Water quality toxicant snapshot survey and diffusive gradient thin films September 2023

Theme: Water and Sediment Quality
WAMSI Westport Marine Science Program

WESTERN AUSTRALIAN MARINE SCIENCE INSTITUTION

WESTPORT

Better science **Better decisions**

WAMSI WESTPORT MARINE SCIENCE PROGRAM

WESTERN AUSTRALIAN MARINE SCIENCE INSTITUTION

WESTPORT

ABOUT THE MARINE SCIENCE PROGRAM

The WAMSI Westport Marine Science Program (WWMSP) is a $13.5 million body of marine research funded by the WA Government. The aims of the WWMSP are to increase knowledge of Cockburn Sound in areas that will inform the environmental impact assessment of the proposed Westport development and help to manage this important and heavily used marine area into the future. Westport is the State Government's program to move container trade from Fremantle to Kwinana, and includes a new container port and associated freight, road and rail, and logistics. The WWMSP comprises more than 30 research projects in the biological, physical and social sciences that are focused on the Cockburn Sound area. They are being delivered by more than 100 scientists from the WAMSI partnership and other organisations.

FUNDING SOURCES
The $13.5 million WAMSI Westport Marine Science Program was funded by the Western Australian Government, Department of Transport. WAMSI partners provided significant in-kind funding to the program to increase the value to >$22 million.

DATA
Finalised datasets will be released as open data, and data and/or metadata will be discoverable through Data WA and the Shared Land Information Platform (SLIP).

LEGAL NOTICE
The Western Australian Marine Science Institution advises that the information contained in this publication comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. This information should therefore not solely be relied on when making commercial or other decisions. WAMSI and its partner organisations take no responsibility for the outcome of decisions based on information contained in this, or related, publications.

YEAR OF PUBLICATION
September 2024

This report is part of the project: Water and Sediment Quality Monitoring

CITATION
Wilson, C., Wienczugow, K. (2024). Water quality toxicant snapshot survey and diffusive gradient thin films September 2023. Prepared for the WAMSI Westport Marine Science Program. Western Austra-lian Marine Science Institution, Perth, Western Australia. 104pp.

FRONT COVER IMAGE
Theme: Water and Sediment Quality
Front cover image: Drone image of Cockburn Sound coastline. Photo courtesy of Michael Cuttler (The University of Western Australia).

Contents

The WAMSI Westport Marine Science Program is a $13.5 million body of research that is designed to fill knowledge gaps relating to the Cockburn Sound region. It was developed with the objectives of improving the capacity to avoid, mitigate and offset environmental impacts of the proposed Westport container port development and increase the WA Government's ability to manage other pressures acting on Cockburn Sound into the future. Funding for the program has been provided by Westport (through the Department of Transport) and the science projects are being delivered by the Western Australian Marine Science Institution.

1 Water Quality Toxicant Snapshot Survey and Diffusive Gradient Thin Films

Author/s
Celeste Wilson and Krzysztof Wienczugow

Project
Westport Project 3.1: Water and Sediment Quality Monitoring

Date
February 2024

Executive Summary

Twenty-eight sampling sites were positioned in Owen Anchorage, Cockburn Sound, Warnbro Sound and Deep-Water Channel for the water quality toxicants snapshot survey. Surface and bottom water samples were taken at each site for subsequent laboratory analysis of:

- Metals/metalloids (aluminium (Al), antimony (Sb), arsenic (As), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), vanadium (V) and zinc (Zn))
- Benzene, toluene, ethylbenzene, and xylenes (BTEX)
- Total petroleum hydrocarbons (TPHs)
- Polycyclic aromatic hydrocarbons (PAHs).

Diffusive Gradients in Thin Films (DGT) devices were deployed at a subset of sampling sites mostly concentrating at the inshore sites of Cockburn Sound. The DGTs are passive samplers using a layer of binding agent impregnated in a hydrogel to accumulate analytes of interest (in this case metals). A diffusion layer comprising a diffusive hydrogel and a filter membrane overlays the binding layer. In situ, labile metal ions diffuse through the filter and diffusive gel and bind to the binding layer. After analysis, results provide the in-situ concentration of the labile metals averaged over the time of deployment. The DGT devices were deployed close to the sediment (~ 600 mm above the sediment) at each site for 13 days for the subsequent laboratory analysis of:

- mercury, hexavalent chromium (VI and III), aluminium, cadmium, cobalt, copper, lead, manganese, nickel, silver, zinc.

Between the regular sampling method of dissolved metals/metalloids and passive sampling devices (DGTs) the metal/metalloid toxicants of sites in Owen Anchorage, Cockburn Sound and Warnbro Sound have been shown to be below the 99% species protection guideline values (95% species protection guideline for cobalt) or at background concentrations for both high protection and moderate protection areas. DGT's were not deployed at the marina sites of NH3 or G1 (these sites had the highest copper and zinc concentrations than other sites), although they were below the moderate protection EQG A values. This study highlighted the differences between the different sampling methods particularly for copper and it is recommended that DGTs be deployed for toxicant surveys where copper is a requirement.

For future monitoring, during dredging and post-dredging, it is recommended that both chromium III and chromium VI are measured in the water column and compared to their respective guideline values (ANZG, 2018).

Organic chemicals, including BTEX, PAHs and TPHs were all below laboratory LORs for all sites, depths and protection areas and were the same as those undertaken by McAlpine et al. (2004). BTEX concentrations and most PAH concentrations were below guideline values where available. PAH values at all sites were below the ANZG (2018) guidelines values except for anthracene in which the laboratory LOR (<0.02 µg/L) was higher than the guideline value of 0.01 µg/L. Other PAH's such as chrysene, fluorene etc which don't have EQG's or guideline values were compared to OSPAR Commission (2014) predicted no effects concentrations (PNECs). For the 5-6 ring PAHs (except dibenzo(a,h)anthrancene), benzo(a)pyrene (which has an ANZG (2018) default guideline value) was used to represent the toxicity for the whole group. From these comparisons, all PAH's were below PNECs except for benz(a)anthracene, chrysene and dibenzo(a,h)anthrancene in which the PNEC was lower than the laboratory LOR.

2 Introduction

Cockburn Sound is a semi-enclosed marine embayment located approximately 30 km south of Perth in Western Australia. Industrial development commenced with the establishment of an oil refinery at James Point in 1955 and by 1978, a wide range of industries had been established, among them; blast furnaces, fertiliser manufacturers, iron, steel, alumina and nickel refineries, a grain export terminal, a power station and a number of tanneries. Industrial growth also led to the construction of wharves, breakwaters and the implementation of shipping channel dredging. Between 1973 and 1976, a causeway was erected from the mainland to Garden Island to accommodate a naval base. The Woodman Point Wastewater Treatment Plant was commissioned in the 1960's and between 1966 and 1984, primary treated effluent was discharged into Cockburn Sound through an outlet 1.85 km from the end of Woodman Point.

Increased environmental concerns following nutrient enrichment and a massive dieback of seagrass in Cockburn Sound, led to a number of environmental studies in the 1970's and later during the 1990's. Now there is a summer water quality monitoring program which has continued for over 30 years. During the late 1970's, it was shown that eutrophication within Cockburn Sound was responsible for the large majority of the reduction in seagrass meadows (Chiffings, 1979). At the time, annual nutrient loads from industrial and domestic waste were estimated to be over 2000 tonnes of nitrogen and 1350 tonnes of phosphorus (DEP, 1996). The diversion of the Woodman Point wastewater outfall and improvements in industrial waste treatment resulted in annual discharges falling to 490 tonnes of nitrogen and 55 tonnes of phosphorus by 1994 (DEP, 1996). Two additional sources of nutrients and contaminants have since been studied in Cockburn Sound; contaminated groundwater discharges (Appleyard, 1994) and sediment nutrient release (Bastyan *et al*., 1994). By 2000, annual discharge into the Sound was estimated to be approximately 300 tonnes of nitrogen, the primary sources being groundwater (200 tonnes) and industrial discharge (55 tonnes; DAL, 2001). Since 2000, sub-marine groundwater discharges (SGD) have been further studied with similar estimates (234 ± 88 tonnes) (Smith *et al*., 2003; Loveless and Oldham, 2008). In October 2005, the large fertiliser manufacturer CSBP also diverted their discharge away from Cockburn Sound into the Sepia Depression Ocean Outlet Line (SDOOL). Water quality monitoring has indicated that nutrient concentrations in the Sound have decreased significantly since the late 1970's. There have also been marked improvements in light attenuation and chlorophyll *a* concentrations (Hale *et al*., 1998). Whilst earlier reports into seagrass health and recovery within Cockburn Sound (Kendrick *et al*., 2002) showed no significant improvements, a recent report indicated that the total seagrass cover within Cockburn Sound has increased by 244 ha between 1999 and 2017 (Hovey and Fraser, 2017).

Since 2007, a new range of industries has been established in Cockburn Sound including the Perth Seawater Desalination Plant located north of James Point. There are also approved plans to build a marina with boating facilities as part of the Port Rockingham Marina project at Wanliss Street. In more recent years there has been increased shipping and construction activities around the Australian Marine Complex (AMC) located in the Jervoise Bay area, and particular to this report the proposed Westport Project which seeks to relocate the Port of Fremantle's facilities into Cockburn Sound.

The specific objectives of the water quality snapshot toxicant survey were to:

- Establish a water quality baseline dataset for toxicants.
- Determine any areas of high concentrations of metals or hydrocarbon toxicants in the study area.

The water quality snapshot toxicant survey forms part of a larger program of baseline surveys to determine the current water and sediment quality of the Cockburn Sound and Owen Anchorage areas.

3 Materials and Methods

3.1 Toxicant Snapshot Survey

3.1.1 Sampling Site Locations and Timing of Survey

Sampling was undertaken over two days on the 20 and 21 September 2023. Twenty-eight sampling sites were positioned in Owen Anchorage, Cockburn Sound, Warnbro Sound and Deep-Water Channel (Figure 1 and Table 1). Six sites were in Owen Anchorage, eighteen sites in Cockburn Sound, two in Warnbro Sound and two in Deep-Water Channel.

3.1.2 Sample Collection

The methods outlined in this section follow the Manual of Standard Operating Procedures for Environmental Monitoring against the Cockburn Sound Environmental Quality Criteria (EPA, 2005). At each site water was collected from the surface and bottom water with an externally sprung Niskin bottle. The Niskin was lowered to the appropriate depth and left to equilibrate before capturing the water. The Niskin bottle was approximately 0.5 m in length, therefore water was captured between 0.2 and 0.7 m depth for the surface sample and 0.2 to 0.7 m above the sediment for the bottom sample. The only site in which bottom water was not collected was at the shallow Mangles Bay site (MB).

3.1.3 Sample Processing, Preservation and Storage

Amber glass containers were filled directly from the unfiltered water in the Niskin bottle for hydrocarbon samples, via a spigot at the bottom of the Niskin. The containers for volatile organic carbons contained a sulfuric acid preservative. All hydrocarbon bottles were filled to the brim to exclude air. Metals/metalloids samples were filtered with 0.45 μm polyethersulphone (PES) disposable syringe filters and stored in polypropylene tubes, while mercury was stored in amber glass. All samples were stored on frozen ice bricks for transport to the laboratories.

3.1.4 Chemical Analysis

Toxicant samples were collected in the surface and bottom water at the locations described above for subsequent laboratory analysis of:

- Metals/metalloids (aluminium (Al), antimony (Sb), arsenic (As), boron (B), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), lead (Pb), manganese (Mn), mercury (Hg), molybdenum (Mo), nickel (Ni), selenium (Se), silver (Ag), vanadium (V) and zinc (Zn))
- Benzene, toluene, ethylbenzene, and xylenes (BTEX)
- Total petroleum hydrocarbons (TPHs)
- Polycyclic aromatic hydrocarbons (PAHs)

See Table 2 for chemicals analysed, their holding times and the laboratories that conducted the analyses.

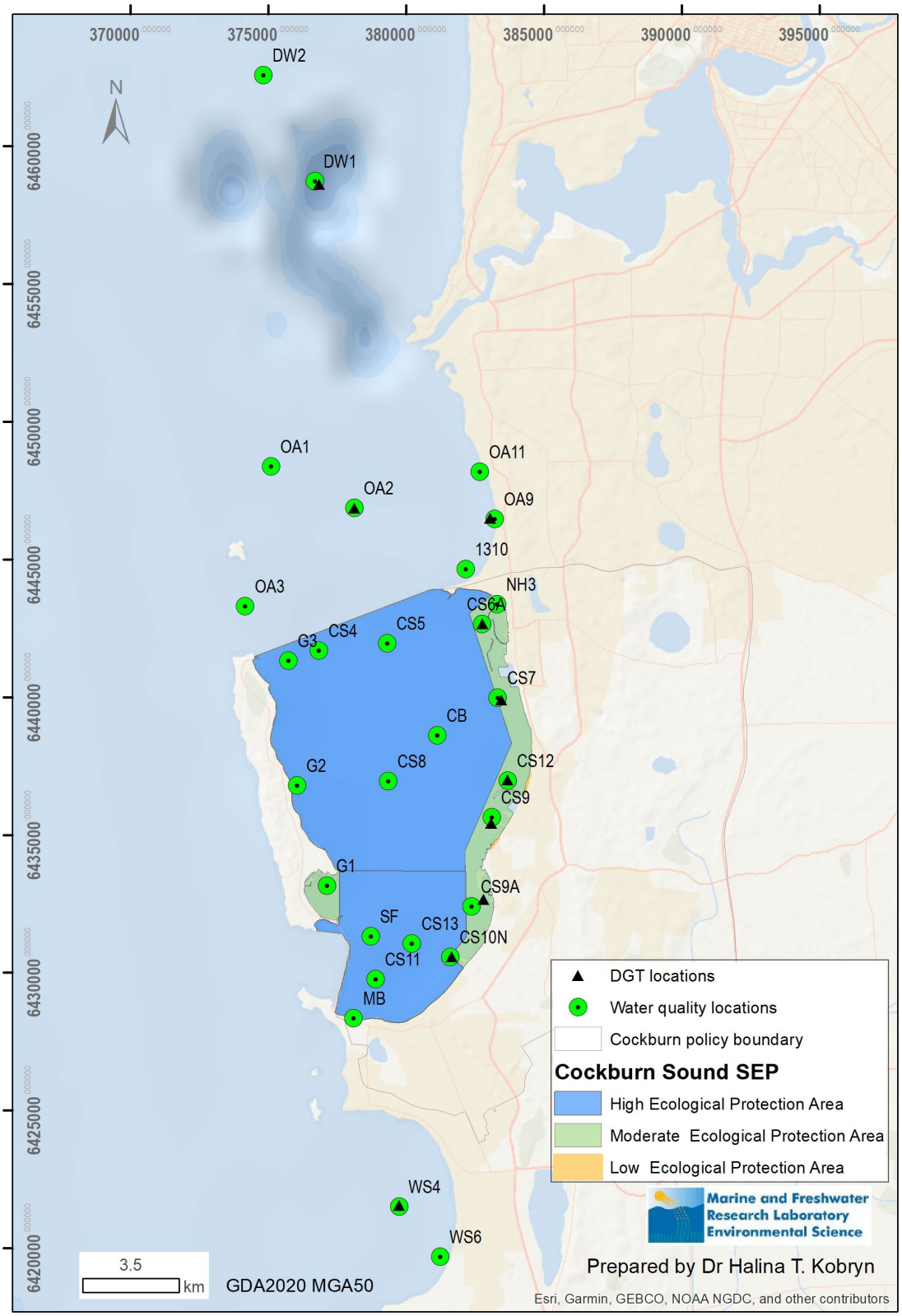

Figure 1. Toxicant sampling sites and DGT locations in Owen Anchorage, Cockburn and Warnbro Sounds and Deep-Water Channel.

Table 1. Toxicant sampling sites, GPS locations (GDA2020 MGA Zone 50), protection area designation and depth.

Site name	Site location	Protection Area	Depth (m)	Easting	Northing
GR1/DW1*	Deep-Water Channel	Reference	18.0	376676	6458727
GR2/DW2	Deep-Water Channel	Reference	18.0	374806	6462578
OA1	Owen Anchorage	High	6.5	375089	6448384
OA2*	Owen Anchorage	High	16.6	378117	6446866
OA3	Owen Anchorage	High	11.7	374151	6443307
OA9*	Owen Anchorage	High	4.1	383210	6446474
1310	Owen Anchorage	High	10.5	382165	6444647
OA11	Owen Anchorage	High	6.5	382672	6448186
CS4	Cockburn Sound northern end deep	High	20.9	376829	6441686
CS5	Cockburn Sound northern end deep	High	18.9	379308	6441958
CS6A*	Outside Northern Harbour	Moderate	10.5	382749	6442651
CS7*	Jervoise Channel south of Southern Harbour	Moderate	10.7	383323	6439972
CS8	Cockburn Sound central basin	High	19.9	379337	6436947
CS9*	Kwinana Bulk Terminal (KBB2)	Moderate	13.0	383098	6435629
CS10N*	Bulk Grain Terminal (CBH)	Moderate	14.0	381593	6430569
CS11	Mangles Bay deep water basin	High	18.0	378890	6429753
CS12*	Calista Channel WC Desalination Plant	Moderate	10.0	383677	6436972
CS9A*	Kwinana Bulk Jetty (KBJ)	Moderate	16.5	382367	6432396
G1	Careening Bay HMAS Stirling	Moderate	15.2	377121	6433158
G2	Garden Island central HMAS Stirling	High	10.2	376039	6436793
G3	Garden Island north HMAS Stirling	High	13.1	375728	6441317
NH3*	Northern Harbour Jervoise Bay	Moderate	9.9	383291	6443373
SF	Southern Flats shallow	High	3.5	378716	6431322
CB	Challenger Beach bank	High	9.3	381133	6438605
CS13	Cockburn Sound southern deep water	High	20.4	380207	6431054
MB	Mangles Bay shallow near shore	High	1.3	378085	6428341
WS4*	Warnbro Sound shallow	Reference	17.3	381234	6419680
WS6	Warnbro Sound basin	Reference	17.0	378637	6421922

*DGT's deployed at these sites

Table 2. Analytical limits of reporting (LOR), guideline values and sample storage, preservation and holding times.

Toxicant category	Toxicant	High protection[1]	Moderate protection[1]	LOR	Storage container	Preservation	Laboratory	Holding
Metals/metalloids	Aluminium (µg/L)[2]	2.1	69	<5	10 mL PP tube	Metal/metalloid samples acidified with nitric acid. Mercury samples acidified with nitric acid and potassium dichromate.	MAFRL	6 months
	Antimony (µg/L)[3]	~0.24	No value	<0.5	10 mL PP tube		MAFRL	6 months
	Arsenic (µg/L)[3]	~1.7	No value	<0.5	10 mL PP tube		MAFRL	6 months
	Boron (µg/L)[3]	~5100	No value	<6	10 mL PP tube		MAFRL	6 months
	Cadmium (µg/L)	0.7	14	<0.1	10 mL PP tube		MAFRL	6 months
	Chromium (µg/L)	7.7 (Cr III)	49 (Cr III)	<0.2	10 mL PP tube		MAFRL	6 months
	Cobalt (µg/L)	1	14	<0.05	10 mL PP tube		MAFRL	6 months
	Copper (µg/L)	0.3	3	<0.2	10 mL PP tube		MAFRL	6 months
	Lead (µg/L)	2.2	6.6	<0.1	10 mL PP tube		MAFRL	6 months
	Manganese (µg/L)[4]	130	660	<0.5	10 mL PP tube		MAFRL	6 months
	Mercury (µg/L)	0.1	0.7	<0.1	120 mL Amber glass		MAFRL	28 days
	Molybdenum (µg/L)[3]	~10	No value	<0.5	10 mL PP tube		MAFRL	6 months
	Nickel (µg/L)	7	200	<0.3	10 mL PP tube		MAFRL	6 months
	Selenium (µg/L)[3]	~3	No value	<1	10 mL PP tube		MAFRL	6 months
	Silver (µg/L)	0.8	1.8	<0.1	10 mL PP tube		MAFRL	6 months
	Vanadium (µg/L)	50	160	<0.3	10 mL PP tube		MAFRL	6 months
	Zinc (µg/L)[5]	3.3	12	<1	10 mL PP tube		MAFRL	6 months
Aromatic Hydrocarbons	Benzene (µg/L)[5]	600	1300	<1	Amber glass jars	Chill	ALS	7 days
	Toluene (µg/L)[5]	110	230	<2	Amber glass jars	Chill	ALS	7 days
	Ethylbenzene (µg/L)[5]	50	110	<2	Amber glass jars	Chill	ALS	7 days
	Xylenes (µg/L)[6]	390	820	<2	Amber glass jars	Chill	ALS	7 days
Polycyclic Aromatic Hydrocarbons	Naphthalene (µg/L)[5]	50	90	<0.02	Amber glass jars	Chill	ALS	7 days
	Acenaphthylene (µg/L)[7]	0.38	-	<0.02	Amber glass jars	Chill	ALS	7 days
	Acenaphthene (µg/L)[7]	0.13	-	<0.02	Amber glass jars	Chill	ALS	7 days
	Fluorene (µg/L)[7]	0.25	-	<0.02	Amber glass jars	Chill	ALS	7 days
	Phenanthrene (µg/L)[5]	0.6	4	<0.02	Amber glass jars	Chill	ALS	7 days
	Anthracene (µg/L)[5]	0.01	1.5	<0.02	Amber glass jars	Chill	ALS	7 days
	Fluoranthene (µg/L)[5]	1	1.7	<0.02	Amber glass jars	Chill	ALS	7 days
	Pyrene (µg/L)[7]	0.023	-	<0.02	Amber glass jars	Chill	ALS	7 days

	Benz(a)anthracene (µg/L)[7]	0.0012	-	<0.02	Amber glass jars	Chill	ALS	7 days
	Chrysene (µg/L)[7]	0.007	-	<0.02	Amber glass jars	Chill	ALS	7 days
	Benzo(b+j)fluoranthene (µg/L)[7]	0.1	0.4	<0.02	Amber glass jars	Chill	ALS	7 days
	Benzo(k)fluoranthene (µg/L)[7]	0.1	0.4	<0.02	Amber glass jars	Chill	ALS	7 days
	Benzo(a)pyrene (µg/L)[5]	0.1	0.4	<0.005	Amber glass jars	Chill	ALS	7 days
	Indeno(1.2.3.cd)pyrene (µg/L)[7]	0.1	0.4	<0.02	Amber glass jars	Chill	ALS	7 days
	Dibenz(a.h)anthracene (µg/L)[7]	0.00014	-	<0.02	Amber glass jars	Chill	ALS	7 days
	Benzo(g.h.i)perylene (µg/L)[7]	0.1	0.4	<0.02	Amber glass jars	Chill	ALS	7 days
Total petroleum Hydrocarbons	C6 – C36 (sum)[7]	70.5	-	<220	Amber glass jars	Chill	ALS	7 days

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004)
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
[6] ANZECC/ARMCANZ 2000 low reliability trigger value.
[7] OSPAR Commission (2014) Predicted No Effect Concentrations.

