasets.

3.1 Chart 1 and 2 – average dredge 46,890 tonnes per year

Samples from the most upstream chart areas sampled are expected to consist of mainly silt / clay, so little variation in composition should be seen over.

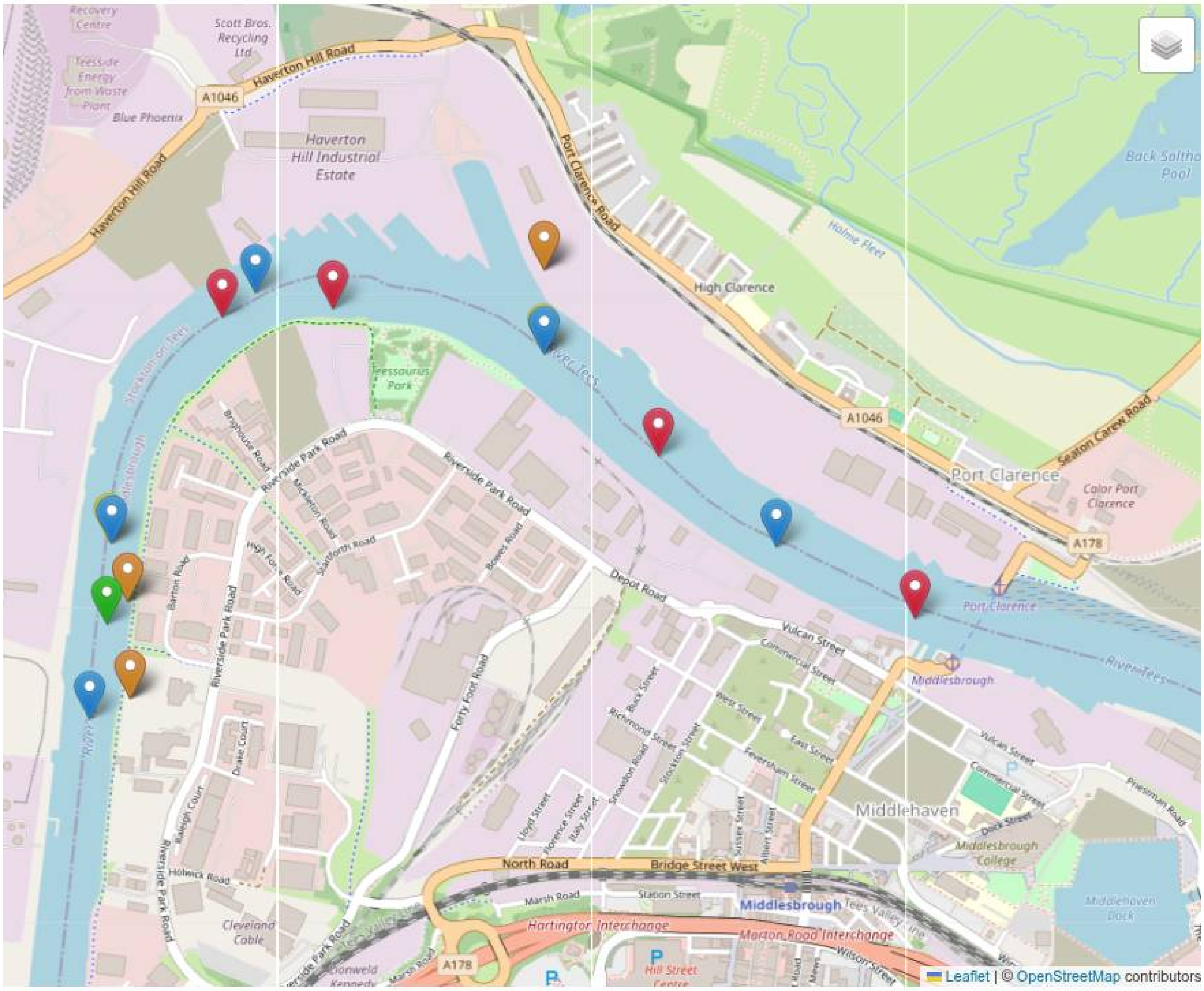


Illustration 10: Chart 1 and 2 - Sampling locations

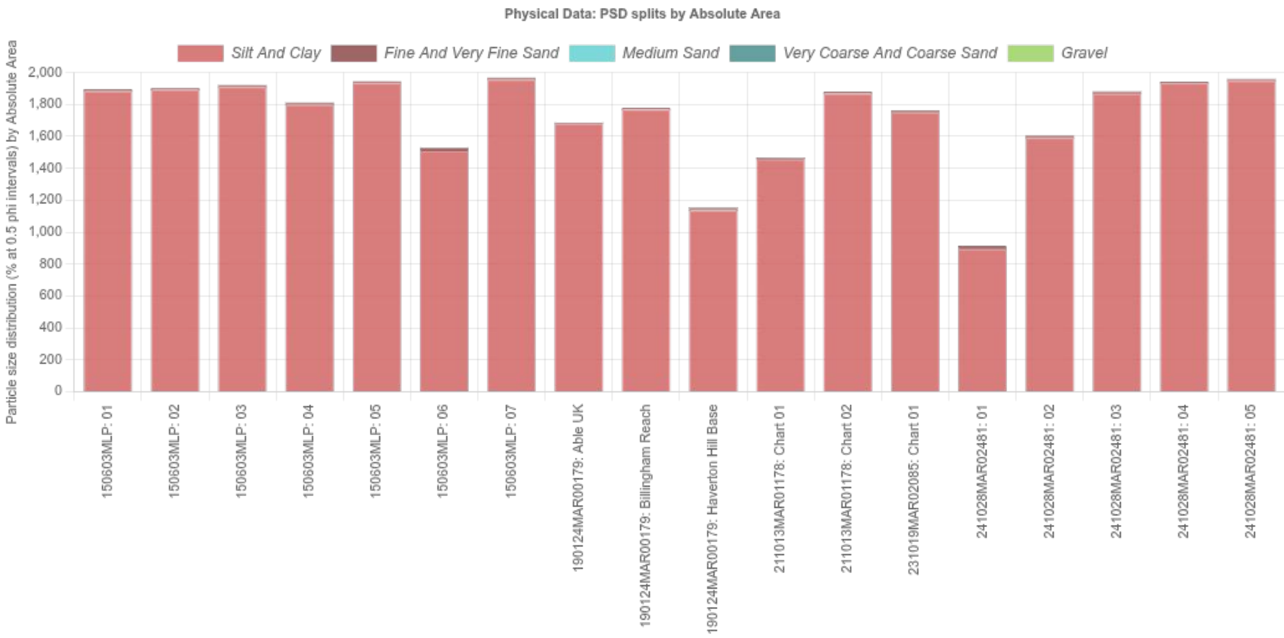


Figure 82: Chart 1 and 2 - Sample relative surface areas – ordered date / longitude

Ordering the samples by date then longitude in Figures 82 and 83 shows both variation in particle composition and contamination over time, with a contamination in 2024 being marginally below that in 2015.

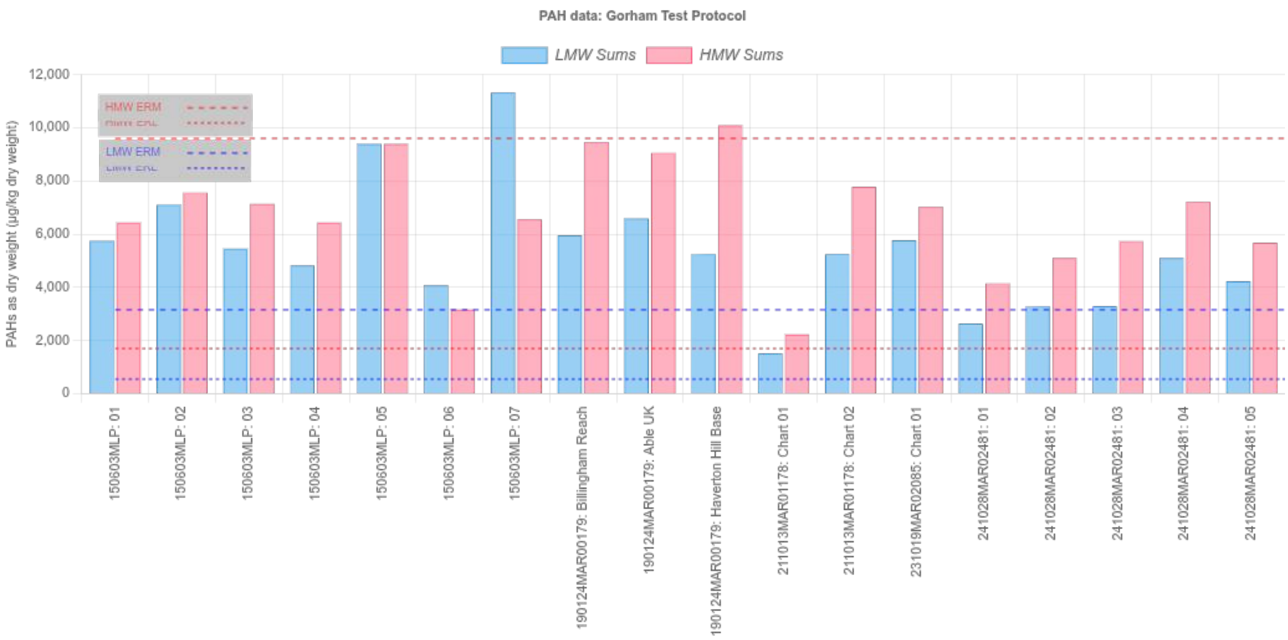


Figure 83: Chart 1 and 2 - PAHs Gorham Test protocol – ordered date / longitude

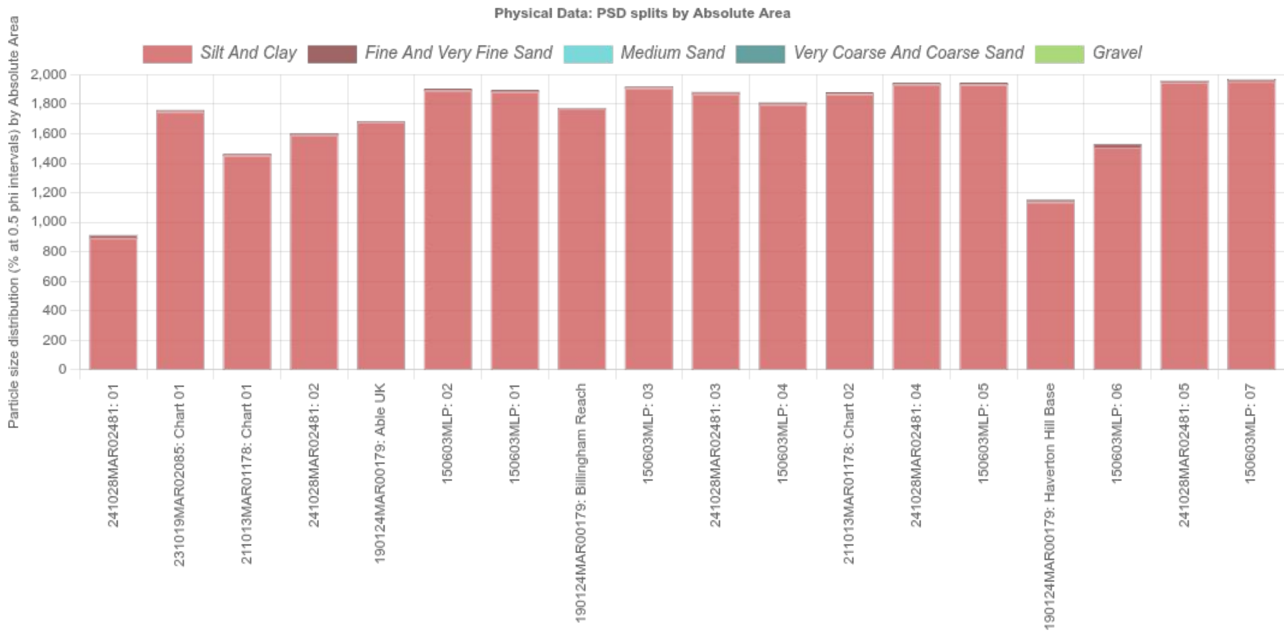


Figure 84: Chart 1 and 2 - Sample relative surface areas – longitude

Ordering the samples by longitude, so going downstream left to right in Figures 84 and 85 does not show the trend that might have been expected, going for higher contamination upstream to lower levels downstream.

