Australian Government
Department of Industry, Science and Resources

National Measurement Institute

Proficiency Test Final Report AQA 25-16 Hydrocarbons and Phenols in River Water

January 2026

Our purpose is to help the government build a better future for all Australians through enabling a productive, resilient and sustainable economy, enriched by science and technology.

measurement.gov.au

ACKNOWLEDGMENTS

This study was conducted by the National Measurement Institute Australia (NMIA). Support funding was provided by the Australian Government Department of Industry, Science and Resources.

I would like to thank the management and staff of the participating laboratories for supporting the study. It is only through widespread participation that we can provide an effective service to laboratories.

The assistance of the following NMIA staff members in the planning, conduct and reporting of the study is acknowledged.

Jasmine Duong

Jenny Xu

Geoff Morschel

Aaron Mamo

Sofia Racomelara

Luminita Antin

Scott Chen

Raluca Iavetz

Manager, Chemical Reference Values

105 Delhi Road, North Ryde, NSW 2113, Australia

Phone: +61 2 9449 0234

Email: proficiency@measurement.gov.au

TABLE OF CONTENTS

SUMMARY

AQA 25-16 Hydrocarbons and Phenols in River Water commenced in August 2025. There was a total of 29 participants, of which 28 participants returned results.

The sample set consisted of four river water samples. Samples were prepared in the Sydney NMIA laboratory. Participants measured total recoverable hydrocarbons (TRH) in Sample S1, volatile hydrocarbons (C6 to C10), benzene, toluene, ethylbenzene and xylenes (BTEX) in Sample S2, polycyclic aromatic hydrocarbons (PAHs) in Sample S3, and phenols in Sample S4.

The assigned values for all scored analytes were the robust averages of participants' results. The associated uncertainties were evaluated from the robust standard deviations of participants' results.

Traceability: The consensus of participants' results is not traceable to any external reference, so although expressed in SI units, metrological traceability has not been established.

The outcomes of the study were assessed against the aims as follows:

- *Compare participants' performances and assess their capabilities to identify and measure hydrocarbons and phenols in river water.*

Laboratories **3**, **7**, **8**, **9**, **11**, **12**, **13**, **16**, **18**, **20**, **22**, **23**, **24**, and **25** reported results for all 21 scored analytes.

Six participants (Laboratories **1**, **5**, **6**, **10**, **27**, and **28**) did not report a numeric result for analytes that were present in the sample and they had tested for. Five participants reported numeric results for additional analytes not spiked into the sample.

Of 523 z-scores, 454 (87%) returned a score of $|z| \leq 2.0$, indicating an acceptable performance.

Of 513 E_n-scores, 381 (74%) returned a score of $|E_n| < 1.0$, indicating agreement of the participant's result with the assigned value within their respective expanded uncertainties.

Laboratories **3**, **20**, and **24** returned acceptable z-scores and E_n-scores for all 21 scored analytes.

- *Develop the practical application of measurement uncertainty, and provide participants with information that will be useful in assessing their uncertainty evaluations.*

Of 556 numeric results, 487 (88%) were reported with an associated expanded measurement uncertainty. Reported expanded uncertainties were within the range of 4.2% to 75% relative.

- *Evaluate participants' methods for the measurement of hydrocarbons and phenols in river water.*

The most common method for TRH was using 500 mL for liquid-liquid extraction using dichloromethane and analysed using GC-FID. There was more variability observed from participants that subsampled for analysis.

The most common method for BTEX was using purge-and-trap GC-MS. BTEX analysis presented minimal challenges for participants, and all results were in good agreement with each other regardless of methodology.

The most common method for PAHs was using a liquid-liquid extraction with dichloromethane and analysed using GC-MS/MS. Participants using higher extract concentration temperatures had results biased low.

The most common method for phenols was using 100 mL for liquid-liquid extraction with dichloromethane and analysed using GC-MS. Participants using higher extract concentration temperatures had results biased low.

- *Produce materials that can be used in method validation and as control samples.*

The test samples of this proficiency study are homogeneous and are well characterised. Surplus samples are available for purchase from NMIA and can be used for quality control and method validation purposes.

1 INTRODUCTION

1.1 NMIA Proficiency Testing Program

The National Measurement Institute Australia (NMIA) is responsible for Australia's national measurement infrastructure, providing a range of services including a chemical proficiency testing program.

Proficiency testing (PT) is the 'evaluation of participant performance against pre-established criteria by means of interlaboratory comparisons'.[1] NMIA PT studies target chemical testing in areas of high public significance such as trade, environment, law enforcement and food safety. NMIA offers studies in:

- per- and polyfluoroalkyl substances in soil, biosolids, water, biota, food, and consumables;
- hydrocarbons, phenols and other organic compounds in soil and water;
- pesticide residues in soil, water, fruit, vegetables, and herbs;
- metals in soil, water, food, filters, and paint;
- nutrients, anions and physical tests in water and soil;
- chlorophyll a in water; and
- controlled drug assay, drugs in wipes, and clandestine laboratory.

1.2 Study Aims

The aims of the study were to:

- compare participants' performances and assess their capabilities to identify and measure hydrocarbons and phenols in river water;
- develop the practical application of measurement uncertainty, and provide participants with information that will be useful in assessing their uncertainty evaluations;
- evaluate participants' methods for the measurement of hydrocarbons and phenols in river water; and
- produce materials that can be used in method validation and as control samples.

The choice of the test method was left to the participating laboratories.

1.3 Study Conduct

The conduct of NMIA proficiency tests is described in the NMIA Study Protocol for Proficiency Testing.[2] The statistical methods used are described in the NMIA Chemical Proficiency Testing Statistical Manual.[3] These documents have been prepared with reference to ISO/IEC 17043,[1] and The International Harmonized Protocol for the Proficiency Testing of Analytical Chemistry Laboratories.[4]

NMIA is accredited by the National Association of Testing Authorities, Australia (NATA) to ISO/IEC 17043 as a provider of proficiency testing schemes.[1] This study falls within the scope of NMIA's accreditation.

2 STUDY INFORMATION

2.1 Study Timetable

The timetable of this study was:

Invitations sent	11/08/2025
Samples sent	01/09/2025
Results due	10/10/2025
Interim Report	14/10/2025
Preliminary Report	17/10/2025

2.2 Participation

Twenty-seven laboratories registered to participate in this study. One laboratory requested multiple sets of test samples to be analysed by different analysts and/or methods, resulting in a total of 29 participants in the study. All participants were assigned a confidential laboratory code number for this study. Twenty-eight participants submitted results.

2.3 Selection of Analytes and Test Material Preparation

The analytes and their concentrations in this study were typical of those encountered by environmental testing laboratories monitoring river water to assess the impact of transport fuels in the environment, or the contamination from industry that entails the use of wood, petroleum or coal to generate heat and power. Investigation levels for the analytes are set out in the National Environmental Protection (Assessment of Site Contamination) Measure, Schedule B1 *Guideline on Investigation Levels for Soil and Groundwater*.[5]

Sample S1 was prepared by spiking river water with treated diesel fuel, and assessed NEPM fractions >C10-C16, >C16-C34, >C34-C40, and total recoverable hydrocarbons (TRH).

Sample S2 was prepared by spiking river water with unleaded petrol and treated diesel fuel, and assessed volatile hydrocarbons (C6-C10), individual benzene, toluene, ethylbenzene, and xylenes (BTEX) components, and total BTEX.

Sample S3 was prepared by spiking river water with various polycyclic aromatic hydrocarbons (PAHs) at the levels presented in Table 1.

Sample S4 was prepared by spiking river water with various phenols at the levels presented in Table 1.

Table 1 Spiked Values of Test Samples

Sample	Analyte	Spiked Value (µg/L)	Uncertainty (µg/L)*
S3	Acenaphthene	20.0	1.0
	Anthracene	4.55	0.23
	Benz[*a*]anthracene	8.91	0.45
	Benzo[*a*]pyrene	5.91	0.30
	Benzo[*b*]fluoranthene	19.9	1.0
	Fluoranthene	12.0	0.6
	Phenanthrene	2.45	0.12
	Pyrene	3.98	0.20

Sample	Analyte	Spiked Value (µg/L)	Uncertainty (µg/L)*
S4	2-Methylphenol	10.7	0.5
	4-Methylphenol**	10.4	0.5
	2,4-Dichlorophenol	12.0	0.6
	2,6-Dichlorophenol	5.02	0.25
	Pentachlorophenol	40.2	2.0

*Evaluated expanded uncertainty at approximately 95% confidence using a coverage factor of 2. Stability was not considered and so the expanded uncertainty is related to the concentration at the time of spiking.
**Sample S4 was spiked with 4-methylphenol only. Participants were requested to report for the total of 3 & 4-methylphenols.

Additional information on sample preparation is provided in Appendix 1.

2.4 Homogeneity and Stability of Test Materials

No homogeneity or stability testing was conducted on these test materials before the samples were sent. The samples were prepared, stored and dispatched using a process that has been demonstrated to produce sufficiently homogeneous and stable samples in previous similar NMIA PT studies. Additionally, the storage stability of petroleum hydrocarbons in water has been previously established.[6]

Participants' results also gave no reason to question the homogeneity or stability of the test samples. Analytes have only been scored if there was a reasonable consensus between participants' results, and if the consensus value to spiked value ratio was similar to those observed in previous NMIA studies.

Additional information is given in Appendix 2.

2.5 Test Material Storage, Dispatch and Receipt

After preparation, the test samples were stored at 4°C. Samples were packaged into insulated polystyrene foam boxes with cooler bricks and dispatched by courier on 1 September 2025.

The following items were also sent to participants:

- a covering letter which included a description of the test samples and instructions for participants; and
- a form for participants to confirm the receipt and condition of the test samples.

An Excel spreadsheet for the electronic reporting of results was emailed to participants.

2.6 Instructions to Participants

Participants were instructed as follows:

- Quantitatively analyse the samples using your routine test method.
- Do not test for volatile hydrocarbons (C6-C10) or BTEX components in Sample S1.
- Participants need not test for all listed analytes.
- If analyses cannot be commenced on the day of receipt, please store the samples chilled.
- For each analyte in each sample, report a single result in units of µg/L expressed as if reporting to a client, applying the limit of reporting of the method used for analysis. This is the figure that will be used in all statistical analysis in the study report.

- For each analyte in each sample, report the associated expanded uncertainty in units of µg/L (e.g. 2000 ± 200 µg/L), if determined.
- Report results for the following:
  - Sample S1: Semi-volatile hydrocarbons (>C10-C40) and Total Recoverable Hydrocarbons (TRH). Use your laboratory's chosen quantitation range, and indicate what this range is. Australian NEPM fractions >C10-C16, >C16-C34, >C34-C40 are encouraged. The concentration range is between 200 – 10000 µg/L.
  - Sample S2: Volatile Hydrocarbons (C6-C10), Benzene, Toluene, Ethylbenzene, Total Xylenes and Total BTEX. Individual BTEX components concentration is between 10 – 2500 µg/L.
  - Sample S3: PAHs. The concentration range is between 0.05 – 50 µg/L.
  - Sample S4: Phenols. The concentration range is between 0.05 – 50 µg/L.
- Give details of your methodology and basis of uncertainty evaluation as requested by the results sheet emailed to you.
- Return the completed results sheet by 26 September 2025 by email to proficiency@measurement.gov.au.

The results due date was extended to 10 October 2025 in response to several participants' requests, due to staffing and analysis constraints.

Participants were provided with a list of PAHs that were potentially spiked into Sample S3 (Table 2) and a list of phenols that were potentially spiked into Sample S4 (Table 3).

Table 2 List of Possible PAHs for Sample S3

Naphthalene	Fluorene	Benz[*a*]anthracene	Benzo[*a*]pyrene
Acenaphthylene	Phenanthrene	Chrysene	Indeno[1,2,3-*cd*]pyrene
Acenaphthene	Fluoranthene	Benzo[*b*]fluoranthene	Dibenz[*a,h*]anthracene
Anthracene	Pyrene	Benzo[*k*]fluoranthene	Benzo[*g,h,i*]perylene

Table 3 List of Possible Phenols for Sample S4

Phenol	2-Nitrophenol	2,4,6-Trichlorophenol
2-Chlorophenol	4-Nitrophenol	2,4,5-Trichlorophenol
2-Methylphenol	2,4-Dichlorophenol	2,3,4,6-Tetrachlorophenol
3 & 4-Methylphenols (total)	2,6-Dichlorophenol	2,4-Dinitrophenol
2,4-Dimethylphenol	4-Chloro-3-methylphenol	Pentachlorophenol

2.7 Interim Report and Preliminary Report

An Interim Report was emailed to all participants on 14 October 2025.

A Preliminary Report was emailed to all participants on 17 October 2025. This report included a summary of the results reported by participants, assigned values, performance coefficients of variation (PCVs), *z*-scores and E_n-scores for each analyte in this study. No scores or statistics from the Preliminary Report have been changed in the present Final Report.

3 PARTICIPANT LABORATORY INFORMATION

3.1 Participants' Test Methods

Participants were requested to provide information about their test methods. Responses are presented in Appendix 4.

3.2 Basis of Participants' Measurement Uncertainty Evaluation

Participants were requested to provide information about their basis of measurement uncertainty (MU). Responses are presented in Tables 4 and 5. Some responses may be modified so that the participant cannot be identified.

Table 4 Basis of Uncertainty Evaluation

Lab. Code	Analyte	Approach to Evaluating MU	Information Sources for MU Evaluation*		Guide Document for Evaluating MU
			Precision	Method Bias	
1	All	Bottom Up (ISO/GUM, fish bone/cause and effect diagram) Coverage factor not reported	Control samples Duplicate analysis Instrument calibration	Laboratory bias from PT studies Instrument calibration Recoveries of SS	
3	All	Top Down - precision and evaluation of the method and laboratory bias Coverage factor not reported	Control samples	CRM Recoveries of SS	Eurachem/CITAC Guide
4	All	Based on historical data k = 2	Standard deviation from PT studies only		Eurachem/CITAC Guide
			Control samples - SS Duplicate analysis Instrument calibration	Instrument calibration Standard purity	
5	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - CRM Duplicate analysis Instrument calibration	CRM Instrument calibration	Eurachem/CITAC Guide
6	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - SS Duplicate analysis Instrument calibration	CRM Instrument calibration Recoveries of SS	ISO/GUM
7	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - RM / Ex PT Sample Duplicate analysis	CRM	ISO/GUM
8	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - CRM	CRM	Eurachem/CITAC Guide
9	All	Bottom Up (ISO/GUM, fish bone/cause and effect diagram) k = 2	Duplicate analysis	Recoveries of SS	
10	BTEX/ PAHs/ Phenols	Coverage factor not reported	Control samples - RM / Ex PT Sample	CRM Instrument calibration Recoveries of SS	
11	All	ASTM E2554-13 Coverage factor not reported	Standard deviation from PT studies only		ASTM E2554-13

Lab. Code	Analyte	Approach to Evaluating MU	Information Sources for MU Evaluation*		Guide Document for Evaluating MU
			Precision	Method Bias	
12	All	Top Down - precision and evaluation of the method and laboratory bias Coverage factor not reported	Duplicate analysis Instrument calibration	CRM Instrument calibration Recoveries of SS Standard purity	ISO/GUM
13	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - SS	Recoveries of SS	Eurachem/CITAC Guide
14	All	Top Down - precision and evaluation of the method and laboratory bias Coverage factor not reported	Control samples Duplicate analysis Instrument calibration	Instrument calibration Recoveries of SS	Eurachem/CITAC Guide
15	All	Standard deviation of replicate analyses multiplied by 2 or 3 Coverage factor not reported	Control samples - SS	Recoveries of SS	
16	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - CRM Duplicate analysis	CRM Instrument calibration Recoveries of SS	NMIA Uncertainty Course
17	TRH/ BTEX	Standard deviation of replicate analyses multiplied by 2 or 3 k = 2	Control samples - SS Duplicate analysis		Eurachem/CITAC Guide
18	All	Top Down - precision and evaluation of the method and laboratory bias Coverage factor not reported	Control samples - SS		ISO/GUM
19	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - SS Duplicate analysis	Instrument calibration Recoveries of SS	Eurachem/CITAC Guide
20	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - SS Duplicate analysis	CRM Instrument calibration Recoveries of SS	Eurachem/CITAC Guide
21	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - SS Instrument calibration	Instrument calibration Recoveries of SS Standard purity	Eurachem/CITAC Guide
22	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - CRM Duplicate analysis Instrument calibration	CRM Instrument calibration Recoveries of SS Standard purity	NMIA Uncertainty Course
23	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - SS	Recoveries of SS	Eurachem/CITAC Guide

Lab. Code	Analyte	Approach to Evaluating MU	Information Sources for MU Evaluation*		Guide Document for Evaluating MU
			Precision	Method Bias	
24	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - SS	Recoveries of SS	Eurachem/CITAC Guide
25	All	Top Down - precision and evaluation of the method and laboratory bias k = 2	Control samples - SS	Recoveries of SS	ISO/GUM
26	PAHs/ Phenols	Based on repeatability Coverage factor not reported	Control samples - SS Duplicate analysis	Recoveries of SS	Eurachem/CITAC Guide
27	BTEX/ PAHs/ Phenols	Coverage factor not reported	Control samples - RM / Ex PT Sample	CRM Instrument calibration Recoveries of SS	
28	BTEX/ PAHs/ Phenols	Coverage factor not reported	Control samples - RM / Ex PT Sample	CRM Instrument calibration Recoveries of SS	
29	TRH/ BTEX/ PAHs	Top Down - precision and evaluation of the method and laboratory bias Coverage factor not reported	Duplicate analysis		Eurachem/CITAC Guide

* CRM = Certified Reference Material; RM = Reference Material; SS = Spiked Samples

Table 5 Basis of Measurement Uncertainty Evaluation – Additional Information

Lab. Code	Additional Information
4	For Sources for precision above, Control Samples was selected as the laboratory does perform a Laboratory Control Spike (LCS) and a Sample Matrix Spike as part of our in-house QC procedure. However, sample spikes are not typically performed on ILCP samples.

3.3 Participants' Comments

Participants were invited to make any comments or suggestions on the samples, this study, or possible future studies. Such feedback may be useful in improving future studies. No comments were received for this study.

4 PRESENTATION OF RESULTS AND STATISTICAL ANALYSIS

4.1 Results Summary

Participant results are listed in Tables 6 to 31 with summary statistics: robust average, median, mean, number of numeric results (N), maximum (Max), minimum (Min), robust standard deviation (Robust SD) and robust coefficient of variation (Robust CV), along with other estimates of analyte concentration. Bar charts of results and performance scores are presented in Figures 2 to 25. An example chart with interpretation guide is shown in Figure 1.

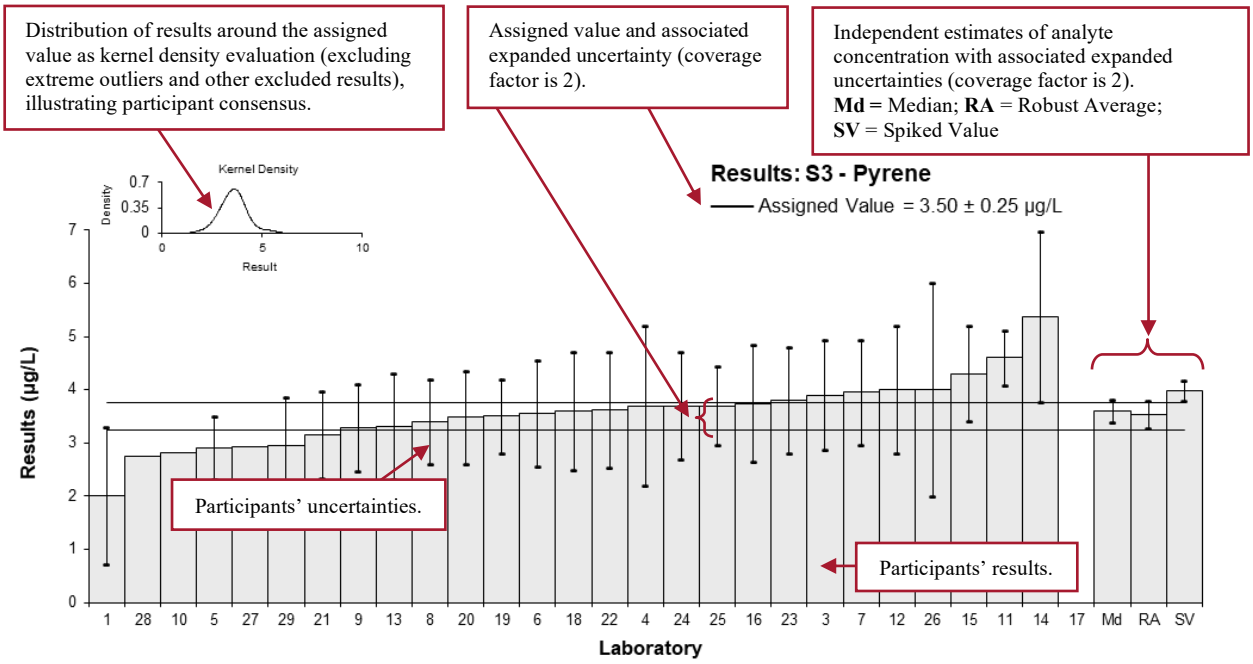


Figure 1 Guide to Presentation of Results

4.2 Outliers, Extreme Outliers and Other Excluded Results

Outliers were results less than 50% and greater than 150% of the robust average, and these were removed before the calculation of the assigned value, if applicable.[3,4] Extreme outliers (gross errors), such as those due to incorrect units, decimal placement errors, or results for a different PT item, were also removed for the calculation of all summary statistics.[3]

The results from Laboratories **1**, **5**, **6**, and **11** in Sample S1 were consistently higher or lower than the assigned value by approximately the same factor. To avoid unfair scoring, these results were excluded from the robust average calculations as they would bias the assigned value; they were also excluded from the calculation of all summary statistics.

4.3 Assigned Value

The assigned value is defined as the 'value attributed to a particular property or characteristic of a proficiency testing item'.[1] In this PT study, the property is the concentration of the analytes in the samples. Assigned values were the robust averages of participants' results, and the expanded uncertainties were evaluated from the associated robust SDs (Appendix 3).

4.4 Robust Average and Robust Between-Laboratory Coefficient of Variation

The robust averages and associated expanded MUs, and robust between-laboratory CVs (a measure of the variability of participants' results) were calculated using the procedure described in ISO 13528.[7]

4.5 Performance Coefficient of Variation

The performance coefficient of variation (PCV) is a fixed measure of the between-laboratory variation that in the judgement of the study coordinator would be expected from participants, given the analyte concentrations. The PCV is not the CV of participants' results; it is set by the study coordinator and is based on the analyte concentrations and experience from previous studies, and is supported by mathematical models such as the Thompson-Horwitz equation.[8] By setting a fixed and realistic value for the PCV, a participant's performance does not depend on other participants' performances and can be compared from study to study.

4.6 Standard Deviation for Proficiency Assessment

The standard deviation for proficiency assessment (SDPA, σ) is the product of the assigned value (X) and the PCV, as presented in Equation 1.

$$\sigma = X \times PCV \qquad \textit{Equation 1}$$

4.7 *z*-Score

For each participant result, a z-score is calculated according to Equation 2.

$$z = \frac{(\chi - X)}{\sigma} \qquad \textit{Equation 2}$$

where:

z is z-score

χ is a participant's result

X is the assigned value

σ is the SDPA from Equation 1

For the absolute value of a z-score ($|z|$):

- $|z| \leq 2.0$ is acceptable;
- $2.0 < |z| < 3.0$ is questionable; and
- $|z| \geq 3.0$ is unacceptable.

To account for potential low bias in consensus value due to inefficient methodologies, scores may be adjusted for a 'maximum acceptable result'. Additional information is given in Section 6.3.

4.8 E_n-Score

The E_n-score is complementary to the z-score in assessment of laboratory performance. E_n-score includes measurement uncertainty and is calculated according to Equation 3.

$$E_n = \frac{(\chi - X)}{\sqrt{U_\chi{}^2 + U_X{}^2}} \qquad \textit{Equation 3}$$

where:

E_n is E_n-score

χ is a participant's result

X is the assigned value

U_χ is the expanded uncertainty of the participant's result

U_X is the expanded uncertainty of the assigned value

For the absolute value of an E_n-score ($|E_n|$):

- $|E_n| < 1.0$ is acceptable; and
- $|E_n| \geq 1.0$ is unacceptable.

4.9 Traceability and Measurement Uncertainty

Laboratories accredited to ISO/IEC 17025 must establish and demonstrate the traceability and MU associated with their test results.[9] Guidelines for quantifying uncertainty in analytical measurement are described in the Eurachem/CITAC Guide.[10]

5 TABLES AND FIGURES

Table 6

Sample Details

Sample No.	S1
Matrix	River Water
Analyte	>C10-C16
Unit	µg/L

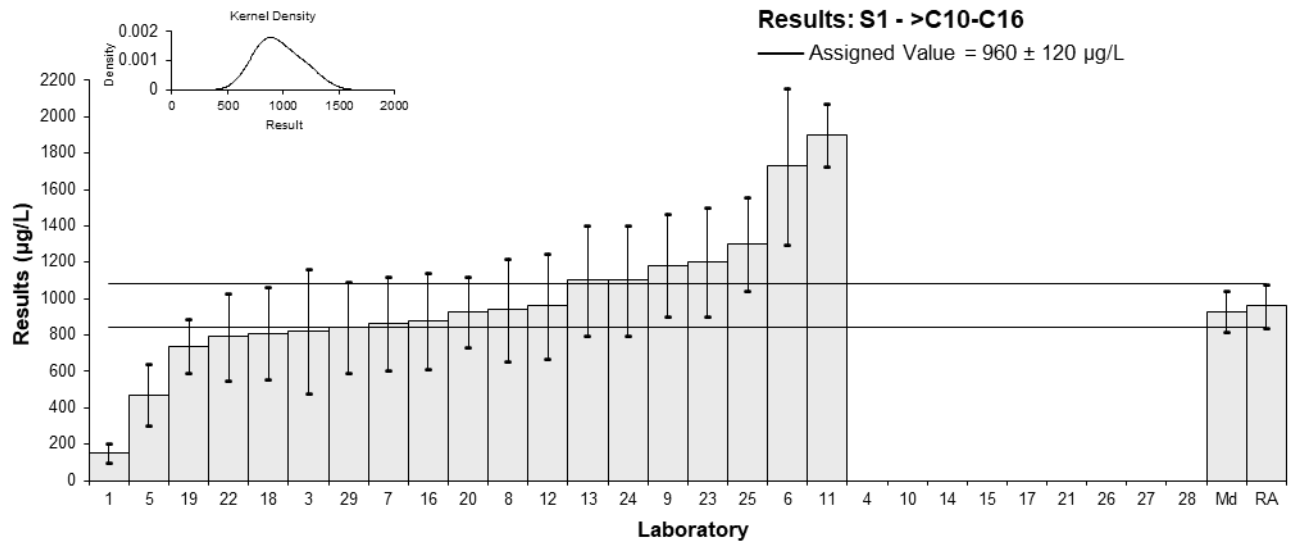
Participant Results

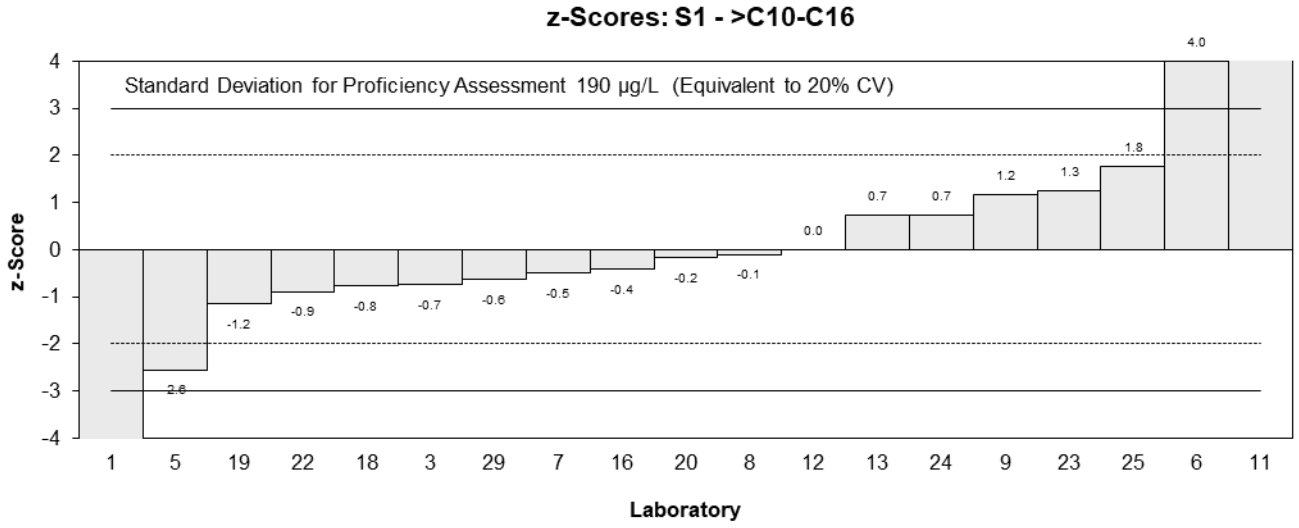
Lab. Code	Result	Uncertainty	z	E_n
1**	150	52	-4.22	-6.19
3	820	342	-0.73	-0.39
4	NR	NR		
5**	470	170	-2.55	-2.35
6**	1728	432	4.00	1.71
7	864	259	-0.50	-0.34
8	940	282	-0.10	-0.07
9	1183	284	1.16	0.72
10	NT	NT		
11**	1900	170	4.90	4.52
12	960	290	0.00	0.00
13	1100	300	0.73	0.43
14	NR	NR		
15	NT	NT		
16	880	264.0	-0.42	-0.28
17	NR	NR		
18	810	251	-0.78	-0.54
19	740	150	-1.15	-1.15
20	928.44	194.97	-0.16	-0.14
21	NR	NR		
22	790	237	-0.89	-0.64
23	1200	300	1.25	0.74
24	1100	300	0.73	0.43
25	1300	260	1.77	1.19
26	NS	NS		
27	NT	NT		
28	NT	NT		
29	840	250	-0.62	-0.43

** Excluded Result, see Section 4.2

Statistics

Assigned Value	960	120
Robust Average	960	120
Median	930	110
Mean	964	
N	15	
Max	1300	
Min	740	
Robust SD	190	
Robust CV	19%	


Kernel Density
Density
Result
Results: S1 - >C10-C16
Assigned Value = 960 ± 120 µg/L
Results (µg/L)
Laboratory
1 5 19 22 18 3 29 7 16 20 8 12 13 24 9 23 25 6 11 4 10 14 15 17 21 26 27 28 Md RA


z-Scores: S1 - >C10-C16
Standard Deviation for Proficiency Assessment 190 µg/L (Equivalent to 20% CV)
z-Score
Laboratory
1 5 19 22 18 3 29 7 16 20 8 12 13 24 9 23 25 6 11
4.0 1.8 1.2 1.3 0.7 0.7 0.0 -0.1 -0.2 -0.4 -0.5 -0.6 -0.7 -0.8 -0.9 -1.2 -2.6

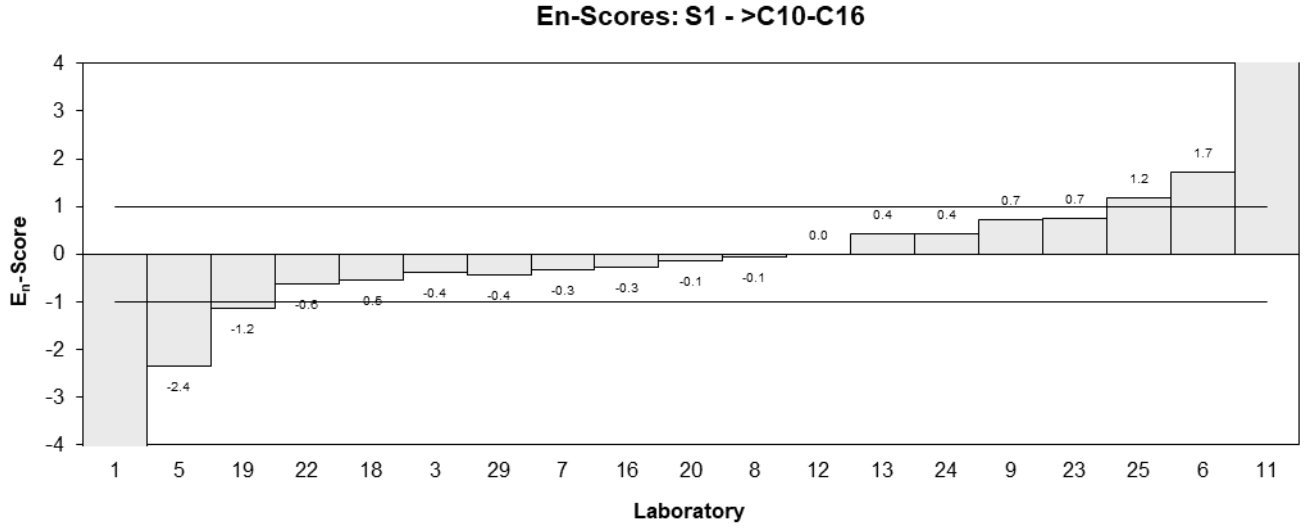

En-Scores: S1 - >C10-C16
En-Score
Laboratory
1 5 19 22 18 3 29 7 16 20 8 12 13 24 9 23 25 6 11
1.7 1.2 0.7 0.7 0.4 0.4 0.0 -0.1 -0.1 -0.3 -0.3 -0.4 -0.4 -0.5 -0.6 -1.2 -2.4

Figure 2

Table 7

Sample Details

Sample No.	S1
Matrix	River Water
Analyte	>C16-C34
Unit	µg/L

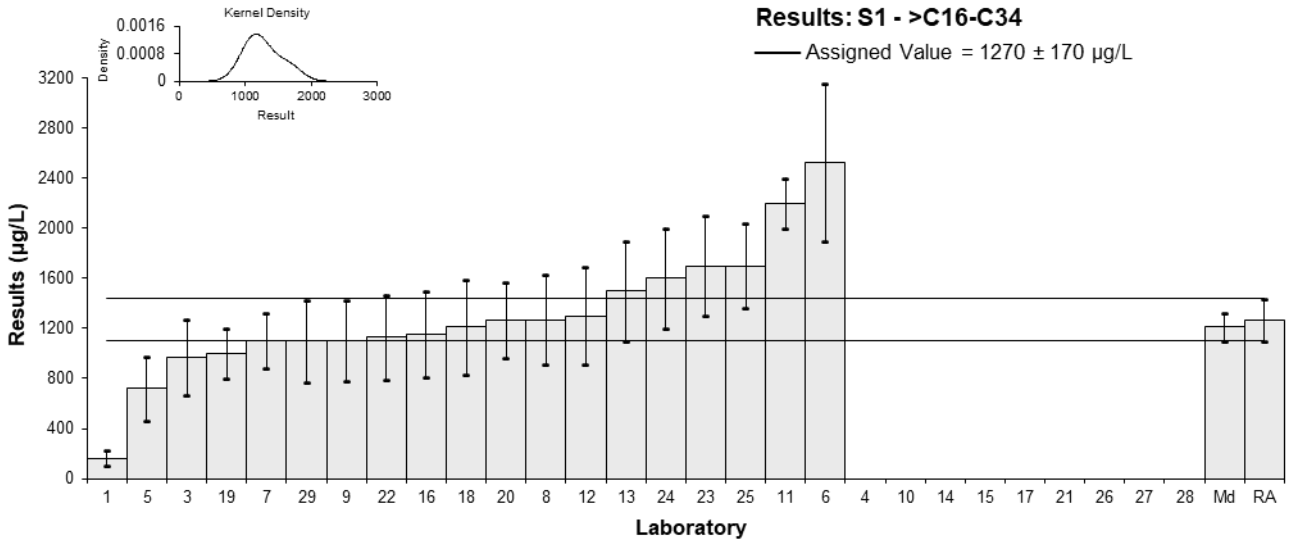
Participant Results

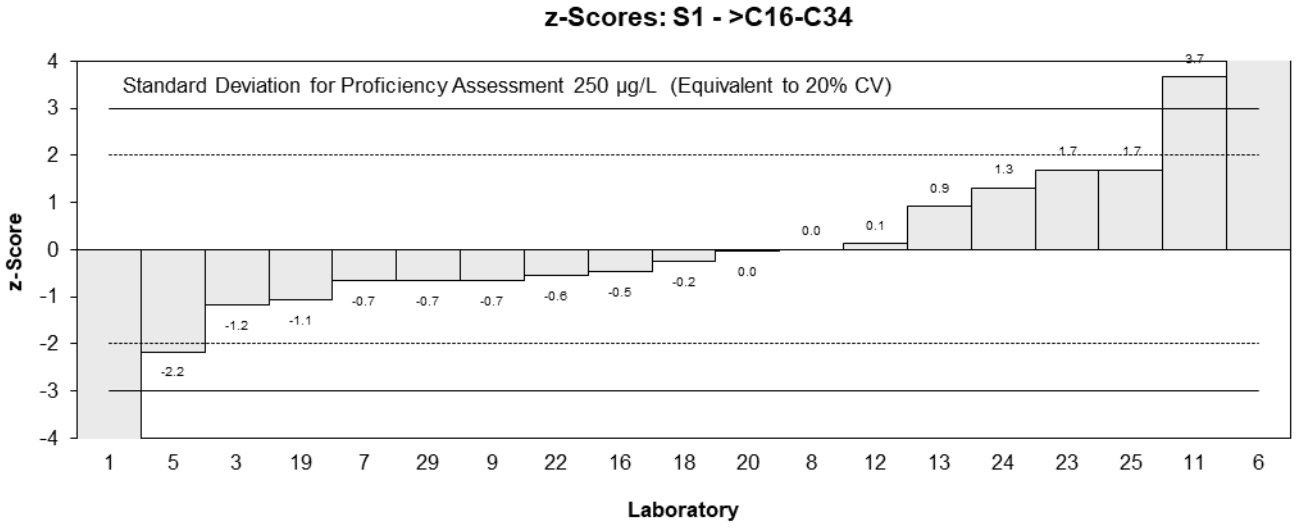
Lab. Code	Result	Uncertainty	z	E_n
1**	160	62	-4.37	-6.13
3	970	306	-1.18	-0.86
4	NR	NR		
5**	720	254	-2.17	-1.80
6**	2523	630	4.93	1.92
7	1100	220	-0.67	-0.61
8	1270	362	0.00	0.00
9	1103	320	-0.66	-0.46
10	NT	NT		
11**	2200	200	3.66	3.54
12	1300	390	0.12	0.07
13	1500	400	0.91	0.53
14	NR	NR		
15	NT	NT		
16	1153	345.9	-0.46	-0.30
17	NR	NR		
18	1210	375	-0.24	-0.15
19	1000	200	-1.06	-1.03
20	1261.62	302.79	-0.03	-0.02
21	NR	NR		
22	1130	339	-0.55	-0.37
23	1700	400	1.69	0.99
24	1600	400	1.30	0.76
25	1700	340	1.69	1.13
26	NS	NS		
27	NT	NT		
28	NT	NT		
29	1100	330	-0.67	-0.46

** Excluded Result, see Section 4.2

Statistics

Assigned Value	1270	170
Robust Average	1270	170
Median	1210	110
Mean	1270	
N	15	
Max	1700	
Min	970	
Robust SD	260	
Robust CV	21%	


Kernel Density
Density
0.0016
0.0008
0
0
1000
2000
3000
Result
Results: S1 - >C16-C34
Assigned Value = 1270 ± 170 µg/L
Results (µg/L)
3200
2800
2400
2000
1600
1200
800
400
0
1 5 3 19 7 29 9 22 16 18 20 8 12 13 24 23 25 11 6 4 10 14 15 17 21 26 27 28 Md RA
Laboratory


z-Scores: S1 - >C16-C34
Standard Deviation for Proficiency Assessment 250 µg/L (Equivalent to 20% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-2.2
-1.2
-1.1
-0.7
-0.7
-0.7
-0.6
-0.5
-0.2
0.0
0.0
0.1
0.9
1.3
1.7
1.7
3.7
1 5 3 19 7 29 9 22 16 18 20 8 12 13 24 23 25 11 6
Laboratory

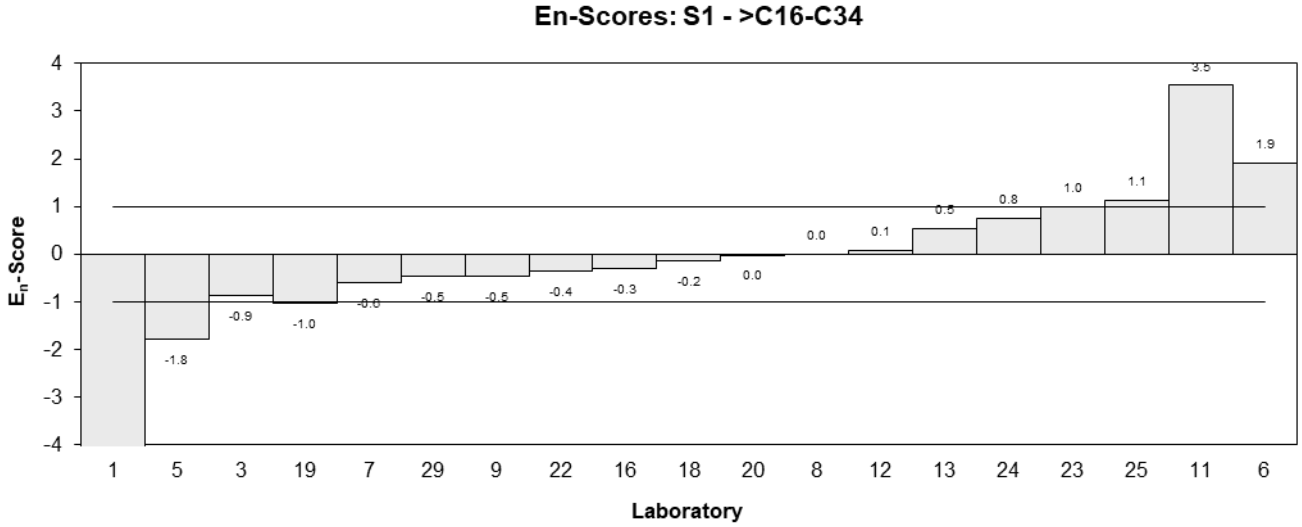

En-Scores: S1 - >C16-C34
En-Score
4
3
2
1
0
-1
-2
-3
-4
-1.8
-0.9
-1.0
-0.6
-0.5
-0.5
-0.4
-0.3
-0.2
0.0
0.0
0.1
0.5
0.8
1.0
1.1
3.5
1.9
1 5 3 19 7 29 9 22 16 18 20 8 12 13 24 23 25 11 6
Laboratory

Figure 3

Table 8

Sample Details

Sample No.	S1
Matrix	River Water
Analyte	>C34-C40
Unit	µg/L

Participant Results

Lab. Code	Result	Uncertainty
1	< 100	63
3	<100	NR
4	NR	NR
5	<100	NR
6	<50	NR
7	<500	500
8	<100	NR
9	<200	NR
10	NT	NT
11	<100	NR
12	<100	NR
13	<100	NR
14	NR	NR
15	NT	NT
16	< 100	NR
17	NR	NR
18	< 100	NR
19	<100	NR
20	<100	NR
21	NR	NR
22	< 100	NR
23	<100	NR
24	<100	NR
25	< 100	NR
26	NS	NS
27	NT	NT
28	NT	NT
29	>100	NR

Statistics

No numerical results reported –
no summary statistics calculated

Table 9 Non-NEPM Hydrocarbon Ranges Reported by Participants for Sample S1

Lab. Code	Range	Result (µg/L)	Uncertainty (µg/L)
1	C10-C14	80	26
	C29-C36	< 50	17
4	C7-C9	<100	67
	C10-C14	670	220
	C15-C36	2840	690
14	C7-C9	<0.2	NR
	C10-C14	300	90
	C15-C36	500	150
17	C10-C14	609	207
	C15-C28	2349	893
	C29-C36	<80	NR
21	C7-C9	<400	NR
	C10-C14	440	136
	C15-C36	1400	418

Table 10

Sample Details

Sample No.	S1
Matrix	River Water
Analyte	TRH
Unit	µg/L

Participant Results

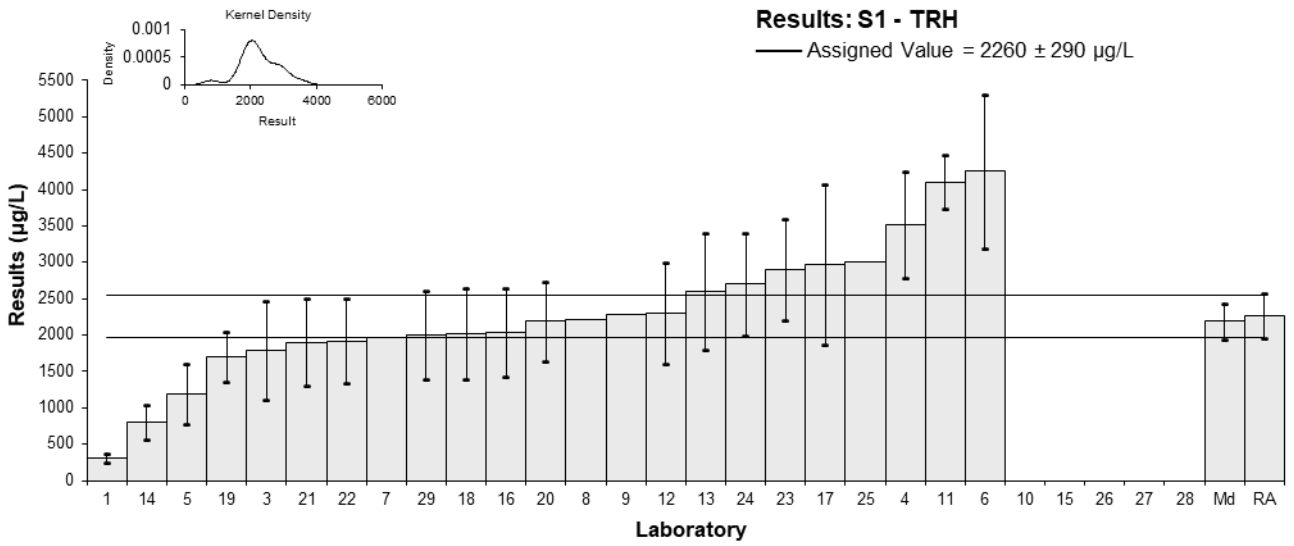
Lab. Code	Result	Uncertainty	z	E_n
1**	310	62	-5.75	-6.58
3	1790	674	-1.39	-0.64
4*	3520	730	3.72	1.60
5**	1190	422	-3.16	-2.09
6**	4251	1062	5.87	1.81
7	1964	NR	-0.87	-1.02
8	2210	NR	-0.15	-0.17
9	2286	NR	0.08	0.09
10	NT	NT		
11**	4100	370	5.43	3.91
12	2300	690	0.12	0.05
13	2600	800	1.00	0.40
14*	800	240	-4.31	-3.88
15	NT	NT		
16	2033	609.9	-0.67	-0.34
17	2964	1100	2.08	0.62
18	2020	626	-0.71	-0.35
19	1700	350	-1.65	-1.23
20	2190.06	547.52	-0.21	-0.11
21	1900	600	-1.06	-0.54
22	1920	576	-1.00	-0.53
23	2900	700	1.89	0.84
24	2700	700	1.30	0.58
25	3000	NR	2.18	2.55
26	NS	NS		
27	NT	NT		
28	NT	NT		
29	2000	600	-0.77	-0.39

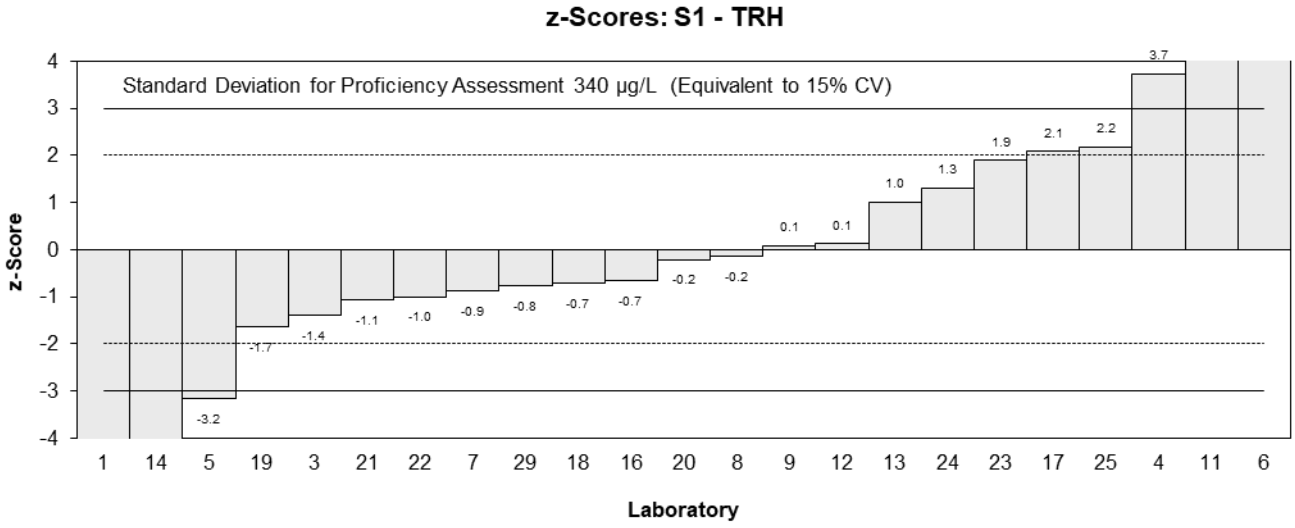
* Outlier, ** Excluded Result, see Section 4.2

Statistics

Assigned Value	2260	290
Robust Average	2260	310
Median	2190	250
Mean	2250	
N	19	
Max	3520	
Min	800	
Robust SD	540	
Robust CV	24%	

Laboratories **7, 9** and **25** did not report a TRH result. The study coordinator calculated TRH values for these laboratories by summing the individual hydrocarbon ranges they reported. Uncertainty evaluations could not be performed for these results.