3.1.5 Field Quality Control procedures

To test for site variability and the potential for sample contamination during collection, storage or transport, the following quality control regime was undertaken:

- 2 x duplicates
- 1 x transport blank
- 1 x field blank

The QA/QC measurement performance criteria and the number of QA/QC samples collected during this survey is summarised in Table 3. A summary of the assessment of all field and laboratory data quality procedures and indicators is provided in Section 4.1.

Table 3. Measurement performance criteria and summary of QA/QC samples collected.

Type	Data Quality Indicators	Frequency	Number of samples collected	Performance Criteria
Transport blank	Accuracy Bias Contamination during transport	One transport blank	One	No analytes detected > ½ limit of reporting (LOR) or > 1/10 sample concentration, whichever is greater
Field blank	Accuracy Bias Contamination during sampling process	One field blank	One	No analytes detected > ½ limit of reporting (LOR) or > 1/10 sample concentration, whichever is greater
Field duplicate	Variation	One field replicate for each analysis per 10 sampling locations	Two	Relative percentage difference (RPD) < 50%

Procedural and record-keeping quality control measures implemented were:

- GPS waypoints were recorded for all sampling sites.
- Water depths, times, dates, samples collected and in situ observations were also recorded onto field sheets (Appendix 2).
- Appropriate chain of custody forms to accompany samples were completed for each laboratory.
- Any changes to the field procedures were documented.

3.1.6 Data Analysis

EPA (2017) recommends comparison of data against environmental quality guidelines (EQG). Specifically, the 95th percentile of the sample concentration from a single site or a defined area (either from one sampling run or all samples over an agreed period of time) should not exceed the environmental quality guideline value (test against EQG A). In addition, where there are mixtures of toxicants the total toxicity of the mixture (TTM) at a single site or for a defined area (either from one sampling run or all samples over an agreed period of time) should not exceed 1 using the TTM formula (EQG B). For the protection areas, the sites assigned to specific protection areas included:

- Owen Anchorage sites were assigned to a high protection area and included OA1, OA2, OA3, OA9, 1310 and OA11.
- Cockburn Sound high protection area separated into northern and southern areas and included sites CS4, CS5, CB, CS8, G2 and G3 in the northern HPA and sites CS11, CS13, SF and MB in the southern HPA.

- Cockburn Sound moderate protection area included sites CS6A, CS7, CS12, CS9, CS9A and CS10N.
- Marinas and harbours in the Cockburn Sound moderate protection area considered separately and consisted of sites NH3 and G1.
- Warnbro Sound high protection area included sites WSSB and WS4.
- Deep-Water Channel high protection area included sites GR1 and GR2.

For contaminants below the laboratory limit of reporting (LOR) the LOR was used in calculations against the EQG. The 95th percentile of each toxicant from each of the protection areas defined above were compared to the EQG A unless there were only a couple of sites, then the toxicant concentration of each site was considered individually.

3.2 Diffusive Gradients in Thin Films

3.2.1 Sampling Site Locations and Timing of Survey

Diffusive gradients in thin films (DGTs) were deployed on the 8 September 2023 and retrieved 13 days later on the 21 September 2023. DGTs were deployed at 10 sites in Owen Anchorage, Cockburn Sound, Warnbro Sound and Deep Water Channel (Figure 1 and Table 1). Sites were generally inshore, with locations similar to the snapshot survey but were adjusted so that the DGT setup was greater than 50 m from any Fremantle Ports infrastructure.

3.2.2 Sample Collection

DGTs were deployed in duplicate (Figure 2), encased in plastic cages, cable tied to the top of a fiberglass stake which was pushed or hammered into the sediment at each site by a diver, so that they were approximately 600 mm above the sediment surface (Figure 3). At each site three cages (with two DGTs in each) were deployed to achieve the sampling of different metals, one cage for mercury, one for hexavalent chromium VI and one for other metals (aluminum, cadmium, cobalt, chromium III, copper, lead, manganese, nickel, silver, zinc). Temperature of the water at each site was measured on deployment and retrieval of the DGTs with a YSI multiparameter water quality sonde (6920 V2). The DGTs at the Deep-Water Channel site were unable to be retrieved and it was speculated that the storm event on the 13 of September (NNW wind gusts over 110 km/hr) dislodged the stake and the DGTs were lost.

3.2.3 Sample Processing, Preservation and Storage

Upon retrieval each DGT was removed from its cage and rinsed with ultrapure water, taking care not to touch the filter face, placed in a labelled ziplock bag and placed on ice bricks for transport back to the laboratory.

3.2.4 Chemical Analysis

In the laboratory the DGT devices were disassembled under clean conditions. The metals of interest were extracted from the binding layer and the accumulated metals were measured by routine methods (ICP MS). The accumulated metals after water temperature corrections and length of time deployed, was used to calculate the time-weighted average concentration of each of the metals in the water at each site. The formula's used to calculate the DGT measured concentration for each metal was as follows:

- First calculate the mass of metal accumulated in the binding gel layer (M) using the equation $M = Ce(VHN0_3 + Vgel/fe$

  Where Ce is the concentration of metals in 1M $HN0_3$ elution solution, $VHN0_3$ is the volume of $HN0_3$ added to the binding gel. Vgel is the volume of the binding gel, typically 0.15 ml and fe is the elution factor for each metal, typically 0.8.

- Next the concentration of metal measured by the DGT (CDGT) can be calculated using

  $CDGT = M\Delta g/(DtA)$

Where Δg is the thickness of the diffusive gel (0.08 cm) plus the thickness of the filter membrane (0.014 cm), D is the diffusive coefficient of metal in the gel (the average water temperature in the field upon deployment and retrieval is used in the calculation for the diffusion coefficient), t is the deployment time and A is the exposure area (3.14 cm^2).

Figure 2. Duplicate DGTs set in their cage.

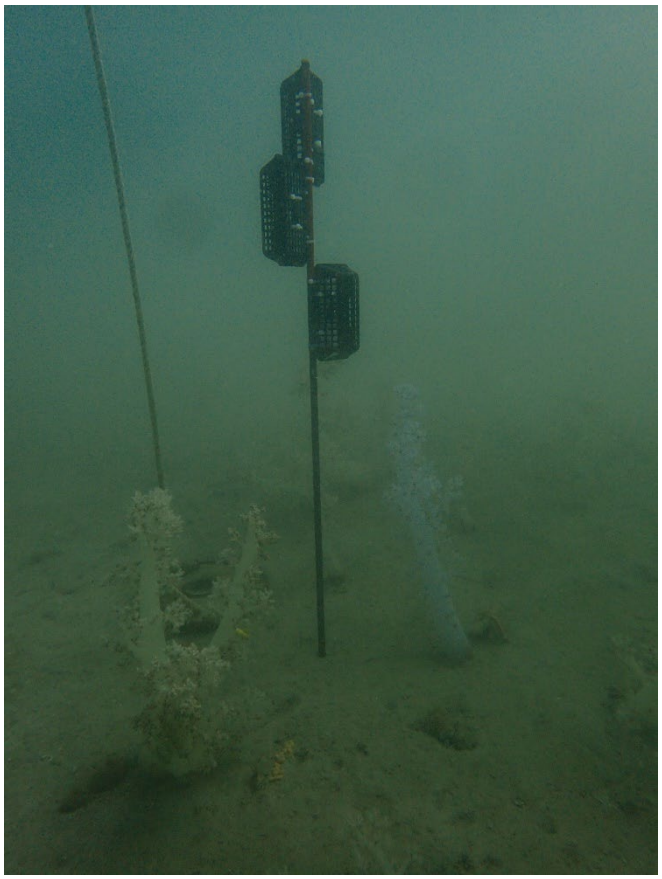

Figure 3. DGT cages deployed at site CS6A.

3.2.5 Field Quality Control procedures

Field blanks of the DGTs were taken into the field, removed from their ziplock bag and exposed to the air, then replaced into the bag. They were kept refrigerated in the laboratory until the return of the field deployed DGT samples. They were then treated the same way as the other samples in terms of processing and analysing. Field blanks were also carried out in duplicate (see Appendix 1 for field blank results).

3.2.6 Data Analysis

The results from the DGTs at all sites in which they were placed (regardless of protection zone) were compared to the ANZG (2018) default guideline values for 99% species protection.

4 Results

4.1 Toxicants

4.1.1 Quality Control Assessment

The samples reached the laboratories within their required holding times (see Table 2 and Appendix 1), however, the ALS laboratory extracted the majority of samples (except for GR1 and GR2) one day later than required for total petroleum hydrocarbons (TPH) and also one day later for polycyclic petroleum hydrocarbons (PAH) for sites MB, WS4, WS6, SF, G1, G2 and CS8. Benzene, toluene, ethylbenzene and xylenes (BTEX) were extracted within the correct holding time for all sites. The late extraction may have affected the concentrations reported. However, the analytes making up TPH that are most subject to biological degradation (e.g. aromatic hydrocarbons - BTEX) were analysed within holding time (< 7 days) and the semi-volatile organics (PAH) were, at the majority of sites, also analysed within holding times, with all results below laboratory reporting limits, therefore, it is unlikely that TPH results would have changed if analysed earlier. The quality control undertaken by each laboratory is provided in Appendix 1.

The field and transport blank results showed no contamination due to the sampling process or the transport and storage of samples; all results were below the laboratory limits of reporting (Appendix 1).

Duplicates in this context are parallel measurements of distinct samples that capture random variation (see Table 3). For the duplicates the performance criterion was that the relative percentage difference (RPD) of the two separate sample results was less than 50%, which was achieved for everything except for zinc for one of the samples and copper for one of the samples, however, as the results were 1 µg/L and 2 µg/L for zinc and 1 µg/L and 0.6 µg/L for copper, the differences were considered to be within site variability (Table 4).

The field sheet in Appendix 2 notes field conditions (weather), sampling locations, water quality analytes sampled, water quality description, date and time of sampling, and identity of samplers.

Table 4. Relative percentage difference (RPD) for within laboratory analysis.

QA/QC	Duplicate	Duplicate
Analyte	Site NH3 surface (RPD %)	Site NH3 bottom (RPD %)
Aluminium	<LOR	<LOR
Antimony	<LOR	<LOR
Arsenic	0	2
Boron	4	4
Cadmium	<LOR	<LOR
Chromium	<LOR	<LOR
Cobalt	<LOR	<LOR
Copper	17	**50**
Lead	<LOR	<LOR
Manganese	12	13
Mercury	<LOR	<LOR
Molybdenum	1	1
Nickel	<LOR	<LOR
Selenium	<LOR	<LOR
Silver	<LOR	<LOR
Vanadium	6	0
Zinc	0	**67**
TPH (C10- C36 sum)	<LOR	<LOR
PAH (sum)	<LOR	<LOR
BTEX	<LOR	<LOR

NOTES:

<LOR - indicates concentrations were below the LOR and therefore RPD was not calculated.

Numbers in bold indicate the RPD was greater than the performance criterion.

4.1.2 Metals/metalloids

There were a number of metals/metalloids that were below the laboratory limit of reporting (LOR) and the EQG for all sites, depths and protection areas including cobalt, nickel, silver, cadmium and mercury (Table 5 to Table 12).

Lead concentrations were generally below the LOR or just detectable at site CB and NH3 but below the EQG for all sites, depths, and protection areas. Similarly zinc concentrations were below the laboratory LOR or detectable at sites NH3 and CS7 but below the EQG for all sites, depths, and protection areas.

Vanadium concentrations ranged from 1.6 to 1.9 µg/L at all sites, well below the high protection EQG of 50 µg/L. Manganese concentrations ranged from <0.5 to 0.9 ug/L at all sites well below of the 99% species protection guideline derived by Stauber et al. (2008) of 130 µg/L.

Chromium concentrations in this study were compared to the chromium III low reliability guidelines, even though the chromium VI guideline reliability was very high. In marine and estuarine conditions, the high sulphate concentrations make chromium VI toxicity unlikely, except at very polluted sites

(ANZECC/ARMCANZ 2000). The estimated natural background concentration of chromium (total dissolved) for Perth marine waters was considered by McAlpine et al. (2004) to be 0.2 µg/L. The chromium concentrations at all sites in this study were 0.2 µg/L or less than 0.2 µg/L. For future monitoring, during dredging and post-dredging, it is recommended that both chromium III and chromium VI are measured in the water column and compared to their respective guideline values (ANZG, 2018).

Some metal/metalloids have no EQG, including antimony, arsenic, boron, molybdenum and selenium. Average background concentrations for arsenic, boron and molybdenum or low reliability values for antimony and selenium have been added to the tables below. McAlpine et al. (2004) sampled Perth coastal waters in 2003 for several different metals including arsenic. The arsenic concentrations ranged from 1.6 to 1.8 µg/L. In this survey the arsenic concentrations ranged from 1.6 to 1.9 µg/L, therefore considered very similar over time. The established background concentration for boron is around 5100 µg/L (ANZECC/ARMCANZ 2000). The concentrations of boron in this study ranged from 4800 to 5400 µg/L, with an average of 5150 µg/L. Therefore, it was considered that boron in this study was at background concentrations for all sites. Molybdenum occurs naturally in seawater at around 10 µg/L (ANZECC/ARMCANZ 2000). The concentrations of molybdenum in this study ranged from 9.9 to 11 µg/L, therefore considered to be at background concentrations. The low reliability value for antimony (III) for marine waters was 270 µg/L (ANZECC/ARMCANZ 2000) and an unknown default guideline value for antimony (total) of 9 µg/L for freshwater (ANZG 2018). Antimony concentrations in this study were all below the laboratory LOR of 0.5 µg/L. The antimony (total) seawater world average concentration is 0.18 µg/L (mean surface seawater concentration in publications from 1985 to 2001) and typical concentrations of total dissolved antimony are usually less than 1 µg/L in non-polluted waters (Filella et al, 2001). The low reliability value for selenium (total) is 3 µg/L (ANZECC/ARMCANZ 2000). In this study selenium concentrations were all below the laboratory LOR of 1 µg/L.

Aluminium concentrations at all sites were below the laboratory LOR of 5 µg/L. However, the 99% species guideline value derived by Golding et al. (2015) was 2.1 µg/L. Therefore, it is unknown if the guideline value was exceeded or not. However, the aluminium concentrations were well below the 95% species protection of 24 µg/L.

Copper concentrations ranged from <0.2 µg/L at a few sites to 1.3 µg/L at site NH3. The copper concentrations at the sites in the moderate protection areas were below the EQG of 3 µg/L, but many of the sites in the high protection areas had copper concentrations either equalling the EQG of 0.3 µg/L or were above. Sites with copper concentrations above the EQG included:

- OA11 with copper concentrations of 0.6 µg/L in the surface water and 0.3 µg/L in the bottom water.
- CS8 with copper concentrations of 0.3 µg/L in the surface water and 0.4 µg/L in the bottom water.
- CB with copper concentrations of 0.4 µg/L in the surface water and 0.4 µg/L in the bottom water.
- G2 with copper concentrations of 0.5 µg/L in the surface water and 0.4 µg/L in the bottom water.
- MB with a copper concentration of 0.5 µg/L in the surface water.
- CS13 with copper concentrations of 0.3 µg/L in the surface water and 0.4 µg/L in the bottom water.
- WS6 with copper concentrations of 0.4 µg/L in the surface water and 0.2 µg/L in the bottom water.

Copper concentrations were highest at the marina sites of G1 and NH3.

Table 5. Metal/metalloid toxicant concentrations in surface water from Owen Anchorage.

Contaminant	Units	Guideline value	Owen Anchorage high protection area						
		EQG A[1]	OA1	OA2	OA3	OA9	1310	OA11	95%ile
Aluminium	µg/L	2.1[2]	<5	<5	<5	<5	<5	<5	<5
Antimony	µg/L	~0.24[3]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	µg/L	~1.7[3]	1.7	1.8	1.8	1.8	1.9	1.8	1.9
Boron	µg/L	~5100[3]	5300	5200	5000	5100	5400	5000	5375
Cadmium	µg/L	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	µg/L	7.7	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	0.2
Cobalt	µg/L	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	µg/L	0.3	0.2	0.3	<0.2	0.3	0.3	**0.6**	**0.54**
Lead	µg/L	2.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	µg/L	130[4]	<0.5	<0.5	<0.5	0.7	0.8	0.8	0.8
Mercury	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	µg/L	~10[3]	11	11	11	11	11	11	11
Nickel	µg/L	7	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Selenium	µg/L	~3[3]	<1	<1	<1	<1	<1	<1	<1
Silver	µg/L	0.8	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1
Vanadium	µg/L	50	1.8	1.7	1.8	1.9	1.9	1.9	1.9
Zinc	µg/L	3.3[5]	<1	<1	<1	<1	<1	<1	<1

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004) or low reliability
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
Note: Data in bold has exceeded the EQG

Table 6. Metal/metalloid toxicant concentrations in bottom water from Owen Anchorage.

