WITHYHEDGE LANDFILL

AIR QUALITY MONITORING INTERIM SUMMARY REPORT 2

Report Number 2423r1v2d0524

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Record of updates to report

Date	**Updates**
16 May 2024	Executive Summary added Photographs of Rudbaxton Bridge added to section 4.2 Tabulated data from Jerome monitoring added to Appendix 4 and 5. Additional text added to section 5. Appendix 6 added.

Executive Summary

This is the second interim reporting summarising the data gathered from the ongoing monitoring around Withyhdege Landfill. The monitoring now includes diffusion tubes for the assessment of Hydrogen Sulphide and Volatile Organic Compounds (VOCs) that provide averaged concentrations over a defined period and instantaneous measurements of Hydrogen Sulphide using a Jerome analyser. The monitoring programme is primarily aimed at gathering quantitative data to provide lines of evidence to help assess risks from the exposure to off-site air quality that is impacted by the landfill.

Comparison of the Hydrogen Sulphide concentrations detected using diffusion tubes with health-based criteria indicates that the concentrations continue to fall below these guidance values for intermediate/lifetime exposure.

For the first time, monitoring of Volatile Organic Compounds (VOC) has been undertaken during the latest exposure period. The testing has revealed many VOCs to be present at very low levels and below evaluation criteria, where available.

Using a hand-held instrument, known as a Jerome, Hydrogen Sulphide concentrations have been logged at different locations. Initial consideration of the data gathered indicates that the values recorded have been above and below a 5ppb guideline value and that these values have been recorded when an odour is detectable / reported and at times when an odour has not been detectable. Ongoing monitoring using the Jerome is focussing on logging data for 30-minutes at 5-minute sampling intervals at the same position as the diffusion tubes. This data will be evaluated in the next data monitoring summary alongside a comparison of the results gathered by different Jerome monitors.

1 SCOPE

The operator of Withyhedge Landfill is implementing a series of measures agreed with NRW to address odours emanating from the site, including re-profiling, capping and additional landfill gas extraction. Alongside these measures, the operator is funding a scheme of air quality monitoring in the communities surrounding the site and also within the site.

The monitoring programme is primarily aimed at gathering quantitative data to provide lines of evidence to help assess risks from the exposure to off-site air quality that is impacted by the landfill.

This is the second interim reporting summarising the data gathered from the ongoing monitoring. The monitoring now includes diffusion tubes for the assessment of Hydrogen Sulphide and Volatile Organic Compounds (VOCs) that provide averaged concentrations over a defined period and instantaneous measurements of Hydrogen Sulphide using a Jerome analyser.

The concentrations recorded by the diffusion tubes are obtained by laboratory analysis of the tubes. The data reported by the laboratories is shared with the operator, Pembrokeshire Council and NRW as soon as it becomes available. The most recent data is presented in this interim report.

2 MONITORING

Landfill gas is typically dominated by methane and carbon dioxide. Numerous other compounds may, however, also be present and some of these can be detected as odour. Such compounds are often sulphur based and can include hydrogen sulphide. As hydrogen sulphide can give rise to odour and can be readily measured, it is being used as a surrogate for the potential presence of landfill gas, whilst recognising that there are a wide range of compounds and sources that can also generate odorous compounds like hydrogen sulphide.

To try and better understand what other compounds may also be present, a sample of air directly above waste exposed at the top of Withyhedge landfill was collected on 8 February 2024. This 'grab sample' was collected by pumping air into a diffusion tube held ~1.3m above exposed waste where there was a strong odour detectable. The diffusion tube was subsequently sealed and returned to an independent laboratory for a test they refer to as an 'odour characterisation screen'. The results from this sample are included in Appendix 1.

Review of the original laboratory certificate indicated that a range of compounds were detected but that the highest concentration was reported for sulphur dioxide. Subsequent discussions with the laboratory indicated that during analysis, any Hydrogen Sulphide present in the sample would have been converted to Sulphur Dioxide during analysis. Therefore, the laboratory issued an updated certificate, which is also included in Appendix 1, where the estimated concentration of Hydrogen Sulphide is given.

Although the odour screen indicates that Hydrogen Sulphide was likely to be the compound present at highest concentration, and therefore most likely responsible for the odours detected during sample collection, the analysis did reveal the presence of other compounds including Volatile Organic Compounds (VOCs). In response, TENAX diffusion tubes designed to allow the analysis of Volatile Organic Compounds were positioned on 8 March at the same position as the Hydrogen Sulphide tubes. This data is presented in this report alongside the Hydrogen Sulphide monitoring which has been ongoing since February 2024.

3 METEOROLOGY

Prior to discussing the air quality monitoring results, it is useful to understand some of the weather conditions experienced during the exposure period. For this reason, data from the weather station located at Withyhedge Landfill has been downloaded and is summarised below.

Between 2 February and 1 March, which was the first exposure period, the prevailing wind was from the west-northwest/northwest, as shown in Figure 3-1.

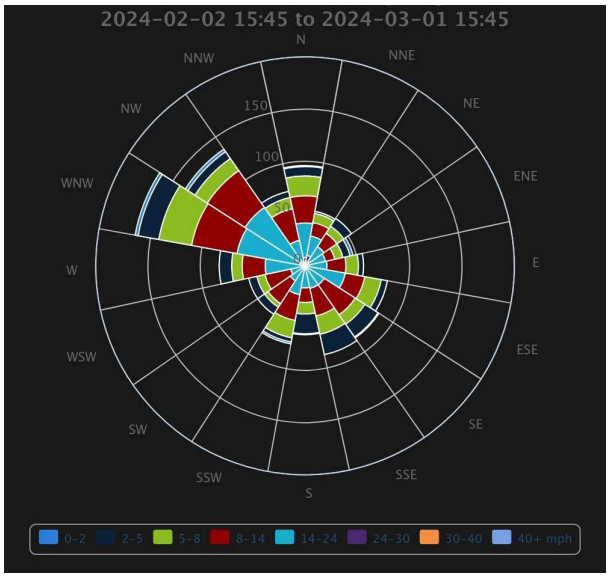


Figure 3-1 Wind-rose showing direction wind blowing from and speed (2 Feb – 1 Mar 2024)

During March, the dominant wind direction has been recorded from the southwest, as shown in Figure 3-2.

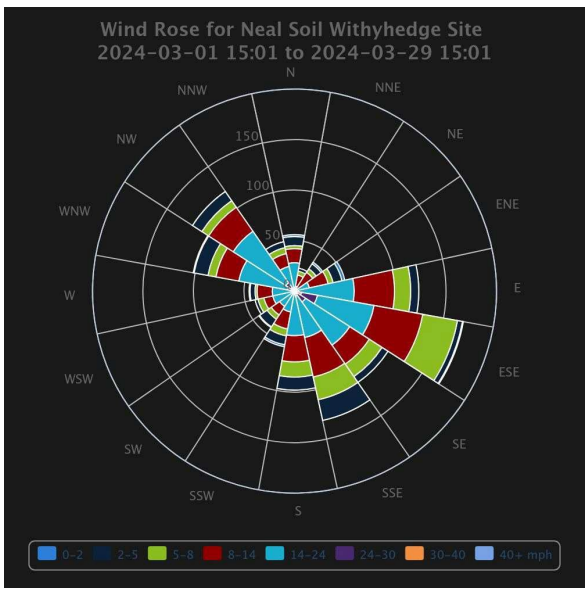


Figure 3-2 Wind-rose showing direction wind blowing from and speed (1 Mar – 29 Mar 2024)

Variations in rainfall, barometric pressure and temperature over these periods are shown in Figures 3-3 to 3-5.

