Provision of Statutory Shellfish Monitoring Services for Scotland- Chemical Contaminant Analysis of Shellfish from Classified Harvesting Areas (2024)

Report to Food Standards Scotland



June 2024 – Final Report

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Chemical Contaminant Analysis of Shellfish from Classified Harvesting Areas (2024)

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Glossary of Main Terms

Term or Acronym	General Meaning of Term
µg/kg	Microgram per kilogram (part per billion)
FAPAS	Food Analysis Proficiency Assurance Scheme
fat weight	Values based on the assessed fat content of the sample
FSA	Food Standards Agency
FSS	Food Standards Scotland
GC-HRMS	Gas chromatography - high resolution mass spectrometry
GC-MS	Gas chromatography –unit resolution mass spectrometry
ICP-MS	Inductively coupled plasma-mass spectrometry
LIMS	Laboratory Information Management System
LOD	Limit of Detection
LOQ	Limit of Quantification
Lower bound (LB)	Assumes values at less than the limit of detection are zero (e.g.<0.07 = 0)
mg/kg	Milligram per kilogram (part per million)
ng/kg	Nanogram per kilogram (part per trillion)
Non-ortho-PCB	Non-ortho-substituted PCB (co-planar)
Ortho-PCB	Ortho-substituted PCB (non planar)
PAH 4	Sum of 4 PAHs (benzo[a]pyrene, benzo[a]anthracene, benzo[b]fluoranthene, chrysene)
PAHs	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyl
PCDD/F	Polychlorinated dibenzo-*p*-dioxin/ polychlorinated dibenzofuran (dioxins)
PFAS	Polyfluorinated and perfluorinated alkyl substances
Sum of ICES 6	Sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180
TEF	Toxic Equivalency Factor – toxicity expressed for each dioxin-like compound relative to 2,3,7,8-TCDD (TEF = 1).
TEQ	Toxic Equivalence – product of the congener concentration and the TEF
Total TEQ	Total of the Sum of all the Toxic Equivalences (TEQs) for each group of compounds
Trace Element	An element in a sample that has an average concentration of less than 100 parts per million (< 100 mg/kg)
Upper bound (UB)	assumes values at less than the limit of detection is equal to the limit of detection (e.g. <0.07 = 0.07)
whole weight	Values based on the sample as received
WHO	World Health Organisation
WHO-TEQ 2005	TEQ based on TEF values set by World Health Organisation in 2005

Executive Summary

This study on chemical contaminants in shellfish from Scottish classified shellfish production areas fulfils the requirements of UK legislation to adopt appropriate monitoring measures and carry out compliance checks on shellfish produced for human consumption. Marine shellfish bio-accumulate environmental contaminants because of their inability to metabolise them to easily excreted compounds. The study determines concentrations of regulated environmental contaminants as well as some currently unregulated compounds of interests in the flesh of edible species, with a view to determine current levels of occurrence and to allow estimation of consumer exposure.

The study analysed 18 samples of shellfish including common mussels, pacific oysters, common cockles and sand gapers for polycyclic aromatic hydrocarbons (PAHs), trace elements, inorganic arsenic, polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs) and per and polyfluorinated alkyl substances (PFAS). The methodologies used for the analyses were UKAS accredited to the ISO 17025 standard (Except Inorganic Arsenic by HPLC) and follow retained European regulations for data quality criteria.

All measured analytes were below their maximum regulatory levels in the test samples. Contaminant profiles from the this study are similar to the previous year's (2023) data.

1. Background to Study

Marine shellfish are an excellent source of protein, are high in essential minerals and low in fat. In many parts of the UK and in Scotland in particular, the shellfish industry makes a significant contribution to the local economy. Shellfish have a recognised potential for bio-accumulating contaminants and some bivalve species such as mussels, are commonly used as early indicators of local pollution. Bivalves feed by filtering plankton from the surrounding water. This feeding mechanism leads to the bio-accumulation of pollutants of biogenic and anthropogenic origin from the surrounding waters. The bio-accumulation potential of the shellfish species used for food is particularly relevant in the case of environmental contaminants with long half-lives such as polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenyls (PCBs). These contaminants have been the subject of several studies (Garraud et al 2007, Lee et al 2007, Fernandes et al 2009, Fernandes et al 2012) relating to the occurrence and bio-accumulation in marine species and the resulting potential for human exposure arising from the consumption of the edible species.

Due to potential food safety concerns, the European Union has defined limits for the control of these contaminants in a range of foods including shellfish. (European Commission 2006). The European Union (Withdrawal) Act as amended (HMSO 2018) converted directly applicable European legislation as it stood at the end of the transition period (11pm on 31 December 2020) into UK law.

PCDD/Fs and PCBs are recognised environmental and food contaminants that are known to bio-accumulate in fish and shellfish. The extent of this accumulation is evident by the levels of these contaminants detected in various studies. In the UK, Total Diet Studies (TDS) (e.g. FSA 2003) carried out over the last two decades; fish (including shellfish) has consistently been one of the highest PCDD/F and PCB containing food groups. Human dietary exposure can therefore be significantly influenced by the fish and shellfish component of the diet, particularly in high level consumers and low body-weight individuals. Although metabolised in many fish species, PAHs persist in shellfish as they are unable to break down these contaminants. Other than this bio-accumulation pathway, PAHs can also arise in fish and shellfish through some food preparation and processing methods – e.g. smoked fish are known to contain elevated levels of PAHs.

Some trace elements e.g. arsenic, cadmium, mercury and lead, are established toxic contaminants. The methylated forms of Arsenic have a lower level of toxicity, and the principal arsenic species found in fish and crustaceans, arsenobetaine, is considered virtually non-toxic. In shellfish, molluscs and seaweed arsenosugars, are the dominating species. The toxicity of these species is not known in detail but appears to be reasonably low. Inorganic arsenic, present as As (III) and As (V), found in food are the most toxic form.

Other elements, such as copper, chromium, selenium and zinc are essential to health but may be toxic at high levels of exposure. These elements may enter marine and aquatic environments and bio-accumulate in some species. Some potentially toxic elements occur naturally as part of the local geology, but others may also be found in the location of certain industries, as a result of unauthorised discharge, or as a result of other anthropogenic activity.

Polyfluorinated alkyl and perfluorinated alkyl compounds, collectively known as PFAS were first developed in the 1940s. Due to their unique properties such as thermal and chemical stability, water resistance and low surface tension they find use within many consumer products and industrial applications. Examples are chrome plating, aqueous film forming foams (AFFF) used in fire fighting, water and stain proofing of textiles, emulsifiers in polymer production and cosmetics. Over 3000 different PFAS are currently on the global market. The properties that make PFAS useful also make them resistant to bio-transformation and environmental degradation. Due to their stability and extensive use, a wide range of PFAS have been detected in terrestrial and aquatic environments, wildlife and humans. The main source of dietary exposure are fish and other seafoods (EFSA CONTAM Panel 2022). Several PFAS are known to have toxic effects in humans, including immune suppression and endocrine disruption, while perfluorooctanoic acid (PFOA) is classed as possibly carcinogenic to humans (IARC 2016).

As part of its monitoring requirements in support of UK regulations, Food Standards Scotland (FSS) has overseen the collection of shellfish, from classified shellfish production areas within relevant local authority areas. Shellfish from classified production areas are monitored, with the edible tissues analysed for the contaminants described above.

Fera has generated environmental contaminant data on shellfish collected from new and existing shellfish production areas in Scotland since 2007. This report collates the results of the individual analyses for dioxins, PAHs, PFAS, trace elements and Inorganic arsenic in

samples of shellfish collected from selected classified Scottish production areas in the first quarter of 2024.

2. Methods

2.1 Sample Collection and Preparation

Sampling officers were required to obtain suitable shellfish samples from designated sampling points within classified shellfish production areas, as defined by FSS. The collection of shellfish and transport logistics were co-ordinated by Cefas. Samples were taken and live shellfish sent to Fera Science Limited (Fera). Eighteen samples of shellfish, including species of common mussels (10 samples), Pacific oysters (5), common cockles (2) and sand gapers (1) were collected between January and March 2024. The sampling period was timed to coincide with the period of optimal contaminant concentrations in the shellfish which relates to the period before annual spawning. Details on the locations, with descriptions of the samples and identification are given in Table 1.

On receipt at the laboratory each sample was given a unique laboratory reference number and the sample details were logged into a Nautilus LIMS database. The samples were stored frozen prior to analysis. Sample preparation consisted of shelling followed by thorough homogenisation. Aliquots were then taken for PAH, trace element, inorganic arsenic, PFAS and dioxin analysis, in line with the monitoring plan determined by FSS. Dioxin sample aliquots underwent additional freeze-drying and were re-homogenised prior to analysis. Table 2 contains information on which analyses were performed on each sample.

2.2 Contaminants measured – Specific Analytes

The following analytes were determined; regulated contaminants are highlighted in **bold,** and summarised regulation limits are listed below:

Analytes	UK Maximum Regulatory Levels (MRL) relevant for live bivalve molluscs (whole weight)
Lead	1.5 mg/kg
Cadmium	1.0 mg/kg
Mercury	0.50 mg/kg
Dioxins and PCBs	Sum of dioxins (WHO PCDD/F-TEQ): 3.5 pg/g Sum of dioxins and dioxin-like PCBs (WHO PCDD/F-PCB-TEQ): 6.5 pg/g Sum of PCB28, PCB52, PCB101, PCB138, PCB153 and PCB180 (ICES 6 Indicator PCBs): 75 ng/g
PAHs	Benzo[a]pyrene: 5.0 µg/kg

	Sum of Benzo[a]pyrene, Benzo[a]anthracene, Benzo[b]fluoranthene and Chrysene): 30 µg/kg

No UK regulations exist for PFAS or inorganic arsenic. For the purpose of evaluating results from this study the proposed EU limits for inorganic arsenic are 0.090 mg/kg for all bivalve molluscs except clam species (i.e. common clams, surf clams) which have a proposed MRL of 0.35 mg/kg. Maximum levels for PFOS, PFOA, PFNAS and PFHxS in bivalve molluscs came into effect within the EU from 1st January 2023 and are given in Table 7 (European Commission 2022).

Dioxins **- all 17, 2,3,7,8-Cl substituted PCDDs and PCDFs.**

Dioxin-like PCBs **- IUPAC no. 77, 81, 105, 114, 118, 123, 126, 156, 157, 167, 169 and 189.**

Non dioxin-like PCBs - IUPAC numbers 18, **28**, 31, 47, 49, 51, **52**, 99, **101**, 128, **138**, **153** and **180**.

PAHs - acenaphthene, acenaphthylene, fluorene, phenanthrene, anthracene, fluoranthene, benzo[c]fluorene, pyrene, benzo[e]pyrene, benzo[b]naptho[2,1-d]thiophene, anthanthrene, coronene, benzo[ghi]fluoranthene, **benzo[a]anthracene (BaA)**, **chrysene (Chr)**, **benzo[b]fluoranthene (BbF)**, benzo[j]fluoranthene, benzo[k]fluoranthene, **benzo[a]pyrene (BaP)**, cyclopenta[cd]pyrene, indeno[1,2,3-cd]pyrene, dibenzo[a,h]anthracene, benzo[ghi]perylene, dibenzo[a,l]pyrene, dibenzo[a,e]pyrene, dibenzo[a,i]pyrene, dibenzo[a,h]pyrene and the alkylated PAH, 5-methylchrysene.