Contaminant	Units	Guideline value	Owen Anchorage high protection area						
		EQG A[1]	OA1	OA2	OA3	OA9	1310	OA11	95%ile
Aluminium	µg/L	2.1[2]	<5	<5	<5	<5	<5	<5	<5
Antimony	µg/L	~0.24[3]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	µg/L	~1.7[3]	1.8	1.7	1.8	1.8	1.8	1.8	1.8
Boron	µg/L	~5100[3]	4800	5100	5100	5200	5100	5100	5175
Cadmium	µg/L	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	µg/L	7.7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Cobalt	µg/L	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	µg/L	0.3	<0.2	<0.2	0.3	0.3	0.3	0.3	0.3
Lead	µg/L	2.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	µg/L	130[4]	<0.5	<0.5	<0.5	0.8	0.8	0.7	0.8
Mercury	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	µg/L	~10[3]	11	11	11	11	11	11	11
Nickel	µg/L	7	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Selenium	µg/L	~3[3]	<1	<1	<1	<1	<1	<1	<1
Silver	µg/L	0.8	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1
Vanadium	µg/L	50	1.8	1.8	1.8	1.8	1.7	1.8	1.8
Zinc	µg/L	3.3[5]	<1	<1	<1	<1	<1	<1	<1

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004)
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
Note: Data in bold has exceeded the EQG

Table 7. Metal/metalloid toxicant concentrations in surface water from Cockburn Sound high protection area

Contaminant	Units	Guideline value	Cockburn Sound high protection area - north							Cockburn Sound high protection area - south				
		EQG A[1]	CS4	CS5	CB	CS8	G2	G1	95%ile	CS11	CS13	SF	MB	95%ile
Aluminium	µg/L	2.1[2]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Antimony	µg/L	~0.24[3]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	µg/L	~1.7[3]	1.8	1.8	1.8	1.7	1.7	1.8	1.8	1.7	1.8	1.7	1.8	1.8
Boron	µg/L	~5100[3]	4900	4900	5100	5200	5100	5300	5275	5400	5200	5300	5100	5385
Cadmium	µg/L	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	µg/L	7.7	<0.2	<0.2	0.2	<0.2	<0.2	<0.2	0.2	<0.2	0.2	0.2	<0.2	0.2
Cobalt	µg/L	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	µg/L	0.3	0.3	0.3	**0.4**	0.3	**0.5**	0.3	**0.48**	0.3	0.3	0.3	**0.5**	**0.47**
Lead	µg/L	2.2	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	µg/L	130[4]	0.6	0.7	0.6	0.6	0.7	0.6	0.7	0.6	0.7	0.6	0.9	0.87
Mercury	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	µg/L	~10[3]	10	10	10	10	10	10	10	10	10	10	10	10
Nickel	µg/L	7	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Selenium	µg/L	~3[3]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Silver	µg/L	0.8	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1
Vanadium	µg/L	50	1.8	1.7	1.6	1.6	1.6	1.8	1.8	1.6	1.6	1.6	1.7	1.7
Zinc	µg/L	3.3[5]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004)
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
Note: Data in bold has exceeded the EQG

Table 8. Metal/metalloid toxicant concentrations in bottom water from Cockburn Sound high protection area

Contaminant	Units	Guideline value	Cockburn Sound high protection area - north							Cockburn Sound high protection area - south			
		EQG A[1]	CS4	CS5	CB	CS8	G2	G1	95%ile	CS11	CS13	SF	95%ile
Aluminium	µg/L	2.1[2]	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Antimony	µg/L	~0.24[3]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	µg/L	~1.7[3]	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Boron	µg/L	~5100[3]	5000	5000	5300	5200	5100	5200	5275	5400	5100	5100	5370
Cadmium	µg/L	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	µg/L	7.7	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	0.2
Cobalt	µg/L	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	µg/L	0.3	<0.2	0.2	**0.4**	**0.4**	**0.4**	0.3	**0.4**	0.3	**0.4**	0.2	**0.39**
Lead	µg/L	2.2	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1
Manganese	µg/L	130[4]	<0.5	0.5	0.7	0.6	0.7	0.5	0.7	0.7	0.7	0.6	0.7
Mercury	µg/L	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	µg/L	~10[3]	10	10	10	10	10	10	10	10	10	10	10
Nickel	µg/L	7	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Selenium	µg/L	~3[3]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Silver	µg/L	0.8	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	0.1	<0.1	<0.1
Vanadium	µg/L	50	1.8	1.8	1.6	1.7	1.6	1.6	1.8	1.7	1.6	1.7	1.7
Zinc	µg/L	3.3[5]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004)
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
Note: Data in bold has exceeded the EQG

Table 9. Metal/metalloid toxicant concentrations in surface water from Cockburn Sound moderate protection area

Contaminant	Units	Guideline value	Cockburn Sound moderate protection area						
		EQG A[1]	CS6A	CS7	CS12	CS9	CS9A	CS10	95%ile
Aluminium	µg/L	69[2]	<5	<5	<5	<5	<5	<5	<5
Antimony	µg/L	~0.24[3]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	µg/L	~1.7[3]	1.8	1.7	1.8	1.8	1.8	1.7	1.8
Boron	µg/L	~5100[3]	5200	5200	5300	5200	5000	5200	5275
Cadmium	µg/L	14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	µg/L	49	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	0.2
Cobalt	µg/L	14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	µg/L	3	0.4	0.5	0.6	0.4	0.4	0.5	0.6
Lead	µg/L	6.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	µg/L	660[4]	0.7	0.7	0.8	0.8	0.8	0.7	0.8
Mercury	µg/L	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	µg/L	~10[3]	10	10	10	10	10	10	10
Nickel	µg/L	200	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Selenium	µg/L	~3[3]	<1	<1	<1	<1	<1	<1	<1
Silver	µg/L	1.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	µg/L	160	1.8	1.8	1.7	1.7	1.7	1.6	1.8
Zinc	µg/L	12[5]	<1	<1	<1	<1	<1	<1	<1

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004)
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
Note: Data in bold has exceeded the EQG

Table 10. Metal/metalloid toxicant concentrations in bottom water from Cockburn Sound moderate protection area

Contaminant	Units	Guideline value	Cockburn Sound moderate protection area						
		EQG A[1]	CS6A	CS7	CS12	CS9	CS9A	CS10	95%ile
Aluminium	µg/L	69[2]	<5	<5	<5	<5	<5	<5	<5
Antimony	µg/L	~0.24[3]	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Arsenic	µg/L	~1.7[3]	1.8	1.7	1.8	1.8	1.8	1.7	1.8
Boron	µg/L	~5100[3]	5200	5000	5200	5200	5200	5300	5275
Cadmium	µg/L	14	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chromium	µg/L	49	<0.2	<0.2	<0.2	0.2	<0.2	<0.2	0.2
Cobalt	µg/L	14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	µg/L	3	0.3	0.6	0.4	0.4	0.3	0.6	0.6
Lead	µg/L	6.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	µg/L	660[4]	0.7	0.7	0.8	0.8	0.8	0.7	0.8
Mercury	µg/L	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	µg/L	~10[3]	10	10	10	10	10	10	10
Nickel	µg/L	200	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Selenium	µg/L	~3[3]	<1	<1	<1	<1	<1	<1	<1
Silver	µg/L	1.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	µg/L	160	1.8	1.8	1.6	1.7	1.7	1.7	1.8
Zinc	µg/L	12[5]	<1	1	<1	<1	<1	<1	1

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004)
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
Note: Data in bold has exceeded the EQG

Table 11. Metal/metalloid toxicant concentrations in surface water from Cockburn Sound moderate protection area (marinas and harbours), Warnbro Sound high protection area and Deep-Water Channel high protection area.

Contaminant	Units	Guideline value	Cockburn Sound moderate protection area		Guideline value	Warnbro Sound high protection area		Deep-Water Channel high protection area	
		EQG A[1]	NH3*	G1	EQG A[1]	WS4	WS6	GR1	GR2
Aluminium	µg/L	69[2]	<5	<5	2.1[2]	<5	<5	<5	<5
Antimony	µg/L	~0.24[3]	<0.5	<0.5	~0.24[3]	<0.5	<0.5	<0.5	<0.5
Arsenic	µg/L	~1.7[3]	1.8	1.8	~1.7[3]	1.9	1.8	1.8	1.8
Boron	µg/L	~5100[3]	4900	5300	~5100[3]	5100	4900	4900	5100
Cadmium	µg/L	14	<0.1	<0.1	0.7	<0.1	<0.1	<0.1	<0.1
Chromium	µg/L	49	<0.2	<0.2	7.7	0.2	0.2	<0.2	<0.2
Cobalt	µg/L	14	<0.05	<0.05	1	<0.05	<0.05	<0.05	<0.05
Copper	µg/L	3	1.3	1.1	0.3	0.3	**0.4**	0.3	0.2
Lead	µg/L	6.6	0.1	<0.1	2.2	<0.1	<0.1	<0.1	<0.1
Manganese	µg/L	660[4]	0.9	0.7	130[4]	<0.5	<0.5	<0.5	<0.5
Mercury	µg/L	0.7	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	µg/L	~10[3]	10	10	~10[3]	10	10	10	10
Nickel	µg/L	200	<0.3	<0.3	7	<0.3	<0.3	<0.3	<0.3
Selenium	µg/L	~3[3]	<1	<1	~3[3]	<1	<1	<1	<1
Silver	µg/L	1.8	<0.1	<0.1	0.8	<0.1	<0.1	<0.1	<0.1
Vanadium	µg/L	160	1.6	1.6	50	1.6	1.6	1.6	1.6
Zinc	µg/L	12[5]	3	1	3.3[5]	<1	<1	<1	<1

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004)
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
* Duplicate samples were taken at site NH3, the highest concentration was used in the table.
Note: Data in bold has exceeded the EQG

Table 12. Metal/metalloid toxicant concentrations in bottom water from Cockburn Sound moderate protection area (marinas and harbours), Warnbro Sound high protection area and Deep-Water Channel high protection area.

Contaminant	Units	Guideline value	Cockburn Sound moderate protection area		Guideline value	Warnbro Sound high protection area		Deep-Water Channel high protection area	
		EQG A[1]	NH3*	G1	EQG A[1]	WS4	WS6	GR1	GR2
Aluminium	µg/L	69[2]	<5	<5	2.1[2]	<5	<5	<5	<5
Antimony	µg/L	~0.24[3]	<0.5	<0.5	~0.24[3]	<0.5	<0.5	<0.5	<0.5
Arsenic	µg/L	~1.7[3]	1.7	1.8	~1.7[3]	1.8	1.8	1.8	1.8
Boron	µg/L	~5100[3]	5200	5100	~5100[3]	5100	5200	5300	5200
Cadmium	µg/L	14	<0.1	<0.1	0.7	<0.1	<0.1	<0.1	<0.1
Chromium	µg/L	49	<0.2	<0.2	7.7	0.2	<0.2	<0.2	0.2
Cobalt	µg/L	14	<0.05	<0.05	1	<0.05	<0.05	<0.05	<0.05
Copper	µg/L	3	1.0	0.4	0.3	0.2	0.2	0.3	0.3
Lead	µg/L	6.6	<0.1	<0.1	2.2	<0.1	<0.1	<0.1	<0.1
Manganese	µg/L	660[4]	0.8	0.6	130[4]	<0.5	0.5	<0.5	<0.5
Mercury	µg/L	0.7	<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1
Molybdenum	µg/L	~10[3]	10	10	~10[3]	10	9.9	10	10
Nickel	µg/L	200	<0.3	<0.3	7	<0.3	<0.3	<0.3	<0.3
Selenium	µg/L	~3[3]	<1	<1	~3[3]	<1	<1	<1	<1
Silver	µg/L	1.8	<0.1	<0.1	0.8	<0.1	<0.1	<0.1	<0.1
Vanadium	µg/L	160	1.7	1.6	50	1.6	1.6	1.6	1.6
Zinc	µg/L	12[5]	1	2	3.3[5]	<1	<1	<1	<1

[1] Environmental quality criteria reference document for Cockburn Sound (EPA 2017)
[2] Golding et al (2015)
[3] Background concentrations (antimony – Filella et al. 2002; boron, molybdenum and total selenium – ANZECC/ARMCANZ 2000; arsenic – McAlpine et al. 2004)
[4] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
[5] ANZG (2018) default guideline value, website accessed 11/12/2023.
Note: Data in bold has exceeded the EQG

4.1.3 BTEX

Benzene, toluene, ethylbenzene and xylenes (BTEX) concentrations were below laboratory LORs at all sites, depths and protection areas. Table 13 shows the surface water concentrations of the Owen Anchorage high protection sites as an example, but all other sites, depth and protection areas have the same values (less than the laboratory limit of reporting). The BTEX results for all sites in this survey can be found in Appendix 1. BTEX values at all sites were well below the ANZG (2018) guidelines values or ANZECC/ARMCANZ (2000) low reliability trigger values for 99% species protection.

4.1.4 Polycyclic aromatic hydrocarbons

Polycyclic aromatic hydrocarbons (PAH) concentrations were below laboratory LORs at all sites, depths and protection areas. Table 13 shows the surface water concentrations of the Owen Anchorage high protection sites as an example, but all other sites, depth and protection areas have the same values (less than the laboratory limit of reporting). The PAH results for all sites in this survey can be found in Appendix 1. PAH values at all sites were below the ANZG (2018) guidelines values except for anthracene in which the laboratory LOR (<0.02 µg/L) was higher than the guideline value of 0.01 µg/L. Other PAH's such as chrysene, fluorene etc which don't have EQG's or guideline values were compared to OSPAR Commission (2014) predicted no effects concentrations (PNECs). For the 5-6 ring PAHs (except dibenzo(a,h)anthrancene), benzo(a)pyrene (which has an ANZG (2014) default guideline value) was used to represent the toxicity for the whole group. From these comparisons, all PAH's were below PNECs except for benz(a)anthracene, chrysene and dibenzo(a,h)anthrancene in which the PNEC was lower than the laboratory LOR.

4.1.5 Total petroleum hydrocarbons

Total petroleum hydrocarbons (TPH) concentrations were below laboratory LORs at all sites, depths and protection areas. Table 13 shows the surface water concentrations of the Owen Anchorage high protection sites as an example, but all other sites, depth and protection areas have the same values (less than the laboratory limit of reporting). The TPH value for each site in this study is calculated from an addition of each of the individual carbon chain fraction laboratory LOR values (i.e. C6-C9 fraction <20 µg/L, C10-C14 fraction <50 µg/L, C15-C28 fraction < 100 µg/L, C29-C36 fraction < 50 µg/L; total <220 µg/L). The OSPAR Commission (OSPAR, 2014) established a predicted no effects concentration for TPH of 70.5 µg/L but the sum of the LORs in this study for individual sites are above this concentration, so it is unknown if this value has been exceeded or not.

Table 13. Organic toxicant concentrations in surface water from Owen Anchorage.

Contaminant	Units	Guideline value	Owen Anchorage high protection area						
		EQG A[1]	OA1	OA2	OA3	OA9	1310	OA11	95%ile
Benzene	µg/L	600	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	110	<2	<2	<2	<2	<2	<2	<2
Ethylbenzene	µg/L	50	<2	<2	<2	<2	<2	<2	<2
Xylenes	µg/L	390[2]	<4	<4	<4	<4	<4	<4	<4
Naphthalene	µg/L	50	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	µg/L	0.38[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	µg/L	0.13[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	µg/L	0.25[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	µg/L	0.6	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	µg/L	0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	µg/L	1	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	µg/L	0.023[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	µg/L	0.0012[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Chrysene	µg/L	0.007[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	µg/L	0.1[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	µg/L	0.1[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	µg/L	0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	µg/L	0.1[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	µg/L	0.00014[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	µg/L	0.1[3]	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Total petroleum hydrocarbons C6 – C36 (sum)	µg/L	70.5[3]	<220	<220	<220	<220	<220	<220	<220

[1] ANZG (2018) default guideline value, website accessed 11/12/2023.
[2] ANZECC/ARMCANZ 2000 low reliability trigger value.
[3] OSPAR Commission (2014) predicted no effect concentrations.

4.2 DGTs

4.2.1 Quality Control Assessment

The field blank results showed no contamination due to the sampling process or the transport and storage of samples, except for one sample for aluminium and cobalt; all other field blank results were below the laboratory limits of reporting (Appendix 1). The result above the LOR for aluminium was the only result above the LOR compared to all the samples and the other field blank, so this just appeared to be a contamination of this one field blank which didn't affect the field sample results. For cobalt the result above the LOR for the field blank was lower than all the cobalt results for all other field samples and the other field blank was not affected. However, in this case, there is a possibility that the field process contributed a small amount of cobalt to the field sample results.

4.2.2 DGT metals/metalloids

The metal/metalloid limits of reporting were generally lower than those for the water quality toxicants, in some cases more than an order of magnitude lower (Table 14). Site WS4 had the lowest DGT metal/metalloid concentrations with site OA2 having the next lowest concentrations compared to the other sites along the Owen Anchorage and Cockburn Sound shoreline.

The metals/metalloids analysed for in the DGTs were all below the ANZG (2018) default guideline values for 99% species protection no matter the site. Aluminium, silver, chromium VI and mercury were all below the laboratory LORs, while chromium III was below the laboratory LOR of 0.05 at all sites and replicates except for one of the OA9 replicates which was just detectable.

For aluminium and chromium VI in which the laboratory LORs for the water quality toxicants were above the guideline values, the DGTs LORs were below the guideline values and all sites had concentrations below the LORs.

Copper concentrations between the water quality toxicants and the DGTs showed the greatest difference. Copper concentrations for most sites measured in the water quality toxicant survey were at or above the 99% species protection guideline value of 0.3 µg/L but the copper measured in the DGTs ranged from <0.05 µg/L at site WS4 to 0.17 µg/L at CS9A.

Table 14. Metal/metalloid toxicant concentrations (µg/L) in DGTs

Metal/metalloid	Aluminium	Chromium III	Chromium VI	Cadmium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Lead	Silver	Zinc
Default Guideline Value (ANZG 2018) [1]	2.1[2]	7.7	0.14	0.7	1.0	0.3	2.2	130[3]	0.1	7	2.2	0.8	3.3
Reliability[1]	-	low	very high	very high	high	very high	low	-	low	very high	low	moderate	very high
OA2-1	<0.3	<0.05	<0.1	0.003	0.007	0.06	0.010	0.25	<0.01	0.11	0.010	<0.001	0.3
OA2-2	<0.3	<0.05	<0.1	0.003	0.007	0.07	0.015	0.31	<0.01	0.13	0.015	<0.001	0.4
OA9-1	<0.3	<0.05	<0.1	0.005	0.017	0.10	0.015	0.66	<0.01	0.14	0.015	<0.001	0.5
OA9-2	<0.3	0.05	<0.1	0.004	0.007	0.11	0.016	0.64	<0.01	0.13	0.016	<0.001	0.5
CS6A-1	<0.3	<0.05	<0.1	0.004	0.008	0.10	0.016	0.49	<0.01	0.13	0.016	<0.001	0.4
CS6A-2	<0.3	<0.05	<0.1	0.004	0.006	0.09	0.013	0.46	<0.01	0.12	0.013	<0.001	0.4
CS7-1	<0.3	<0.05	<0.1	0.005	0.008	0.12	0.016	0.52	<0.01	0.15	0.016	<0.001	0.5
CS7-2	<0.3	<0.05	<0.1	0.005	0.012	0.09	0.016	0.48	<0.01	0.14	0.016	<0.001	0.5
CS9-1	<0.3	<0.05	<0.1	0.005	0.027	0.12	0.014	0.56	<0.01	0.15	0.014	<0.001	0.7
CS9-2	<0.3	<0.05	<0.1	0.005	0.010	0.11	0.013	0.53	<0.01	0.14	0.013	<0.001	0.5
CS10N-1	<0.3	<0.05	<0.1	0.005	0.010	0.12	0.012	0.50	<0.01	0.14	0.012	<0.001	0.5
CS10N-2	<0.3	<0.05	<0.1	0.005	0.007	0.11	0.011	0.52	<0.01	0.13	0.011	<0.001	0.4
CS12-1	<0.3	<0.05	<0.1	0.005	0.010	0.10	0.014	0.57	<0.01	0.14	0.014	<0.001	0.5
CS12-2	<0.3	<0.05	<0.1	0.004	0.009	0.13	0.014	0.56	<0.01	0.15	0.014	<0.001	0.4
CS9A-1	<0.3	<0.05	<0.1	0.005	0.008	0.17	0.013	0.54	<0.01	0.51	0.013	<0.001	0.4
CS9A-2	<0.3	<0.05	<0.1	0.005	0.010	0.13	0.011	0.51	<0.01	0.14	0.011	<0.001	0.4
WS4-1	<0.3	<0.05	<0.1	0.003	0.006	0.07	0.005	0.33	<0.01	0.11	0.005	<0.001	0.2
WS4-2	<0.3	<0.05	<0.1	0.003	0.006	<0.05	<0.005	0.31	<0.01	0.10	<0.005	<0.001	<0.2

[1] ANZG (2018) default guideline value for 99% species protection and reliability values, website accessed 11/12/2023.
[2] Golding et al (2015).
[3] Draft submission paper to the Council of Australian Government's Standing Council on Environment and Water (Stauber *et al*., 2008).
Note: Data in bold has exceeded the ANZG (2018) default guideline value for 99% species protection.

5 Discussion

5.1 Toxicants

5.1.1 Metals/metalloids

All metals/metalloids in the surface and bottom water of the moderate protection area sites for Cockburn Sound and marinas and harbours were below the EQG A values. Copper concentrations were highest at the marina sites of Careening Bay (Site G1) and Northern Harbour (Site NH3) and zinc concentrations highest at NH3 compared to all other sites in this survey.

For the surface and bottom waters at sites in the high protection areas, all metals/metalloids were below the EQG A values, except for copper. There were metals such as aluminium and chromium in which the laboratory limits of reporting (LORs) were above the EQG A values and other metals/metalloids, such as antimony, arsenic, boron, molybdenum and selenium, which had no EQG A values.

The copper concentrations at many of the sites in the high protection areas either equalled the EQG of 0.3 µg/L or were above. Sites with copper concentrations above the EQG included OA11 (surface water), CS8 (bottom water), CB (surface and bottom water), G2 (surface and bottom water), MB (surface water), CS13 (bottom water), WS6 (surface water).