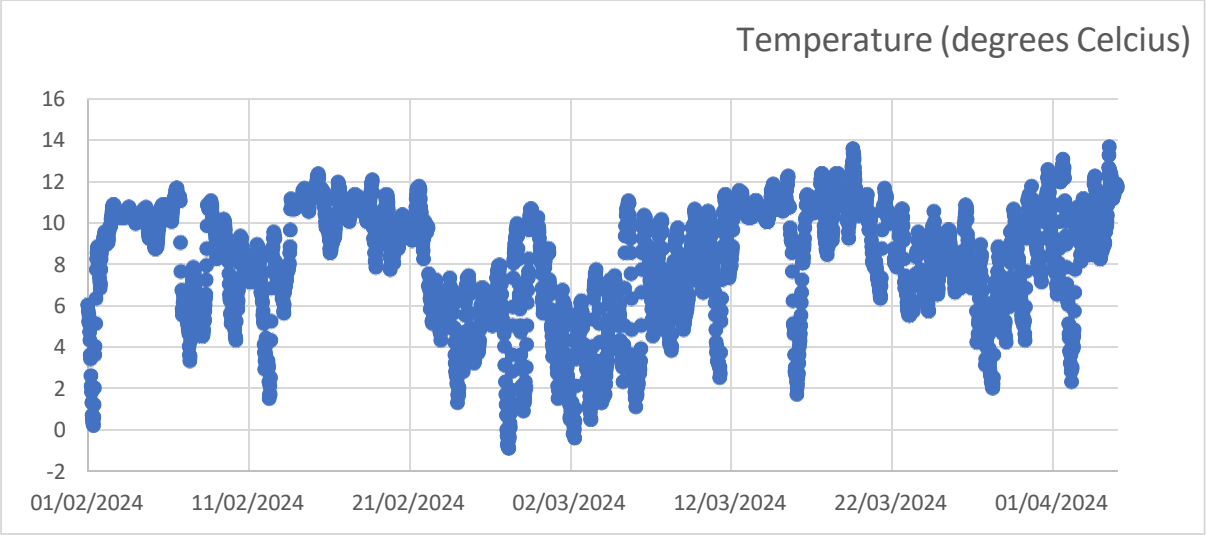


Figure 3-3 Air Temperature

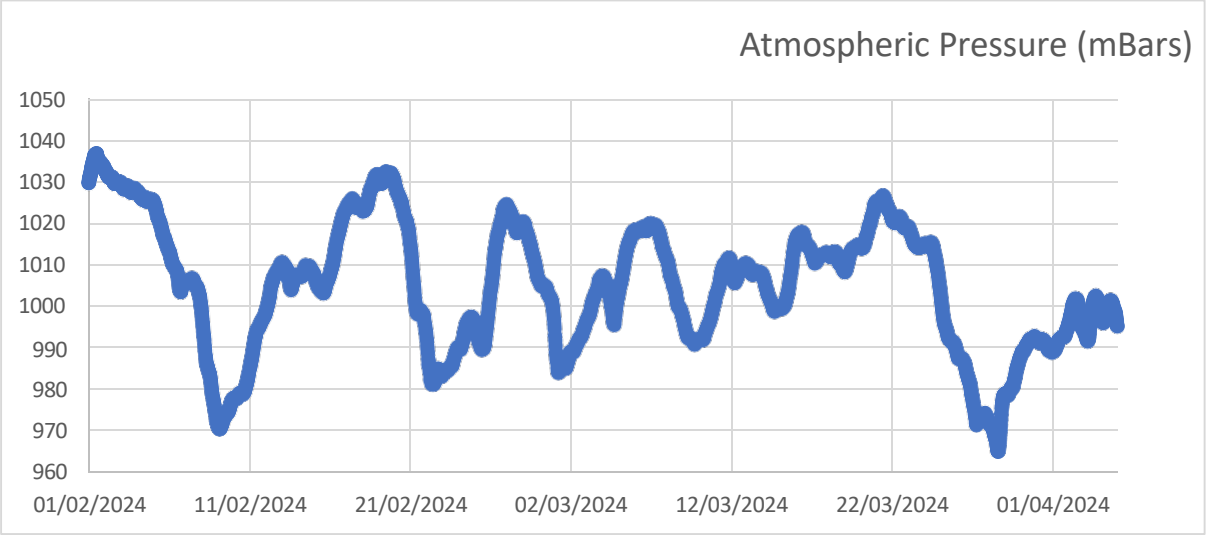


Figure 3-4 Atmospheric Pressure

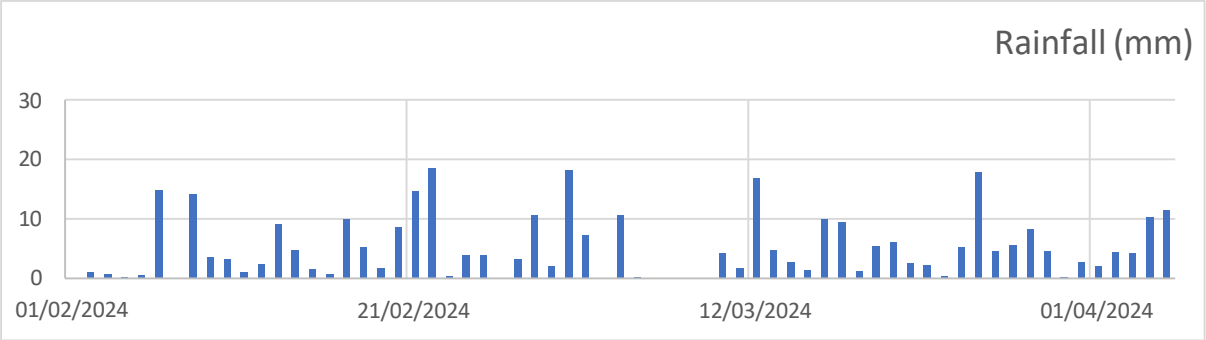


Figure 3-5 Rainfall

4 DIFFUSION TUBE MONITORING

4.1 Hydrogen Sulphide Monitoring

Diffusion tubes monitoring Hydrogen Sulphide have been set at ten off-site locations at various compass directions around Withyhedge Landfill with additional tubes on-site, as shown on Figures 4-1 and 4-2. The tubes are positioned to take into account the need for free air movement, safety during maintenance and consideration of potential damage, theft or vandalism. The suitability of the current positions will be reviewed as the programme develops. Details of each position are summarised in Table 4-1.

Table 4-1 Monitoring positions

Figure 4-1 & 4-2 reference	Location Description	Position	Height above ground
Community monitoring locations			
D1	Spittal Cross cross-roads west of Spittal	Street furniture at cross-roads	0.6 (old & new)
D2	Adjacent Spittal School	Lamp post	2.1
D3	Corner of spring gardens and Castle Rise, Spittal. Adjacent farm.	Lamp post	2.1
D4	Cross-roads of B4329 and Spring Gardens East of Spittal	Street furniture	2
D5	B4329 between Scolton and Bethlehem	Street furniture	2.2
D6	B4329 at Bethlehem	Lamp post	2.2
D7	On road heading west out of Poyston Cross	Lamp post	2.2
D8	Adjacent properties at Poyston Water	Lamp post	2.1
D9	Rudbaxton Water Bridge	Northern side of bridge	1.2
D10	Adjacent Corner Piece Inn	Lamp post	1.9
On-site monitoring locations			
Access ramp (WL1)	Eastern side of access ramp	Metal post	2.1
Fence posts (WL2)	Fence post close to edge of permanent capping	Fence post	1.1
Litter skids (WL3)	Metal post close to edge of permanent capping	Metal post	2.2
Field fence post (WL4)	Fence post west of temporary capping	Fence post	0.9
CCTV tower (WL5)	Metal post south of active Cell 8	Metal post	2.2
IBC cell 8 (WL6)	Metal post west of active Cell 8	Metal post	1.65
Cell 7 IBC corner (WL7)	Metal post south of Cell 7	Metal post	1.9

Figure 4-1 Community monitoring positions D1- D10

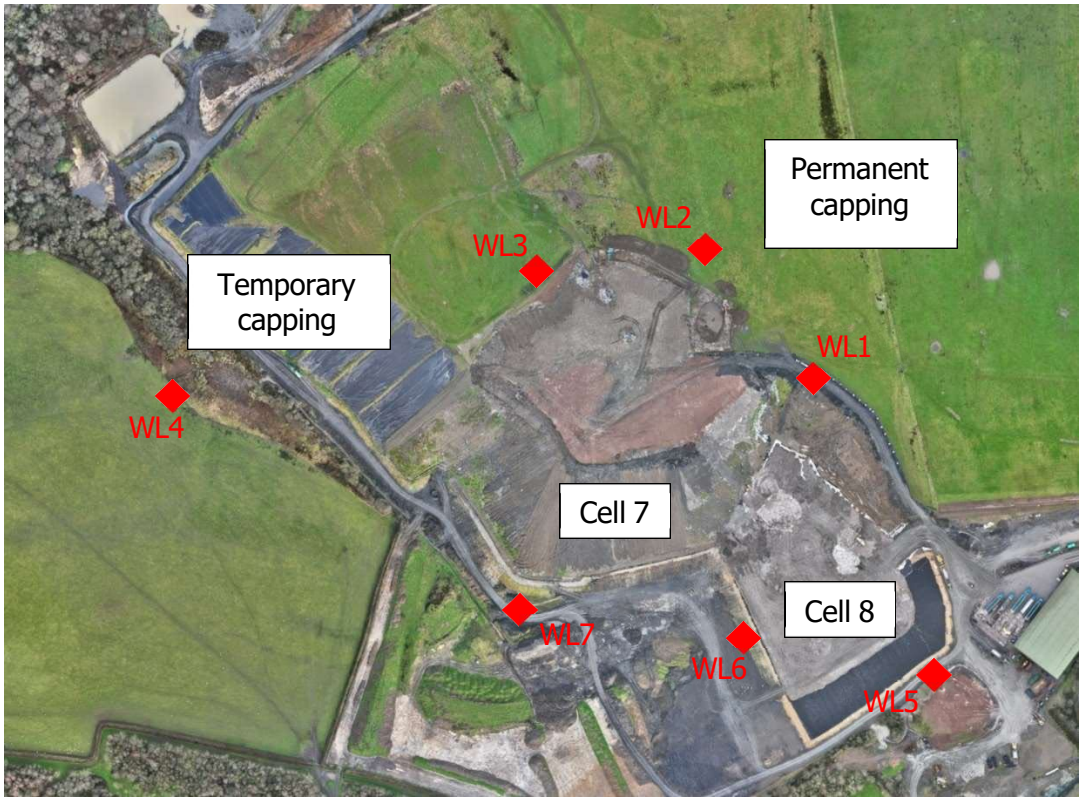


Figure 4-2 On-site monitoring positions

4.1.1 Review of Hydrogen Sulphide Results

There are now two sets of diffusion tube results available for Hydrogen Sulphide and these are summarised in Tables 4-2 and 4-3. The original laboratory certificates from the latest monitoring are included in Appendix 2. The term exposure period is used to define the sampling period when air was able to diffuse into the tubes before the tubes were taken down, sealed and returned to the laboratory for analysis. Analysis has been performed at Gradko International which is a UKAS accredited testing laboratory (No. 2187).

Some tubes were not available for analysis due to the following reasons:

- On 14 March 2024, the two sets of cable ties holding the diffusion tubes in place at D1 (adjacent farm at Spittal Cross) were found to have been cut and the tubes removed. This is the reason that there is no data for D1 during the second exposure period. In response, a new adjacent monitoring position has been identified at the cross roads.
- Similarly, the infrastructure holding the tubes at on-site monitoring position WL1 were moved as part of ongoing operations and the tube lost.
- On 26 April, the street furniture at D10 and the attached tubes from the ongoing third exposure period were found to have been removed. A new monitoring position in this area is to be identified for the next exposure period starting early May.

Table 4-2 Hydrogen Sulphide results from Community Monitoring Positions

	Exposure Period	
	5 Feb - 1 Mar	**1 Mar - 3 Apr**
	H_2S	**H_2S**
Location	**ppb**	**ppb**
Laboratory Blank	0.05	0.04
Spittal Farm - D1	<0.08	Removed
Spittal School - D2	<0.08	<0.06
Spittal - D3	<0.08	<0.06
Upper Scolton - D4	<0.08	<0.06
Scolton Road - D5	<0.08	<0.06
Bethlehem - D6	<0.08	<0.06
Poyston Cross - D7	<0.08	<0.06
Poyston Water - D8	<0.08	<0.06
Rudbaxton - D9	0.10	0.07
Corner Piece Inn - D10	<0.08	0.07

Table 4-3 On-site Hydrogen Sulphide monitoring results

	Exposure Period	
	8 Feb - 1 Mar	**1 Mar - 3 Apr**
	H_2S	**H_2S**
Location	**ppb**	**ppb**
Laboratory Blank	0.05	0.04
Access ramp (WL1)	1.48	Lost
Fence posts (WL2)	1.82	No tube deployed
Litter skids (WL3)	2.04	No tube deployed
Field fence post (WL4)	0.29	1.38
CCTV tower (WL5)	0.60	4.40
IBC cell 8 (WL6)	1.04	No tube deployed
Cell 7 IBC corner (WL7)	1.80	6.54
Note: 7 tubes deployed during 1st exposure period and 4 in 2nd period		

During the first exposure period wastes were being removed from the crest of the site, gas wells were being drilled into the waste mass and temporary capping of the west facing flank was in progress. During the second exposure period further capping was being undertaken and additional gas extraction wells were being drilled.

The average concentration of hydrogen sulphide measured in each diffusion tube during the exposure periods has been below the limit of detection (less than 0.08ppb or 0.06 part per billion), with the exception of D9 at Rudbaxton Bridge and D10 close to Corner Piece Inn.

Comparison of the concentrations detected using diffusion tubes with the health-based evaluation criteria in Table 4-4 indicates that the concentrations fall below these guidance values for intermediate/lifetime exposure.

Table 4-4 Referenced health based guidance values

	Intermediate exposure criteria (up to 1 year)	**Lifetime exposure criteria**
Hydrogen Sulphide concentration	20 ppb (30 µg/m^3)	1 ppb (2 µg/m^3)
Values taken from references 1 and 2		

Higher concentrations of hydrogen sulphide were reported from the tubes exposed on site. The values observed to date range from 0.04ppb to 6.54ppb. These concentrations are below the workplace exposure limit of 5000 ppb for an 8-hour time-weighted average reference period (Ref 3).

4.2 Volatile Organic Compound Monitoring

For the first time, monitoring of Volatile Organic Compounds (VOC) has been undertaken during the latest exposure period. The diffusion tubes used for this monitoring are called TENAX tubes and were provided by the same laboratory providing the Hydrogen Sulphide tube analysis. These tubes were positioned alongside the Hydrogen Sulphide tubes and work in the same way i.e. during the exposure period air is free to circulate into the tube and at the end of the period the tube is sealed and returned to the laboratory for analysis. This exposure period was from 8 March 2024 to 3 April 2024.

As noted in relation to the Hydrogen Sulphide tubes, some tubes were not available for analysis due to the following reasons:

- On 14 March 2024, the cable ties holding the diffusion tubes in place at D1 (adjacent farm at Spittal Cross) were found to have been cut and the tubes removed. This is the reason that there is no data for D1 during the latest exposure period. In response, a new adjacent monitoring position has been identified.
- The infrastructure holding the tubes at on-site monitoring position WL1 were moved as part of ongoing operations. This resulted in the loss of the hydrogen sulphide tube. The VOC tube survived but was moved on-site from its original monitoring position.
- On 26 April, the street furniture at D10 and the attached Hydrogen Sulphide and VOC tubes were found to have been removed. A new monitoring position in this area is to be identified for the next exposure period starting early May.

Following return of the tubes, the laboratory identified that the screw cap on tube 425464 from monitoring position WL7 (IBC Cell 6/7 Corner) had become loose during transport. These results may therefore be compromised.