Kernel Density
Density
0.001
0.0005
0
0
2000
4000
6000
Result
Results: S1 - TRH
Assigned Value = 2260 ± 290 µg/L
Results (µg/L)
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1 14 5 19 3 21 22 7 29 18 16 20 8 9 12 13 24 23 17 25 4 11 6 10 15 26 27 28 Md RA
Laboratory


z-Scores: S1 - TRH
Standard Deviation for Proficiency Assessment 340 µg/L (Equivalent to 15% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-3.2
-1.7
-1.4
-1.1
-1.0
-0.9
-0.8
-0.7
-0.7
-0.2
-0.2
0.1
0.1
1.0
1.3
1.9
2.1
2.2
3.7
1 14 5 19 3 21 22 7 29 18 16 20 8 9 12 13 24 23 17 25 4 11 6
Laboratory

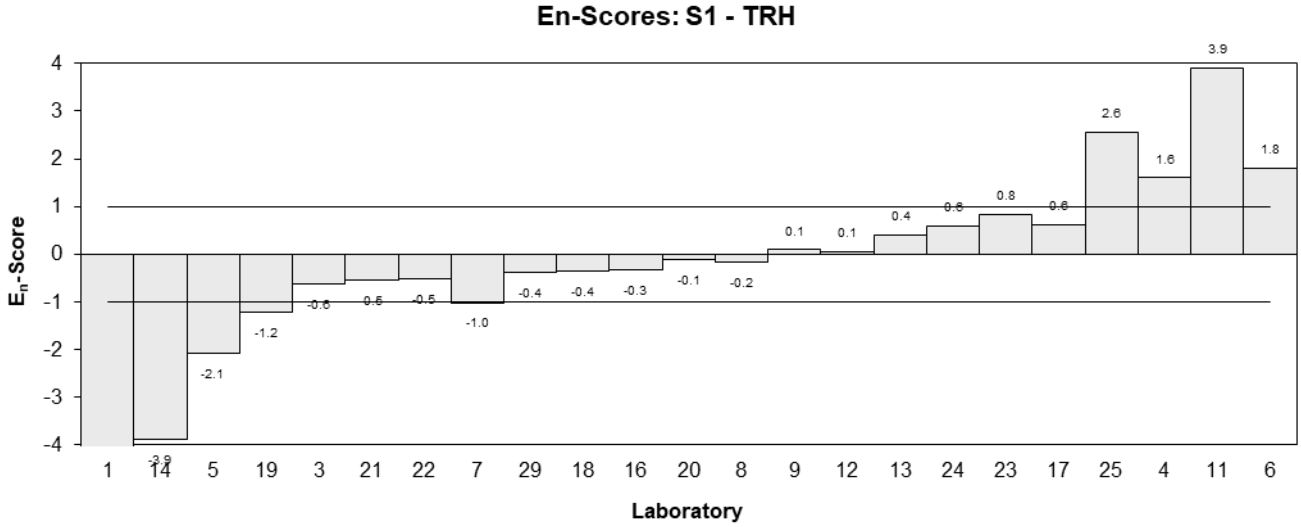

En-Scores: S1 - TRH
En-Score
4
3
2
1
0
-1
-2
-3
-4
-3.9
-2.1
-1.2
-0.6
-0.5
-0.5
-1.0
-0.4
-0.4
-0.3
-0.1
-0.2
0.1
0.1
0.4
0.6
0.8
0.6
2.6
1.6
3.9
1.8
1 14 5 19 3 21 22 7 29 18 16 20 8 9 12 13 24 23 17 25 4 11 6
Laboratory

Figure 4

Table 11

Sample Details

Sample No.	S2
Matrix	River Water
Analyte	C6-C10
Unit	µg/L

Participant Results

Lab. Code	Result	Uncertainty
1	390	87.5
3	580	134.58
4	NT	NT
5	490	98
6	537	161
7	585	180
8	430	81.8
9	484	60
10	440.7499	NR
11	369	29
12	530	159
13	530	100
14	NT	NT
15	NT	NT
16	530.07	159.0
17	NT	NT
18	529	159
19	280	56
20	457.3	96.03
21	NT	NT
22	526.09	157.83
23	530	100
24	560	100
25	540	110
26	NS	NS
27	438.7978	NR
28	NT	NT
29	560	170

Statistics

Assigned Value	Not Set	
Robust Average	498	39
Median	529	32
Mean	491	
N	21	
Max	585	
Min	280	
Robust SD	71	
Robust CV	14%	

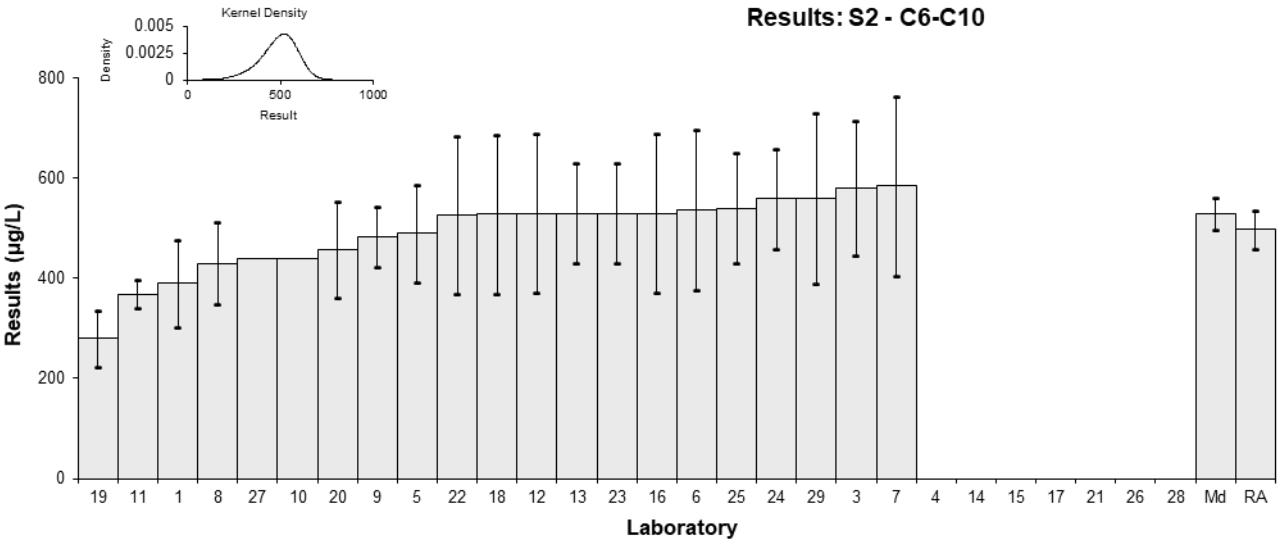

Results: S2 - C6-C10
Kernel Density
Density
0.005
0.0025
0
0
500
1000
Result
Results (µg/L)
800
600
400
200
0
19 11 1 8 27 10 20 9 5 22 18 12 13 23 16 6 25 24 29 3 7 4 14 15 17 21 26 28 Md RA
Laboratory

Figure 5

Table 12

Sample Details

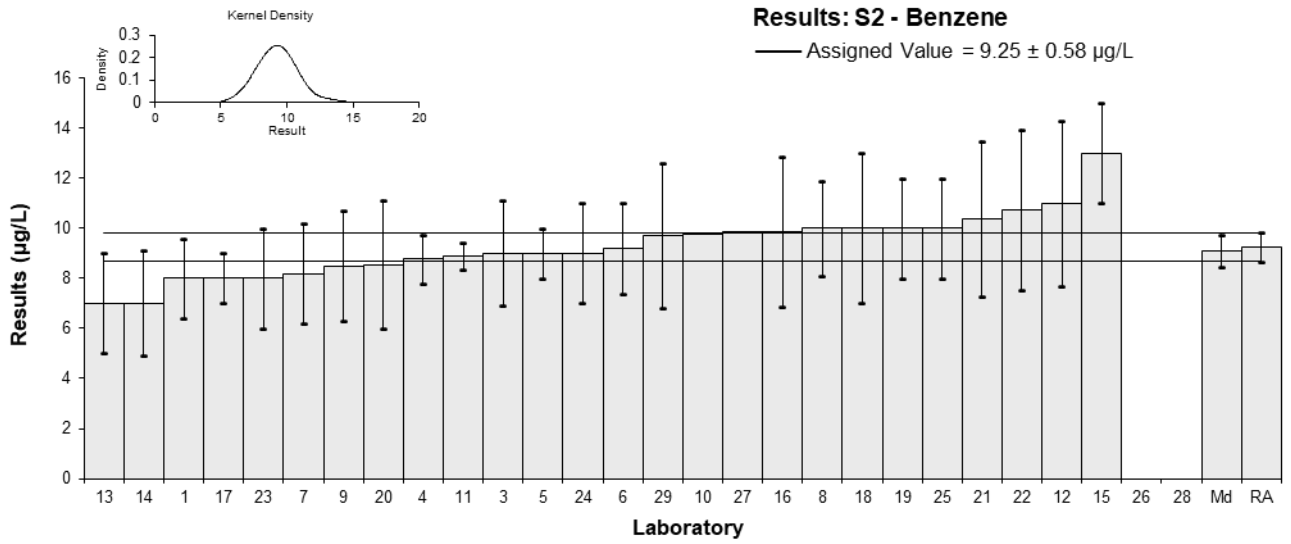
Sample No.	S2
Matrix	River Water
Analyte	Benzene
Unit	µg/L

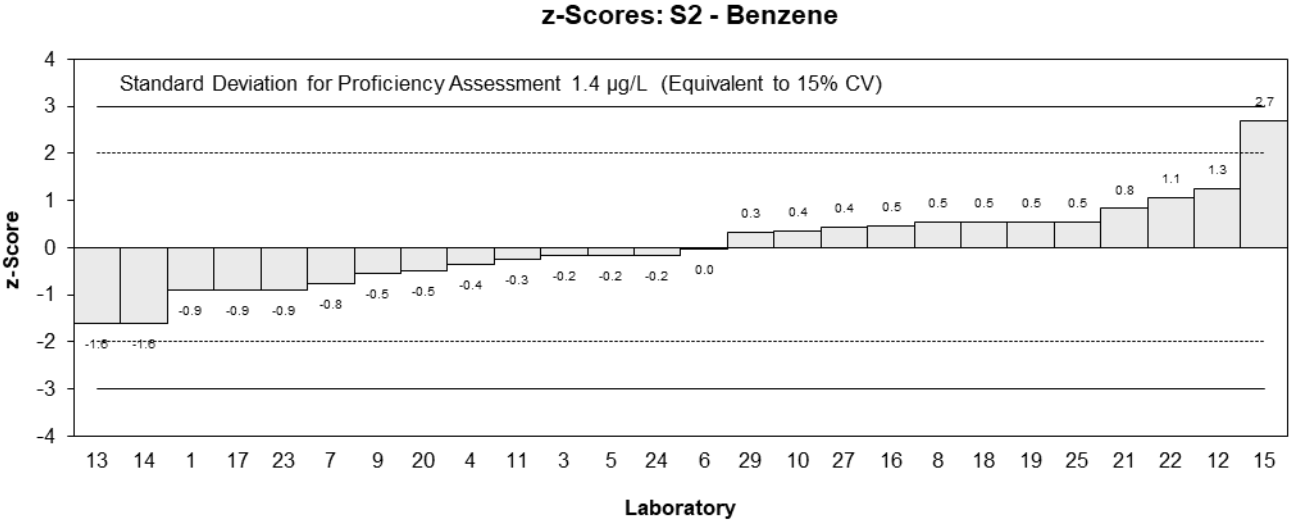
Participant Results

Lab. Code	Result	Uncertainty	z	E_n
1	8	1.6	-0.90	-0.73
3	9	2.1	-0.18	-0.11
4	8.77	0.98	-0.35	-0.42
5	9	1	-0.18	-0.22
6	9.2	1.8	-0.04	-0.03
7	8.19	2	-0.76	-0.51
8	10	1.9	0.54	0.38
9	8.5	2.21	-0.54	-0.33
10	9.7457	NR	0.36	0.85
11	8.9	0.52	-0.25	-0.45
12	11	3.3	1.26	0.52
13	7	2	-1.62	-1.08
14	7	2.1	-1.62	-1.03
15	13	2	2.70	1.80
16	9.88	3.0	0.45	0.21
17	8	1	-0.90	-1.08
18	10	3	0.54	0.25
19	10	2	0.54	0.36
20	8.56	2.57	-0.50	-0.26
21	10.4	3.1	0.83	0.36
22	10.74	3.22	1.07	0.46
23	8	2	-0.90	-0.60
24	9	2	-0.18	-0.12
25	10	2	0.54	0.36
26	NS	NS		
27	9.8515	NR	0.43	1.04
28	NT	NT		
29	9.7	2.9	0.32	0.15

Statistics

Assigned Value	9.25	0.58
Robust Average	9.25	0.58
Median	9.10	0.65
Mean	9.29	
N	26	
Max	13	
Min	7	
Robust SD	1.2	
Robust CV	13%	


Kernel Density
Density
Result
Results: S2 - Benzene
Assigned Value = 9.25 ± 0.58 µg/L
Results (µg/L)
Laboratory
13 14 1 17 23 7 9 20 4 11 3 5 24 6 29 10 27 16 8 18 19 25 21 22 12 15 26 28 Md RA


z-Scores: S2 - Benzene
Standard Deviation for Proficiency Assessment 1.4 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
13 14 1 17 23 7 9 20 4 11 3 5 24 6 29 10 27 16 8 18 19 25 21 22 12 15

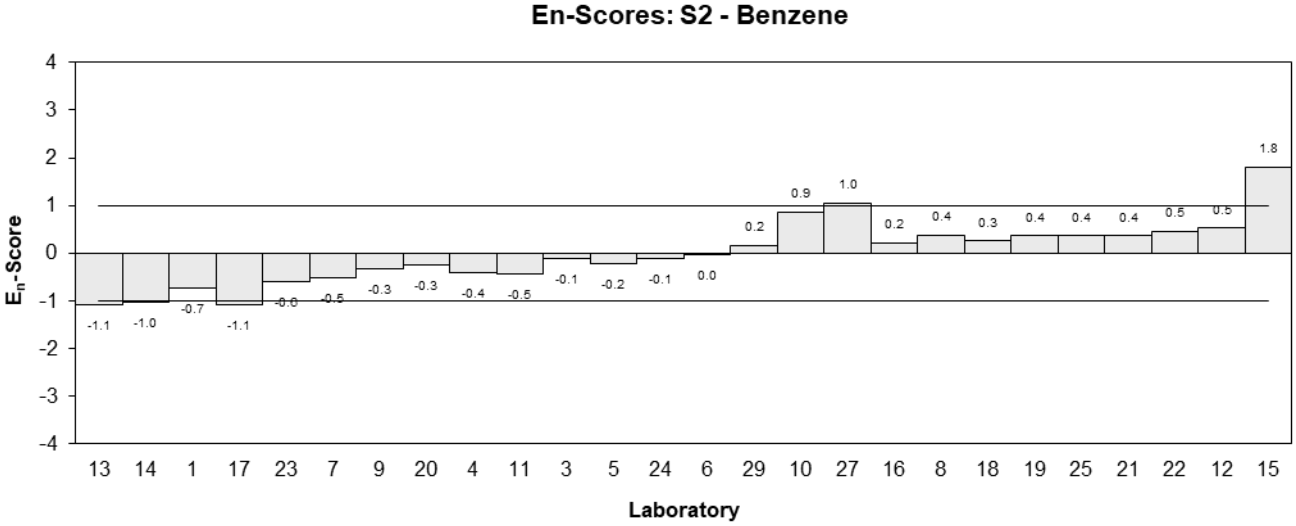

En-Scores: S2 - Benzene
En-Score
Laboratory
13 14 1 17 23 7 9 20 4 11 3 5 24 6 29 10 27 16 8 18 19 25 21 22 12 15

Figure 6

Table 13

Sample Details

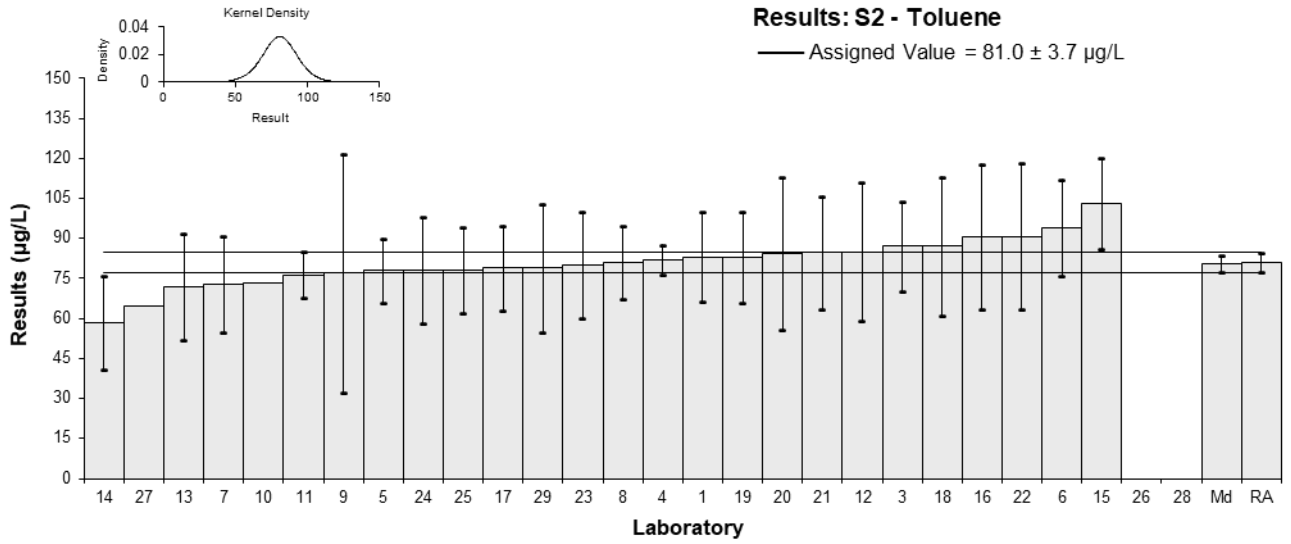
Sample No.	S2
Matrix	River Water
Analyte	Toluene
Unit	µg/L

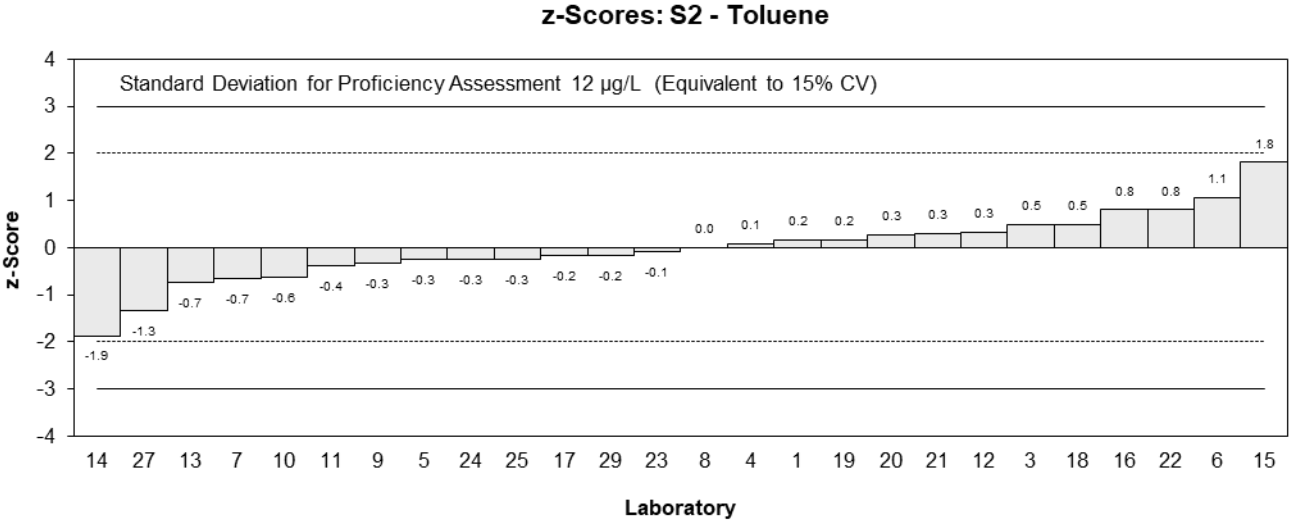
Participant Results

Lab. Code	Result	Uncertainty	z	E_n
1	83	16.9	0.16	0.12
3	87	16.73	0.49	0.35
4	82.1	5.5	0.09	0.17
5	78	12	-0.25	-0.24
6	94	18	1.07	0.71
7	72.8	18	-0.67	-0.45
8	81	13.5	0.00	0.00
9	77	44.64	-0.33	-0.09
10	73.3669	NR	-0.63	-2.06
11	76.4	8.5	-0.38	-0.50
12	85	26	0.33	0.15
13	72	20	-0.74	-0.44
14	58.3	17.49	-1.87	-1.27
15	103	17	1.81	1.26
16	90.7	27.2	0.80	0.35
17	79	15.8	-0.16	-0.12
18	87	26.1	0.49	0.23
19	83	17	0.16	0.11
20	84.21	28.63	0.26	0.11
21	84.7	21.2	0.30	0.17
22	90.78	27.24	0.80	0.36
23	80	20	-0.08	-0.05
24	78	20	-0.25	-0.15
25	78	16	-0.25	-0.18
26	NS	NS		
27	64.7501	NR	-1.34	-4.39
28	NT	NT		
29	79	24	-0.16	-0.08

Statistics

Assigned Value	81.0	3.7
Robust Average	81.0	3.7
Median	80.5	3.0
Mean	80.9	
N	26	
Max	103	
Min	58.3	
Robust SD	7.5	
Robust CV	9.3%	


Kernel Density
Density
Result
Results: S2 - Toluene
Assigned Value = 81.0 ± 3.7 µg/L
Results (µg/L)
Laboratory
14 27 13 7 10 11 9 5 24 25 17 29 23 8 4 1 19 20 21 12 3 18 16 22 6 15 26 28 Md RA


z-Scores: S2 - Toluene
Standard Deviation for Proficiency Assessment 12 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
14 27 13 7 10 11 9 5 24 25 17 29 23 8 4 1 19 20 21 12 3 18 16 22 6 15

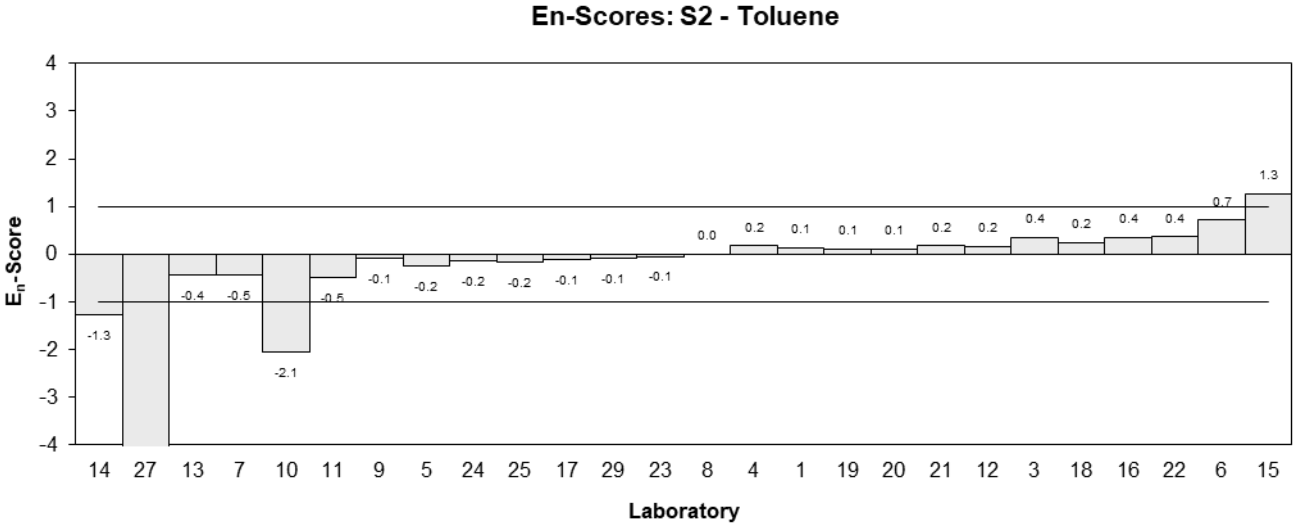

En-Scores: S2 - Toluene
En-Score
Laboratory
14 27 13 7 10 11 9 5 24 25 17 29 23 8 4 1 19 20 21 12 3 18 16 22 6 15

Figure 7

Table 14

Sample Details

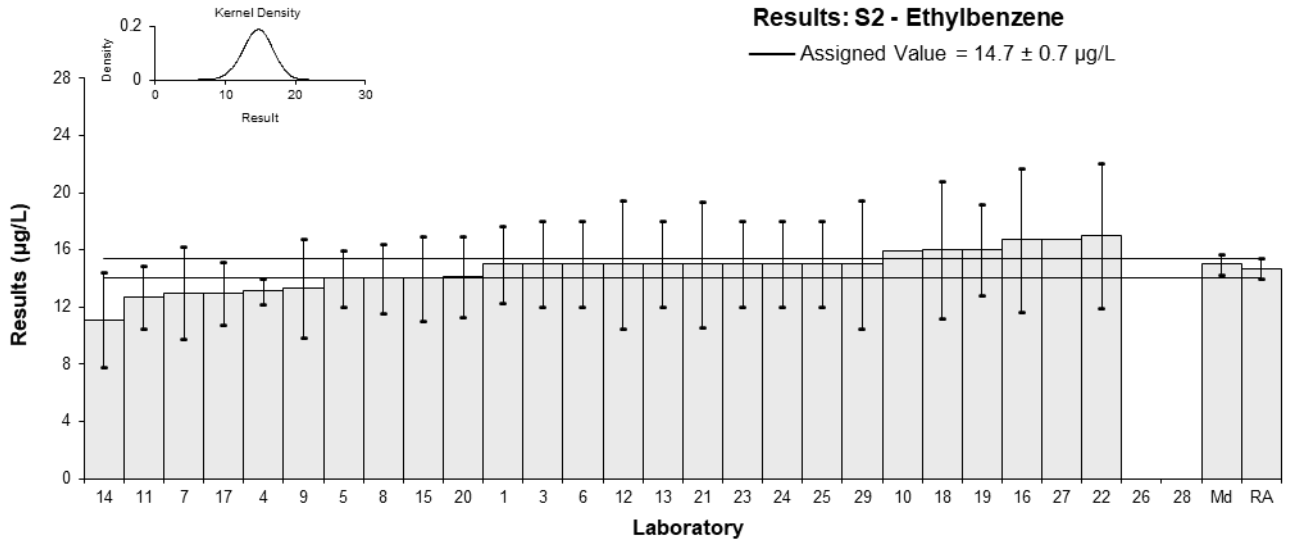
Sample No.	S2
Matrix	River Water
Analyte	Ethylbenzene
Unit	µg/L

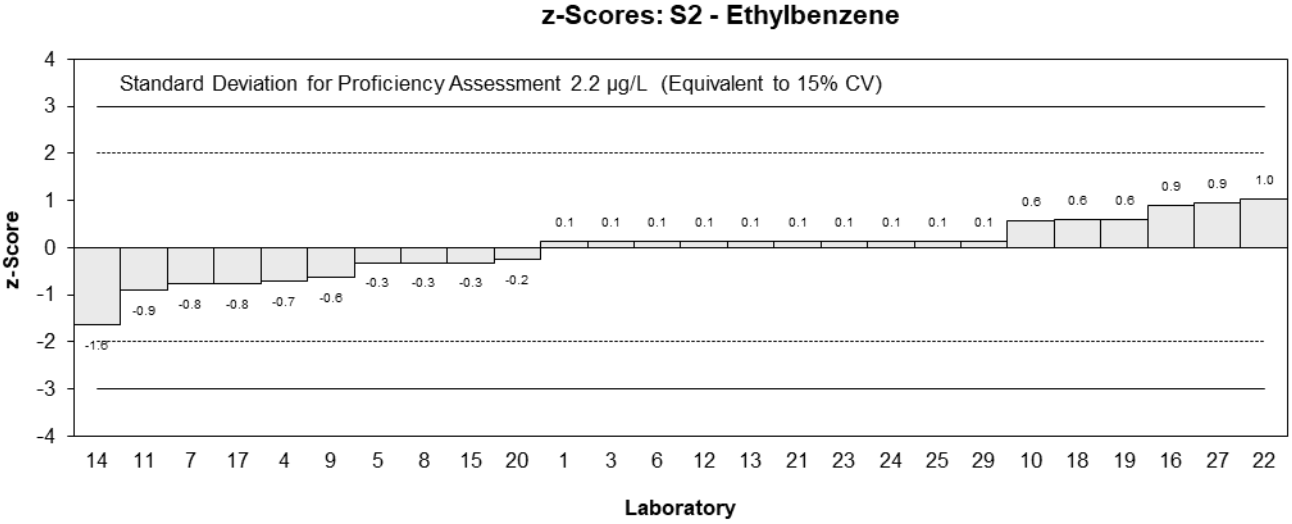
Participant Results

Lab. Code	Result	Uncertainty	z	E_n
1	15	2.7	0.14	0.11
3	15	3	0.14	0.10
4	13.12	0.89	-0.72	-1.40
5	14	2	-0.32	-0.33
6	15	3	0.14	0.10
7	13	3.2	-0.77	-0.52
8	14	2.4	-0.32	-0.28
9	13.3	3.47	-0.63	-0.40
10	15.9269	NR	0.56	1.75
11	12.7	2.2	-0.91	-0.87
12	15	4.5	0.14	0.07
13	15	3	0.14	0.10
14	11.1	3.33	-1.63	-1.06
15	14	3	-0.32	-0.23
16	16.69	5.0	0.90	0.39
17	13	2.2	-0.77	-0.74
18	16	4.8	0.59	0.27
19	16	3.2	0.59	0.40
20	14.16	2.83	-0.24	-0.19
21	15	4.4	0.14	0.07
22	17.00	5.10	1.04	0.45
23	15	3	0.14	0.10
24	15	3	0.14	0.10
25	15	3	0.14	0.10
26	NS	NS		
27	16.7658	NR	0.94	2.95
28	NT	NT		
29	15	4.5	0.14	0.07

Statistics

Assigned Value	14.7	0.7
Robust Average	14.7	0.7
Median	15.0	0.7
Mean	14.6	
N	26	
Max	17	
Min	11.1	
Robust SD	1.4	
Robust CV	9.6%	


Kernel Density
Density
Result
Results: S2 - Ethylbenzene
Assigned Value = 14.7 ± 0.7 µg/L
Results (µg/L)
Laboratory
14 11 7 17 4 9 5 8 15 20 1 3 6 12 13 21 23 24 25 29 10 18 19 16 27 22 26 28 Md RA


z-Scores: S2 - Ethylbenzene
Standard Deviation for Proficiency Assessment 2.2 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
14 11 7 17 4 9 5 8 15 20 1 3 6 12 13 21 23 24 25 29 10 18 19 16 27 22

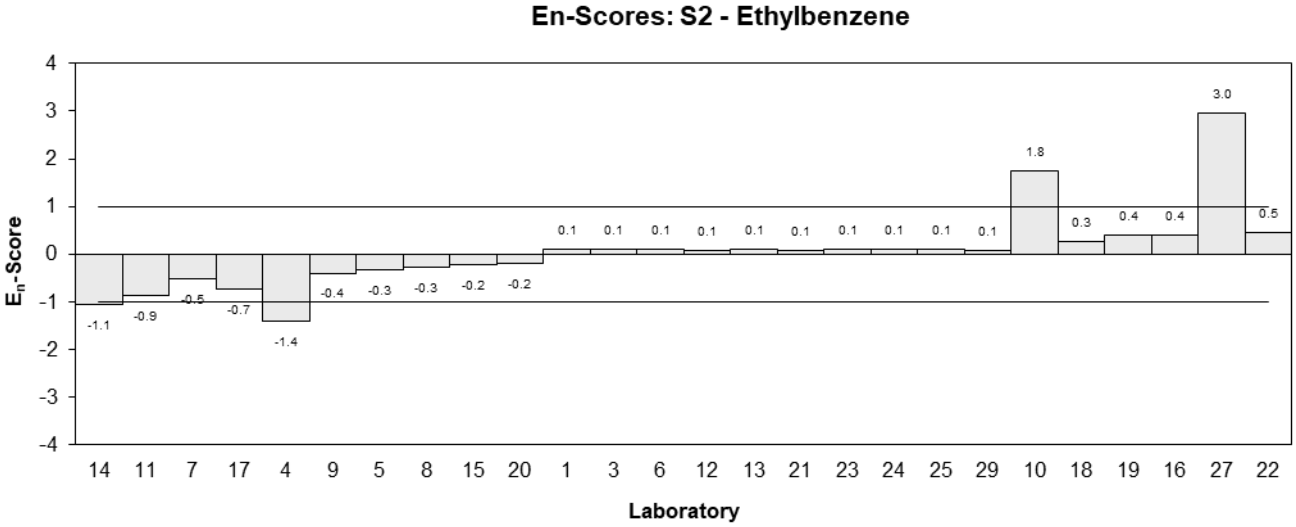

En-Scores: S2 - Ethylbenzene
En-Score
Laboratory
14 11 7 17 4 9 5 8 15 20 1 3 6 12 13 21 23 24 25 29 10 18 19 16 27 22

Figure 8

Table 15

Sample Details

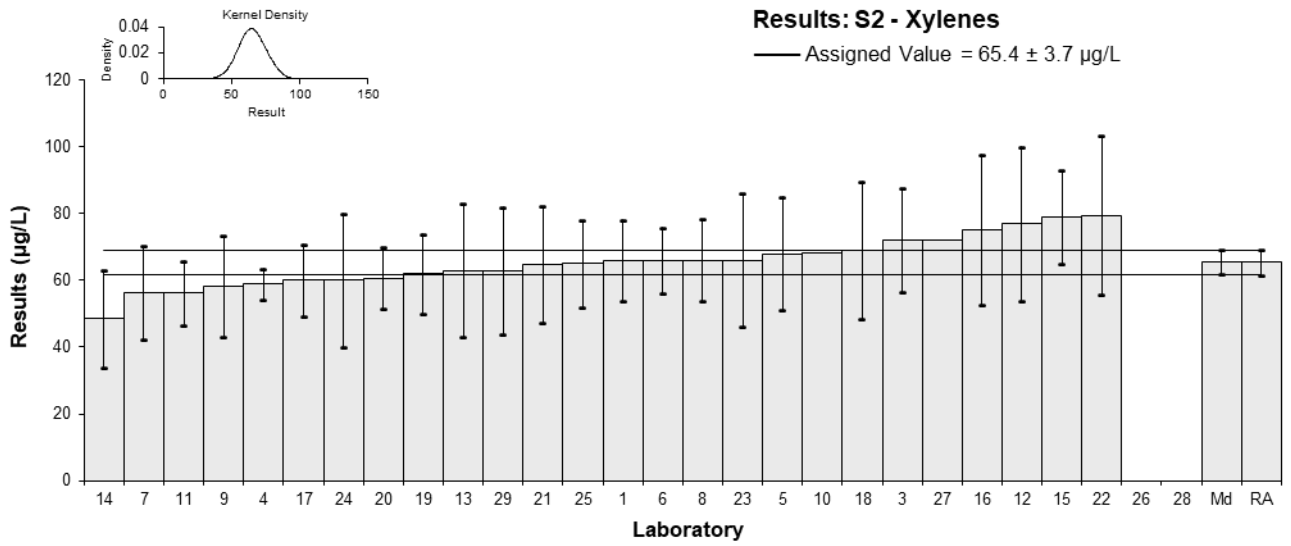
Sample No.	S2
Matrix	River Water
Analyte	Xylenes
Unit	µg/L

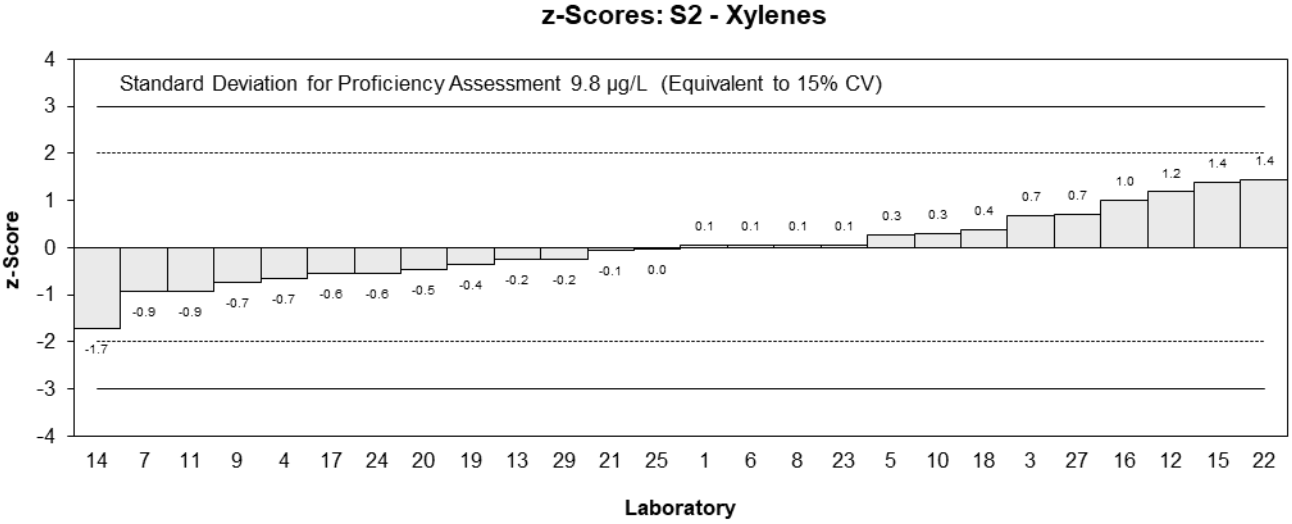
Participant Results

Lab. Code	Result	Uncertainty	z	E_n
1	66	12.2	0.06	0.05
3	72	15.63	0.67	0.41
4	58.9	4.6	-0.66	-1.10
5	68	17	0.27	0.15
6	66	9.9	0.06	0.06
7	56.2	14	-0.94	-0.64
8	66	12.3	0.06	0.05
9	58.2	15.13	-0.73	-0.46
10	68.211	NR	0.29	0.76
11	56.2	9.6	-0.94	-0.89
12	77	23	1.18	0.50
13	63	20	-0.24	-0.12
14	48.5	14.55	-1.72	-1.13
15	79	14	1.39	0.94
16	75.25	22.6	1.00	0.43
17	60	10.8	-0.55	-0.47
18	69	20.7	0.37	0.17
19	62	12	-0.35	-0.27
20	60.7	9.11	-0.48	-0.48
21	64.7	17.5	-0.07	-0.04
22	79.49	23.85	1.44	0.58
23	66	20	0.06	0.03
24	60	20	-0.55	-0.27
25	65	13	-0.04	-0.03
26	NS	NS		
27	72.224	NR	0.70	1.84
28	NT	NT		
29	63	19	-0.24	-0.12

Statistics

Assigned Value	65.4	3.7
Robust Average	65.4	3.7
Median	65.5	3.7
Mean	65.4	
N	26	
Max	79.49	
Min	48.5	
Robust SD	7.5	
Robust CV	11%	