Aluminium concentrations at all sites were below the laboratory LOR of 5 µg/L. However, the 99% species guideline value derived by Golding et al. (2015) was 2.1 µg/L. Therefore, it is unknown if the guideline value was exceeded or not. However, the aluminium concentrations were well below the 95% species protection of 24 µg/L.

Chromium concentrations in this study were compared to the chromium III low reliability guidelines, even though the chromium VI guideline reliability was very high. In marine and estuarine conditions, the high sulphate concentrations make chromium VI toxicity unlikely, except at very polluted sites (ANZECC/ARMCANZ 2000). The estimated natural background concentration of chromium (total dissolved) for Perth marine waters was considered by McAlpine et al. (2004) to be 0.2 µg/L. The chromium concentrations at all sites in this study were 0.2 µg/L or less than 0.2 µg/L.

For the metals/metalloids with no EQGs, average background concentrations for arsenic, boron and molybdenum or low reliability values for antimony and selenium were used. McAlpine et al. (2004) sampled Perth coastal waters in 2003 for several different metals including arsenic. The arsenic concentrations ranged from 1.6 to 1.8 µg/L. In this survey the arsenic concentrations ranged from 1.6 to 1.9 µg/L, therefore considered very similar over time. The established background concentration for boron is around 5100 µg/L (ANZECC/ARMCANZ 2000). The concentrations of boron in this study ranged from 4800 to 5400 µg/L, with an average of 5150 µg/L. Therefore, it was considered that boron in this study was at background concentrations for all sites. Molybdenum occurs naturally in seawater at around 10 µg/L (ANZECC/ARMCANZ 2000). The concentrations of molybdenum in this study ranged from 9.9 to 11 µg/L, therefore considered to be at background concentrations. The low reliability value for antimony (III) for marine waters was 270 µg/L (ANZECC/ARMCANZ 2000) and an unknown default guideline value for antimony (total) of 9 µg/L for freshwater (ANZG 2018). Antimony concentrations in this study were all below the laboratory LOR of 0.5 µg/L. The antimony (total) seawater world average concentration is 0.18 µg/L (mean surface seawater concentration in publications from 1985 to 2001) and typical concentrations of total dissolved antimony are usually less than 1 µg/L in non-polluted waters (Filella et al, 2001). The low reliability value for selenium (total) is 3 µg/L (ANZECC/ARMCANZ 2000). In this study selenium concentrations were all below the laboratory LOR of 1 µg/L.

5.1.2 Organics

Benzene, toluene, ethylbenzene and xylenes (BTEX), polycyclic aromatic hydrocarbon (PAH) and total petroleum hydrocarbon (TPHs) concentrations were below laboratory LORs at all sites, depths and protection areas.

BTEX values at all sites were well below the ANZG (2018) guidelines values or ANZECC/ARMCANZ (2000) low reliability trigger values for 99% species protection. PAH values at all sites were below the ANZG (2018) guidelines values except for anthracene in which the laboratory LOR (<0.02 µg/L) was higher than the guideline value of 0.01 µg/L and benz(a)anthracene, chrysene and dibenzo(a,h)anthrancene in which the OSPAR Commission (2014) predicted no effects concentration (PNEC) was lower than the laboratory LOR. Total petroleum hydrocarbons (TPH) concentrations were below laboratory LORs at all sites, depths and protection areas. The TPH value for each site in this study was calculated from an addition of each of the individual carbon chain fraction laboratory LOR values (i.e. C6-C9 fraction <20 µg/L, C10-C14 fraction <50 µg/L, C15-C28 fraction < 100 µg/L, C29-C36 fraction < 50 µg/L; total <220 µg/L). The OSPAR Commission (OSPAR ,2014) established a predicted no effects concentration for TPH of 70.5 µg/L but the sum of the LORs in this study for individual sites are above this concentration, so it is unknown if this value has been exceeded or not.

5.2 DGT metals/metalloids

The metal/metalloid limits of reporting were generally lower than those for the water quality toxicants, in some cases more than an order of magnitude lower. Site WS4 had the lowest DGT metal/metalloid concentrations with site OA2 having the next lowest concentrations compared to the other sites along the Owen Anchorage and Cockburn Sound shoreline.

The metals/metalloids analysed for in the DGTs were all below the ANZG (2018) default guideline values for 99% species protection no matter the protection area.

For aluminium and chromium VI in which the laboratory LORs for the water quality toxicants were above the guideline values, the DGTs LORs were below the guideline values and all sites had concentrations below the LORs.

Copper concentrations between the water quality toxicants and the DGTs showed the greatest difference. Copper concentrations for most sites measured in the water quality toxicant survey were at or above the 99% species protection guideline value of 0.3 µg/L but the copper measured in the DGTs ranged from <0.05 µg/L at site WS4 to 0.17 µg/L at CS9A, all below the 99% species protection guideline. This discrepancy between sampling methods for copper has been highlighted by NIWA (2019) and McAlpine et al. (2004) and explained by ANZECC/ARMCANZ (2000) as being due to copper being largely complexed by natural dissolved organic matter (DOM). Therefore, the more toxic inorganic copper species comprise only a relatively minor proportion of the dissolved copper pool in coastal water, estuaries and rivers (ANZECC/ARMCANZ, 2000). The DGTs measure labile copper or the copper that can easily diffuse through the diffusive gel. This excludes copper that is bound to DOM. Because of this DGT copper measurements are similar to the bioavailable fraction and lower than the dissolved copper concentrations.

6 Conclusions/recommendations

Between the regular sampling method of dissolved metals/metalloids and passive sampling devices (DGTs) the metal/metalloid toxicants of sites in Owen Anchorage, Cockburn Sound and Warnbro Sound have been shown to be below the 99% species protection guideline values (95% species protection guideline for cobalt) or at background concentrations for both high protection and moderate protection areas. DGT's were not deployed at the marina sites of NH3 or G1 (these sites had the highest copper and zinc concentrations than other sites), although they were below the moderate protection EQG A values. This study highlighted the differences between the different sampling methods particularly for copper and it is recommended that DGTs be deployed for toxicant surveys where copper is a requirement.

For future monitoring, during dredging and post-dredging, it is recommended that both chromium III and chromium VI are measured in the water column and compared to their respective guideline values (ANZG, 2018).

Organic chemicals, including BTEX, PAHs and TPHs were all below laboratory LORs for all sites, depths and protection areas and were the same as those undertaken by McAlpine et al. (2004). BTEX concentrations and most PAH concentrations were below guideline values where available. PAH values at all sites were below the ANZG (2018) guidelines values except for anthracene in which the laboratory LOR (<0.02 µg/L) was higher than the guideline value of 0.01 µg/L. Other PAH's such as chrysene, fluorene etc which don't have EQG's or guideline values were compared to OSPAR Commission (2014) predicted no effects concentrations (PNECs). For the 5-6 ring PAHs (except dibenzo(a,h)anthrancene), benzo(a)pyrene (which has an ANZG (2014) default guideline value) was used to represent the toxicity for the whole group. From these comparisons, all PAH's were below PNECs except for benz(a)anthracene, chrysene and dibenzo(a,h)anthrancene in which the PNEC was lower than the laboratory LOR.

7 References

ANZECC/ARMCANZ (2000) National Water Quality Management Strategy: Paper No 4 – Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Volume 2 – Aquatic Ecosystems – Rationale and Background Information (Chapter 8). Australian and New Zealand Environment and Conservation Council and Agricultural and Resource Management Council of Australia and New Zealand, Canberra, Australian Capital Territory, October 2000.

ANZG (2018) http://www.waterquality.gov.au/anz-guidelines Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia (accessed 11/12/2023).

Appleyard SJ (1994) The flux of nitrogen and phosphorus from groundwater to the ocean in the Perth metropolitan region. Geological Survey of Western Australia, Hydrogeology Report 1990/64.

Bastyan G, Paling EI, Wilson CC (1994) Cockburn Sound Water Quality Studies: Nutrient release from the sediments and water quality. MAFRA 94/2 (CSBP).

Chiffings AW (1979) Cockburn Sound Environmental Study, Technical Report on Nutrient Enrichment and Phytoplankton. Report No. 2. Department of Conservation and Environment, Perth, Western Australia. 59pp.

DAL (2001) The State of Cockburn Sound: A Pressure-State-Response Report. Report to the Cockburn Sound Management Council by D.A. Lord and Associates. Report Number 01/187/1.

Department of Environmental Protection (1996). Southern Metropolitan Coastal Waters Study (1991-1994). Department of Environmental Protection, Perth, Western Australia, Report 17.

Environmental Protection Authority (2005). Manual of Standard Operating Procedures for Environmental Monitoring against the Cockburn Sound Environmental Quality Criteria (2003-2004). A supporting document to the State Environmental (Cockburn Sound) Policy 2005. Environmental Protection Authority, WA. December 2004.

Environmental Protection Authority (2017). Environmental Quality Criteria Reference Document for Cockburn Sound. A supporting document to the State Environmental (Cockburn Sound) Policy 2015. Perth, The Government of Western Australia.

Filella M, Belzile N, Chen Y-W (2002). Antimony in the environment: a review focused on natural waters. I. Occurrence. Earth Science Reviews 57: 125-176.

Golding LA, Angel BM, Batley GE, Apte SC, Krassoi R, Doyle CJ (2015) Derivation of a water quality guideline for aluminium in marine waters. Environmental Toxicology and Chemistry 34:141–151.

Hale J, Wilson C, Paling EI (1998) Water Quality of Cockburn Sound (December 1997 to March 1998). Report to Kwinana Industry Council. Report No. MAFRA 98/3.

Hovey RK, Fraser WF (2018) Benthic Habitat Mapping of Cockburn Sound. Oceans Institute and School of Biological Sciences, University of Western Australia.

Kendrick GA, Aylward MJ, Hegge BJ, Cambridge ML, Hillman K, Wyllie A, Lord DA (2002) Changes in seagrass coverage in Cockburn Sound, Western Australia between 1967 and 1999. Aquat. Bot. 73:75-87.

Loveless AM, Oldham CE (2008) Natural attenuation of nitrogen in groundwater discharging through a sandy beach. Biogeochemistry 98: 75-87.

McAlpine KW, Wenziker, KJ, Apte SC, Masini R (2004) Background quality for coastal waters of Perth, Western Australia. Technical Series 117. Department of Environment, Perth, WA.

NIWA (2019). Monitoring water quality in urban streams and stormwater. Guidance for New Zealand practitioners. NIWA Client Report 2019168AK prepared for Enviolink.

OSPAR Commission (OSPAR (2014). Background Document. Establishment of a list of Predicted No Effect Concentrations (PNECs) for naturally occurring substances in produced water. OSPAR Agreement 2014-05.

Smith, A.J. Turner, J.V. Herne, D.E. and Hick, W.P. (2003). Quantifying submarine groundwater discharge and nutrient discharge into Cockburn Sound Western Australia, Technical report no. 01/03, Commonwealth Scientific and Industrial Research Organisation, Floreat, Western Australia, p 185.

Stauber JL, Binet M, Jones R, King C, Krassoi R, Smith R (2008) Toxicity of manganese to marine biota: derivation of a manganese water quality guideline for tropical ecosystems. Proceedings of Society for Environmental Toxicology and Chemistry 5th World Congress, 3-7 August 2008, Sydney, Australia.

8 Appendices

8.1 Appendix 1 Laboratory data

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

WATER QUALITY DATA

Contact: Luke Twomey
Customer: Western Australian Marine Science Istitution
Address: Level 5, Indian Ocean Marine Research Centre (IOMRC) 64 Fairway, Crawley WA 6009

Date of Issue: 9/10/2023
Date Received: 21/09/2023
Our Reference: WAMS23-9

METHOD SAMPLE CODE	Sampling Date	MS001 Filtered Al µg/L	MS001 Filtered V µg/L	MS001 Filtered Cr µg/L	MS001 Filtered Mn µg/L	MS001 Filtered Co µg/L	MS001 Filtered Ni µg/L	MS001 Filtered Cu µg/L	MS001 Filtered Zn µg/L	MS001 Filtered As µg/L
Reporting Limit		<5	<0.3	<0.2	<0.5	<0.05	<0.3	<0.2	<1	<0.5
Analysis Date		21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023
File		23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901
OA1-Bot	20/09/2023	<5	1.8	<0.2	<0.5	<0.05	<0.3	<0.2	<1	1.8
OA1	20/09/2023	<5	1.8	<0.2	<0.5	<0.05	<0.3	0.2	<1	1.7
OA2	20/09/2023	<5	1.7	<0.2	<0.5	<0.05	<0.3	0.3	<1	1.8
OA2-Bot	20/09/2023	<5	1.8	<0.2	<0.5	<0.05	<0.3	<0.2	<1	1.7
OA3	20/09/2023	<5	1.8	<0.2	<0.5	<0.05	<0.3	<0.2	<1	1.8
OA3-Bot	20/09/2023	<5	1.8	<0.2	<0.5	<0.05	<0.3	0.3	<1	1.8
OA9	20/09/2023	<5	1.9	<0.2	0.7	<0.05	<0.3	0.3	<1	1.8
OA9-Bot	20/09/2023	<5	1.8	<0.2	0.8	<0.05	<0.3	0.3	<1	1.8
1310	20/09/2023	<5	1.9	<0.2	0.8	<0.05	<0.3	0.3	<1	1.9
1310-Bot	20/09/2023	<5	1.7	<0.2	0.8	<0.05	<0.3	0.3	<1	1.8
OA11	20/09/2023	<5	1.9	0.2	0.8	<0.05	<0.3	0.6	<1	1.8
OA11-Bot	20/09/2023	<5	1.8	<0.2	0.7	<0.05	<0.3	0.3	<1	1.8
CS4	20/09/2023	<5	1.8	<0.2	0.6	<0.05	<0.3	0.3	<1	1.8
CS4-Bot	20/09/2023	<5	1.8	<0.2	<0.5	<0.05	<0.3	<0.2	<1	1.8
CS5	20/09/2023	<5	1.7	<0.2	0.7	<0.05	<0.3	0.3	<1	1.8
CS5-Bot	20/09/2023	<5	1.8	<0.2	0.5	<0.05	<0.3	0.2	<1	1.8
CS6A	20/09/2023	<5	1.8	<0.2	0.7	<0.05	<0.3	0.4	<1	1.8
CS6A-Bot	20/09/2023	<5	1.8	<0.2	0.7	<0.05	<0.3	0.3	<1	1.8
CS7	20/09/2023	<5	1.8	<0.2	0.7	<0.05	<0.3	0.5	<1	1.7
CS7-Bot	20/09/2023	<5	1.6	<0.2	0.7	<0.05	<0.3	0.6	1	1.7
CS8	20/09/2023	<5	1.6	<0.2	0.6	<0.05	<0.3	0.3	<1	1.7

Signatory: Lirong Han
Date: 9/10/2023

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

WATER QUALITY DATA

Contact: Luke Twomey
Customer: Western Australian Marine Science Istitution
Address: Level 5, Indian Ocean Marine Research Centre (IOMRC) 64 Fairway, Crawley WA 6009

Date of Issue: 9/10/2023
Date Received: 21/09/2023
Our Reference: WAMS23-9

METHOD SAMPLE CODE	Sampling Date	MS001 Filtered Al µg/L	MS001 Filtered V µg/L	MS001 Filtered Cr µg/L	MS001 Filtered Mn µg/L	MS001 Filtered Co µg/L	MS001 Filtered Ni µg/L	MS001 Filtered Cu µg/L	MS001 Filtered Zn µg/L	MS001 Filtered As µg/L
Reporting Limit		<5	<0.3	<0.2	<0.5	<0.05	<0.3	<0.2	<1	<0.5
Analysis Date		21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023
File		23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901
CS8-Bot	20/09/2023	<5	1.7	<0.2	0.6	<0.05	<0.3	0.4	<1	1.8
CS9	20/09/2023	<5	1.7	0.2	0.8	<0.05	<0.3	0.4	<1	1.8
CS9-Bot	20/09/2023	<5	1.7	0.2	0.8	<0.05	<0.3	0.4	<1	1.8
CS10N	20/09/2023	<5	1.6	<0.2	0.7	<0.05	<0.3	0.5	<1	1.7
CS10N-Bot	20/09/2023	<5	1.7	<0.2	0.7	<0.05	<0.3	0.6	<1	1.7
CS11	20/09/2023	<5	1.6	<0.2	0.6	<0.05	<0.3	0.3	<1	1.7
CS11-Bot	20/09/2023	<5	1.7	<0.2	0.7	<0.05	<0.3	0.3	<1	1.8
CS12	20/09/2023	<5	1.7	<0.2	0.8	<0.05	<0.3	0.6	<1	1.8
CS12-Bot	20/09/2023	<5	1.6	<0.2	0.8	<0.05	<0.3	0.4	<1	1.8
CS9A	20/09/2023	<5	1.7	<0.2	0.8	<0.05	<0.3	0.4	<1	1.8
CS9A-Bot	20/09/2023	<5	1.7	<0.2	0.6	<0.05	<0.3	0.3	<1	1.8
G1	20/09/2023	<5	1.6	<0.2	0.7	<0.05	<0.3	1.1	<1	1.8
G1-Bot	20/09/2023	<5	1.6	<0.2	0.6	<0.05	<0.3	0.4	<1	1.8
G2	20/09/2023	<5	1.6	<0.2	0.7	<0.05	<0.3	0.5	<1	1.7
G2-Bot	20/09/2023	<5	1.7	<0.2	0.7	<0.05	<0.3	0.4	<1	1.8
G3	20/09/2023	<5	1.8	<0.2	0.6	<0.05	<0.3	0.3	<1	1.8
G3-Bot	20/09/2023	<5	1.6	<0.2	0.5	<0.05	<0.3	0.3	<1	1.8
NH3	20/09/2023	<5	1.6	<0.2	0.9	<0.05	<0.3	1.3	3	1.8
NH3-Bot	20/09/2023	<5	1.7	<0.2	0.8	<0.05	<0.3	1.0	1	1.7
SF	20/09/2023	<5	1.6	0.2	0.6	<0.05	<0.3	0.3	<1	1.8
SF-Bot	20/09/2023	<5	1.7	0.2	0.6	<0.05	<0.3	0.2	<1	1.9

Signatory: Lirong Han
Date: 9/10/2023

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

WATER QUALITY DATA

Contact: Luke Twomey
Customer: Western Australian Marine Science Istitution
Address: Level 5, Indian Ocean Marine Research Centre (IOMRC) 64 Fairway, Crawley WA 6009

Date of Issue: 9/10/2023
Date Received: 21/09/2023
Our Reference: WAMS23-9

METHOD SAMPLE CODE	Sampling Date	MS001 Filtered Al µg/L	MS001 Filtered V µg/L	MS001 Filtered Cr µg/L	MS001 Filtered Mn µg/L	MS001 Filtered Co µg/L	MS001 Filtered Ni µg/L	MS001 Filtered Cu µg/L	MS001 Filtered Zn µg/L	MS001 Filtered As µg/L
Reporting Limit		<5	<0.3	<0.2	<0.5	<0.05	<0.3	<0.2	<1	<0.5
Analysis Date		21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023
File		23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901
CB	20/09/2023	<5	1.6	0.2	0.6	<0.05	<0.3	0.4	<1	1.8
CB-Bot	20/09/2023	<5	1.6	<0.2	0.7	<0.05	<0.3	0.4	<1	1.8
CS13	20/09/2023	<5	1.6	0.2	0.7	<0.05	<0.3	0.3	<1	1.8
CS13-Bot	20/09/2023	<5	1.6	<0.2	0.7	<0.05	<0.3	0.4	<1	1.8
MB	20/09/2023	<5	1.7	<0.2	0.9	<0.05	<0.3	0.5	<1	1.8
WS4	20/09/2023	<5	1.6	0.2	<0.5	<0.05	<0.3	0.3	<1	1.9
WS4-Bot	20/09/2023	<5	1.6	0.2	<0.5	<0.05	<0.3	0.2	<1	1.8
WS6	20/09/2023	<5	1.6	0.2	<0.5	<0.05	<0.3	0.4	<1	1.8
WS6-Bot	20/09/2023	<5	1.6	<0.2	0.5	<0.05	<0.3	0.2	<1	1.8
GR1	21/09/2023	<5	1.6	<0.2	<0.5	<0.05	<0.3	0.3	<1	1.8
GR1-Bot	21/09/2023	<5	1.6	<0.2	<0.5	<0.05	<0.3	0.3	<1	1.8
GR2	20/09/2023	<5	1.6	<0.2	<0.5	<0.05	<0.3	0.2	<1	1.8
GR2-Bot	20/09/2023	<5	1.6	0.2	<0.5	<0.05	<0.3	0.3	<1	1.8
QA	20/09/2023	<5	1.7	0.2	0.8	<0.05	<0.3	1.1	3	1.8
QC	20/09/2023	<5	1.7	<0.2	0.7	<0.05	<0.3	0.6	2	1.8
Field blank		<5	<0.3	<0.2	<0.5	<0.05	<0.3	<0.2	<1	<0.5
Transport blank		<5	<0.3	<0.2	<0.5	<0.05	<0.3	<0.2	<1	<0.5