The wooden posts holding the tubes at D9 Rudbaxton Bridge also appear to have been recently stained. It is not precisely known when this work was done or the nature of the product used but it is sometime after 21 March based on review of photographs in Plate 4-1 and 4-2. Such wood stains can potentially contain and release VOCs to the air.

Plate 4-1 Photograph of posts at Rudbaxton Bridge on 21 Mach 2024

Plate 4-2 Photograph of posts at Rudbaxton Bridge on 16 May 2024

4.2.1 Review of VOC Results

Volatile organic compounds (VOCs) are a complex variety of chemical substances. Like Hydrogen Sulphide, they may be generated and released by a variety of natural processes and human activities. This large group of compounds is defined on the basis of their ability to exist as a vapour. Common examples include the recognisable odour associated with paint and petrol, the smell detectable from air fresheners and the smell of freshly cut grass – all these smells are due to the presence of a range of different VOCs, some of which produce a detectable odour.

Given the range of VOCs that are known and the wide range of sources, the diffusion tubes have been analysed for what the laboratory term a 'full scan'. Using their analytical equipment, this scan allows the laboratory to identify a wide range of VOCs present on the absorbent in the tube and to estimate their concentration.

The VOC laboratory certificate is presented in Appendix 3. Readers will note that the certificate spans several pages and includes tables of data from each of the different monitoring positions. To aid understanding, visualisation and assessment of this data the concentration data expressed as microg/m^3 (micro grammes per cubic meter of air) has been extracted from the last column of the certificate and repeated in Table 4-5 which spans several pages. This same data is also graphically presented as a series of charts following the table.

To the right-hand side of the monitoring data in Table 4-5 are three criteria used to assess air quality. These come from a range of sources and are intended to provide an initial yardstick against which the reader can better appreciate the levels reported from the diffusion tubes. It is evident from this comparison that the concentration levels estimated from the tubes are lower than these criteria, where values have currently been found to be available.

Coupled with review of the charts it is evident that:

- the VOCs reported are present at low levels just above the level of detection in many cases
- Widest range of compounds was detected from tube at D9 on Rudbaxton Bridge
- Some compounds are detected at higher concentration off-site compared to the tubes located on-site, and vice versa

As the initial full scan has revealed many VOCs are present at very low levels, the next analysis will focus on the top 20 compounds found to be present. This will allow focus on the compounds present at highest concentration and their associated evaluation criteria.

Table 4-5 Results from VOC Diffusion Tubes (continues over several pages)

	Off-site diffusion tube data									On-site tube results				Evaluation Criteria	
Sample ID	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**WL5**	**WL4**	**WL1**	**WL7**	**EAL & EA 2010**	**PHE IAQ**
Tetracosane	36		2.1	5.7		2.4	3.5		3.9			5.0			
Decane								14						200	
1-Hexanol, 2-thyl-	1.4	0.9		1.2	0.8	1.3	1.0		1.3	9.7		3.9	2.7	570	
Benzoic acid	7.5		4.2	8.9	4.1	2.2		4.9			2.7	3.1	0.7		
Cyclotrisiloxane, hexamethyl-	9.3	8.2	2.7	13	4.6	11	7.2	11	3.7	14	2.5	8.3	8.7		
Undecane								8.9							
Pentacosane			5.4	15		5.9									
Isopropyl myristate													11		
Nonanal**	2.5	2.1	1.9	5.7		1.6	2.5	4.1	1.6	1.1		2.4	3.0		
Dodecane								6.6							
Benzene,1-ethyl -3-methyl-								4.6							
Pentacosane							8.5		11			12			
m/p-Xylene								3.5					0.7	4410	100
Nonane								3.4						200	
Acenaphthene								4.0						210	
Benzene	0.6	0.7		0.5		0.4	0.5	1.9	0.4	0.4			0.5	5 / 30	
Cyclotetrasiloxane, octamethyl-	3.6	3.9		3.8		2.7	2.8	7.0		5.8		3.3	4.2		
Eicosane				6.6											
cis-Pinen-3-ol								3.5							
Dibenzofuran								3.7							
Benzaldehyde**	1.9	1.4	1.7	2.1	1.9	1.5	1.2		0.9	1.3	0.8	1.6	1.0	350	
Phenol	1.2			0.8		0.6				0.7		1.8		200 / 3900	
Cyclohexane, propyl-								2.3							

	Off-site diffusion tube data									On-site tube results				Evaluation Criteria	
Sample ID	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**WL5**	**WL4**	**WL1**	**WL7**	**EAL & EA 2010**	**PHE IAQ**
Phenylmaleic anhydride	2.9		2.2	3.1	1.9	1.0						1.4			
Benzene, 1,2,3-trimethyl-								2.0						1250	
Tridecane								3.1							
Acetophenone**	1.7	1.1	1.3	1.9	1.6	1.7	1.0	1.9	0.6	1.3	0.9	1.5	1.0		
Benzene, 1-methyl-3-propyl-								2.0							
Nonane, 2,6-dimethyl-								2.4							
Benzene, 1-methyl-4-(1-methylethyl)-								1.9							
(E)-3(10)-Caren-4-ol								2.1							
o-Xylene								1.5						4410	100
Naphthalene, decahydro-, trans-								1.9							
Benzene, 4-ethyl-1,2-dimethyl-								1.7							
Cyclohexane, butyl-								1.7							
Ethylbenzene								1.3						4410	100
Benzene, 1,3,5-trimethyl-								1.3							
Benzene, 1,2,3,4-tetramethyl-								1.5							
Nonane, 2-methyl-								1.6							
Acetic acid	0.6	0.4		0.4		0.4		0.6		0.5			0.6	3700	
Toluene	0.8							0.5				0.6	0.9	8000	2300/15000
Benzene, 1,2,4,5-								1.4							

	Off-site diffusion tube data									On-site tube results				Evaluation Criteria	
Sample ID	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**WL5**	**WL4**	**WL1**	**WL7**	**EAL & EA 2010**	**PHE IAQ**
tetramethyl-															
Octane								1.1							
Undecane, 2,6-dimethyl-								1.8							
Silanediol, dimethyl-				0.7				0.9							
Benzenecarbothioic acid				1.3											
Phenanthrene								1.7							
Cyclopentasiloxane, decamethyl-		2.0						3.4		2.4			2.6		
Undecane, 2-methyl-								1.5							
Fluorene								1.5						140	
4,4-Dimethyl-2-ropenyl cyclopentanone								1.3							
Hexanedioic acid, bis (2-ethylhexyl) ester				3.2											
Benzenecarbothioic acid	1.2														
Benzene, (1-methylpropyl)-								1.1							
Benzenesulfonamide, N-butyl-													1.7		
Naphthalene, 2-methyl-								1.1							
Nonane, 4-methyl-								1.0							
Benzene, 1,2,3,5-tetramethyl-								1.0							

	Off-site diffusion tube data									On-site tube results				Evaluation Criteria	
Sample ID	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**WL5**	**WL4**	**WL1**	**WL7**	**EAL & EA 2010**	**PHE IAQ**
Benzene, 1-ethyl-2-methyl-								0.8							
Octanal**				0.9											
Naphthalene								0.9						3	
Cyclohexane, hexyl-								1.1							
Silanediol, dimethyl-	0.6														
Benzene, propyl-								0.8							
Naphthalene, 1,2,3,4-tetrahydro-2-methyl-								0.9							
Naphthalene, 1-methyl								0.9							
Benzene, 1-methyl-3-(1-methylethyl)-								0.8							
Undecane, 4-methyl-								1.1							
Tetradecane								1.2							
Cyclohexane, (2-methylpropyl)								0.9							
Cyclohexane, 1-ethyl-2-methyl								0.7							
Cyclohexanol, 2,2-dimethyl-				0.8											
Hexanal**				0.6									0.6		
Undecane, 3-methyl-								1.0							
Nonane, 3-methyl-								0.8							
Decanal**													0.9		

	Off-site diffusion tube data									On-site tube results				Evaluation Criteria	
Sample ID	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**WL5**	**WL4**	**WL1**	**WL7**	**EAL & EA 2010**	**PHE IAQ**
Benzene, 2-ethyl-1,4-dimethyl-								0.7							

NOTES
** Compounds may be an artefact due to reaction of ozone with Tenax sorbent.
Compounds with a quality match below 85% are noted as a tentative identity and shown in italics. These compounds are outside of the scope of laboratory UKAS accreditation.
Wooden posts at D9 Rudbaxton Bridge appear to have been recently stained. It is not precisely known when this work was done but it was not before 21 March based on review of photographs.

Evaluation Criteria:
EAL / EA 2010 – Environmental Assessment Level. EALs represent a pollutant concentration in ambient air at which no appreciable risks or minimal risks to human health are expected. EAL values taken from Air emissions risk assessment for your environmental permit available on gov.uk and EA 2010 values from Environment Agency Report: P1-396/R Table 5.2.

PHE IAQ – Criteria from Public Health England. Indoor Air Quality Guidelines for selected Volatile Organic Compounds (VOCs) in the UK. 2019.