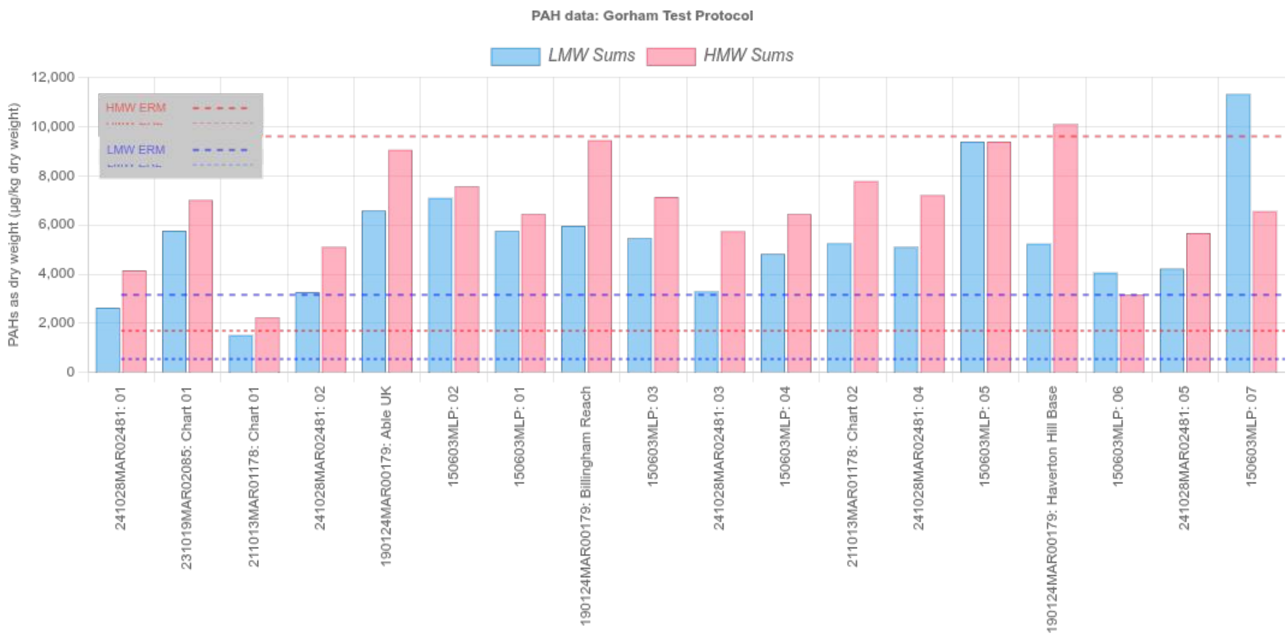


Figure 85: Chart 1 and 2 - PAHs Gorham Test protocol – longitude

3.2 Chart 3 and 4 – average dredge 34,107 tonnes per year

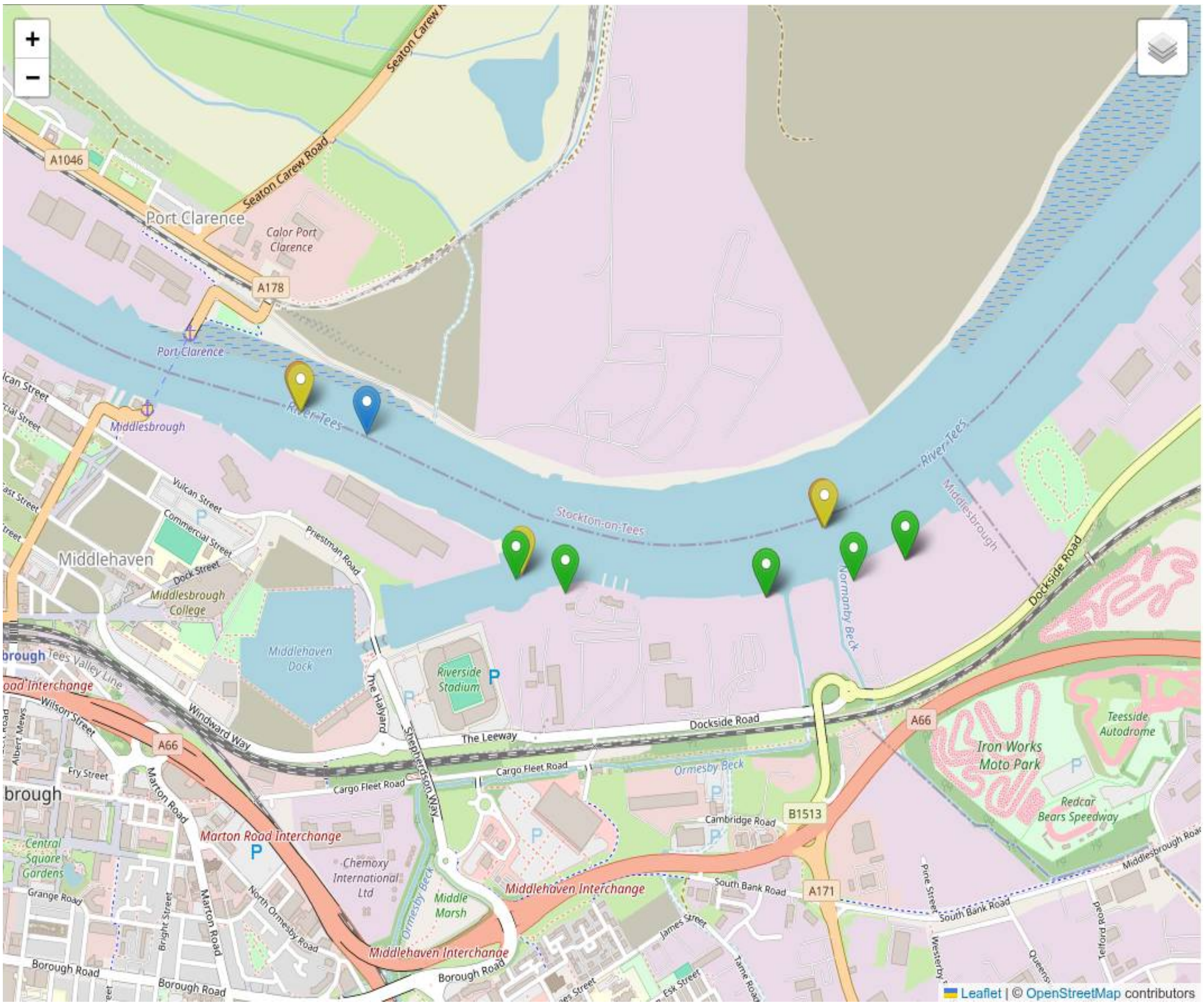


Illustration 11: Chart 3 and 4 - Sampling locations

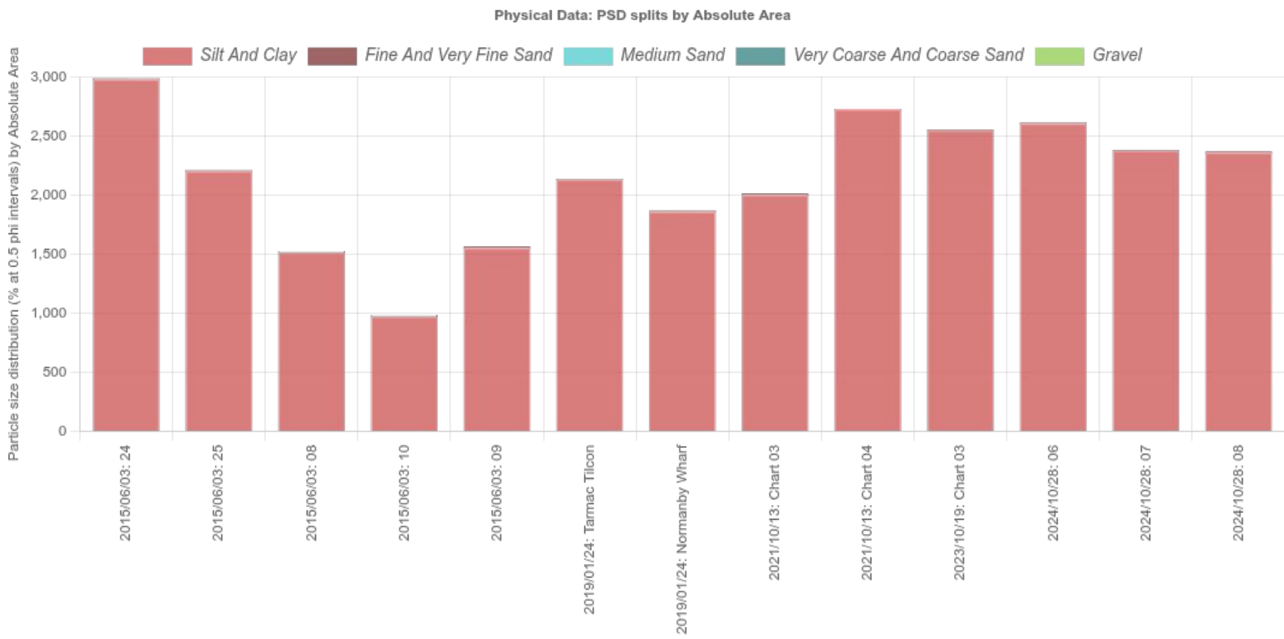


Figure 86: Chart 3 and 4 - Sample relative surface areas – ordered date / longitude

The results from 2024 show less contamination than in 2015 and 2019.

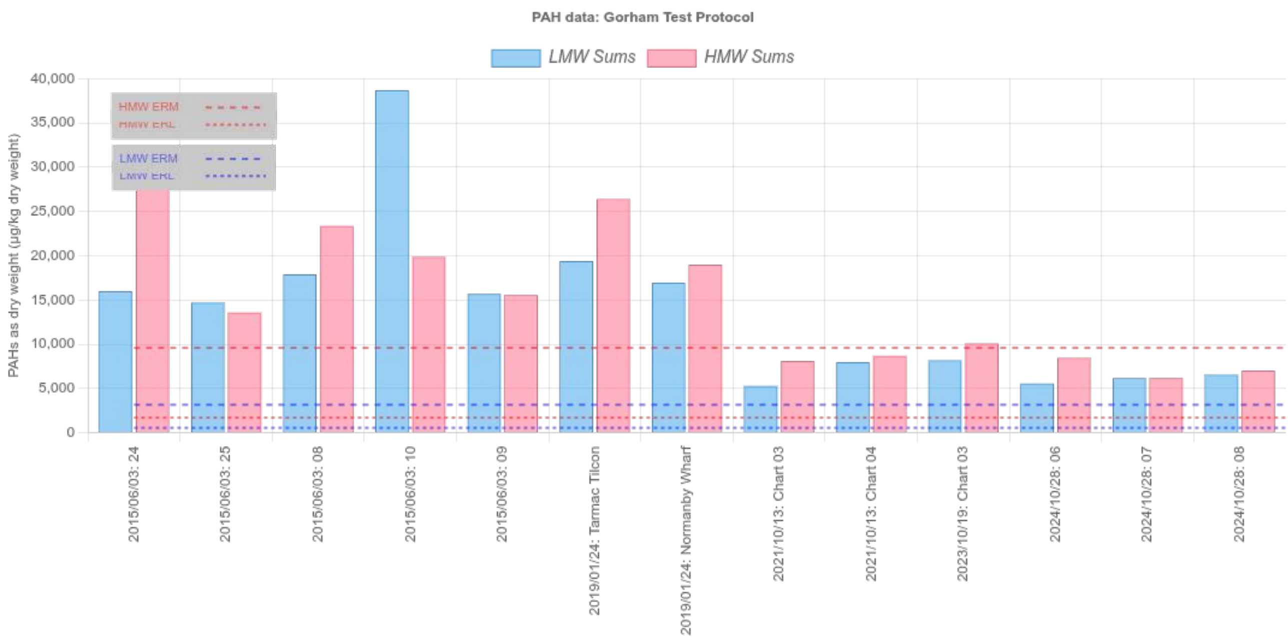


Figure 87: Chart 3 and 4 - PAHs Gorham Test protocol – ordered date / longitude

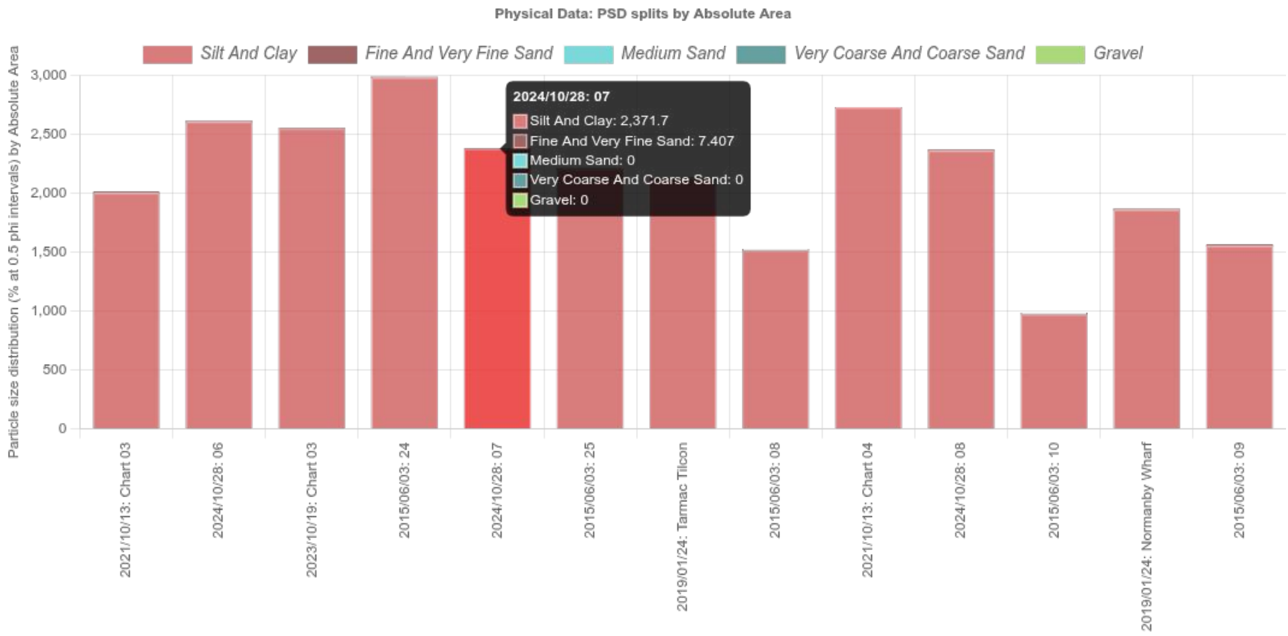


Figure 88: Chart 3 and 4 - Sample relative surface areas – ordered longitude

Too few samples to identify any areas which are more contaminated than any other.