Trace elements – chromium (Cr), manganese (Mn), cobalt (Co), nickel (Ni), copper (Cu), Zinc (Zn), total arsenic (As), inorganic arsenic (*i*-As), selenium (Se), silver (Ag), **cadmium (Cd), mercury (Hg), lead (Pb)**

PFAS – perfluoro-n-nonanoic acid (PFNA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanesulfonic acid (PFOS), perfluoro-n-decanoic acid (PFDA), perfluoro-1-butanesulfonic acid (PFBS), perfluoro-n-dodecanoic acid (PFDoA), perfluoro-n-heptanoic acid (PFHpA), perflouoro-n-hexanoic acid (PFHxA), perfluoro-n-pentanoic acid (PFPeA), perfluoro-n-butanoic acid (PFBA), perfluoro-n-octanoic acid (PFOA)

2.3 PCDD/F and PCB - Analytical Methodology

(Fera SOPs FSG 401-414)

The method used for the preparation, extraction and analysis of samples has been reported previously (Fernandes et al 2004) and is part of the CEN EN16215:2012 standard. In brief, samples were fortified with ^{13}C-labelled analogues of target compounds and exhaustively extracted using mixed organic solvents. Ortho substituted PCBs were separated from non-ortho substituted PCBs and PCDD/Fs by fractionation on activated carbon. The two fractions were further purified using adsorption chromatography on alumina. Analytical measurement was carried out using GC-HRMS

All analyses were UKAS accredited to ISO17025 standards, with the inclusion of reference material (in-house reference material, LIMS No. S11-018695 crude cod liver oil) and method blanks which were evaluated prior to reporting. Quality control evaluation for the accompanying data follows the criteria specified for chlorinated dioxins and PCBs. In addition, as the National Reference Laboratory (NRL) for dioxins and halogenated contaminants, Fera participates in proficiency testing (PT) exercises and other inter-laboratory exercises organised by the European Union Reference Laboratory (EU-RL) and achieves consistently good results.

2.4 Polycyclic Aromatic Hydrocarbons (PAH) - Analytical Methodology

(Fera SOP FSG 410)

The analytical methodology for the PAHs has been reported before (Rose et al 2007) and is based on internal standardisation with GC-MS measurement. An aliquot of the homogenised sample was fortified with ^{13}C-labelled analogues of target compounds and saponified with methanolic potassium hydroxide. The extracted PAH solutions were purified in two stages with a dimethylformamide/cyclohexane partition followed by adsorption chromatography on activated silica. Purified extracts were sensitivity standardised and measured using GC-MS.

The analytical procedure for PAHs is UKAS accredited to ISO17025 and includes the assessment of method blanks and reference materials, (e.g. T0658, PAHs in cocoa butter) for compliance with the accreditation criteria. The methodology also meets the criteria required for evaluating data against the maximum permitted limits for benzo[a]pyrene as specified in retained Commission Regulations. Fera regularly participates in Food Analysis Proficiency Assurance Scheme (FAPAS) PT exercises for PAHs in food and achieves consistently good results.

2.5 Trace Elements - Analytical Methodology

(Fera SOP FSG 461 and 457)

Aliquots of the homogenised sample were weighed into allotted digestion vessels and a mixture (4:1) of nitric acid and hydrochloric acid added. The vessels were capped and the contents digested using a high-pressure microwave digestion system. Reagent blanks, certified reference materials and a spiked sample were also taken through the procedure. The resulting solutions were transferred to pre-marked acid-clean plastic test tubes and diluted to 10 ml with deionised water. The digest solutions together with a set of standards covering the expected concentration range, were internally standardised with indium and rhodium in dilute nitric acid (1 %v/v). Measurements were made using an Agilent 7700x ICP-MS with collision cell.

The analytical procedure is accredited to ISO17025. The criteria used to assess data included checks on instrument drift, spike recovery, replicate agreement, limits of detection and certified reference material (e.g. CE 278K mussel tissue) values. Regular, successful participation in FAPAS inter-comparison exercises provides further confidence in the data. In addition, as NRL for trace elements, Fera participates in PT exercises and other inter-laboratory exercises organised by the EU-RL and achieves consistently good results.

Inorganic arsenic was determined using in-house method FSG 466. The procedure can be summarised as: A representative test portion of the sample is treated with a diluted nitric acid and hydrogen peroxide solution in a heated oven. Hereby the arsenic species are extracted into solution and As (III) is oxidized to As (V). The inorganic arsenic is selectively separated from other arsenic compounds using anion exchange HPLC (High Performance Liquid Chromatography) coupled online to the element-specific detector ICP-MS (Inductively Coupled Plasma Mass Spectrometry) for the determination of the mass fraction of inorganic arsenic. External calibration with solvent matrix-matched standards is used for quantification of the amount of inorganic arsenic. This procedure has been submitted to UKAS for extension to scope and it is expected to move onto Fera's official UKAS schedule in July 2024.

For this reason, the samples were also analysed for inorganic arsenic using another in-house method (FSG 456), which is summarised as: Aliquots of homogenised test sample were solubilised in hydrochloric acid. After reduction by hydrobromic acid and hydrazine sulphate, the inorganic arsenic was extracted into chloroform then back-extracted into dilute hydrochloric acid prior to quantification by ICP-MS with collision cell. Quality checks included

blanks, spikes, and certified reference materials. The applied method will also extract mono methyl arsenic species (MMA). If MMA is present, an overestimate of the inorganic arsenic content will occur. The method is accredited to ISO17025.

2.6 Fat analysis

For samples requiring dioxin and PCB analysis, total fat was determined by the Werner-Schmidt method under UKAS accreditation, by Microsearch Laboratories Ltd.

2.7 Poly and Per-Fluorinated Alkyl Substances - Analytical Methodology

(Accredited to ISO17025)

Aliquots of homogenised test samples were spiked with isotope standards (internal standards) and extracted using methanol. The resulting solvent extracts were evaporated to near-dryness, resuspended in deionised water and passed through WAX SPE columns. WAX columns allow for the retention of both short and longer chain PFAS analytes due to the ionic exchange and reverse phase properties. Non-specific interferences were washed from the column whilst retained PFAS analytes were eluted using ammonia in methanol. Samples were concentrated and reconstituted in methanol and analysed by ultra-high performance liquid chromatography coupled to a tandem mass spectrometer (UHPLC-MS/MS) and quantified against calibration standards of known concentrations of the PFAS.

3. Results

Analyte concentrations are presented in Tables 3 to 7. The limits of quantification (LOQ, quoted as “<”) for dioxins, PCBs and PAHs are estimated as a dynamic parameter and therefore represent the limits of determination that prevail during the measurement. Data on the reference materials that were analysed concurrently with the samples, were within established acceptable limits, and are available if required. Measurement uncertainty (MU) was calculated and applied to data following guidelines and principals set out in “Measurement Uncertainty For Persistent Organic Pollutants By Isotope-Dilution Mass Spectrometry” (Eppe et al 2014). MU and reference material data can be made available if required.

Eighteen samples were tested for PCDD/Fs and PCBs. All samples contained PCDD/Fs and PCBs above the LOQ but well within the regulatory limits. Concentrations of individual congeners on a whole and fat weight basis are given in Table 4.

The dioxin-like toxicity of the samples arising from PCDD/Fs and dioxin-like PCBs has also been reported as a toxic equivalent (WHO-TEQ), which is calculated by multiplying the concentration of each congener of interest by its toxicity equivalency factor (WHO-TEF). The TEQs are presented in Tables 3a and 3b in terms of the 2005 TEFs (van den Berg et al 2006) on a whole and fat weight basis respectively.

Additionally, the sum of the ICES-6 Marker PCBs is also provided (Tables 3a and 3b). The regulations for shellfish are based on whole weight concentrations; however, in keeping with previous reports to Food Standards Scotland, the results for PCDD/Fs and PCBs have also been reported on a fat weight basis.

The range for total TEQ (PCDD/F + PCB) on a whole weight, upper bound basis (UB) was 0.05 ng TEQ/kg to 0.32 ng TEQ/kg.

The concentration of ICES-6 PCBs on a whole weight basis (UB) ranged from 0.06 µg/kg to 2.05 µg/kg.

Unlike in 2022, no individual PCB was detected above LOQ in all samples. The most commonly detected PCB's were PCB138 and PCB153 both had incidence levels of 72%. PCB's 18, 51, 114, 123 and 189 were not measured above LOQ in any sample.

Two samples had the highest concentrations of TEQ and ICES6, they are: S24-004117 (Mussels, Clift Sound Whal Wick) and S24-005193 (Mussels, Cliftsound Houss).

PAH's were detected in all 18 samples analysed. All samples showed levels below the MRL for BaP (5 µg/kg) and PAH4 (30 µg/kg). BaP was detected above LOQ in 50% of the samples. Sum of PAH4 concentrations (UB) ranged from 0.91 µg/kg to 3.37 µg/kg. The sample containing the highest concentration of PAH4 (3.37 µg/kg) was a pacific oysters sample from Loch Leurbost (S24-005096). In general, PAH4 concentrations were higher in pacific oysters than in any other species tested. The results from the PAH is displayed in table 5.

All 18 samples were analysed for heavy metals and inorganic arsenic. The results of which are detailed in Table 6. Concentrations of the regulated heavy metals (Cd, Hg, Pb) were all below the regulatory limit. The concentration ranges for Cd, Hg and Pb were 0.040 mg/kg to 0.261 mg/kg, <0.007 mg/kg to 0.017 mg/kg and 0.031 mg/kg to 0.202 mg/kg respectively.

All samples contained quantifiable levels of Cd and Pb, whereas Hg was detected above LOQ in 78% of samples.

The highest concentration of Cd was found in a sample of pacific oysters from Kildonan Bay (S24-022309), this sample also contained the highest levels of Zn, Cu and As. The highest concentration of Pb was found in a sample of common mussels from Aith Voe Sletta, Slyde (S24-022843). Mercury was detected above LOQ in 78% of samples, with the highest concentration found in a sample of common mussels from Loch Carloway (S24-004000). Across all samples the 3 most abundant heavy metals were Zn and Cu, with Zn present at the highest concentration, albeit the range of concentrations did vary from 6.2 mg/kg to 200 mg/kg, with a mean of 54 mg/kg.

Inorganic arsenic concentrations (shown as "*i*- As" in Table 6) ranged from 0.01 mg/kg to 0.09 mg/kg, with a mean of 0.03 mg/kg. In previous years there had been potential issues with over-estimation due to interference of monomethyl arsenic, however this year inorganic arsenic was measured by HPLC. Therefore, the results presented represent the true value of inorganic arsenic and are all very low for all samples.

In general, the patterns of the contaminant classes were consistent with those recorded last year.

All 18 samples were analysed for PFAS. All samples returned values of <0.32 µg/kg for the SUM EU PFAS 4. Only three of the ten PFAS compounds had incidence levels (>LOQ) of more than 0%. PFHpA (100%), PFHxA (100%) and PFPeA (5.5% - equivalent to one sample). The highest concentration for an individual PFAS was PFHpA (1.93 µg/kg in S24-022843, Mussels, Aith Voe Sletta, Slyde). The sample also had the highest concentration of Pb (as noted above). Data for PFAS can be found in Table 7, with the current EU MPL included for comparison.