Kernel Density
Density
Result
Results: S2 - Xylenes
Assigned Value = 65.4 ± 3.7 µg/L
Results (µg/L)
Laboratory
14 7 11 9 4 17 24 20 19 13 29 21 25 1 6 8 23 5 10 18 3 27 16 12 15 22 26 28 Md RA


z-Scores: S2 - Xylenes
Standard Deviation for Proficiency Assessment 9.8 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
14 7 11 9 4 17 24 20 19 13 29 21 25 1 6 8 23 5 10 18 3 27 16 12 15 22

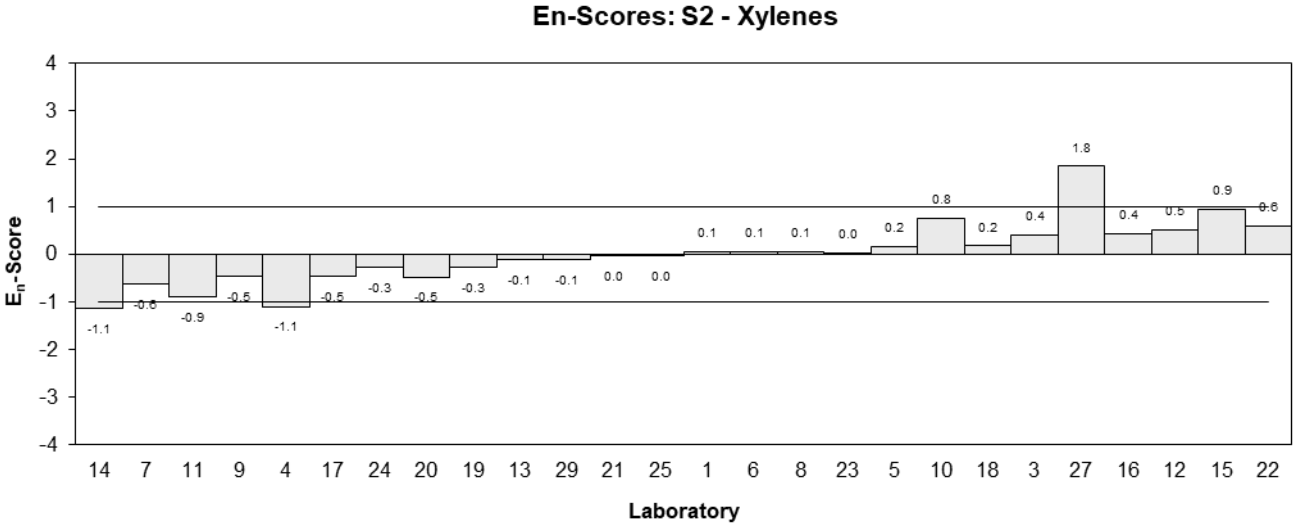

En-Scores: S2 - Xylenes
En-Score
Laboratory
14 7 11 9 4 17 24 20 19 13 29 21 25 1 6 8 23 5 10 18 3 27 16 12 15 22

Figure 9

Table 16

Sample Details

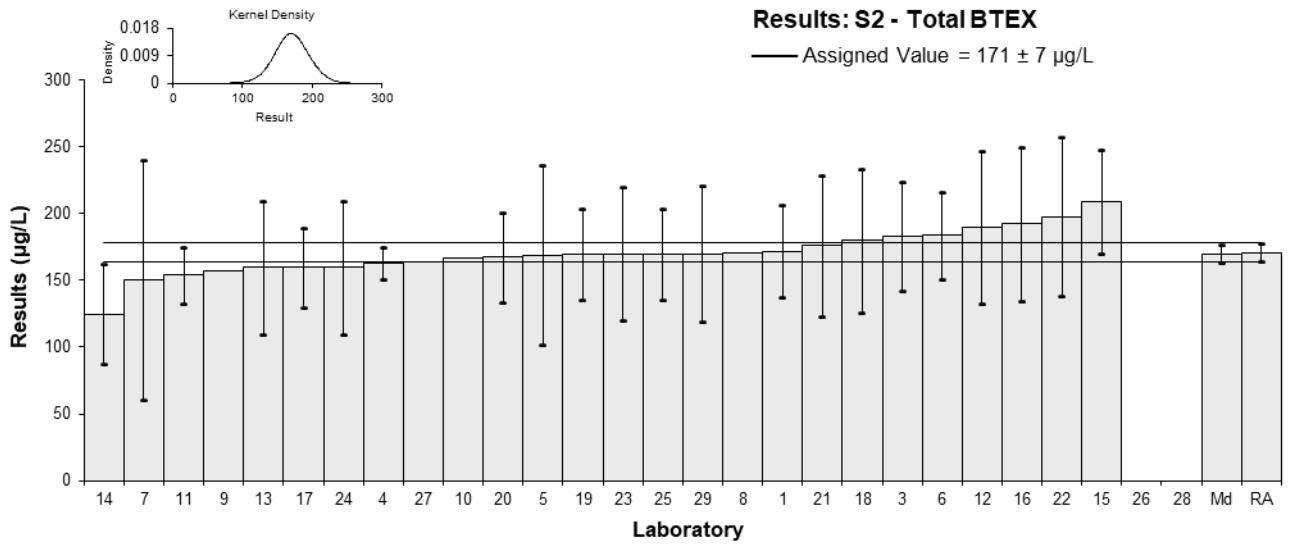
Sample No.	S2
Matrix	River Water
Analyte	Total BTEX
Unit	µg/L

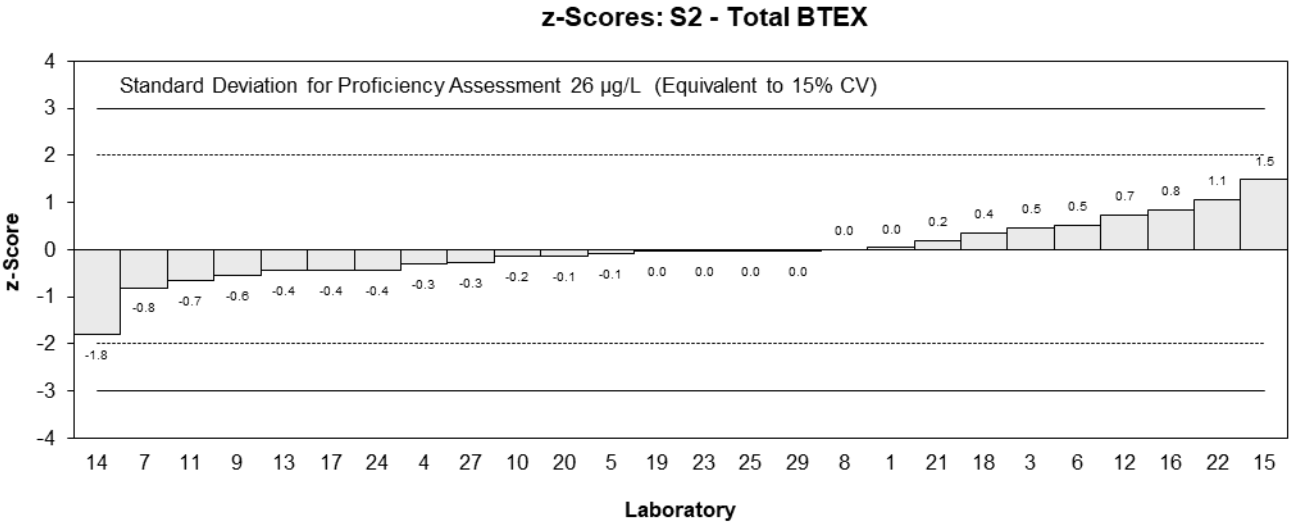
Participant Results

Lab. Code	Result	Uncertainty	z	E_n
1	172	34.4	0.04	0.03
3	183	41.07	0.47	0.29
4	163	12	-0.31	-0.58
5	169	67	-0.08	-0.03
6	184	32.7	0.51	0.39
7	150.2	90	-0.81	-0.23
8	171	NR	0.00	0.00
9	157	NR	-0.55	-2.00
10	167.2507	NR	-0.15	-0.54
11	154	21	-0.66	-0.77
12	190	57	0.74	0.33
13	160	50	-0.43	-0.22
14	124.9	37.47	-1.80	-1.21
15	209	39	1.48	0.96
16	192.52	57.8	0.84	0.37
17	160	29.8	-0.43	-0.36
18	180	54	0.35	0.17
19	170	34	-0.04	-0.03
20	167.63	33.53	-0.13	-0.10
21	176	53	0.19	0.09
22	198.01	59.40	1.05	0.45
23	170	50	-0.04	-0.02
24	160	50	-0.43	-0.22
25	170	34	-0.04	-0.03
26	NS	NS		
27	163.5912	NR	-0.29	-1.06
28	NT	NT		
29	170	51	-0.04	-0.02

Statistics

Assigned Value	171	7
Robust Average	171	7
Median	170	7
Mean	170	
N	26	
Max	209	
Min	124.9	
Robust SD	14	
Robust CV	8.5%	


Kernel Density
Density
0.018
0.009
0
0
100
200
300
Result
Results: S2 - Total BTEX
Assigned Value = 171 ± 7 µg/L
Results (µg/L)
300
250
200
150
100
50
0
14 7 11 9 13 17 24 4 27 10 20 5 19 23 25 29 8 1 21 18 3 6 12 16 22 15 26 28 Md RA
Laboratory


z-Scores: S2 - Total BTEX
Standard Deviation for Proficiency Assessment 26 µg/L (Equivalent to 15% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-1.8 -0.8 -0.7 -0.6 -0.4 -0.4 -0.4 -0.3 -0.3 -0.2 -0.1 -0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.2 0.4 0.5 0.5 0.7 0.8 1.1 1.5
14 7 11 9 13 17 24 4 27 10 20 5 19 23 25 29 8 1 21 18 3 6 12 16 22 15
Laboratory

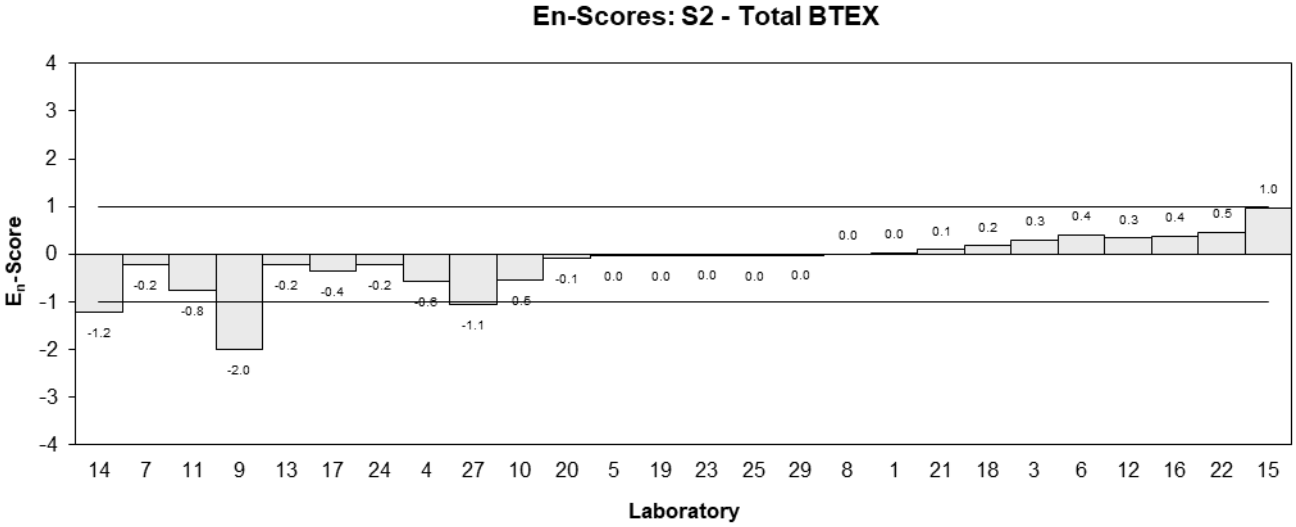

En-Scores: S2 - Total BTEX
En-Score
4
3
2
1
0
-1
-2
-3
-4
-1.2 -0.2 -0.8 -2.0 -0.2 -0.4 -0.2 -0.6 -1.1 -0.5 -0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.3 0.4 0.3 0.4 0.5 1.0
14 7 11 9 13 17 24 4 27 10 20 5 19 23 25 29 8 1 21 18 3 6 12 16 22 15
Laboratory

Figure 10

Table 17

Sample Details

Sample No.	S3
Matrix	River Water
Analyte	Acenaphthene
Unit	µg/L

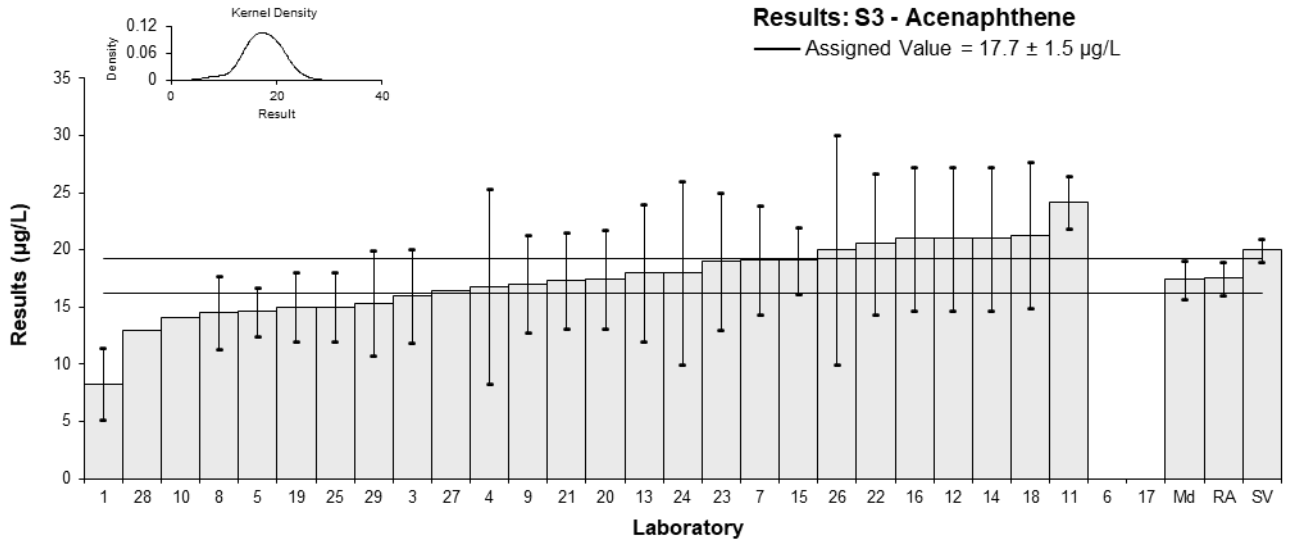
Participant Results

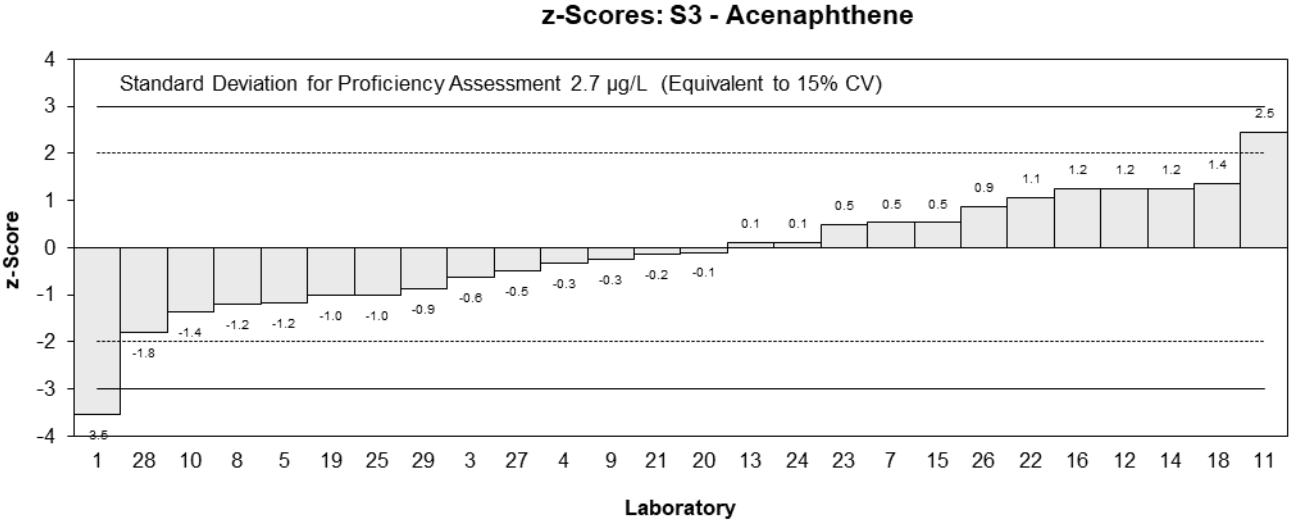
Lab. Code	Result	Uncertainty	z	E_n
1*	8.3	3.1	-3.54	-2.73
3	16.0	4.06	-0.64	-0.39
4	16.8	8.5	-0.34	-0.10
5	14.6	2.1	-1.17	-1.20
6	<0.01	NR		
7	19.1	4.8	0.53	0.28
8	14.5	3.2	-1.21	-0.91
9	17.03	4.26	-0.25	-0.15
10	14.0928	NR	-1.36	-2.40
11	24.2	2.3	2.45	2.37
12	21	6.3	1.24	0.51
13	18	6	0.11	0.05
14	21	6.3	1.24	0.51
15	19.1	2.9	0.53	0.43
16	20.99	6.3	1.24	0.51
17	NS	NS		
18	21.3	6.39	1.36	0.55
19	15	3.0	-1.02	-0.80
20	17.429	4.36	-0.10	-0.06
21	17.3	4.2	-0.15	-0.09
22	20.55	6.17	1.07	0.45
23	19	6	0.49	0.21
24	18	8	0.11	0.04
25	15	3.0	-1.02	-0.80
26	20	10	0.87	0.23
27	16.4015	NR	-0.49	-0.87
28	12.9307	NR	-1.80	-3.18
29	15.36	4.6	-0.88	-0.48

* Outlier, see Section 4.2

Statistics

Assigned Value	17.7	1.5
Spike Value	20.0	1.0
Robust Average	17.5	1.5
Median	17.4	1.7
Mean	17.4	
N	26	
Max	24.2	
Min	8.3	
Robust SD	3.1	
Robust CV	18%	


Kernel Density
Density
0.12
0.06
0
0
20
40
Result
Results: S3 - Acenaphthene
Assigned Value = 17.7 ± 1.5 µg/L
Results (µg/L)
35
30
25
20
15
10
5
0
1 28 10 8 5 19 25 29 3 27 4 9 21 20 13 24 23 7 15 26 22 16 12 14 18 11 6 17 Md RA SV
Laboratory


z-Scores: S3 - Acenaphthene
Standard Deviation for Proficiency Assessment 2.7 µg/L (Equivalent to 15% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-3.6 -1.8 -1.4 -1.2 -1.2 -1.0 -1.0 -0.9 -0.6 -0.5 -0.3 -0.3 -0.2 -0.1 0.1 0.1 0.5 0.5 0.5 0.9 1.1 1.2 1.2 1.2 1.4 2.5
1 28 10 8 5 19 25 29 3 27 4 9 21 20 13 24 23 7 15 26 22 16 12 14 18 11
Laboratory

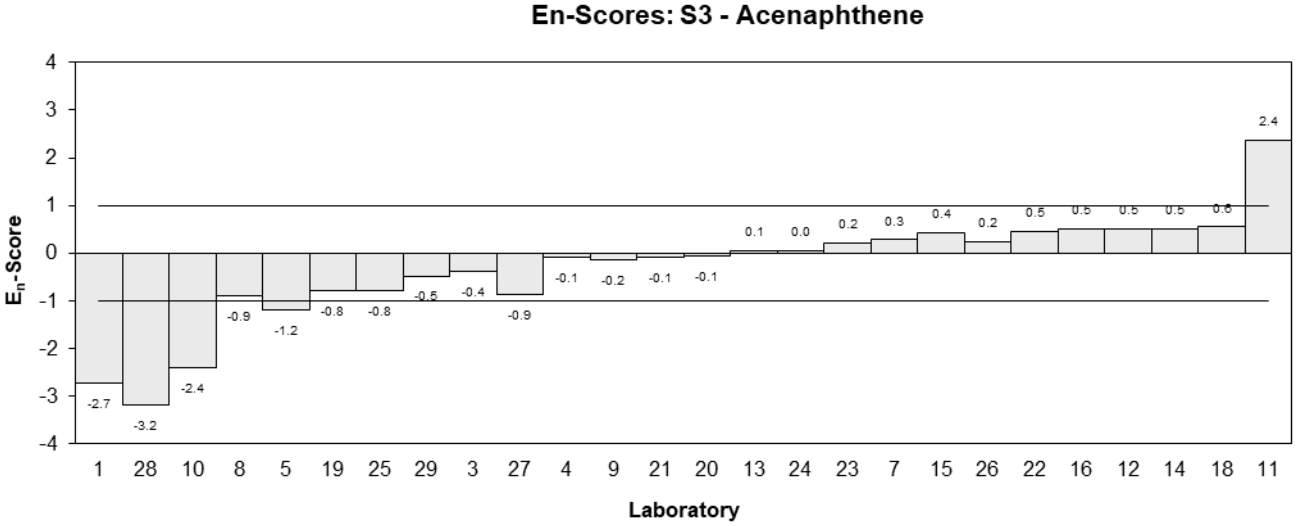

En-Scores: S3 - Acenaphthene
En-Score
4
3
2
1
0
-1
-2
-3
-4
-2.7 -3.2 -2.4 -0.9 -1.2 -0.8 -0.8 -0.5 -0.4 -0.9 -0.1 -0.2 -0.1 -0.1 0.1 0.0 0.2 0.3 0.4 0.2 0.5 0.5 0.5 0.5 0.6 2.4
1 28 10 8 5 19 25 29 3 27 4 9 21 20 13 24 23 7 15 26 22 16 12 14 18 11
Laboratory

Figure 11

Table 18

Sample Details

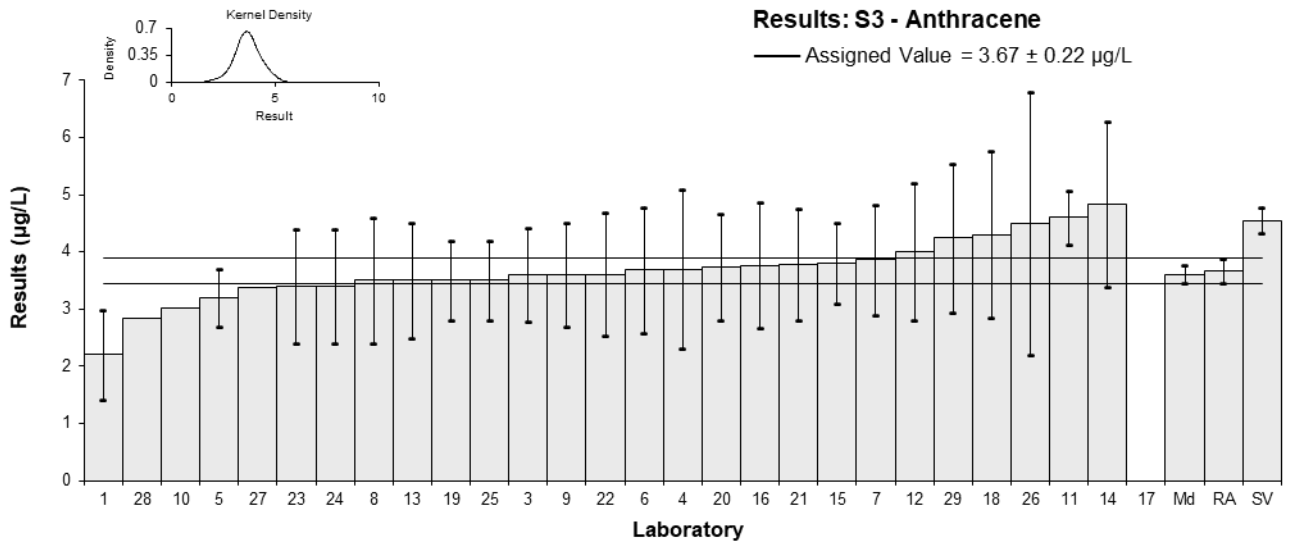
Sample No.	S3
Matrix	River Water
Analyte	Anthracene
Unit	µg/L

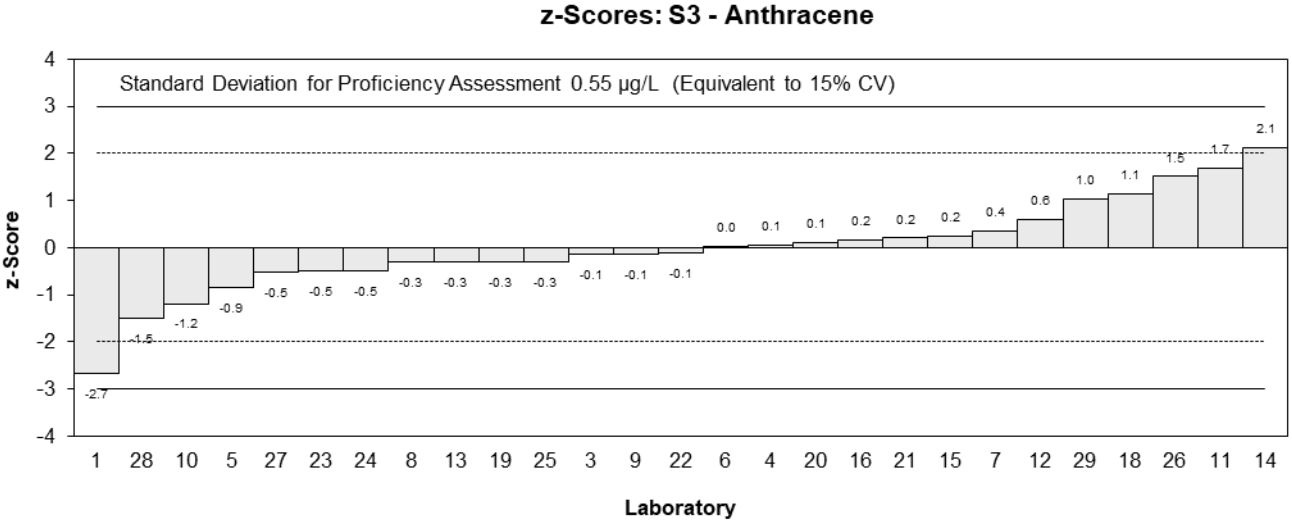
Participant Results

Lab. Code	Result	Uncertainty	z	E_n
1	2.2	0.78	-2.67	-1.81
3	3.6	0.81	-0.13	-0.08
4	3.7	1.4	0.05	0.02
5	3.2	0.5	-0.85	-0.86
6	3.68	1.1	0.02	0.01
7	3.86	0.96	0.35	0.19
8	3.5	1.1	-0.31	-0.15
9	3.6	0.9	-0.13	-0.08
10	3.0144	NR	-1.19	-2.98
11	4.6	0.48	1.69	1.76
12	4.0	1.2	0.60	0.27
13	3.5	1	-0.31	-0.17
14	4.83	1.449	2.11	0.79
15	3.8	0.7	0.24	0.18
16	3.76	1.1	0.16	0.08
17	NS	NS		
18	4.3	1.46	1.14	0.43
19	3.5	0.70	-0.31	-0.23
20	3.728	0.93	0.11	0.06
21	3.78	0.98	0.20	0.11
22	3.61	1.08	-0.11	-0.05
23	3.4	1	-0.49	-0.26
24	3.4	1	-0.49	-0.26
25	3.5	0.7	-0.31	-0.23
26	4.5	2.3	1.51	0.36
27	3.3756	NR	-0.53	-1.34
28	2.8438	NR	-1.50	-3.76
29	4.24	1.3	1.04	0.43

Statistics

Assigned Value	3.67	0.22
Spike Value	4.55	0.23
Robust Average	3.67	0.22
Median	3.61	0.15
Mean	3.67	
N	27	
Max	4.83	
Min	2.2	
Robust SD	0.46	
Robust CV	13%	


Kernel Density
Density
0.7
0.35
0
0
5
10
Result
Results: S3 - Anthracene
Assigned Value = 3.67 ± 0.22 µg/L
Results (µg/L)
0
1
2
3
4
5
6
7
1 28 10 5 27 23 24 8 13 19 25 3 9 22 6 4 20 16 21 15 7 12 29 18 26 11 14 17 Md RA SV
Laboratory


z-Scores: S3 - Anthracene
Standard Deviation for Proficiency Assessment 0.55 µg/L (Equivalent to 15% CV)
z-Score
-4
-3
-2
-1
0
1
2
3
4
-2.7 -1.5 -1.2 -0.9 -0.5 -0.5 -0.5 -0.3 -0.3 -0.3 -0.3 -0.1 -0.1 -0.1 0.0 0.1 0.1 0.2 0.2 0.2 0.4 0.6 1.0 1.1 1.5 1.7 2.1
1 28 10 5 27 23 24 8 13 19 25 3 9 22 6 4 20 16 21 15 7 12 29 18 26 11 14
Laboratory

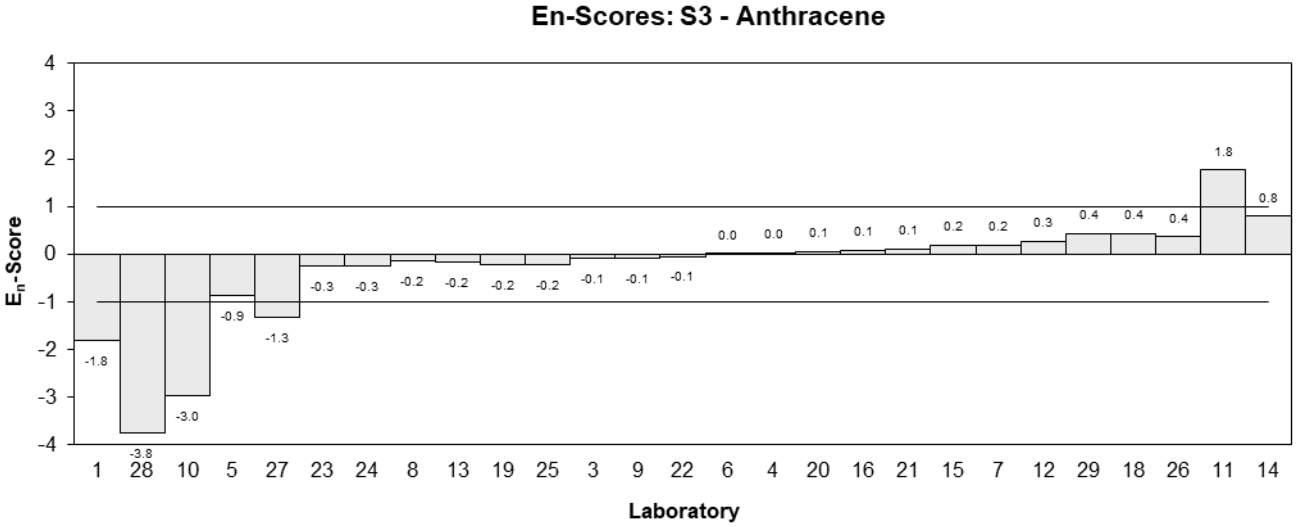

En-Scores: S3 - Anthracene
En-Score
-4
-3
-2
-1
0
1
2
3
4
-1.8 -3.8 -3.0 -0.9 -1.3 -0.3 -0.3 -0.2 -0.2 -0.2 -0.2 -0.1 -0.1 -0.1 0.0 0.0 0.1 0.1 0.1 0.2 0.2 0.3 0.4 0.4 0.4 1.8 0.8
1 28 10 5 27 23 24 8 13 19 25 3 9 22 6 4 20 16 21 15 7 12 29 18 26 11 14
Laboratory

Figure 12

Table 19

Sample Details

Sample No.	S3
Matrix	River Water
Analyte	Benz[*a*]anthracene
Unit	µg/L

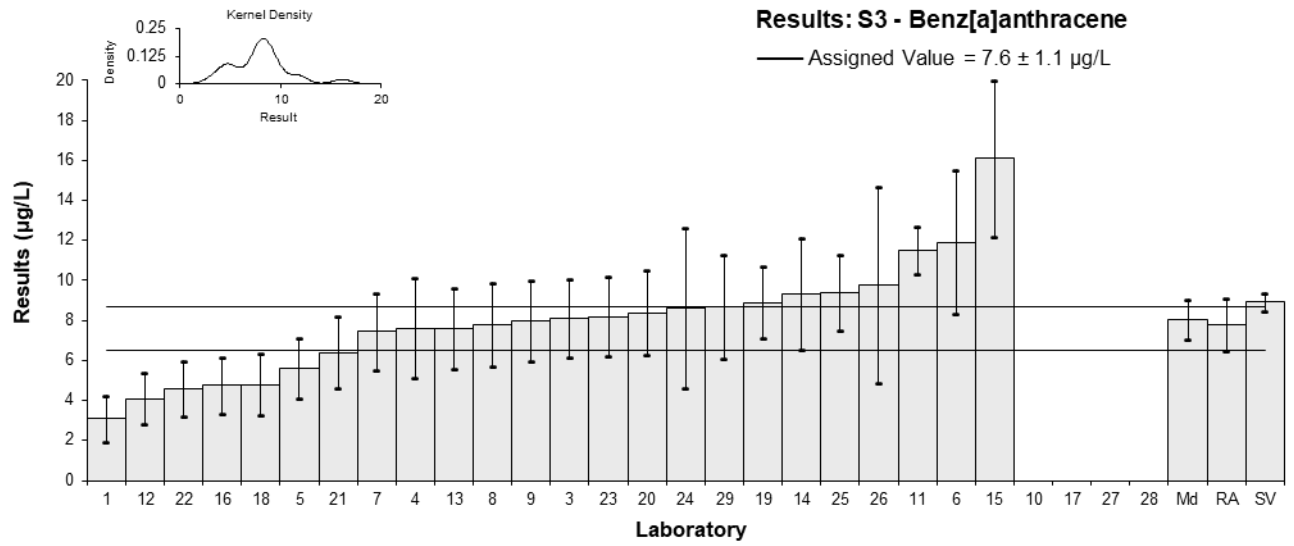
Participant Results

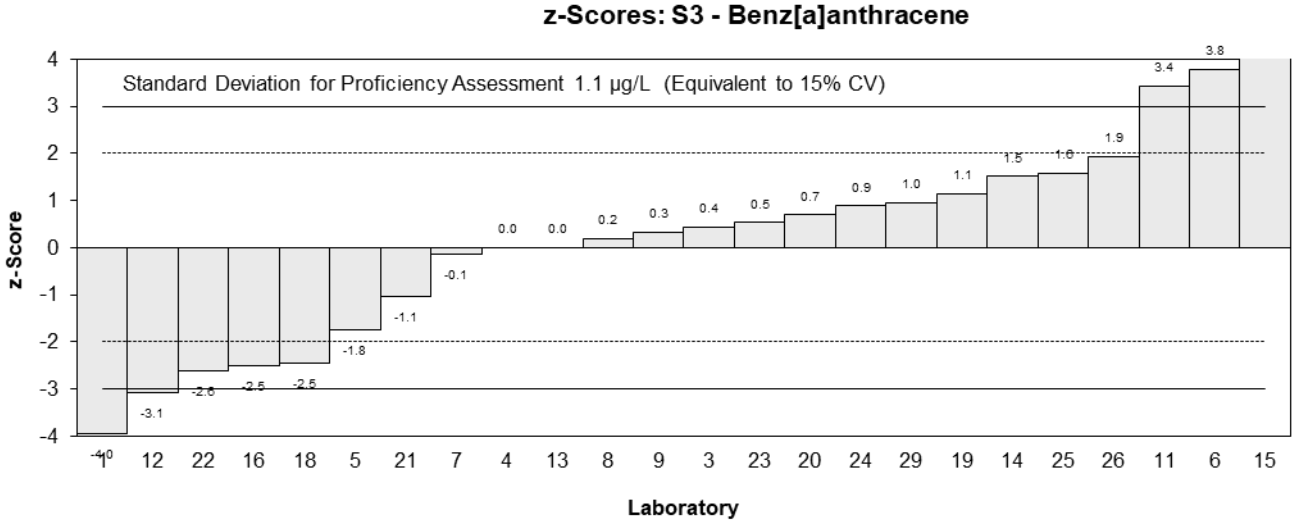
Lab. Code	Result	Uncertainty	z	E_n
1*	3.1	1.16	-3.95	-2.81
3	8.1	1.95	0.44	0.22
4	7.6	2.5	0.00	0.00
5	5.6	1.5	-1.75	-1.08
6*	11.91	3.6	3.78	1.14
7	7.44	1.9	-0.14	-0.07
8	7.8	2.1	0.18	0.08
9	7.98	1.99	0.33	0.17
10	<0.01	NR		
11	11.5	1.2	3.42	2.40
12	4.1	1.3	-3.07	-2.06
13	7.6	2	0.00	0.00
14	9.32	2.796	1.51	0.57
15*	16.1	3.9	7.46	2.10
16	4.75	1.4	-2.50	-1.60
17	NS	NS		
18	4.8	1.54	-2.46	-1.48
19	8.9	1.8	1.14	0.62
20	8.39	2.10	0.69	0.33
21	6.4	1.8	-1.05	-0.57
22	4.6	1.38	-2.63	-1.70
23	8.2	2	0.53	0.26
24	8.6	4	0.88	0.24
25	9.4	1.9	1.58	0.82
26	9.8	4.9	1.93	0.44
27	<0.01	NR		
28	<0.01	NR		
29	8.7	2.6	0.96	0.39

* Outlier, see Section 4.2

Statistics

Assigned Value	7.6	1.1
Spike Value	8.91	0.45
Robust Average	7.8	1.3
Median	8.0	1.0
Mean	7.9	
N	24	
Max	16.1	
Min	3.1	
Robust SD	2.6	
Robust CV	33%	


Kernel Density
Density
Result
Results: S3 - Benz[a]anthracene
Assigned Value = 7.6 ± 1.1 µg/L
Results (µg/L)
Laboratory
1 12 22 16 18 5 21 7 4 13 8 9 3 23 20 24 29 19 14 25 26 11 6 15 10 17 27 28 Md RA SV


z-Scores: S3 - Benz[a]anthracene
Standard Deviation for Proficiency Assessment 1.1 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
1 12 22 16 18 5 21 7 4 13 8 9 3 23 20 24 29 19 14 25 26 11 6 15

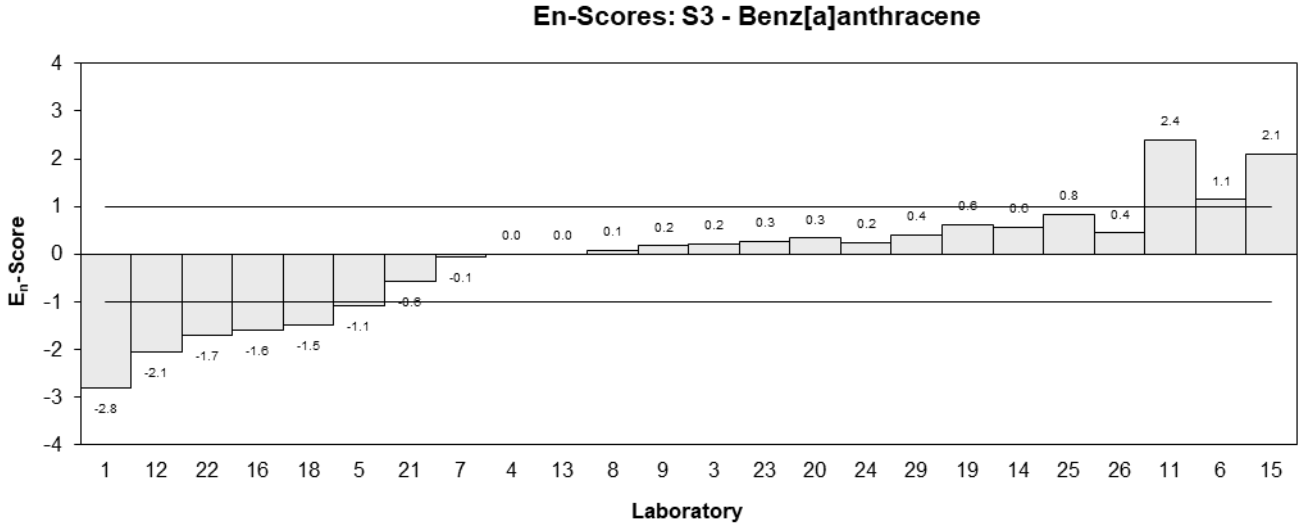

En-Scores: S3 - Benz[a]anthracene
En-Score
Laboratory
1 12 22 16 18 5 21 7 4 13 8 9 3 23 20 24 29 19 14 25 26 11 6 15

Figure 13

Table 20

Sample Details

Sample No.	S3
Matrix	River Water
Analyte	Benzo[*a*]pyrene
Unit	µg/L

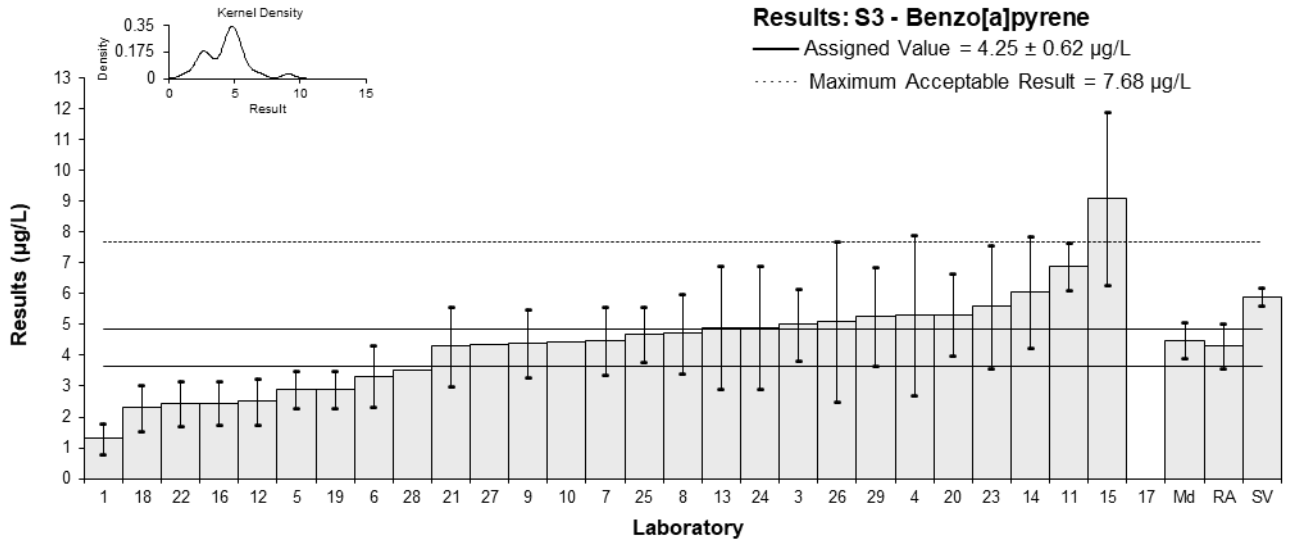
Participant Results

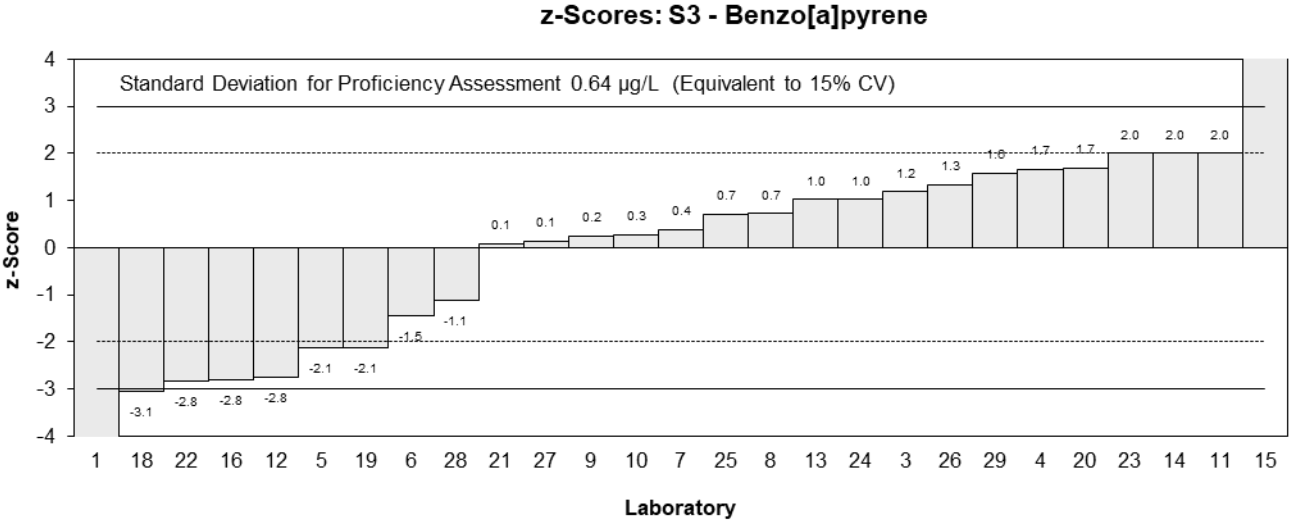
Lab. Code	Result	Uncertainty	z	E_n
1*	1.3	0.5	-4.63	-3.70
3	5.0	1.16	1.18	0.57
4	5.3	2.6	1.65	0.39
5	2.9	0.6	-2.12	-1.56
6	3.32	1	-1.46	-0.79
7	4.49	1.1	0.38	0.19
8	4.71	1.3	0.72	0.32
9	4.4	1.1	0.24	0.12
10	4.4215	NR	0.27	0.28
11*	6.9	0.76	2.00▼	
12	2.5	0.75	-2.75	-1.80
13	4.9	2	1.02	0.31
14	6.07	1.821	2.00▼	
15*	9.1	2.8	7.61	1.69
16	2.45	0.7	-2.82	-1.92
17	NS	NS		
18	2.3	0.74	-3.06	-2.02
19	2.9	0.59	-2.12	-1.58
20	5.32	1.33	1.68	0.73
21	4.3	1.3	0.08	0.03
22	2.44	0.73	-2.84	-1.89
23	5.6	2	2.00▼	
24	4.9	2	1.02	0.31
25	4.7	0.9	0.71	0.41
26	5.1	2.6	1.33	0.32
27	4.3424	NR	0.14	0.15
28	3.5321	NR	-1.13	-1.16
29	5.26	1.6	1.58	0.59