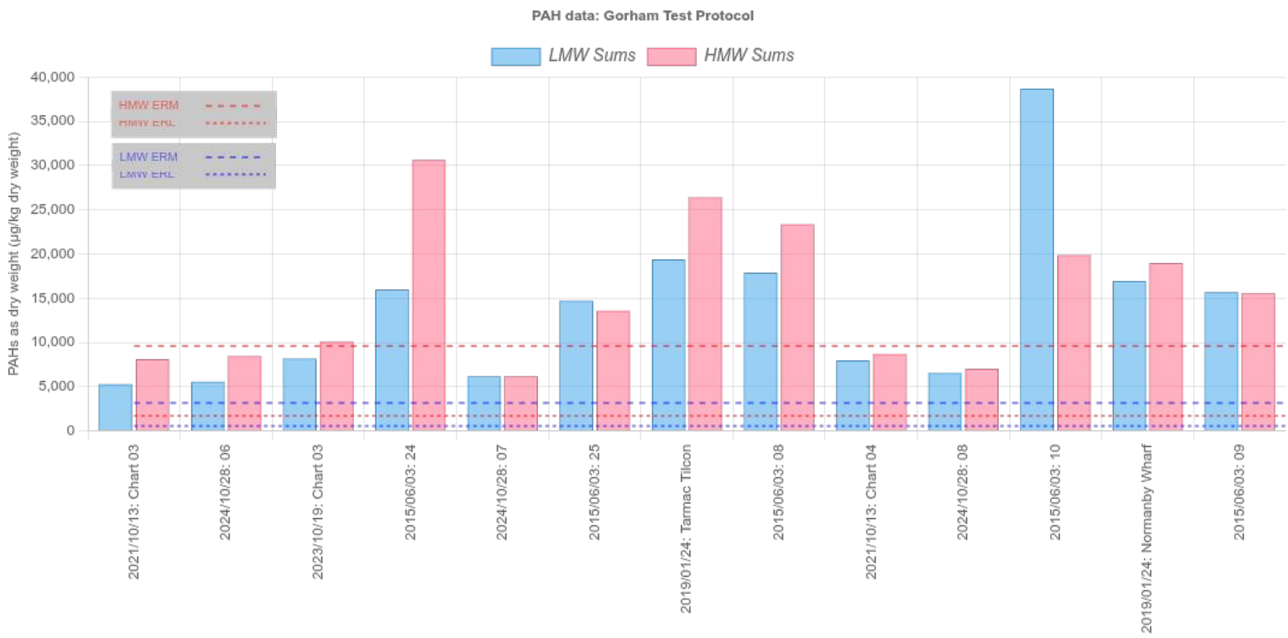


Figure 89: Chart 3 and 4 - PAHs Gorham Test protocol – ordered longitude

3.3 Chart 5 and 6 – average dredge 16,243 tonnes per year

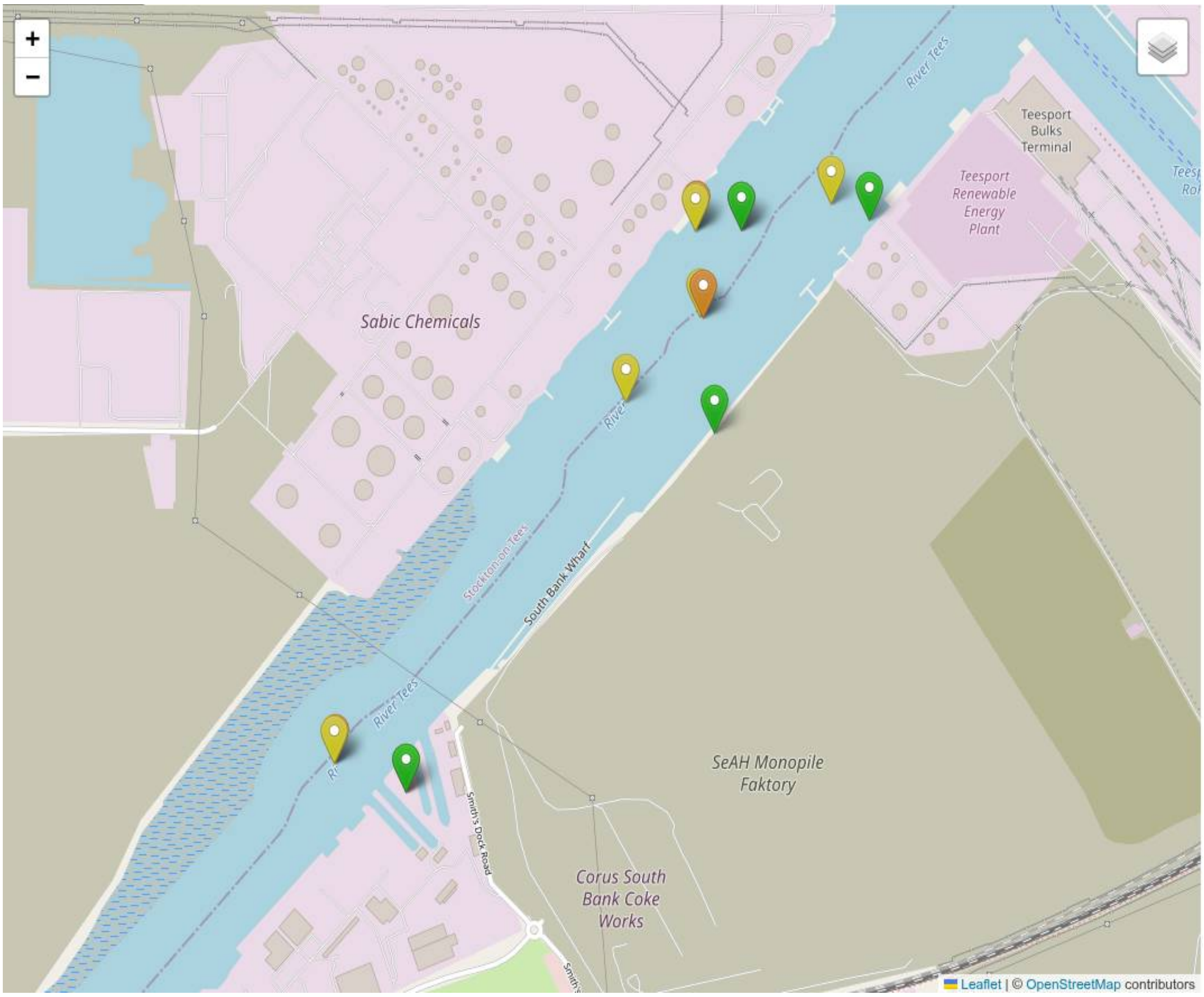


Illustration 12: Chart 5 and 6 - Sampling locations

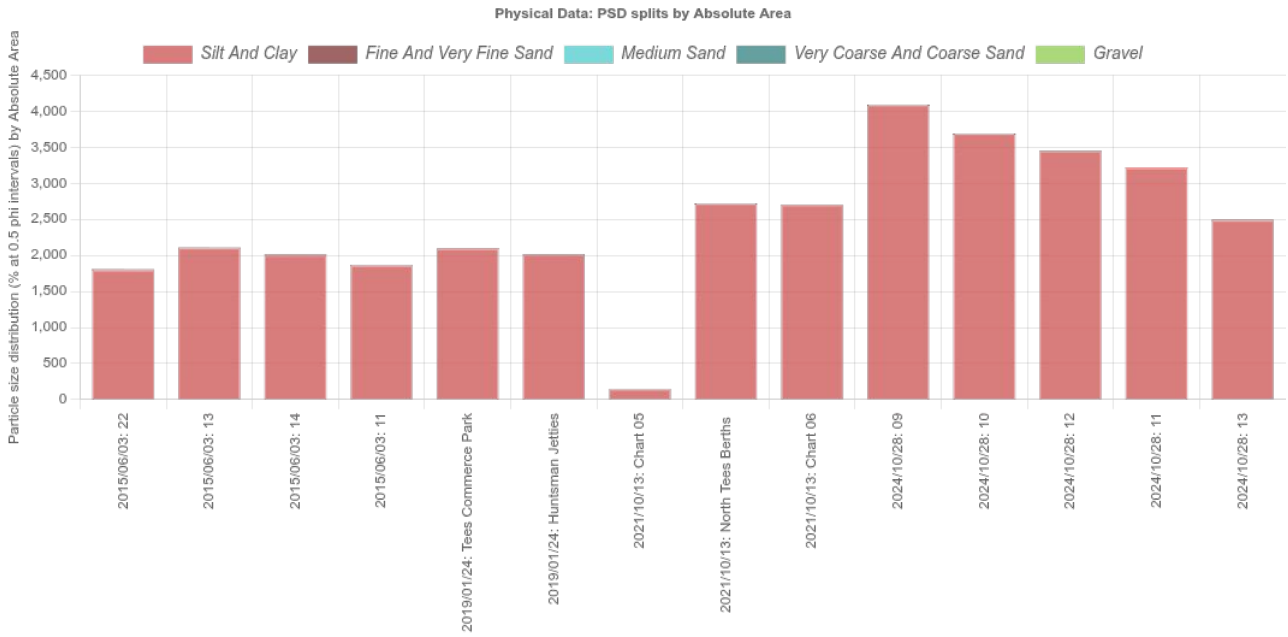


Figure 90: Chart 5 and 6 - Sample relative surface areas – ordered date / longitude

Two samples taken in 2015 were considerably more contaminated than 2024, in 2015 the South Bank coke ovens were still operational and this could have been an input of hydrocarbons.

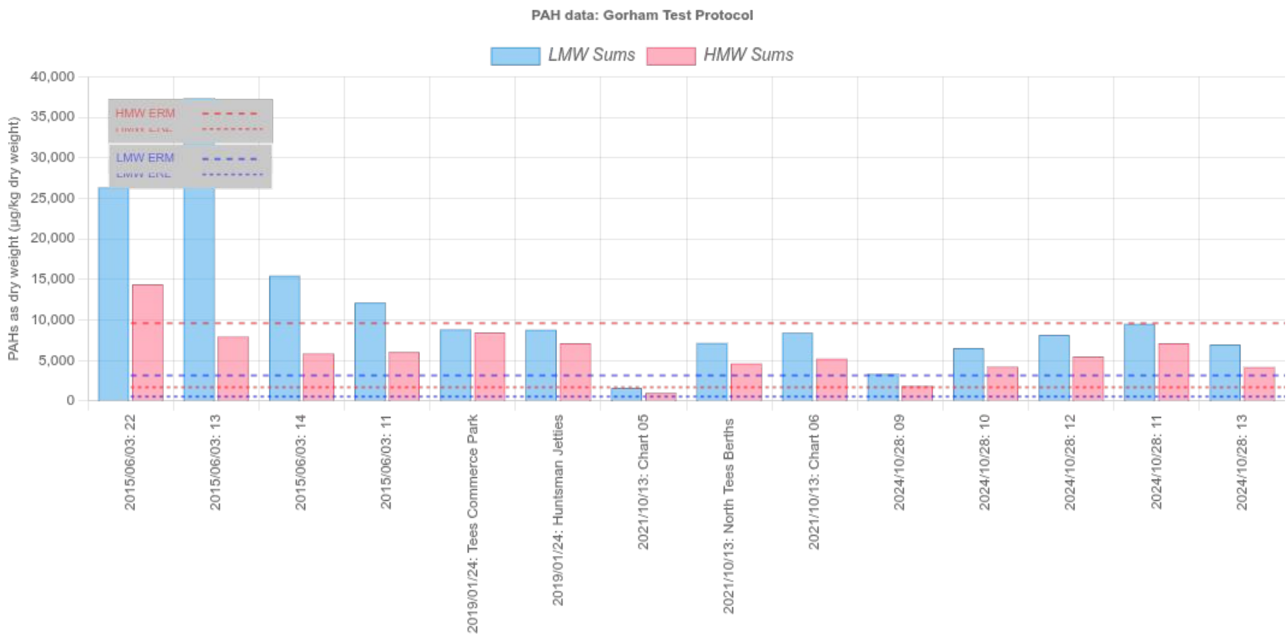


Figure 91: Chart 5 and 6 - PAHs Gorham Test protocol – ordered date / longitude

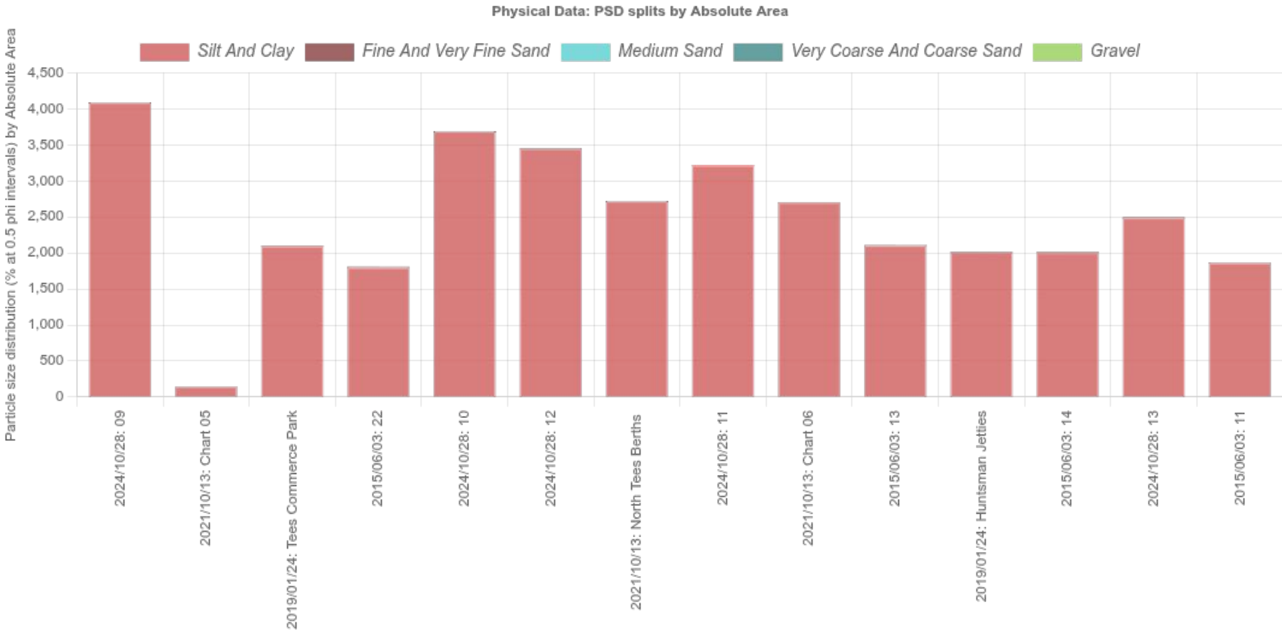


Figure 92: Chart 5 and 6 - Sample relative surface areas – longitude

Once again no evidence of locations of higher contamination over the 10years of sampling.