Note: For results for compliance purposes uncertainity of measurement (MU) will sometimes affect the interpretation whether the result passes or fails the compliance limit.
Tables for measurement uncertainity are available online at www.mafrl.murdoch.edu.au

Signatory: Lirong Han
Date: 9/10/2023

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

WATER QUALITY DATA

Contact: Luke Twomey
Customer: Western Australian Marine Science Istitution
Address: Level 5, Indian Ocean Marine Research Centre (IOMRC) 64 Fairway, Crawley WA 6009

Date of Issue: 9/10/2023
Date Received: 21/09/2023
Our Reference: WAMS23-9

METHOD	Sampling	MS001	MS001	MS001	MS001	MS001	MS001	ICP001	ICP006
SAMPLE CODE	Date	Filtered Se	Filtered Mo	Filtered Ag	Filtered Cd	Filtered Sb	Filtered Pb	B	Hg
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L
Reporting Limit		<1	<0.5	<0.1	<0.1	<0.5	<0.1	<0.006	<0.0001
Analysis Date		21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	26/09/2023	2/10/2023
File		23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092601	23100201
OA1-Bot	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	4.8	<0.0001
OA1	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.3	<0.0001
OA2	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
OA2-Bot	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
OA3	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.0	<0.0001
OA3-Bot	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
OA9	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
OA9-Bot	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
1310	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.4	<0.0001
1310-Bot	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
OA11	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.0	<0.0001
OA11-Bot	20/09/2023	<1	11	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
CS4	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	4.9	<0.0001
CS4-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.0	<0.0001
CS5	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS5-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.4	<0.0001
CS6A	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS6A-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS7	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS7-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.0	<0.0001
CS8	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Signatory: Lirong Han
Date: 9/10/2023

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

WATER QUALITY DATA

Contact: Luke Twomey
Customer: Western Australian Marine Science Istitution
Address: Level 5, Indian Ocean Marine Research Centre (IOMRC) 64 Fairway, Crawley WA 6009

Date of Issue: 9/10/2023
Date Received: 21/09/2023
Our Reference: WAMS23-9

METHOD	Sampling	MS001	MS001	MS001	MS001	MS001	MS001	ICP001	ICP006
SAMPLE CODE	Date	Filtered Se	Filtered Mo	Filtered Ag	Filtered Cd	Filtered Sb	Filtered Pb	B	Hg
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	mg/L	mg/L
Reporting Limit		<1	<0.5	<0.1	<0.1	<0.5	<0.1	<0.006	<0.0001
Analysis Date		21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	21/09/2023	26/09/2023	2/10/2023
File		23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092101-2901	23092601	23100201
CS8-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS9	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS9-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS10N	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS10N-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.3	<0.0001
CS11	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.4	<0.0001
CS11-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.4	<0.0001
CS12	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.3	<0.0001
CS12-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS9A	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.0	<0.0001
CS9A-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
G1	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.3	<0.0001
G1-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
G2	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
G2-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
G3	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.3	<0.0001
G3-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
NH3	20/09/2023	<1	10	<0.1	<0.1	<0.5	0.1	4.9	<0.0001
NH3-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
SF	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.3	<0.0001
SF-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Signatory: Lirong Han
Date: 9/10/2023

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Accreditation Number: 10603
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations and/or measurements included is this document are traceable to Australian/national standards.

Murdoch UNIVERSITY

WATER QUALITY DATA

Contact: Luke Twomey
Customer: Western Australian Marine Science Istitution
Address: Level 5, Indian Ocean Marine Research Centre (IOMRC) 64 Fairway, Crawley WA 6009

Date of Issue: 9/10/2023
Date Received: 21/09/2023
Our Reference: WAMS23-9

METHOD SAMPLE CODE	Sampling Date	MS001 Filtered Se µg/L	MS001 Filtered Mo µg/L	MS001 Filtered Ag µg/L	MS001 Filtered Cd µg/L	MS001 Filtered Sb µg/L	MS001 Filtered Pb µg/L	ICP001 B mg/L	ICP006 Hg mg/L
Reporting Limit		**<1**	**<0.5**	**<0.1**	**<0.1**	**<0.5**	**<0.1**	**<0.006**	**<0.0001**
Analysis Date		**21/09/2023**	**21/09/2023**	**21/09/2023**	**21/09/2023**	**21/09/2023**	**21/09/2023**	**26/09/2023**	**2/10/2023**
File		**23092101-2901**	**23092101-2901**	**23092101-2901**	**23092101-2901**	**23092101-2901**	**23092101-2901**	**23092601**	**23100201**
CB	20/09/2023	<1	10	<0.1	<0.1	<0.5	0.1	5.1	<0.0001
CB-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	0.1	5.3	<0.0001
CS13	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
CS13-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
MB	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
WS4	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
WS4-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
WS6	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	4.9	<0.0001
WS6-Bot	20/09/2023	<1	9.9	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
GR1	21/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	4.9	<0.0001
GR1-Bot	21/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
GR2	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.3	<0.0001
GR2-Bot	20/09/2023	<1	10	<0.1	<0.1	<0.5	<0.1	5.2	<0.0001
QA	20/09/2023	<1	9.9	<0.1	<0.1	<0.5	<0.1	5.1	<0.0001
QC	20/09/2023	<1	9.9	<0.1	<0.1	<0.5	<0.1	5.0	<0.0001
Field blank		<1	<0.5	<0.1	<0.1	<0.5	<0.1	<0.006	<0.0001
Transport blank		<1	<0.5	<0.1	<0.1	<0.5	<0.1	<0.006	<0.0001

Signatory: Lirong Han
Date: 9/10/2023

The results only apply to the sample as received and to the sample tested.
Spare test items will be held for two months unless otherwise requested.

Marine and Freshwater
Research Laboratory
Environmental Science
Tel: 08 93602907 Address: 90 South St, Murdoch, WA, 6150

Murdoch UNIVERSITY

DGT DATA

Contact: Luke Twomey
Customer: Western Australian Marine Science Institution
Address: M095, Level 5, Indian Ocean Marine Research Centre (IOMRC) 64 Fairway, Crawley, WA 6009

Date of Issue: 24/10/2023
Date Received: 21/09/2023
Our Reference: WAMS23-12
Your Reference: WCP3.1 DGT

METHOD	Deployed	Retrieved	MS005	MS005	MS005	MS005	MS005	MS005	MS005	MS005	MS005	MS005	MS005	MS005
SAMPLE CODE	Date/Time	Date/Time	Al	Cr III	Mn	Co	Ni	Cu	Zn	Ag	Cd	Pb	Cr VI	Hg
			µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
Reporting Limit			<0.3	<0.05	<0.02	<0.002	<0.03	<0.05	<0.2	<0.001	<0.001	<0.005	<0.1	<0.01
Analysis Date			3/10/2023	3/10/2023	3/10/2023	3/10/2023	3/10/2023	3/10/2023	3/10/2023	3/10/2023	3/10/2023	3/10/2023	3/10/2023	11/10/2023
File			23100301	23100301	23100301	23100301	23100301	23100301	23100301	23100301	23100301	23100301	23100301	23101103
OA2 - 1	8/09/2023 16:04	21/09/2023 11:05	<0.3	<0.05	0.25	0.007	0.11	0.06	0.3	<0.001	0.003	0.010	<0.1	<0.01
OA2 - 2	8/09/2023 16:04	21/09/2023 11:05	<0.3	<0.05	0.31	0.007	0.13	0.07	0.4	<0.001	0.003	0.015	<0.1	<0.01
OA9 - 1	8/09/2023 16:28	21/09/2023 11:29	<0.3	<0.05	0.66	0.017	0.14	0.10	0.5	<0.001	0.005	0.015	<0.1	<0.01
OA9 - 2	8/09/2023 16:28	21/09/2023 11:29	<0.3	0.05	0.64	0.007	0.13	0.11	0.5	<0.001	0.004	0.016	<0.1	<0.01
CS6A - 1	8/09/2023 10:00	21/09/2023 12:07	<0.3	<0.05	0.49	0.008	0.13	0.10	0.4	<0.001	0.004	0.016	<0.1	<0.01
CS6A - 2	8/09/2023 10:00	21/09/2023 12:07	<0.3	<0.05	0.46	0.006	0.12	0.09	0.4	<0.001	0.004	0.013	<0.1	<0.01
CS7 - 1	8/09/2023 10:24	21/09/2023 12:24	<0.3	<0.05	0.52	0.008	0.15	0.12	0.5	<0.001	0.005	0.016	<0.1	<0.01
CS7 - 2	8/09/2023 10:24	21/09/2023 12:24	<0.3	<0.05	0.48	0.012	0.14	0.09	0.5	<0.001	0.005	0.016	<0.1	<0.01
CS9 - 1	8/09/2023 11:41	21/09/2023 12:58	<0.3	<0.05	0.56	0.027	0.15	0.12	0.7	<0.001	0.005	0.014	<0.1	<0.01
CS9 - 2	8/09/2023 11:41	21/09/2023 12:58	<0.3	<0.05	0.53	0.010	0.14	0.11	0.5	<0.001	0.005	0.013	<0.1	<0.01
CS10N - 1	8/09/2023 12:43	21/09/2023 13:30	<0.3	<0.05	0.50	0.010	0.14	0.12	0.5	<0.001	0.005	0.012	<0.1	<0.01
CS10N - 2	8/09/2023 12:43	21/09/2023 13:30	<0.3	<0.05	0.52	0.007	0.13	0.11	0.4	<0.001	0.005	0.011	<0.1	<0.01
CS12 - 1	8/09/2023 11:24	21/09/2023 12:44	<0.3	<0.05	0.57	0.010	0.14	0.10	0.5	<0.001	0.005	0.014	<0.1	<0.01
CS12 - 2	8/09/2023 11:24	21/09/2023 12:44	<0.3	<0.05	0.56	0.009	0.15	0.13	0.4	<0.001	0.004	0.014	<0.1	<0.01
CS9A - 1	8/09/2023 12:12	21/09/2023 13:15	<0.3	<0.05	0.54	0.008	0.51	0.17	0.4	<0.001	0.005	0.013	<0.1	<0.01
CS9A - 2	8/09/2023 12:12	21/09/2023 13:15	<0.3	<0.05	0.51	0.010	0.14	0.13	0.4	<0.001	0.005	0.011	<0.1	<0.01
WS4 - 1	8/09/2023 13:40	21/09/2023 14:00	<0.3	<0.05	0.33	0.006	0.11	0.07	0.2	<0.001	0.003	0.005	<0.1	<0.01
WS4 - 2	8/09/2023 13:40	21/09/2023 14:00	<0.3	<0.05	0.31	0.006	0.10	<0.05	<0.2	<0.001	0.003	<0.005	<0.1	<0.01
Field Blank 1	8/09/2023 16:04	21/09/2023 11:05	0.4	<0.05	<0.02	0.005	<0.03	<0.05	<0.2	<0.001	<0.001	<0.005	<0.1	<0.01
Field Blank 2	8/09/2023 10:00	21/09/2023 12:07	<0.3	<0.05	<0.02	<0.002	<0.03	<0.05	<0.2	<0.001	<0.001	<0.005	<0.1	<0.01

Note: This testing is outside the scope of accreditation.
Analysis performed as per http://www.dgtresearch.com/guides-to-using-dgt/

Signatory: Jamie Woodward
Date: 24/10/2023

The results only apply to the sample tested.
Spare test items will be held for two months unless otherwise requested.

CERTIFICATE OF ANALYSIS

Work Order	: **EP2313186**	Page	: 1 of 27
Client	: **MARINE AND FRESHWATER RESEARCH LABORATORY**	Laboratory	: Environmental Division Perth
Contact	: KRZYSZTOF WIENCZUGOW	Contact	: Customer Services EP
Address	: C/- MURDOCH UNIVERSITY, SOUTH STREET MURDOCH WA, AUSTRALIA 6150	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 93602907	Telephone	: +61-8-9406 1301
Project	: WAMS23-9	Date Samples Received	: 22-Sep-2023 11:00
Order number	: ----	Date Analysis Commenced	: 26-Sep-2023
C-O-C number	: ----	Issue Date	: 04-Oct-2023 13:46
Sampler	: ----		
Site	: ----		
Quote number	: EP23MARFRE0004		
No. of samples received	: 59		
No. of samples analysed	: 59		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results
- Surrogate Control Limits

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Thomas Donovan	Senior Organic Chemist	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EP132-LL: Where reported, Total PAH is the sum of the reported concentrations of all PAHs at or above the LOR.
- EP080: Where reported, Total Xylenes is the sum of the reported concentrations of m&p-Xylene and o-Xylene at or above the LOR.
- EP132-LL: Sample ' OA11-Bot (EP2313186-020)' required re-extraction to confirm results. There was insufficient volume remaining for standard analysis. LOR values have been adjusted accordingly.

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	CS6A	CS6A-Bot	CS5	CS5-Bot	CS4
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-001	EP2313186-002	EP2313186-003	EP2313186-004	EP2313186-005
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)				Sample ID	CS6A	CS6A-Bot	CS5	CS5-Bot	CS4
				Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit		EP2313186-001	EP2313186-002	EP2313186-003	EP2313186-004	EP2313186-005
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**109**	**109**	**112**	**111**	**113**
Toluene-D8	2037-26-5	2	%		**98.9**	**95.5**	**96.6**	**95.1**	**96.5**
4-Bromofluorobenzene	460-00-4	2	%		**105**	**106**	**103**	**103**	**105**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**62.2**	**67.8**	**59.7**	**54.5**	**56.6**
Anthracene-d10	1719-06-8	0.02	%		**85.0**	**83.5**	**85.9**	**69.2**	**77.5**
4-Terphenyl-d14	1718-51-0	0.02	%		**87.6**	**95.8**	**92.4**	**71.2**	**80.8**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	CS4-Bot	G3	G3-Bot	OA3	OA3-Bot
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-006	EP2313186-007	EP2313186-008	EP2313186-009	EP2313186-010
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	CS4-Bot	G3	G3-Bot	OA3	OA3-Bot
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-006	EP2313186-007	EP2313186-008	EP2313186-009	EP2313186-010
				Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued								
Chrysene	218-01-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**108**	**110**	**111**	**113**	**102**
Toluene-D8	2037-26-5	2	%	**97.7**	**96.5**	**96.4**	**97.6**	**99.2**
4-Bromofluorobenzene	460-00-4	2	%	**105**	**106**	**105**	**106**	**106**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)								
2-Fluorobiphenyl	321-60-8	0.02	%	**54.9**	**56.9**	**56.0**	**59.6**	**60.1**
Anthracene-d10	1719-06-8	0.02	%	**73.7**	**88.7**	**74.4**	**75.2**	**79.3**
4-Terphenyl-d14	1718-51-0	0.02	%	**85.1**	**93.0**	**84.7**	**87.9**	**83.4**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	OA1	OA1-Bot	OA2	OA2-Bot	GR1
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	21-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-011	EP2313186-012	EP2313186-013	EP2313186-014	EP2313186-015
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	OA1	OA1-Bot	OA2	OA2-Bot	GR1
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	21-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-011	EP2313186-012	EP2313186-013	EP2313186-014	EP2313186-015
				Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued								
Chrysene	218-01-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**107**	**106**	**108**	**107**	**109**
Toluene-D8	2037-26-5	2	%	**97.0**	**97.0**	**96.3**	**97.2**	**96.4**
4-Bromofluorobenzene	460-00-4	2	%	**108**	**104**	**104**	**104**	**104**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)								
2-Fluorobiphenyl	321-60-8	0.02	%	**59.5**	**65.7**	**60.2**	**58.8**	**60.0**
Anthracene-d10	1719-06-8	0.02	%	**77.0**	**81.6**	**74.8**	**78.4**	**73.3**
4-Terphenyl-d14	1718-51-0	0.02	%	**89.1**	**87.2**	**86.9**	**83.4**	**84.1**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	GR1-Bot	GR2	GR2-Bot	OA11	OA11-Bot
			Sampling date / time	21-Sep-2023 00:00	21-Sep-2023 00:00	21-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-016	EP2313186-017	EP2313186-018	EP2313186-019	EP2313186-020
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)				Sample ID	GR1-Bot	GR2	GR2-Bot	OA11	OA11-Bot
				Sampling date / time	21-Sep-2023 00:00	21-Sep-2023 00:00	21-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit		EP2313186-016	EP2313186-017	EP2313186-018	EP2313186-019	EP2313186-020
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.006
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**112**	**112**	**108**	**112**	**110**
Toluene-D8	2037-26-5	2	%		**95.2**	**96.7**	**96.1**	**97.0**	**97.0**
4-Bromofluorobenzene	460-00-4	2	%		**107**	**108**	**102**	**106**	**106**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**67.4**	**80.5**	**65.3**	**45.6**	**60.2**
Anthracene-d10	1719-06-8	0.02	%		**76.4**	**83.1**	**70.9**	**65.3**	**70.0**
4-Terphenyl-d14	1718-51-0	0.02	%		**88.1**	**95.9**	**79.2**	**77.3**	**79.1**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	OA9	OA9-Bot	1310	1310-Bot	NH3
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-021	EP2313186-022	EP2313186-023	EP2313186-024	EP2313186-025
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)				Sample ID	OA9	OA9-Bot	1310	1310-Bot	NH3
				Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit		EP2313186-021	EP2313186-022	EP2313186-023	EP2313186-024	EP2313186-025
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
^ **Total PAH**	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
^ **Benzo(a)pyrene TEQ (zero)**	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**116**	**105**	**109**	**115**	**110**
Toluene-D8	2037-26-5	2	%		**103**	**96.1**	**96.3**	**99.7**	**97.3**
4-Bromofluorobenzene	460-00-4	2	%		**93.7**	**91.2**	**90.4**	**97.2**	**94.9**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**58.0**	**46.0**	**43.4**	**56.0**	**52.6**
Anthracene-d10	1719-06-8	0.02	%		**74.5**	**64.9**	**65.1**	**69.2**	**64.2**
4-Terphenyl-d14	1718-51-0	0.02	%		**87.1**	**73.1**	**68.2**	**86.0**	**77.0**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	NH3-Bot	QA	QC	CS7	CS7-Bot
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-026	EP2313186-027	EP2313186-028	EP2313186-029	EP2313186-030
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	NH3-Bot	QA	QC	CS7	CS7-Bot
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-026	EP2313186-027	EP2313186-028	EP2313186-029	EP2313186-030
				Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued								
Chrysene	218-01-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L	<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates								
1.2-Dichloroethane-D4	17060-07-0	2	%	**106**	**114**	**111**	**111**	**110**
Toluene-D8	2037-26-5	2	%	**101**	**100**	**98.4**	**101**	**101**
4-Bromofluorobenzene	460-00-4	2	%	**97.4**	**102**	**99.6**	**94.6**	**95.9**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)								
2-Fluorobiphenyl	321-60-8	0.02	%	**48.2**	**53.3**	**71.2**	**66.1**	**56.7**
Anthracene-d10	1719-06-8	0.02	%	**67.9**	**78.0**	**87.6**	**84.2**	**70.7**
4-Terphenyl-d14	1718-51-0	0.02	%	**85.7**	**90.4**	**97.4**	**92.4**	**84.2**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	CB	CB-Bot	CS12	CS12-Bot	CS9
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-031	EP2313186-032	EP2313186-033	EP2313186-034	EP2313186-035
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: **MARINE WATER** (Matrix: **WATER**)