Chart 4-1 VOC's at D2 Spittal School

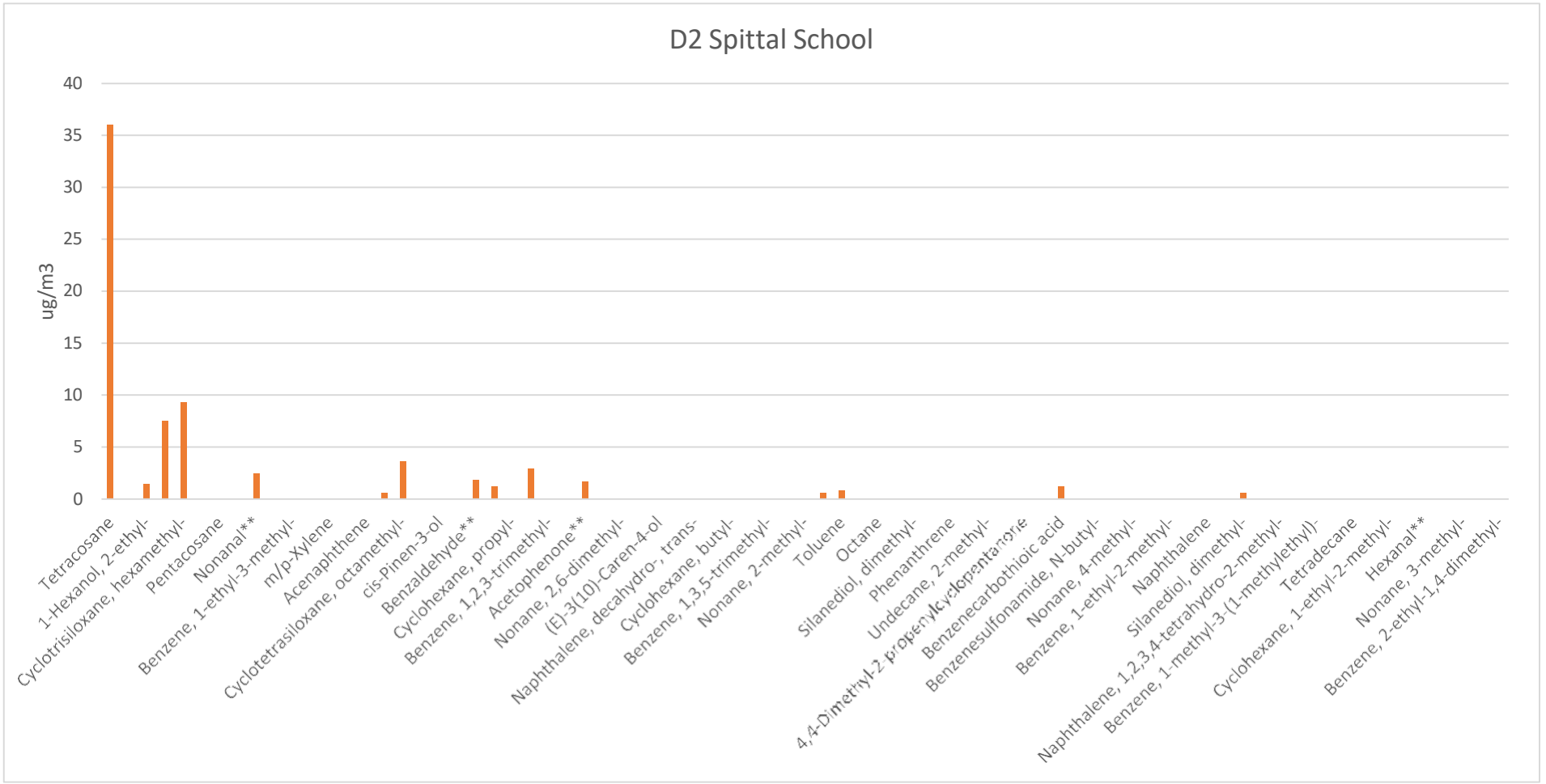


Chart 4-2 VOC's at D3 Spittal

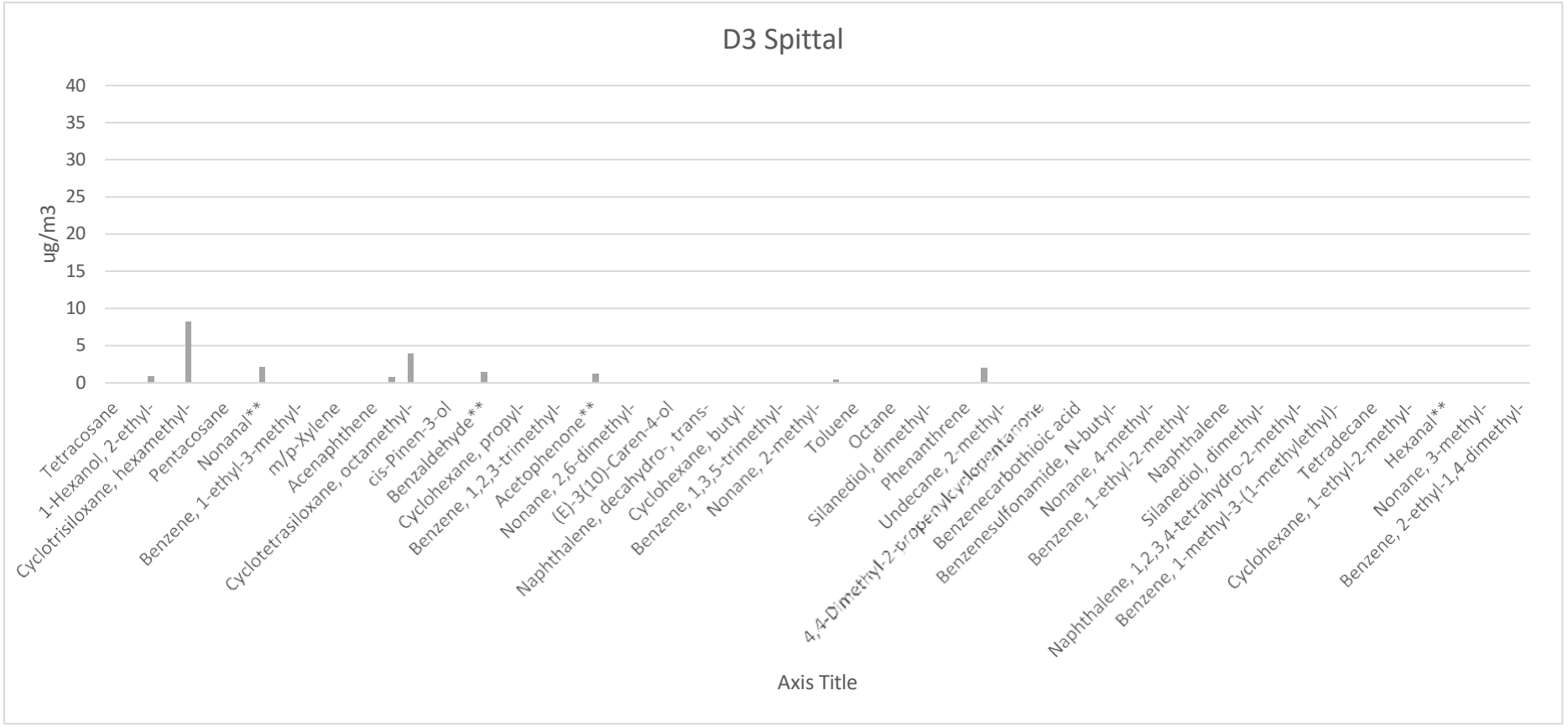


Chart 4-3 VOC's at D4 Upper Scolton

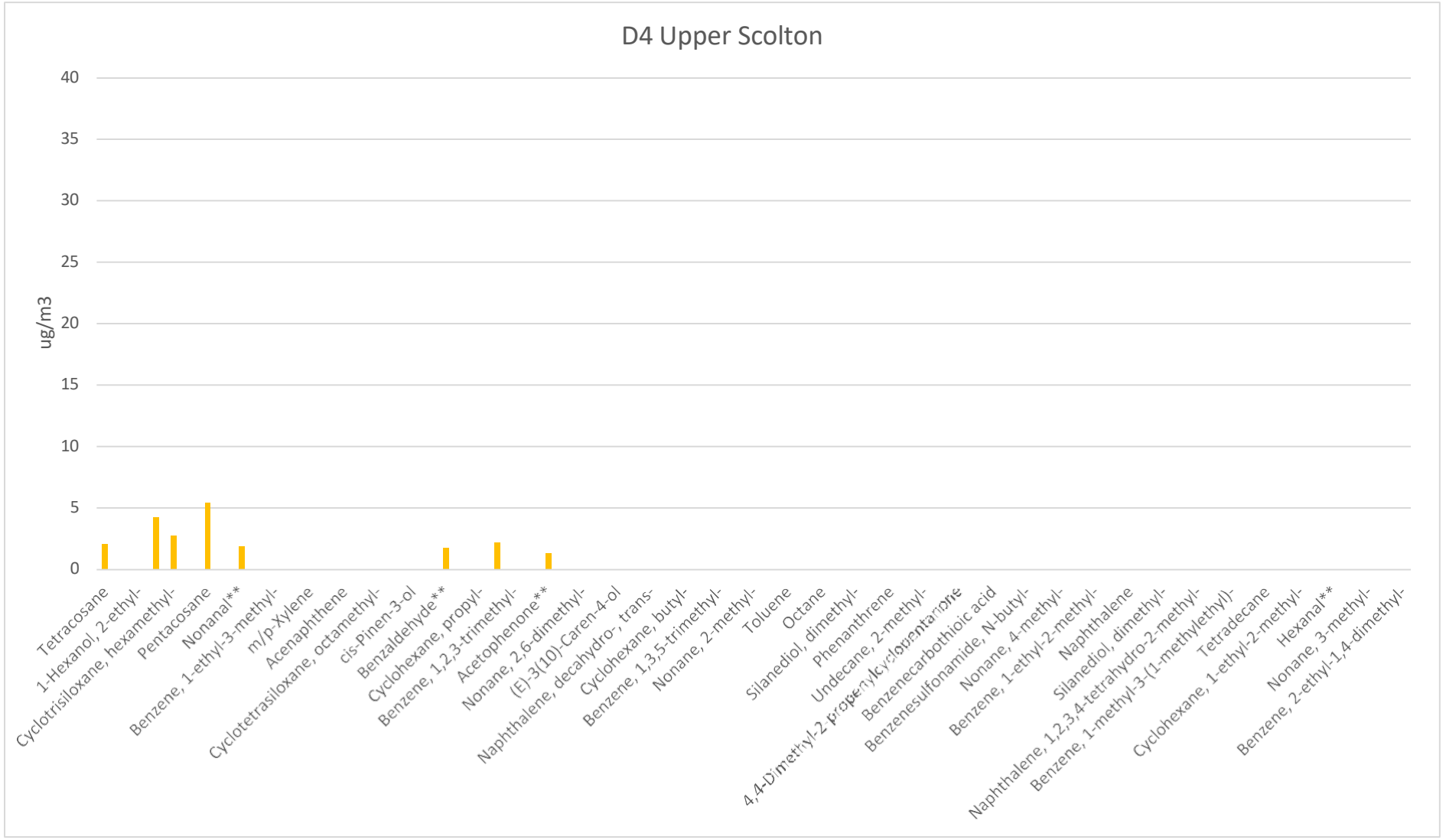


Chart 4-4 VOC's at D5 Scolton

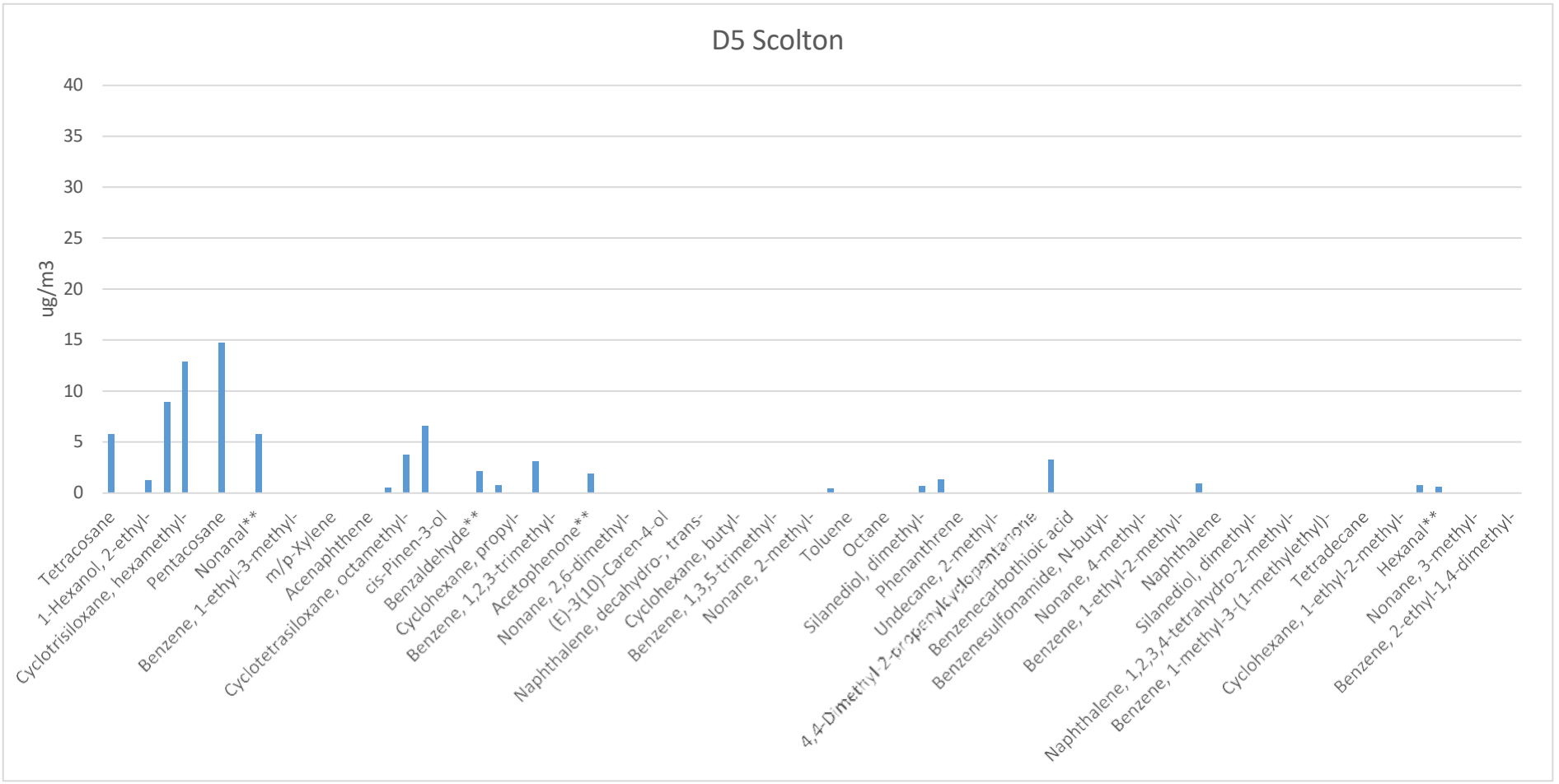


Chart 4-5 VOC's at D6 Bethlehem

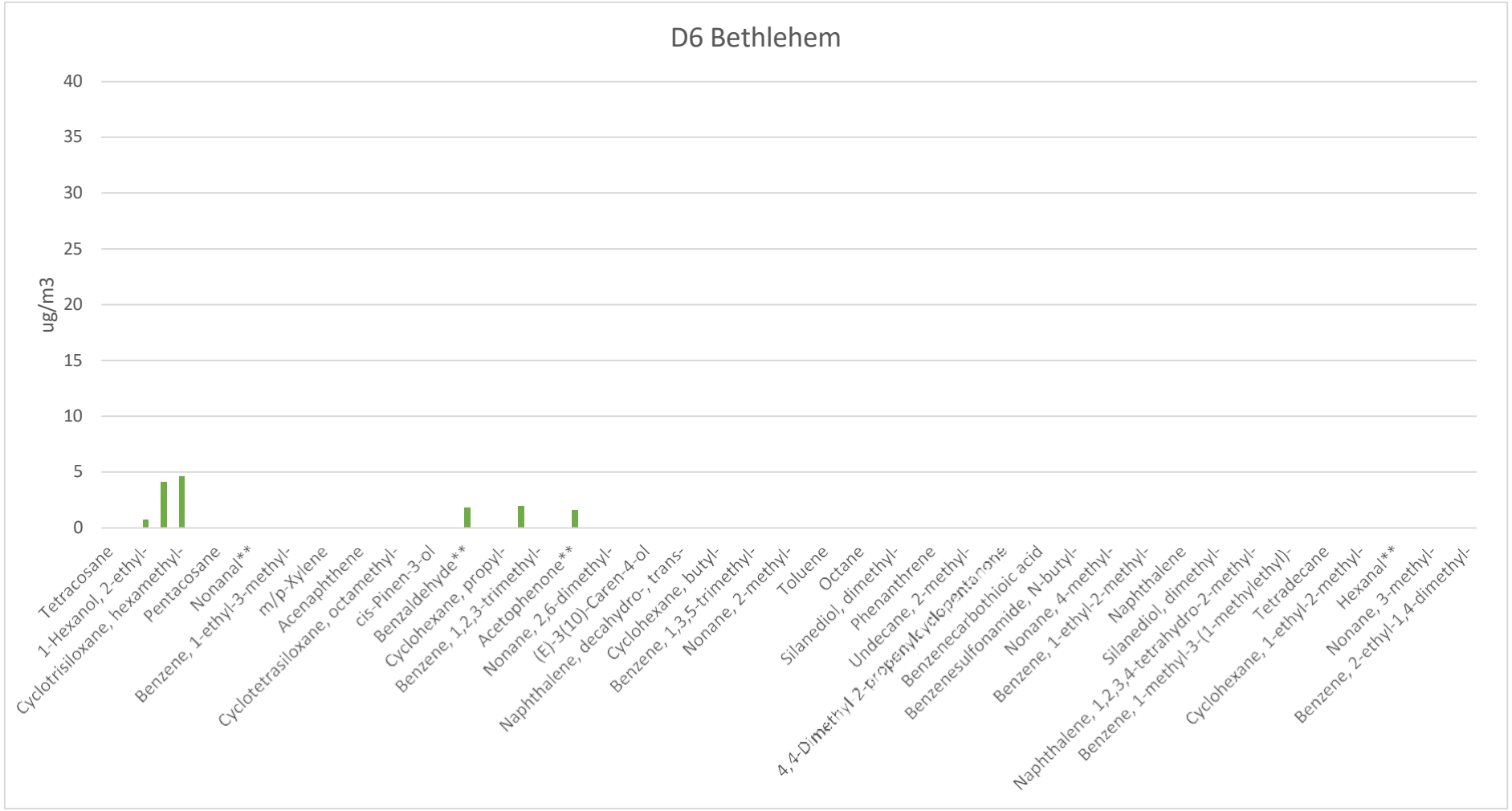


Chart 4-6 VOC's at D7 Poyston Cross

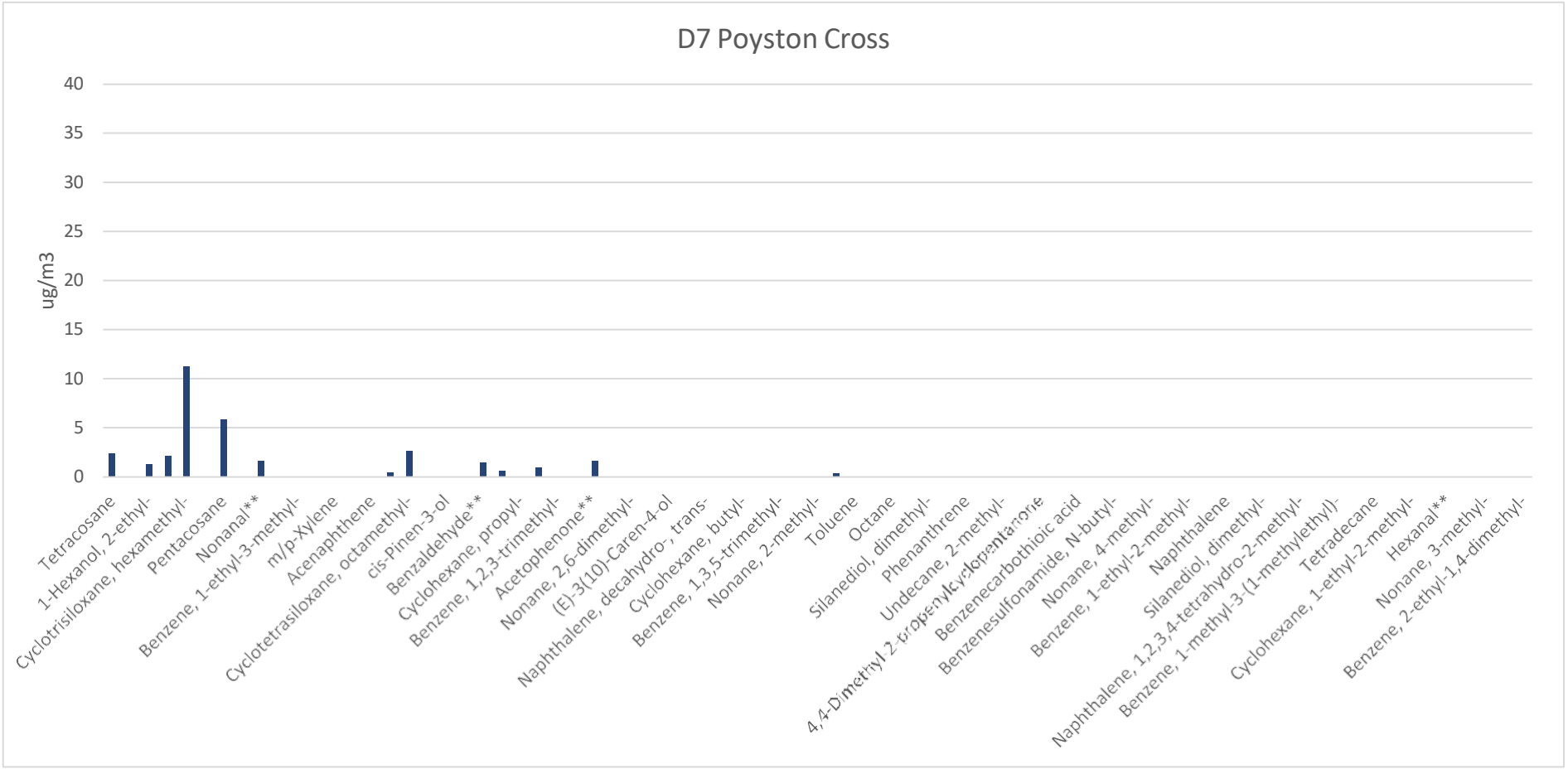


Chart 4-7 VOC's at D8 Poyston Water

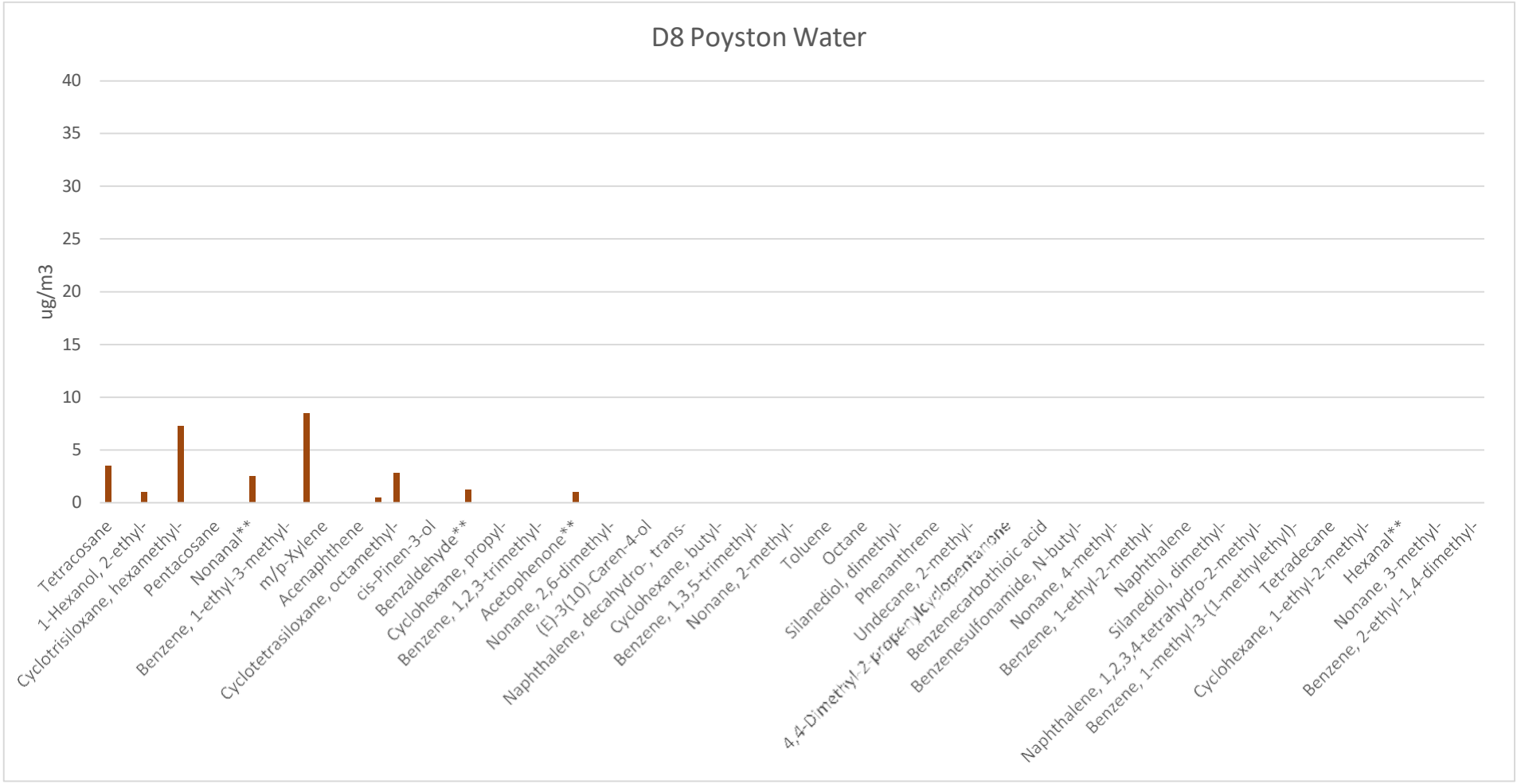


Chart 4-8 VOC's at D9 Rudbaxton Bridge

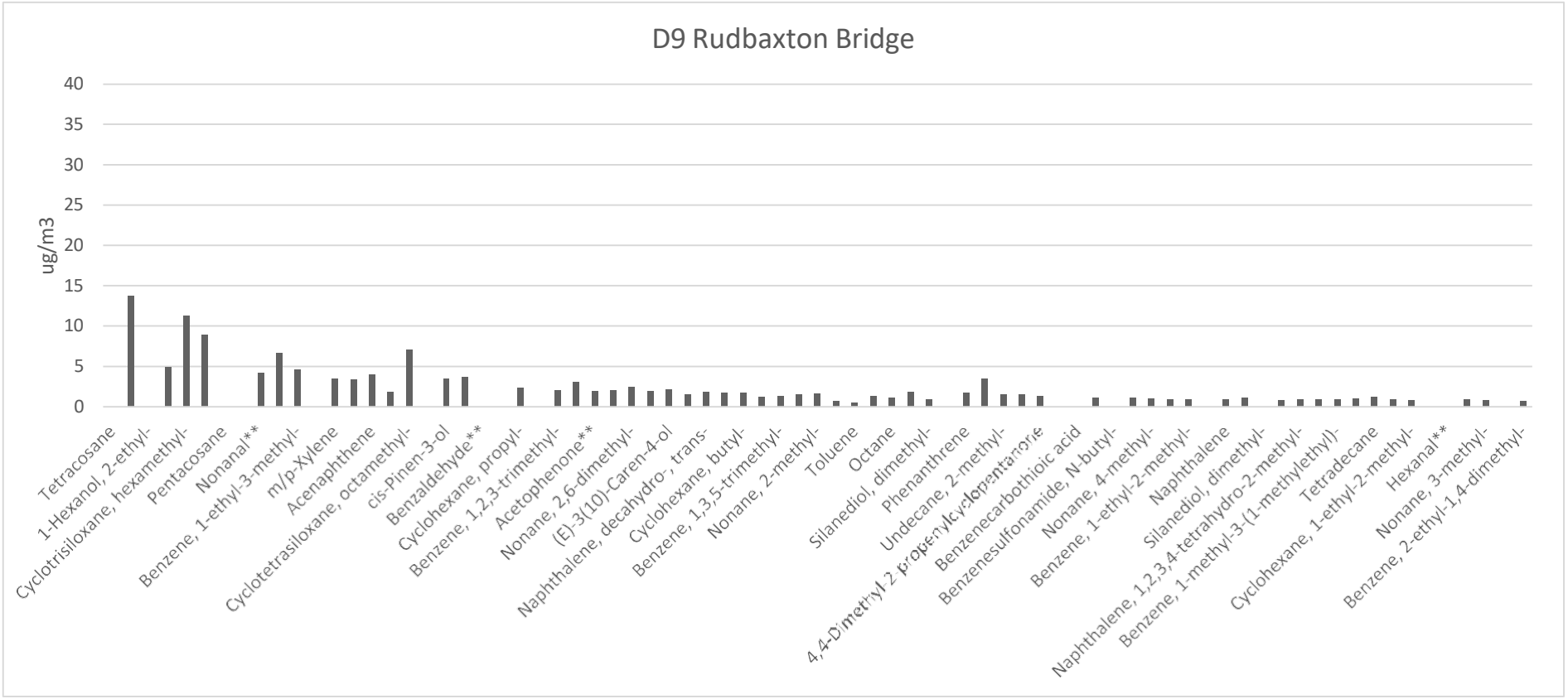


Chart 4-9 VOC's at D10 Corner Piece Inn

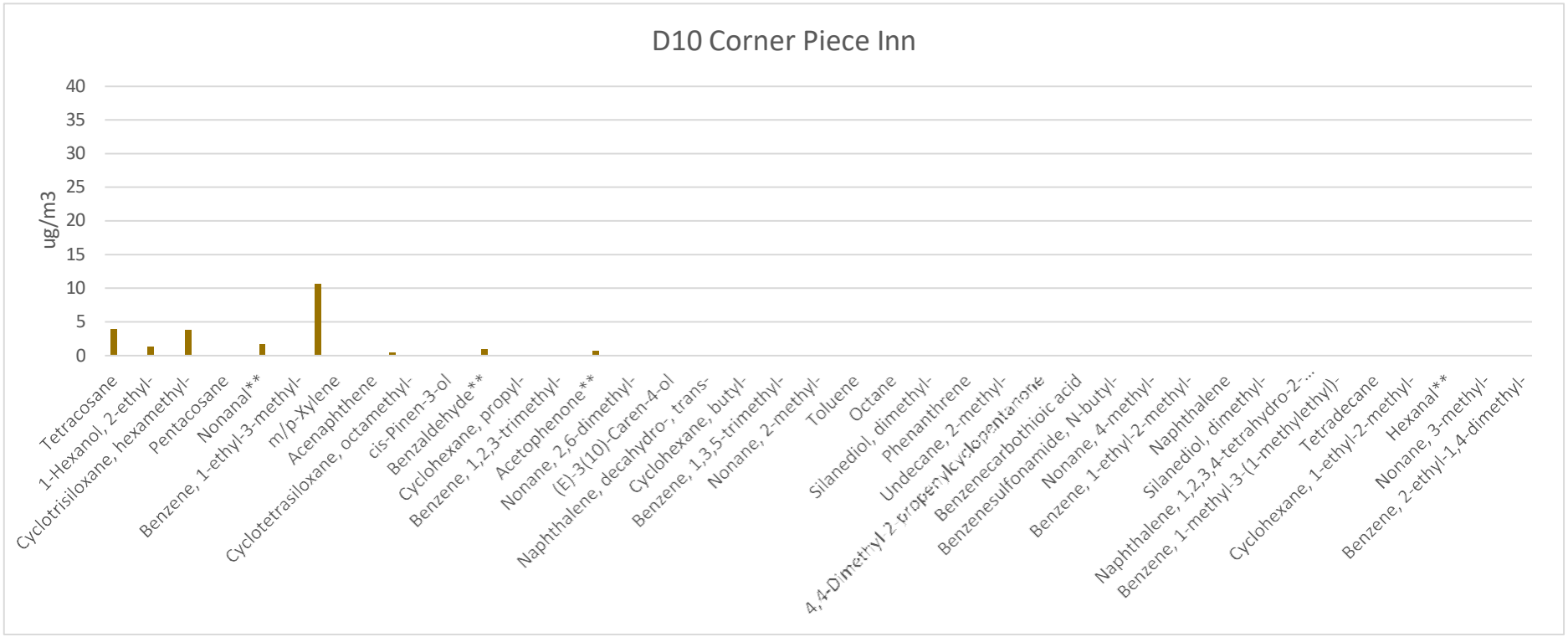