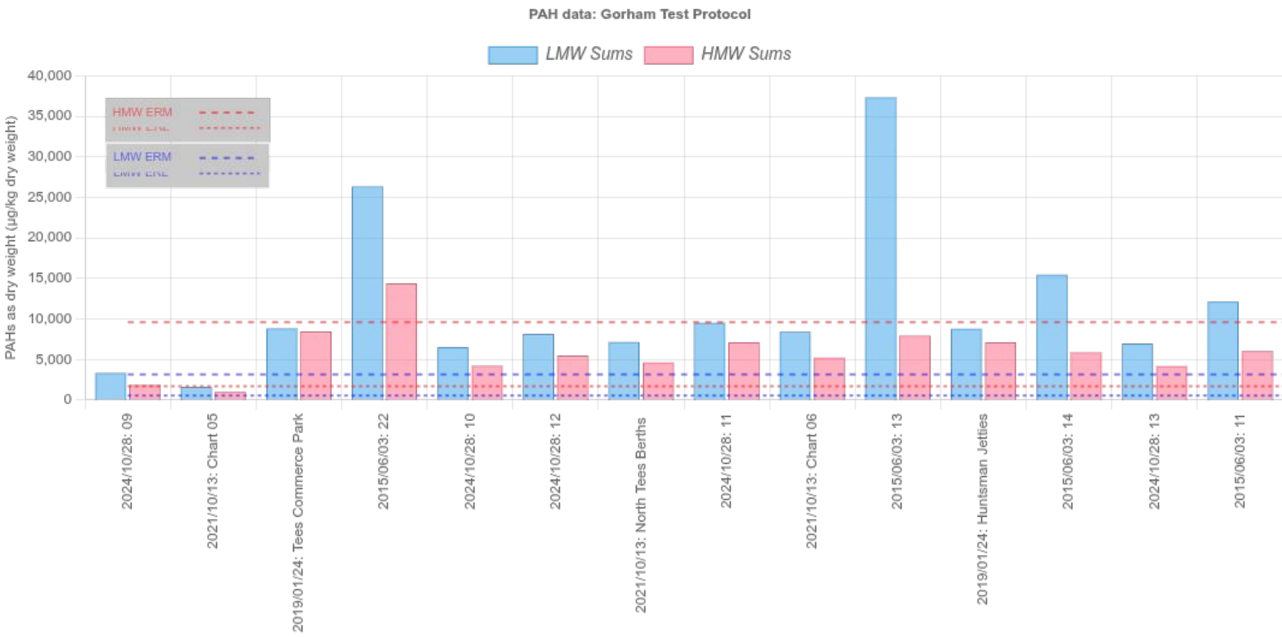


Figure 93: Chart 5 and 6 - PAHs Gorham Test protocol – ordered longitude

3.4 Chart 7 and 8 – average dredge 175,469 tonnes per year

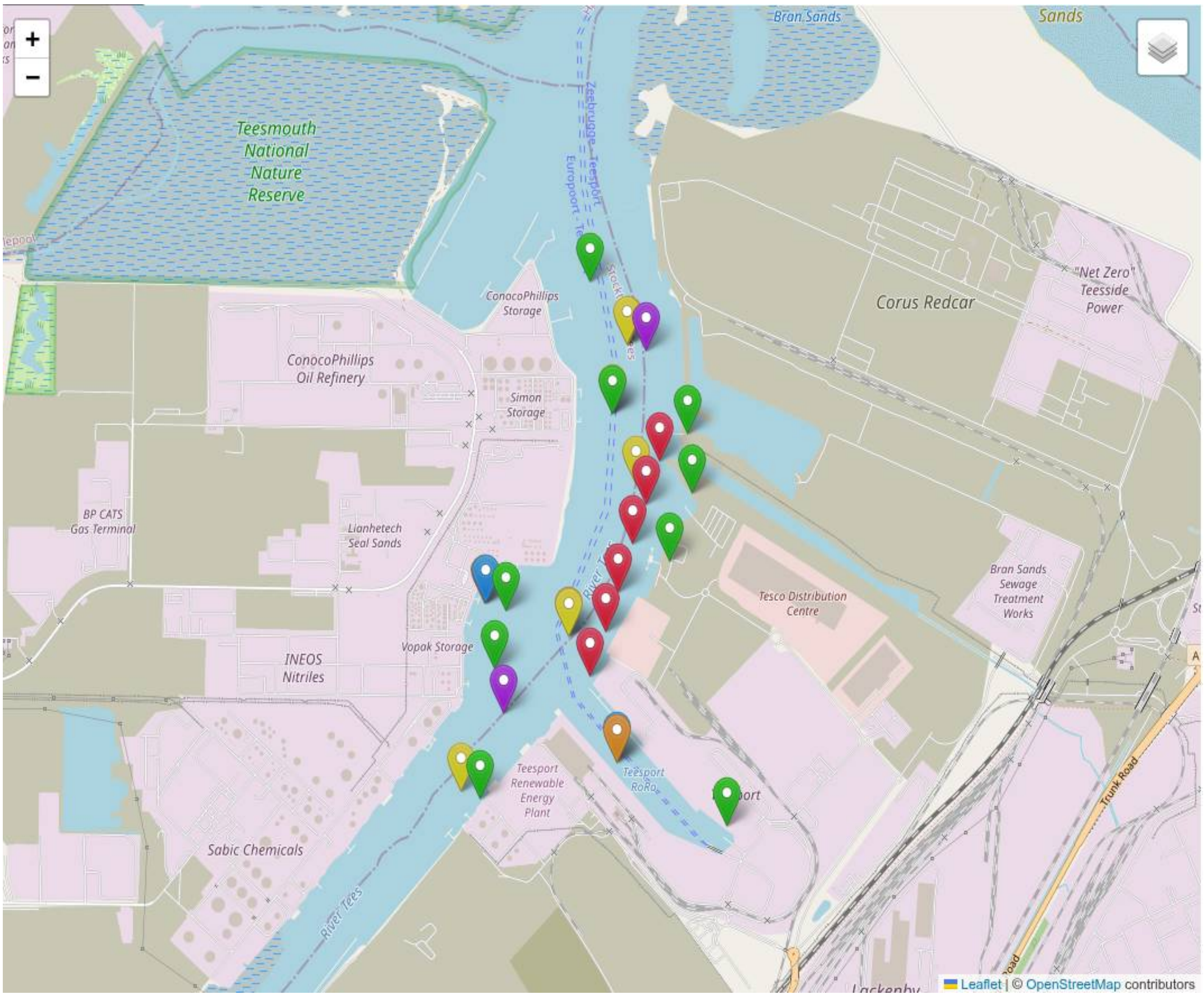


Illustration 13: Chart 7 and 8 - Sampling locations

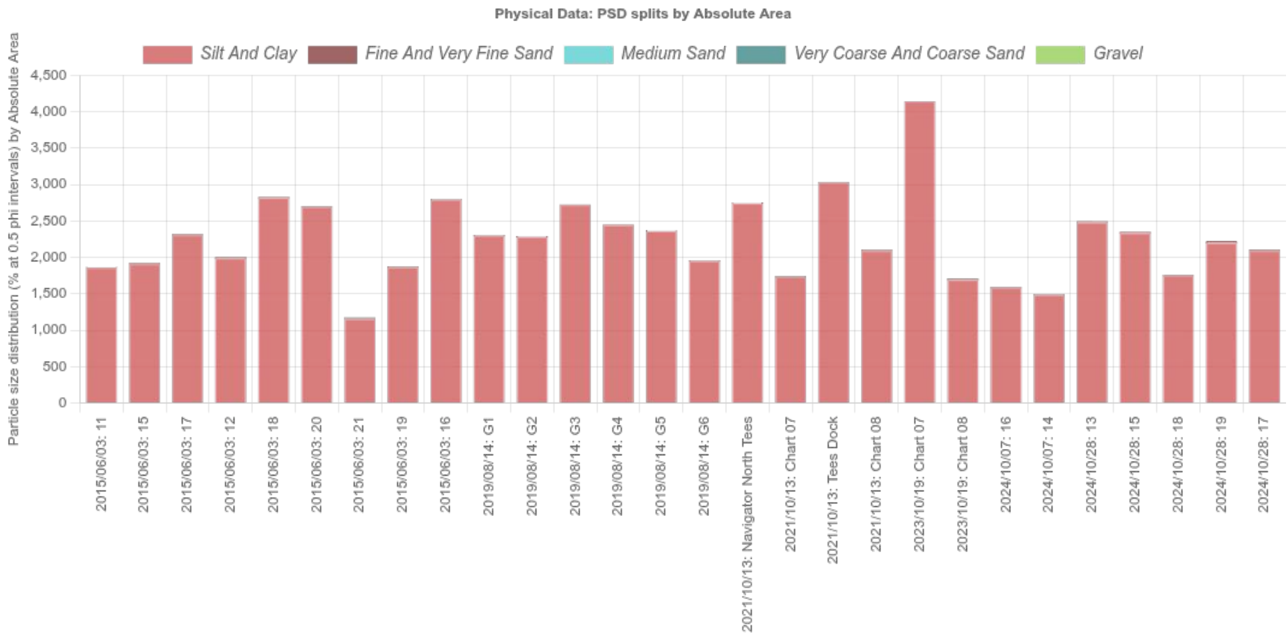


Figure 94: Chart 7 and 8 - Sample relative surface areas – ordered date / longitude

Sample cleaner than in 2015, but still considerable PAH present being above ERL for HMW PAHs and ERM for all the LMW PAHs.