Compound	CAS Number	LOR	Unit	Sample ID	CB	CB-Bot	CS12	CS12-Bot	CS9
				Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
					EP2313186-031	EP2313186-032	EP2313186-033	EP2313186-034	EP2313186-035
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
^ **Total PAH**	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
^ **Benzo(a)pyrene TEQ (zero)**	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**111**	**113**	**112**	**108**	**106**
Toluene-D8	2037-26-5	2	%		**98.3**	**99.8**	**102**	**99.3**	**96.4**
4-Bromofluorobenzene	460-00-4	2	%		**96.6**	**101**	**95.5**	**95.7**	**93.2**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**59.1**	**58.1**	**54.4**	**49.5**	**53.0**
Anthracene-d10	1719-06-8	0.02	%		**73.0**	**74.1**	**73.6**	**68.9**	**69.1**
4-Terphenyl-d14	1718-51-0	0.02	%		**82.4**	**84.3**	**87.4**	**78.6**	**79.7**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	CS9-Bot	CS9A	CS9A-Bot	CS10N	CS10N-Bot
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-036	EP2313186-037	EP2313186-038	EP2313186-039	EP2313186-040
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)				Sample ID	CS9-Bot	CS9A	CS9A-Bot	CS10N	CS10N-Bot
				Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit		EP2313186-036	EP2313186-037	EP2313186-038	EP2313186-039	EP2313186-040
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**106**	**105**	**108**	**105**	**106**
Toluene-D8	2037-26-5	2	%		**97.0**	**102**	**99.6**	**102**	**102**
4-Bromofluorobenzene	460-00-4	2	%		**94.4**	**96.6**	**96.1**	**96.5**	**97.3**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**53.4**	**54.2**	**51.2**	**53.0**	**51.8**
Anthracene-d10	1719-06-8	0.02	%		**68.1**	**67.1**	**68.3**	**79.0**	**80.1**
4-Terphenyl-d14	1718-51-0	0.02	%		**73.3**	**77.0**	**74.7**	**84.1**	**73.3**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	CS13	CS13-Bot	CS11	CS11-Bot	MB
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-041	EP2313186-042	EP2313186-043	EP2313186-044	EP2313186-045
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)				Sample ID	CS13	CS13-Bot	CS11	CS11-Bot	MB
				Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit		EP2313186-041	EP2313186-042	EP2313186-043	EP2313186-044	EP2313186-045
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**102**	**107**	**106**	**103**	**103**
Toluene-D8	2037-26-5	2	%		**98.3**	**98.4**	**98.2**	**97.8**	**97.7**
4-Bromofluorobenzene	460-00-4	2	%		**105**	**106**	**106**	**105**	**104**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**58.9**	**44.7**	**55.5**	**48.3**	**59.4**
Anthracene-d10	1719-06-8	0.02	%		**78.7**	**73.9**	**74.4**	**68.9**	**75.5**
4-Terphenyl-d14	1718-51-0	0.02	%		**89.8**	**78.4**	**90.5**	**74.8**	**84.1**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	WS4	WS4-Bot	WS6	WS6-Bot	SF
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-046	EP2313186-047	EP2313186-048	EP2313186-049	EP2313186-050
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	**0.13**
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)				Sample ID	WS4	WS4-Bot	WS6	WS6-Bot	SF
				Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit		EP2313186-046	EP2313186-047	EP2313186-048	EP2313186-049	EP2313186-050
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	**0.130**
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**104**	**103**	**104**	**104**	**107**
Toluene-D8	2037-26-5	2	%		**97.9**	**97.2**	**98.0**	**95.6**	**98.8**
4-Bromofluorobenzene	460-00-4	2	%		**106**	**104**	**105**	**104**	**106**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**53.4**	**59.5**	**62.5**	**59.4**	**64.9**
Anthracene-d10	1719-06-8	0.02	%		**64.8**	**77.8**	**73.6**	**70.4**	**73.0**
4-Terphenyl-d14	1718-51-0	0.02	%		**76.9**	**101**	**87.6**	**82.2**	**92.2**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	SF-Bot	G1	G1-Bot	G2	G2-Bot
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit	EP2313186-051	EP2313186-052	EP2313186-053	EP2313186-054	EP2313186-055
				Result	Result	Result	Result	Result
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	<20
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	<50
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	<50
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	<20
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	<20
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	<100
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	<100
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	<1
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	<2
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	<2
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	<2
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	<2
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	<2
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	<1
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	<5
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	**0.15**	<0.02	<0.02	<0.02	<0.02
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	<0.02

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)				Sample ID	SF-Bot	G1	G1-Bot	G2	G2-Bot
				Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00
Compound	CAS Number	LOR	Unit		EP2313186-051	EP2313186-052	EP2313186-053	EP2313186-054	EP2313186-055
					Result	Result	Result	Result	Result
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	<0.02
^ Total PAH	----	0.005	µg/L		**0.150**	<0.005	<0.005	<0.005	<0.005
^ Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	<0.005
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**108**	**103**	**104**	**104**	**106**
Toluene-D8	2037-26-5	2	%		**99.2**	**98.5**	**99.2**	**97.7**	**101**
4-Bromofluorobenzene	460-00-4	2	%		**107**	**104**	**101**	**105**	**106**
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**73.4**	**50.1**	**67.5**	**57.2**	**47.8**
Anthracene-d10	1719-06-8	0.02	%		**75.2**	**70.5**	**80.5**	**66.7**	**64.9**
4-Terphenyl-d14	1718-51-0	0.02	%		**92.7**	**78.8**	**110**	**79.0**	**85.8**

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)			Sample ID	Transport Blank	Field Blank	CS8	CS8-Bot	----
			Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	----
Compound	CAS Number	LOR	Unit	EP2313186-056	EP2313186-057	EP2313186-058	EP2313186-059	--------
				Result	Result	Result	Result	----
EP080/071: Total Petroleum Hydrocarbons								
C6 - C9 Fraction	----	20	µg/L	<20	<20	<20	<20	----
C10 - C14 Fraction	----	50	µg/L	<50	<50	<50	<50	----
C15 - C28 Fraction	----	100	µg/L	<100	<100	<100	<100	----
C29 - C36 Fraction	----	50	µg/L	<50	<50	<50	<50	----
^ C10 - C36 Fraction (sum)	----	50	µg/L	<50	<50	<50	<50	----
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions								
C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	<20	<20	----
^ C6 - C10 Fraction minus BTEX (F1)	C6_C10-BTEX	20	µg/L	<20	<20	<20	<20	----
>C10 - C16 Fraction	----	100	µg/L	<100	<100	<100	<100	----
>C16 - C34 Fraction	----	100	µg/L	<100	<100	<100	<100	----
>C34 - C40 Fraction	----	100	µg/L	<100	<100	<100	<100	----
^ >C10 - C40 Fraction (sum)	----	100	µg/L	<100	<100	<100	<100	----
^ >C10 - C16 Fraction minus Naphthalene (F2)	----	100	µg/L	<100	<100	<100	<100	----
EP080: BTEXN								
Benzene	71-43-2	1	µg/L	<1	<1	<1	<1	----
Toluene	108-88-3	2	µg/L	<2	<2	<2	<2	----
Ethylbenzene	100-41-4	2	µg/L	<2	<2	<2	<2	----
meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	<2	<2	----
ortho-Xylene	95-47-6	2	µg/L	<2	<2	<2	<2	----
^ Total Xylenes	----	2	µg/L	<2	<2	<2	<2	----
^ Sum of BTEX	----	1	µg/L	<1	<1	<1	<1	----
Naphthalene	91-20-3	5	µg/L	<5	<5	<5	<5	----
EP132B: Polynuclear Aromatic Hydrocarbons								
Naphthalene	91-20-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----
Acenaphthylene	208-96-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----
Acenaphthene	83-32-9	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----
Fluorene	86-73-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----
Phenanthrene	85-01-8	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----
Anthracene	120-12-7	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----
Fluoranthene	206-44-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----
Pyrene	129-00-0	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----
Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	<0.02	<0.02	<0.02	----

Analytical Results

Sub-Matrix: MARINE WATER (Matrix: WATER)				Sample ID	Transport Blank	Field Blank	CS8	CS8-Bot	----
				Sampling date / time	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	20-Sep-2023 00:00	----
Compound	CAS Number	LOR	Unit		EP2313186-056	EP2313186-057	EP2313186-058	EP2313186-059	--------
					Result	Result	Result	Result	----
EP132B: Polynuclear Aromatic Hydrocarbons - Continued									
Chrysene	218-01-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	----
Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	----
Benzo(k)fluoranthene	207-08-9	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	----
Benzo(a)pyrene	50-32-8	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	----
Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	----
Dibenz(a.h)anthracene	53-70-3	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	----
Benzo(g.h.i)perylene	191-24-2	0.02	µg/L		<0.02	<0.02	<0.02	<0.02	----
^ **Total PAH**	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	----
^ **Benzo(a)pyrene TEQ (zero)**	----	0.005	µg/L		<0.005	<0.005	<0.005	<0.005	----
EP080S: TPH(V)/BTEX Surrogates									
1.2-Dichloroethane-D4	17060-07-0	2	%		**99.1**	**103**	**122**	**102**	----
Toluene-D8	2037-26-5	2	%		**101**	**100.0**	**94.5**	**100.0**	----
4-Bromofluorobenzene	460-00-4	2	%		**105**	**104**	**106**	**104**	----
EP132T: Base/Neutral Extractable Surrogates (Low-Level)									
2-Fluorobiphenyl	321-60-8	0.02	%		**58.0**	**50.8**	**55.4**	**64.2**	----
Anthracene-d10	1719-06-8	0.02	%		**78.5**	**66.5**	**66.5**	**73.8**	----
4-Terphenyl-d14	1718-51-0	0.02	%		**96.6**	**89.1**	**93.9**	**109**	----

Surrogate Control Limits

Sub-Matrix: **MARINE WATER**		Recovery Limits (%)	
Compound	*CAS Number*	*Low*	*High*
EP080S: TPH(V)/BTEX Surrogates			
1.2-Dichloroethane-D4	17060-07-0	61	141
Toluene-D8	2037-26-5	73	126
4-Bromofluorobenzene	460-00-4	60	125
EP132T: Base/Neutral Extractable Surrogates (Low-Level)			
2-Fluorobiphenyl	321-60-8	38	122
Anthracene-d10	1719-06-8	64	130
4-Terphenyl-d14	1718-51-0	47	147

QUALITY CONTROL REPORT

Work Order	: **EP2313186**	Page	: 1 of 9
Client	: **MARINE AND FRESHWATER RESEARCH LABORATORY**	Laboratory	: Environmental Division Perth
Contact	: KRZYSZTOF WIENCZUGOW	Contact	: Customer Services EP
Address	: C/- MURDOCH UNIVERSITY, SOUTH STREET MURDOCH WA, AUSTRALIA 6150	Address	: 26 Rigali Way Wangara WA Australia 6065
Telephone	: +61 08 93602907	Telephone	: +61-8-9406 1301
Project	: WAMS23-9	Date Samples Received	: 22-Sep-2023
Order number	: ----	Date Analysis Commenced	: 26-Sep-2023
C-O-C number	: ----	Issue Date	: 04-Oct-2023
Sampler	: ----		
Site	: ----		
Quote number	: EP23MARFRE0004		
No. of samples received	: 59		
No. of samples analysed	: 59		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Thomas Donovan	Senior Organic Chemist	Perth Organics, Wangara, WA

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	Sample ID	Method: Compound	CAS Number	LOR	Unit	Original Result	Duplicate Result	RPD (%)	Acceptable RPD (%)
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5321758)									
EP2313186-001	CS6A	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP2313186-011	OA1	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5321763)									
EP2313186-021	OA9	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP2313186-031	CB	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Petroleum Hydrocarbons (QC Lot: 5321765)									
EP2313186-041	CS13	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP2313186-051	SF-Bot	EP080: C6 - C9 Fraction	----	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5321758)									
EP2313186-001	CS6A	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP2313186-011	OA1	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5321763)									
EP2313186-021	OA9	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP2313186-031	CB	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QC Lot: 5321765)									
EP2313186-041	CS13	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP2313186-051	SF-Bot	EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	<20	0.0	No Limit
EP080: BTEXN (QC Lot: 5321758)									
EP2313186-001	CS6A	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Acceptable RPD (%)*
EP080: BTEXN (QC Lot: 5321758) - continued									
EP2313186-001	CS6A	EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
EP2313186-011	OA1	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
EP080: BTEXN (QC Lot: 5321763)									
EP2313186-021	OA9	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
EP2313186-031	CB	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
EP080: BTEXN (QC Lot: 5321765)									
EP2313186-041	CS13	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit
EP2313186-051	SF-Bot	EP080: Benzene	71-43-2	1	µg/L	<1	<1	0.0	No Limit
		EP080: Toluene	108-88-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: Ethylbenzene	100-41-4	2	µg/L	<2	<2	0.0	No Limit
		EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	<2	0.0	No Limit
		EP080: ortho-Xylene	95-47-6	2	µg/L	<2	<2	0.0	No Limit
		EP080: Naphthalene	91-20-3	5	µg/L	<5	<5	0.0	No Limit

Method Blank (MB) and Laboratory Control Sample (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Sample (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5321758)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	360 µg/L	98.8	73.6	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5321763)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	360 µg/L	98.6	73.6	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5321765)								
EP080: C6 - C9 Fraction	----	20	µg/L	<20	360 µg/L	97.7	73.6	113
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5324241)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	341 µg/L	95.6	39.3	103
EP071: C15 - C28 Fraction	----	100	µg/L	<100	343 µg/L	74.2	47.2	122
EP071: C29 - C36 Fraction	----	50	µg/L	<50	257 µg/L	109	42.5	119
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5324245)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	341 µg/L	103	39.3	103
EP071: C15 - C28 Fraction	----	100	µg/L	<100	343 µg/L	79.8	47.2	122
EP071: C29 - C36 Fraction	----	50	µg/L	<50	257 µg/L	116	42.5	119
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5324246)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	341 µg/L	95.6	39.3	103
EP071: C15 - C28 Fraction	----	100	µg/L	<100	343 µg/L	74.2	47.2	122
EP071: C29 - C36 Fraction	----	50	µg/L	<50	257 µg/L	109	42.5	119
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5327231)								
EP071: C10 - C14 Fraction	----	50	µg/L	<50	341 µg/L	78.8	39.3	103
EP071: C15 - C28 Fraction	----	100	µg/L	<100	343 µg/L	110	47.2	122
EP071: C29 - C36 Fraction	----	50	µg/L	<50	257 µg/L	115	42.5	119
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5321758)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	450 µg/L	99.6	73.9	115
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5321763)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	450 µg/L	98.2	73.9	115
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5321765)								
EP080: C6 - C10 Fraction	C6_C10	20	µg/L	<20	450 µg/L	97.9	73.9	115
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5324241)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	346 µg/L	78.4	47.0	100
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	430 µg/L	96.4	46.2	116

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5324241) - continued								
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	161 µg/L	71.6	24.7	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5324245)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	346 µg/L	84.0	47.0	100
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	430 µg/L	107	46.2	116
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	161 µg/L	93.0	24.7	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5324246)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	346 µg/L	78.4	47.0	100
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	430 µg/L	96.4	46.2	116
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	161 µg/L	71.6	24.7	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5327231)								
EP071: >C10 - C16 Fraction	----	100	µg/L	<100	346 µg/L	83.0	47.0	100
EP071: >C16 - C34 Fraction	----	100	µg/L	<100	430 µg/L	116	46.2	116
EP071: >C34 - C40 Fraction	----	100	µg/L	<100	161 µg/L	112	24.7	137
EP080: BTEXN (QCLot: 5321758)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	98.6	84.1	114
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	101	81.0	115
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	100	84.4	113
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	99.5	84.3	114
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	98.3	86.5	111
EP080: Naphthalene	91-20-3	5	µg/L	<5	5 µg/L	102	77.0	118
EP080: BTEXN (QCLot: 5321763)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	101	84.1	114
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	101	81.0	115
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	102	84.4	113
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	101	84.3	114
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	109	86.5	111
EP080: Naphthalene	91-20-3	5	µg/L	<5	5 µg/L	98.2	77.0	118
EP080: BTEXN (QCLot: 5321765)								
EP080: Benzene	71-43-2	1	µg/L	<1	20 µg/L	98.1	84.1	114
EP080: Toluene	108-88-3	2	µg/L	<2	20 µg/L	104	81.0	115
EP080: Ethylbenzene	100-41-4	2	µg/L	<2	20 µg/L	100	84.4	113
EP080: meta- & para-Xylene	108-38-3 106-42-3	2	µg/L	<2	40 µg/L	100	84.3	114

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report		
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EP080: BTEXN (QCLot: 5321765) - continued								
EP080: ortho-Xylene	95-47-6	2	µg/L	<2	20 µg/L	102	86.5	111
EP080: Naphthalene	91-20-3	5	µg/L	<5	5 µg/L	101	77.0	118
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 5324229)								
EP132-LL: Naphthalene	91-20-3	0.02	µg/L	<0.02	0.25 µg/L	65.1	42.0	136
EP132-LL: Acenaphthylene	208-96-8	0.02	µg/L	<0.02	0.25 µg/L	62.8	40.0	124
EP132-LL: Acenaphthene	83-32-9	0.02	µg/L	<0.02	0.25 µg/L	69.3	42.0	128
EP132-LL: Fluorene	86-73-7	0.02	µg/L	<0.02	0.25 µg/L	77.4	48.0	126
EP132-LL: Phenanthrene	85-01-8	0.02	µg/L	<0.02	0.25 µg/L	77.3	59.0	125
EP132-LL: Anthracene	120-12-7	0.02	µg/L	<0.02	0.25 µg/L	65.8	45.0	117
EP132-LL: Fluoranthene	206-44-0	0.02	µg/L	<0.02	0.25 µg/L	78.9	60.0	120
EP132-LL: Pyrene	129-00-0	0.02	µg/L	<0.02	0.25 µg/L	74.3	63.0	121
EP132-LL: Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	0.25 µg/L	72.6	65.0	133
EP132-LL: Chrysene	218-01-9	0.02	µg/L	<0.02	0.25 µg/L	85.4	56.0	124
EP132-LL: Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	0.25 µg/L	77.6	55.0	131
EP132-LL: Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	0.25 µg/L	83.0	45.0	125
EP132-LL: Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.005	0.25 µg/L	68.4	53.0	111
EP132-LL: Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	0.25 µg/L	77.5	58.0	122
EP132-LL: Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	0.25 µg/L	76.8	59.0	121
EP132-LL: Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	0.25 µg/L	80.2	50.0	134
EP132-LL: Total PAH	----	0.005	µg/L	<0.005	----	----	----	----
EP132-LL: Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L	<0.005	----	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 5324236)								
EP132-LL: Naphthalene	91-20-3	0.02	µg/L	<0.02	0.25 µg/L	63.1	42.0	136
EP132-LL: Acenaphthylene	208-96-8	0.02	µg/L	<0.02	0.25 µg/L	56.2	40.0	124
EP132-LL: Acenaphthene	83-32-9	0.02	µg/L	<0.02	0.25 µg/L	61.5	42.0	128
EP132-LL: Fluorene	86-73-7	0.02	µg/L	<0.02	0.25 µg/L	64.8	48.0	126
EP132-LL: Phenanthrene	85-01-8	0.02	µg/L	<0.02	0.25 µg/L	60.3	59.0	125
EP132-LL: Anthracene	120-12-7	0.02	µg/L	<0.02	0.25 µg/L	59.0	45.0	117
EP132-LL: Fluoranthene	206-44-0	0.02	µg/L	<0.02	0.25 µg/L	65.3	60.0	120
EP132-LL: Pyrene	129-00-0	0.02	µg/L	<0.02	0.25 µg/L	65.1	63.0	121
EP132-LL: Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	0.25 µg/L	67.8	65.0	133
EP132-LL: Chrysene	218-01-9	0.02	µg/L	<0.02	0.25 µg/L	68.1	56.0	124
EP132-LL: Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	0.25 µg/L	82.0	55.0	131

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Acceptable Limits (%)	
				Result	Concentration	LCS	Low	High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 5324236) - continued								
EP132-LL: Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	0.25 µg/L	84.3	45.0	125
EP132-LL: Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.005	0.25 µg/L	68.0	53.0	111
EP132-LL: Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	0.25 µg/L	60.5	58.0	122
EP132-LL: Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	0.25 µg/L	59.0	59.0	121
EP132-LL: Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	0.25 µg/L	72.2	50.0	134
EP132-LL: Total PAH	----	0.005	µg/L	<0.005	----	----	----	----
EP132-LL: Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L	<0.005	----	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 5324238)								
EP132-LL: Naphthalene	91-20-3	0.02	µg/L	<0.02	0.25 µg/L	80.0	42.0	136
EP132-LL: Acenaphthylene	208-96-8	0.02	µg/L	<0.02	0.25 µg/L	63.8	40.0	124
EP132-LL: Acenaphthene	83-32-9	0.02	µg/L	<0.02	0.25 µg/L	74.4	42.0	128
EP132-LL: Fluorene	86-73-7	0.02	µg/L	<0.02	0.25 µg/L	80.6	48.0	126
EP132-LL: Phenanthrene	85-01-8	0.02	µg/L	<0.02	0.25 µg/L	76.3	59.0	125
EP132-LL: Anthracene	120-12-7	0.02	µg/L	<0.02	0.25 µg/L	66.0	45.0	117
EP132-LL: Fluoranthene	206-44-0	0.02	µg/L	<0.02	0.25 µg/L	84.0	60.0	120
EP132-LL: Pyrene	129-00-0	0.02	µg/L	<0.02	0.25 µg/L	80.6	63.0	121
EP132-LL: Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	0.25 µg/L	70.1	65.0	133
EP132-LL: Chrysene	218-01-9	0.02	µg/L	<0.02	0.25 µg/L	85.2	56.0	124
EP132-LL: Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	0.25 µg/L	78.3	55.0	131
EP132-LL: Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	0.25 µg/L	84.6	45.0	125
EP132-LL: Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.005	0.25 µg/L	82.1	53.0	111
EP132-LL: Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	0.25 µg/L	74.9	58.0	122
EP132-LL: Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	0.25 µg/L	71.5	59.0	121
EP132-LL: Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	0.25 µg/L	84.1	50.0	134
EP132-LL: Total PAH	----	0.005	µg/L	<0.005	----	----	----	----
EP132-LL: Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L	<0.005	----	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 5327225)								
EP132-LL: Naphthalene	91-20-3	0.02	µg/L	<0.02	0.25 µg/L	68.6	42.0	136
EP132-LL: Acenaphthylene	208-96-8	0.02	µg/L	<0.02	0.25 µg/L	64.9	40.0	124
EP132-LL: Acenaphthene	83-32-9	0.02	µg/L	<0.02	0.25 µg/L	70.7	42.0	128
EP132-LL: Fluorene	86-73-7	0.02	µg/L	<0.02	0.25 µg/L	69.4	48.0	126
EP132-LL: Phenanthrene	85-01-8	0.02	µg/L	<0.02	0.25 µg/L	92.0	59.0	125
EP132-LL: Anthracene	120-12-7	0.02	µg/L	<0.02	0.25 µg/L	77.1	45.0	117