* Outlier, see Section 4.2; ▼ Adjusted Score, see Section 6.3

Statistics

Assigned Value	4.25	0.62
Spike Value	5.91	0.30
Robust Average	4.31	0.71
Max Acceptable Result	7.68	
Median	4.49	0.59
Mean	4.39	
N	27	
Max	9.1	
Min	1.3	
Robust SD	1.5	
Robust CV	34%	


Kernel Density
Density
Result
Results: S3 - Benzo[a]pyrene
Assigned Value = 4.25 ± 0.62 µg/L
Maximum Acceptable Result = 7.68 µg/L
Results (µg/L)
Laboratory
1 18 22 16 12 5 19 6 28 21 27 9 10 7 25 8 13 24 3 26 29 4 20 23 14 11 15 17 Md RA SV


z-Scores: S3 - Benzo[a]pyrene
Standard Deviation for Proficiency Assessment 0.64 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
1 18 22 16 12 5 19 6 28 21 27 9 10 7 25 8 13 24 3 26 29 4 20 23 14 11 15


En-Scores: S3 - Benzo[a]pyrene
En-Score
Laboratory
1 18 22 16 12 5 19 6 28 21 27 9 10 7 25 8 13 24 3 26 29 4 20 23 14 11 15

Figure 14

Table 21

Sample Details

Sample No.	S3
Matrix	River Water
Analyte	Benzo[*b*]fluoranthene
Unit	µg/L

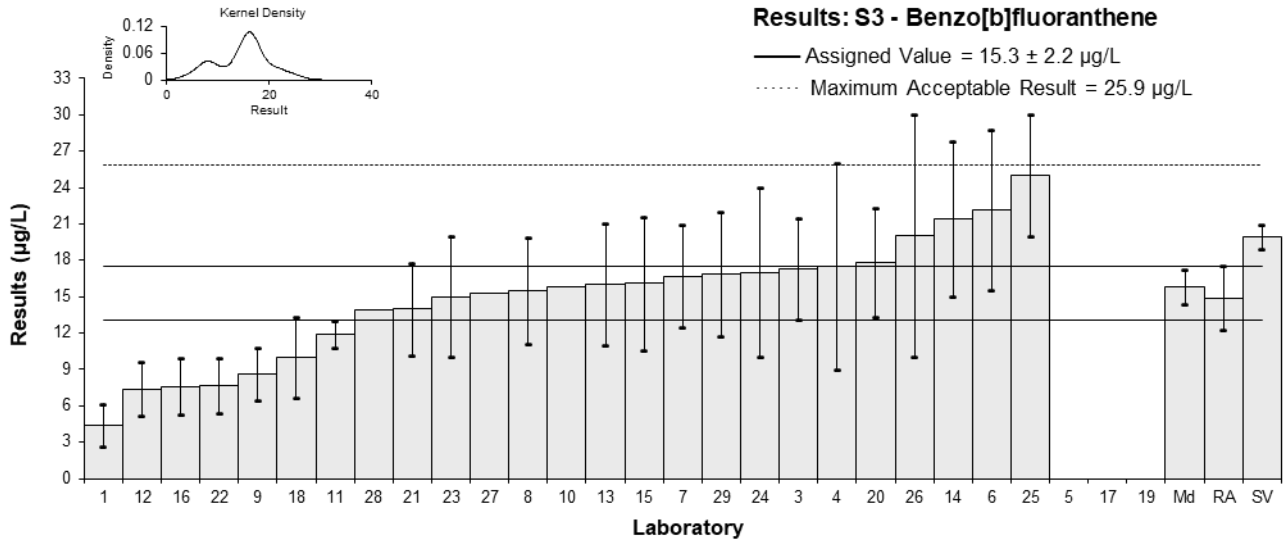
Participant Results

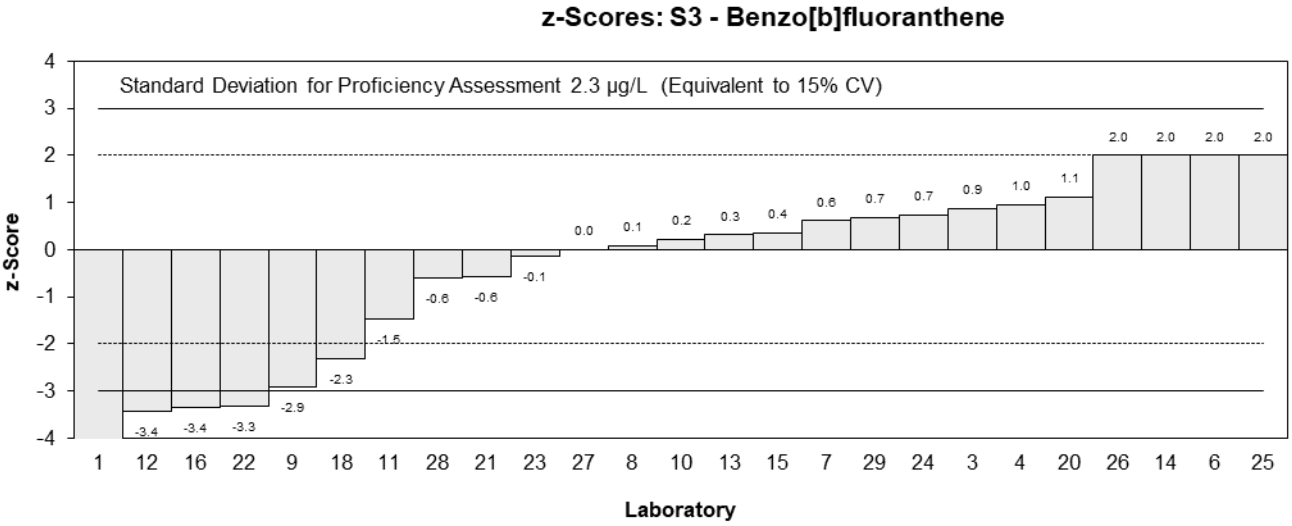
Lab. Code	Result	Uncertainty	z	E_n
1*	4.4	1.75	-4.75	-3.88
3	17.3	4.19	0.87	0.42
4	17.5	8.5	0.96	0.25
5	NT	NT		
6	22.16	6.6	2.00▼	
7	16.7	4.2	0.61	0.30
8	15.5	4.4	0.09	0.04
9	8.6	2.15	-2.92	-2.18
10	15.7883	NR	0.21	0.22
11	11.9	1.1	-1.48	-1.38
12*	7.4	2.2	-3.44	-2.54
13	16	5	0.31	0.13
14	21.4	6.42	2.00▼	
15	16.1	5.5	0.35	0.14
16	7.61	2.3	-3.35	-2.42
17	NS	NS		
18	10	3.3	-2.31	-1.34
19	NT	NT		
20	17.836	4.46	1.11	0.51
21	14	3.8	-0.57	-0.30
22	7.66	2.3	-3.33	-2.40
23	15	5	-0.13	-0.05
24	17	7	0.74	0.23
25*	25	5	2.00▼	
26	20	10	2.00▼	
27	15.3061	NR	0.00	0.00
28	13.927	NR	-0.60	-0.62
29	16.87	5.1	0.68	0.28

* Outlier, see Section 4.2; ▼ Adjusted Score, see Section 6.3

Statistics

Assigned Value	15.3	2.2
Spike Value	19.9	1.0
Robust Average	14.9	2.6
Max Acceptable Result	25.9	
Median	15.8	1.4
Mean	14.8	
N	25	
Max	25	
Min	4.4	
Robust SD	5.3	
Robust CV	36%	


Kernel Density
Density
0.12
0.06
0
0
20
40
Result
Results: S3 - Benzo[b]fluoranthene
Assigned Value = 15.3 ± 2.2 µg/L
Maximum Acceptable Result = 25.9 µg/L
Results (µg/L)
Laboratory
1 12 16 22 9 18 11 28 21 23 27 8 10 13 15 7 29 24 3 4 20 26 14 6 25 5 17 19 Md RA SV


z-Scores: S3 - Benzo[b]fluoranthene
Standard Deviation for Proficiency Assessment 2.3 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
1 12 16 22 9 18 11 28 21 23 27 8 10 13 15 7 29 24 3 4 20 26 14 6 25
-3.4 -3.4 -3.3 -2.9 -2.3 -1.5 -0.6 -0.6 -0.1 0.0 0.1 0.2 0.3 0.4 0.6 0.7 0.7 0.9 1.0 1.1 2.0 2.0 2.0 2.0

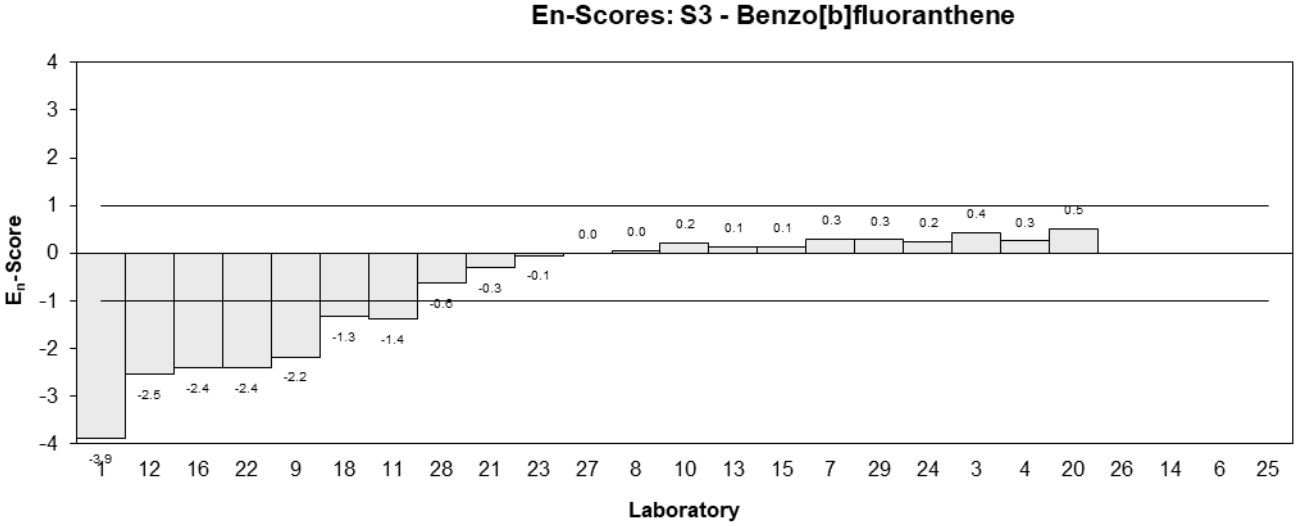

En-Scores: S3 - Benzo[b]fluoranthene
En-Score
Laboratory
1 12 16 22 9 18 11 28 21 23 27 8 10 13 15 7 29 24 3 4 20 26 14 6 25
-3.9 -2.5 -2.4 -2.4 -2.2 -1.3 -1.4 -0.6 -0.3 -0.1 0.0 0.0 0.2 0.1 0.1 0.3 0.3 0.2 0.4 0.3 0.5

Figure 15

Table 22

Sample Details

Sample No.	S3
Matrix	River Water
Analyte	Fluoranthene
Unit	µg/L

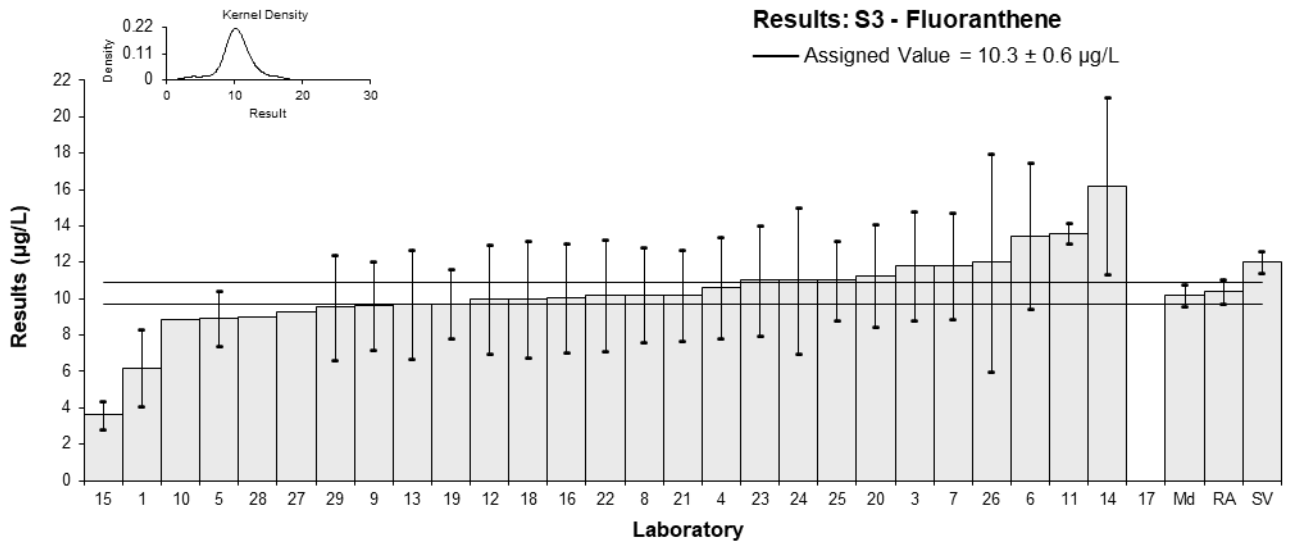
Participant Results

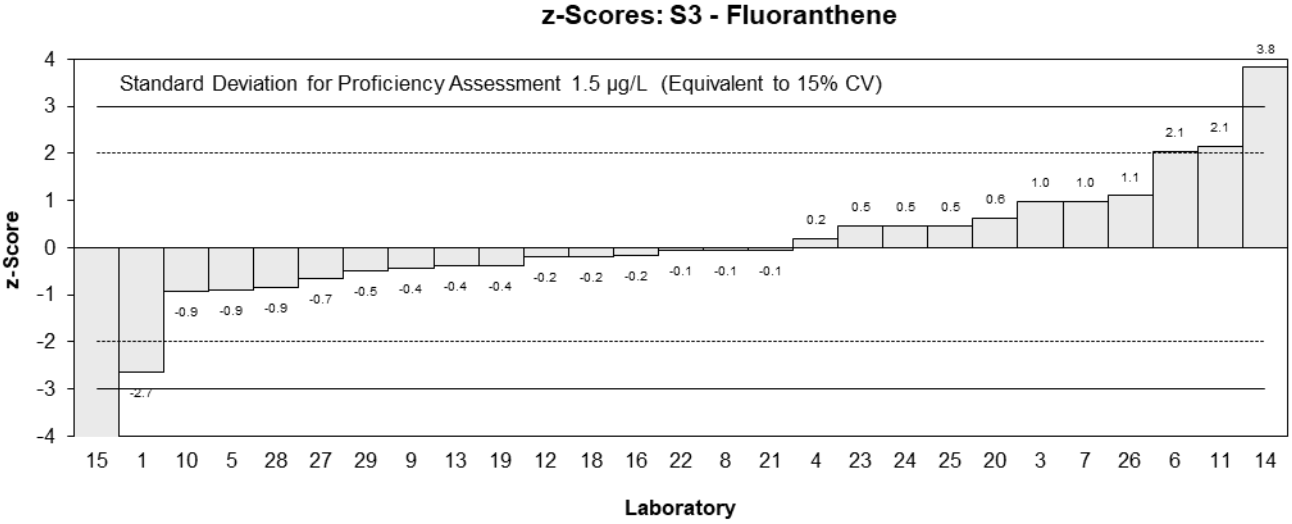
Lab. Code	Result	Uncertainty	z	E_n
1	6.2	2.1	-2.65	-1.88
3	11.8	3.01	0.97	0.49
4	10.6	2.8	0.19	0.10
5	8.9	1.5	-0.91	-0.87
6	13.46	4	2.05	0.78
7	11.8	2.9	0.97	0.51
8	10.2	2.6	-0.06	-0.04
9	9.63	2.41	-0.43	-0.27
10	8.8714	NR	-0.92	-2.38
11	13.6	0.57	2.14	3.99
12	10	3.0	-0.19	-0.10
13	9.7	3	-0.39	-0.20
14*	16.2	4.86	3.82	1.20
15*	3.6	0.76	-4.34	-6.92
16	10.06	3.0	-0.16	-0.08
17	NS	NS		
18	10.0	3.2	-0.19	-0.09
19	9.7	1.9	-0.39	-0.30
20	11.255	2.81	0.62	0.33
21	10.2	2.5	-0.06	-0.04
22	10.19	3.06	-0.07	-0.04
23	11	3	0.45	0.23
24	11	4	0.45	0.17
25	11	2.2	0.45	0.31
26	12	6	1.10	0.28
27	9.3027	NR	-0.65	-1.66
28	8.9651	NR	-0.86	-2.22
29	9.52	2.9	-0.50	-0.26

* Outlier, see Section 4.2

Statistics

Assigned Value	10.3	0.6
Spike Value	12.0	0.6
Robust Average	10.4	0.7
Median	10.2	0.6
Mean	10.3	
N	27	
Max	16.2	
Min	3.6	
Robust SD	1.4	
Robust CV	14%	


Kernel Density
Density
Result
Results: S3 - Fluoranthene
Assigned Value = 10.3 ± 0.6 µg/L
Results (µg/L)
Laboratory
15 1 10 5 28 27 29 9 13 19 12 18 16 22 8 21 4 23 24 25 20 3 7 26 6 11 14 17 Md RA SV


z-Scores: S3 - Fluoranthene
Standard Deviation for Proficiency Assessment 1.5 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
15 1 10 5 28 27 29 9 13 19 12 18 16 22 8 21 4 23 24 25 20 3 7 26 6 11 14

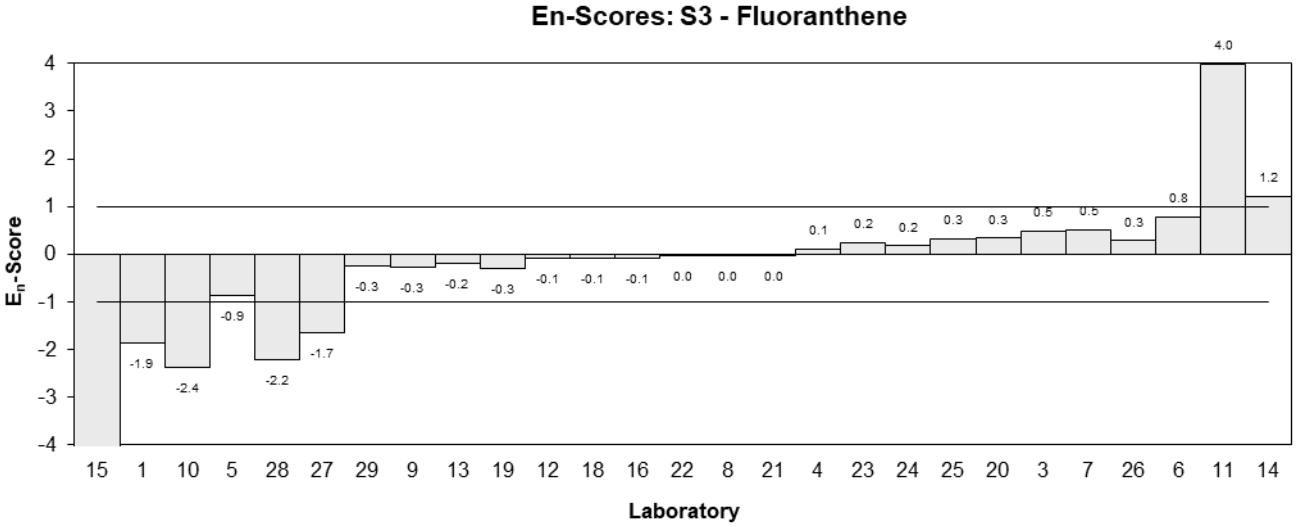

En-Scores: S3 - Fluoranthene
En-Score
Laboratory
15 1 10 5 28 27 29 9 13 19 12 18 16 22 8 21 4 23 24 25 20 3 7 26 6 11 14

Figure 16

Table 23

Sample Details

Sample No.	S3
Matrix	River Water
Analyte	Phenanthrene
Unit	µg/L

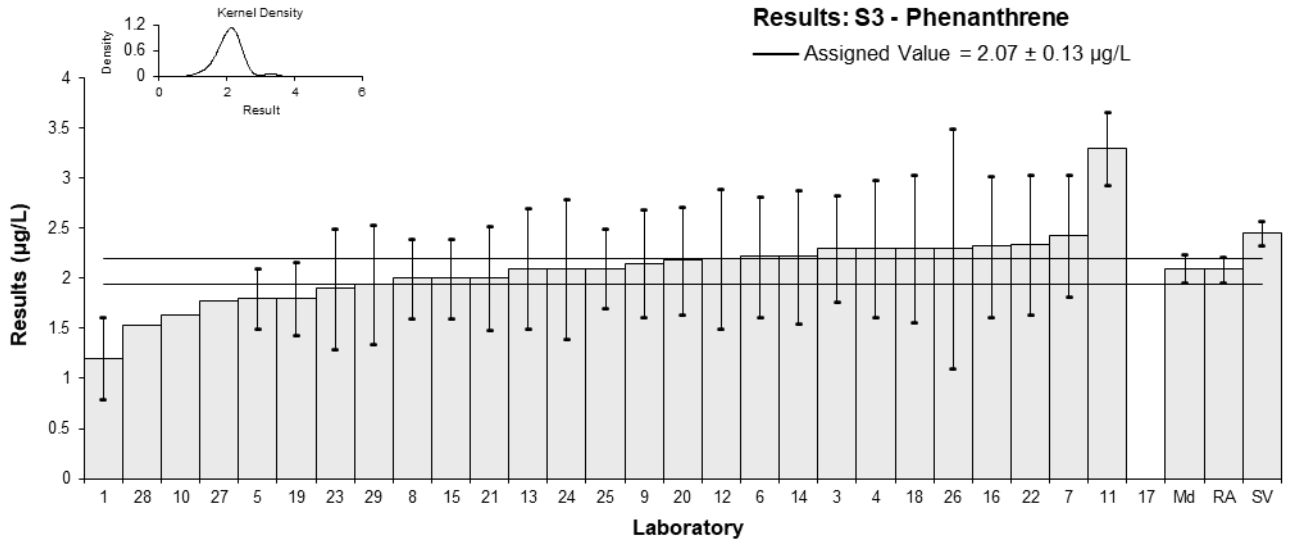
Participant Results

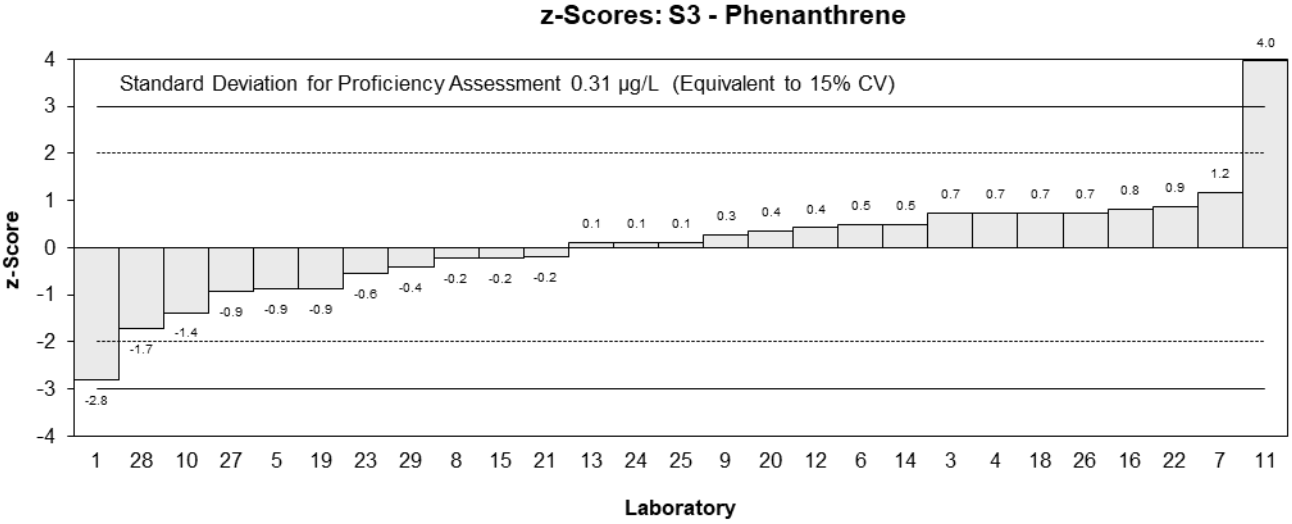
Lab. Code	Result	Uncertainty	z	E_n
1	1.2	0.41	-2.80	-2.02
3	2.3	0.53	0.74	0.42
4	2.3	0.69	0.74	0.33
5	1.8	0.3	-0.87	-0.83
6	2.22	0.6	0.48	0.24
7	2.43	0.61	1.16	0.58
8	2	0.4	-0.23	-0.17
9	2.15	0.54	0.26	0.14
10	1.6406	NR	-1.38	-3.30
11*	3.3	0.36	3.96	3.21
12	2.2	0.70	0.42	0.18
13	2.1	0.6	0.10	0.05
14	2.22	0.666	0.48	0.22
15	2	0.4	-0.23	-0.17
16	2.32	0.7	0.81	0.35
17	NS	NS		
18	2.3	0.74	0.74	0.31
19	1.8	0.37	-0.87	-0.69
20	2.179	0.54	0.35	0.20
21	2.01	0.52	-0.19	-0.11
22	2.34	0.7	0.87	0.38
23	1.9	0.6	-0.55	-0.28
24	2.1	0.7	0.10	0.04
25	2.1	0.4	0.10	0.07
26	2.3	1.2	0.74	0.19
27	1.7785	NR	-0.94	-2.24
28	1.5332	NR	-1.73	-4.13
29	1.94	0.6	-0.42	-0.21

* Outlier, see Section 4.2

Statistics

Assigned Value	2.07	0.13
Spike Value	2.45	0.12
Robust Average	2.09	0.13
Median	2.10	0.14
Mean	2.09	
N	27	
Max	3.3	
Min	1.2	
Robust SD	0.27	
Robust CV	13%	


Kernel Density
Density
Result
Results: S3 - Phenanthrene
Assigned Value = 2.07 ± 0.13 µg/L
Results (µg/L)
Laboratory
1 28 10 27 5 19 23 29 8 15 21 13 24 25 9 20 12 6 14 3 4 18 26 16 22 7 11 17 Md RA SV


z-Scores: S3 - Phenanthrene
Standard Deviation for Proficiency Assessment 0.31 µg/L (Equivalent to 15% CV)
z-Score
Laboratory
1 28 10 27 5 19 23 29 8 15 21 13 24 25 9 20 12 6 14 3 4 18 26 16 22 7 11

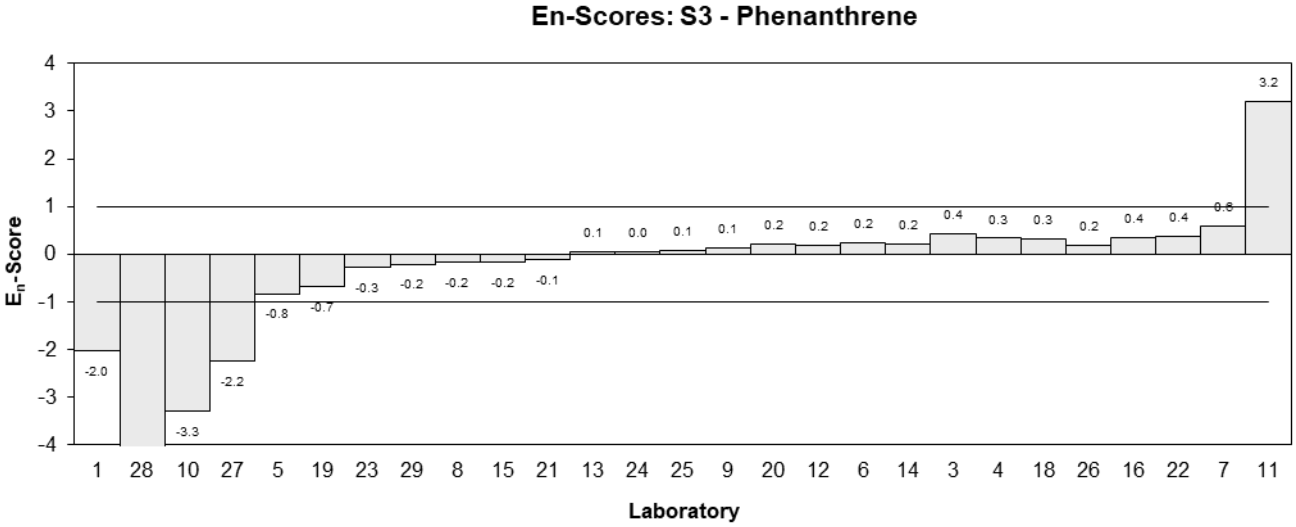

En-Scores: S3 - Phenanthrene
En-Score
Laboratory
1 28 10 27 5 19 23 29 8 15 21 13 24 25 9 20 12 6 14 3 4 18 26 16 22 7 11

Figure 17

Table 24

Sample Details

Sample No.	S3
Matrix	River Water
Analyte	Pyrene
Unit	µg/L

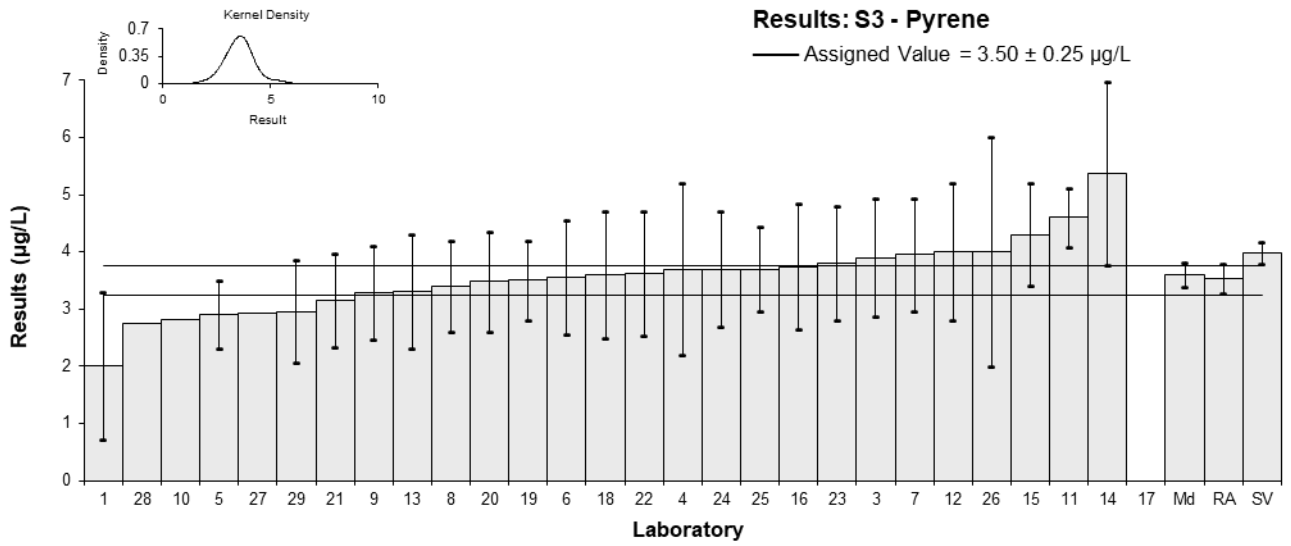
Participant Results

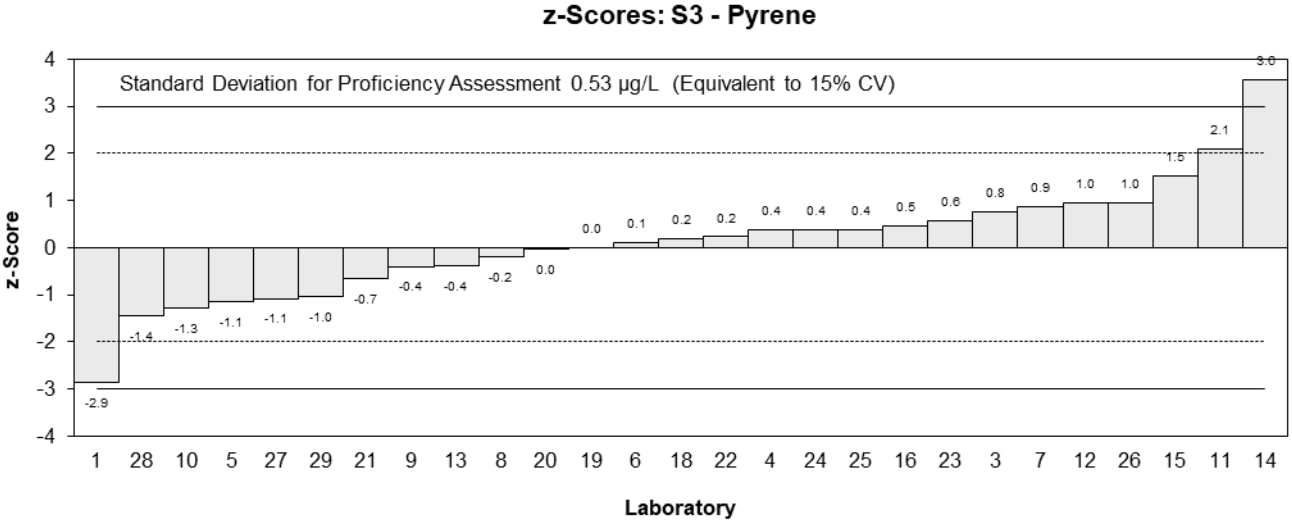
Lab. Code	Result	Uncertainty	z	E_n
1	2	1.29	-2.86	-1.14
3	3.9	1.04	0.76	0.37
4	3.7	1.5	0.38	0.13
5	2.9	0.6	-1.14	-0.92
6	3.56	1	0.11	0.06
7	3.95	0.99	0.86	0.44
8	3.4	0.8	-0.19	-0.12
9	3.29	0.82	-0.40	-0.24
10	2.8232	NR	-1.29	-2.71
11	4.6	0.51	2.10	1.94
12	4.0	1.2	0.95	0.41
13	3.3	1	-0.38	-0.19
14*	5.37	1.611	3.56	1.15
15	4.3	0.9	1.52	0.86
16	3.74	1.1	0.46	0.21
17	NS	NS		
18	3.6	1.12	0.19	0.09
19	3.5	0.70	0.00	0.00
20	3.483	0.87	-0.03	-0.02
21	3.16	0.82	-0.65	-0.40
22	3.62	1.08	0.23	0.11
23	3.8	1	0.57	0.29
24	3.7	1	0.38	0.19
25	3.7	0.74	0.38	0.26
26	4	2	0.95	0.25
27	2.9316	NR	-1.08	-2.27
28	2.7465	NR	-1.44	-3.01
29	2.96	0.9	-1.03	-0.58

* Outlier, see Section 4.2

Statistics

Assigned Value	3.50	0.25
Spike Value	3.98	0.20
Robust Average	3.54	0.26
Median	3.60	0.22
Mean	3.56	
N	27	
Max	5.37	
Min	2	
Robust SD	0.55	
Robust CV	15%	


Kernel Density
Density
0.7
0.35
0
0
5
10
Result
Results: S3 - Pyrene
Assigned Value = 3.50 ± 0.25 µg/L
Results (µg/L)
0
1
2
3
4
5
6
7
1 28 10 5 27 29 21 9 13 8 20 19 6 18 22 4 24 25 16 23 3 7 12 26 15 11 14 17 Md RA SV
Laboratory


z-Scores: S3 - Pyrene
Standard Deviation for Proficiency Assessment 0.53 µg/L (Equivalent to 15% CV)
z-Score
-4
-3
-2
-1
0
1
2
3
4
-2.9 -1.4 -1.3 -1.1 -1.1 -1.0 -0.7 -0.4 -0.4 -0.2 0.0 0.1 0.2 0.2 0.4 0.4 0.4 0.5 0.6 0.8 0.9 1.0 1.0 1.5 2.1 3.0
1 28 10 5 27 29 21 9 13 8 20 19 6 18 22 4 24 25 16 23 3 7 12 26 15 11 14
Laboratory

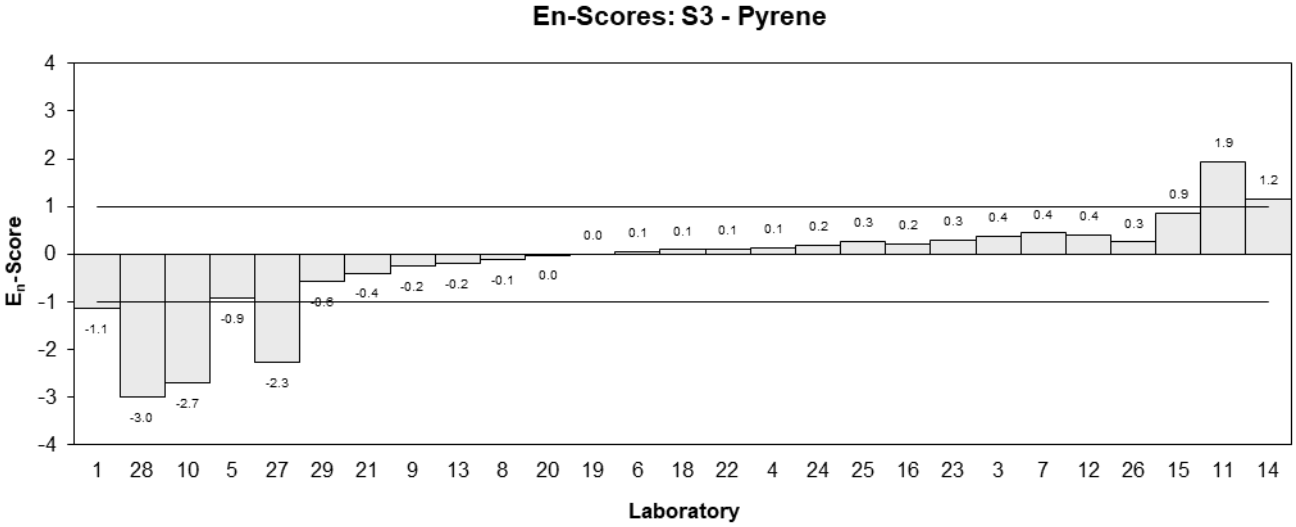

En-Scores: S3 - Pyrene
En-Score
-4
-3
-2
-1
0
1
2
3
4
-1.1 -3.0 -2.7 -0.9 -2.3 -0.6 -0.4 -0.2 -0.2 -0.1 0.0 0.0 0.1 0.1 0.1 0.1 0.2 0.3 0.2 0.3 0.4 0.4 0.4 0.3 0.9 1.9 1.2
1 28 10 5 27 29 21 9 13 8 20 19 6 18 22 4 24 25 16 23 3 7 12 26 15 11 14
Laboratory

Figure 18

Table 25

Sample Details

Sample No.	S4
Matrix	River Water
Analyte	Phenol
Unit	µg/L

Participant Results

Lab. Code	Result	Uncertainty
1	< 1.0	NR
3	<1.0	NR
4	<0.5	NR
5	<1.0	NR
6	0.5	0.15
7	0.56	0.14
8	<1.0	NR
9	1.41	0.28
10	0.656	NR
11	<2	NR
12	<3	NR
13	<1	NR
14	<0.00200	NR
15	<10	NR
16	< 3	NR
17	NS	NS
18	< 3	NR
19	<1	NR
20	1.467	0.29
21	<1	NR
22	< 3	NR
23	<1	NR
24	<1	NR
25	< 1	NR
26	< 5.1	NR
27	0.2757	NR
28	0.4375	NR
29	NS	NS

Statistics

Assigned Value	Not Set	
Spike Value	Not Spiked	
Robust Average	0.76	0.51
Median	0.56	0.17
Mean	0.76	
N	7	
Max	1.467	
Min	0.2757	
Robust SD	0.54	
Robust CV	72%	

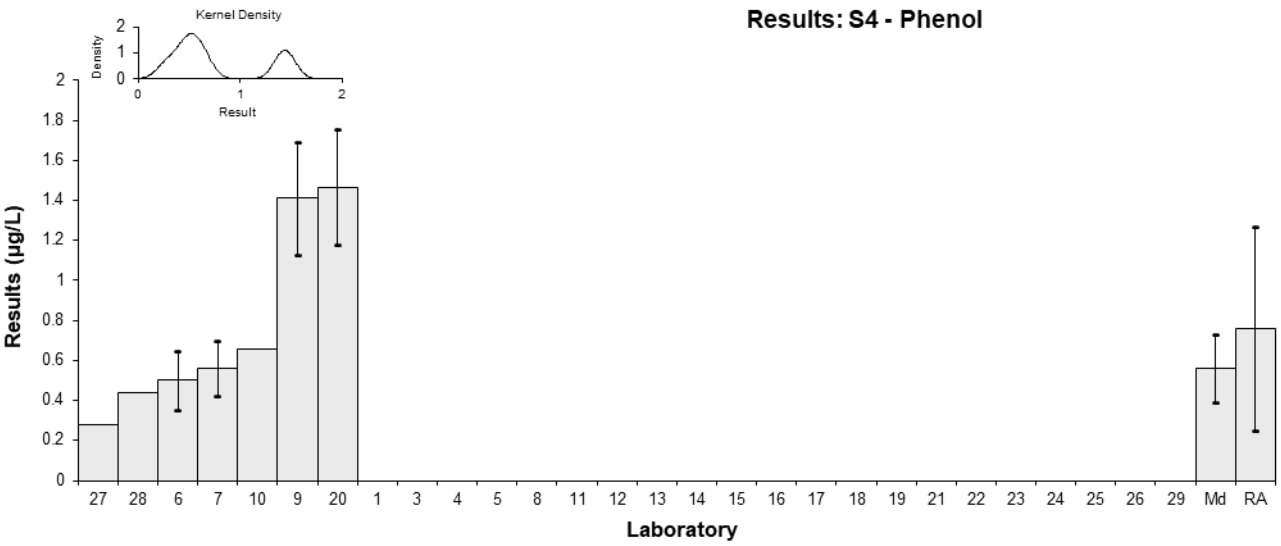

Results: S4 - Phenol
Kernel Density
Density
Result
Results (µg/L)
Laboratory
27 28 6 7 10 9 20 1 3 4 5 8 11 12 13 14 15 16 17 18 19 21 22 23 24 25 26 29 Md RA