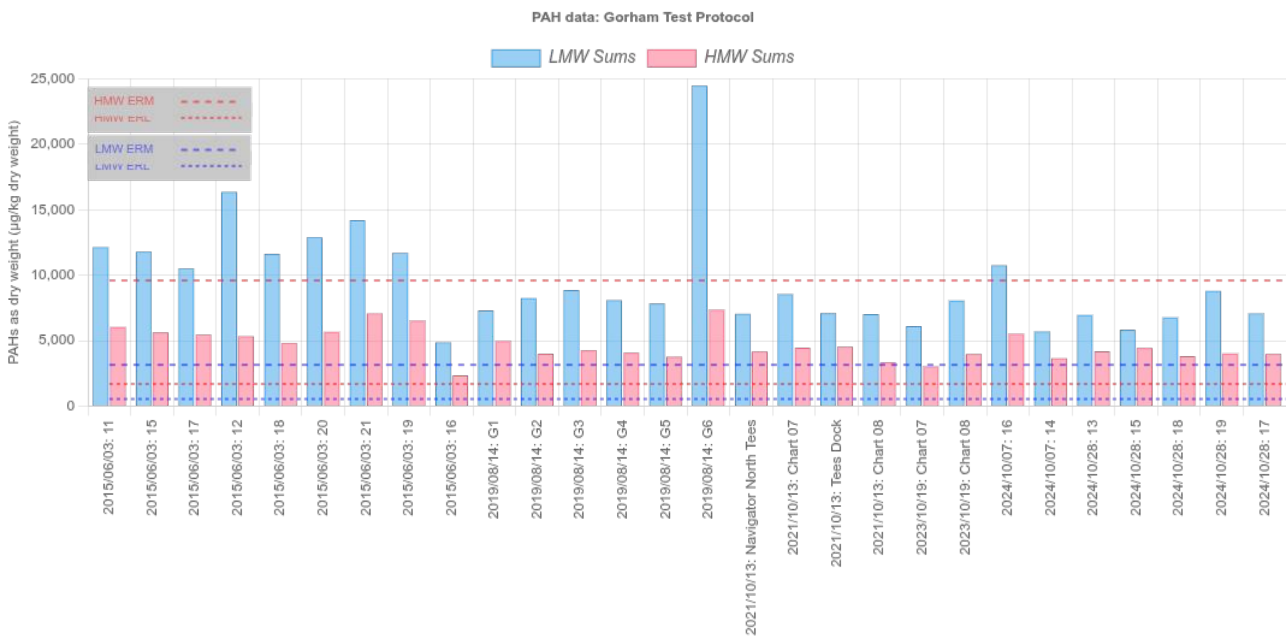


Figure 95: Chart 7 and 8 - PAHs Gorham Test protocol – ordered date / longitude

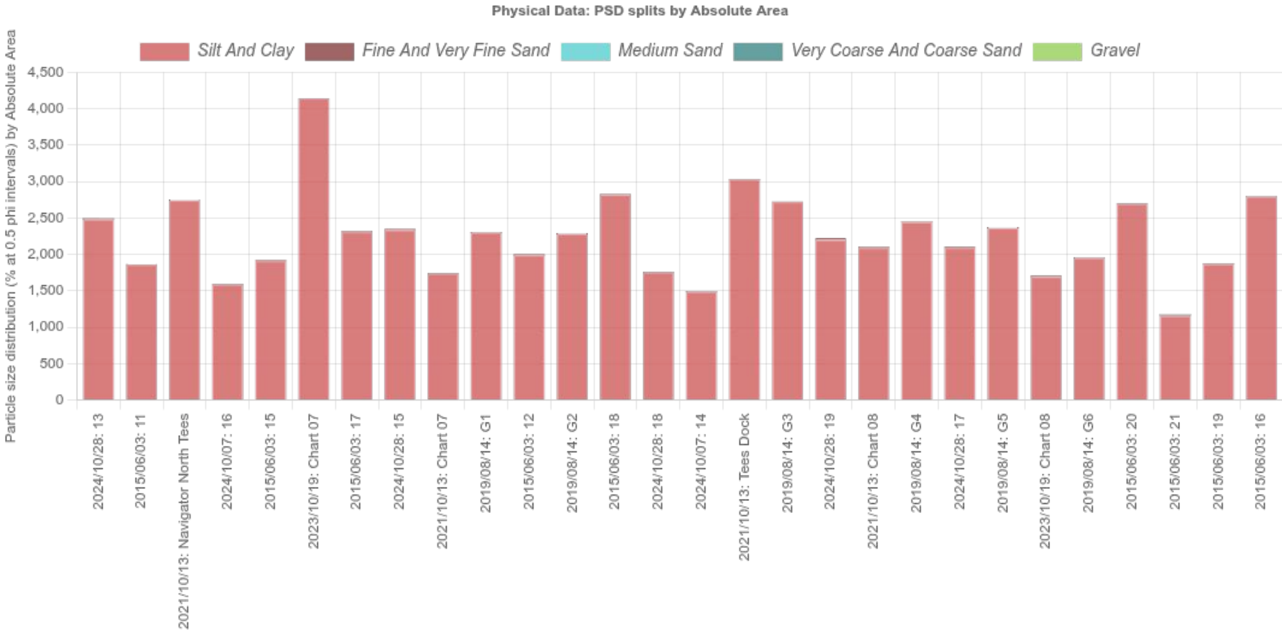


Figure 96: Chart 7 and 8 - Sample relative surface areas – ordered longitude

No location variation visible.

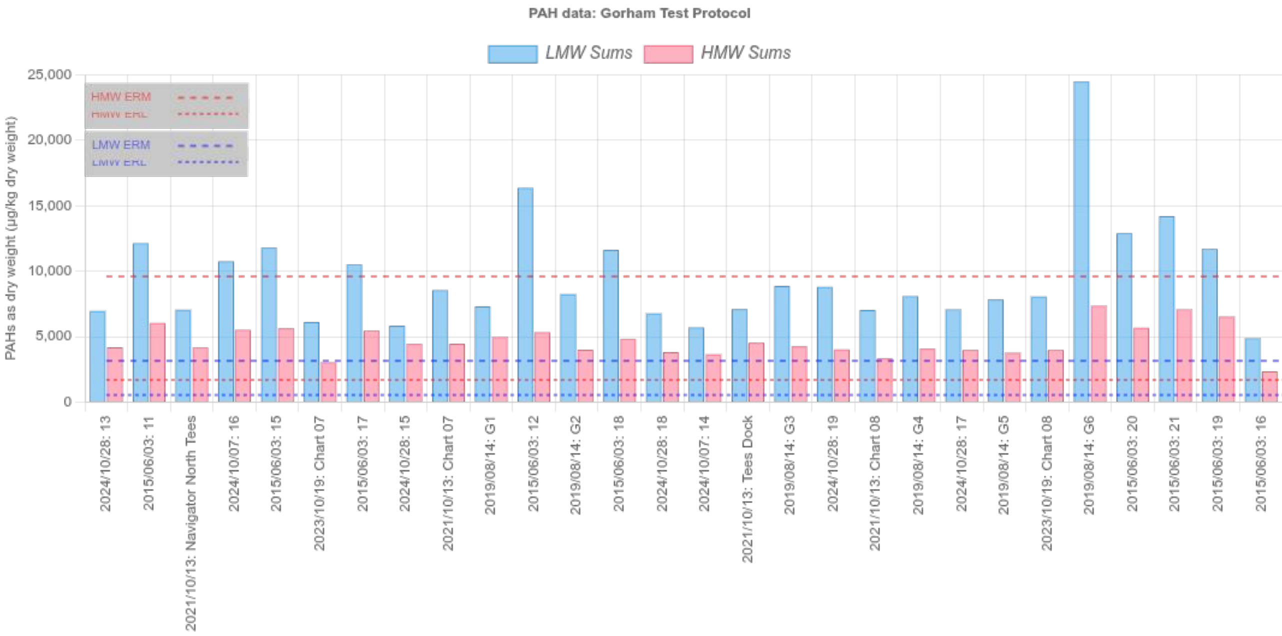


Figure 97: Chart 7 and 8 - PAHs Gorham Test protocol – ordered longitude

3.5 Chart 9 and 10 – average dredge 310,924 tonnes per year

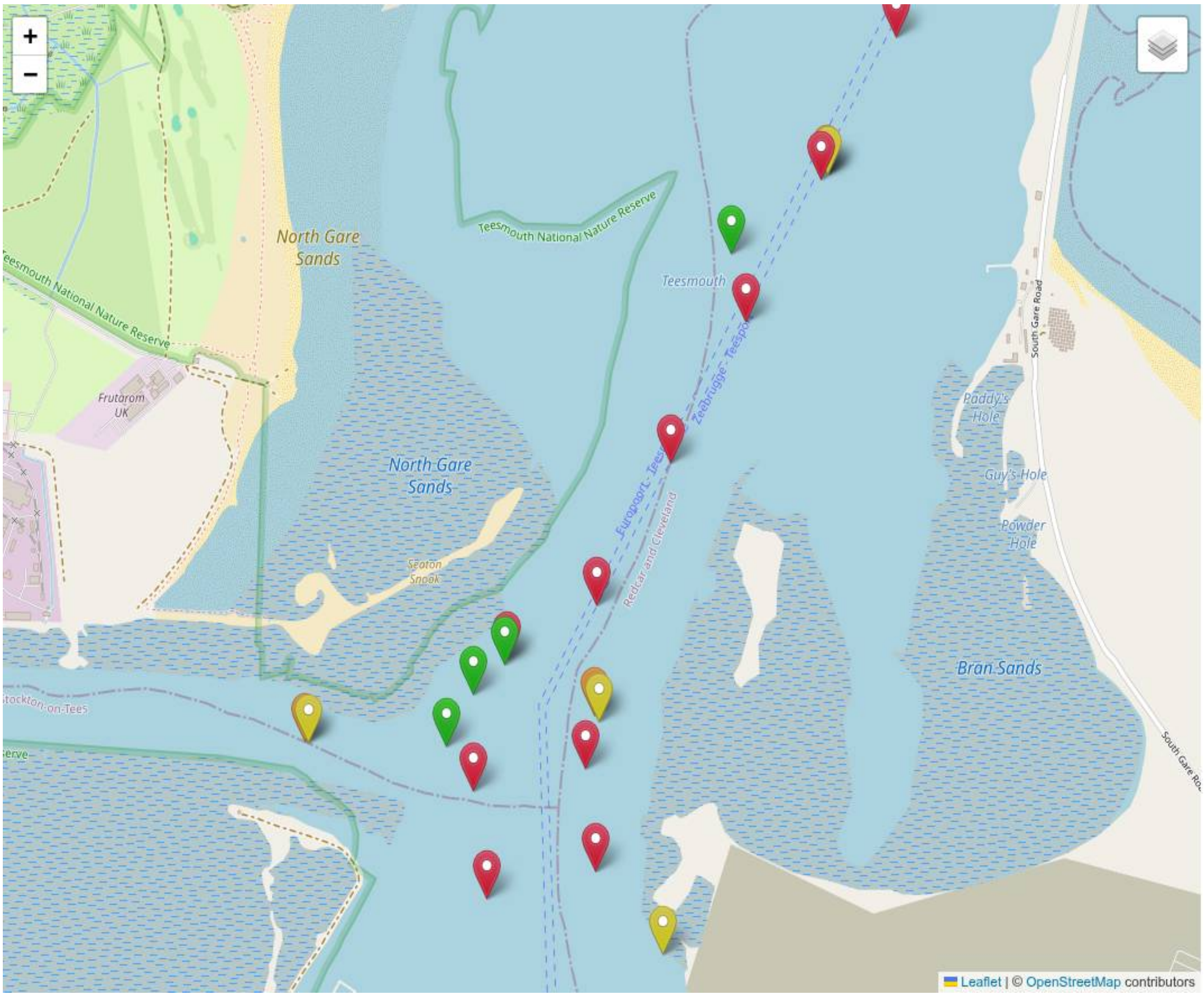


Illustration 14: Chart 9 and 10 - Sampling locations

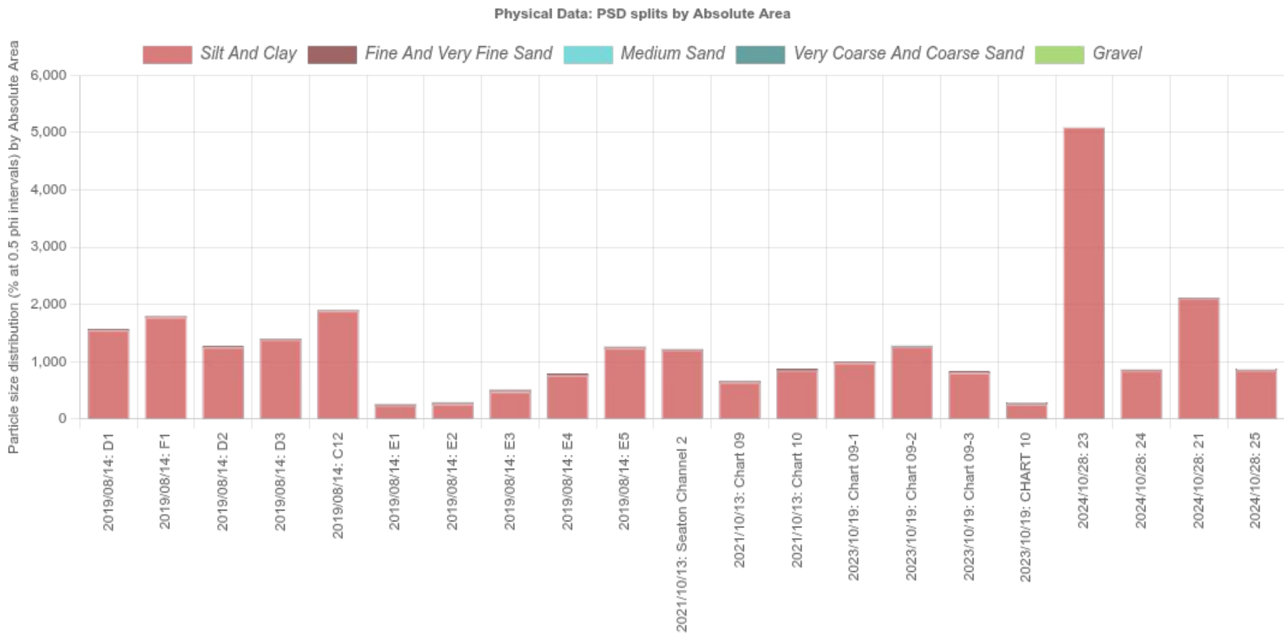


Figure 98: Chart 9 and 10 - Sample relative surface areas – ordered date / longitude

There is limited time evolution data for this area as no samples were taken here in 2015, which is concerning as in 2019 the area shows considerable contamination. Considerable variation is seen in sample composition over time and despite position at the mouth of the river there is only a slight decrease in LMW PAHs, but a decrease in HMW PAHs, however levels are now higher than in 2021 and 2023.