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Table 1: Overview of all Samples*

Local Authority	Production Area	Site Name	Site Identification Number	Grid Reference	Species	Date Sample Taken	Date Received at Fera	FERA LIMS No.
Argyll & Bute	Eilean an Atha	Eilean an Atha	AB-877-2390-13	NM 7487 0781	Pacific oysters	15/01/2024	16/01/2024	S24-001403
Dumfries & Galloway	Loch Ryan West Side	Loch Ryan West Side	DG-885-2418-18	NX 04590 68457	Sand Gapers	19/02/2024	20/02/2024	S24-013182
Highland: Lochaber	Kildonan Oysters	Kildonan Bay	HL-796-2082-13	NM 4876 8476	Pacific oysters	25/02/2024	01/03/2024	S24-022309
Lewis & Harris	Loch Carloway	Loch Carloway Mussels	LH-891-2455-08 LH-907-2455-08	NB 1868 4222	Common Mussels	06/02/2024	07/02/2024	S24-004000
Lewis & Harris	Loch Leurbost: Crosbost	Site 1 Crosbost	LH-339-795-13	NB 3923 2430	Pacific oysters	13/02/2024	15/02/2024	S24-005096
Lewis & Harris	Loch Roag: Linngeam	Cliatasay	LH-187-699-08	NB 1462 3333	Common mussels	20/02/2024	21/02/2024	S24-021192
Highland: Ross & Cromarty	Cromarty Firth Mussels	Cromarty Firth Mussels	RC-884-2413-08	NH 7496 6720	Common mussels	09/01/2024	11/01/2024	S24-000941
Shetland Islands	Aith Voe Sletta	Slyde	SI-326-733-08	HU 3529 5841	Common mussels	05/03/2024	07/03/2024	S24-022843
Shetland Islands	Clift Sound Houss	Clift Sound Houss	SI-633-1270-08	HU 3855 3194	Common mussels	14/02/2024	16/02/2024	S24-005193
Shetland Islands	Clift Sound: Whal Wick	Wester Quarf	SI-038-1522-08	HU 4016 3535	Common mussels	07/02/2024	08/02/2024	S24-004117
Shetland Islands	Dales Voe - Fora Ness	West Taing	SI-502-869-08	HU 4401 7106	Common mussels	13/02/2024	14/02/2024	S24-004901
Shetland Islands	Gon Firth	Cole Deep	SI-076-1338-08	HU 3405 6402	Common mussels	05/03/2024	07/03/2024	S24-022842
Shetland Islands	Gruting Voe: Braewick Voe	Braewick Voe	SI-080-424-08	HU 2458 4792	Common mussels	05/02/2024	07/02/2024	S24-004001

Local Authority	Production Area	Site Name	Site Identification Number	Grid Reference	Species	Date Sample Taken	Date Received at Fera	FERA LIMS No.
Shetland Islands	Mid Noost Pacific Oysters	Mid Noost Pacific Oysters	SI-882-2408-13	HU 3896 5133	Pacific oysters	29/01/2024	31/01/2024	S24-003210
Shetland Islands	Vementry South	Clousta Voe - Noonsbrough	SI-321-459-08	HU 2927 5770	Common mussels	29/01/2024	31/01/2024	S24-003213
Highland: Skye & Lochalsh	Loch Portree Cockles	Loch Portree Cockles	SL-880-2405-04	NG 4832 4186	Common cockles	10/02/2024	14/02/2024	S24-004900
Highland: Skye & Lochalsh	Loch Sligachan Cockles	Inner Loch	SL-889-2436-04	NG 5011 3120	Common cockles	09/03/2024	12/03/2024	S24-023622
Uist & Barra	Ardmhor	Ardmhor	UB-874-2385-13	NF 7076 0477	Pacific oysters	11/03/2024	12/03/2024	S24-023621

**Quality statement: Information relating to the origin of the samples (place, date of collection and GR/NGR details) is as provided by sampling staff and has not undergone verification checks by Fera or Cefas*

Table 2: Samples: Chemical contaminant monitoring plan

FERA LIMS No.	Production Area	Sample Site Name	Species	Trace Elements	*i*-As	PAHs	DXN/ PCBs	PFAS
S24-001403	Eilean an Atha	Eilean an Atha	Pacific oysters	X	X	X	X	X
S24-013182	Loch Ryan West Side	Loch Ryan West Side	Sand Gapers	X	X	X	X	X
S24-022309	Kildonan Oysters	Kildonan Bay	Pacific oysters	X	X	X	X	X
S24-004000	Loch Carloway	Loch Carloway Mussels	Common Mussels	X	X	X	X	X
S24-005096	Loch Leurbost: Crosbost	Site 1 Crosbost	Pacific oysters	X	X	X	X	X
S24-021192	Loch Roag: Linngeam	Cliatasay	Common mussels	X	X	X	X	X
S24-000941	Cromarty Firth Mussels	Cromarty Firth Mussels	Common mussels	X	X	X	X	X
S24-022843	Aith Voe Sletta	Slyde	Common mussels	X	X	X	X	X
S24-005193	Clift Sound Houss	Clift Sound Houss	Common mussels	X	X	X	X	X
S24-004117	Clift Sound: Whal Wick	Wester Quarf	Common mussels	X	X	X	X	X
S24-004901	Dales Voe - Fora Ness	West Taing	Common mussels	X	X	X	X	X
S24-022842	Gon Firth	Cole Deep	Common mussels	X	X	X	X	X
S24-004001	Gruting Voe: Braewick Voe	Braewick Voe	Common mussels	X	X	X	X	X
S24-003210	Mid Noost Pacific Oysters	Mid Noost Pacific Oysters	Pacific oysters	X	X	X	X	X
S24-003213	Vementry South	Clousta Voe - Noonsbrough	Common mussels	X	X	X	X	X
S24-004900	Loch Portree Cockles	Loch Portree Cockles	Common cockles	X	X	X	X	X
S24-023622	Loch Sligachan Cockles	Inner Loch	Common cockles	X	X	X	X	X
S24-023621	Ardmhor	Ardmhor	Pacific oysters	X	X	X	X	X

Table 3a: PCDD/Fs and PCB - TEQ and ICES6 summary, Whole weight

FERA LIMS No.	S24-000941	S24-001403	S24-003210	S24-003213	S24-004000
Description	Common mussels, Cromarty Firth Mussels	Pacific oysters, Eilean an Atha, Eilean an Atha	Pacific Oysters, Mid Noost	Common mussels, Vementry South, Clousta Voe - Noonsbrough	Common Mussels, Lock Carloway, Carloway Pier
PCDD/F TEQ LB (ng/kg)	0.05	0.07	0.19	0.09	0.07
PCDD/F TEQ UB (ng/kg)	0.07	0.08	0.19	0.1	0.09
PCB TEQ LB (ng/kg)	0.07	0.03	0.08	0.05	0.03
PCB TEQ UB (ng/kg)	0.07	0.04	0.09	0.06	0.04
PCDD/F + PCB WHO-TEQ LB (ng/kg)	0.12	0.1	0.27	0.14	0.1
PCDD/F + PCB WHO-TEQ UB (ng/kg)	0.14	0.12	0.28	0.16	0.13
SUM ICES 6 LB (µg/kg)	1.06	0.12	0.22	0.21	0.07
SUM ICES 6 UB (µg/kg)	1.06	0.15	0.25	0.24	0.11

FERA LIMS No.	S24-004001	S24-004117	S24-004900	S24-004901	S24-005096
Description	Mussels, Gruting Voe, Braewick Voe	Mussels, Clift Sound Whal Wick, Wester Quarf	Cockles, Loch Portree Cockles, Loch Portree	Mussels, Dales Voe Foraness, West Taing	Pacific Oysters, Loch Leurbost Crosbost, Site 1 Crosbost
PCDD/F TEQ LB (ng/kg)	0.12	0.1	0	0.08	0.22
PCDD/F TEQ UB (ng/kg)	0.12	0.11	0.03	0.09	0.23
PCB TEQ LB (ng/kg)	0.05	0.21	0.01	0.05	0.08
PCB TEQ UB (ng/kg)	0.06	0.21	0.02	0.06	0.09
PCDD/F + PCB WHO-TEQ LB (ng/kg)	0.17	0.31	0.01	0.13	0.3

FERA LIMS No.	S24-004001	S24-004117	S24-004900	S24-004901	S24-005096
Description	Mussels, Gruting Voe, Braewick Voe	Mussels, Clift Sound Whal Wick, Wester Quarf	Cockles, Loch Portree Cockles, Loch Portree	Mussels, Dales Voe Foraness, West Taing	Pacific Oysters, Loch Leurbost Crosbost, Site 1 Crosbost
PCDD/F + PCB WHO-TEQ UB (ng/kg)	0.18	0.32	0.05	0.15	0.32
SUM ICES 6 LB (µg/kg)	0.15	2.05	0.02	0.23	0.27
SUM ICES 6 UB (µg/kg)	0.18	2.05	0.06	0.25	0.29

FERA LIMS No.	S24-005193	S24-013182	S24-021192	S24-022309	S24-022842
Description	Mussels, Cliftsound Houss, Houss	Sand Gapers, Loch Ryan west side, Loch Ryan West side	Common Mussels, Loch Roag Linngearn, Cliatasay	Pacific Oysters, Kildonan Oysters, Kildonan Bay	Mussels, Gonfirth, Coledeep
PCDD/F TEQ LB (ng/kg)	0.11	0.06	0.05	0.19	0.08
PCDD/F TEQ UB (ng/kg)	0.12	0.08	0.06	0.19	0.09
PCB TEQ LB (ng/kg)	0.2	0.04	0.03	0.07	0.04
PCB TEQ UB (ng/kg)	0.2	0.05	0.04	0.08	0.05
PCDD/F + PCB WHO-TEQ LB (ng/kg)	0.31	0.1	0.08	0.26	0.12
PCDD/F + PCB WHO-TEQ UB (ng/kg)	0.32	0.13	0.1	0.27	0.14
SUM ICES 6 LB (µg/kg)	1.99	0.6	0.14	0	0
SUM ICES 6 UB (µg/kg)	1.99	0.6	0.17	0.66	0.72

FERA LIMS No.	S24-022843	S24-023621	S24-023622
Description	Mussels, Aith Voe Sletta, Slyde	Pacific Oysters, Ardmhor	Cockles, Loch Sligachan, Inner Loch
PCDD/F TEQ LB (ng/kg)	0.08	0.15	0.01
PCDD/F TEQ UB (ng/kg)	0.1	0.15	0.03
PCB TEQ LB (ng/kg)	0.05	0.05	0.01
PCB TEQ UB (ng/kg)	0.06	0.06	0.02
PCDD/F + PCB WHO-TEQ LB (ng/kg)	0.13	0.2	0.02
PCDD/F + PCB WHO-TEQ UB (ng/kg)	0.16	0.21	0.05
SUM ICES 6 LB (µg/kg)	0	0	0
SUM ICES 6 UB (µg/kg)	0.81	0.66	0.93