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP132B: Polynuclear Aromatic Hydrocarbons (QCLot: 5327225) - continued								
EP132-LL: Fluoranthene	206-44-0	0.02	µg/L	<0.02	0.25 µg/L	94.9	60.0	120
EP132-LL: Pyrene	129-00-0	0.02	µg/L	<0.02	0.25 µg/L	89.9	63.0	121
EP132-LL: Benz(a)anthracene	56-55-3	0.02	µg/L	<0.02	0.25 µg/L	67.7	65.0	133
EP132-LL: Chrysene	218-01-9	0.02	µg/L	<0.02	0.25 µg/L	108	56.0	124
EP132-LL: Benzo(b+j)fluoranthene	205-99-2 205-82-3	0.02	µg/L	<0.02	0.25 µg/L	101	55.0	131
EP132-LL: Benzo(k)fluoranthene	207-08-9	0.02	µg/L	<0.02	0.25 µg/L	116	45.0	125
EP132-LL: Benzo(a)pyrene	50-32-8	0.005	µg/L	<0.005	0.25 µg/L	96.7	53.0	111
EP132-LL: Indeno(1.2.3.cd)pyrene	193-39-5	0.02	µg/L	<0.02	0.25 µg/L	85.2	58.0	122
EP132-LL: Dibenz(a.h)anthracene	53-70-3	0.02	µg/L	<0.02	0.25 µg/L	84.5	59.0	121
EP132-LL: Benzo(g.h.i)perylene	191-24-2	0.02	µg/L	<0.02	0.25 µg/L	103	50.0	134
EP132-LL: Total PAH	----	0.005	µg/L	<0.005	----	----	----	----
EP132-LL: Benzo(a)pyrene TEQ (zero)	----	0.005	µg/L	<0.005	----	----	----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Acceptable Limits (%): Low	Acceptable Limits (%): High
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5321758)							
EP2313186-002	CS6A-Bot	EP080: C6 - C9 Fraction	----	240 µg/L	126	77.0	137
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5321763)							
EP2313186-022	OA9-Bot	EP080: C6 - C9 Fraction	----	240 µg/L	125	77.0	137
EP080/071: Total Petroleum Hydrocarbons (QCLot: 5321765)							
EP2313186-042	CS13-Bot	EP080: C6 - C9 Fraction	----	240 µg/L	111	77.0	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5321758)							
EP2313186-002	CS6A-Bot	EP080: C6 - C10 Fraction	C6_C10	290 µg/L	122	77.0	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5321763)							
EP2313186-022	OA9-Bot	EP080: C6 - C10 Fraction	C6_C10	290 µg/L	122	77.0	137
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions (QCLot: 5321765)							
EP2313186-042	CS13-Bot	EP080: C6 - C10 Fraction	C6_C10	290 µg/L	108	77.0	137
EP080: BTEXN (QCLot: 5321758)							
EP2313186-002	CS6A-Bot	EP080: Benzene	71-43-2	20 µg/L	121	77.0	122

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Acceptable Limits (%)	
Laboratory sample ID	*Sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EP080: BTEXN (QCLot: 5321758) - continued							
EP2313186-002	CS6A-Bot	EP080: Toluene	108-88-3	20 µg/L	123	73.5	126
EP080: BTEXN (QCLot: 5321763)							
EP2313186-022	OA9-Bot	EP080: Benzene	71-43-2	20 µg/L	122	77.0	122
		EP080: Toluene	108-88-3	20 µg/L	117	73.5	126
EP080: BTEXN (QCLot: 5321765)							
EP2313186-042	CS13-Bot	EP080: Benzene	71-43-2	20 µg/L	111	77.0	122
		EP080: Toluene	108-88-3	20 µg/L	114	73.5	126

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EP2313186**	Page	: 1 of 12
Client	: **MARINE AND FRESHWATER RESEARCH LABORATORY**	Laboratory	: Environmental Division Perth
Contact	: KRZYSZTOF WIENCZUGOW	Telephone	: +61-8-9406 1301
Project	: WAMS23-9	Date Samples Received	: 22-Sep-2023
Site	: ----	Issue Date	: 04-Oct-2023
Sampler	: ----	No. of samples received	: 59
Order number	: ----	No. of samples analysed	: 59

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **Quality Control Sample Frequency Outliers exist - please see following pages for full details.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method		Extraction / Preparation			Analysis		
Container / Client Sample ID(s)		Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved							
MB,	WS4,	28-Sep-2023	27-Sep-2023	1	----	----	----
WS4-Bot,	WS6,						
WS6-Bot,	SF,						
SF-Bot,	G1,						
G1-Bot,	G2,						
G2-Bot,	Transport Blank,						
Field Blank,	CS8,						
CS8-Bot							
Amber Glass Bottle - Unpreserved							
CS6A,	CS6A-Bot,	28-Sep-2023	27-Sep-2023	1	----	----	----
CS5,	CS5-Bot,						
CS4,	CS4-Bot,						
G3,	G3-Bot,						
OA3,	OA3-Bot,						
OA1,	OA1-Bot,						
OA2,	OA2-Bot,						
OA11,	OA11-Bot,						
OA9,	OA9-Bot,						
1310,	1310-Bot,						
NH3,	NH3-Bot,						
QA,	QC,						
CS7,	CS7-Bot,						
CB,	CB-Bot,						
CS12,	CS12-Bot,						
CS9,	CS9-Bot,						
CS9A,	CS9A-Bot,						
CS10N,	CS13, CS10N-Bot,						
CS13-Bot,							
CS11,	CS11-Bot						
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Analysis Holding Time						
Amber Glass Bottle - Unpreserved						
MB, WS4, WS4-Bot, WS6, WS6-Bot, SF, SF-Bot, G1, G1-Bot, G2, G2-Bot, Transport Blank, Field Blank, CS8, CS8-Bot	28-Sep-2023	27-Sep-2023	1	----	----	----
Amber Glass Bottle - Unpreserved						
CS6A, CS6A-Bot, CS5, CS5-Bot, CS4, CS4-Bot, G3, G3-Bot, OA3, OA3-Bot, OA1, OA1-Bot, OA2, OA2-Bot, OA11, OA11-Bot, OA9, OA9-Bot, 1310, 1310-Bot, NH3, NH3-Bot, QA, QC, CS7, CS7-Bot, CB, CB-Bot, CS12, CS12-Bot, CS9, CS9-Bot, CS9A, CS9A-Bot, CS10N, CS13, CS10N-Bot, CS13-Bot, CS11, CS11-Bot	28-Sep-2023	27-Sep-2023	1	----	----	----
EP132B: Polynuclear Aromatic Hydrocarbons						
Amber Glass Bottle - Unpreserved						
MB, WS4, WS4-Bot, WS6, WS6-Bot, SF, SF-Bot, G1, G1-Bot, G2, G2-Bot, Transport Blank, Field Blank, CS8, CS8-Bot	28-Sep-2023	27-Sep-2023	1	----	----	----

Outliers : Frequency of Quality Control Samples

Matrix: **WATER**

Quality Control Sample Type / Method	Count		Rate (%)		Quality Control Specification
	QC	Regular	Actual	Expected	
	0				
Laboratory Duplicates (DUP)					
PAH Compounds in Water	0	59	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	65	0.00	10.00	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)					
PAH Compounds in Water	0	59	0.00	5.00	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	0	65	0.00	5.00	NEPM 2013 B3 & ALS QC Standard

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / ***Container*** / Client Sample ID(s)	***Sample Date***	*Extraction / Preparation*			*Analysis*		
		Date extracted	Due for extraction	Evaluation	***Date analysed***	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP071)							
MB, WS4, WS4-Bot, WS6, WS6-Bot, SF, SF-Bot, G1, G1-Bot, G2, G2-Bot, Transport Blank, Field Blank, CS8, CS8-Bot	**20-Sep-2023**	**28-Sep-2023**	27-Sep-2023	×	**02-Oct-2023**	07-Nov-2023	✓
Amber Glass Bottle - Unpreserved (EP071)							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)		Sample Date	Extraction / Preparation			Analysis		
			Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons - Continued								
CS6A,	CS6A-Bot,	**20-Sep-2023**	**28-Sep-2023**	27-Sep-2023	×	**03-Oct-2023**	07-Nov-2023	✓
CS5,	CS5-Bot,							
CS4,	CS4-Bot,							
G3,	G3-Bot,							
OA3,	OA3-Bot,							
OA1,	OA1-Bot,							
OA2,	OA2-Bot,							
OA11,	OA11-Bot,							
OA9,	OA9-Bot,							
1310,	1310-Bot,							
NH3,	NH3-Bot,							
QA,	QC,							
CS7,	CS7-Bot,							
CB,	CB-Bot,							
CS12,	CS12-Bot,							
CS9,	CS9-Bot,							
CS9A,	CS9A-Bot,							
CS10N,	CS13, CS10N-Bot,							
CS13-Bot,								
CS11,	CS11-Bot							
Amber Glass Bottle - Unpreserved (EP071)								
GR1,	GR1-Bot,	**21-Sep-2023**	**28-Sep-2023**	28-Sep-2023	✓	**03-Oct-2023**	07-Nov-2023	✓
GR2,	GR2-Bot							
Amber VOC Vial - Sulfuric Acid (EP080)								

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Petroleum Hydrocarbons - Continued							
CS6A, CS6A-Bot, CS5, CS5-Bot, CS4, CS4-Bot, G3, G3-Bot, OA3, OA3-Bot, OA1, OA1-Bot, OA2, OA2-Bot, OA11, OA11-Bot, OA9, OA9-Bot, 1310, 1310-Bot, NH3, NH3-Bot, QA, QC, CS7, CS7-Bot, CB, CB-Bot, CS12, CS12-Bot, CS9, CS9-Bot, CS9A, CS9A-Bot, CS10N, CS13, CS10N-Bot, CS13-Bot, CS11, CS11-Bot, MB, WS4, WS4-Bot, WS6, WS6-Bot, SF, SF-Bot, G1	**20-Sep-2023**	**26-Sep-2023**	04-Oct-2023	✓	**26-Sep-2023**	04-Oct-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
G1-Bot, G2, G2-Bot, Transport Blank, Field Blank, CS8, CS8-Bot	**20-Sep-2023**	**26-Sep-2023**	04-Oct-2023	✓	**27-Sep-2023**	04-Oct-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
GR1, GR1-Bot, GR2, GR2-Bot	**21-Sep-2023**	**26-Sep-2023**	05-Oct-2023	✓	**26-Sep-2023**	05-Oct-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions							
Amber Glass Bottle - Unpreserved (EP071)							
MB, WS4, WS4-Bot, WS6, WS6-Bot, SF, SF-Bot, G1, G1-Bot, G2, G2-Bot, Transport Blank, Field Blank, CS8, CS8-Bot	**20-Sep-2023**	**28-Sep-2023**	27-Sep-2023	×	**02-Oct-2023**	07-Nov-2023	✓
Amber Glass Bottle - Unpreserved (EP071)							
CS6A, CS6A-Bot, CS5, CS5-Bot, CS4, CS4-Bot, G3, G3-Bot, OA3, OA3-Bot, OA1, OA1-Bot, OA2, OA2-Bot, OA11, OA11-Bot, OA9, OA9-Bot, 1310, 1310-Bot, NH3, NH3-Bot, QA, QC, CS7, CS7-Bot, CB, CB-Bot, CS12, CS12-Bot, CS9, CS9-Bot, CS9A, CS9A-Bot, CS10N, CS13, CS10N-Bot, CS13-Bot, CS11, CS11-Bot	**20-Sep-2023**	**28-Sep-2023**	27-Sep-2023	×	**03-Oct-2023**	07-Nov-2023	✓
Amber Glass Bottle - Unpreserved (EP071)							
GR1, GR1-Bot, GR2, GR2-Bot	**21-Sep-2023**	**28-Sep-2023**	28-Sep-2023	✓	**03-Oct-2023**	07-Nov-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080)							

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080/071: Total Recoverable Hydrocarbons - NEPM 2013 Fractions - Continued							
CS6A, CS6A-Bot, CS5, CS5-Bot, CS4, CS4-Bot, G3, G3-Bot, OA3, OA3-Bot, OA1, OA1-Bot, OA2, OA2-Bot, OA11, OA11-Bot, OA9, OA9-Bot, 1310, 1310-Bot, NH3, NH3-Bot, QA, QC, CS7, CS7-Bot, CB, CB-Bot, CS12, CS12-Bot, CS9, CS9-Bot, CS9A, CS9A-Bot, CS10N, CS13, CS10N-Bot, CS13-Bot, CS11, CS11-Bot, MB, WS4, WS4-Bot, WS6, WS6-Bot, SF, SF-Bot, G1	**20-Sep-2023**	**26-Sep-2023**	04-Oct-2023	✓	**26-Sep-2023**	04-Oct-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080) G1-Bot, G2, G2-Bot, Transport Blank, Field Blank, CS8, CS8-Bot	**20-Sep-2023**	**26-Sep-2023**	04-Oct-2023	✓	**27-Sep-2023**	04-Oct-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080) GR1, GR1-Bot, GR2, GR2-Bot	**21-Sep-2023**	**26-Sep-2023**	05-Oct-2023	✓	**26-Sep-2023**	05-Oct-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP080: BTEXN							
Amber VOC Vial - Sulfuric Acid (EP080)							
CS6A, CS6A-Bot, CS5, CS5-Bot, CS4, CS4-Bot, G3, G3-Bot, OA3, OA3-Bot, OA1, OA1-Bot, OA2, OA2-Bot, OA11, OA11-Bot, OA9, OA9-Bot, 1310, 1310-Bot, NH3, NH3-Bot, QA, QC, CS7, CS7-Bot, CB, CB-Bot, CS12, CS12-Bot, CS9, CS9-Bot, CS9A, CS9A-Bot, CS10N, CS13, CS10N-Bot, CS13-Bot, CS11, CS11-Bot, MB, WS4, WS4-Bot, WS6, WS6-Bot, SF, SF-Bot, G1	**20-Sep-2023**	**26-Sep-2023**	04-Oct-2023	✓	**26-Sep-2023**	04-Oct-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
G1-Bot, G2, G2-Bot, Transport Blank, Field Blank, CS8, CS8-Bot	**20-Sep-2023**	**26-Sep-2023**	04-Oct-2023	✓	**27-Sep-2023**	04-Oct-2023	✓
Amber VOC Vial - Sulfuric Acid (EP080)							
GR1, GR1-Bot, GR2, GR2-Bot	**21-Sep-2023**	**26-Sep-2023**	05-Oct-2023	✓	**26-Sep-2023**	05-Oct-2023	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EP132B: Polynuclear Aromatic Hydrocarbons							
Amber Glass Bottle - Unpreserved (EP132-LL)							
CS6A, CS6A-Bot, CS5, CS5-Bot, CS4, CS4-Bot, G3, G3-Bot, OA3, OA3-Bot, OA1, OA1-Bot, OA2, OA2-Bot, OA11, OA11-Bot, OA9	**20-Sep-2023**	**27-Sep-2023**	27-Sep-2023	✓	**02-Oct-2023**	06-Nov-2023	✓
Amber Glass Bottle - Unpreserved (EP132-LL)							
OA9-Bot, 1310, 1310-Bot, NH3, NH3-Bot, QA, QC, CS7, CS7-Bot, CB, CB-Bot, CS12, CS12-Bot, CS9, CS9-Bot, CS9A, CS9A-Bot, CS10N, CS10N-Bot, CS13, CS13-Bot, CS11, CS11-Bot	**20-Sep-2023**	**27-Sep-2023**	27-Sep-2023	✓	**03-Oct-2023**	06-Nov-2023	✓
Amber Glass Bottle - Unpreserved (EP132-LL)							
MB, WS4, WS4-Bot, WS6, WS6-Bot, SF, SF-Bot, G1, G1-Bot, G2, G2-Bot, Transport Blank, Field Blank, CS8, CS8-Bot	**20-Sep-2023**	**28-Sep-2023**	27-Sep-2023	×	**03-Oct-2023**	07-Nov-2023	✓
Amber Glass Bottle - Unpreserved (EP132-LL)							
GR1, GR1-Bot, GR2, GR2-Bot	**21-Sep-2023**	**28-Sep-2023**	28-Sep-2023	✓	**03-Oct-2023**	07-Nov-2023	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
PAH Compounds in Water	EP132-LL	0	59	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	65	**0.00**	**10.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	6	59	**10.17**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
PAH Compounds in Water	EP132-LL	4	59	**6.78**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	4	65	**6.15**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	3	59	**5.08**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
PAH Compounds in Water	EP132-LL	4	59	**6.78**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	4	65	**6.15**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	3	59	**5.08**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
PAH Compounds in Water	EP132-LL	0	59	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH - Semivolatile Fraction	EP071	0	65	**0.00**	**5.00**	×	NEPM 2013 B3 & ALS QC Standard
TRH Volatiles/BTEX	EP080	3	59	**5.08**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
TRH - Semivolatile Fraction	EP071	WATER	In house: Referenced to USEPA SW 846 - 8015 The sample extract is analysed by Capillary GC/FID and quantification is by comparison against an established 5 point calibration curve of n-Alkane standards. This method is compliant with the QC requirements of NEPM Schedule B(3)
TRH Volatiles/BTEX	EP080	WATER	In house: Referenced to USEPA SW 846 - 8260 Water samples are directly purged prior to analysis by Capillary GC/MS and quantification is by comparison against an established 5 point calibration curve. Alternatively, a sample is equilibrated in a headspace vial and a portion of the headspace determined by GCMS analysis. This method is compliant with the QC requirements of NEPM Schedule B(3)
PAH Compounds in Water	EP132-LL	WATER	In house, Samples are extracted into solvent in original containers. Determination by large volume injection GCMS in selected ion monitoring (SIM) mode.

Preparation Methods	Method	Matrix	Method Descriptions
Separatory Funnel Extraction of Liquids	ORG14	WATER	In house: Referenced to USEPA SW 846 - 3510 100 mL to 1L of sample is transferred to a separatory funnel and serially extracted three times using DCM for each extract. The resultant extracts are combined, dehydrated and concentrated for analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Sep. Funnel Extraction /Acetylation of Phenolic Compounds	ORG14-AC	WATER	In house: Referenced to USEPA 3510 (Extraction) / In-house (Acetylation): A 1L sample is extracted into dichloromethane and concentrated to 1 mL with echange into cyclohexane. Phenolic compounds are reacted with acetic anhydride to yield phenyl acetates suitable for ultra-trace analysis. This method is compliant with NEPM Schedule B(3) . ALS default excludes sediment which may be resident in the container.
Volatiles Water Preparation	ORG16-W	WATER	A 5 mL aliquot or 5 mL of a diluted sample is added to a 40 mL VOC vial for purging.

CHAIN OF CUSTODY

Marine and Freshwater Research Laboratory Environmental Science

Murdoch UNIVERSITY

To: Georgina Neary-Grant	From: Marine and Freshwater Research Laboratory
Address: 26 Rigali Way	Address: Murdoch University,
Wangara WA	90 South St, Murdoch, 6150
Phone: 94061301	Phone: 08 93602907
Email:	Email: k.wienczugow@murdoch.edu.au
Quote Number: EP23MARFRE0004	Job Number: WAMS23-9 PO/ Account #:

Sample Preservation: None / Warm / Cool / (On Ice) / Frozen / Acidified / Filtered / Other: _____

Sample Type: Water / Bore / Fresh / Estuarine / (Marine) / Brine / Plant / Sediment / Soil / Other: _____

	No	Sample Code	Sampling Date	Analysis Required: GW-1							
1	1	CSGA	20/9/23	↓							
2	2	CSGA-Bot	↓								
3	3	CS5									
4	4	CS5-Bot									
5	5	CS4									
6	6	CS4-Bot									
7	7	G3									
8	8	G3-Bot									
9	9	OA3									
10	10	OA3-Bot									
11	11	OA1									
12	12	OA1-Bot									
13	13	OA2									
14	14	OA2-Bot	↓								
15	15	GR1	21/9/23								
16	16	GR1-Bot	↓								
17	17	GR2									
18	18	GR2-Bot	↓								
19	19	OA11	20/9/23								
20	20	OA11-Bot	"	↓							

Environmental Division
Perth
Work Order Reference
EP2313186

Telephone : -61-8-9406 1301

Relinquished by:	Date:	Time:	Received by:	Date:	Time	Job Number:
C. WILSON	22/9/23	11:00am	[illegible]	22/9	11am	

Sample Condition:

Please acknowledge receipt of samples by signing, stating sample condition, quoting job number and returning to the sender by email.