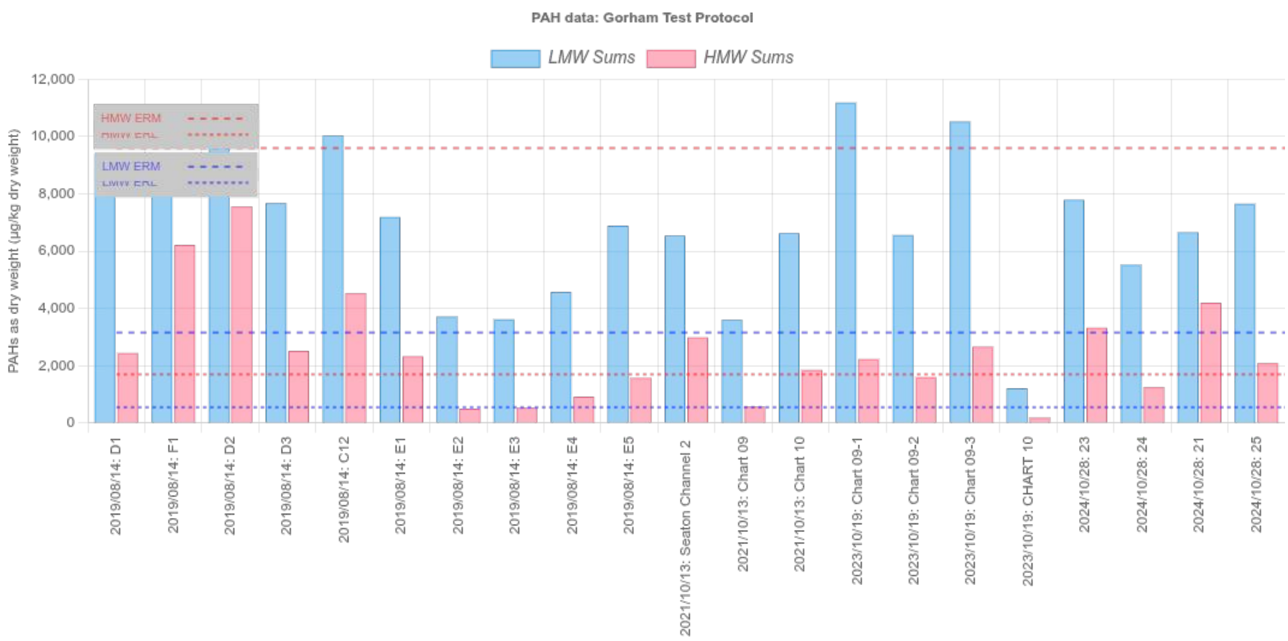


Figure 99: Chart 9 and 10 - PAHs Gorham Test protocol – ordered date / longitude

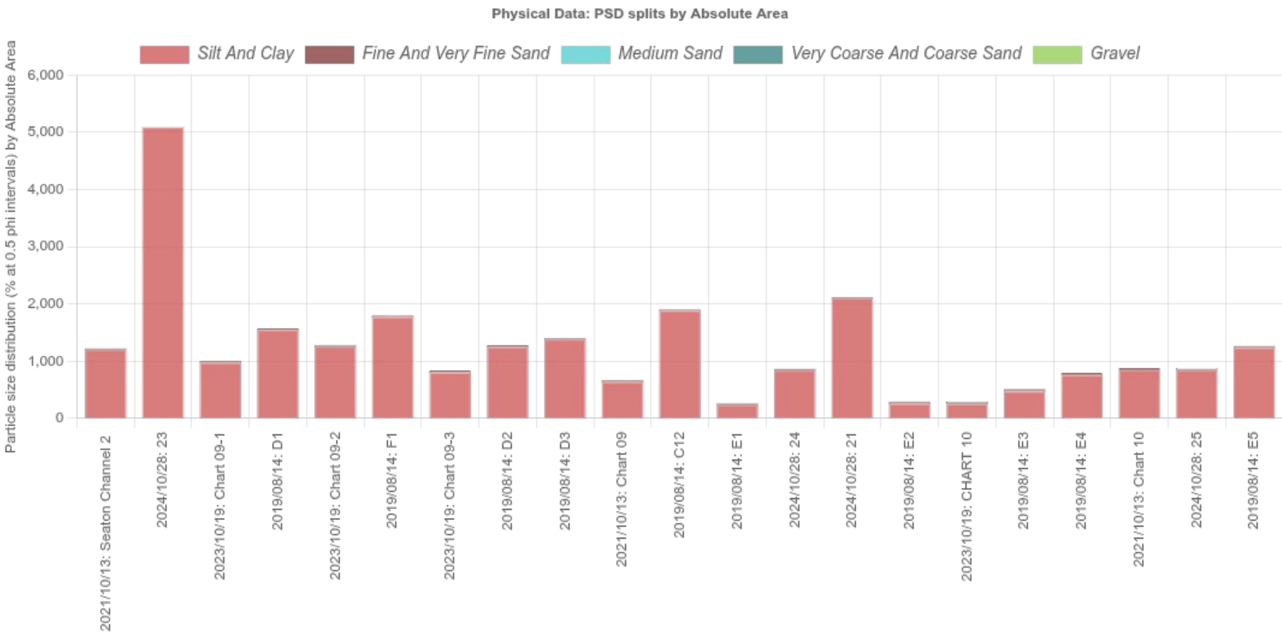


Figure 100: Chart 9 and 10 - Sample relative surface areas – ordered longitude

Slight indication that the sediment further downstream is slightly less contaminated.

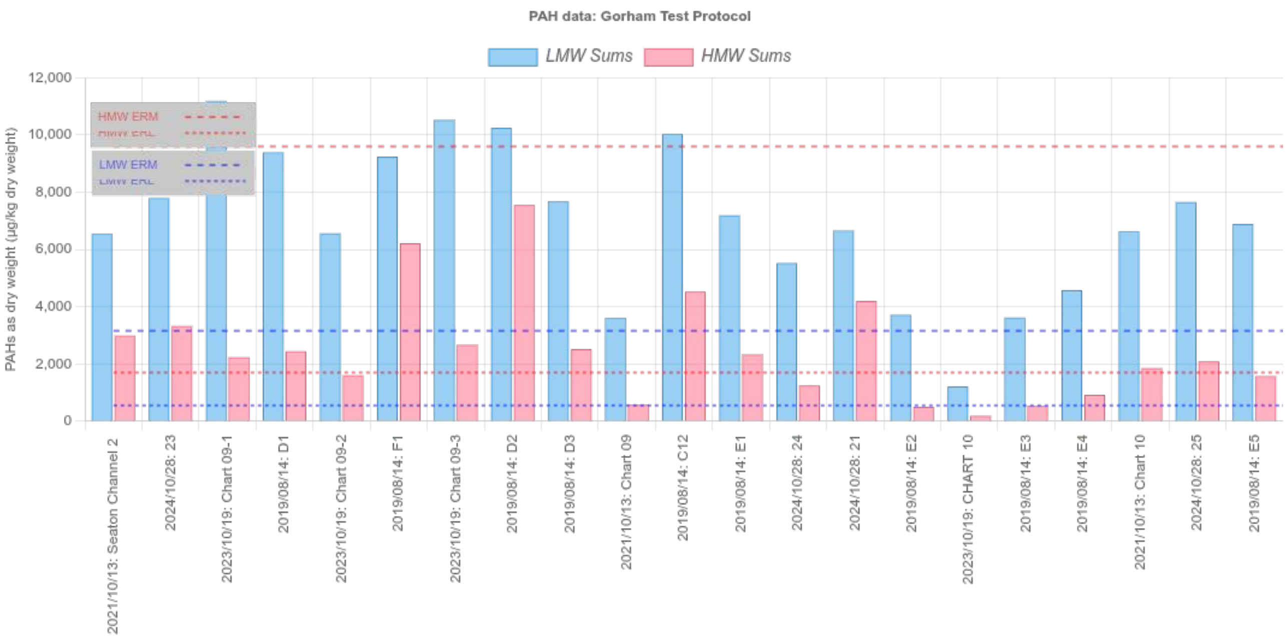


Figure 101: Chart 9 and 10 - PAHs Gorham Test protocol – ordered longitude

3.6 Chart 11 and 12 – average dredge 67,908 tonnes per year

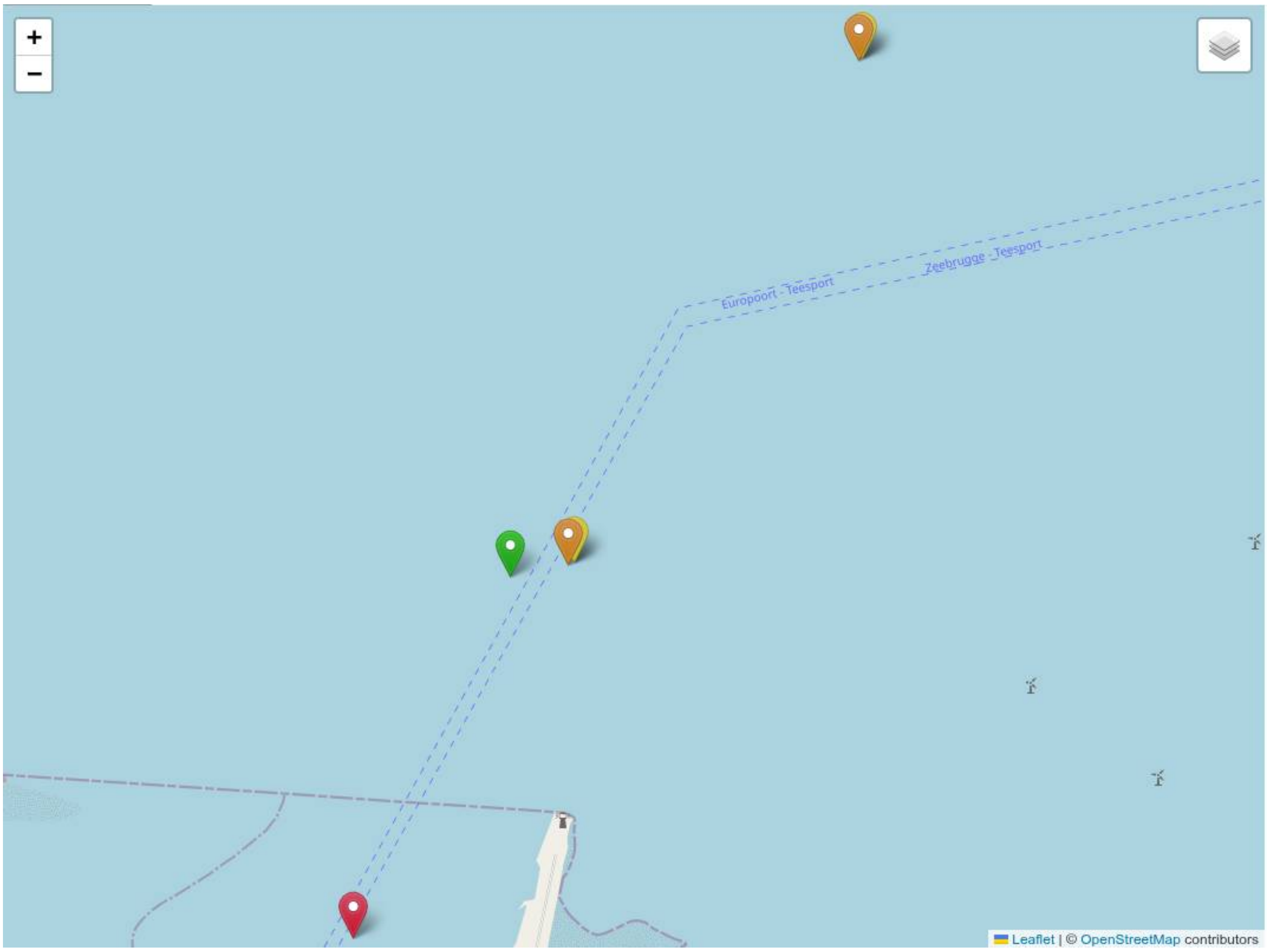


Illustration 15: Chart 11 and 12 – Sampling locations

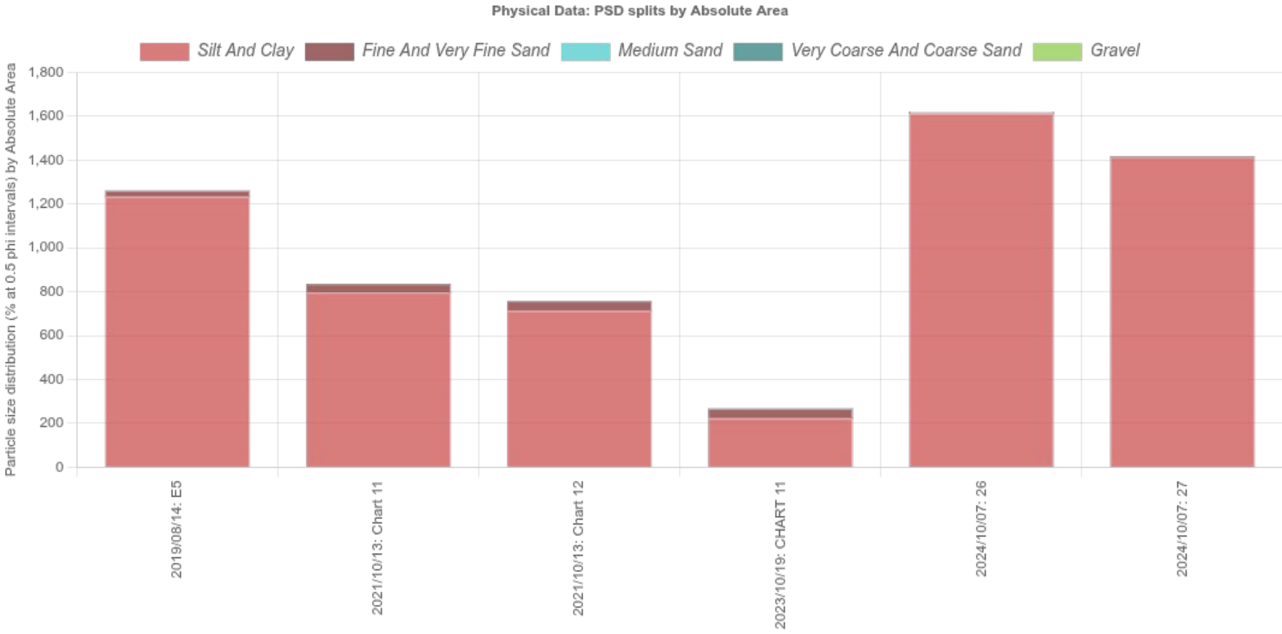


Figure 102: Chart 11 and 12 - Sample relative surface areas – ordered date / longitude

Very few samples here both spatial and in time.