Table 3b: PCDD/Fs and PCB - TEQ and ICES6 summary, Fat weight

FERA LIMS No.	S24-000941	S24-001403	S24-003210	S24-003213	S24-004000
Description	Common mussels, Cromarty Firth Mussels	Pacific oysters, Eilean an Atha, Eilean an Atha	Pacific Oysters, Mid Noost	Common mussels, Vementry South, Clousta Voe - Noonsbrough	Common Mussels, Lock Carloway, Carloway Pier
Fat %	0.81	0.51	0.75	0.89	0.53
PCDD/F TEQ LB (ng/kg)	7.05	15.49	10.69	7.09	8.12
PCDD/F TEQ UB (ng/kg)	7.05	15.52	10.69	7.21	8.32
PCB TEQ LB (ng/kg)	8.12	5.64	4.8	3.87	3.19
PCB TEQ UB (ng/kg)	8.12	5.64	4.8	3.87	3.19
PCDD/F + PCB WHO-TEQ LB (ng/kg)	15.17	21.13	15.49	10.96	11.31
PCDD/F + PCB WHO-TEQ UB (ng/kg)	15.17	21.16	15.49	11.08	11.51
SUM ICES 6 LB (µg/kg)	130.85	26.77	33.98	24.73	15.25
SUM ICES 6 UB (µg/kg)	130.85	26.77	33.98	24.73	15.25

FERA LIMS No.	S24-004001	S24-004117	S24-004900	S24-004901	S24-005096
Description	Mussels, Gruting Voe, Braewick Voe	Mussels, Clift Sound Whal Wick, Wester Quarf	Cockles, Loch Portree Cockles, Loch Portree	Mussels, Dales Voe Foraness, West Taing	Pacific Oysters, Loch Leurbost Crosbost, Site 1 Crosbost
Fat %	0.83	1.17	0.32	1.3	1.29
PCDD/F TEQ LB (ng/kg)	8.69	9.13	4.01	7.31	10.83
PCDD/F TEQ UB (ng/kg)	8.79	9.13	4.01	7.31	10.99
PCB TEQ LB (ng/kg)	4.03	17.72	3.86	3.77	3.95
PCB TEQ UB (ng/kg)	4.03	17.74	3.86	3.77	3.95
PCDD/F + PCB WHO-TEQ LB (ng/kg)	12.72	26.85	7.87	11.08	14.78
PCDD/F + PCB WHO-TEQ UB (ng/kg)	12.82	26.87	7.87	11.08	14.94
SUM ICES 6 LB (µg/kg)	19.63	176.24	13.6	19.02	22.52
SUM ICES 6 UB (µg/kg)	19.63	176.24	13.6	19.02	22.52

FERA LIMS No.	S24-005193	S24-013182	S24-021192	S24-022309	S24-022842
Description	Mussels, Cliftsound Houss, Houss	Sand Gapers, Loch Ryan west side, Loch Ryan West side	Common Mussels, Loch Roag Linngearn, Cliatasay	Pacific Oysters, Kildonan Oysters, Kildonan Bay	Mussels, Gonfirth, Coledeep
Fat %	1.15	1.21	0.78	1.21	1.01
PCDD/F TEQ LB (ng/kg)	10.28	6.16	8.2	15.45	8.57
PCDD/F TEQ UB (ng/kg)	10.28	6.22	8.2	15.51	8.62
PCB TEQ LB (ng/kg)	17.61	4	3.99	5.37	3.75
PCB TEQ UB (ng/kg)	17.62	4	3.99	6.12	4.72
PCDD/F + PCB WHO-TEQ LB (ng/kg)	27.89	10.16	12.19	20.82	12.32
PCDD/F + PCB WHO-TEQ UB (ng/kg)	27.9	10.22	12.19	21.63	13.34
SUM ICES 6 LB (µg/kg)	173.69	49.77	20.03	0	0
SUM ICES 6 UB (µg/kg)	173.69	49.77	20.03	55.48	71.92

FERA LIMS No.	S24-022843	S24-023621	S24-023622
Description	Mussels, Aith Voe Sletta, Slyde	Pacific Oysters, Ardmhor	Cockles, Loch Sligachan, Inner Loch
Fat %	1.47	1.43	1.25
PCDD/F TEQ LB (ng/kg)	6.63	10.37	1.74
PCDD/F TEQ UB (ng/kg)	6.66	10.49	2.14
PCB TEQ LB (ng/kg)	3.35	3.67	1.1
PCB TEQ UB (ng/kg)	4.09	4.3	2.11
PCDD/F + PCB WHO-TEQ LB (ng/kg)	9.98	14.04	2.84
PCDD/F + PCB WHO-TEQ UB (ng/kg)	10.75	14.79	4.25
SUM ICES 6 LB (µg/kg)	0	0	0
SUM ICES 6 UB (µg/kg)	55.06	46.32	75.02

Table 4: PCDD/F & PCB concentrations

	FERA LIMS No.	S24-000941		S24-001403	
	Description	Common mussels, Cromarty Firth Mussels		Pacific oysters, Eilean an Atha, Eilean an Atha	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	<0.01	0.74	<0.01	1.59
1,2,3,7,8-PeCDD	ng/kg	0.02	2.03	0.03	6.16
1,2,3,4,7,8-HxCDD	ng/kg	<0.01	1.21	<0.01	1.94
1,2,3,6,7,8-HxCDD	ng/kg	0.01	1.36	0.02	3.86
1,2,3,7,8,9-HxCDD	ng/kg	<0.01	0.87	0.02	3.26
1,2,3,4,6,7,8-HpCDD	ng/kg	0.07	8.31	0.03	5.41
OCDD	ng/kg	0.28	34.61	0.15	29.58
2,3,7,8-TCDF	ng/kg	0.12	15.29	0.14	27.45
1,2,3,7,8-PeCDF	ng/kg	0.02	2.88	0.02	3.45
2,3,4,7,8-PeCDF	ng/kg	0.05	6.17	0.06	11.61
1,2,3,4,7,8-HxCDF	ng/kg	<0.01	0.91	<0.01	<0.16
1,2,3,6,7,8-HxCDF	ng/kg	<0.01	0.68	<0.01	1.23
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	0.23	<0.01	<0.1
2,3,4,6,7,8-HxCDF	ng/kg	0.01	1.69	0.02	3.13
1,2,3,4,6,7,8-HpCDF	ng/kg	0.02	2.48	<0.01	0.44
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	<0.1	<0.01	0.04
OCDF	ng/kg	0.02	3.04	<0.01	1.19
PCB 77	ng/kg	3.67	453.17	1.13	221.29
PCB 81	ng/kg	0.28	34.20	0.09	18.32
PCB 126	ng/kg	0.56	69.20	0.25	49.59
PCB 169	ng/kg	0.12	15.21	0.08	15.88
PCB 105	µg/kg	0.04	4.33	<0.01	1.06
PCB 114	µg/kg	<0.01	0.15	<0.01	0.04
PCB 118	µg/kg	0.12	15.08	0.02	3.94
PCB 123	µg/kg	<0.01	0.58	<0.01	0.19
PCB 156	µg/kg	0.01	1.33	<0.01	0.2
PCB 157	µg/kg	<0.01	0.46	<0.01	0.13
PCB 167	µg/kg	<0.01	0.83	<0.01	0.37
PCB 189	µg/kg	<0.01	0.18	<0.01	0.02
PCB 28	µg/kg	0.02	2.49	<0.01	0.67
PCB 52	µg/kg	0.04	5.09	<0.01	1.03
PCB 101	µg/kg	0.15	18.18	0.02	3.44
PCB 138	µg/kg	0.21	26.28	0.04	8.53
PCB 153	µg/kg	0.62	76.21	0.06	12.37
PCB 180	µg/kg	0.02	2.6	<0.01	0.73
PCB 18	µg/kg	<0.01	0.67	<0.01	0.19
PCB 31	µg/kg	0.02	1.87	<0.01	0.48
PCB 47	µg/kg	0.01	1.72	<0.01	0.68
PCB 49	µg/kg	0.03	3.45	<0.01	0.72
PCB 51	µg/kg	<0.01	0.08	<0.01	0.12
PCB 99	µg/kg	0.06	7.71	0.01	2.53
PCB 128	µg/kg	0.03	3.3	<0.01	0.69

	FERA LIMS No.	S24-003210		S24-003213	
	Description	Pacific Oysters, Mid Noost		Common mussels, Vementry South, Clousta Voe - Noonsbrough	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	0.03	1.43	<0.01	0.64
1,2,3,7,8-PeCDD	ng/kg	0.06	3.58	0.03	2.42
1,2,3,4,7,8-HxCDD	ng/kg	0.01	0.62	0.01	0.82
1,2,3,6,7,8-HxCDD	ng/kg	0.03	1.47	0.02	1.49
1,2,3,7,8,9-HxCDD	ng/kg	0.02	0.88	<0.02	<1.24
1,2,3,4,6,7,8-HpCDD	ng/kg	0.04	2.05	0.09	6.22
OCDD	ng/kg	0.14	7.90	0.27	19.54
2,3,7,8-TCDF	ng/kg	0.38	21.15	0.18	12.73
1,2,3,7,8-PeCDF	ng/kg	0.06	3.38	0.03	2.36
2,3,4,7,8-PeCDF	ng/kg	0.16	9.15	0.09	6.37
1,2,3,4,7,8-HxCDF	ng/kg	<0.01	0.11	0.01	1.06
1,2,3,6,7,8-HxCDF	ng/kg	0.02	1.13	0.01	1.03
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	0.16	<0.01	0.30
2,3,4,6,7,8-HxCDF	ng/kg	0.04	2.47	0.03	2.09
1,2,3,4,6,7,8-HpCDF	ng/kg	0.01	0.57	0.03	2.19
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	0.10	<0.01	0.13
OCDF	ng/kg	0.02	1.23	0.03	2.09
PCB 77	ng/kg	2.75	154.64	1.17	85.00
PCB 81	ng/kg	0.25	14.05	0.09	6.55
PCB 126	ng/kg	0.76	42.73	0.47	33.87
PCB 169	ng/kg	0.19	10.69	0.14	10.19
PCB 105	µg/kg	<0.01	0.99	<0.01	1.07
PCB 114	µg/kg	<0.01	0.03	<0.01	0.04
PCB 118	µg/kg	0.03	4.41	0.03	3.89
PCB 123	µg/kg	<0.01	0.19	<0.01	<0.09
PCB 156	µg/kg	<0.01	0.17	<0.01	0.28
PCB 157	µg/kg	<0.01	0.13	<0.01	0.13
PCB 167	µg/kg	<0.01	0.36	<0.01	0.19
PCB 189	µg/kg	<0.01	<0.01	<0.01	0.03
PCB 28	µg/kg	<0.01	0.7	<0.01	0.4
PCB 52	µg/kg	<0.01	1.22	<0.01	0.87
PCB 101	µg/kg	0.03	4.52	0.03	3.11
PCB 138	µg/kg	0.06	8.42	0.06	6.8
PCB 153	µg/kg	0.13iR	17.95iR	0.12iR	13.2iR
PCB 180	µg/kg	<0.01	1.17	<0.01	0.35
PCB 18	µg/kg	<0.01	<0.15	<0.01	<0.19
PCB 31	µg/kg	<0.01	0.52	<0.01	0.3
PCB 47	µg/kg	<0.01	0.69	<0.01	0.48
PCB 49	µg/kg	<0.01	0.79	<0.01	0.45
PCB 51	µg/kg	<0.01	0.06	<0.01	0.04
PCB 99	µg/kg	0.02	2.9	0.02	1.76
PCB 128	µg/kg	<0.01	0.52	<0.01	0.97