Chart 4-10 VOC's at WL1 1BC Access Ramp

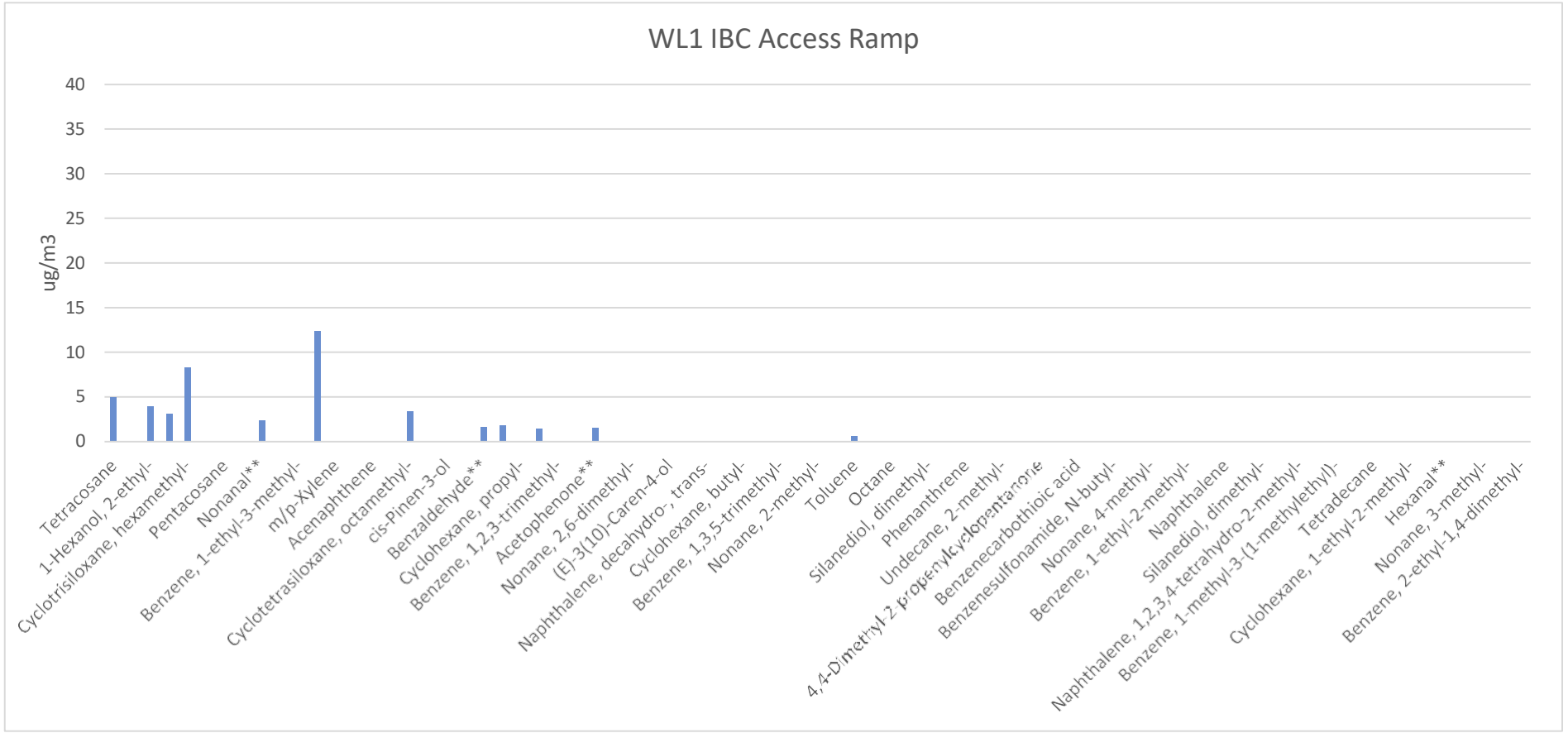


Chart 4-11 VOC's at WL4 Fence Post W

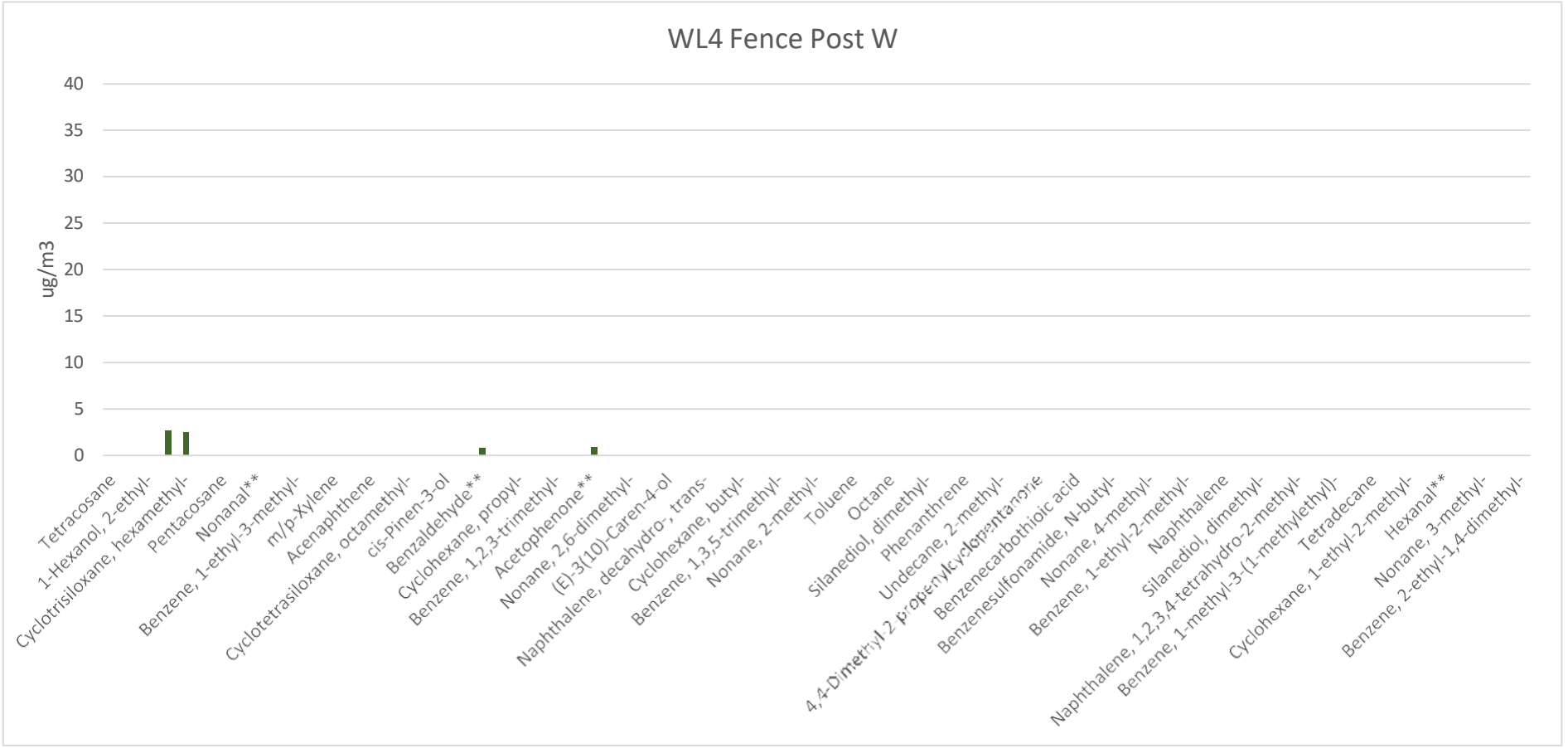


Chart 4-12 VOC's at WL5 CCTV Tower

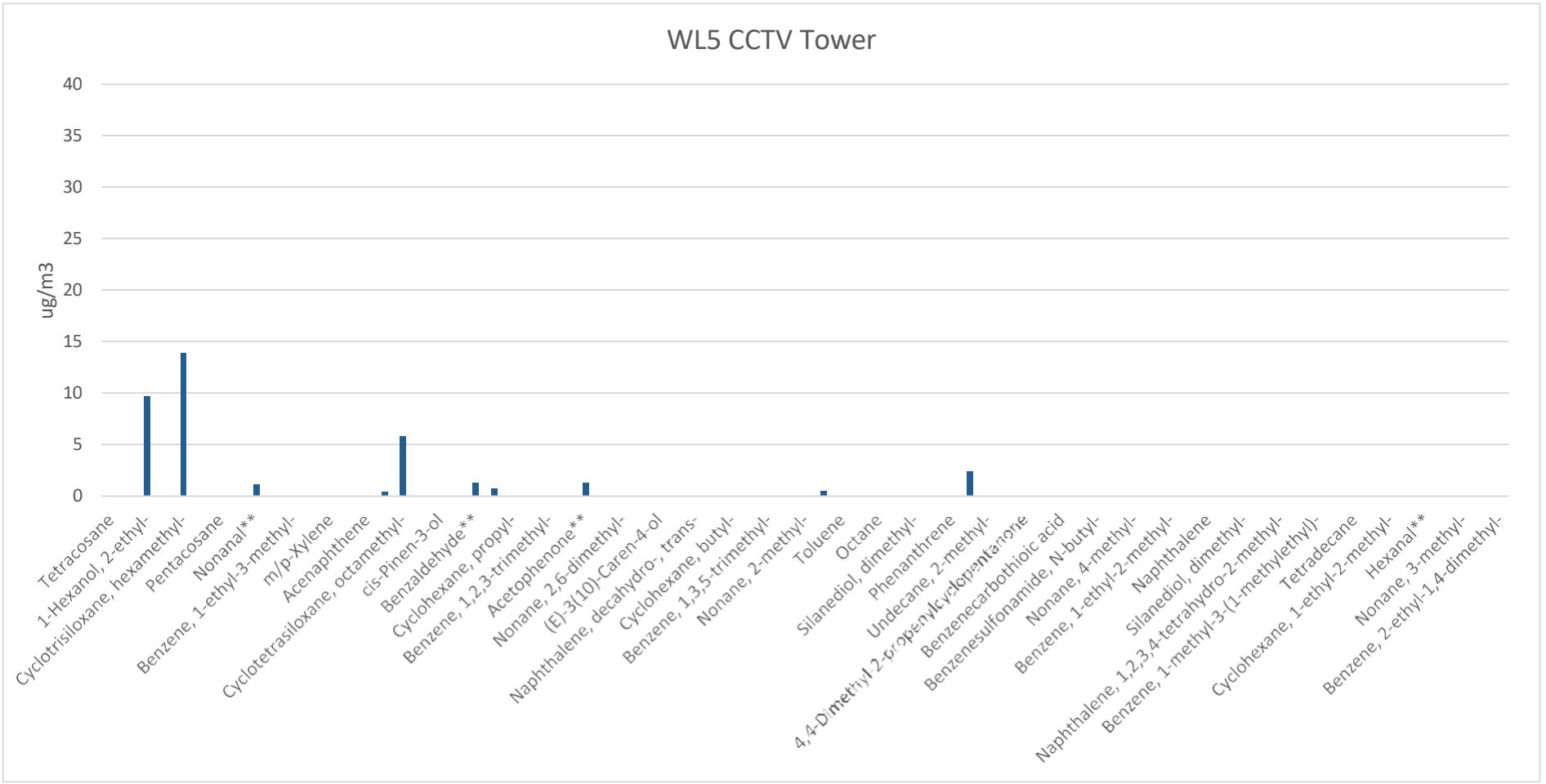
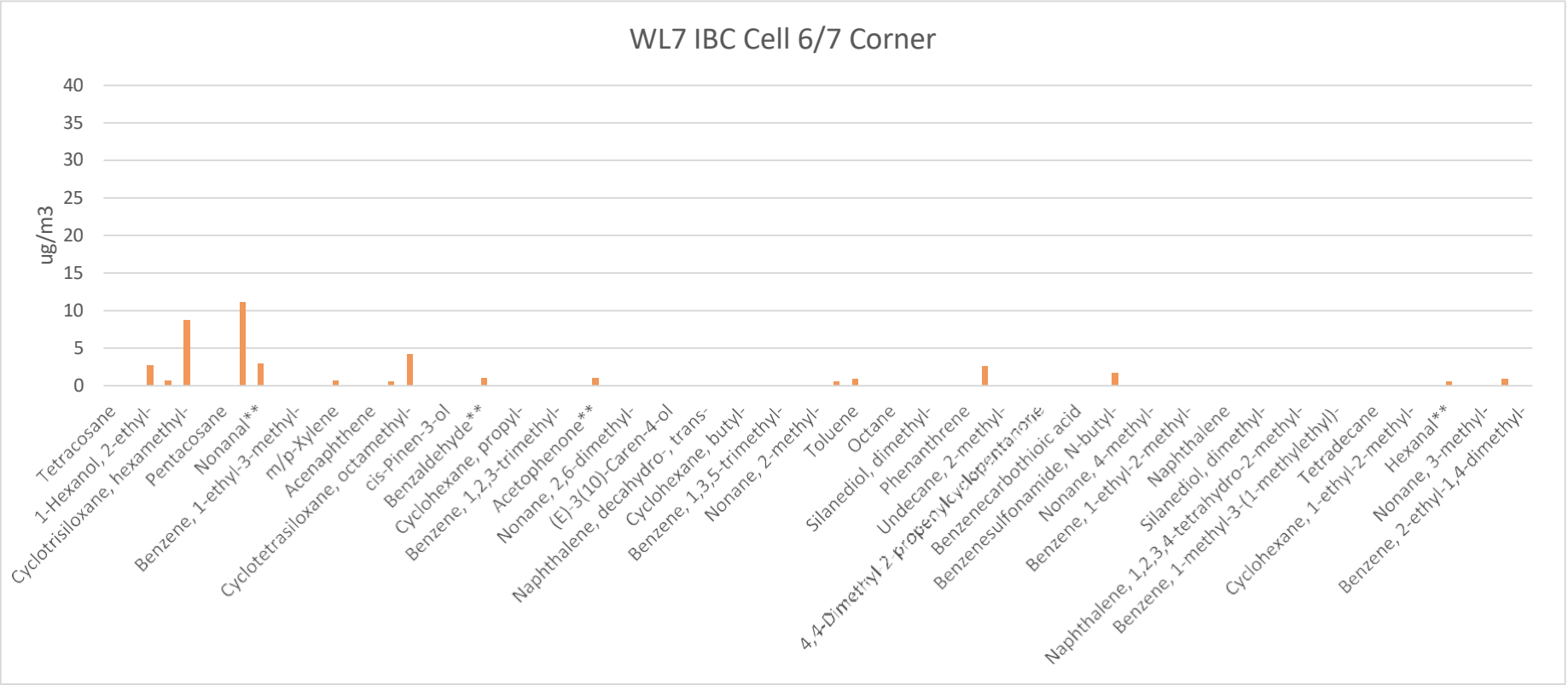


Chart 4-13 VOC's at WL7 IBC Cell 6/7 Corner



5 INSTANTANEOUS MONITORING OF HYDROGEN SULPHIDE

5.1 Monitoring using a Jerome Analyser

To date, the recorded concentrations of hydrogen sulphide measured at each diffusion tube in the community has averaged 0.1ppb or less. However, it is suspected that the instantaneous concentration over the exposure period would have risen and fallen throughout the period for a number of reasons. To aid understanding of these potential shorter-term variations, and to utilise another method of hydrogen sulphide analysis at a different height above ground-level, Geotechnology has been using a Jerome® J605 Hydrogen Sulphide Analyzer analyser since 14 March 2024. At the time of writing, it is understood that other organisations are starting to also use the same model of Jerome monitor and it is hoped that this will provide opportunity for instrument comparison. It is hoped that this will be reported in the next summary and allow further data discussion.

The Jerome is a hand-held instrument capable of measuring Hydrogen Sulphide. The instrument contains a gold film sensor that is sensitive to Hydrogen Sulphide. To take a sample, an internal pump pulls ambient air over the gold film sensor. The sensor absorbs the hydrogen sulphide present in the sample and undergoes an increase in electrical resistance proportional to the mass of Hydrogen Sulphide. This allows the instrument to calculate and display the measured concentration of hydrogen sulphide. Measurements below 3ppb are reported as zero and at 5 ppb the instrument has an accuracy of ±1 ppb and a precision of 10%. In practice, this means a displayed value of 0 ppb is <3ppb and a reported value of 5ppb is equivalent to an actual concentration of about 4-6 ppb. The current calibration certification for the Jerome instrument being used is provided in Appendix 6.