Figure 19

Table 26

Sample Details

Sample No.	S4
Matrix	River Water
Analyte	2-Methylphenol
Unit	µg/L

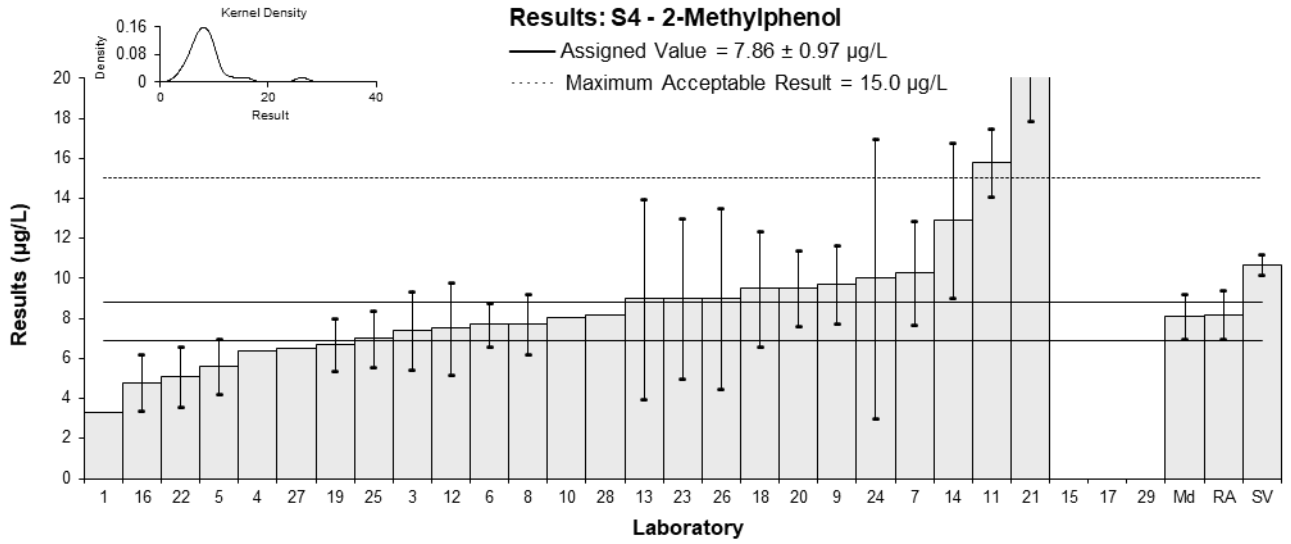
Participant Results

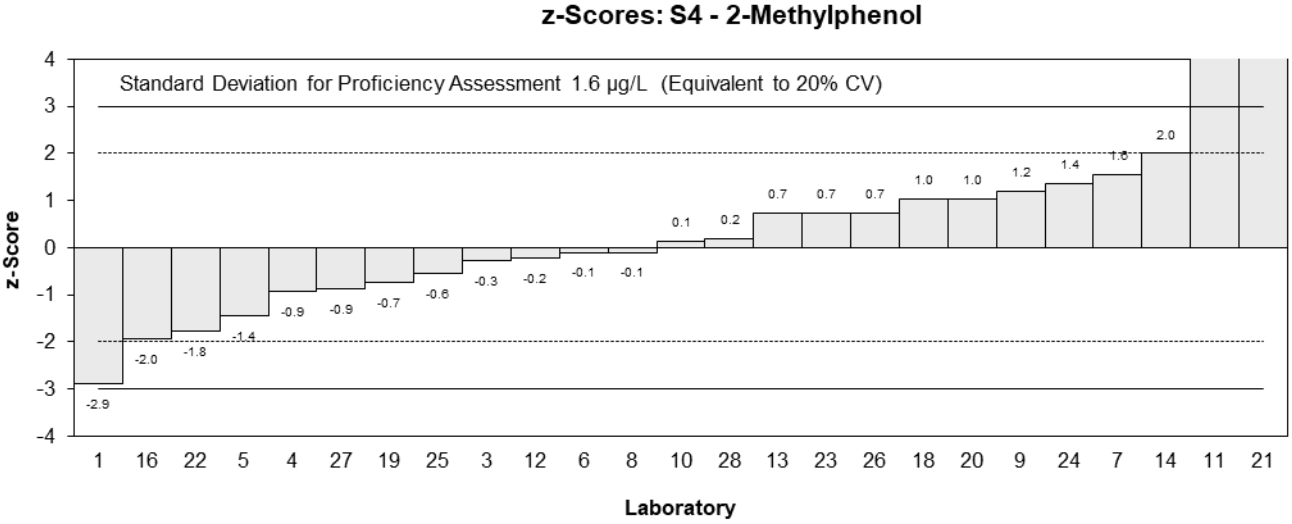
Lab. Code	Result	Uncertainty	z	E_n
1*	3.3	NR	-2.90	-4.70
3	7.4	1.98	-0.29	-0.21
4	6.4	NR	-0.93	-1.51
5	5.6	1.4	-1.44	-1.33
6	7.7	1.1	-0.10	-0.11
7	10.3	2.6	1.55	0.88
8	7.7	1.5	-0.10	-0.09
9	9.73	1.95	1.19	0.86
10	8.0619	NR	0.13	0.21
11*	15.8	1.7	5.05	4.06
12	7.5	2.3	-0.23	-0.14
13	9	5	0.73	0.22
14*	12.9	3.87	2.00▼	
15	NT	NT		
16	4.8	1.4	-1.95	-1.80
17	NS	NS		
18	9.5	2.9	1.04	0.54
19	6.7	1.3	-0.74	-0.72
20	9.5	1.9	1.04	0.77
21*	26.3	8.4	11.73	2.18
22	5.08	1.52	-1.77	-1.54
23	9	4	0.73	0.28
24	10	7	1.36	0.30
25	7	1.4	-0.55	-0.50
26	9	4.5	0.73	0.25
27	6.4997	NR	-0.87	-1.40
28	8.1653	NR	0.19	0.31
29	NS	NS		

* Outlier, see Section 4.2; ▼ Adjusted Score, see Section 6.3

Statistics

Assigned Value	7.86	0.97
Spike Value	10.7	0.5
Robust Average	8.2	1.2
Max Acceptable Result	15.0	
Median	8.1	1.1
Mean	8.9	
N	25	
Max	26.3	
Min	3.3	
Robust SD	2.4	
Robust CV	29%	


Kernel Density
Density
0.16
0.08
0
0
20
40
Result
Results: S4 - 2-Methylphenol
Assigned Value = 7.86 ± 0.97 µg/L
Maximum Acceptable Result = 15.0 µg/L
Results (µg/L)
Laboratory
1 16 22 5 4 27 19 25 3 12 6 8 10 28 13 23 26 18 20 9 24 7 14 11 21 15 17 29 Md RA SV


z-Scores: S4 - 2-Methylphenol
Standard Deviation for Proficiency Assessment 1.6 µg/L (Equivalent to 20% CV)
z-Score
-2.9 -2.0 -1.8 -1.4 -0.9 -0.9 -0.7 -0.6 -0.3 -0.2 -0.1 -0.1 0.1 0.2 0.7 0.7 0.7 1.0 1.0 1.2 1.4 1.6 2.0
Laboratory
1 16 22 5 4 27 19 25 3 12 6 8 10 28 13 23 26 18 20 9 24 7 14 11 21

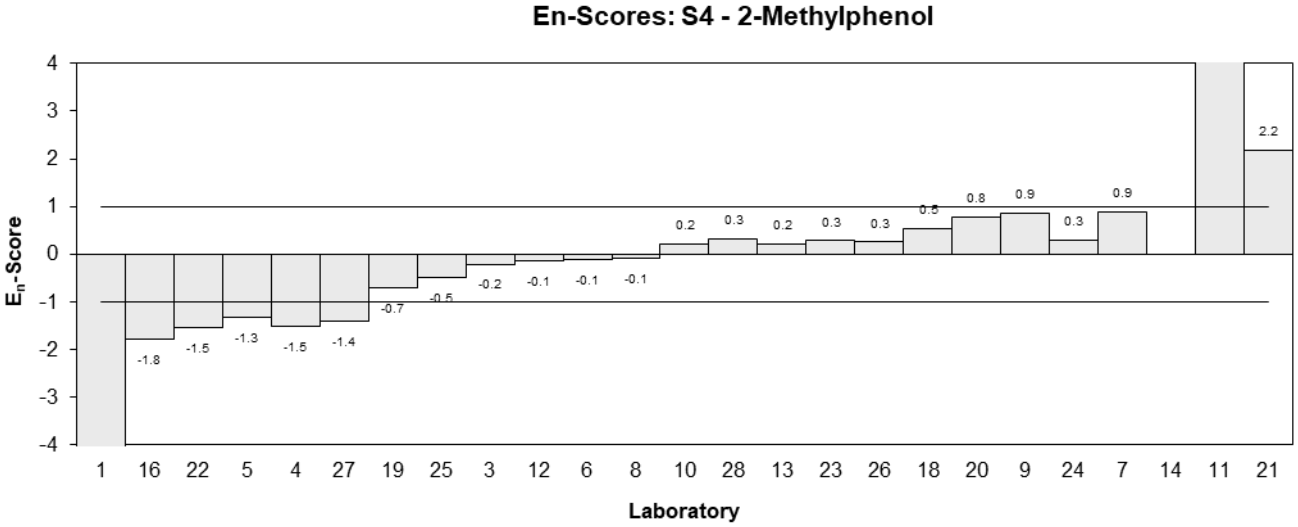

En-Scores: S4 - 2-Methylphenol
En-Score
-1.8 -1.5 -1.3 -1.5 -1.4 -0.7 -0.5 -0.2 -0.1 -0.1 -0.1 0.2 0.3 0.2 0.3 0.3 0.5 0.8 0.9 0.3 0.9 2.2
Laboratory
1 16 22 5 4 27 19 25 3 12 6 8 10 28 13 23 26 18 20 9 24 7 14 11 21

Figure 20

Table 27

Sample Details

Sample No.	S4
Matrix	River Water
Analyte	3 & 4-Methylphenols (total)
Unit	µg/L

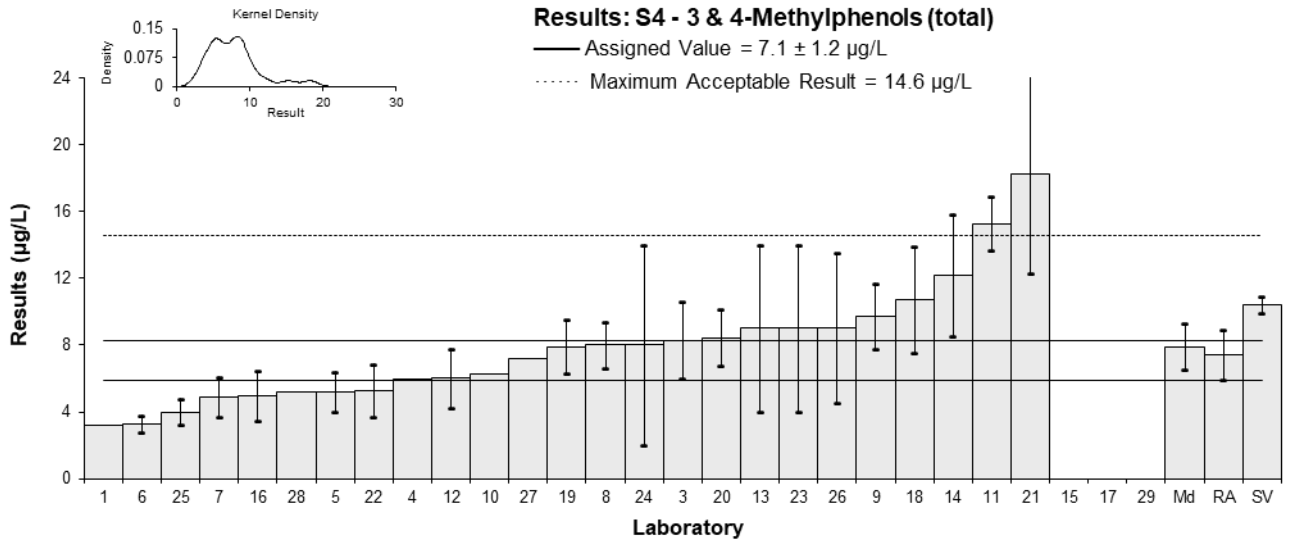
Participant Results

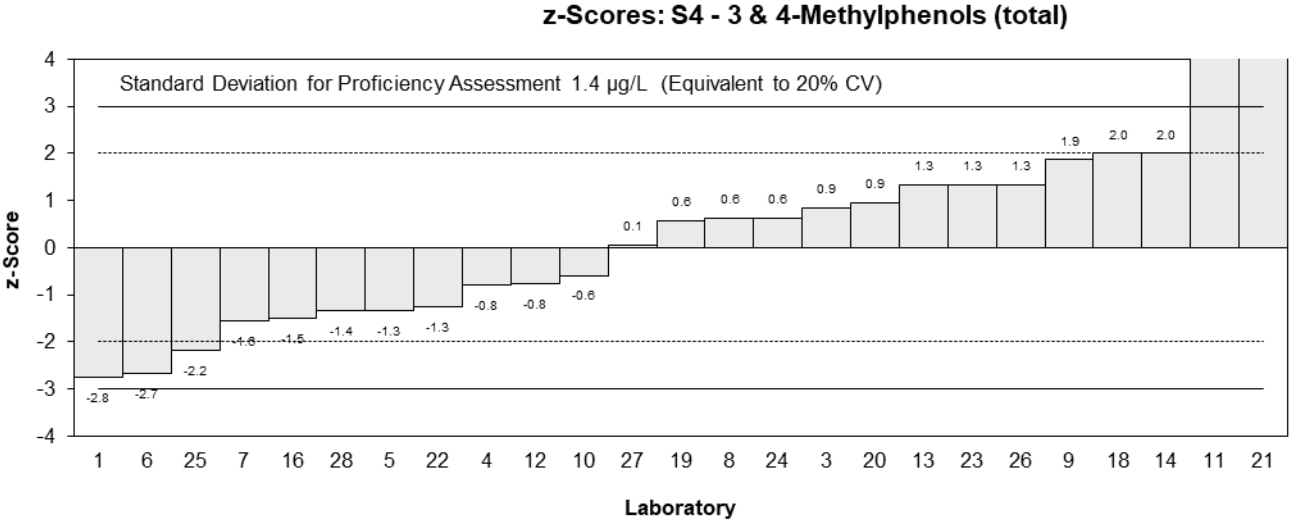
Lab. Code	Result	Uncertainty	z	E_n
1*	3.2	NR	-2.75	-3.25
3	8.3	2.28	0.85	0.47
4	5.96	NR	-0.80	-0.95
5	5.2	1.2	-1.34	-1.12
6*	3.3	0.5	-2.68	-2.92
7	4.88	1.2	-1.56	-1.31
8	8	1.4	0.63	0.49
9	9.74	1.95	1.86	1.15
10	6.2663	NR	-0.59	-0.69
11*	15.3	1.6	5.77	4.10
12	6	1.8	-0.77	-0.51
13	9	5	1.34	0.37
14*	12.2	3.66	2.00▼	
15	NT	NT		
16	4.95	1.5	-1.51	-1.12
17	NS	NS		
18	10.7	3.2	2.00▼	
19	7.9	1.6	0.56	0.40
20	8.433	1.69	0.94	0.64
21*	18.3	6	7.89	1.83
22	5.29	1.59	-1.27	-0.91
23	9	5	1.34	0.37
24	8	6	0.63	0.15
25	4	0.8	-2.18	-2.15
26	9	4.5	1.34	0.41
27	7.1775	NR	0.05	0.06
28	5.1869	NR	-1.35	-1.59
29	NS	NS		

* Outlier, see Section 4.2; ▼ Adjusted Score, see Section 6.3

Statistics

Assigned Value	7.1	1.2
Spike Value	10.4	0.5
Robust Average	7.4	1.5
Max Acceptable Result	14.6	
Median	7.9	1.4
Mean	7.8	
N	25	
Max	18.3	
Min	3.2	
Robust SD	3.0	
Robust CV	40%	


Kernel Density
Density
Result
Results: S4 - 3 & 4-Methylphenols (total)
Assigned Value = 7.1 ± 1.2 µg/L
Maximum Acceptable Result = 14.6 µg/L
Results (µg/L)
Laboratory
1 6 25 7 16 28 5 22 4 12 10 27 19 8 24 3 20 13 23 26 9 18 14 11 21 15 17 29 Md RA SV


z-Scores: S4 - 3 & 4-Methylphenols (total)
Standard Deviation for Proficiency Assessment 1.4 µg/L (Equivalent to 20% CV)
z-Score
Laboratory
1 6 25 7 16 28 5 22 4 12 10 27 19 8 24 3 20 13 23 26 9 18 14 11 21

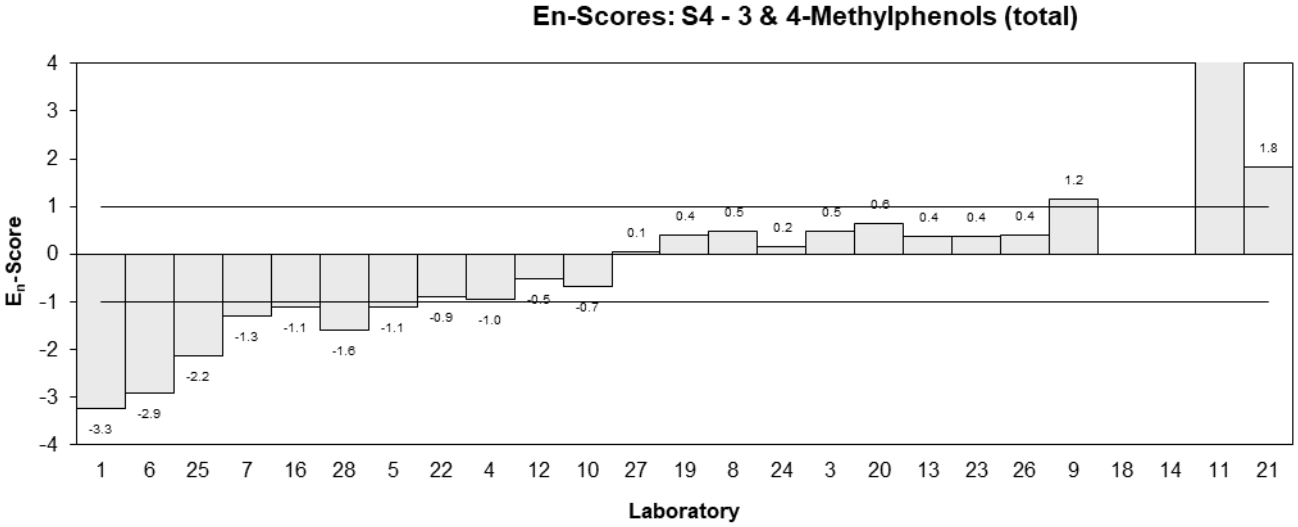

En-Scores: S4 - 3 & 4-Methylphenols (total)
En-Score
Laboratory
1 6 25 7 16 28 5 22 4 12 10 27 19 8 24 3 20 13 23 26 9 18 14 11 21

Figure 21

Table 28

Sample Details

Sample No.	S4
Matrix	River Water
Analyte	2,4-Dichlorophenol
Unit	µg/L

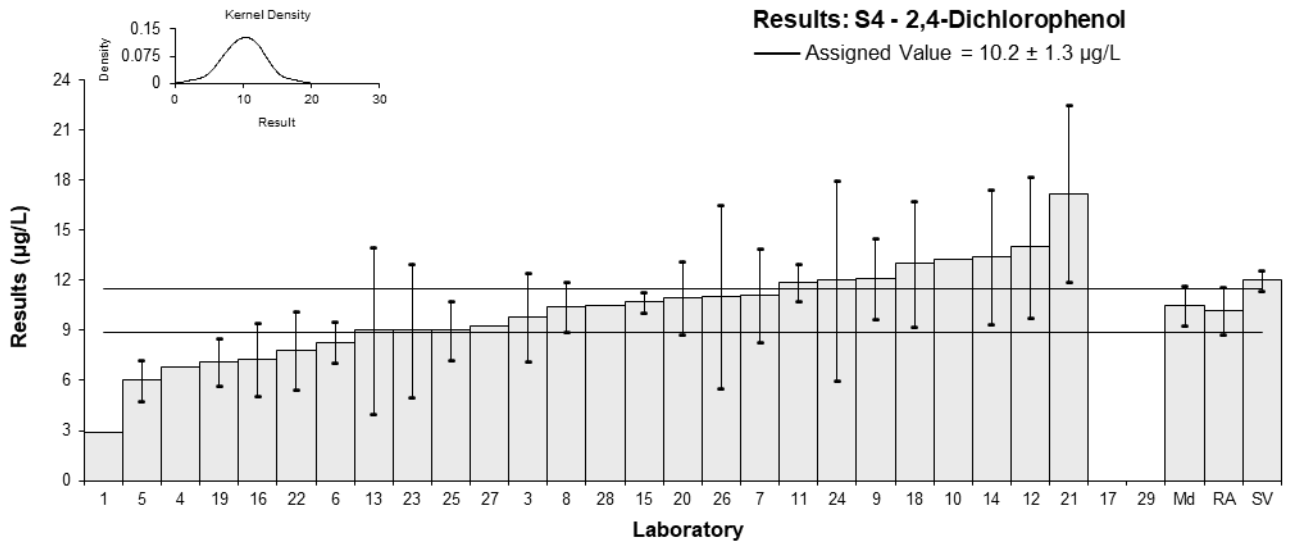
Participant Results

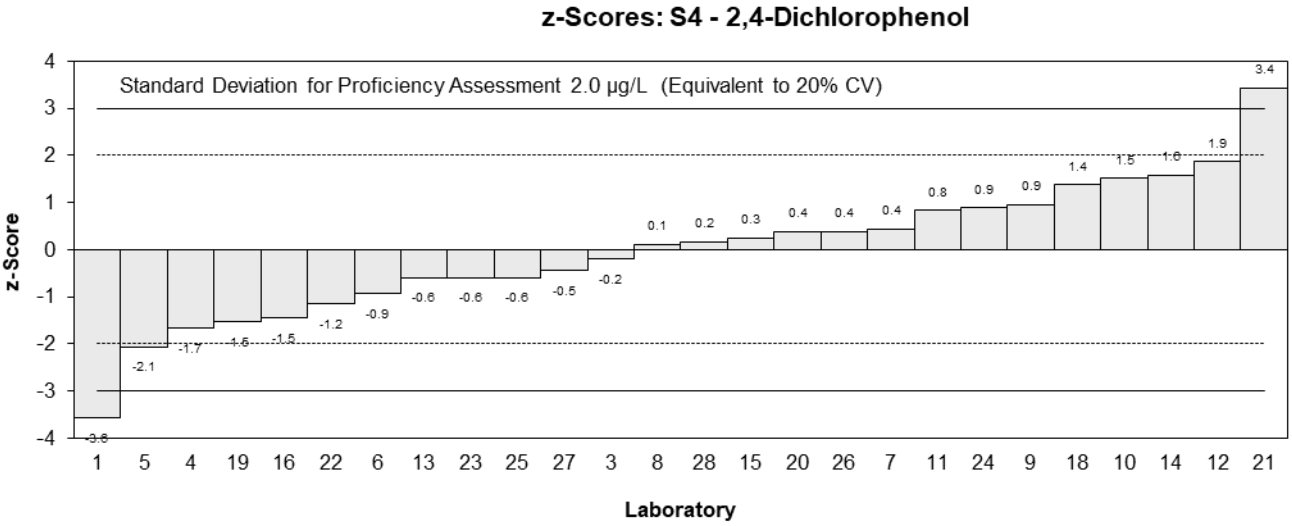
Lab. Code	Result	Uncertainty	z	E_n
1*	2.9	NR	-3.58	-5.62
3	9.8	2.67	-0.20	-0.13
4	6.8	NR	-1.67	-2.62
5	6.0	1.2	-2.06	-2.37
6	8.3	1.2	-0.93	-1.07
7	11.1	2.8	0.44	0.29
8	10.4	1.5	0.10	0.10
9	12.11	2.42	0.94	0.70
10	13.2853	NR	1.51	2.37
11	11.9	1.1	0.83	1.00
12	14	4.2	1.86	0.86
13	9	5	-0.59	-0.23
14	13.4	4.02	1.57	0.76
15	10.7	0.6	0.25	0.35
16	7.25	2.2	-1.45	-1.15
17	NS	NS		
18	13	3.8	1.37	0.70
19	7.1	1.4	-1.52	-1.62
20	10.967	2.19	0.38	0.30
21*	17.2	5.3	3.43	1.28
22	7.83	2.35	-1.16	-0.88
23	9	4	-0.59	-0.29
24	12	6	0.88	0.29
25	9	1.8	-0.59	-0.54
26	11	5.5	0.39	0.14
27	9.2775	NR	-0.45	-0.71
28	10.5206	NR	0.16	0.25
29	NS	NS		

* Outlier, see Section 4.2

Statistics

Assigned Value	10.2	1.3
Spike Value	12.0	0.6
Robust Average	10.2	1.4
Median	10.5	1.2
Mean	10.1	
N	26	
Max	17.2	
Min	2.9	
Robust SD	2.8	
Robust CV	27%	


Results: S4 - 2,4-Dichlorophenol
Assigned Value = 10.2 ± 1.3 µg/L
Kernel Density
Density
Result
Results (µg/L)
Laboratory
1 5 4 19 16 22 6 13 23 25 27 3 8 28 15 20 26 7 11 24 9 18 10 14 12 21 17 29 Md RA SV


z-Scores: S4 - 2,4-Dichlorophenol
Standard Deviation for Proficiency Assessment 2.0 µg/L (Equivalent to 20% CV)
z-Score
Laboratory
1 5 4 19 16 22 6 13 23 25 27 3 8 28 15 20 26 7 11 24 9 18 10 14 12 21

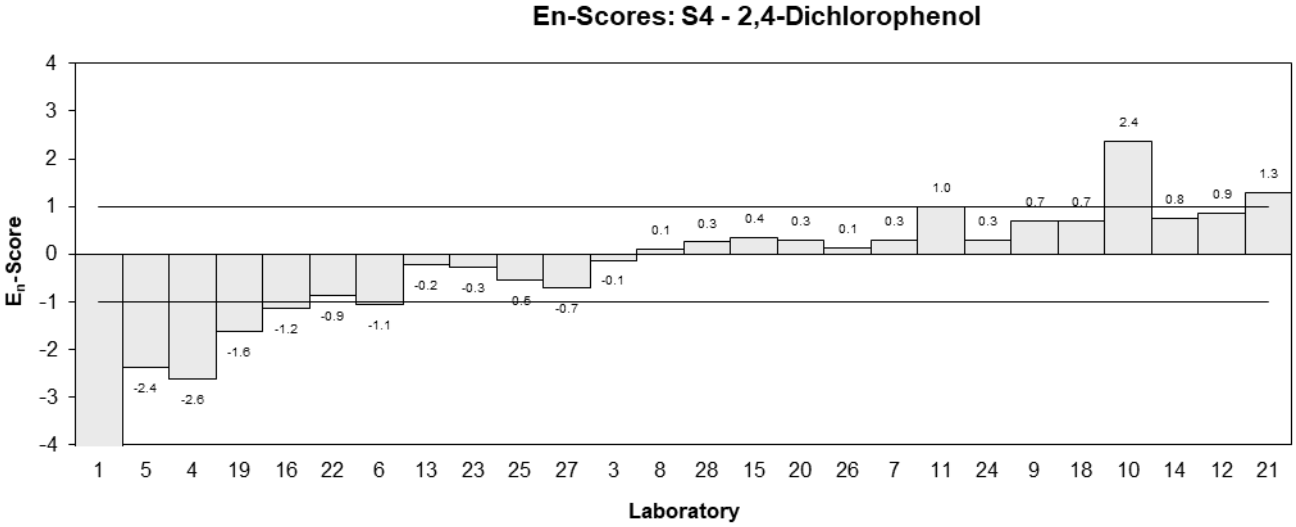

En-Scores: S4 - 2,4-Dichlorophenol
En-Score
Laboratory
1 5 4 19 16 22 6 13 23 25 27 3 8 28 15 20 26 7 11 24 9 18 10 14 12 21

Figure 22

Table 29

Sample Details

Sample No.	S4
Matrix	River Water
Analyte	2,6-Dichlorophenol
Unit	µg/L

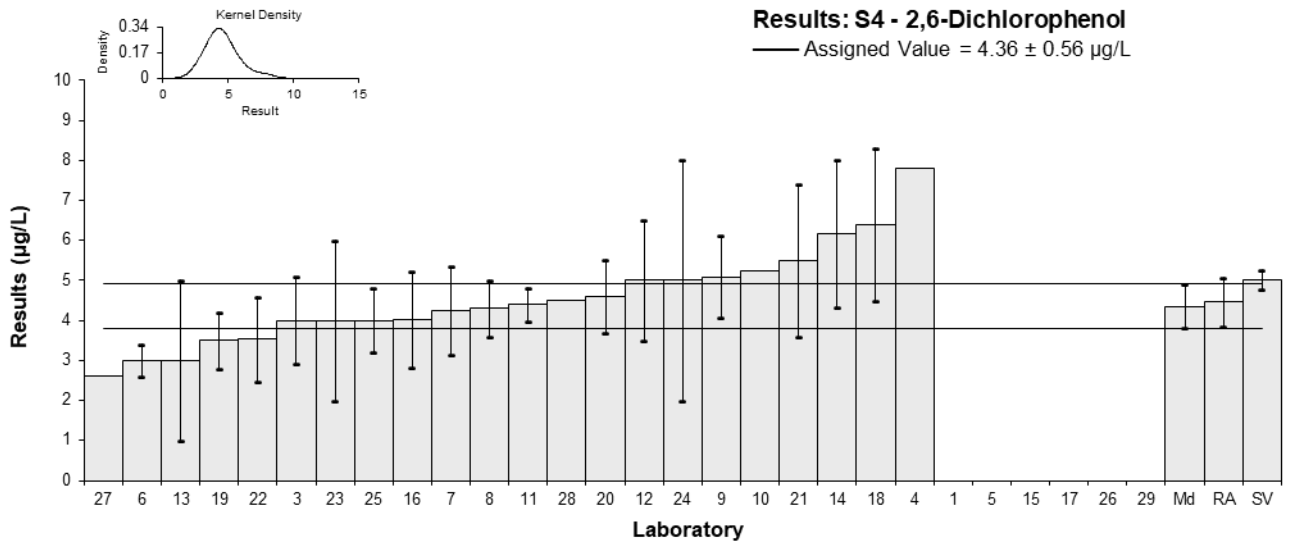
Participant Results

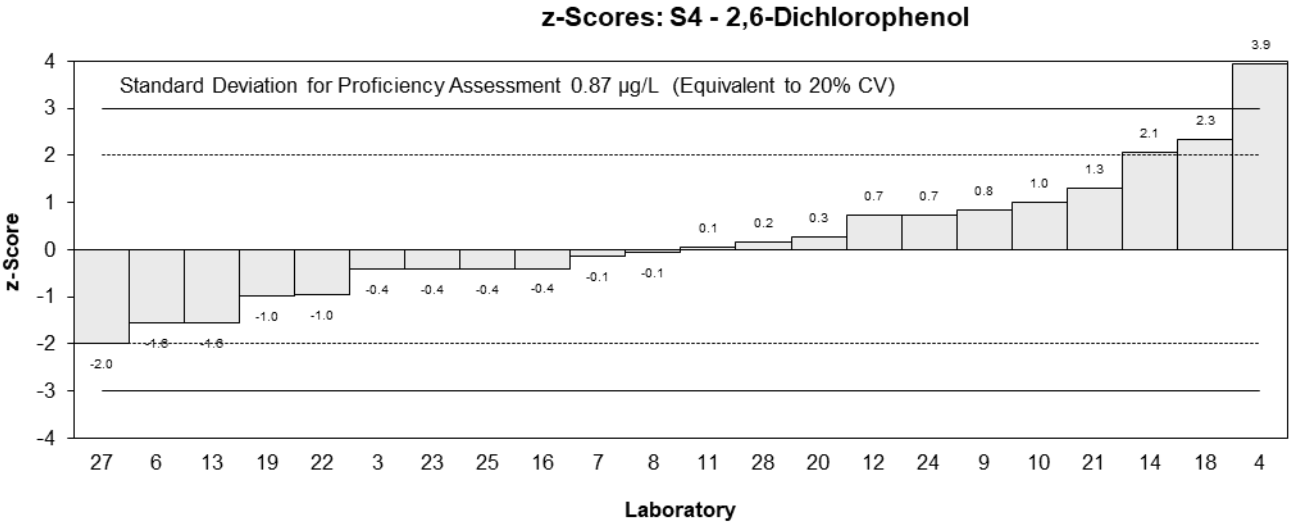
Lab. Code	Result	Uncertainty	z	E_n
1	< 1.0	NR		
3	4.0	1.08	-0.41	-0.30
4*	7.8	NR	3.94	6.14
5	<1.0	NR		
6	3	0.4	-1.56	-1.98
7	4.25	1.1	-0.13	-0.09
8	4.3	0.7	-0.07	-0.07
9	5.09	1.02	0.84	0.63
10	5.2387	NR	1.01	1.57
11	4.4	0.42	0.05	0.06
12	5.0	1.5	0.73	0.40
13	3	2	-1.56	-0.65
14	6.16	1.848	2.06	0.93
15	<10	NR		
16	4.01	1.2	-0.40	-0.26
17	NS	NS		
18	6.4	1.9	2.34	1.03
19	3.5	0.70	-0.99	-0.96
20	4.6	0.92	0.28	0.22
21	5.5	1.9	1.31	0.58
22	3.53	1.06	-0.95	-0.69
23	4	2	-0.41	-0.17
24	5	3	0.73	0.21
25	4	0.8	-0.41	-0.37
26	< 5.1	NR		
27	2.6256	NR	-1.99	-3.10
28	4.5091	NR	0.17	0.27
29	NS	NS		

* Outlier, see Section 4.2

Statistics

Assigned Value	4.36	0.56
Spike Value	5.02	0.25
Robust Average	4.46	0.61
Median	4.35	0.55
Mean	4.54	
N	22	
Max	7.8	
Min	2.6256	
Robust SD	1.1	
Robust CV	26%	


Kernel Density
Density
0.34
0.17
0
0
5
10
15
Result
Results: S4 - 2,6-Dichlorophenol
Assigned Value = 4.36 ± 0.56 µg/L
Results (µg/L)
0
1
2
3
4
5
6
7
8
9
10
27 6 13 19 22 3 23 25 16 7 8 11 28 20 12 24 9 10 21 14 18 4 1 5 15 17 26 29 Md RA SV
Laboratory


z-Scores: S4 - 2,6-Dichlorophenol
Standard Deviation for Proficiency Assessment 0.87 µg/L (Equivalent to 20% CV)
z-Score
-2.0 -1.6 -1.6 -1.0 -1.0 -0.4 -0.4 -0.4 -0.4 -0.1 -0.1 0.1 0.2 0.3 0.7 0.7 0.8 1.0 1.3 2.1 2.3 3.9
27 6 13 19 22 3 23 25 16 7 8 11 28 20 12 24 9 10 21 14 18 4
Laboratory

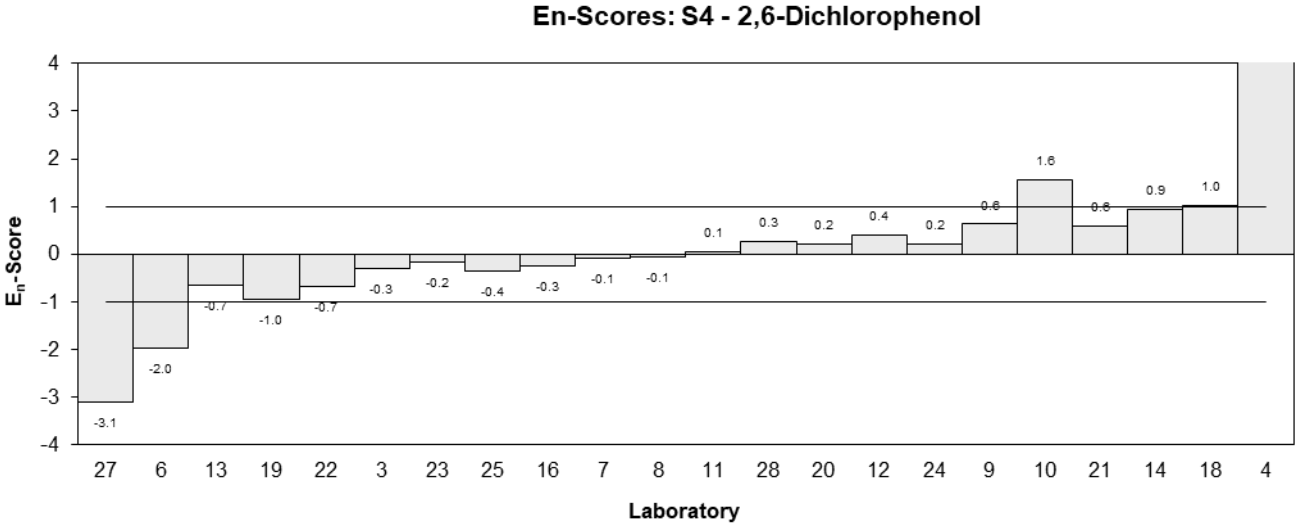

En-Scores: S4 - 2,6-Dichlorophenol
En-Score
-3.1 -2.0 -0.7 -1.0 -0.7 -0.3 -0.2 -0.4 -0.3 -0.1 -0.1 0.1 0.3 0.2 0.4 0.2 0.6 1.6 0.6 0.9 1.0
27 6 13 19 22 3 23 25 16 7 8 11 28 20 12 24 9 10 21 14 18 4
Laboratory

Figure 23

Table 30

Sample Details

Sample No.	S4
Matrix	River Water
Analyte	2,3,4,6-Tetrachlorophenol
Unit	µg/L

Participant Results

Lab. Code	Result	Uncertainty
1	NT	NT
3	<2.0	NR
4	0.34	NR
5	NT	NT
6	<0.1	NR
7	<1	1
8	<0.1	NR
9	<0.1	NR
10	0.3207	NR
11	<2	NR
12	<5	NR
13	<1	NR
14	0.48	0.144
15	<10	NR
16	< 10	NR
17	NS	NS
18	< 10	NR
19	<2	NR
20	<1	NR
21	<1	NR
22	< 10	NR
23	<1	NR
24	<1	NR
25	< 1	NR
26	< 5.1	NR
27	0.2094	NR
28	0.2461	NR
29	NS	NS

Statistics

Assigned Value	Not Set	
Spike Value	Not Spiked	
Robust Average	NA (N<6)	
Median	0.32	0.12
Mean	0.319	
N	5	
Max	0.48	
Min	0.2094	
Robust SD	NA (N<6)	
Robust CV	NA (N<6)	

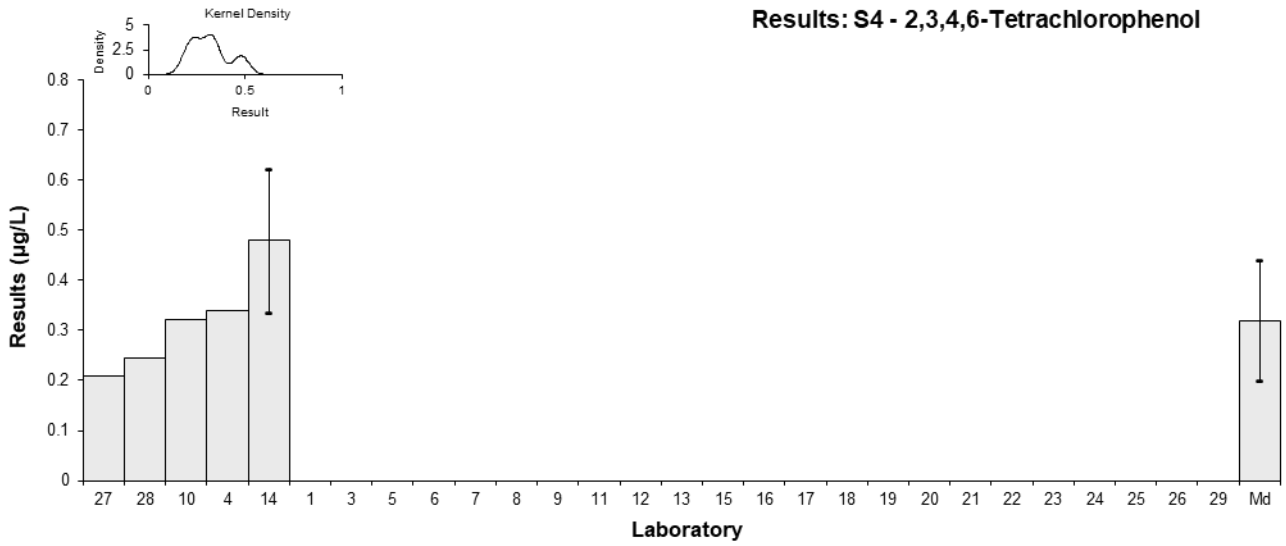

Results: S4 - 2,3,4,6-Tetrachlorophenol
Kernel Density
Density
5
2.5
0
0
0.5
1
Result
Results (µg/L)
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
27 28 10 4 14 1 3 5 6 7 8 9 11 12 13 15 16 17 18 19 20 21 22 23 24 25 26 29 Md
Laboratory

Figure 24

Table 31

Sample Details

Sample No.	S4
Matrix	River Water
Analyte	Pentachlorophenol
Unit	µg/L

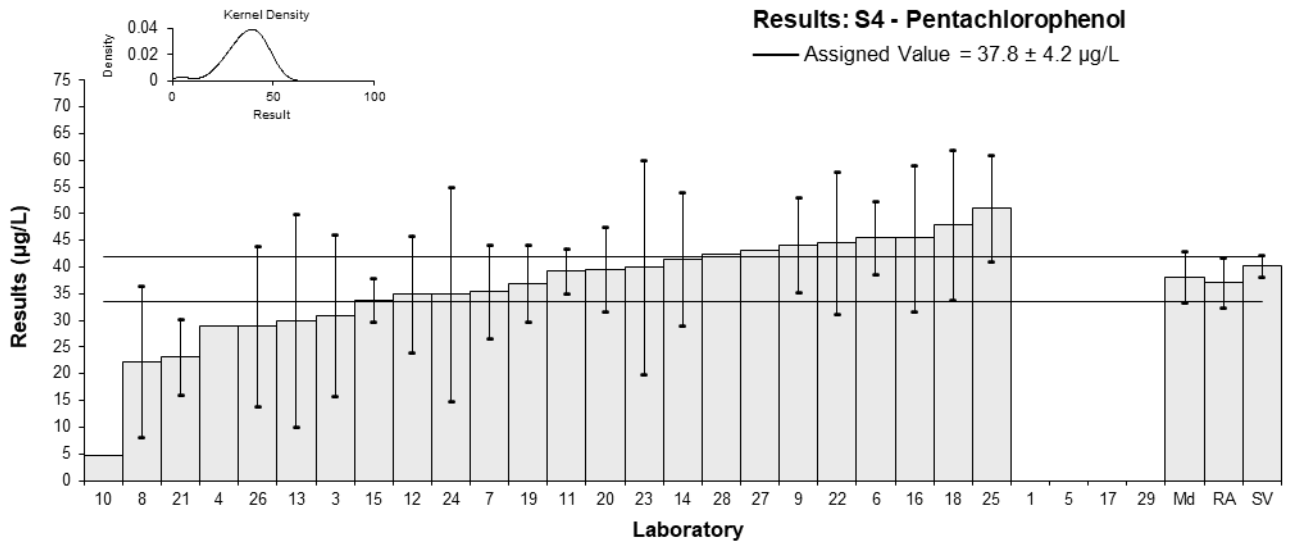
Participant Results

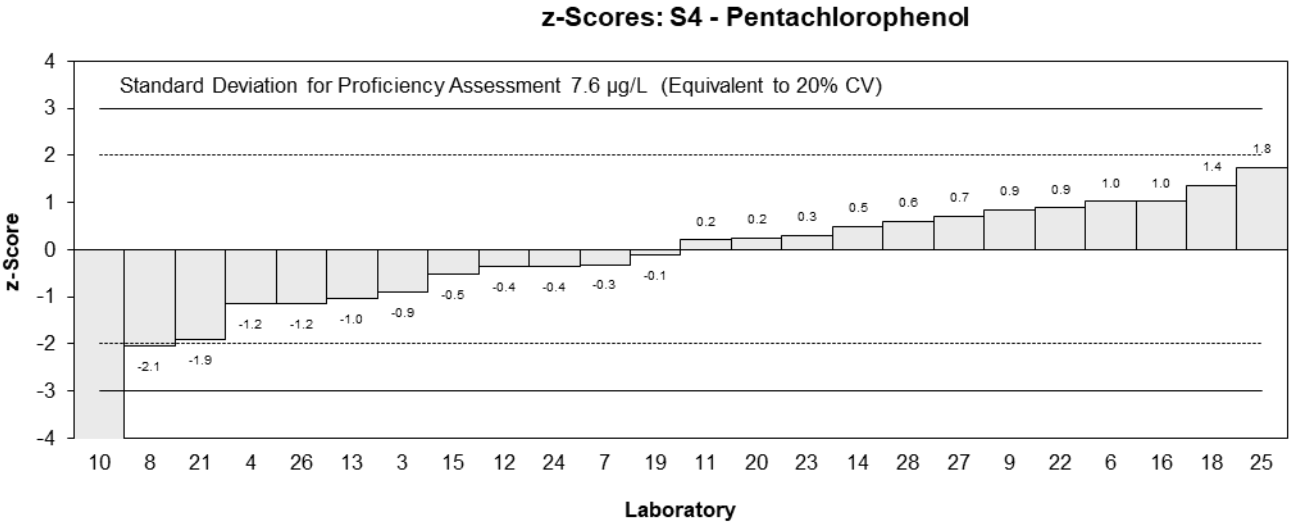
Lab. Code	Result	Uncertainty	z	E_n
1	< 2.0	NR		
3	31	15.07	-0.90	-0.43
4	29	NR	-1.16	-2.10
5	<2.0	NR		
6	45.5	6.8	1.02	0.96
7	35.4	8.8	-0.32	-0.25
8	22.3	14.2	-2.05	-1.05
9	44.21	8.84	0.85	0.65
10*	4.6068	NR	-4.39	-7.90
11	39.3	4.3	0.20	0.25
12	35	11	-0.37	-0.24
13	30	20	-1.03	-0.38
14	41.5	12.45	0.49	0.28
15	33.8	4.1	-0.53	-0.68
16	45.52	13.7	1.02	0.54
17	NS	NS		
18	48	14	1.35	0.70
19	37	7.3	-0.11	-0.09
20	39.633	7.93	0.24	0.20
21	23.3	7.1	-1.92	-1.76
22	44.48	13.34	0.88	0.48
23	40	20	0.29	0.11
24	35	20	-0.37	-0.14
25	51	10	1.75	1.22
26	29	15	-1.16	-0.56
27	43.0875	NR	0.70	1.26
28	42.321	NR	0.60	1.08
29	NS	NS		

* Outlier, see Section 4.2

Statistics

Assigned Value	37.8	4.2
Spike Value	40.2	2.0
Robust Average	37.1	4.6
Median	38.2	4.7
Mean	36.2	
N	24	
Max	51	
Min	4.6068	
Robust SD	8.9	
Robust CV	24%	


Kernel Density
Density
0.04
0.02
0
0
50
100
Result
Results: S4 - Pentachlorophenol
Assigned Value = 37.8 ± 4.2 µg/L
Results (µg/L)
Laboratory
10 8 21 4 26 13 3 15 12 24 7 19 11 20 23 14 28 27 9 22 6 16 18 25 1 5 17 29 Md RA SV


z-Scores: S4 - Pentachlorophenol
Standard Deviation for Proficiency Assessment 7.6 µg/L (Equivalent to 20% CV)
z-Score
Laboratory
10 8 21 4 26 13 3 15 12 24 7 19 11 20 23 14 28 27 9 22 6 16 18 25
-2.1 -1.9 -1.2 -1.2 -1.0 -0.9 -0.5 -0.4 -0.4 -0.3 -0.1 0.2 0.2 0.3 0.5 0.6 0.7 0.9 0.9 1.0 1.0 1.4 1.8

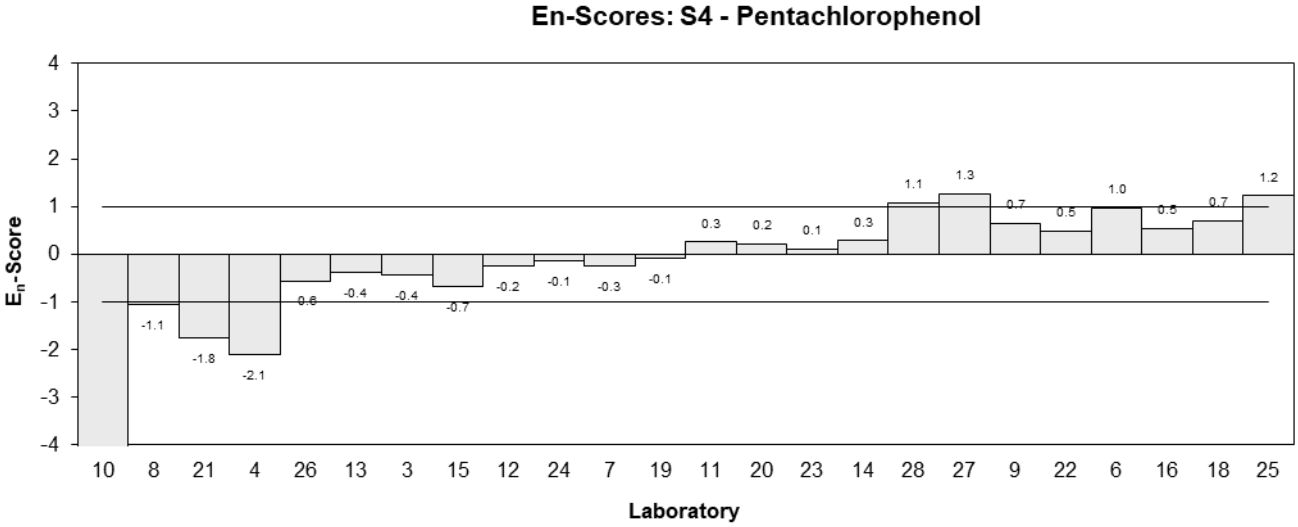

En-Scores: S4 - Pentachlorophenol
En-Score
Laboratory
10 8 21 4 26 13 3 15 12 24 7 19 11 20 23 14 28 27 9 22 6 16 18 25
-1.1 -1.8 -2.1 -0.6 -0.4 -0.4 -0.7 -0.2 -0.1 -0.3 -0.1 0.3 0.2 0.1 0.3 1.1 1.3 0.7 0.5 1.0 0.5 0.7 1.2

Figure 25

6 DISCUSSION OF RESULTS

6.1 Assigned Value

The assigned values for all scored analytes were the robust averages of participants' results. If there were results less than 50% or greater than 150% of the robust average, these were excluded from the calculation of each assigned value.[3,4] The robust averages and associated expanded uncertainties were calculated using the procedure described in ISO 13528.[7] The calculation of the expanded uncertainty for robust averages is presented in Appendix 3, using Sample S2 toluene as an example.