	FERA LIMS No.	S24-004000		S24-004001	
	Description	Common Mussels, Lock Carloway, Carloway Pier		Mussels, Gruting Voe, Braewick Voe	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	<0.01	0.66	0.01	0.84
1,2,3,7,8-PeCDD	ng/kg	0.03	3.23	0.04	2.96
1,2,3,4,7,8-HxCDD	ng/kg	0.02	2.17	0.01	0.99
1,2,3,6,7,8-HxCDD	ng/kg	<0.02	<1.97	0.03	2.08
1,2,3,7,8,9-HxCDD	ng/kg	0.02	2.22	<0.01	<1.02
1,2,3,4,6,7,8-HpCDD	ng/kg	0.22	21.34	0.10	7.55
OCDD	ng/kg	1.14	109.38	0.34	25.25
2,3,7,8-TCDF	ng/kg	0.10	9.81	0.19	14.47
1,2,3,7,8-PeCDF	ng/kg	0.02	2.30	0.03	2.55
2,3,4,7,8-PeCDF	ng/kg	0.07	6.37	0.11	7.99
1,2,3,4,7,8-HxCDF	ng/kg	0.02	1.53	0.02	1.15
1,2,3,6,7,8-HxCDF	ng/kg	0.01	1.12	0.01	0.83
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	0.57	<0.01	0.52
2,3,4,6,7,8-HxCDF	ng/kg	0.02	2.17	0.04	2.96
1,2,3,4,6,7,8-HpCDF	ng/kg	0.05	4.41	0.04	2.85
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	0.17	<0.01	0.45
OCDF	ng/kg	0.05	4.93	0.04	3.12
PCB 77	ng/kg	0.81	77.93	1.22	91.39
PCB 81	ng/kg	0.07	6.70	0.10	7.42
PCB 126	ng/kg	0.29	27.95	0.48	35.59
PCB 169	ng/kg	0.11	10.30	0.16	11.71
PCB 105	µg/kg	<0.01	0.53	<0.01	0.66
PCB 114	µg/kg	<0.01	0.02	<0.01	0.02
PCB 118	µg/kg	<0.01	1.76	0.02	2.38
PCB 123	µg/kg	<0.01	0.06	<0.01	0.09
PCB 156	µg/kg	<0.01	0.17	<0.01	0.19
PCB 157	µg/kg	<0.01	0.08	<0.01	0.09
PCB 167	µg/kg	<0.01	0.14	<0.01	0.19
PCB 189	µg/kg	<0.01	0.03	<0.01	0.03
PCB 28	µg/kg	<0.01	0.35	<0.01	0.43
PCB 52	µg/kg	<0.01	0.54	<0.01	0.82
PCB 101	µg/kg	<0.01	1.59	0.02	2.68
PCB 138	µg/kg	0.03	4.81	0.05	6.02
PCB 153	µg/kg	0.04iR	7.62iR	0.08iR	9.24iR
PCB 180	µg/kg	<0.01	0.34	<0.01	0.44
PCB 18	µg/kg	<0.01	<0.25	<0.01	<0.19
PCB 31	µg/kg	<0.01	<0.38	<0.01	0.36
PCB 47	µg/kg	<0.01	0.29	<0.01	0.42
PCB 49	µg/kg	<0.01	0.3	<0.01	0.46
PCB 51	µg/kg	<0.01	<0.03	<0.01	0.03
PCB 99	µg/kg	<0.01	0.97	0.01	1.43
PCB 128	µg/kg	<0.01	0.54	<0.01	0.64

	FERA LIMS No.	S24-004117		S24-004900	
	Description	Mussels, Clift Sound Whal Wick, Wester Quarf		Cockles, Loch Portree Cockles, Loch Portree	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	<0.01	0.61	<0.01	0.36
1,2,3,7,8-PeCDD	ng/kg	0.03	2.20	<0.01	1.04
1,2,3,4,7,8-HxCDD	ng/kg	<0.01	0.74	<0.01	0.72
1,2,3,6,7,8-HxCDD	ng/kg	0.02	2.02	<0.01	1.32
1,2,3,7,8,9-HxCDD	ng/kg	0.01	1.09	<0.01	1.32
1,2,3,4,6,7,8-HpCDD	ng/kg	0.09	8.00	0.04	11.19
OCDD	ng/kg	0.32	26.97	0.20	62.62
2,3,7,8-TCDF	ng/kg	0.30	25.99	0.02	5.98
1,2,3,7,8-PeCDF	ng/kg	0.03	2.31	<0.01	1.90
2,3,4,7,8-PeCDF	ng/kg	0.10	8.83	<0.01	3.17
1,2,3,4,7,8-HxCDF	ng/kg	0.02	1.37	<0.01	1.38
1,2,3,6,7,8-HxCDF	ng/kg	0.01	1.00	<0.01	1.46
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	0.29	<0.01	0.52
2,3,4,6,7,8-HxCDF	ng/kg	0.03	2.32	<0.01	1.48
1,2,3,4,6,7,8-HpCDF	ng/kg	0.03	2.89	0.01	4.49
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	0.16	<0.01	0.54
OCDF	ng/kg	0.04	3.44	0.01	4.71
PCB 77	ng/kg	5.57	476.37	0.41	128.99
PCB 81	ng/kg	0.27	22.66	0.03	8.24
PCB 126	ng/kg	1.80	153.53	0.10	32.72
PCB 169	ng/kg	0.18	15.62	0.05	16.24
PCB 105	µg/kg	0.13	10.75	<0.01	0.58
PCB 114	µg/kg	<0.01	0.27	<0.01	0.02
PCB 118	µg/kg	0.51	44	<0.01	1.9
PCB 123	µg/kg	<0.01	<0.44	<0.01	<0.02
PCB 156	µg/kg	0.03	2.87	<0.01	0.24
PCB 157	µg/kg	0.01	1.15	<0.01	0.1
PCB 167	µg/kg	0.03	2.27	<0.01	0.18
PCB 189	µg/kg	<0.01	0.11	<0.01	0.04
PCB 28	µg/kg	0.01	1.03	<0.01	0.82
PCB 52	µg/kg	0.11	9.43	<0.01	1.14
PCB 101	µg/kg	0.56	47.72	<0.01	1.84
PCB 138	µg/kg	0.7	60	0.01	4.17
PCB 153	µg/kg	0.66	56.79	0.01	4.69
PCB 180	µg/kg	0.01	1.27	<0.01	0.94
PCB 18	µg/kg	<0.01	0.22	<0.01	0.4
PCB 31	µg/kg	<0.01	0.56	<0.01	0.7
PCB 47	µg/kg	0.02	1.71	<0.01	0.94
PCB 49	µg/kg	0.05	3.89	<0.01	0.7
PCB 51	µg/kg	<0.01	0.07	<0.01	0.14
PCB 99	µg/kg	0.22	18.85	<0.01	1.1
PCB 128	µg/kg	0.13	10.81	<0.01	0.64

	FERA LIMS No.	S24-004901		S24-005096	
	Description	Mussels, Dales Voe Foraness, West Taing		Pacific Oysters, Loch Leurbost Crosbost, Site 1 Crosbost	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	<0.01	0.59	0.03	1.45
1,2,3,7,8-PeCDD	ng/kg	0.02	1.89	0.09	4.28
1,2,3,4,7,8-HxCDD	ng/kg	0.01	1.05	0.03	1.42
1,2,3,6,7,8-HxCDD	ng/kg	0.03	2.15	<0.03	<1.61
1,2,3,7,8,9-HxCDD	ng/kg	0.01	1.09	0.03	1.68
1,2,3,4,6,7,8-HpCDD	ng/kg	0.10	7.68	0.09	4.30
OCDD	ng/kg	0.27	20.60	0.26	12.67
2,3,7,8-TCDF	ng/kg	0.19	14.35	0.39	18.74
1,2,3,7,8-PeCDF	ng/kg	0.03	2.56	0.07	3.26
2,3,4,7,8-PeCDF	ng/kg	0.10	7.61	0.16	7.91
1,2,3,4,7,8-HxCDF	ng/kg	0.02	1.20	<0.01	0.18
1,2,3,6,7,8-HxCDF	ng/kg	0.01	1.04	0.02	1.06
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	0.37	<0.01	0.17
2,3,4,6,7,8-HxCDF	ng/kg	0.03	2.28	0.05	2.53
1,2,3,4,6,7,8-HpCDF	ng/kg	0.04	2.93	0.01	0.58
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	0.32	<0.01	0.05
OCDF	ng/kg	0.04	3.06	0.01	0.72
PCB 77	ng/kg	1.10	84.94	2.62	125.98
PCB 81	ng/kg	0.08	6.39	0.25	12.07
PCB 126	ng/kg	0.43	32.88	0.74	35.48
PCB 169	ng/kg	0.15	11.64	0.20	9.53
PCB 105	µg/kg	0.01	0.81	0.01	0.78
PCB 114	µg/kg	<0.01	0.03	<0.01	0.03
PCB 118	µg/kg	0.04	2.7	0.02	1.79
PCB 123	µg/kg	<0.01	<0.02	<0.01	0.25
PCB 156	µg/kg	<0.01	0.21	<0.01	0.13
PCB 157	µg/kg	<0.01	0.1	<0.01	0.05
PCB 167	µg/kg	<0.01	0.21	<0.01	0.18
PCB 189	µg/kg	<0.01	0.02	<0.01	0.03
PCB 28	µg/kg	<0.01	0.49	<0.01	0.52
PCB 52	µg/kg	0.01	0.88	0.01	0.86
PCB 101	µg/kg	0.03	2.65	0.03	2.66
PCB 138	µg/kg	0.08	6.22	0.07	5.62
PCB 153	µg/kg	0.11	8.42	0.16iR	12.15iR
PCB 180	µg/kg	<0.01	0.36	<0.01	0.71
PCB 18	µg/kg	<0.01	0.2	<0.01	0.12
PCB 31	µg/kg	<0.01	0.41	<0.01	0.38
PCB 47	µg/kg	<0.01	0.42	<0.01	0.5
PCB 49	µg/kg	<0.01	0.51	<0.01	0.58
PCB 51	µg/kg	<0.01	0.03	<0.01	0.08
PCB 99	µg/kg	0.02	1.63	0.03	1.99
PCB 128	µg/kg	0.01	0.9	<0.01	0.27