CHAIN OF CUSTODY

Marine and Freshwater Research Laboratory Environmental Science

Murdoch UNIVERSITY

To: Georgina	From: Marine and Freshwater Research Laboratory
Address: 26 Rigali Way	Address: Murdoch University,
Wangara WA	90 South St, Murdoch, 6150
Phone: 94061301	Phone: 08 93602907
Email:	Email: k.wienczugow@murdoch.edu.au
Quote Number: EP23MARFREOOL4	Job Number: WAMS23-9 PO/ Account #:

Sample Preservation: None / Warm / Cool / (On Ice) / Frozen / Acidified / Filtered / Other: _____

Sample Type: Water / Bore / Fresh / Estuarine / (Marine) / Brine / Plant / Sediment / Soil / Other: _____

No	Sample Code	Sampling Date	Analysis Required: GW-1							
1	OA9	20/9/23								
2	OA9 -Bot									
3	1310									
4	1310 -Bot									
5	NH3									
6	NH3 - bot									
7	QA									
8	QA -Bot									
9	QC									
10	QC - Bot									
11	CS7									
12	CS7 -Bot									
13	CB									
14	CB - Bot									
15	CS12									
16	CS12 - Bot									
17	CS9									
18	CS9 - Bot									
19	CS9A									
20	CS9A - Bot									

Relinquished by:	Date:	Time:	Received by:	Date:	Time	Job Number:
C. WILSON	22/9/23	11:00 am				

Sample Condition:

Please acknowledge receipt of samples by signing, stating sample condition, quoting job number and returning to the sender by email.

CHAIN OF CUSTODY

Marine and Freshwater Research Laboratory Environmental Science

Murdoch UNIVERSITY

To: Georgina	From: Marine and Freshwater Research Laboratory
Address: 26 Rigali Way	Address: Murdoch University,
Wangara WA	90 South St, Murdoch, 6150
Phone: 94061301	Phone: 08 93602907
Email:	Email: k.wienczugow@murdoch.edu.au
Quote Number: EP23MARFRE0004	Job Number: WAMS 23-9 PO/ Account #:

Sample Preservation: None / Warm / Cool / (On Ice) / Frozen / Acidified / Filtered / Other: _____

Sample Type: Water / Bore / Fresh / Estuarine / (Marine) / Brine / Plant / Sediment / Soil / Other: _____

	No	Sample Code	Sampling Date	Analysis Required: GW-1							
39	1	CS1ON	20/9/23								
40	2	CS1ON-Bot									
41	3	CS13									
42	4	CS13-Bot									
43	5	CS11									
44	6	CS11-Bot									
45	7	MB									
46	8	WS4									
47	9	WS4-Bot									
48	10	WS6									
49	11	WS6-Bot									
50	12	SF									
51	13	SF-Bot									
52	14	G1									
53	15	G1-Bot									
54	16	G2									
55	17	G2-Bot									
SNR	18	SC8									
SNR	19	SC8-Bot									
56	20	Transport Blank									

Relinquished by:	Date:	Time:	Received by:	Date:	Time	Job Number:
C. WILSON	22/9/23	11:00am				

Sample Condition:

Please acknowledge receipt of samples by signing, stating sample condition, quoting job number and returning to the sender by email.

CHAIN OF CUSTODY

Marine and Freshwater Research Laboratory Environmental Science

Murdoch UNIVERSITY

To: Georgina	From: Marine and Freshwater Research Laboratory
Address: 26 Rigali Way	Address: Murdoch University,
Wangara WA	90 South St, Murdoch, 6150
Phone: 94061301	Phone: 08 93602907
Email:	Email: k.wienczugow@murdoch.edu.au
Quote Number: EP23MARFREO004	Job Number: WAMS23-9 PO/ Account #:

Sample Preservation: None / Warm / Cool / (On Ice) / Frozen / Acidified / Filtered / Other: _____

Sample Type: Water / Bore / Fresh / Estuarine / (Marine) / Brine / Plant / Sediment / Soil / Other: _____

	No	Sample Code	Sampling Date	Analysis Required							
				GW-1							
57	1	Field Blank	20/9/23								
58	2	CS8									
59	3	CS8-Bot									
	4										
	5										
	6										
	7										
	8										
	9										
	10										
	11										
	12										
	13										
	14										
	15										
	16										
	17										
	18										
	19										
	20										

Relinquished by:	Date:	Time:	Received by:	Date:	Time	Job Number:
CWILSON	22/9/23	11:00a				
Sample Condition:						

Please acknowledge receipt of samples by signing, stating sample condition, quoting job number and returning to the sender by email.

8.2 Appendix 2 Field sheets

WAMSI WESTPORT MONITORING

Marine and Freshwater Research Laboratory Environmental Science
MURDOCH UNIVERSITY

YSI

see other side for GPS positions

MAFRL JOB CODE: WAMS23-12	DATE: 8/9/2023
LOCATION: Owen Anchorage, Cockburn Sound, Warnbro Sound and Gage Roads FIELD OPERATORS: Kris Wienczugow, Heather Denham, Jamie Woodward and Celeste Wilson	

SITE	GPS location	Deployment date	Deployment time	Retrieval date	Retrieval time	Temperature IN	Temperature OUT	Comments
OA2 -DGT	0017	8/9/23	1604	21/9/23	11:05	15.1m → 16.63°C	SBE #14	sand 17.88°C
OA9_DGT	0018	8/9/23	1628	21/9/23	11:29	7.3m → 16.60°C	SBE #15	Sand 17.80°C
CS6A-DGT	0009	8/9/23	10:00am	21/9/23	12:07	10.6m → 16.63°C	#16	Soft coral 17.84°C 10.2m top of stick (600mm)
CS7-DGT	0010	8/9/23	10:24	21/9/23	12:24	10.1m → 16.53°C	SBE #17	Fine seds 17.81°C
CS9_DGT	0012	8/9/23	11:41	21/9/23	12:58	9.1m → 16.50°C	SBE #19	v. fine, Jelly 17.99°C
CS10N_DGT	0014	8/9/23	12:43	21/9/23	1330	7.8m → 16.6°C	SBE #21	On rope 8.0m depth 17.50°C
CS12-DGT	0011	8/9/23	11:24	21/9/23	12:44	10.1m → 17.24°C	SBE #18	V. fine sed 17.95°C
CS9A-DGT	0013	8/9/23	12:12	21/9/23	1315	10.7m → 16.66°C	SBE #20	logger @ 10m depth v. fine 17.57°C
WS4_DGT	0015	8/9/23	1340	21/9/23	1400	16.7m → 16.87°C	SBE #22	On rope 17m depth 17.65°C
GR1_DGT	0016	8/9/23	1504	21/9/23	10:20	14.2m → 16.95°C	SBE #13	Seagrass & sand (could not find DGT's) Storm
								last week 100 knt winds

Important Information:

Relinquished by:	Date:	Time:	Received by:	Date:	Time:	Sample Condition:
C WILSON	21/9/23	16:00		21/9/23	1600	Cool 0-6°C

JBIGA_L - logger OK; S4S10_L - logger OK; CSR14_L - logger OK; CSSF_L - logger OK

S4S2 - turbidity fouled or obscured as central nut unscrewed OA1_DL - logger OK

50H

CS6A-DGT (0009) - 0382774 6442674

CS7_DGT (0010) - 0383449 6439909

CS12_DGT (0011) - 0383687 6436997

CS9_DGT (0012) - 0383081 6435432

CS9A_DGT (0013) - 0382802 6432668

CS10N_DGT (0014) - 0381651 6430582

WS4_DGT (0015) - 0379739 6421546

GR1_DGT (0016) - 0376849 6458632

OA2_DGT (0017) - 0378116 6446869

OA9_DGT (0018) - 0387047 6446499

Fig

Hex Cr

other metal.

WAMSI WESTPORT WATER QUALITY MONITORING

Marine and Freshwater Research Laboratory Environmental Science
MURDOCH UNIVERSITY

North 1

MAFRL JOB CODE: **WAMS23-9** | DATE: 20/9/2023

LOCATION: Owen Anchorage and Cockburn
FIELD OPERATORS: K. Wienczuyow + C. Wilson

SITE	TIME	Sampling Depth (0M- 0.5>)	SECCHI DEPTH (m)	SBE CAST #	TPH/PAH	BTEX1/BTEX2	ICPMS/ICPAES	Hg-F	Metals UF	WEATHER CONDITIONS (wind direction/strength, % cloud	Comments/Observation (Note Turbid plumes from river/dredging/vessel movements)
CS6A	9:28	0.5-1.5m	7.0m	#1	✓	✓✓	✓✓	✓	✓	E 0-2knts; 100% CC	Greenish sargassum floating on water
CS6A-Bot		9.0-10.0			✓	✓✓	✓✓	✓	✓		
CS5	9:56	0.5-1.5	8.2m	#2	✓	✓✓	✓✓	✓	✓	〃 〃	Clear 2x little penguins
CS5-Bot		17-18			✓	✓✓	✓✓	✓	✓		
CS4	10:19	0.5-1.5	8.0m	#3	✓	✓✓	✓✓	✓	✓	E 2-5knts; 100% CC	Clear
CS4-Bot		19.5-20.5			✓	✓✓	✓✓	✓	✓		
G3	10:41	0.5-1.5	8.5m	#4	✓	✓✓	✓✓	✓	✓	〃 〃	Clear
G3-Bot		11.0-12.0			✓	✓✓	✓✓	✓	✓		
OA3	11:03	0.5-1.5	7.3	#5	✓	✓✓	✓✓	✓	✓	〃 〃 0.5m swell	—
OA3-Bot		9-10			✓	✓✓	✓✓	✓	✓		
OA1	11:37	0.5-1.5	6.4	#6	✓	✓✓	✓✓	✓	✓	〃 〃	—
OA1-Bot		6.0-7.0			✓	✓✓	✓✓	✓	✓		
OA2	12:06	0.5-1.5	9.0	#7	✓	✓✓	✓✓	✓	✓	S 2-5knts 100% CC	—
OA2-Bot		14-15			✓	✓✓	✓✓	✓	✓		

Important Information: SBE Deep

Sunrise: 6:08am Sunset: 6:11pm

Relinquished by:	Date:	Time:	Received by:	Date:	Time:	Sample Condition:
CWilson	20/9/23	1600		20/9/23	1600	Temp 0-6°C

WAMSI WESTPORT WATER QUALITY MONITORING

Marine and Freshwater Research Laboratory Environmental Science — MURDOCH UNIVERSITY

NORTH 2

MAFRL JOB CODE: WAMS23-9 | DATE: 20/9/23 → 21/9/23

LOCATION: Owen Anchorage and Gauge Roads

FIELD OPERATORS: KW + CW

SITE	TIME	Sampling Depth (0M- 0.5>)	SECCHI DEPTH (m)	SBE CAST #	TPH/PAH	BTEX1/BTEX2	ICPMS/ICPAES	Hg-F	Metals UF	WEATHER CONDITIONS (wind direction/strength, % cloud	Comments/Observation (Note Turbid plumes from river/dredging/vessel movements)
G1 CR1	10:01	0.5-1.5	6.0	#13	✓	✓✓	✓✓	✓	✓	NE 5-7 knts; 90% CC	Clear
G1-Bot					✓	✓✓	✓✓	✓	✓		
G2 CR2	9:31	0.5-1.5	6.0	#12	✓	✓✓	✓✓	✓	✓	NE 5-7 knts; 85% CC	Clear
G2-Bot		15.5-16.5			✓	✓✓	✓✓	✓	✓		
OA11	1300	0.5-1.5	5.9	#8	✓	✓✓	✓✓	✓	✓	SW 5-7 knts; 50% CC	—
OA11-Bot		5-6			✓	✓✓	✓✓	✓	✓		
OA9	1321	0.5-1.5	5.0	#9	✓	✓✓	✓✓	✓	✓	SW 7-9 knts; 40% CC	Turbid
OA9-Bot		6-7			✓	✓✓	✓✓	✓	✓		
1310	1346	0.5-1.5	2.2	#10	✓	✓✓	✓✓	✓	✓	SW 10-12 knts; 20% CC	Very turbid
1310-Bot		8-9			✓	✓✓	✓✓	✓	✓		
NH3	1427	0.5-1.5	3.9	#11	✓	✓✓	✓✓	✓	✓	SW 10 Knts 10% CC	QA - NH3 dup
NH3-Bot		7.3-8.3			✓	✓✓	✓✓	✓	✓		QC - NH3 bot dup

Important Information: SBE deep

Sunrise: 6:08am Sunset: 6:11pm

Relinquished by:	Date:	Time:	Received by:	Date:	Time:	Sample Condition:
C. Wilson	21/9/2023	1600		21/9/2023	1600	Temp 0-6°C

Trip Blank

Field "

WAMSI WESTPORT WATER QUALITY MONITORING

Marine and Freshwater Research Laboratory
Environmental Science
MURDOCH UNIVERSITY

South 1

MAFRL JOB CODE: WAMS23-9 | DATE: 20/9/23

LOCATION: Cockburn and Warnbro Sounds
FIELD OPERATORS:
HD, JW

SITE	TIME	Sampling Depth (0M- 0.5>)	SECCHI DEPTH (m)	SBE CAST #	TPH/PAH	BTEX1/BTEX2	ICPMS/ICPAES	Hg-F	Metals UF	WEATHER CONDITIONS (wind direction/strength, % cloud	Comments/Observation (Note Turbid plumes from river/dredging/vessel movements)
CS7	947	0.5	6.5	1#	✓	✓	✓	✓	✓	0-3kt SE, 95% CC	Tugs in channel
CS7-Bot		9.9			✓	✓	✓	✓	✓		
CB	1000	0.5	7.5	2#	✓	✓	✓	✓	✓	" " " "	Large particles in water
CB-Bot		8.7			✓	✓	✓	✓	✓		
CS12	1023	0.5	4.9m	3#	✓	✓	✓	✓	✓	" " " "	
CS12-Bot		9.3			✓	✓	✓	✓	✓		
CS9	1042	0.5	8.5m	4#	✓	✓	✓	✓	✓	" " " "	Ship unloading; Glassy @surface, Brown algae large
CS9-Bot		12.0			✓	✓	✓	✓	✓		
CS9A	1103	0.5	8.8	5#	✓	✓	✓	✓	✓	" "	Dark Blue
CS9A-Bot		15.2			✓	✓	✓	✓	✓		
CS10N	1124	0.5	8.5	#6	—	—	✓	—	✓	S 0.2 kts 95% CC	Clear off
CS10N-Bot		13.4			—	—	—	✓	—		
CS13	1140	0.5	8.6	#7	✓	—	—	—	—	" " " "	Algae chunks glass off
CS13-Bot		19.3			—	—	—	—	✓		
CS11	1204	0.5	8.0	8#	✓	✓	✓	✓	✓	" " " "	Seagrass @ surface, & algae

Sunrise: 6:15 Sunset: 6:11

Important Information:

Relinquished by:	Date:	Time:	Received by:	Date:	Time:	Sample Condition:
HDenham	20/9/23	1600		20/9/23	1600	Temp 0-6°C

WAMSI WESTPORT WATER QUALITY MONITORING

Marine and Freshwater Research Laboratory
Environmental Science
MURDOCH UNIVERSITY

SOUTH 2

MAFRL JOB CODE: WAMS23-9 | DATE: 20/9/23

LOCATION: Cockburn and Warnbro Sounds
FIELD OPERATORS: JW, HP

SITE	TIME	Sampling Depth (0M- 0.5>)	SECCHI DEPTH (m)	SBE CAST #	TPH/PAH	BTEX1/BTEX2	ICPMS/ICPAES	Hg-F	Metals UF	WEATHER CONDITIONS (wind direction/strength, % cloud	Comments/Observation (Note Turbid plumes from river/dredging/vessel movements)
CS11-Bot				#8							Clear off. Dead fish (1)
MB	1225	1.0m	1.6m+	#9	✓	✓	✓	✓	✓	S 0-5 knts. 95% CC	Seagrass
~~MB-Bot~~					—	—	—	—	—		Algae on Surface
WS4	1302	0.5	6.8	#10	✓	✓	✓	✓	✓	" " " 75% "	Brown algae
WS4-Bot		16.2			✓	✓	✓	✓	✓		
WS6	1324	0.5	4.9	#11	✓	✓	✓	✓	✓	" " " 60% "	Brown algae, seagrass
WS6-Bot		16.1			✓	✓	✓	✓	✓		
SF	1407	0.5	2.9+	#12	✓	✓	✓	✓	✓	S 5-7 knts 20% CC	Brown algae
SF-Bot		2.4			✓	—	—	—	—		
G1	1432	0.5	7.0	#13	—	—	✓	✓	✓	S 7-9 knts 10% CC	Seagrass
G1-Bot		14.7			—	✓	✓	—	✓		
G2	1454	0.5	7.9	#14	—	✓	✓	—	—	S 8-10 knts 10% CC	Seagrass
G2-Bot		7.5			—	✓	✓	✓	✓		
SC8	1513	0-5	7.6	#15	—	—	—	—	—	" " " "	
SC8-Bot		18.9			—	—	✓	✓	✓		

Important Information:

Sunrise: 6:15 Sunset: 611

Relinquished by:	Date:	Time:	Received by:	Date:	Time:	Sample Condition:
[signature]	20/9/23	1600	[signature]	20/9/23	1600	Temp 0-6°C

Table 1: Water quality sites and GPS locations (Grid UTM/UPS, Datum: WGS84, Zone: 50H)

Site name	Site location	Protection Area	Depth (m)	Easting	Northing
OA1	Owen Anchorage	High	6.5	375836 089	6448785 384
OA2	Owen Anchorage	High	16.6	378117	6446866
OA3	Owen Anchorage	High	11.7	374151	6443307
OA9	Owen Anchorage	High	4.1	383210	6446474
1310	Owen Anchorage	High	10.5	382165	6444647
OA11	Owen Anchorage	High	6.5	382779 672	6448686 186
CS4	Cockburn Sound northern end deep	High	20.9	376829	6441686
CS5	Cockburn Sound northern end deep	High	18.9	379308	6441958
CS6A	Outside Northern Harbour,	Moderate	10.5	382749	6442651
CS7	Jervoise Channel south of Southern Harbour	Moderate	10.7	383323	6439972
CS8	Cockburn Sound central basin	High	19.9	379337	6436947
CS9	Kwinana Bulk Terminal (KBB2)	Moderate	13.0	383098	6436629
CS10N	Bulk Grain Terminal (CBH)	Moderate	14.0	381593	6430569
CS11	Mangles Bay deep water basin	High	18.0	378690	6429753
CS12	Calista Channel WC Desalination Plant	Moderate	10.0	383677	6436972
CS9A	Kwinana Bulk Jetty (KBJ)	Moderate	16.5	382367	6432996
G1	Careening Bay HMAS Stirling	Moderate	15.2	377121	6433158
G2	Garden Island central HMAS Stirling	High	10.2	376039	6436793
G3	Garden Island north HMAS Stirling	High	13.1	375728	6441317
NH3	Northern Harbour Jervoise Bay	Moderate	9.9	383291	6443373
SF	Southern Flats shallow	High	3.5	378716	6431322
CB	Challenger Beach bank	High	9.3	381133	6438605
CS13	Cockburn Sound southern deep water	High	20.4	380207	6431054
MB	Mangles Bay shallow near shore	High	1.3	378085	6428341
WS4	Warnbro Sound	Reference	17.9	379741	6421498
WS6	Warnbro Sound	Reference	17.0	381234	6419680
GR1	Gage Roads (DW1) Deep water channel	Spoil Ground	18.0	TBC 376676	6458727
GR2	Gage Roads (DW2) Deep water channel	Spoil Ground	18.0	TBC 374806	6462578

Submitted as draft	20/2/2024
Review completed	12/7/2024
Submitted as revised draft	23/7/2024
Approved by Science Program Leadership Team	8/8/2024
Approved by WAMSI CEO	6/9/2024
Final report	6/9/2024

WESTERN AUSTRALIAN
MARINE SCIENCE
INSTITUTION