Samples S1 and S2 were spiked with commercially purchased products, and spiked values are not available. For Samples S3 and S4, a comparison of the assigned values and spiked values is presented in Table 32. Assigned values were 68% to 94% of the spiked values, which is similar to ratios observed in previous NMIA hydrocarbons and phenols in river water PT studies. Assigned values were set if there was a reasonable consensus of participants' results.

Table 32 Comparison of Assigned Value and Spiked Value

Sample	Analyte	Assigned Value (µg/L)	Spiked Value (µg/L)	Assigned Value / Spiked Value (%)
S3	Acenaphthene	17.7	20.0	89
	Anthracene	3.67	4.55	81
	Benz[*a*]anthracene	7.6	8.91	85
	Benzo[*a*]pyrene	4.25	5.91	72
	Benzo[*b*]fluoranthene	15.3	19.9	77
	Fluoranthene	10.3	12.0	86
	Phenanthrene	2.07	2.45	84
	Pyrene	3.50	3.98	88
S4	2-Methylphenol	7.86	10.7	73
	3 & 4-Methylphenols (total)*	7.1	10.4	68
	2,4-Dichlorophenol	10.2	12.0	85
	2,6-Dichlorophenol	4.36	5.02	87
	Pentachlorophenol	37.8	40.2	94

**Sample S4 was spiked with 4-methylphenol only. Participants were requested to report for the total of 3 & 4-methylphenols.

Sample S4 phenol and 2,3,4,6-tetrachlorophenol were not spiked into the test samples by the study coordinator and may be incurred analytes or trace contaminants in the standards spiked into this sample; no assigned values were set for these analytes. Sample S2 C6-C10 range was also not scored; historically this has been due to its volatile nature and therefore data has been provided for information only, though participants' results were in good agreement with each other for this study. Participants may still compare their results with the descriptive statistics and spiked values presented in Section 5.

Traceability: The consensus of participants' results is not traceable to any external reference, so although expressed in SI units, metrological traceability has not been established.

6.2 Measurement Uncertainty Reported by Participants

Participants were asked to report the expanded uncertainty evaluations associated with their results and the basis of this uncertainty. It is a requirement of ISO/IEC 17025 that laboratories

have procedures to evaluate the uncertainty of chemical measurements and to report this uncertainty in specific circumstances, including when the client's instruction so requires.[9]

Of 556 numeric results submitted for analytes of interest in this study, 487 (88%) were reported with an associated uncertainty. Participants used a wide variety of procedures to evaluate their expanded MU (Tables 4 and 5). Laboratory **11** reported using ASTM E2554-13 as their guide document for evaluating MU; this is a historical version of this standard, and an updated version is available.[11]

The magnitude of reported uncertainties was within the range of 4.2% to 75% relative. In general, an expanded measurement uncertainty of less than 15% relative is likely to be unrealistically small for the routine measurement of hydrocarbons and phenols in river water, while an expanded uncertainty of over 50% is likely too large to be fit for purpose. Of 487 MUs, 431 (89%) were between 10% and 50% relative, while 37 were less than 15% relative, and 19 were greater than 50% relative. Uncertainties associated with results returning an acceptable *z*-score, but an unacceptable E_n-score, may have been underestimated.

Laboratories **1** and **7** attached a numeric uncertainty to at least one of their non-numeric results. An evaluation of uncertainty expressed as a value should not be attached to a non-numeric result.[10]

The Sample S1 TRH result from Laboratories **7**, **9**, and **25** had no uncertainty as the result was calculated by the study coordinator by summing the individual hydrocarbon range results reported, and uncertainty evaluation could not be performed for these results.

Laboratories **1** and **4** did not report uncertainties for their Sample S4 phenols results only. Laboratories **8** and **9** did not report uncertainties for the total tests (Sample S1 TRH and/or Sample S2 Total BTEX) only. Laboratories **10**, **27**, and **28** did not report uncertainties for any of their reported numeric results. These participants reported being accredited to ISO/IEC 17025 for all analyte types they tested for.

Participants were requested to report the coverage factor associated with their uncertainty. All participants reporting a coverage factor reported using k = 2.

In some cases, results were reported with an inappropriate number of significant figures. Including too many significant figures may inaccurately reflect the measurement precision. The recommended format is to write uncertainty to no more than two significant figures and then to write the result with the corresponding number of decimal places. For example, instead of 1261.62 ± 302.79 µg/L, it is better to report 1260 ± 300 µg/L.[10]

6.3 z-Score

The z-score compares the participant's deviation from the assigned value based on the standard deviation for proficiency assessment (SDPA). The SDPA defines acceptable performance in a PT study. SDPAs equivalent to 20% PCV was used to calculate *z*-scores for Sample S1 >C10-C16, >C16-C34, >C34-C40, and all analytes in Sample S4. All other *z*-scores were calculated using an SDPA equivalent of 15% PCV. CVs predicted by the Thompson-Horwitz equation,[8] between-laboratory CVs and SDPAs (as PCV) for this study are presented for comparison in Table 33.

Table 33 Comparison of Thompson-Horwitz CV, Between-Laboratory CV and SDPA*

Sample	Analyte	Assigned Value (µg/L)	Thompson-Horwitz CV (%)	Between-Laboratory CV (%)	SDPA (as PCV, %)
S1	>C10-C16	960	16	19	20
	>C16-C34	1270	15	21	20
	TRH	2260	14	21	15
S2	C6-C10	498**	18	14	Not Set
	Benzene	9.25	22	13	15
	Toluene	81.0	22	9.3	15
	Ethylbenzene	14.7	22	9.6	15
	Xylenes	65.4	22	11	15
	Total BTEX	171	21	8.5	15
S3	Acenaphthene	17.7	22	17	15
	Anthracene	3.67	22	13	15
	Benz[*a*]anthracene	7.6	22	27	15
	Benzo[*a*]pyrene	4.25	22	29	15
	Benzo[*b*]fluoranthene	15.3	22	27	15
	Fluoranthene	10.3	22	12	15
	Phenanthrene	2.07	22	12	15
	Pyrene	3.50	22	15	15
S4	Phenol	0.76**	22	72	Not Set
	2-Methylphenol	7.86	22	23	20
	3 & 4-Methylphenols (total)	7.1	22	30	20
	2,4-Dichlorophenol	10.2	22	25	20
	2,6-Dichlorophenol	4.36	22	23	20
	2,3,4,6-Tetrachlorophenol	0.32**	22	34	Not Set
	Pentachlorophenol	37.8	22	21	20

*Thompson-Horwitz CV calculated from the assigned value. The between-laboratory CV is the between-laboratory CV with outliers removed, if applicable. Shaded cells represent between-laboratory CVs higher than both the SDPA and the Thompson-Horwitz CV for scored analytes.
**Robust average or median as applicable (assigned value not set).

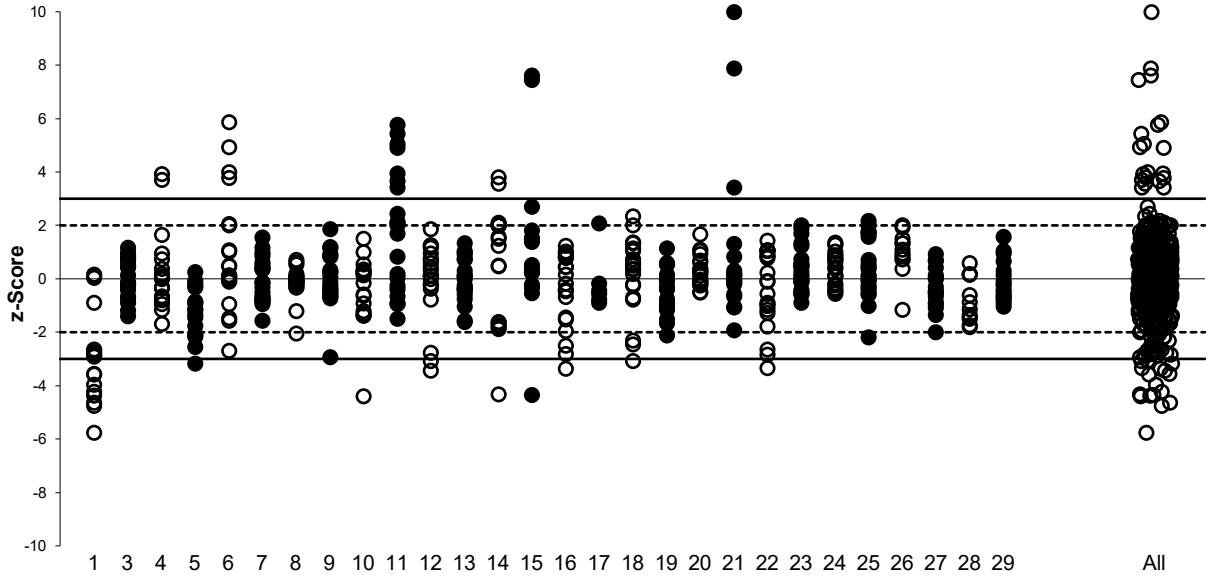
To account for possible low bias in the consensus values due to laboratories using inefficient extraction or analytical techniques, a total of ten *z*-scores were adjusted across the following analytes: Samples S3 benzo[*a*]pyrene and benzo[*b*]fluoranthene, and Sample S4 2-methylphenol and 3 & 4-methylphenols (total). For these analytes, a maximum acceptable result was set as the spiked value plus two SDPAs of the spiked value. Results lower than the maximum acceptable result but with a *z*-score greater than 2.0 had their *z*-score adjusted to 2.0. This ensured that participants reporting results close to the spiked value were not penalised. *z*-Scores for results greater than the maximum acceptable result, and *z*-scores less than 2.0, were left unaltered.

Of 523 results for which *z*-scores were calculated, 454 (87%) returned an acceptable score of $|z| \leq 2.0$.

Laboratories **3**, **7**, **8**, **9**, **11**, **12**, **13**, **16**, **18**, **20**, **22**, **23**, **24**, and **25** reported results for all 21 scored analytes. Of these participants, Laboratories **3**, **7**, **13**, **20**, **23**, and **24** returned acceptable *z*-scores for all scored analytes.

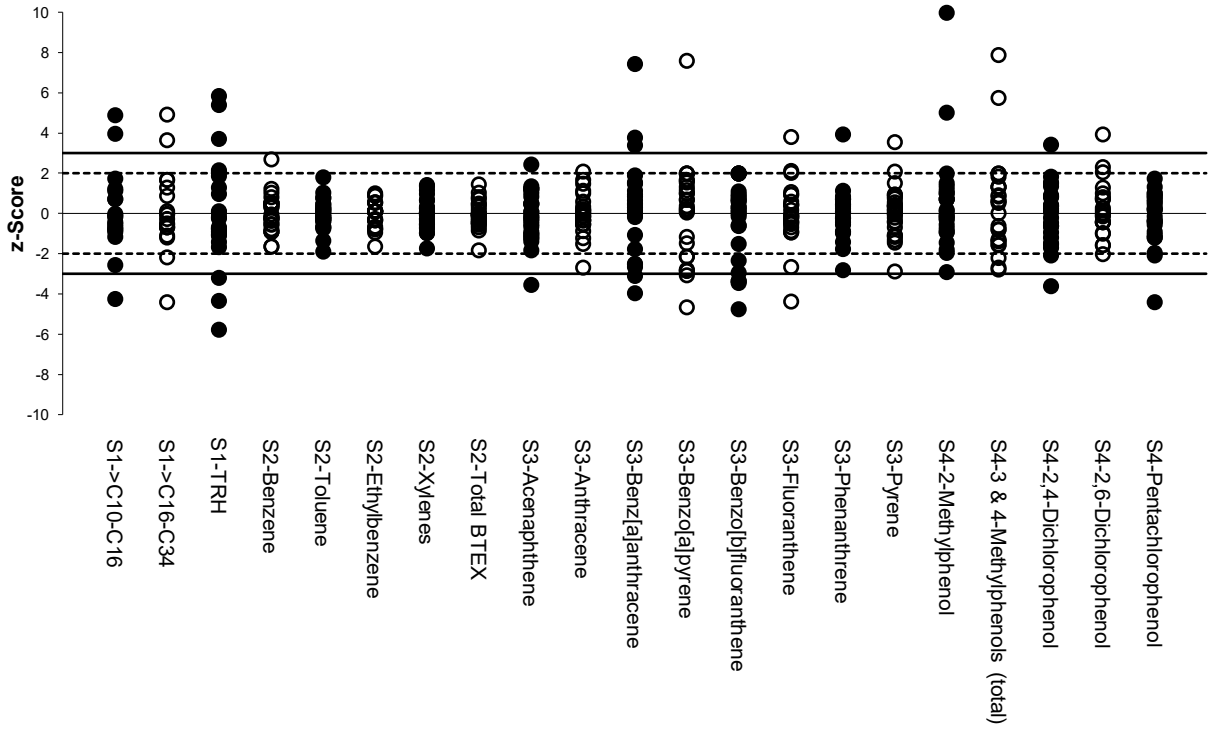
Some participants analysed only a subset of the samples in this study. Laboratory **29** analysed Samples S1, S2, and S3 only, and returned acceptable *z*-scores for all 16 scored analytes. Of the other participants analysing a subset of samples, three participants received acceptable *z*-scores for all their reported scored results: Laboratories **27** (17), **26** (12), and **28** (12).

A summary of participants' *z*-scores dispersal is presented by laboratory in Figure 26 and by analyte in Figure 27.



z-Scores greater than 10.0 have been plotted at 10.0.

Figure 26 *z*-Score Dispersal by Laboratory



z-Scores greater than 10.0 have been plotted at 10.0.

Figure 27 *z*-Score Dispersal by Sample and Analyte

Figure 28 presents participants' *z*-scores for Sample S1 (TRH) only. Results have relatively good consensus across the board. Laboratories **1**, **5**, **6**, and **11** reported individual fraction and TRH results that were consistently higher or lower than the assigned value by approximately the same factor; these participants may have applied an incorrect dilution factor or may have applied inefficient extraction methods.

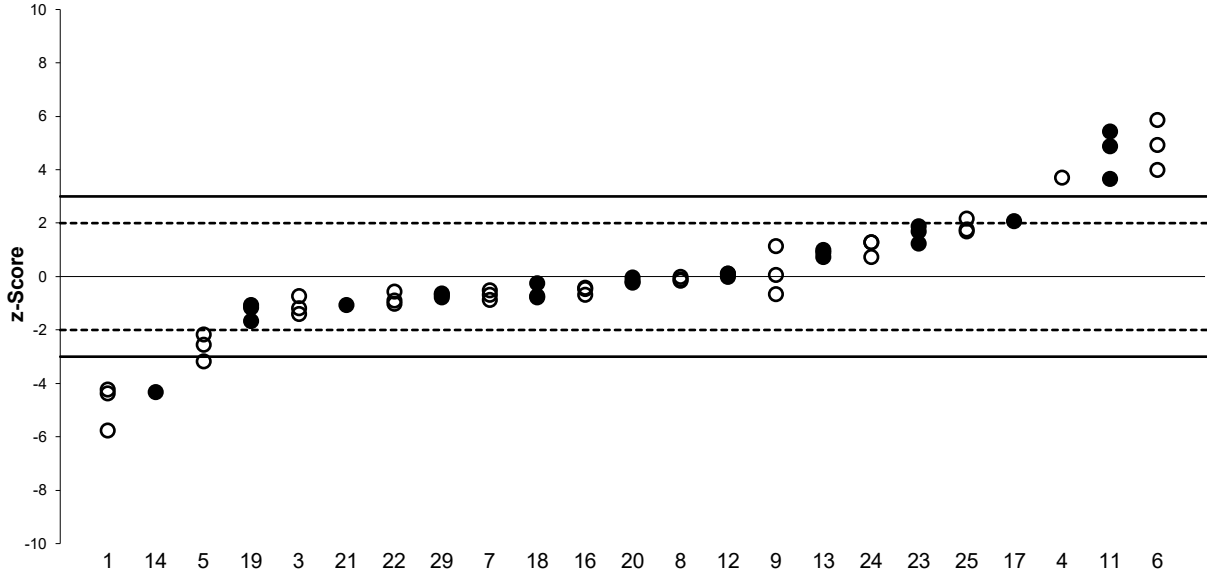


Figure 28 Sample S1 (TRH) *z*-Score Dispersal by Laboratory

Figure 29 presents participants' *z*-scores for Sample S2 (BTEX) only. Participants' results were in excellent agreement with each other. All except one result returned acceptable *z*-scores.

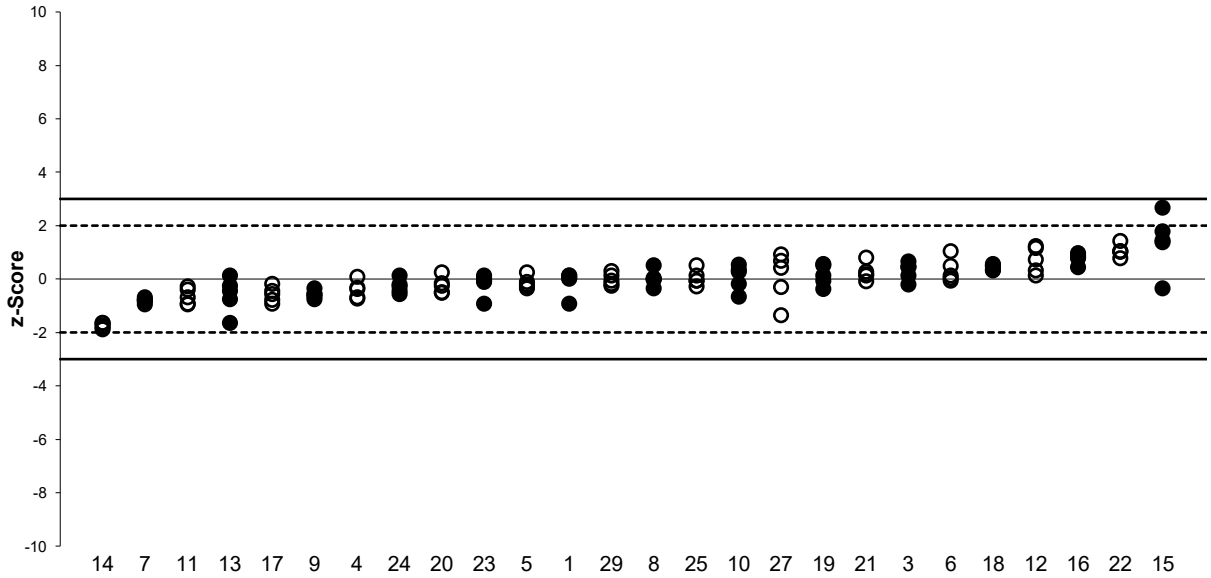


Figure 29 Sample S2 (BTEX) *z*-Score Dispersal by Laboratory

Figure 30 presents participants' *z*-scores for Samples S3 (PAHs) only. Participants with a trend of questionable or unacceptable *z*-scores below the zero line may have an inefficient extraction process for PAHs. As the ratio of the assigned values to the spiked values ranged from 72% to 89%, results with higher acceptable *z*-scores may correspond to more efficient extraction of PAHs.

Laboratory **15** reported varied results for PAHs. Two of their results were biased high (212% and 214% of the assigned value), and one result was biased low (35% of the assigned value).

Laboratories **12**, **16**, **18**, and **22** also reported varied results for PAHs. These participants had two 'clusters' of results, with some analytes returning acceptable *z*-scores, and other analytes being biased low.

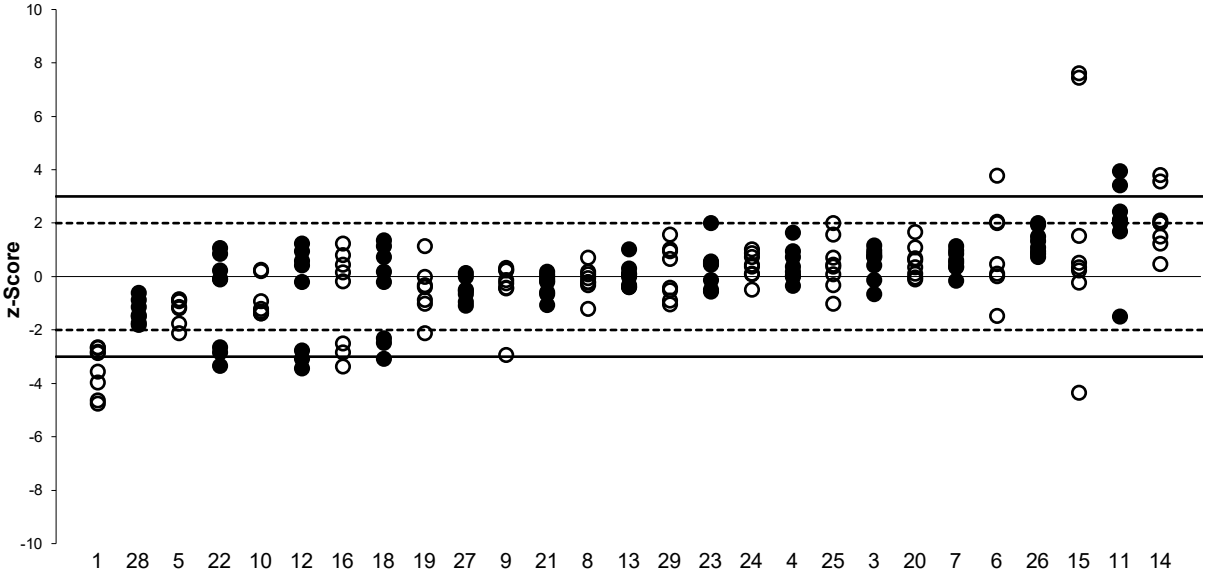
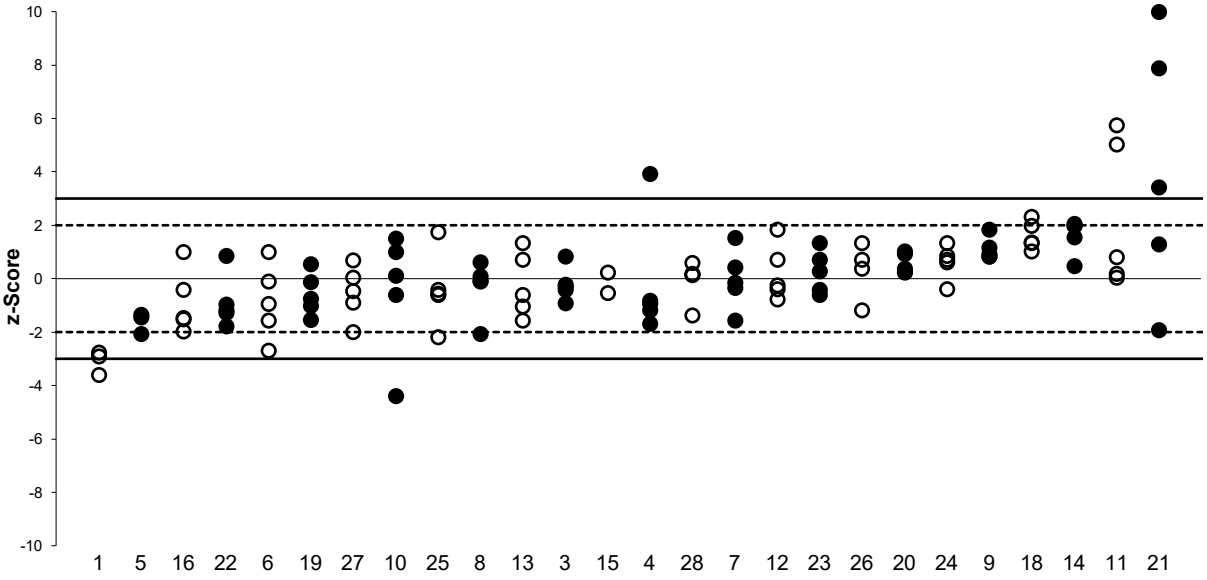


Figure 30 Sample S3 (PAHs) *z*-Score Dispersal by Laboratory

Figure 31 presents participants' *z*-scores for Sample S4 (Phenols) only. Like PAHs, participants with a trend of *z*-scores below the zero line may have an inefficient extraction process for phenols. With assigned value to spike value ratios between 68% to 94%, some phenols proved more challenging than other analytes to extract. This may in part be due to the affinity of the different phenol analytes to water over other extraction solvents.



z-Scores greater than 10.0 have been plotted at 10.0.

Figure 31 Sample S4 (Phenols) *z*-Score Dispersal by Laboratory

6.4 E_n-Score

E_n-Scores can be interpreted in conjunction with *z*-scores, as an unacceptable E_n-score can either be caused by issues with measurement, or uncertainty, or both. If a participant did not

report any uncertainty with a result, an expanded uncertainty of zero (0) was used to calculate the E_n-score. For results whose z-scores were adjusted as discussed in Section 6.3, no E_n-score has been calculated.

Of 513 results for which E_n-scores were calculated, 381 (74%) returned an acceptable score of $|E_n| < 1.0$, indicating agreement of the participant's result with the assigned value within their respective expanded uncertainties.

Laboratories **3**, **20**, and **24** returned acceptable E_n-scores for all 21 scored analytes. One result reported by Laboratory **23** had a result with an adjusted z-score and therefore no E_n-score; all 20 other reported results returned acceptable E_n-scores.

Laboratory **29** (analysing Samples S1, S2, and S3 only) also received acceptable E_n-scores for all 16 scored analytes. Laboratory **26** had a result with an adjusted z-scores and therefore no E_n-score; all 11 other reported results returned acceptable E_n-scores.

A summary of E_n-score dispersal by laboratory is presented in Figure 32.

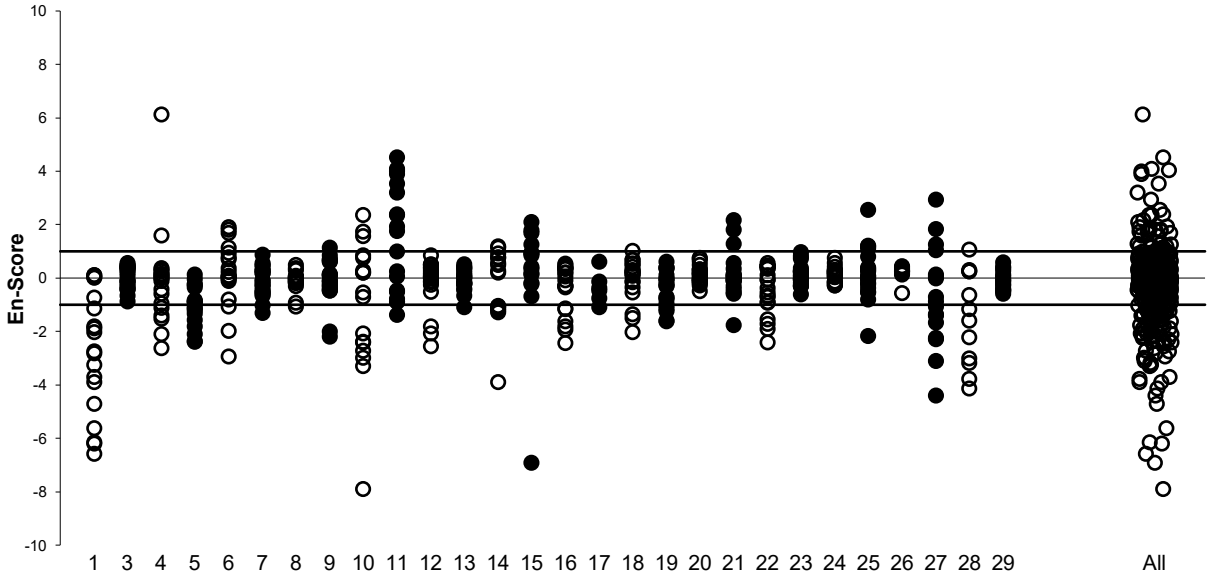


Figure 32 E_n-Score Dispersal by Laboratory

6.5 False Negatives

Table 34 presents false negative results. These are analytes present in the samples which a participant tested for but did not report a numeric result; for example, participants reporting a 'less than' result (< x) when the assigned value was greater than their limit of reporting (LOR), or if no value was reported.

In Sample S3, Laboratories **10**, **27**, and **28** returned false negatives for benz[a]anthracene, however they all reported numeric results for chrysene which was not spiked into this sample (see Section 6.6). These two analytes usually have very similar retention times,[12] and so these participants may have misidentified them and switched their results.

Table 34 False Negatives

Lab. Code	Sample	Analyte	Assigned Value (µg/L)	Spiked Value (µg/L)	Result (µg/L)
1	S4	2,6-dichlorophenol	4.36	5.02	< 1.0
		Pentachlorophenol	37.8	40.2	< 2.0
5	S4	2,6-dichlorophenol	4.36	5.02	<1.0
		Pentachlorophenol	37.8	40.2	<2.0

Lab. Code	Sample	Analyte	Assigned Value (µg/L)	Spiked Value (µg/L)	Result (µg/L)
6*	S3	Acenaphthene	17.7	20	<0.01
10	S3	Benz[*a*]anthracene	7.6	8.91	<0.01
27	S3	Benz[*a*]anthracene	7.6	8.91	<0.01
28	S3	Benz[*a*]anthracene	7.6	8.91	<0.01

*After the release of the Interim Report, Laboratory **6** reported they had swapped the results of acenaphthene and acenaphthylene in their results submission. If these reported results were swapped, Laboratory **6** would not have returned a false negative for acenaphthene.

6.6 Reporting of Additional Analytes

Table 35 presents additional analytes reported by participants that were not spiked into the test samples by the study coordinator. In general, participants should take care to avoid any potential cross-contamination when analysing their samples.

Table 35 Non-Spiked Analytes Reported by Participants

Lab. Code	Sample	Analyte	Result (µg/L)	Uncertainty (µg/L)
6*	S3	Acenaphthylene	18.54	5.5
10	S3	Chrysene	5.774	NR
26	S3	Acenaphthylene	0.31	0.16
27	S3	Chrysene	6.1182	NR
28	S3	Chrysene	5.2627	NR

*As indicated in Section 6.5, after the release of the Interim Report, Laboratory **6** reported they had swapped the results of acenaphthene and acenaphthylene in their results submission. If these reported results were swapped, Laboratory **6** would not have returned an additional analyte for acenaphthylene.

For Sample S1 >C34-C40, Laboratory **29** reported a result of >100 µg/L. Based on sample preparation, it was not expected to be any detectable >C34-C40, and this is also reflected by the results submitted by the other participants. This participant's result may be a typo (that is, they may have intended to report <100 µg/L).

6.7 Participants' Analytical Methods

Participants' results excluded from all summary statistics in Section 5 have also been excluded from discussion in this section. Where charts refer to 'n = *x*', this corresponds to *x* number of participants using that technique.

Sample S1 TRH

A comparison of TRH *z*-scores and sample volume is presented in Figure 33.

Of participants reporting numeric results, six participants reported taking the whole sample for analysis, and all these participants reported that they rinsed the bottle. This was the most common volume used. Others reported sample test portions ranging from 35 mL to 250 mL.

In this study, all participants using and rinsing the full sample bottle returned acceptable *z*-scores. There was more variability observed when participants used only part of the sample. Participants should take care that any subsample taken is representative of the whole sample.

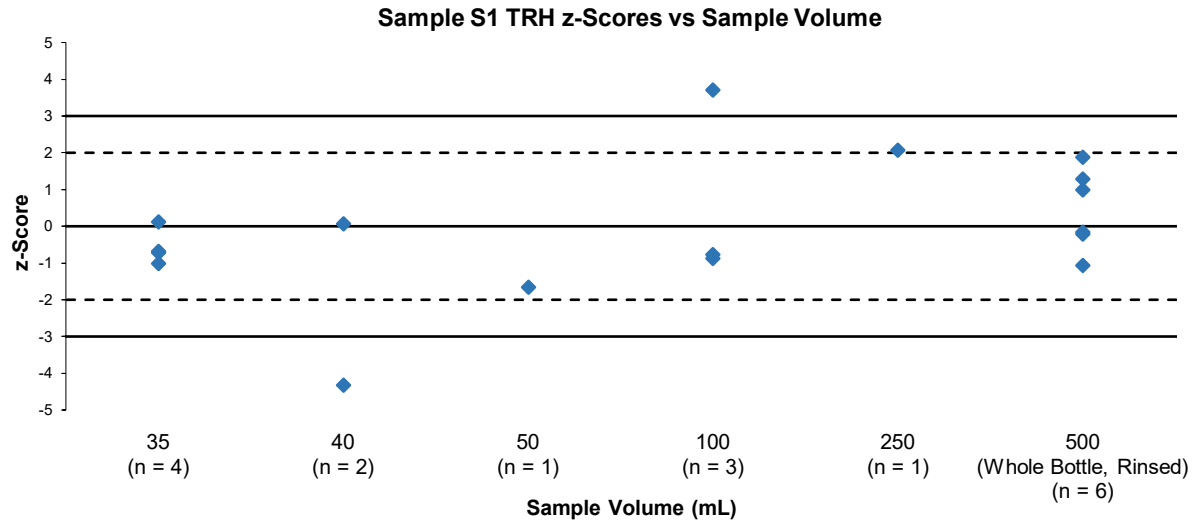


Figure 33 Sample S1 TRH *z*-scores vs Sample Volume

A comparison of the TRH *z*-scores and methodology used is presented in Figures 34 and 35.

All participants reported using liquid-liquid extraction (LLE) with mechanical agitation. Thirteen participants reported using dichloromethane (DCM), three participants reported using hexane (Hex), and one participant reported using a mixture of hexane and pentane (Hex/Pent) as the extraction solution. In this study, results from participants using hexane were not in good agreement with each other or the assigned value.

A range of extraction times were used, ranging from 3 to 120 minutes, with no clear trend observed. Generally, those participants employing multiple extraction steps returned better TRH recovery. Most participants reported concentrating extracts by evaporation under nitrogen or argon, two participants reported using a water bath, and other participants did not further concentrate their extracts. A wide range of extract concentration times and temperatures were reported, and for this study, participants concentrating their extracts for a longer period returned better TRH recovery. One participant reported using a silica clean-up step.

Fourteen participants reported using gas chromatography (GC) coupled with flame ionisation detection (FID) for analysis and three participants reported using GC coupled with a mass spectrometer (MS) or tandem mass spectrometer (MS/MS). Participants that utilised a GC-MS or GC-MS/MS produced compatible results to participants that used a GC-FID.

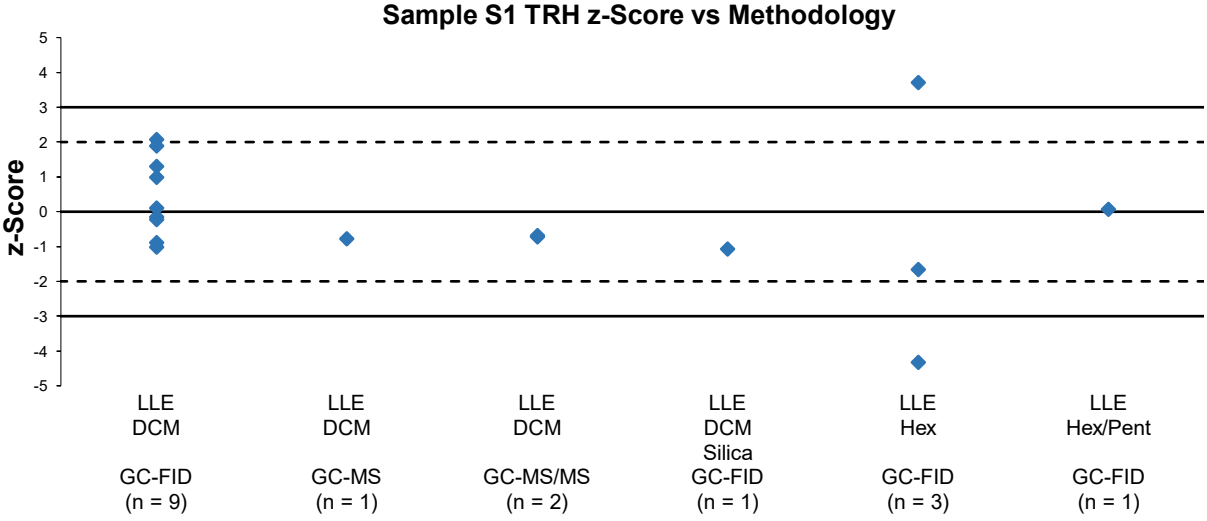


Figure 34 Sample S1 TRH *z*-Scores vs Methodology

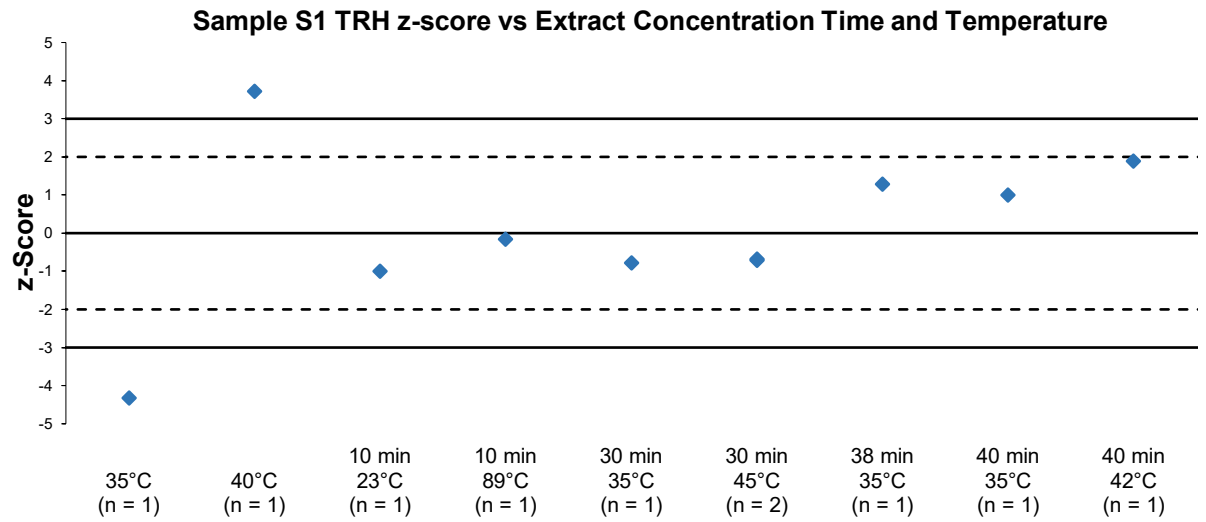


Figure 35 Sample S1 TRH *z*-Scores vs Extract Concentration Time and Temperature

Sample S2 BTEX

A comparison of the Total BTEX results and methodology used is presented in Figures 36 to 38.

Participants were in very good agreement with each other, with all but one Sample S2 result returning acceptable *z*-scores, indicating that BTEX analysis was not challenging to participants, and all analysis techniques utilised performed acceptably and were compatible with each other.

For BTEX analysis, participants used either purge-and-trap (P&T) GC-MS or headspace GC-MS. The most common methodology was P&T GC-MS (19 participants). Results reported by participants using headspace GC-MS were more varied, though still acceptable. Whether participants diluted the sample, or performed a blank subtraction, did not significantly affect results in this study.