	FERA LIMS No.	S24-005193		S24-013182	
	Description	Mussels, Cliftsound Houss, Houss		Sand Gapers, Loch Ryan west side, Loch Ryan West side	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	<0.01	0.33	<0.01	0.68
1,2,3,7,8-PeCDD	ng/kg	0.03	2.85	0.02	1.72
1,2,3,4,7,8-HxCDD	ng/kg	0.02	2.06	0.01	1.13
1,2,3,6,7,8-HxCDD	ng/kg	0.02	2.14	0.01	1.18
1,2,3,7,8,9-HxCDD	ng/kg	<0.01	0.76	0.02	1.26
1,2,3,4,6,7,8-HpCDD	ng/kg	0.10	8.79	0.10	8.03
OCDD	ng/kg	0.32	27.38	0.59	49.11
2,3,7,8-TCDF	ng/kg	0.35	30.47	0.19	16.02
1,2,3,7,8-PeCDF	ng/kg	0.03	2.89	<0.02	<1.35
2,3,4,7,8-PeCDF	ng/kg	0.11	9.48	0.06	4.77
1,2,3,4,7,8-HxCDF	ng/kg	0.01	1.11	<0.01	0.53
1,2,3,6,7,8-HxCDF	ng/kg	0.01	1.17	<0.01	0.54
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	0.30	<0.01	<0.15
2,3,4,6,7,8-HxCDF	ng/kg	0.03	2.42	0.02	1.40
1,2,3,4,6,7,8-HpCDF	ng/kg	0.03	2.78	0.04	2.92
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	0.32	<0.01	0.07
OCDF	ng/kg	0.04	3.41	0.03	2.76
PCB 77	ng/kg	5.97	517.29	3.58	295.61
PCB 81	ng/kg	0.32	28.12	0.23	18.79
PCB 126	ng/kg	1.76	152.88	0.41	34.27
PCB 169	ng/kg	0.19	16.31	0.09	7.42
PCB 105	µg/kg	0.12	10.2	0.03	2.25
PCB 114	µg/kg	<0.01	0.26	<0.01	0.05
PCB 118	µg/kg	0.49	42.06	0.09	7.23
PCB 123	µg/kg	<0.01	<0.19	<0.01	<0.03
PCB 156	µg/kg	0.03	2.7	<0.01	0.28
PCB 157	µg/kg	0.01	1.13	<0.01	0.26
PCB 167	µg/kg	0.03	2.52	<0.01	0.47
PCB 189	µg/kg	<0.01	0.11	<0.01	0.04
PCB 28	µg/kg	0.01	1.15	0.01	1.2
PCB 52	µg/kg	0.11	9.92	0.03	2.39
PCB 101	µg/kg	0.55	47.78	0.1	8.43
PCB 138	µg/kg	0.67	57.88	0.2	16.38
PCB 153	µg/kg	0.64	55.83	0.24	19.75
PCB 180	µg/kg	0.01	1.13	0.02	1.62
PCB 18	µg/kg	<0.01	0.26	<0.01	0.25
PCB 31	µg/kg	<0.01	0.67	<0.01	0.79
PCB 47	µg/kg	0.02	1.94	0.01	1.03
PCB 49	µg/kg	0.05	4.1	0.02	1.59
PCB 51	µg/kg	<0.01	0.05	<0.01	0.14
PCB 99	µg/kg	0.23	19.63	0.06	4.91
PCB 128	µg/kg	0.12	10.82	0.03	2.31

	FERA LIMS No.	S24-021192		S24-022309	
	Description	Common Mussels, Loch Roag Linngearn, Cliatasay		Pacific Oysters, Kildonan Oysters, Kildonan Bay	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	<0.01	0.72	0.02	1.62
1,2,3,7,8-PeCDD	ng/kg	0.02	3.03	0.08	6.36
1,2,3,4,7,8-HxCDD	ng/kg	0.01	1.70	0.01	1.12
1,2,3,6,7,8-HxCDD	ng/kg	0.02	2.55	0.03	2.50
1,2,3,7,8,9-HxCDD	ng/kg	0.02	1.98	0.03	2.33
1,2,3,4,6,7,8-HpCDD	ng/kg	0.15	18.73	0.10	8.61
OCDD	ng/kg	0.67	85.37	0.36	29.57
2,3,7,8-TCDF	ng/kg	0.10	12.77	0.34	27.79
1,2,3,7,8-PeCDF	ng/kg	0.02	2.13	0.05	4.35
2,3,4,7,8-PeCDF	ng/kg	0.04	5.76	0.14	11.32
1,2,3,4,7,8-HxCDF	ng/kg	0.01	1.61	<0.01	<0.44
1,2,3,6,7,8-HxCDF	ng/kg	<0.01	1.04	0.02	1.46
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	0.22	<0.01	<0.11
2,3,4,6,7,8-HxCDF	ng/kg	0.02	2.13	0.04	3.10
1,2,3,4,6,7,8-HpCDF	ng/kg	0.03	4.40	0.02	1.75
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	0.29	<0.01	<0.14
OCDF	ng/kg	0.04	4.55	0.02	1.53
PCB 77	ng/kg	0.71	91.51	2.21	182.25
PCB 81	ng/kg	0.06	7.51	0.17	14.03
PCB 126	ng/kg	0.27	34.75	0.60	49.53
PCB 169	ng/kg	0.10	13.00	0.16	13.18
PCB 105	µg/kg	<0.01	0.71	<0.07	<5.54
PCB 114	µg/kg	<0.01	0.03	<0.02	<1.39
PCB 118	µg/kg	0.02	2.44	<0.12	<9.96
PCB 123	µg/kg	<0.01	<0.02	<0.01	<0.49
PCB 156	µg/kg	<0.01	0.23	<0.04	<3.06
PCB 157	µg/kg	<0.01	0.1	<0.02	<1.7
PCB 167	µg/kg	<0.01	0.26	<0.03	<2.56
PCB 189	µg/kg	<0.01	0.03	<0.01	<0.27
PCB 28	µg/kg	<0.01	0.48	<0.05	<4.18
PCB 52	µg/kg	<0.01	0.82	<0.09	<7.59
PCB 101	µg/kg	0.02	2.33	<0.11	<9.46
PCB 138	µg/kg	0.05	6.46	<0.16	<13.56
PCB 153	µg/kg	0.07	9.54	<0.16	<13.35
PCB 180	µg/kg	<0.01	0.4	<0.09	<7.34
PCB 18	µg/kg	<0.01	0.21	<0.02	<1.39
PCB 31	µg/kg	<0.01	0.41	<0.04	<3.4
PCB 47	µg/kg	<0.01	0.46	<0.05	<4.22
PCB 49	µg/kg	<0.01	0.48	<0.06	<4.66
PCB 51	µg/kg	<0.01	0.04	<0.01	<0.17
PCB 99	µg/kg	0.01	1.6	<0.1	<8.16
PCB 128	µg/kg	<0.01	0.81	<0.05	<4.53

	FERA LIMS No.	S24-022842		S24-022843	
	Description	Mussels, Gonfirth, Coledeep		Mussels, Aith Voe Sletta, Slyde	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	<0.01	0.60	<0.01	0.67
1,2,3,7,8-PeCDD	ng/kg	0.03	3.08	0.03	2.28
1,2,3,4,7,8-HxCDD	ng/kg	<0.01	0.82	<0.01	0.59
1,2,3,6,7,8-HxCDD	ng/kg	0.03	2.49	0.02	1.07
1,2,3,7,8,9-HxCDD	ng/kg	<0.01	0.98	0.01	0.85
1,2,3,4,6,7,8-HpCDD	ng/kg	0.09	8.77	0.09	6.05
OCDD	ng/kg	0.26	25.50	0.30	20.67
2,3,7,8-TCDF	ng/kg	0.13	13.32	0.19	12.84
1,2,3,7,8-PeCDF	ng/kg	0.02	2.40	0.03	2.18
2,3,4,7,8-PeCDF	ng/kg	0.08	8.20	0.08	5.31
1,2,3,4,7,8-HxCDF	ng/kg	0.01	1.01	0.01	1.00
1,2,3,6,7,8-HxCDF	ng/kg	0.01	1.04	0.01	0.97
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	<0.47	<0.01	<0.29
2,3,4,6,7,8-HxCDF	ng/kg	0.03	2.61	0.03	1.96
1,2,3,4,6,7,8-HpCDF	ng/kg	0.03	3.14	0.04	2.81
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	<0.25	<0.01	<0.2
OCDF	ng/kg	0.04	4.06	0.05	3.07
PCB 77	ng/kg	0.76	75.25	1.06	71.92
PCB 81	ng/kg	0.08	7.65	0.09	5.95
PCB 126	ng/kg	0.34	33.91	0.44	30.20
PCB 169	ng/kg	0.12	11.70	0.16	10.74
PCB 105	µg/kg	<0.07	<7.18	<0.08	<5.5
PCB 114	µg/kg	<0.02	<1.8	<0.02	<1.38
PCB 118	µg/kg	<0.13	<12.91	<0.15	<9.89
PCB 123	µg/kg	<0.01	<0.63	<0.01	<0.48
PCB 156	µg/kg	<0.04	<3.97	<0.04	<3.04
PCB 157	µg/kg	<0.02	<2.2	<0.02	<1.69
PCB 167	µg/kg	<0.03	<3.32	<0.04	<2.54
PCB 189	µg/kg	<0.01	<0.35	<0.01	<0.27
PCB 28	µg/kg	<0.05	<5.42	<0.06	<4.15
PCB 52	µg/kg	<0.1	<9.84	<0.11	<7.53
PCB 101	µg/kg	<0.12	<12.26	<0.14	<9.39
PCB 138	µg/kg	<0.18	<17.58	<0.2	<13.46
PCB 153	µg/kg	<0.17	<17.3	<0.19	<13.24
PCB 180	µg/kg	<0.1	<9.52	<0.11	<7.29
PCB 18	µg/kg	<0.02	<1.8	<0.02	<1.38
PCB 31	µg/kg	<0.04	<4.4	<0.05	<3.37
PCB 47	µg/kg	<0.05	<5.46	<0.06	<4.18
PCB 49	µg/kg	<0.06	<6.04	<0.07	<4.62
PCB 51	µg/kg	<0.01	<0.21	<0.01	<0.16
PCB 99	µg/kg	<0.11	<10.57	<0.12	<8.09
PCB 128	µg/kg	<0.06	<5.87	<0.07	<4.5

	FERA LIMS No.	S24-023621		S24-023622	
	Description	Pacific Oysters, Ardmhor		Cockles, Loch Sligachan, Inner Loch	
	Units	Whole	Fat (%)	Whole	Fat (%)
2,3,7,8-TCDD	ng/kg	0.01	0.81	<0.01	<0.37
1,2,3,7,8-PeCDD	ng/kg	0.07	4.98	<0.01	0.67
1,2,3,4,7,8-HxCDD	ng/kg	0.01	0.93	<0.01	0.19
1,2,3,6,7,8-HxCDD	ng/kg	0.01	0.99	0.01	0.92
1,2,3,7,8,9-HxCDD	ng/kg	<0.01	<0.44	<0.01	0.52
1,2,3,4,6,7,8-HpCDD	ng/kg	0.08	5.51	0.08	6.46
OCDD	ng/kg	0.37	25.79	0.40	32.52
2,3,7,8-TCDF	ng/kg	0.25	17.20	0.02	1.85
1,2,3,7,8-PeCDF	ng/kg	0.03	2.37	<0.01	0.63
2,3,4,7,8-PeCDF	ng/kg	0.11	7.71	0.01	1.13
1,2,3,4,7,8-HxCDF	ng/kg	<0.01	<0.5	0.01	0.94
1,2,3,6,7,8-HxCDF	ng/kg	0.01	0.74	<0.01	0.68
1,2,3,7,8,9-HxCDF	ng/kg	<0.01	<0.26	<0.01	<0.24
2,3,4,6,7,8-HxCDF	ng/kg	0.02	1.22	0.01	1.00
1,2,3,4,6,7,8-HpCDF	ng/kg	0.03	2.04	0.04	2.85
1,2,3,4,7,8,9-HpCDF	ng/kg	<0.01	<0.15	<0.01	<0.5
OCDF	ng/kg	0.02	1.33	0.03	2.65
PCB 77	ng/kg	1.39	97.21	0.47	37.54
PCB 81	ng/kg	0.13	8.76	0.02	1.98
PCB 126	ng/kg	0.48	33.76	0.12	9.31
PCB 169	ng/kg	0.14	9.53	0.07	5.60
PCB 105	µg/kg	<0.07	<4.63	<0.09	<7.49
PCB 114	µg/kg	<0.02	<1.16	<0.02	<1.88
PCB 118	µg/kg	<0.12	<8.32	<0.17	<13.47
PCB 123	µg/kg	<0.01	<0.41	<0.01	<0.66
PCB 156	µg/kg	<0.04	<2.56	<0.05	<4.14
PCB 157	µg/kg	<0.02	<1.42	<0.03	<2.3
PCB 167	µg/kg	<0.03	<2.14	<0.04	<3.46
PCB 189	µg/kg	<0.01	<0.23	<0.01	<0.37
PCB 28	µg/kg	<0.05	<3.49	<0.07	<5.65
PCB 52	µg/kg	<0.09	<6.34	<0.13	<10.26
PCB 101	µg/kg	<0.11	<7.9	<0.16	<12.79
PCB 138	µg/kg	<0.16	<11.32	<0.23	<18.34
PCB 153	µg/kg	<0.16	<11.14	<0.22	<18.05
PCB 180	µg/kg	<0.09	<6.13	<0.12	<9.93
PCB 18	µg/kg	<0.02	<1.16	<0.02	<1.87
PCB 31	µg/kg	<0.04	<2.84	<0.06	<4.59
PCB 47	µg/kg	<0.05	<3.52	<0.07	<5.7
PCB 49	µg/kg	<0.06	<3.89	<0.08	<6.3
PCB 51	µg/kg	<0.01	<0.14	<0.01	<0.22
PCB 99	µg/kg	<0.1	<6.81	<0.14	<11.03
PCB 128	µg/kg	<0.05	<3.78	<0.08	<6.13