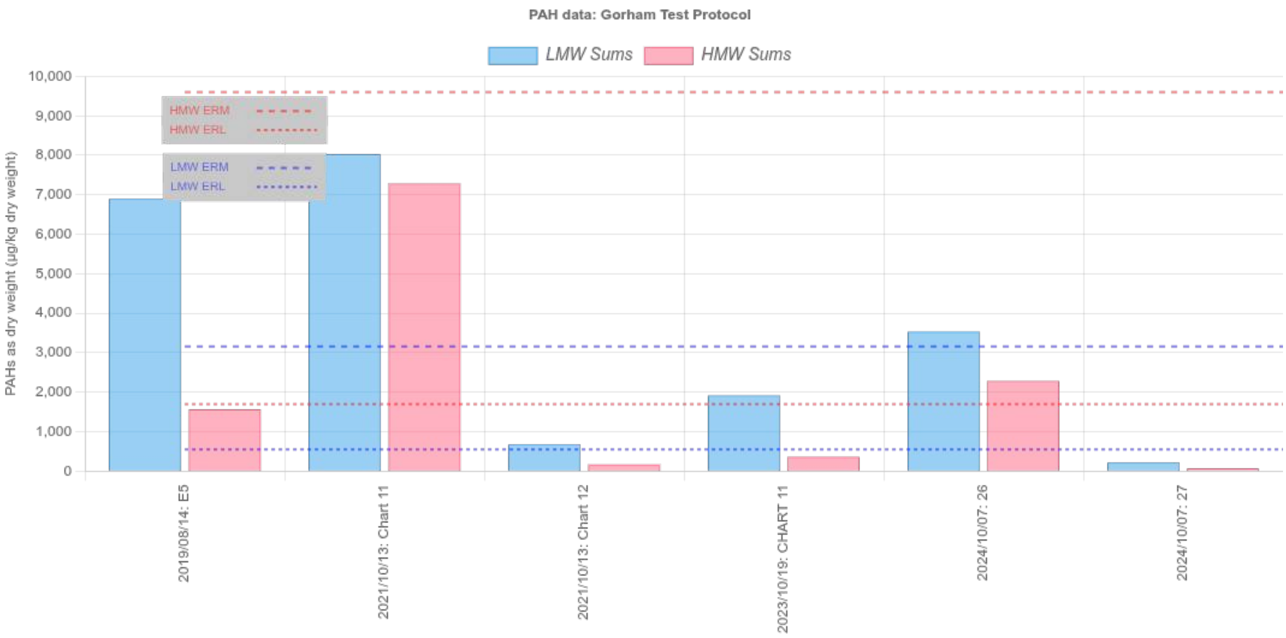


Figure 103: Chart 11 and 12 - PAHs Gorham Test protocol – ordered date / longitude

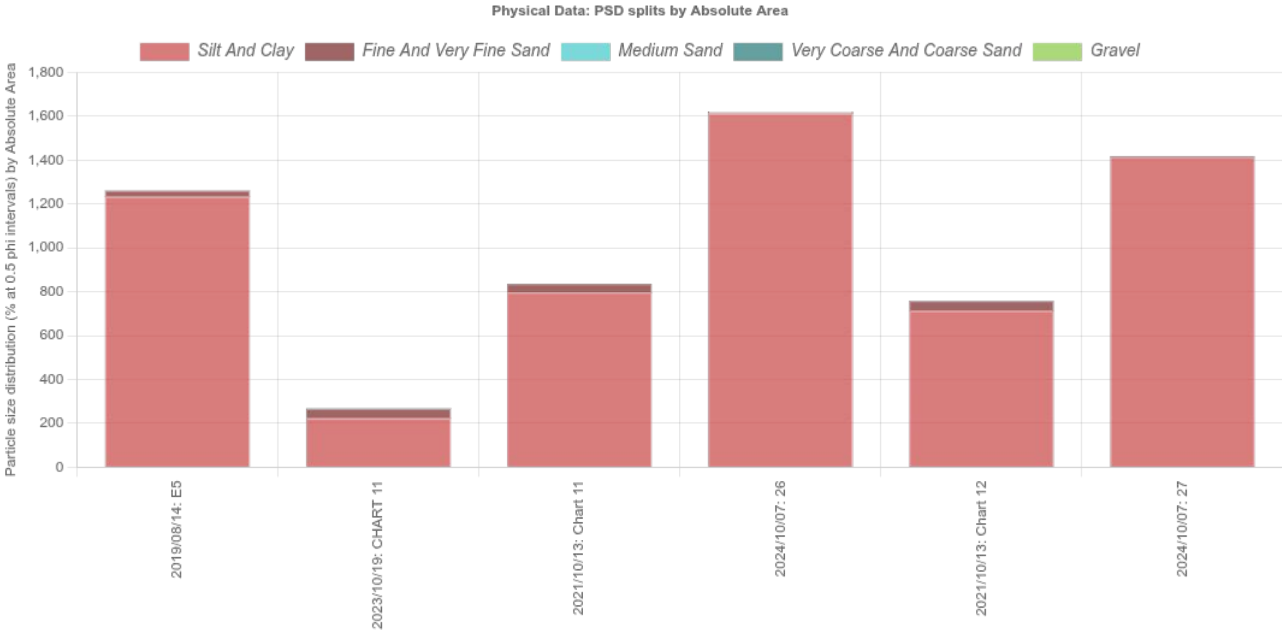


Figure 104: Chart 11 and 12 - Sample relative surface areas – ordered longitude

The most contaminated sample from this areas was sampled in 2021 just after the UKD Orca had finished dredging this area. These samples are effectively at sea, so should be composed of clean sand, however this indicates that there is a source of contamination and that it is not clean sand which is being dredged.

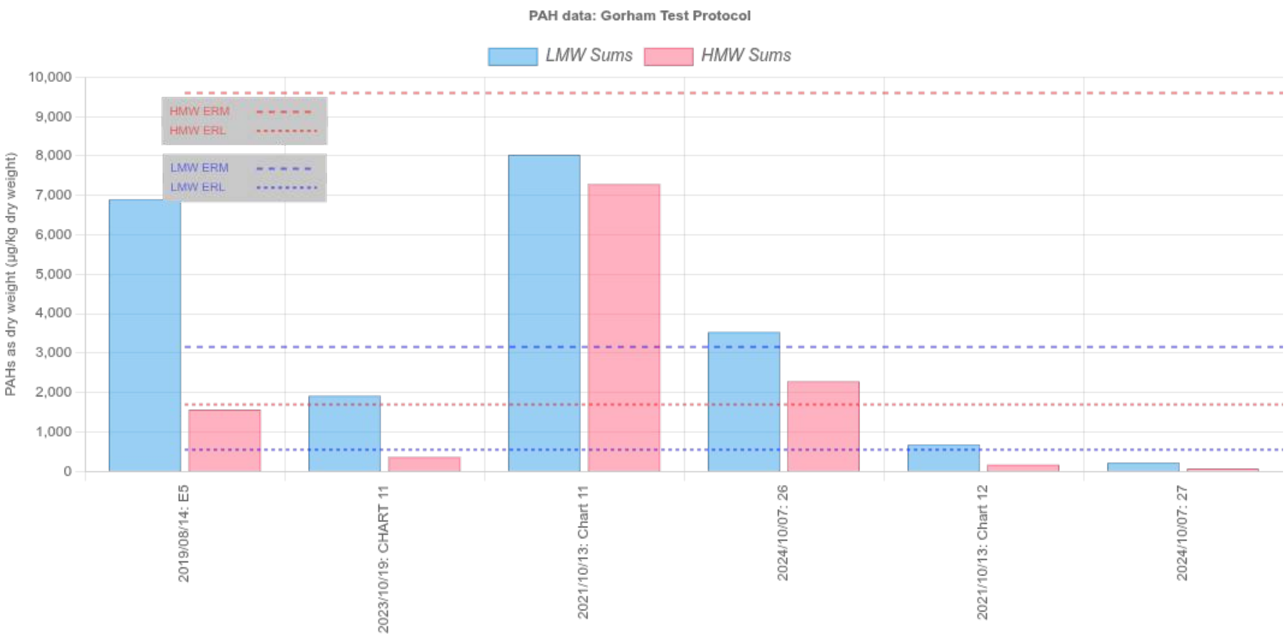


Figure 105: Chart 11 and 12 - PAHs Gorham Test protocol – ordered longitude

3.7 Hartlepool

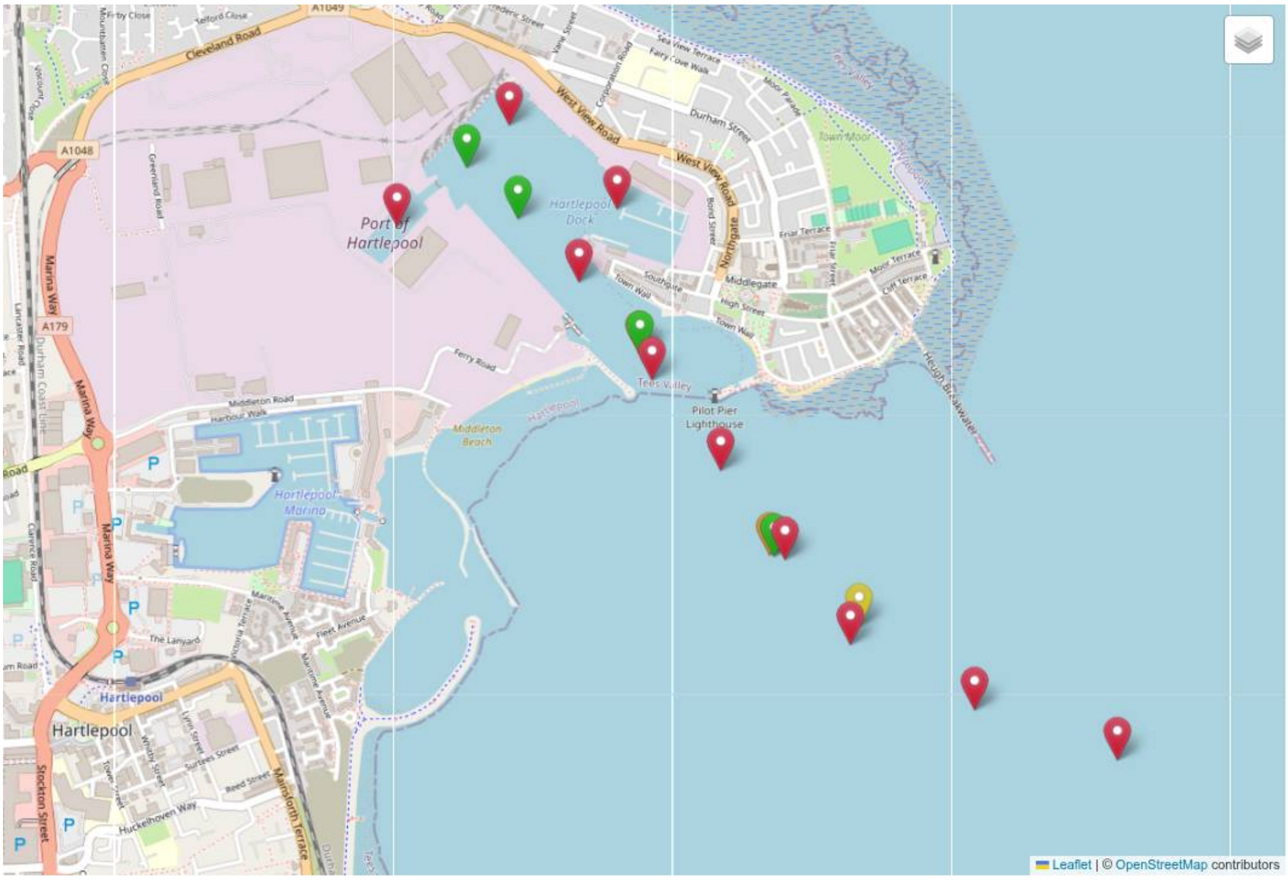


Illustration 16: Hartlepool - Sample locations

The sample compositions show considerable variation, which could be concerning as the samples with the lowest level of contamination are the ones with the lowest surface area. The concern is that as the sediment is highly mobile and only a fraction of the range of particle sizes is being sampled then contamination will be under detected.