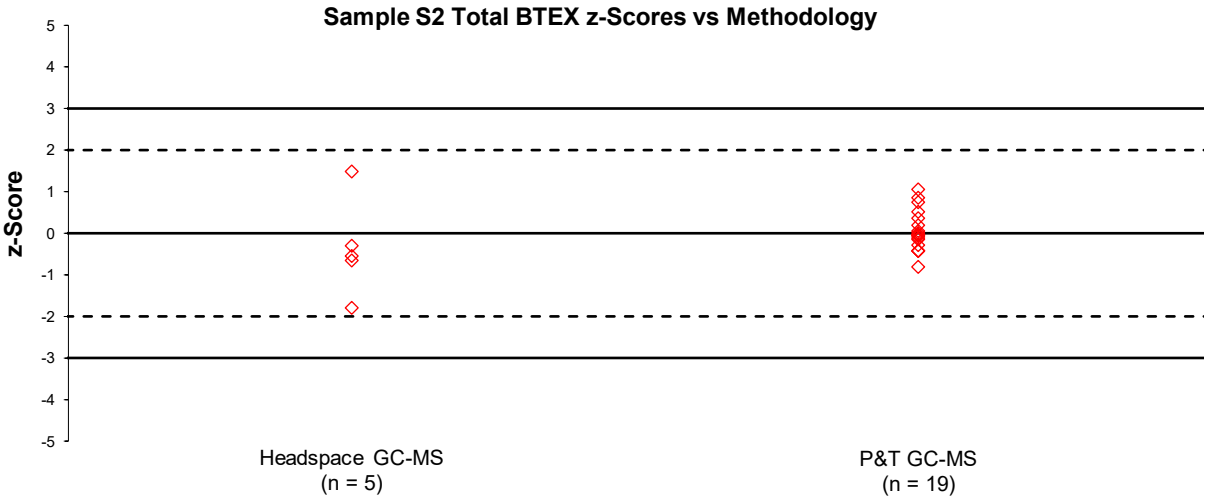


Figure 36 Sample S2 Total BTEX Results vs Methodology

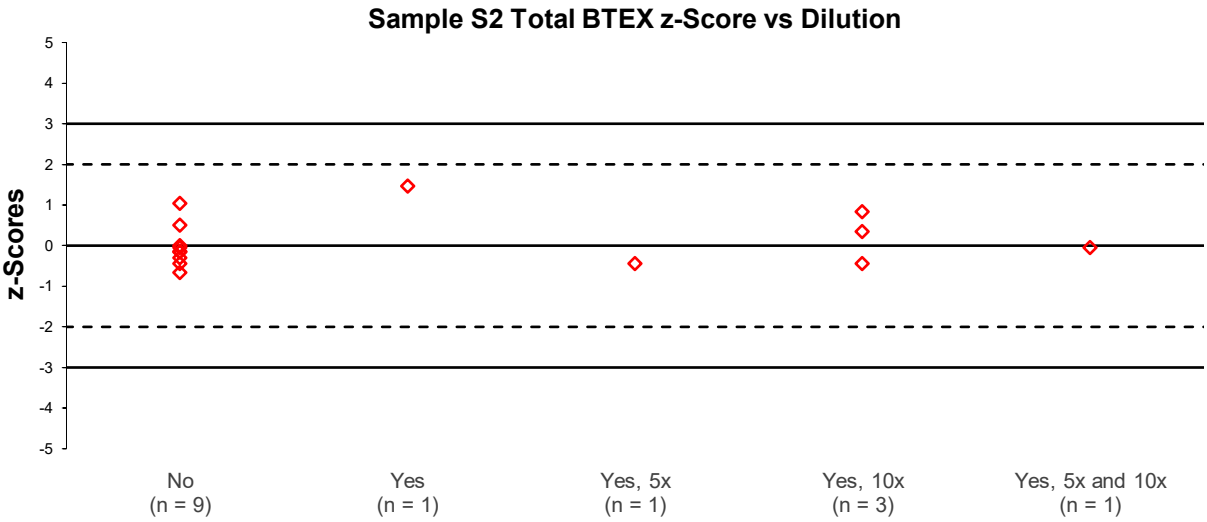


Figure 37 Sample S2 Total BTEX Results vs Dilution

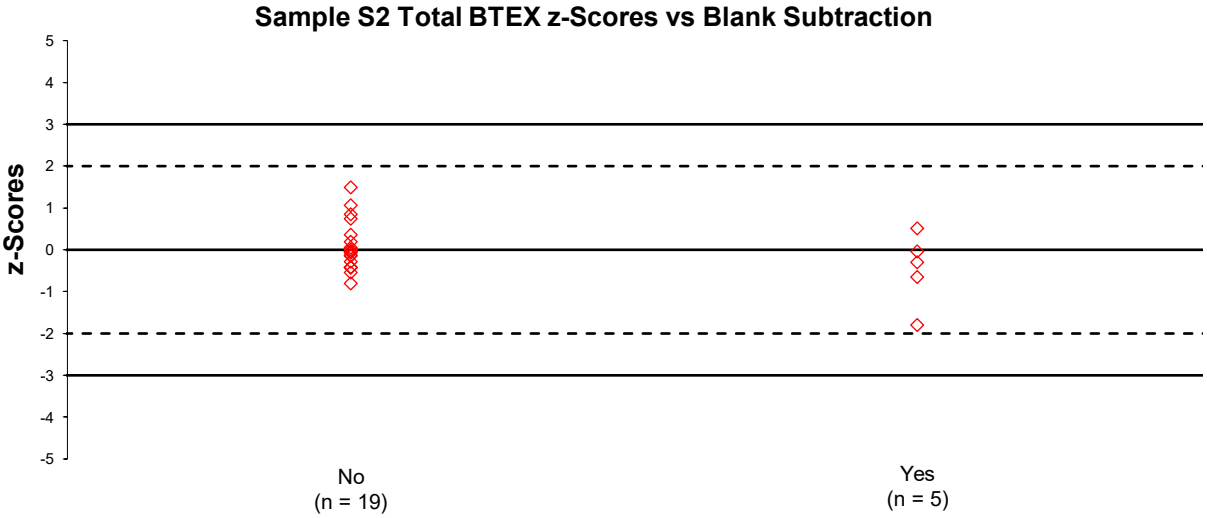


Figure 38 Sample S2 Total BTEX Results vs Blank Subtraction

Sample S3 PAHs

In this study, participants were given the option of samples as either 3 x 100 mL bottles or 1 x 500 mL, depending on which size was more amenable to their laboratory's method.

A comparison of the PAHs *z*-scores and sample volume used is presented in Figure 39.

Participants that received 3 x 100 mL reported testing portions ranging from 30 mL to 100 mL while participants that received 1 x 500 mL reported testing portions ranging from 30 mL to 500 mL. In this study, no significant trend was observed with regards to sample volume used or whether the bottle was rinsed.

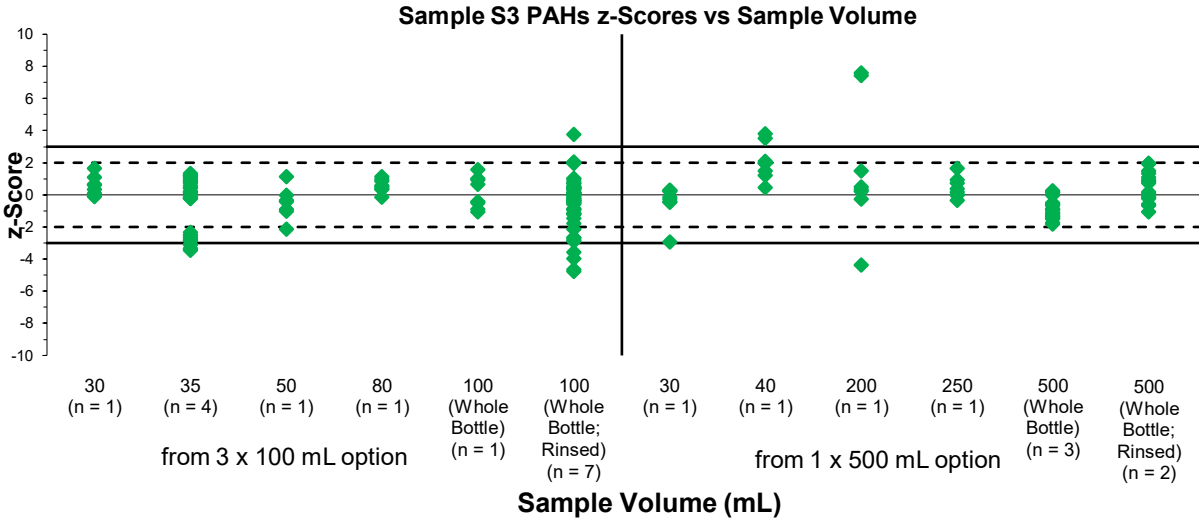


Figure 39 Sample S3 PAHs *z*-Scores vs Sample Volume

A comparison of the PAHs results and methodology used is presented in Figures 40 and 41.

Seventeen participants reported using LLE (mechanical agitation) using DCM, and one participant reported using hexane (Hex) as the extraction solvent instead. Four participants reported using solid phase extraction (SPE) with DCM/ethyl acetate (EtOAc). No participant used a clean-up step. Results from using SPE with DCM/EtOAc all returned acceptable *z*-scores, however were negatively biased, corresponding to lower recovery of the PAHs as compared to the spiked value.

A range of extraction times were used, ranging from 3 to 90 minutes. Most participants reported concentrating extracts by evaporation under nitrogen or argon, while other participants reported using a water bath, rotary evaporator, or other concentrators; some participants did not further concentrate their extracts. A wide range of extract concentration times and temperatures were reported. Participants that used concentration temperatures of 65°C and above returned *z*-scores that were biased low; it is possible there was some loss of PAHs with the increased temperature.

Most participants reported using various deuterated labelled PAHs as internal standards.

All participants utilised GC-MS(/MS) for analysis.

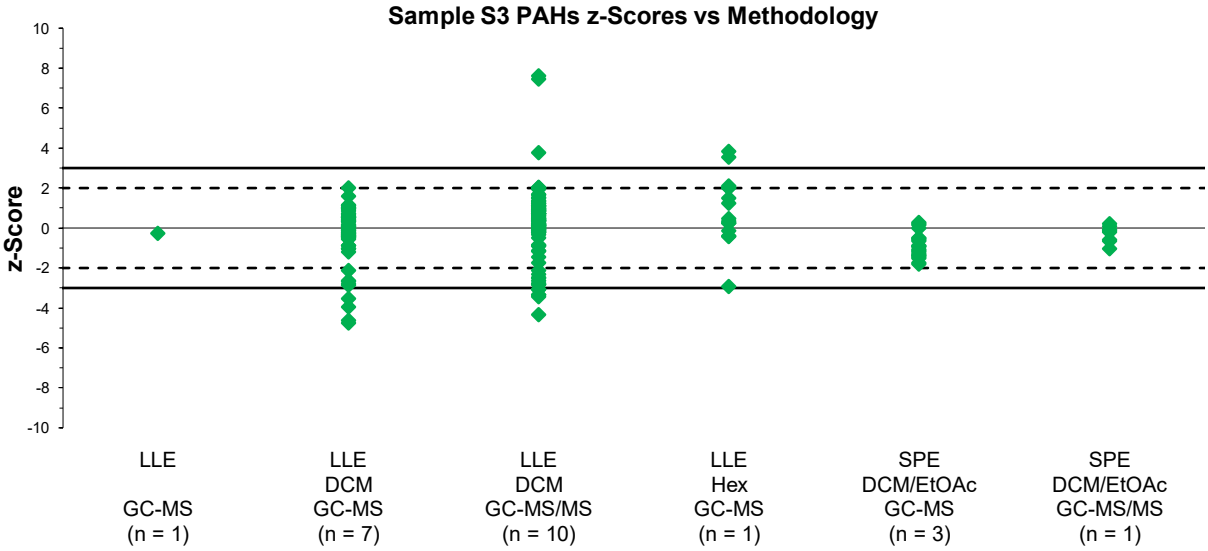


Figure 40 Sample S3 PAHs *z*-Scores vs Methodology

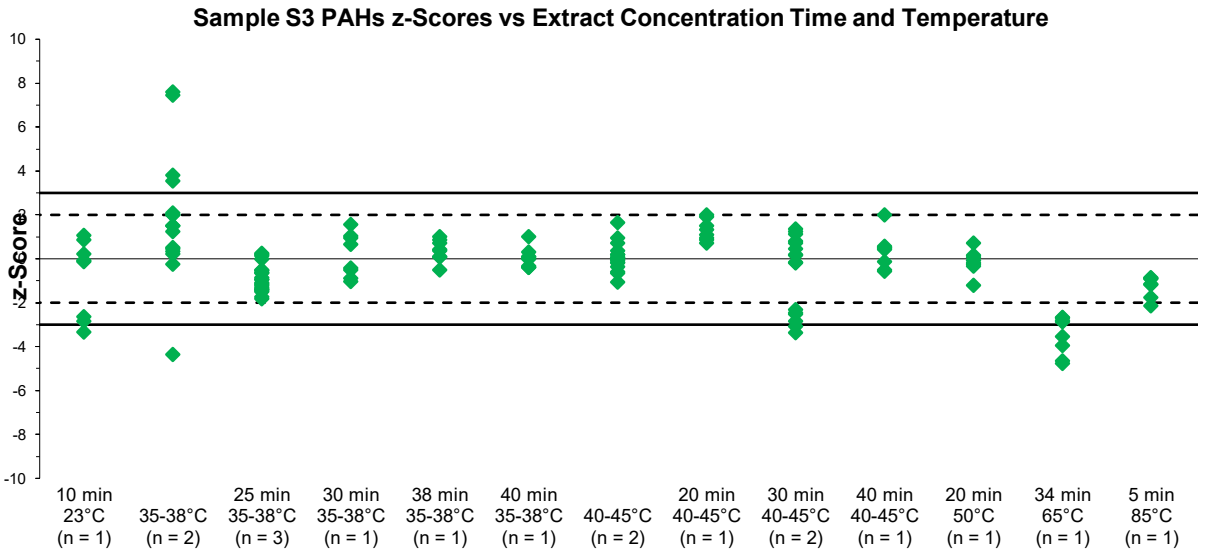


Figure 41 Sample S3 PAHs *z*-Scores vs Extract Concentration Time and Temperature

Sample S4 Phenols

A comparison of the phenol *z*-scores and sample volumes used is presented in Figure 42.

About half of the participants reported using the entire contents of one of the provided bottles, and of these, eight reporting rinsing the bottle while four did not. Other participants reported sample test portions ranging from 1 mL to 80 mL.

The participant using a sample volume of 10 mL reported very varied results. This may in part be due to the smaller subsample not being a suitable representation of the whole sample. This participant also used a different methodology compared to other participants, and may need to review their procedure more generally to identify the source of their result variability.

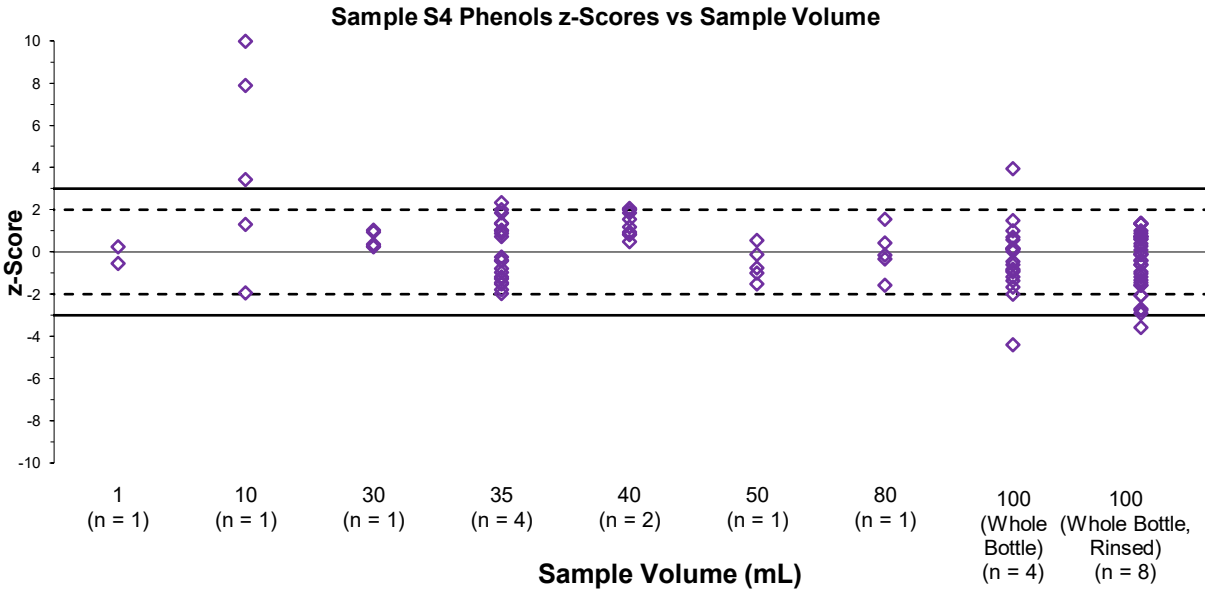


Figure 42 Sample S4 Phenol *z*-Scores vs Sample Volume

A comparison of the phenols *z*-scores and methodology used is presented in Figures 43 and 44.

Eighteen participants reported using LLE (mechanical agitation) and GC-MS(/MS) for analysis. Of these participants, all except for one participant also reported using DCM as an extraction solvent; one participant reported using methyl tert-butyl ether (MTBE). Three

participants reported using SPE with DCM/EtOAC and utilising GC-MS to analyse the sample. One participant reported direct injection (DI) of the sample using liquid chromatography (LC)-MS/MS and one other participant reported extracting using solid phase microextraction (SPME) and then GC-MS/MS for analysis. No participant reported using a clean-up step.

A range of extraction times were used, ranging from 3 to 180 minutes. Most participants reported concentrating extracts by evaporation under nitrogen or argon, while other participants reported using a water bath, or other concentrators; some participants did not further concentrate their extracts. A wide range of extract concentration times and temperatures were reported. Participants that reported using concentration temperature at 65°C and above returned results that were biased low; it is possible there was some loss of phenols with the increased temperature.

Participants used a range of different internal standards including labelled PAHs or other semi-volatile analytes. There was no significant trend observed with regards to the choice of internal standard.

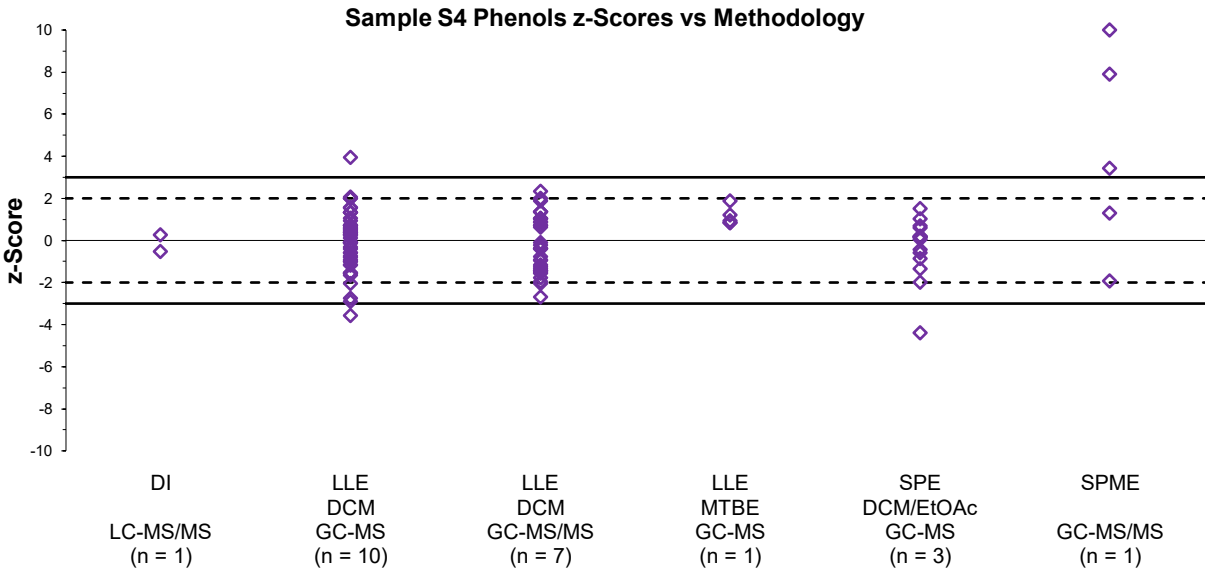


Figure 43 Sample S4 Phenol *z*-Scores vs Methodology

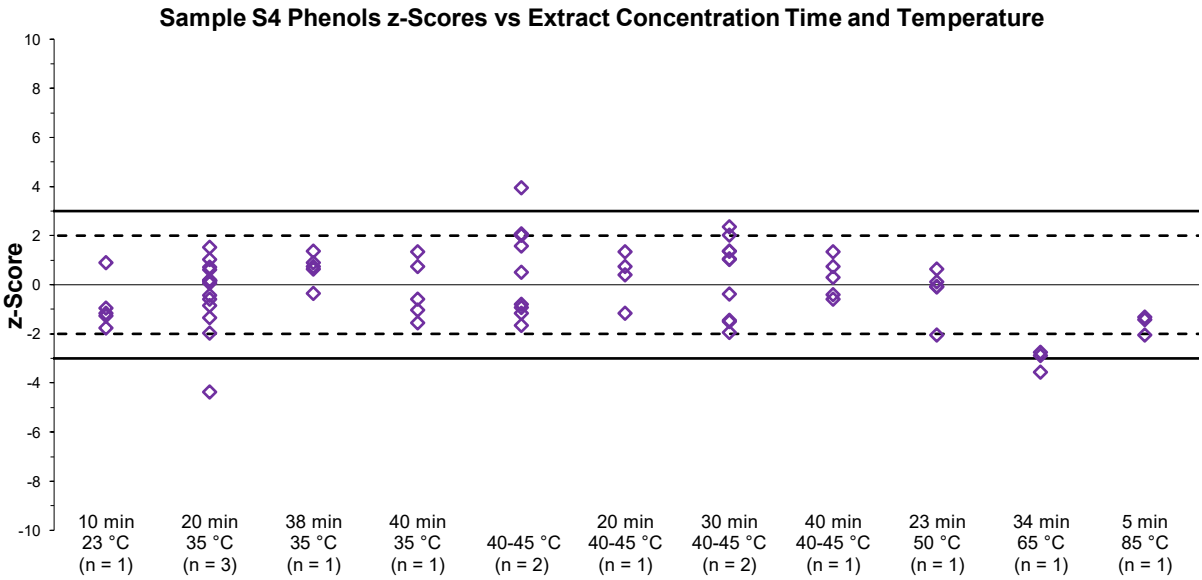


Figure 44 Sample S4 Phenol *z*-Scores vs Extract Concentration Time and Temperature

6.8 Certified Reference Materials

Participants were requested to report whether certified standards or matrix reference materials had been used as part of the quality assurance for the analysis.

Nineteen participants reported using certified standards, one participant reported using matrix reference materials, and one participant reported using both. Participants reported sourcing these standards from:

- NMIA (e.g. MX015)
- Accustandard
- o2si
- Sigma-Aldrich (e.g. CRM47993)
- Restek
- Other ISO 17034 standards

These materials may or may not meet the internationally recognised definition of a CRM:

> '***reference material***, *accompanied by documentation issued by an authoritative body and providing one or more specified property values with associated uncertainties and traceabilities, using valid procedures*'[13]

6.9 Summary of Participants' Performance

Summaries of participants' results and performances for scored analytes in this PT study are presented in Tables 36 to 38 and Figure 45.

Table 36 Summary of Participants Result for Sample S1 and S2 Scored Analytes*

Lab. Code	S1 >C10-C16	S1 >C16-C34	S1 Total TRH	S2 Benzene	S2 Toluene	S2 Ethylbenzene	S2 Xylenes	S2 Total BTEX
AV	960	1270	2260	9.25	81.0	14.7	65.4	171
1	150	160	310	8	83	15	66	172
3	820	970	1790	9	87	15	72	183
4	NR	NR	3520	8.77	82.1	13.12	58.9	163
5	470	720	1190	9	78	14	68	169
6	1728	2523	4251	9.2	94	15	66	184
7	864	1100	1964	8.19	72.8	13	56.2	150.2
8	940	1270	2210	10	81	14	66	171
9	1183	1103	2286	8.5	77	13.3	58.2	157
10	NT	NT	NT	9.7457	73.3669	15.9269	68.211	167.2507
11	1900	2200	4100	8.9	76.4	12.7	56.2	154
12	960	1300	2300	11	85	15	77	190
13	1100	1500	2600	7	72	15	63	160
14	NR	NR	800	7	58.3	11.1	48.5	124.9
15	NT	NT	NT	13	103	14	79	209
16	880	1153	2033	9.88	90.7	16.69	75.25	192.52
17	NR	NR	2964	8	79	13	60	160
18	810	1210	2020	10	87	16	69	180
19	740	1000	1700	10	83	16	62	170
20	928.44	1261.62	2190.06	8.56	84.21	14.16	60.7	167.63
21	NR	NR	1900	10.4	84.7	15	64.7	176
22	790	1130	1920	10.74	90.78	17.00	79.49	198.01
23	1200	1700	2900	8	80	15	66	170
24	1100	1600	2700	9	78	15	60	160
25	1300	1700	3000	10	78	15	65	170
26	NS	NS	NS	NS	NS	NS	NS	NS
27	NT	NT	NT	9.8515	64.7501	16.7658	72.224	163.5912
28	NT	NT	NT	NT	NT	NT	NT	NT
29	840	1100	2000	9.7	79	15	63	170

*All values are in µg/L. Shaded cells are results which returned a questionable or unacceptable *z*-score. AV = Assigned Value; NT = Not Tested; NS = Not Supplied; NR = Not Reported.

Table 37 Summary of Participants' Results for Sample S3 Scored Analytes*

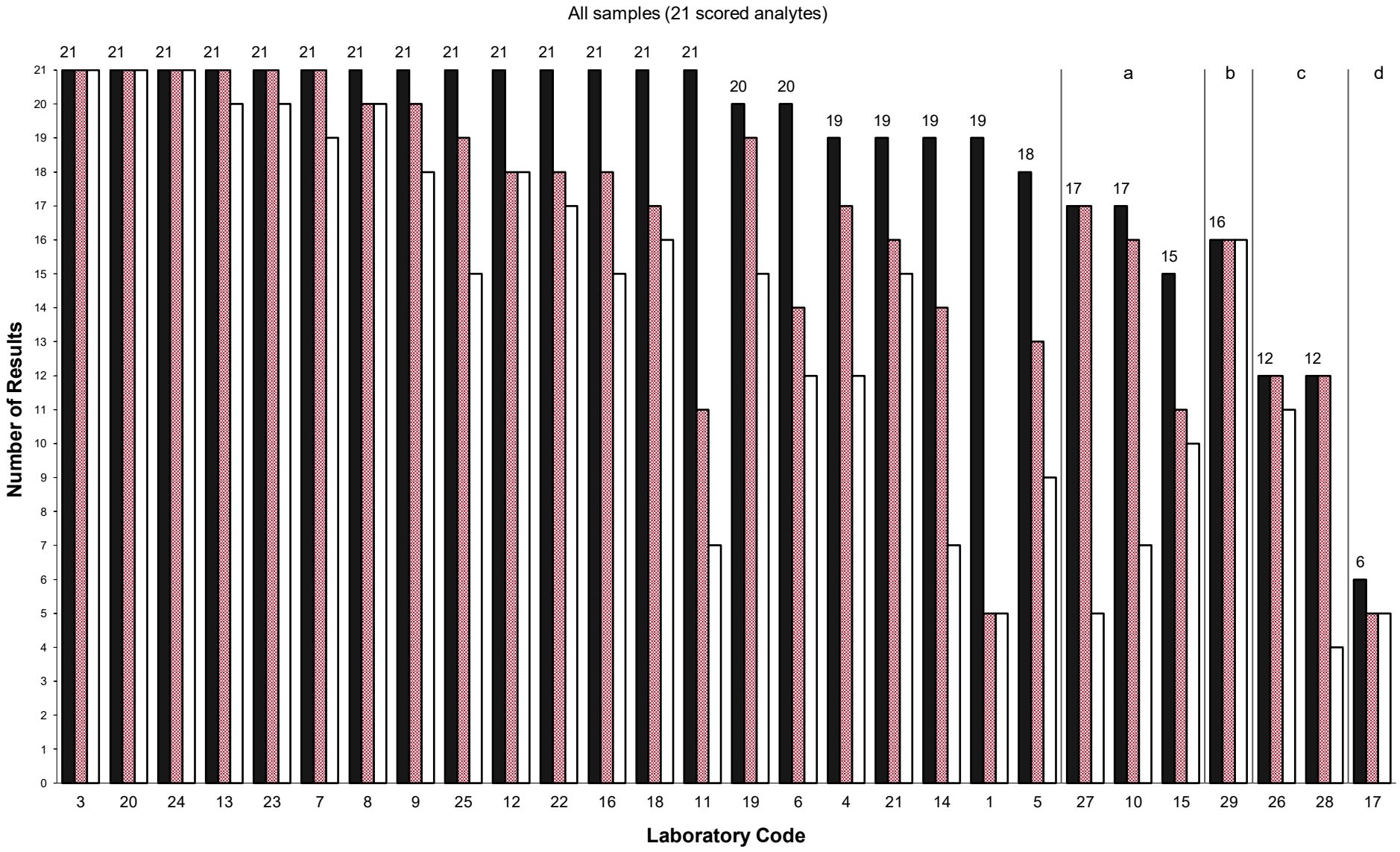
Lab. Code	Acenaphthene	Anthracene	Benz[*a*]anthracene	Benzo[*a*]pyrene	Benzo[*b*]fluoranthene	Fluoranthene	Phenanthrene	Pyrene
AV	17.7	3.67	7.6	4.25	15.3	10.3	2.07	3.50
1	8.3	2.2	3.1	1.3	4.4	6.2	1.2	2
3	16.0	3.6	8.1	5.0	17.3	11.8	2.3	3.9
4	16.8	3.7	7.6	5.3	17.5	10.6	2.3	3.7
5	14.6	3.2	5.6	2.9	NT	8.9	1.8	2.9
6	<0.01	3.68	11.91	3.32	22.16	13.46	2.22	3.56
7	19.1	3.86	7.44	4.49	16.7	11.8	2.43	3.95
8	14.5	3.5	7.8	4.71	15.5	10.2	2	3.4
9	17.03	3.6	7.98	4.4	8.6	9.63	2.15	3.29
10	14.0928	3.0144	<0.01	4.4215	15.7883	8.8714	1.6406	2.8232
11	24.2	4.6	11.5	6.9	11.9	13.6	3.3	4.6
12	21	4.0	4.1	2.5	7.4	10	2.2	4.0
13	18	3.5	7.6	4.9	16	9.7	2.1	3.3
14	21	4.83	9.32	6.07	21.4	16.2	2.22	5.37
15	19.1	3.8	16.1	9.1	16.1	3.6	2	4.3
16	20.99	3.76	4.75	2.45	7.61	10.06	2.32	3.74
17	NS	NS	NS	NS	NS	NS	NS	NS
18	21.3	4.3	4.8	2.3	10	10.0	2.3	3.6
19	15	3.5	8.9	2.9	NT	9.7	1.8	3.5
20	17.429	3.728	8.39	5.32	17.836	11.255	2.179	3.483
21	17.3	3.78	6.4	4.3	14	10.2	2.01	3.16
22	20.55	3.61	4.6	2.44	7.66	10.19	2.34	3.62
23	19	3.4	8.2	5.6	15	11	1.9	3.8
24	18	3.4	8.6	4.9	17	11	2.1	3.7
25	15	3.5	9.4	4.7	25	11	2.1	3.7
26	20	4.5	9.8	5.1	20	12	2.3	4
27	16.4015	3.3756	<0.01	4.3424	15.3061	9.3027	1.7785	2.9316
28	12.9307	2.8438	<0.01	3.5321	13.927	8.9651	1.5332	2.7465
29	15.36	4.24	8.7	5.26	16.87	9.52	1.94	2.96

*All values are in µg/L. Shaded cells are results which returned a questionable or unacceptable *z*-score. AV = Assigned Value; NT = Not Tested; NS = Not Supplied.

Table 38 Summary of Participants' Results for Sample S4 Scored Analytes*

Lab	2-Methylphenol	3 & 4-Methylphenols (total)	2,4-Dichlorophenol	2,6-Dichlorophenol	Pentachlorophenol
AV	7.86	7.1	10.2	4.36	37.8
1	3.3	3.2	2.9	< 1.0	< 2.0
3	7.4	8.3	9.8	4.0	31
4	6.4	5.96	6.8	7.8	29
5	5.6	5.2	6.0	<1.0	<2.0
6	7.7	3.3	8.3	3	45.5
7	10.3	4.88	11.1	4.25	35.4
8	7.7	8	10.4	4.3	22.3
9	9.73	9.74	12.11	5.09	44.21
10	8.0619	6.2663	13.2853	5.2387	4.6068
11	15.8	15.3	11.9	4.4	39.3
12	7.5	6	14	5.0	35
13	9	9	9	3	30
14	12.9	12.2	13.4	6.16	41.5
15	NT	NT	10.7	<10	33.8
16	4.8	4.95	7.25	4.01	45.52
17	NS	NS	NS	NS	NS
18	9.5	10.7	13	6.4	48
19	6.7	7.9	7.1	3.5	37
20	9.5	8.433	10.967	4.6	39.633
21	26.3	18.3	17.2	5.5	23.3
22	5.08	5.29	7.83	3.53	44.48
23	9	9	9	4	40
24	10	8	12	5	35
25	7	4	9	4	51
26	9	9	11	< 5.1	29
27	6.4997	7.1775	9.2775	2.6256	43.0875
28	8.1653	5.1869	10.5206	4.5091	42.321
29	NS	NS	NS	NS	NS

*All values are in µg/L. Shaded cells are results which returned a questionable or unacceptable *z*-score. AV = Assigned Value; NT = Not Tested; NS = Not Supplied.



a) Samples S2, S3, and S4 only (18 scored analytes); b) Samples S1, S2, and S3 only (16 scored analytes); c) Samples S3 and S4 only (13 scored analytes); d) Samples S1 and S2 only (8 scored analytes)

Figure 45 Summary of Participants' Performance

6.10 Comparison with Previous Studies

TRH

A summary of acceptable *z*-scores and E_n-scores, presented as a percentage of the total number of scores for each study, obtained by participants for TRH in river water over the last 10 scored studies (2015–2025) is presented in Figure 46. Over this period, the proportion of acceptable scores has fluctuated, with averages of 75% and 64% respectively for *z*-scores and E_n-scores. This study has one of the lower proportions of acceptable scores for TRH over this period; concentration was slightly higher in this study than most previous studies.

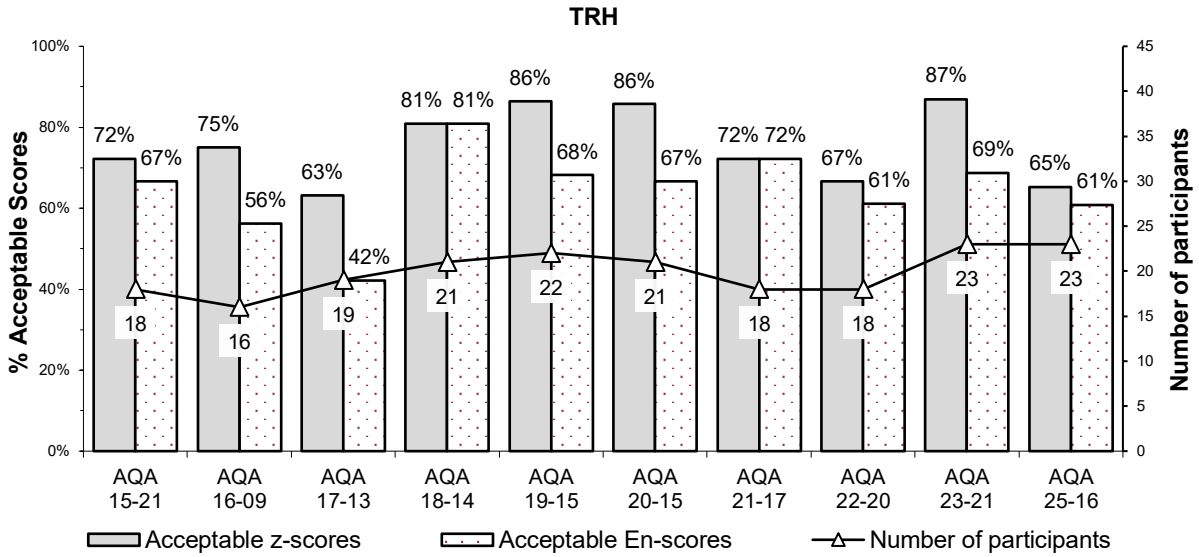


Figure 46 Summary of Acceptable Scores for TRH in River Water PT Studies

Total BTEX

A summary of acceptable *z*-scores and E_n-scores, presented as a percentage of the total number of scores for each study, obtained by participants for total BTEX in river water over the last 10 studies (2016–2025) is presented in Figure 47. Over this period, the proportion of acceptable scores has remained high, with an average proportion of 94% and 87% for *z*-scores and E_n-scores respectively. The proportion of acceptable scores in this study is above average.

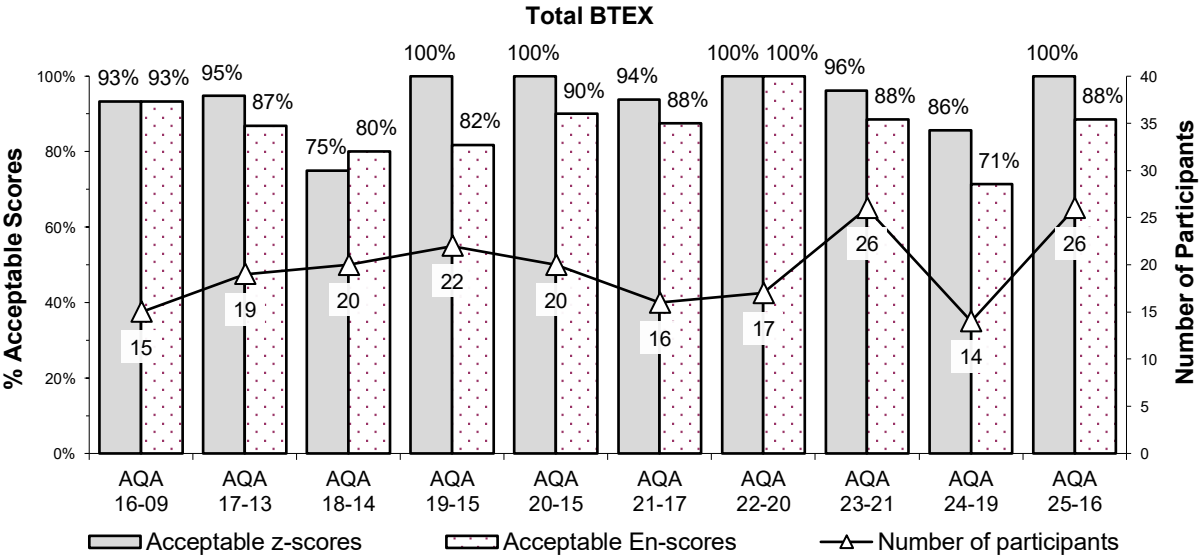


Figure 47 Summary of Acceptable Scores for Total BTEX in River Water PT Studies

PAHs

A summary of acceptable *z*-scores and E_n-scores, presented as a percentage of the total number of scores for each study, obtained by participants for PAHs in river water over the last 10 studies (2016–2025) is presented in Figure 48. Over this period, the proportion of acceptable scores has remained fairly consistent, with an average proportion of 87% and 80% for *z*-scores and E_n-scores respectively. However, this study has one of the lower proportions of acceptable scores for both *z*-scores and E_n-scores.

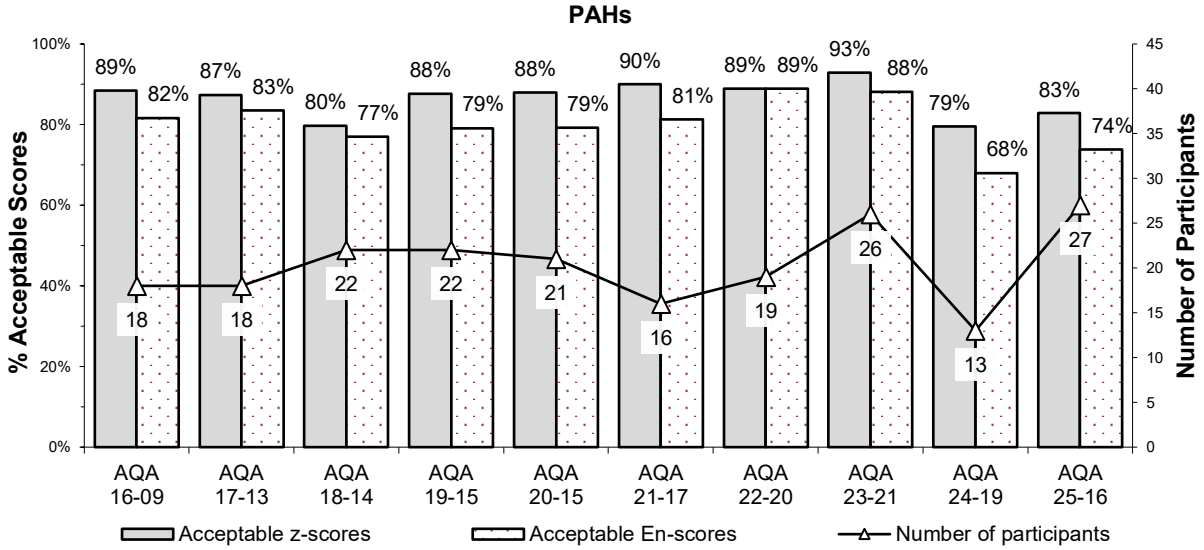
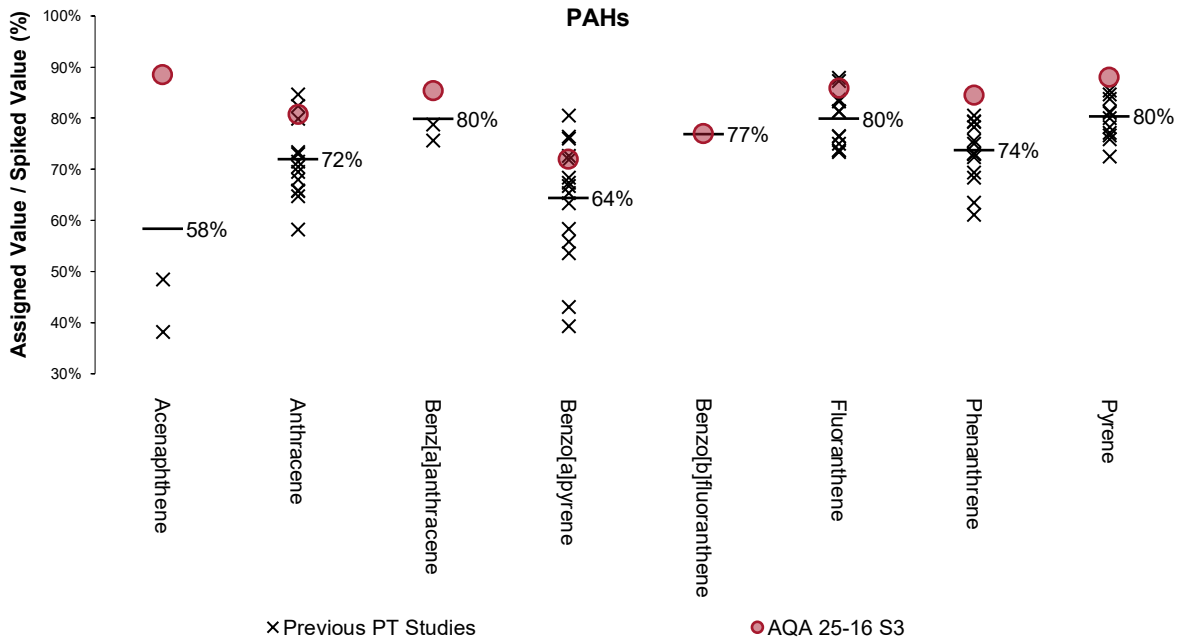


Figure 48 Summary of Acceptable Scores for PAHs in River Water PT Studies

A plot of the assigned value (or robust average where no assigned value was set), expressed as a percentage of the spiked value, for PAHs in river water since 2015 is presented in Figure 49. This is the first study in which benzo[*b*]fluoranthene had been spiked into a river water sample. Participants in this study returned results closer to the spiked values for acenaphthene, benz[*a*]anthracene, phenanthrene, and pyrene compared to participants in previous studies with all performance across all analytes improving against the average since 2015.