NOTE: *where shown i = indicative*

Table 5: PAH concentrations (µg/kg Whole weight)

FERA LIMS No.	S24-000941	S24-001403	S24-003210	S24-003213	S24-004000
Description	Common mussels, Cromarty Firth Mussels	Pacific oysters, Eilean an Atha, Eilean an Atha	Pacific Oysters, Mid Noost	Common mussels, Vementry South, Clousta Voe - Noonsbrough	Common Mussels, Lock Carloway, Carloway Pier
acenaphthylene	0.22	<0.13	<0.14	<0.14	<0.14
acenaphthene	<0.85	<0.85	<0.71	<0.72	<0.73
fluorene	<0.92	<0.92	<0.97	<0.99	<1.00
phenanthrene	2.49	<1.56	<1.27	<1.29	<1.29
anthracene	0.52	<0.11	<0.08	<0.08	<0.08
fluoranthene	2.08	1.79	2.22	<1.07	<1.08
benzo[c]fluorene	<0.13	<0.08	0.07	<0.01	<0.01
pyrene	2.41	<1.62	1.95	<1.41	<1.42
benzo[ghi]fluoranthene	0.49	0.47	0.61	0.21	0.18
benzo[a]anthracene	0.37	0.19	0.43	0.09	0.11
benzo[b]naphtho[2,1-d]thiophene	0.11	0.09	0.11	0.03	0.04
cyclopenta[cd]pyrene	<0.03	0.23	0.04	<0.01	<0.01
chrysene	0.51	0.39	0.60	0.28	0.24
5-methylchrysene	<0.01	<0.01	<0.02	<0.01	<0.01
benzo[b]fluoranthene	0.55	0.98	1.22	0.50	0.40
benzo[j]fluoranthene	0.26	0.25	0.29	0.18	0.14
benzo[k]fluoranthene	0.22	0.34	0.47	0.16	0.14
benzo[e]pyrene	0.68	1.10	1.07	0.43	0.38
benzo[a]pyrene	0.33	0.22	0.27	<0.18	<0.19
indeno[1,2,3-cd]pyrene	<0.31	<0.20	<0.27	<0.25	<0.22
dibenz[a,h]anthracene	<0.13	<0.13	<0.10	<0.11	<0.11
benzo[ghi]perylene	0.35	0.24	0.29	0.33	0.22
anthanthrene	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,l]pyrene	<0.33	<0.33	<0.32	<0.33	<0.33
dibenzo[a,e]pyrene	<0.17	<0.15	<0.16	<0.16	<0.17
dibenzo[a,i]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,h]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10
coronene	0.14	<0.10	<0.10	0.14	<0.10
PAH 4 Sum LB	**1.76**	**1.78**	**2.52**	**0.87**	**0.75**
PAH 4 Sum UB	**1.76**	**1.78**	**2.52**	**1.05**	**0.94**

FERA LIMS No.	S24-004001	S24-004117	S24-004900	S24-004901	S24-005096
Description	Mussels, Gruting Voe, Braewick Voe	Mussels, Clift Sound Whal Wick, Wester Quarf	Cockles, Loch Portree Cockles, Loch Portree	Mussels, Dales Voe Foraness, West Taing	Pacific Oysters, Loch Leurbost Crosbost, Site 1 Crosbost
acenaphthylene	<0.14	<0.16	0.61	<0.48	<0.48
acenaphthene	<0.72	<0.72	<1.12	<1.12	<1.12
fluorene	<0.99	<0.99	<2.63	<2.62	<2.62
phenanthrene	1.90	4.86	<2.75	<2.74	<2.74
anthracene	<0.08	2.51	<0.20	<0.20	<0.20
fluoranthene	1.49	<1.07	<3.48	<3.47	<3.48
benzo[c]fluorene	<0.01	0.05	<0.51	<0.51	<0.51
pyrene	<1.42	<1.42	<2.92	<2.91	<2.91
benzo[ghi]fluoranthene	0.29	0.18	<0.37	<0.20	0.70
benzo[a]anthracene	0.12	<0.19	0.23	0.13	0.42
benzo[b]naphtho[2,1-d]thiophene	0.03	<0.14	<0.35	<0.34	<0.35
cyclopenta[cd]pyrene	0.01	<0.03	<0.08	<0.08	<0.08
chrysene	0.32	0.31	0.20	0.33	0.46
5-methylchrysene	<0.01	<0.01	<0.12	<0.12	<0.12
benzo[b]fluoranthene	0.70	<0.37	0.41	0.70	2.19
benzo[j]fluoranthene	0.26	0.23	0.26	0.30	0.53
benzo[k]fluoranthene	0.26	<0.38	0.30	0.27	0.83
benzo[e]pyrene	0.72	0.57	0.53	0.90	2.04
benzo[a]pyrene	0.20	<0.19	0.42	<0.24	0.30
indeno[1,2,3-cd]pyrene	<0.30	<0.33	0.39	0.36	0.37
dibenzo[ah]anthracene	<0.11	<0.11	<0.17	<0.17	<0.17
benzo[ghi]perylene	0.39	0.36	0.38	0.53	0.53
anthanthrene	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,l]pyrene	<0.33	<0.33	<0.33	<0.32	<0.33
dibenzo[a,e]pyrene	<0.17	<0.17	<0.32	<0.32	<0.32
dibenzo[a,i]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,h]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10
coronene	0.16	<0.12	0.15	0.24	0.12
PAH 4 Sum LB	**1.34**	**0.31**	**1.26**	**1.16**	**3.37**
PAH 4 Sum UB	**1.34**	**1.06**	**1.26**	**1.40**	**3.37**

FERA LIMS No.	S24-005193	S24-013182	S24-021192	S24-022309	S24-022842

Description	Mussels, Cliftsound Houss, Houss	Sand Gapers, Loch Ryan west side, Loch Ryan West side	Common Mussels, Loch Roag Linngearn, Cliatasay	Pacific Oysters, Kildonan Oysters, Kildonan Bay	Mussels, Gonfirth, Coledeep
acenaphthylene	<0.48	0.18	<0.12	<0.12	<0.33
acenaphthene	<1.11	<0.19	<0.19	<0.20	<0.97
fluorene	<2.59	<0.87	<0.86	<0.87	<1.04
phenanthrene	<2.71	2.64	<1.49	<1.51	<1.29
anthracene	<0.20	0.20	<0.09	<0.09	<0.02
fluoranthene	<3.44	2.55	<1.36	<1.37	<1.04
benzo[c]fluorene	<0.51	0.10	<0.07	0.08	<0.03
pyrene	<2.88	3.42	<1.73	<1.75	<1.61
benzo[ghi]fluoranthene	<0.20	0.78	<0.36	0.77	<0.28
benzo[a]anthracene	0.15	0.24	0.12	0.31	0.11
benzo[b]naphtho[2,1-d]thiophene	<0.34	<0.12	<0.10	0.21	0.03
cyclopenta[cd]pyrene	<0.08	0.03	<0.02	0.03	<0.06
chrysene	0.26	0.38	0.26	0.66	0.23
5-methylchrysene	<0.12	<0.01	<0.01	<0.03	<0.01
benzo[b]fluoranthene	0.75	0.38	0.31	1.66	0.53
benzo[j]fluoranthene	0.30	0.22	0.14	0.39	0.17
benzo[k]fluoranthene	0.25	0.23	0.18	0.67	0.19
benzo[e]pyrene	1.24	0.95	0.39	1.30	0.51
benzo[a]pyrene	0.29	0.23	<0.22	<0.22	<0.19
indeno[1,2,3-cd]pyrene	0.44	<0.29	<0.18	<0.28	<0.28
dibenzo[ah]anthracene	<0.17	<0.27	<0.27	<0.27	<0.11
benzo[ghi]perylene	0.60	0.35	0.20	0.35	0.37
anthanthrene	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,l]pyrene	<0.32	<0.35	<0.35	<0.35	<0.33
dibenzo[a,e]pyrene	<0.32	<0.16	<0.13	<0.12	<0.25
dibenzo[a,i]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10
dibenzo[a,h]pyrene	<0.10	<0.10	<0.10	<0.10	<0.10
coronene	0.19	0.14	<0.10	<0.10	0.12
PAH 4 Sum LB	**1.45**	**1.23**	**0.69**	**2.63**	**0.87**
PAH 4 Sum UB	**1.45**	**1.23**	**0.91**	**2.85**	**1.06**

FERA LIMS No.	S24-022843	S24-023621	S24-023622

Description	Mussels, Aith Voe Sletta, Slyde	Pacific Oysters, Ardmhor	Cockles, Loch Sligachan, Inner Loch
acenaphthylene	<0.12	<0.12	<0.12
acenaphthene	<0.19	<0.20	<0.20
fluorene	<0.86	<0.87	<0.88
phenanthrene	<1.49	<1.51	<1.51
anthracene	<0.09	<0.09	<0.09
fluoranthene	<1.35	<1.37	<1.38
benzo[c]fluorene	0.06	0.08	<0.07
pyrene	<1.72	<1.75	<1.76
benzo[ghi]fluoranthene	0.44	<0.37	<0.36
benzo[a]anthracene	0.18	0.12	0.15
benzo[b]naphtho[2,1-d]thiophene	0.09	<0.11	<0.09
cyclopenta[cd]pyrene	<0.03	0.02	0.01
chrysene	0.39	0.37	0.26
5-methylchrysene	<0.02	<0.01	<0.01
benzo[b]fluoranthene	0.86	0.53	0.32
benzo[j]fluoranthene	0.30	0.12	0.18
benzo[k]fluoranthene	0.31	0.28	0.26
benzo[e]pyrene	0.97	0.53	0.41
benzo[a]pyrene	<0.22	<0.22	0.23
indeno[1,2,3-cd]pyrene	0.41	<0.13	<0.40
dibenzo[ah]anthracene	<0.27	<0.27	<0.27
benzo[ghi]perylene	0.53	0.12	0.34
anthanthrene	<0.10	<0.10	<0.10
dibenzo[a,l]pyrene	<0.34	<0.35	<0.35
dibenzo[a,e]pyrene	<0.15	<0.11	<0.16
dibenzo[a,i]pyrene	<0.10	<0.10	<0.10
dibenzo[a,h]pyrene	<0.10	<0.10	<0.10
coronene	0.18	<0.10	0.17
PAH 4 Sum LB	**1.43**	**1.02**	**0.96**
PAH 4 Sum UB	**1.65**	**1.24**	**0.96**