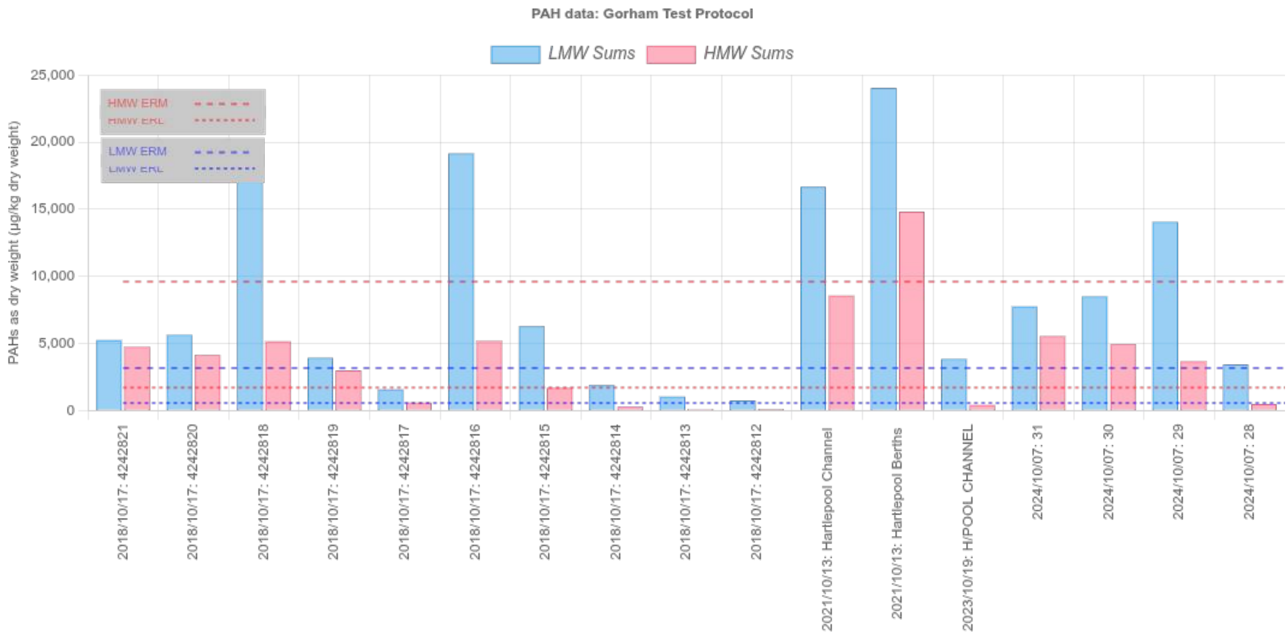


Figure 106: Hartlepool - PAHs Gorham Test protocol – ordered date / longitude

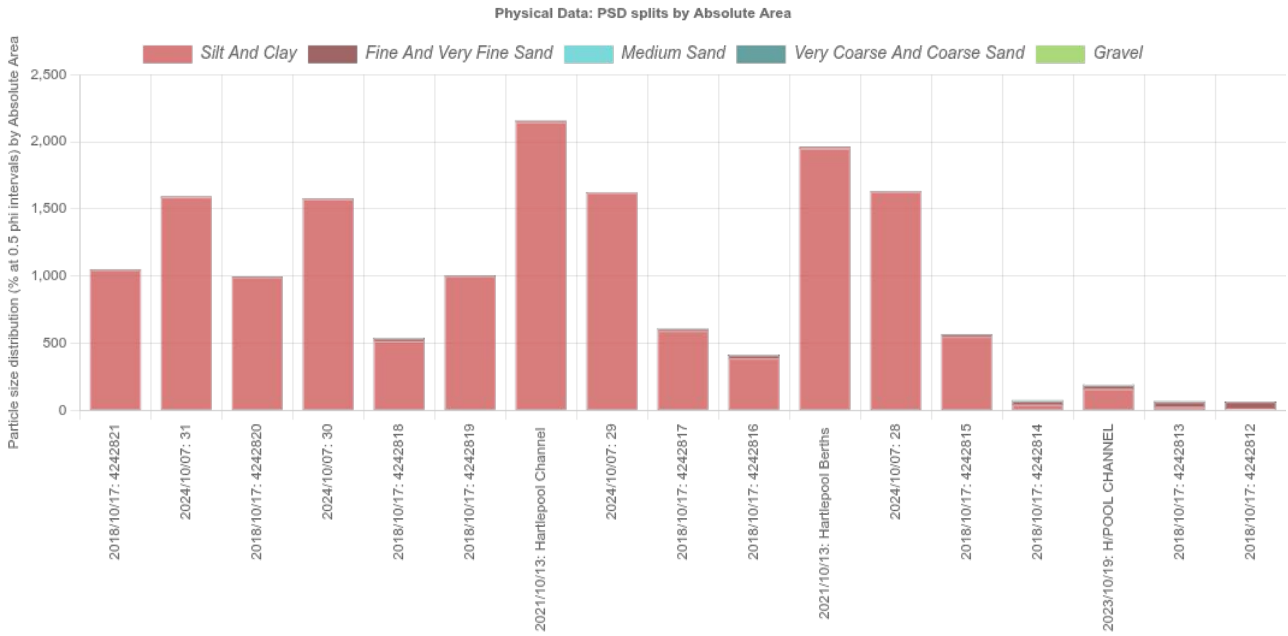


Figure 107: Hartlepool - Sample relative surface areas – ordered longitude

However as the samples with the lowest surface area are in the bay then this could be a real reflection of a constant sandy sediment which would be expected, but has not been seen in the Tees.

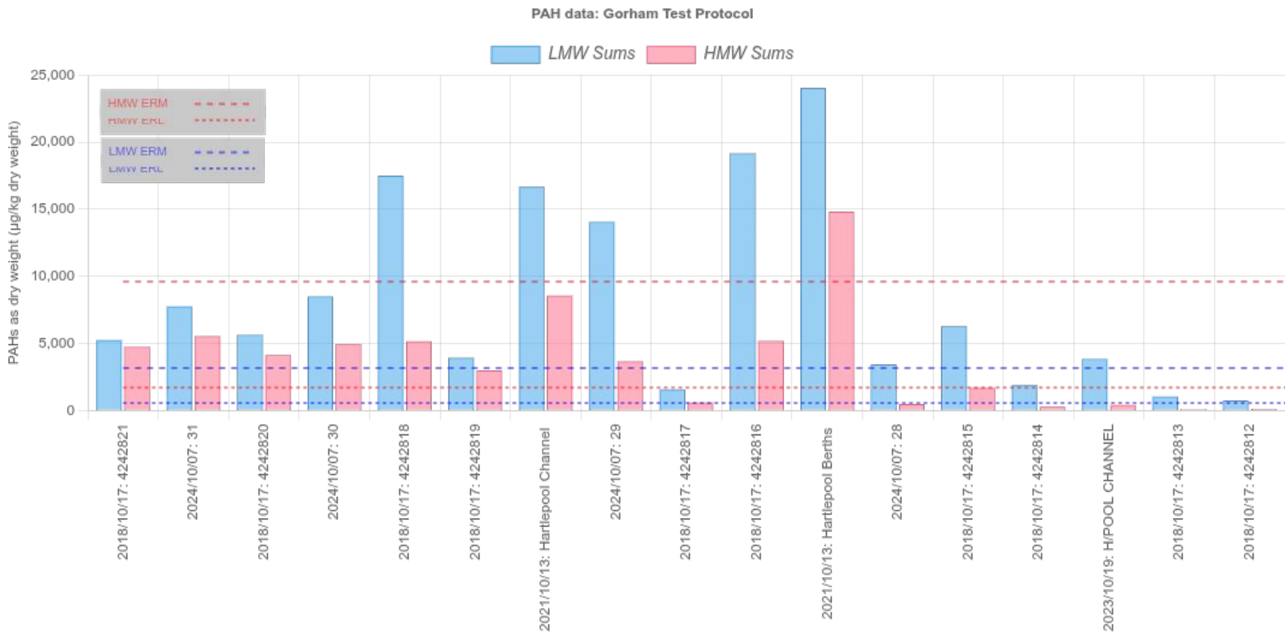


Figure 108: Hartlepool - PAHs Gorham Test protocol – ordered longitude

4 North East Marine Research Group

The North-East Marine Research Group (NEMRG) is an informal group of fishers from the North East Fishing Collective, academics from Durham, Newcastle, and Hull Universities, and interested individuals including representatives of community organisations including Climate Action Stokesley & Villages and Reclaim Our Sea and the Fishmongers' Company's Fisheries Charitable Trust.

Together the group works:

- *to understand the cause of the Tees Estuary ecocide event of September 2021*
- *to understand persistent issues occurring in the marine ecosystem*
- *to provide information relevant to sound environmental governance to properly safeguard the Tees environment, wider marine ecosystem, and the industries that rely on it.*

5 References

(1) Gibbon, S. *MLA/2025/00263 – Tees and Hartlepool Maintenance Dredging and Disposal Licence Renewal - Representation from North East Marine Research Group*; North East Marine Research Group, 2025.
(2) Gibbon, S. *Best Practices for Environmentally Responsible Maintenance Dredging in the River Tees: An Integrated Framework for TSHD Operations*; North East Marine Research Group, 2025.
(3) Miedema, S. A. A SENSITIVITY ANALYSIS OF THE SCALING OF TSHD'S. In *Proceedings of the Western Dredging Association 29th Technical Conference and 40th Texas A&M Dredging Seminar*; Center for Dredging Studies, Texas A&M: Texas, USA, 2009.
(4) Royal HaskoningDHV. *2025 Tees Maintenance Dredge Protocol (MDP) Baseline Document - Renewal Application for Maintenance Dredging L/2015/00427/7*; PC6304-RHD-XX-XX-RP-X–0001; Royal HaskoningDHV, 2025.
(5) PD Teesport. *Tees Maintenance Dredging Baseline Document*; R345/1; PD Teesport, 2005; p 59.
(6) ABP mer. *Tees Entrance Channel Study Part 1 - Conceptual Model of Estuary Processes*; R.972; ABP mer, 2002; p 103.
(7) ABP mer. *Tees Entrance Channel Study Part 2 - Numerical Modelling of Deepening of Seaton Channel*; R.991; ABP mer, 2003.
(8) Henderson, G.; Bresnan, E.; Brooke, J.; Davidson, K.; Dearnaley, M.; Fitzsimons, M.; Ford, A.; Galloway, T.; Halsall, C.; Horton, T.; Inall, M.; Scott, M.; Wilcockson, D. *Independent Expert Assessment of Unusual Crustacean Mortality in the North-East of England in 2021 and 2022*; DEFRA, 2023; p 66.
(9) Royal HaskoningDHV. *MLA/2020/00506 Condition 5.2.11 Note P03*; PC1084-RHD-SB-EN-ME-EV-1145; Royal HaskoningDHV, 2023; p 75.
(10) Wilson, S. C.; Bunce, S.; Crawford, I.; Hardy, J.; Wise, R. *Tees Estuary Seal Study (TESS) II Health and Welfae - Tees and North-East Harbour Seal Pup Morbidity 2024*; 2025.
(11) Debier, C.; Pomeroy, P.; Dupont, C.; Joiris, C.; Comblin, V.; Le Boulengé, E.; Larondelle, Y.; Thomé, J. Quantitative Dynamics of PCB Transfer from Mother to Pup during Lactation in UK Grey Seals Halichoerus Grypus. *Mar. Ecol. Prog. Ser.* **2003**, *247*, 237–248. https://doi.org/10.3354/meps247237.
(12) Wilson, S. C. Population Growth, Reproductive Rate and Neo-Natal Morbidity in a Re-Establishing Harbour Seal Colony. *Mammalia* **2001**, *65* (3), 319–334. https://doi.org/10.1515/mamm.2001.65.3.319.
(13) Mos, L.; Cameron, M.; Jeffries, S. J.; Koop, B. F.; Ross, P. S. Risk-Based Analysis of Polychlorinated Biphenyl Toxicity in Harbor Seals. *Integr. Environ. Assess. Manag.* **2010**, *6* (4), 631–640. https://doi.org/10.1002/ieam.104.
(14) Ashley, E. A.; Olson, J. K.; Adler, T. E.; Raverty, S.; Anderson, E. M.; Jeffries, S.; Gaydos, J. K. Causes of Mortality in a Harbor Seal (Phoca Vitulina) Population at Equilibrium. *Front. Mar. Sci.* **2020**, *7*, 319. https://doi.org/10.3389/fmars.2020.00319.
(15) Asl, A. G.; Nabavi, S. M. B.; Rouzbahani, M. M.; Alipour, S. S.; Monavari, S. M. Persistent Organic Pollutants Influence the Marine Benthic Macroinvertebrate Assemblages in Surface Sediments of Nayband National Park and Bay, Northern Persian Gulf, Iran. *Environ. Sci. Pollut. Res.* **2022**, *30* (11), 30254–30270. https://doi.org/10.1007/s11356-022-24232-w.

(16) Marine Management Organisation. *Marine licensing: Sediment Analysis*. https://www.gov.uk/guidance/marine-licensing-sediment-analysis-and-sample-plans (accessed 2025-08-04).
(17) Gibbon, S. Sediment Data Explorer, 2025. https://github.com/steps39/SedDataExp (accessed 2025-08-04).
(18) *Sediment-Associated Contaminants*. US Geological Service. https://www.usgs.gov/mission-areas/water-resources/science/sediment-associated-contaminants (accessed 2025-08-04).
(19) Royal HaskoningDHV. *2000-2005 Baseline (Redacted)*; 9S2047; Royal HaskoningDHV, 2008; p 72.
(20) BBC News. Concerns after Tees Barrage Fault Causes Water Level Drop. *BBC News*. April 14, 2023. https://www.bbc.co.uk/news/uk-england-tees-65261533 (accessed 2025-08-04).
(21) Gibbon, S. How Teesworks Dredges the Tees. *North East Bylines*. 05/072023. https://northeastbylines.co.uk/news/teesworks-the-shadow-inquiry/how-teesworks-dredges-the-tees/ (accessed 2025-08-04).
(22) Wilson, S. C. Population Growth, Reproductive Rate and Neo-Natal Morbidity in a Re-Establishing Harbour Seal Colony. *mamm* **2001**, *65* (3), 319–334. https://doi.org/10.1515/mamm.2001.65.3.319.
(23) Centre for Environment, Fisheries and Aquaculture Science. Marine and Coastal Access Act (2009). Formal Request for Application Advice by Associated British Ports Southampton for the Maintenance Dredging at the Port of Southampton Licence Renewal - Reference Number: MLA/2025/00234, 2025. https://marinelicensing.marinemanagement.org.uk/ (accessed 2025-08-04).
(24) Centre for Environment, Fisheries and Aquaculture Science. Application by PD Teesport Limited for the Continued Disposal of Dredge Material from Tees and Hartlepool to Tees Bay A Disposal Site, North Sea Reference Number MLA/2025/00263, 2025. https://marinelicensing.marinemanagement.org.uk/ (accessed 2025-08-04).
(25) OSPAR Commission. *OSPAR Guidelines for the Management of Dredged Material at Sea - Agreement 2014-06*; 2024; p 32.
(26) OSPAR Commission. *CEMP Guidelines for Monitoring Contaminants in Sediments - OSPAR Agreement 2002-16*; 2002.