Lines indicate the average for each PAH. Where no assigned value was set, the robust average was used instead.

Figure 49 Ratio of Assigned Value to Spiked Value for PAHs in River Water PT Studies

Phenols

A summary of acceptable *z*-scores and E_n-scores, presented as a percentage of the total number of scores for each study, obtained by participants for phenols in river water over the last 2 studies (2023–2025) is presented in Figure 50. Participants performed similarly across both studies.

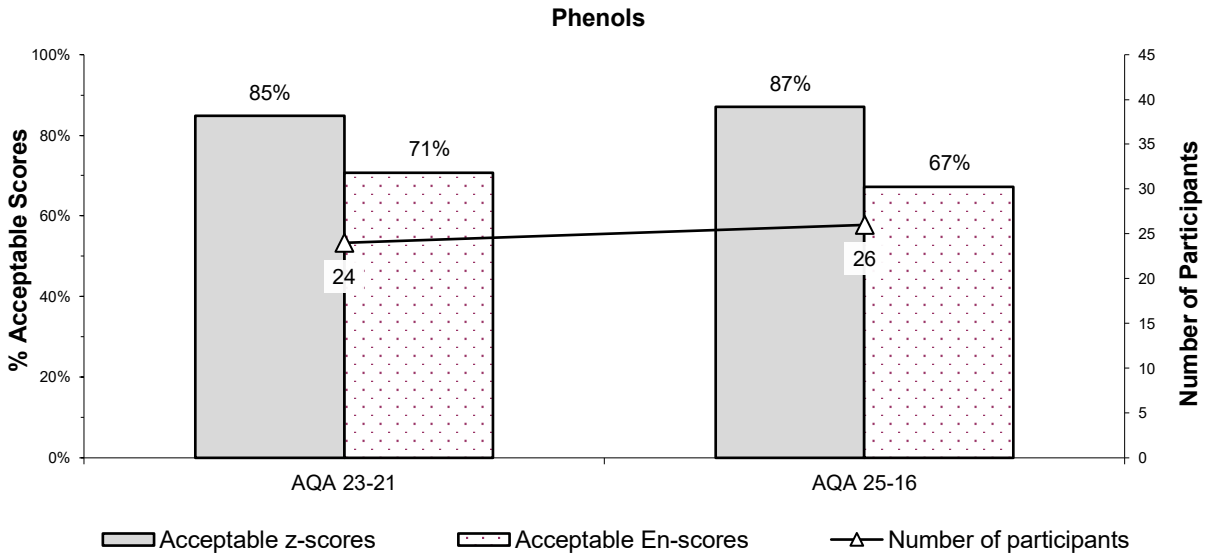
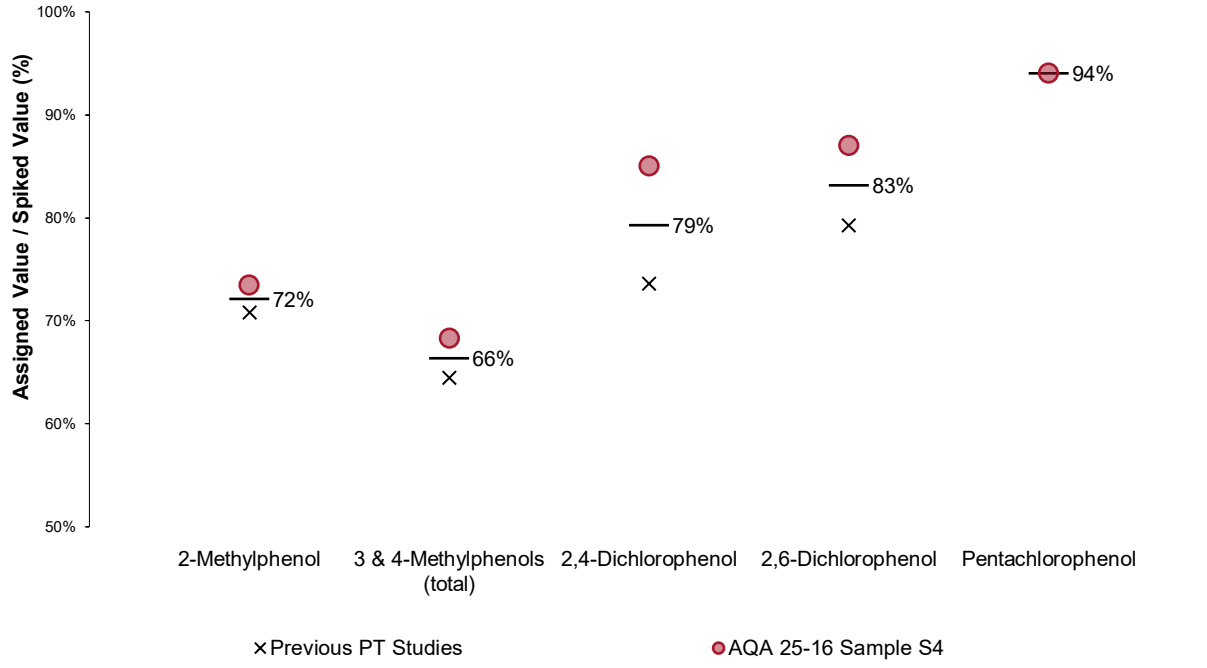


Figure 50 Summary of Acceptable Scores for Phenols in River Water PT Studies

Figure 51 presents a plot of assigned value and spike value ratio for scored analytes in the study over the last 2 studies. This study marks the first time pentachlorophenol has been spiked into river water and participants results were much closer to the spiked value in comparison to the other analytes spiked into the same sample; this may also be due to the higher level this analyte was spiked at. For all other analytes, participants' results were closer to the spiked value as compared to the previous study.



Lines indicate the average for each phenol.

Figure 51 Ratio of Assigned Value to Spiked Value for Phenols in River Water PT Studies

Measurement Uncertainties

As discussed in Section 6.2, it is a requirement of ISO/IEC 17025 that laboratories report their uncertainties if the client's instruction so requires.[9] Figure 52 presents a summary of the relative uncertainties as reported by participants over the last 10 studies (2016–2025). Over this period, 91% of participants reported that they were accredited to ISO/IEC 17025, and the vast majority (93%) of numeric results were reported with uncertainties.

The proportion of participants reporting that they are accredited to ISO/IEC 17025 remains high in this study. The proportion of results reported without uncertainties in this study was lower than for the previous study, however still relatively high compared to the average over the last 10 studies.

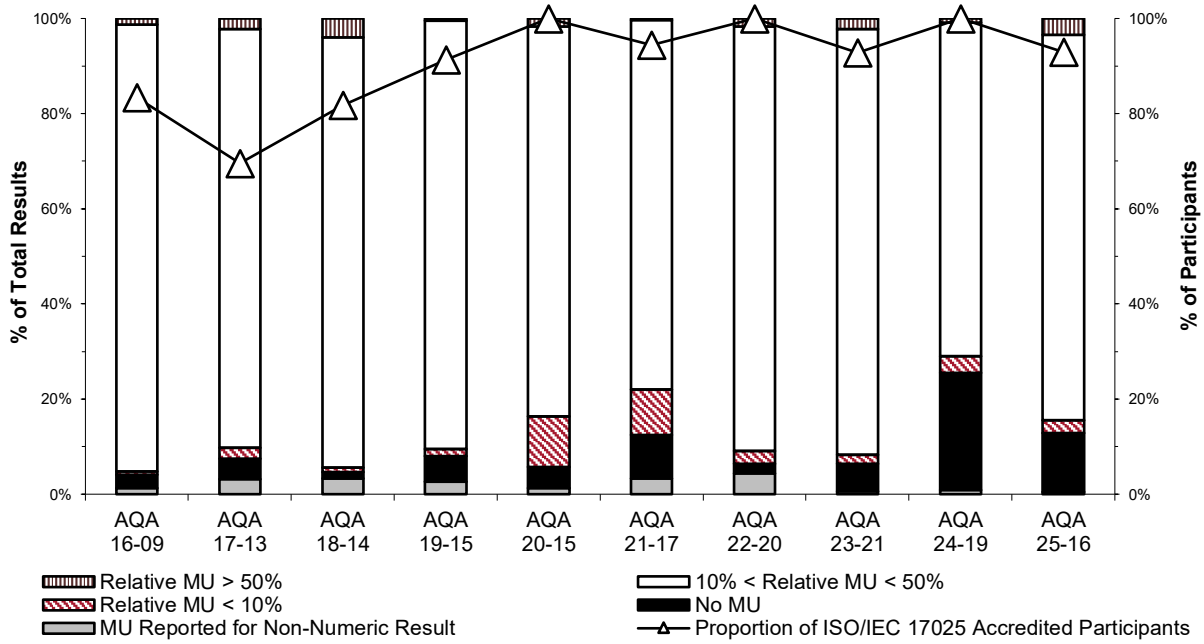


Figure 52 Summary of Participants' Relative Uncertainties for NMIA Hydrocarbons and Phenols in River Water PT Studies

7 REFERENCES

Please note that for all undated references, the latest edition of the referenced document (including any amendments) applies.

[1] ISO/IEC 17043, *Conformity assessment – General requirements for the competence of proficiency testing providers.*

[2] Commonwealth of Australia, Department of Industry, Science and Resources, NMIA, 2025, *Study Protocol for Proficiency Testing,* viewed December 2025, <https://www.industry.gov.au/sites/default/files/2020-10/cpt_study_protocol.pdf>

[3] Commonwealth of Australia, Department of Industry, Science and Resources, NMIA, 2025, *Statistical Manual*, viewed December 2025, <https://www.industry.gov.au/sites/default/files/2019-07/cpt_statistical_manual.pdf>

[4] Thompson, M., Ellison, S.L.R., & Wood, R., 2006, 'The International Harmonized Protocol for the Proficiency Testing of Analytical Chemistry Laboratories', *Pure Appl. Chem.,* vol 78, pp 145–196.

[5] National Environment Protection Council, National Environment Protection (Assessment of Site Contamination) Measure 1999 as amended 2013, viewed December 2025, <https://www.legislation.gov.au/F2008B00713/latest/text/12>

[6] La Greca, B., 1996, 'Storage Stability Study: Petrol BTEX Residues in Water', *ACSL Public Interest Project*, AGAL.

[7] ISO 13528, *Statistical methods for use in proficiency testing by interlaboratory comparison*.

[8] Thompson, M., 2000, 'Recent trends in inter-laboratory precision at ppb and sub-ppb concentrations in relation to fitness for purpose criteria in proficiency testing', *Analyst*, vol 125, pp 385–386.

[9] ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories.*

[10] Eurachem/CITAC Guide CG 4, QUAM:2012.P1, *Quantifying Uncertainty in Analytical Measurement*, 3rd edition, viewed December 2025, <http://www.eurachem.org/images/stories/Guides/pdf/QUAM2012_P1.pdf>

[11] ASTM E2554-18(2024)e1, *Standard Practice for Estimating and Monitoring the Uncertainty of Test Results of a Test Method Using Control Chart Techniques*, viewed December 2025, <https://store.astm.org/e2554-18r24e01.html>

[12] USEPA, 1984, *Method 610: Polynuclear Aromatic Hydrocarbons*.

[13] BIPM, JCGM 200:2012, *International vocabulary of metrology – Basic and general concepts and associated terms (VIM)*, 3rd ed.

APPENDIX 1 SAMPLE PREPARATION

A1.1 Diesel Fuel and River Water Preparation

Diesel fuel was purchased from a local retail outlet and treated to remove volatiles. Treatment continued until the GC-FID chromatogram indicated that essentially all the hydrocarbons eluting before C_{10} had been removed.

Water was sampled from Brown's Waterhole at Turramurra and filtered through a glass fibre filter. After filtration, the water was autoclaved.

The bottles used for S1, S3, and S4 were rinsed with acetone and heated to 140°C overnight.

A1.2 Test Sample Preparation

Sample S1 TRH

A spiking solution was prepared using the treated diesel fuel. Each bottle was filled with filtered and autoclaved river water (498.5 ± 0.2 g). An aliquot of the spiking solution was added to each bottle.

Sample S2 BTEX

A spiking solution was prepared using the treated diesel fuel and unleaded petrol. Each vial was filled with filtered and autoclaved river water (41.88 ± 0.05 g). An aliquot of the spiking solution was added to each bottle.

Sample S3 PAHs

A composite spiking solution was prepared using eight PAHs standards. Each bottle was filled with filtered and autoclaved river water to be either 500 mL (498.6 g ± 1.5 g) or 100 mL (99.7 g ± 0.3 g). An aliquot of the spiking solution was added to each bottle, proportional to the amount of river water.

Sample S4 Phenols

A composite spiking solution was prepared using five phenol standards. Each bottle was filled with filtered and autoclaved river water (98.42 g ± 0.05 g). An aliquot of spiking solution was added to each bottle.

All bottles and vials were immediately capped after spiking, labelled with fill order, and shrink-wrapped. Between preparation and dispatch, the samples were stored at 4ºC.

APPENDIX 2 ASSESSMENT OF HOMOGENEITY AND STABILITY

A2.1 Homogeneity

No homogeneity testing was completed for this study, as the samples were prepared using a process previously demonstrated to produce sufficiently homogeneous samples for similar analytes and matrices. Results returned by participants also gave no reason to question these samples' homogeneity.

A2.2 Stability

No stability testing was conducted for this study as the samples were stored and dispatched using a process previously demonstrated to produce sufficiently stable samples for similar analytes and matrices.

Results returned by participants also gave no reason to question the samples' stability. Comparisons of *z*-scores to days in transit are presented in Figures 53 to 67 for scored analytes (results excluded from statistics in Section 5 have also been excluded in this section and all *z*-scores greater than 10.0 have been plotted at 10.0).

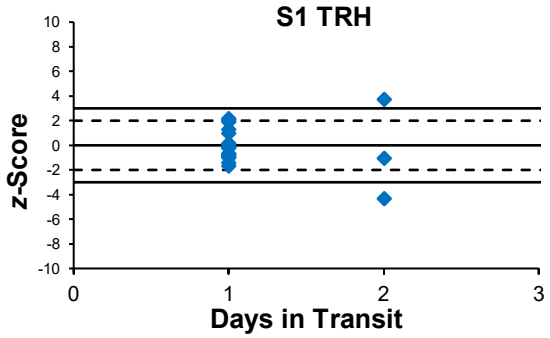


Figure 53 S1 TRH vs Transit Days

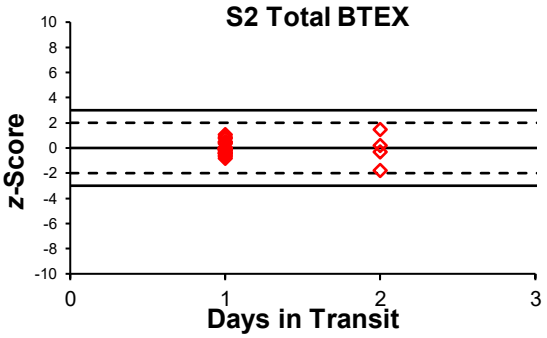


Figure 54 S2 Total BTEX vs Transit Days

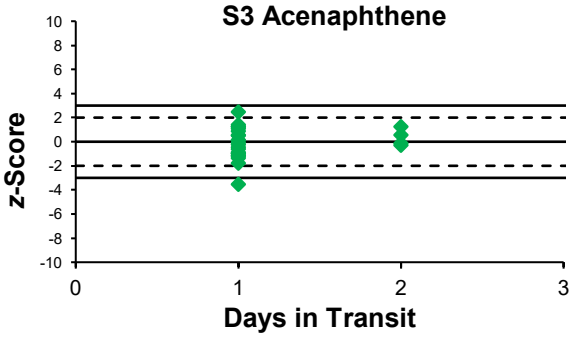


Figure 55 S3 Acenaphthene vs Transit Days

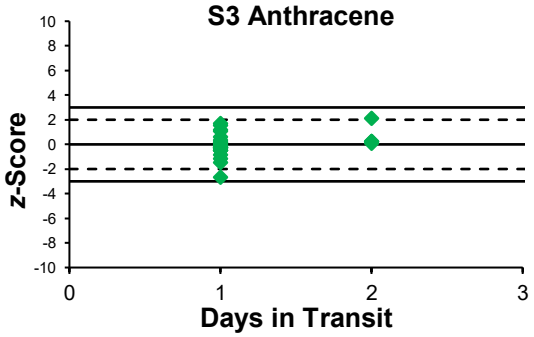


Figure 56 S3 Anthracene vs Transit Days

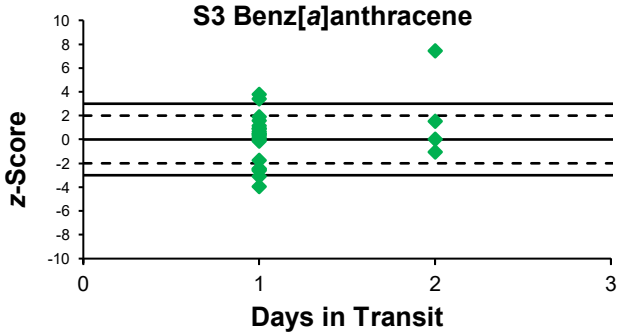


Figure 57 S3 Benz[*a*]anthracene vs Transit Days

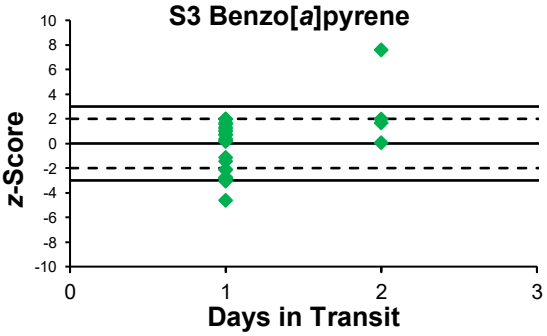


Figure 58 S3 Benzo[*a*]pyrene vs Transit Days

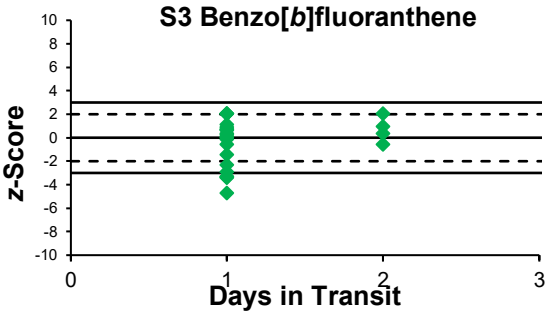


Figure 59 S3 Benzo[*b*]fluoranthene vs Transit Days

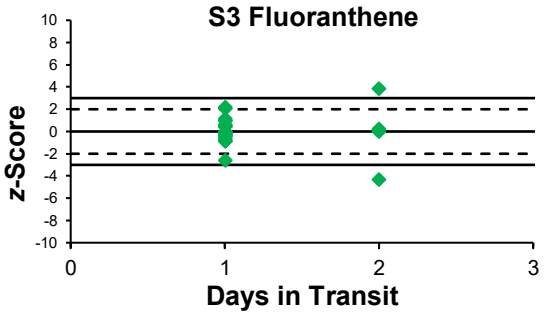


Figure 60 S3 Fluoranthene vs Transit Days

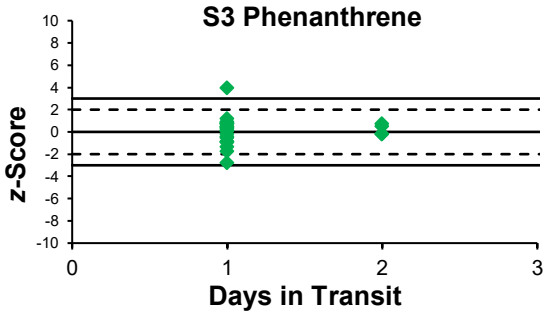


Figure 61 S3 Phenanthrene vs Transit Days

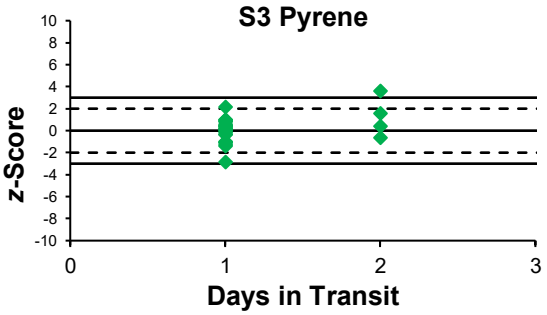


Figure 62 S3 Pyrene vs Transit Days

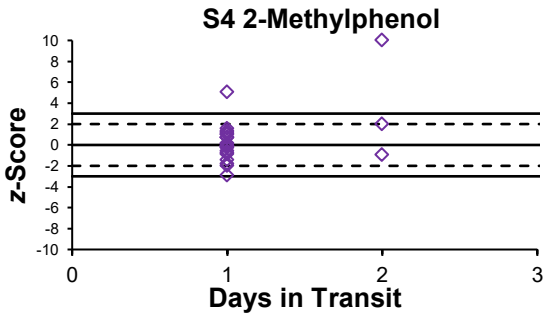


Figure 63 S4 2-Methylphenol vs Transit Days

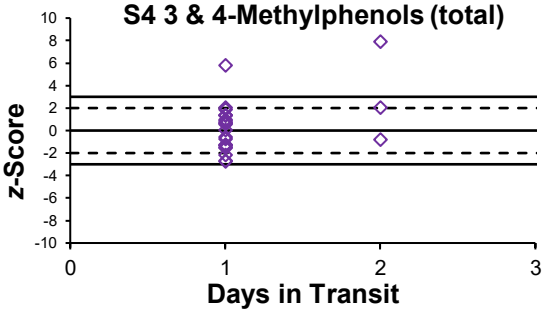


Figure 64 S4 3 & 4-Methylphenols (total) vs Transit Days

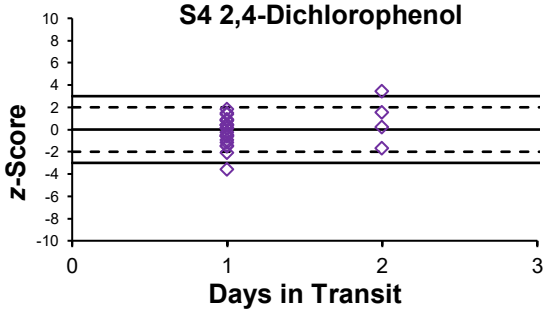


Figure 65 S4 2,4-Dichlorophenol vs Transit Days

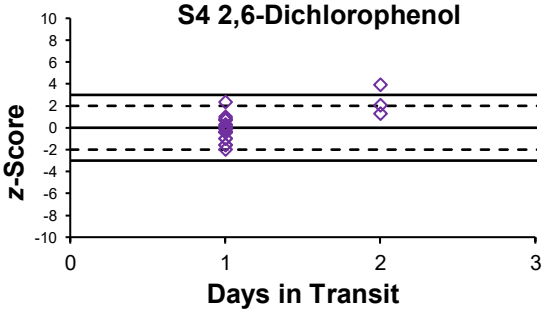


Figure 66 S4 2,6-Dichlorophenol vs Transit Days

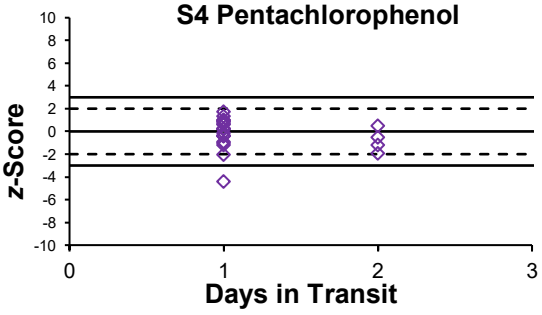


Figure 67 S4 Pentachlorophenol vs Transit Days

APPENDIX 3 ROBUST AVERAGE AND ASSOCIATED UNCERTAINTY, z-SCORE AND E_n-SCORE CALCULATIONS

A3.1 Robust Average and Associated Uncertainty

Robust averages were calculated using the procedure described in ISO 13528.[7] The associated uncertainties were evaluated as according to Equation 4.

$$u_{rob\ av} = 1.25 \times \frac{S_{rob\ av}}{\sqrt{p}} \qquad \textit{Equation 4}$$

where:

$u_{rob\ av}$ is the standard uncertainty of the robust average

$S_{rob\ av}$ is the standard deviation of the robust average

p is the number of results

The expanded uncertainty ($U_{rob\ av}$) is the standard uncertainty multiplied by a coverage factor of 2 at approximately 95% confidence level.

A worked example is set out below in Table 39 (values have been rounded in this table, however exact values were used for calculations).

Table 39 Uncertainty of the Robust Average for Sample S2 Toluene

Number of results (p)	26
Robust Average	81.0 µg/L
$S_{rob\ av}$	7.5 µg/L
$u_{rob\ av}$	1.8 µg/L
k	2
$U_{rob\ av}$	3.7 µg/L

Therefore, the robust average for toluene in Sample S2 is 81.0 ± 3.7 µg/L.

A3.2 z-Score and E_n-Score Calculation

For each participant's result, a z-score and E_n-score are calculated according to Equations 2 and 3 respectively (Section 4).

A worked example is set out below in Table 40.

Table 40 z-Score and E_n-Score for Sample S3 Pyrene Result Reported by Laboratory 9

Participant Result (µg/L)	Assigned Value (µg/L)	Standard Deviation for Proficiency Assessment	z-Score	E_n-Score
3.29 ± 0.82	3.50 ± 0.25	15% as PCV, or: 0.15 × 3.50 = 0.525 µg/L	$z = \frac{3.29 - 3.50}{0.525} = -0.40$	$E_n = \frac{3.29 - 3.50}{\sqrt{0.82^2 + 0.25^2}} = -0.24$

APPENDIX 4 PARTICIPANTS' TEST METHODS

Participants were requested to provide information about their test methods. Responses are presented in Tables 41 to 49. Some responses may be modified so that the participant cannot be identified.

Table 41 Methodology – Sample S1 TRH

Lab. Code	Sample Volume (mL)	Was the bottle rinsed?	Extraction Technique	Extraction Solvent	Extraction Time (min)	Extraction Volume and Number of Steps	Extract Concentration Technique	Extract Concentration Time (min)	Extract Concentration Temperature (°C)	Clean-Up	Measurement Technique
1	500	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	4	3 x 6 mL	Syncore Concentrator	34	65		GC-FID
4	100	N/A	Liquid-Liquid (Mechanical Agitation)	Hexane	20mins in total	Step 1: 5mls and step 2: 2.5mls	Evaporation under nitrogen	Not set	40	Nil	GC-FID
5	100 mL	N/A	Liquid-Liquid (Mechanical Agitation)	DCM	3 x 10 minutes	6 mL DCM for each step - final extract 18 mL	KD concentration	5 minutes	85 °C	N/A	GC-FID
6	500	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	3	1x 40mL		N/A	N/A	N/A	GC-FID
7	100	No	Liquid-Liquid (Mechanical Agitation)	DCM						NO	GC-FID
8	500	Yes	Liquid-Liquid (Mechanical Agitation)	Methylene Chloride	20	30 mL and 3 times	Water bath	10	89	No	GC-FID
9	40 mL	N/A	Liquid-Liquid (Mechanical Agitation)	Hexane - Pentane (80:20)			Evaporation under nitrogen				GC-FID
12	35		Liquid-Liquid (Mechanical Agitation)	DCM	10	2mL x 1					GC-FID
13	500	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	10	3 x 10mL	Evaporation under nitrogen	approx 40min	35	none	GC-FID
14	40	No	Liquid-Liquid (Mechanical Agitation)	Hexane	NA	0.5mL final V	Evaporation under nitrogen	NA	35	NA	GC-FID
16	35	N/A	Liquid-Liquid (Mechanical Agitation)	DCM	30	1 x 35	Evaporation under nitrogen	30	45	None	GC-MS/MS
17	250	No	Liquid-Liquid (Mechanical Agitation)	Dichloromethane	120	10mL	NA				GC-FID
18	35	N/A	Liquid-Liquid (Mechanical Agitation)	DCM	30	1 x 35	Evaporation under nitrogen	30	45	None	GC-MS/MS
19	50	N/A	Liquid-Liquid (Mechanical Agitation)	Hexane			Water bath			No	GC-FID

Lab. Code	Sample Volume (mL)	Was the bottle rinsed?	Extraction Technique	Extraction Solvent	Extraction Time (min)	Extraction Volume and Number of Steps	Extract Concentration Technique	Extract Concentration Time (min)	Extract Concentration Temperature (°C)	Clean-Up	Measurement Technique
20	500	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	10	1 x 20 mL	N/A	N/A	N/A	N/A	GC-FID
21	500	Yes	Liquid-Liquid (Mechanical Agitation)	Dichloromethane	10					Silica	GC-FID
22*	35	N/A	Liquid-Liquid (Mechanical Agitation)	DCM	10	1 x 2ml	Direct	10	23	N/A	GC-FID
23	500	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	3	2 x 50mL	Evaporation under Argon	40	42	None	GC-FID
24	500	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	10	3x10 mL	Evaporation under nitrogen	38	35	None	GC-FID
29	100	No	Liquid-Liquid (Mechanical Agitation)	DCM	10	15 mL x 2	Evaporation under nitrogen	30 min	35		GC-MS

* Additional information provided in Table 42.

Table 42 Methodology – Sample S1 TRH Additional Information

Lab. Code	Methodology Additional Information
22	USEPA 8015

Table 43 Methodology – Sample S2 BTEX

Lab. Code	Blank Subtracted?	Dilution?	Measurement Technique
1	No		P&T GC-MS
4	Yes	N/A	Headspace GC-MS
5	No		P&T GC-MS
6	Yes	No	P&T GC-MS
7	No		P&T GC-MS
8	No	No	P&T GC-MS
9	No		Headspace GC-MS
10*	No	No	P&T GC-MS
11	Yes	no	Headspace GC-MS
12	No		P&T GC-MS

Lab. Code	Blank Subtracted?	Dilution?	Measurement Technique
13	No	Toluene from x5	P&T GC-MS
14	Yes	NA	Headspace GC-MS
15	No	yes	Headspace GC-MS
16	No	Yes, 10x	P&T GC-MS
17	No	No	P&T GC-MS
18	No	Yes, 10x	P&T GC-MS
19	Yes		P&T GC-MS
20	No	No	P&T GC-MS
21	No		P&T GC-MS
22*	No	No	P&T GC-MS
23	No	5 and 10	P&T GC-MS
24*	No	Toluene from x10	P&T GC-MS
26	NS	NS	NS
27*	No	No	P&T GC-MS
28*	No	No	P&T GC-MS
29	No	No	P&T GC-MS

* Additional information provided in Table 44.

Table 44 Methodology – Sample S2 BTEX Additional Information

Lab. Code	Methodology Additional Information
10	Direct Injection
22	USEPA 8260
24	USEPA 8260
27	Direct Injection
28	Direct Injection

Table 45 Methodology – Sample S3 PAHs

Lab. Code	Sample Volume (mL)	Was the bottle rinsed?	Extraction Technique	Extraction Solvent	Extraction Time (min)	Extraction Volume and Number of Steps	Extract Concentration Technique	Extract Concentration Time (min)	Extract Concentration Temperature (°C)	Type of Internal Standard Used	Please specify the internal standard used	Measurement Technique
1	100	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	4	3 x 6mL	Syncore Concentrator	34	65	PAHs	Naphthalene-D8, Acenapthene-D10, Phenanthrene-D10, Chrysene-D12, Perylene-D12	GC-MS
4	250	N/A	Liquid-Liquid (Mechanical Agitation)	Dichloromethane	45mins in total	Step 1: 10mls, step 2: 5ml and step 3: 5mls	Evaporation under nitrogen	Not set	40	Deuterated PAHs	In-house OC/PAH ISTD mix	GC-MS/MS
5	100 mL	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	3 x 10 minutes	6 mL DCM for each step - final extract 18 mL	KD concentration	5 minutes	85 °C	SV Internal Standard Mix	1,4-dichlorobenzene-d4, Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12, Perylene-d12	GC-MS/MS
6	105mL	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	3	2x 10ml		NA	NA	PAHs	Accustandard	GC-MS/MS
7	80	No	Liquid-Liquid (Mechanical Agitation)	DCM								GC-MS
8	100	Yes	Liquid-Liquid (Mechanical Agitation)	Methylene Chloride	20	6 mL and 3 times	Water bath	20	50	PAHs	Semi volatile Internal standard mixture	GC-MS
9	30 mL	No	Liquid-Liquid (Mechanical Agitation)	Hexane			Evaporation under nitrogen			PAHs	PAH internal standard mix	GC-MS
10	500	No	SPE	DCM/ EtOAc	25	25mL, 10 steps	Evaporation under nitrogen	25	35		Method 525.2 Int. Std. Mix.	GC-MS
12	35		Liquid-Liquid (Mechanical Agitation)	DCM	10	2mL x 1				PAHs		GC-MS/MS

Lab. Code	Sample Volume (mL)	Was the bottle rinsed?	Extraction Technique	Extraction Solvent	Extraction Time (min)	Extraction Volume and Number of Steps	Extract Concentration Technique	Extract Concentration Time (min)	Extract Concentration Temperature (°C)	Type of Internal Standard Used	Please specify the internal standard used	Measurement Technique
13	100	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	10	3 x 10mL	Evaporation under nitrogen	approx 40 minutes	35	PAHs	Deuterated 8270 Internal Standard Mix	GC-MS
14	40	No	Liquid-Liquid (Mechanical Agitation)	Hexane	NA	0.5mL final V	Evaporation under nitrogen	NA	35	PAHs	Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12	GC-MS
15	200	No	liquid-liquid extraction	Dichloromethane		60 mL, 3 steps (3 x 20 mL)	Rotavap		38	PAHs	d10-Phenanthrene	GC-MS/MS
16	35	N/A	Liquid-Liquid (Mechanical Agitation)	DCM	30	1 x 35mL	Evaporation under nitrogen	30	45	PAHs	Naphthalene-D8, Acenaphthene-D10, Perylene-D12	GC-MS/MS
18	35	N/A	Liquid-Liquid (Mechanical Agitation)	DCM	30	1 x 35mL	Evaporation under nitrogen	30	45	PAHs	Naphthalene-D8, Acenaphthene-D10, Perylene-D12	GC-MS/MS
19	50	N/A	Liquid-Liquid (Mechanical Agitation)	DCM			Water bath			PAHs	Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12	GC-MS
20	30	No	Liquid-Liquid (Mechanical Agitation)	DCM	90	1 x 1.5 mL	N/A	N/A	N/A	PAHs	Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12, Perylene-d12	GC-MS/MS
21	500	Yes	SPE	dichloromethane/ ethyl acetate 1;1			Evaporation under nitrogen		40	PAHs	phenanthrene-d10, acenapthene-d10, chrysene-d12	GC-MS/MS
22*	35	N/A	Liquid-Liquid (Mechanical Agitation)	DCM	10	1 x 2ml	Direct	10	23	PAHs	Naphthalene-d8 / Acenaphthene-d10 /Chrysene-d12 /Perylene-d12	GC-MS/MS

Lab. Code	Sample Volume (mL)	Was the bottle rinsed?	Extraction Technique	Extraction Solvent	Extraction Time (min)	Extraction Volume and Number of Steps	Extract Concentration Technique	Extract Concentration Time (min)	Extract Concentration Temperature (°C)	Type of Internal Standard Used	Please specify the internal standard used	Measurement Technique
23	100	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	3	2 x 10mL	Evaporation under Argon	40	42	PAHs	Deuterated PAHs	GC-MS
24*	100	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	38	3x10 mL	Evaporation under nitrogen	38	35	PAHs	Deuterated 8270 Internal Standard Mix	GC-MS/MS
26	501	Yes	Liquid-Liquid (Mechanical Agitation)	Dichloromethane	10	100mL, 100mL, 30mL	Evaporation under nitrogen	20	40	PAHs	Deuterated PAH	GC-MS/MS
27	500	No	SPE	DCM/ EtOAc	25	25mL, 10 steps	Evaporation under nitrogen	25	35		Method 525.2 Int. Std. Mix.	GC-MS
28	500	No	SPE	DCM/ EtOAc	25	25mL, 10 steps	Evaporation under nitrogen	25	35		Method 525.2 Int. Std. Mix.	GC-MS
29	100	No	Liquid-Liquid (Mechanical Agitation)	DCM	10	15 mL x 2	Evaporation under nitrogen	30	35	PAHs	ISO 17034	GC-MS

* Additional information provided in Table 46.

Table 46 Methodology – Sample S3 PAHs Additional Information

Lab. Code	Methodology Additional Information
22	USEPA 8270
24	USEPA 8270

Table 47 Methodology – Sample S4 Phenols

Lab. Code	Sample Volume (mL)	Was the bottle rinsed?	pH adjustment?	Extraction Technique	Extraction Solvent	Extraction Time (min)	Extraction Volume and Number of Steps	Extract Concentration Technique	Extract Concentration Time (min)	Extract Concentration Temperature (°C)	Type of Internal Standard Used	Please specify the internal standard used	Measurement Technique
1	100	Yes	No	Liquid-Liquid (Mechanical Agitation)	DCM	4	3 x 6mL	Syncore Concentrator	34	65	PAHs	Naphthalene-D8, Acenapthene-D10, Phenanthrene-D10, Chrysene-D12, Perylene-D12	GC-MS

Lab. Code	Sample Volume (mL)	Was the bottle rinsed?	pH adjustment?	Extraction Technique	Extraction Solvent	Extraction Time (min)	Extraction Volume and Number of Steps	Extract Concentration Technique	Extract Concentration Time (min)	Extract Concentration Temperature (°C)	Type of Internal Standard Used	Please specify the internal standard used	Measurement Technique
4*	100	No	Yes	Liquid-Liquid (Mechanical Agitation)	Dichloromethane	180	20ml	Evaporation under nitrogen	Not set	40	Phenol	2,4,6-Tribromobiphenyl	GC-MS
5	100 mL	Yes	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	3 x 10 minutes	6 mL DCM for each step - final extract 18 mL	KD concentration	5 minutes	85 °C	SV Internal Standard Mix	1,4-dichlorobenzene-d4, Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12, Perylene-d12	GC-MS/MS
6	105mL	Yes	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	3	2x 10ml		NA	NA	Phenol	Accustandard	GC-MS/MS
7	80	No	No	Liquid-Liquid (Mechanical Agitation)	DCM						PAHs		GC-MS
8	100	Yes	Yes	Liquid-Liquid (Mechanical Agitation)	Methylene Chloride	20	6 mL and 3 times	Water bath	23	50	Phenol	Semi volatile Internal standard mixture	GC-MS
9*	40 mL	N/A	Yes	Liquid-Liquid (Mechanical Agitation)	MTBE			Water bath					GC-MS
10	2x100	No	No	SPE	DCM/ EtOAc	20	20mL, 10 steps	Evaporation under nitrogen	20	35		Method 525.2 Int. Std. Mix.	GC-MS
12	35		Yes	Liquid-Liquid (Mechanical Agitation)	DCM	10	2mL x 1				Phenol		GC-MS/MS
13	100	Yes	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	10	3 x 10	Evaporation under nitrogen	Approx. 40min	35	PAHs	Deuterated 8270 Internal Standard Mix	GC-MS
14	40	No	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	NA	0.25mL final V	Evaporation under nitrogen	NA	40	Phenol	1,4-Dichlorobenzene-d4, Naphthalene-d8, Acenaphthene-d10,	GC-MS
15	1	No	No	Direct Injection	NA	NA	NA	NA	NA	NA	chlorinated phenyl acetic acid	2,4 dichlorophenylacetic acid	LC-MS/MS
16	35	N/A	No	Liquid-Liquid (Mechanical Agitation)	DCM	30	1 x 35mL	Evaporation under nitrogen	30	45		1,4-Dichlorobenzene-D4	GC-MS/MS

Lab. Code	Sample Volume (mL)	Was the bottle rinsed?	pH adjustment?	Extraction Technique	Extraction Solvent	Extraction Time (min)	Extraction Volume and Number of Steps	Extract Concentration Technique	Extract Concentration Time (min)	Extract Concentration Temperature (°C)	Type of Internal Standard Used	Please specify the internal standard used	Measurement Technique
18	35	N/A	No	Liquid-Liquid (Mechanical Agitation)	DCM	30	1 x 35mL	Evaporation under nitrogen	30	45		1,4-Dichlorobenzene-D4	GC-MS/MS
19	50	N/A	Yes	Liquid-Liquid (Mechanical Agitation)	DCM			Water bath			PAHs	Naphthalene-d8, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d12	GC-MS
20	30	No	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	90	1 x 1.5 mL	N/A	N/A	N/A	PAHs	Naphthalene-d10, Acenaphthene-d10, Phenanthrene-d10, Chrysene-d10, Perylene-d10	GC-MS
21*	10		Yes	SPME		30					Phenol	tribromophenol	GC/MS/MS
22*	35	N/A	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	10	1 x 2ml	Direct	10	23	Phenol	1,4-Dichlorobenzene-d4	GC-MS/MS
23	100	Yes	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	3	2 x 10mL	Evaporation under Argon	40	42	PAHs	Deuterated PAHs	GC-MS
24*	100	Yes	Yes	Liquid-Liquid (Mechanical Agitation)	DCM	38	3x10 mL	Evaporation under nitrogen	38	35	PAHs	Deuterated 8270 Internal Standard Mix	GC-MS/MS
26	198	Yes	Yes	Liquid-Liquid (Mechanical Agitation)	Dichloromethane	10	100mL, 100mL, 30mL	Evaporation under nitrogen	20	40	PAHs	Deuterated Naphthalene, Acenaphthene, 1,4-Chlorobenzene	GC-MS
27	2x100	No	No	SPE	DCM/ EtOAc	20	20mL, 10 steps	Evaporation under nitrogen	20	35		Method 525.2 Int. Std. Mix.	GC-MS
28	2x100	No	No	SPE	DCM/ EtOAc	20	20mL, 10 steps	Evaporation under nitrogen	20	35		Method 525.2 Int. Std. Mix.	GC-MS

* Additional information provided in Table 48.

Table 48 Methodology – Sample S4 Phenols Additional Information

Lab. Code	Methodology Additional Information
4	The sample extract is solvent exchanged into Methanol and acetylated.
9	Pyridine - acetic anhydride derivatisation
21	Carbon WR/PDMS fibre, salt added
22	USEPA 8270
24	USEPA 8270

Table 49 Methodology –Participants' General Comments

Lab. Code	Sample	Participant's Comments
3	S1	It is not a whole bottle extraction.
9	S4	4-Methylphenol was only observed.
15	S3	Result reported to Benzo[b]fluoranthene is total of Benzo[b]fluoranthene and Benzo[k]fluoranthene
20	S2	C6-C10 Hydrocarbons result reported includes Total BTEX results.
26	S3	Our laboratory reports Benzo[b+f+j+k]fluoranthene rather than individual compounds of Benzo[b]fluoranthene and Benzo[k]fluoranthene. Therefore the results added to the spread sheet above in Benzo[b]fluoranthene is a mix of Benzo[b+f+j+k]fluoranthene.
	S4	We only report 4- Methylphenol - result entered in "3 & 4 Methyphenols, total' field

APPENDIX 5 ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
AV	Assigned Value
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CITAC	Cooperation on International Traceability in Analytical Chemistry
CRM	Certified Reference Material
CV	Coefficient of Variation
DCM	Dichloromethane
EtOAc	Ethyl Acetate
FID	Flame Ionisation Detection
GC	Gas Chromatography
GUM	Guide to the expression of Uncertainty in Measurement
Hex	Hexane
IEC	International Electrotechnical Commission
ILCP	Interlaboratory Comparison Program
ISO	International Organization for Standardization
k	Coverage factor
LC	Liquid Chromatography
LCS	Laboratory Control Sample
LLE	Liquid-Liquid Extraction
LOR	Limit Of Reporting
Max	Maximum
Md	Median
Min	Minimum
MS	Mass Spectrometry
MS/MS	Tandem Mass Spectrometry
MTBE	Methyl tert-butyl ether
MU	Measurement Uncertainty
N	Number of numeric results
NA	Not Applicable
NATA	National Association of Testing Authorities, Australia
NEPM	National Environmental Protection Measure
NMIA	National Measurement Institute, Australia
NR	Not Reported
NS	Not Supplied

NT	Not Tested
P&T	Purge and Trap
PAH	Polycyclic Aromatic Hydrocarbon
PCV	Performance Coefficient of Variation
Pent	Pentane
PT	Proficiency Testing
QC	Quality Control
RA	Robust Average
RM	Reference Material
SD	Standard Deviation
SDPA	Standard Deviation for Proficiency Assessment
SI	International System of Units
SPE	Solid Phase Extraction
SPME	Solid Phase Microextraction
SS	Spiked Samples
SV	Spiked Value (or formulated concentration of a PT sample)
TRH	Total Recoverable Hydrocarbons
USEPA	United States Environmental Protection Agency

END OF REPORT