Table 6: Trace Element Concentrations (mg/kg whole weight)

FERA LIMS No.	S24-000941	S24-001403	S24-003210	S24-003213	S24-004000
Description	Common mussels, Cromarty Firth Mussels	Pacific oysters, Eilean an Atha, Eilean an Atha	Pacific Oysters, Mid Noost	Common mussels, Vementry South, Clousta Voe - Noonsbrough	Common Mussels, Lock Carloway, Carloway Pier
Chromium	0.22	0.06	0.07	0.1	0.29
Manganese	3.85	2.54	2.2	0.58	1.32
Cobalt	0.103	0.024	0.034	0.021	0.049
Nickel	0.23	0.05	0.08	0.11	0.19
Copper	0.91	7.28	5.79	0.69	0.67
Zinc	7.19	134	171	16.4	11.4
Arsenic	1.76	1.92	1.73	1.38	2.06
i-As	0.02	0.02	0.02	0.01	0.04
Selenium	0.49	0.17	0.26	0.3	0.37
Silver	0.004	0.337	0.182	0.01	0.006
Cadmium	0.05	0.093	0.203	0.149	0.107
Mercury	0.01	0.012	0.009	<0.007	0.017
Lead	0.149	0.039	0.031	0.113	0.193

FERA LIMS No.	S24-004001	S24-004117	S24-004900	S24-004901	S24-005096
Description	Mussels, Gruting Voe, Braewick Voe	Mussels, Clift Sound Whal Wick, Wester Quarf	Cockles, Loch Portree Cockles, Loch Portree	Mussels, Dales Voe Foraness, West Taing	Pacific Oysters, Loch Leurbost Crosbost, Site 1 Crosbost
Chromium	0.1	0.11	0.64	0.1	0.09
Manganese	2.75	0.55	1.9	0.65	1.46
Cobalt	0.062	0.023	0.229	0.028	0.022
Nickel	0.14	0.1	3.07	0.12	0.07
Copper	0.89	0.78	0.42	1.03	5.47
Zinc	13.3	14.7	6.2	18.4	160
Arsenic	1.5	1.82	1.4	1.99	1.82
i-As	0.02	0.05	0.09	0.01	0.02
Selenium	0.3	0.32	0.24	0.47	0.26
Silver	0.006	<0.003	0.004	0.006	0.301
Cadmium	0.117	0.083	0.042	0.176	0.199
Mercury	0.008	<0.007	0.009	0.008	0.014
Lead	0.073	0.126	0.058	0.139	0.06

FERA LIMS No.	S24-005193	S24-013182	S24-021192	S24-022309	S24-022842
Description	Mussels, Cliftsound Houss, Houss	Sand Gapers, Loch Ryan west side, Loch Ryan West side	Common Mussels, Loch Roag Linngearn, Cliatasay	Pacific Oysters, Kildonan Oysters, Kildonan Bay	Mussels, Gonfirth, Coledeep
Chromium	0.16	0.27	0.1	0.09	0.11
Manganese	0.73	2.26	0.7	1.97	0.55
Cobalt	0.03	0.126	0.024	0.027	0.027
Nickel	0.12	0.22	0.09	0.09	0.11
Copper	0.87	0.85	0.65	13	0.75
Zinc	20.1	8.43	11.7	200	19.7
Arsenic	2.19	0.97	1.73	2.15	1.89
i- As	0.06	0.02	0.02	0.02	0.01
Selenium	0.36	0.35	0.43	0.32	0.34
Silver	<0.004	0.244	0.007	1.03	0.003
Cadmium	0.096	0.061	0.067	0.261	0.188
Mercury	<0.007	<0.007	0.01	0.015	0.007
Lead	0.161	0.117	0.078	0.067	0.163

FERA LIMS No.	S24-022843	S24-023621	S24-023622
Description	Mussels, Aith Voe Sletta, Slyde	Pacific Oysters, Ardmhor	Cockles, Loch Sligachan, Inner Loch
Chromium	0.24	0.05	0.29
Manganese	0.87	0.97	1.44
Cobalt	0.03	0.023	0.178
Nickel	0.16	0.07	3.14
Copper	0.78	5.81	0.41
Zinc	20.2	143	7.28
Arsenic	2.09	2.06	1.67
i- As	0.02	0.01	0.08
Selenium	0.38	0.34	0.32
Silver	0.005	0.584	0.003
Cadmium	0.117	0.168	0.04
Mercury	0.01	0.013	0.009
Lead	0.202	0.071	0.068

Table 7: PFAS Concentrations (µg/kg whole weight)

FERA LIMS No.		S24-000941	S24-001403	S24-003210	S24-003213	S24-004000
Description	MPL Regulation (EU) 2022/2388	Common mussels, Cromarty Firth Mussels	Pacific oysters, Eilean an Atha, Eilean an Atha	Pacific Oysters, Mid Noost	Common mussels, Vementry South, Clousta Voe - Noonsbrough	Common Mussels, Lock Carloway, Carloway Pier
PFNA	**1.0**	<0.025	<0.025	<0.025	<0.025	<0.025
PFHxS LB	**1.5**	<0.09	<0.09	<0.09	<0.09	<0.09
PFHxS UB		<0.09	<0.09	<0.09	<0.09	<0.09
PFOS LB	**3.0**	<0.18	<0.18	<0.18	<0.18	<0.18
PFOS UB		<0.18	<0.18	<0.18	<0.18	<0.18
PFDA		<0.05	<0.05	<0.05	<0.05	<0.05
PFBS		<0.04	<0.04	<0.04	<0.04	<0.04
PFDoA		<0.05	<0.05	<0.05	<0.05	<0.05
PFHpA		0.27	0.15	0.13	0.09	0.23
PFHxA		0.21	0.12	0.13	0.11	0.19
PFPeA		<0.05	0.14	<0.05	<0.05	<0.05
PFOA	**0.70**	<0.025	<0.025	<0.025	<0.025	<0.025
SUM EU 4 PFAS LB	**5.0**	<0.32	<0.32	<0.32	<0.32	<0.32
SUM EU 4 PFAS UB	**5.0**	<0.32	<0.32	<0.32	<0.32	<0.32

FERA LIMS No.		S24-005193	S24-013182	S24-021192	S24-022309	S24-022842
Description	MPL Regulation (EU) 2022/2388	Mussels, Cliftsound Houss, Houss	Sand Gapers, Loch Ryan west side, Loch Ryan West side	Common Mussels, Loch Roag Linngearn, Cliatasay	Pacific Oysters, Kildonan Oysters, Kildonan Bay	Mussels, Gonfirth, Coledeep
PFNA	**1.0**	<0.025	<0.025	<0.025	<0.025	<0.025
PFHxS LB	**1.5**	<0.09	<0.09	<0.09	<0.09	<0.09
PFHxS UB		<0.09	<0.09	<0.09	<0.09	<0.09
PFOS LB	**3.0**	<0.18	<0.18	<0.18	<0.18	<0.18
PFOS UB		<0.18	<0.18	<0.18	<0.18	<0.18
PFDA		<0.05	<0.05	<0.05	<0.05	<0.05
PFBS		<0.04	<0.04	<0.04	<0.04	<0.04
PFDoA		<0.05	<0.05	<0.05	<0.05	<0.05
PFHpA		0.03	0.42	0.11	0.10	0.28
PFHxA		0.06	0.22	0.09	0.06	0.20
PFPeA		<0.05	<0.05	<0.05	<0.05	<0.05
PFOA	**0.70**	<0.025	<0.025	<0.025	<0.025	<0.025
SUM EU 4 PFAS LB	**5.0**	<0.32	<0.32	<0.32	<0.32	<0.32
SUM EU 4 PFAS UB	**5.0**	<0.32	<0.32	<0.32	<0.32	<0.32

FERA LIMS No.		S24-004001	S24-004117	S24-004900	S24-004901	S24-005096
Description	MPL Regulation (EU) 2022/2388	Mussels, Gruting Voe, Braewick Voe	Mussels, Clift Sound Whal Wick, Wester Quarf	Cockles, Loch Portree Cockles, Loch Portree	Mussels, Dales Voe Foraness, West Taing	Pacific Oysters, Loch Leurbost Crosbost, Site 1 Crosbost
PFNA	**1.0**	<0.025	<0.025	<0.025	<0.025	<0.025
PFHxS LB	**1.5**	<0.09	<0.09	<0.09	<0.09	<0.09
PFHxS UB		<0.09	<0.09	<0.09	<0.09	<0.09
PFOS LB	**3.0**	<0.18	<0.18	<0.18	<0.18	<0.18
PFOS UB		<0.18	<0.18	<0.18	<0.18	<0.18
PFDA		<0.05	<0.05	<0.05	<0.05	<0.05
PFBS		<0.04	<0.04	<0.04	<0.04	<0.04
PFDoA		<0.05	<0.05	<0.05	<0.05	<0.05
PFHpA		0.32	0.26	0.26	0.23	0.14
PFHxA		0.22	0.19	0.19	0.18	0.10
PFPeA		<0.05	<0.05	<0.05	<0.05	<0.05
PFOA	**0.70**	<0.025	<0.025	<0.025	<0.025	<0.025
SUM EU 4 PFAS LB	**5.0**	<0.32	<0.32	<0.32	<0.32	<0.32
SUM EU 4 PFAS UB	**5.0**	<0.32	<0.32	<0.32	<0.32	<0.32

FERA LIMS No.		S24-022843	S24-023621	S24-023622
Description	MPL Regulation (EU) 2022/2388	Mussels, Aith Voe Sletta, Slyde	Pacific Oysters, Ardmhor	Cockles, Loch Sligachan, Inner Loch
PFNA	**1.0**	<0.025	<0.025	<0.025
PFHxS LB	**1.5**	<0.09	<0.09	<0.09
PFHxS UB		<0.09	<0.09	<0.09
PFOS LB	**3.0**	<0.18	<0.18	<0.18
PFOS UB		<0.18	<0.18	<0.18
PFDA		<0.05	<0.05	<0.05
PFBS		<0.04	<0.04	<0.04
PFDoA		<0.05	<0.05	<0.05
PFHpA		1.93	0.04	0.07
PFHxA		1.19	0.06	0.06
PFPeA		<0.05	<0.05	<0.05
PFOA	**0.70**	<0.025	<0.025	<0.025
SUM EU 4 PFAS LB	**5.0**	<0.32	<0.32	<0.32
SUM EU 4 PFAS UB	**5.0**	<0.32	<0.32	<0.32