Using the Jerome, monitoring data has been gathered using several different approaches:

- 30 minute logging of airborne Hydrogen Sulphide at 5-minute intervals
- 24-hr (or more) of logging airborne Hydrogen Sulphide at 15-minute intervals
- Spot levels – where measurements have been made in real-time at different locations. Some of this monitoring has been undertaken by a local resident.

This data is presented in this report as parts per billion (ppb).

For each approach the same protocol has been followed with the instrument undergoing a 45-minute 'Regeneration' process at the start and end of each day, and as dictated by the sensor saturation. At the start of each monitoring interval a 5-minute 'Warm-up' routine with a Zero Air Filter has also been undertaken.

The reader should note that the instrument does, on occasion, produce a high value at the start of a monitoring interval. This is understood to be related to sensor stability at the start of the monitoring interval – such values have been retained in the data presented.

5.2 30-minute interval logging

Appendix 4 contains the results of 30-minute logging undertaken around the Withyhedge Landfill site. This includes the positions referenced D1-D10 and also other positions which are identified. Also included is commentary related to the observation of odour at the time of monitoring.

The dataset is complex with readings close to the detection limit reported at times when there was no discernible odour and similar values when an odour was discernible. There is, however, an increase in the reported concentration when odours are more strongly discernible. A good example of this is shown by the data from 5 April 2024.

5.3 Spot Measurements

Following an introduction to the use of the Jerome and the sampling protocol, spot measurements were made by a resident in several different areas. The results of this monitoring are presented in Table 5-1 with the full dataset included at the rear of Appendix 4.

Table 5-1 Spot measurements and observation made by resident

Date	Smell Strength	Location	Reading / ppb
19/04/2024	Weak	Spittal (In House)	6.18
19/04/2024	Medium	Crundale (Coss Lane)	8.98
19/04/2024	Strong	Rudbaxton (House)	12.98
20/04/2024	Weak	Camrose	4.59
20/04/2024	Weak	Keeston	3.78
21/04/2024	Weak	Haverfordwest (Cuckoo Lane)	8.02
21/04/2024	Weak	Prendergast	4.54

These results are comparable to the data gathered during the 30-minute logging. The highest values are associated with the strongest odours.

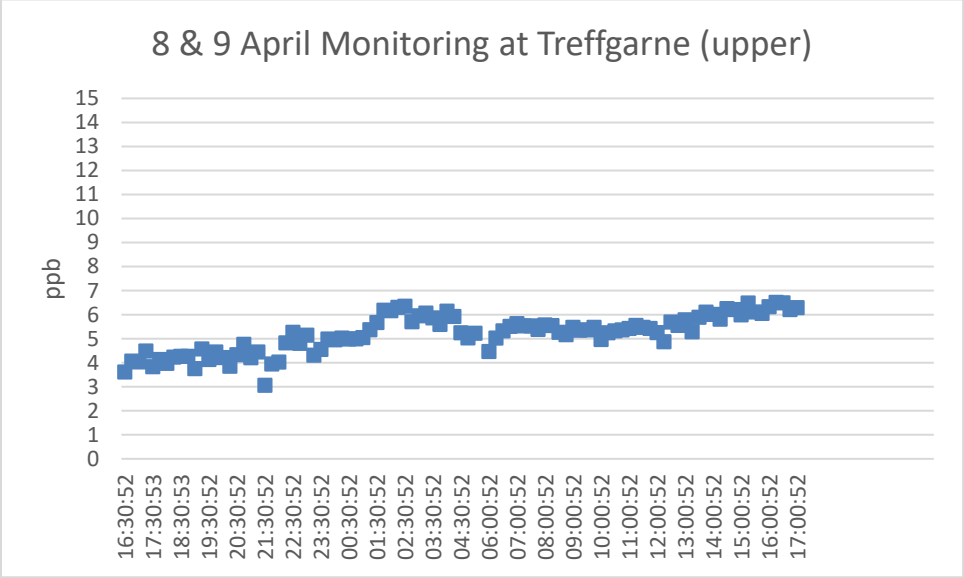
Reference to the full dataset at the rear of Appendix 4 indicates that higher values were recorded during this spot monitoring. These higher values are considered to be related to sensor stability at the start of the monitoring interval as they occur immediately following the warm-up cycle.

5.4 Longer Duration Monitoring

With further help of several local residents, the Jerome has been used to monitor for extended periods of up to and over 24-hrs. This has been possible by positioning the Jerome in the open doorway of outbuildings that provided protection from direct rainfall (as the instrument is not waterproof) whilst still providing an opportunity for air sampling. At one property in Spittal the Jerome was placed adjacent to an open window in an attic space above a garage – this is the highest position (~3m) above ground level where the Jerome has been deployed. The results of all this monitoring are presented in charts overleaf.

During such monitoring the Jerome automatically undertakes a 'Regeneration' of the sensor and at these times a zero value is reported. These zero values have been removed from the datasets presented so that only the automatically logged sampling measurements are shown.

Apart from at the very start of monitoring on 8 April, when there was a very faint impersistent odour detectable, the residents from the properties did not report distinct odours during the period when the Jerome was monitoring in their outbuilding.


8 & 9 April Monitoring at Treffgarne (upper)
ppb
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
16:30:52
17:30:53
18:30:53
19:30:52
20:30:52
21:30:52
22:30:52
23:30:52
00:30:52
01:30:52
02:30:52
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07:00:52
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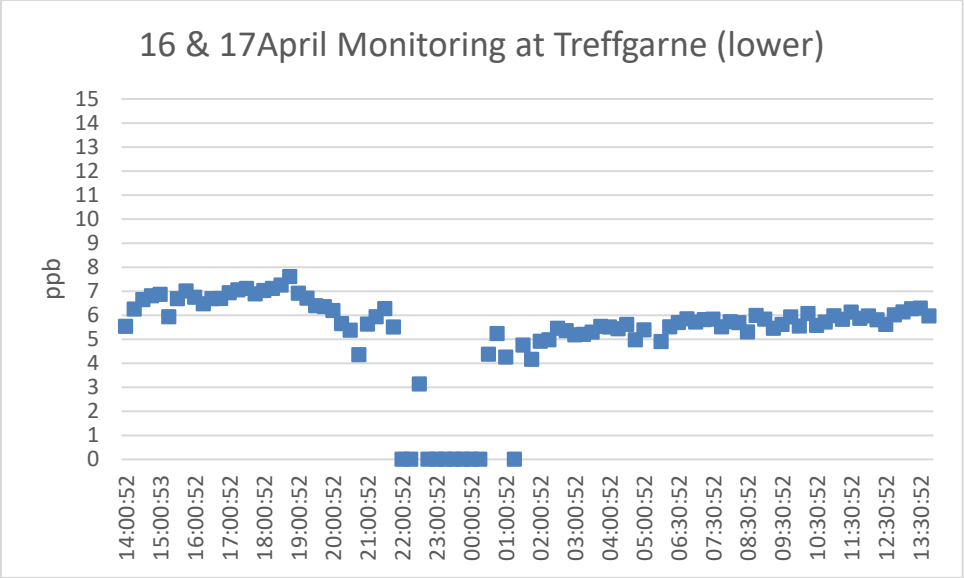
16:00:52
17:00:52


16 & 17April Monitoring at Treffgarne (lower)
ppb
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
14:00:52
15:00:53
16:00:52
17:00:52
18:00:52
19:00:52
20:00:52
21:00:52
22:00:52
23:00:52
00:00:52
01:00:52
02:00:52
03:00:52
04:00:52
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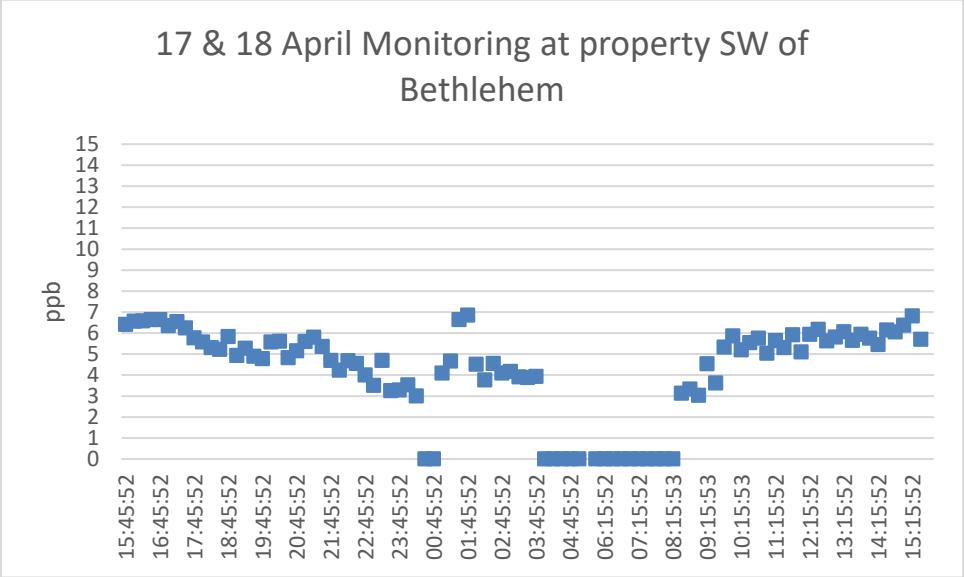
10:30:52
11:30:52
12:30:52
13:30:52


17 & 18 April Monitoring at property SW of Bethlehem
ppb
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
15:45:52
16:45:52
17:45:52
18:45:52
19:45:52
20:45:52
21:45:52
22:45:52
23:45:52
00:45:52
01:45:52
02:45:52
03:45:52
04:45:52
06:15:52
07:15:52
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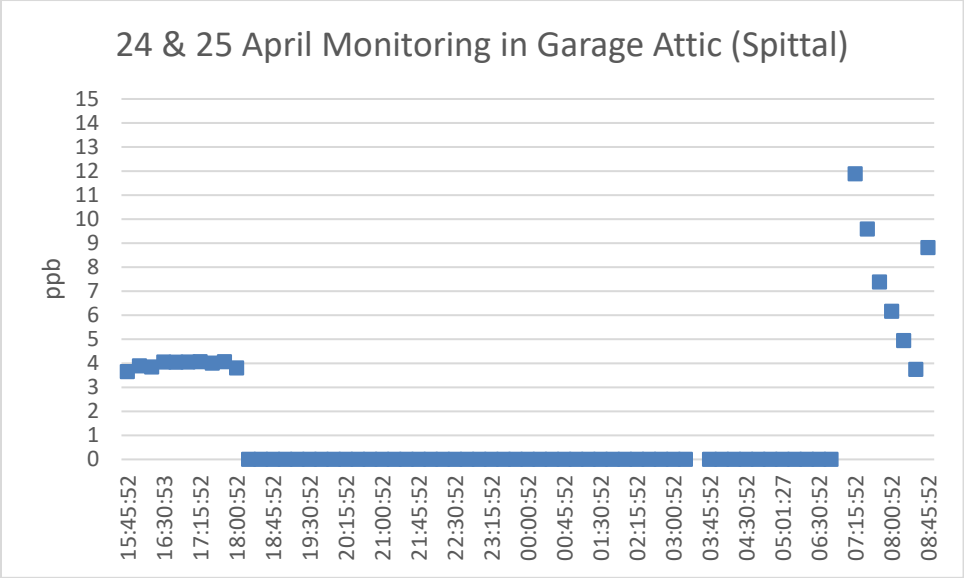
10:15:53
11:15:52
12:15:52
13:15:52
14:15:52
15:15:52


24 & 25 April Monitoring in Garage Attic (Spittal)
ppb
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
15:45:52
16:30:53
17:15:52
18:00:52
18:45:52
19:30:52
20:15:52
21:00:52
21:45:52
22:30:52
23:15:52
00:00:52
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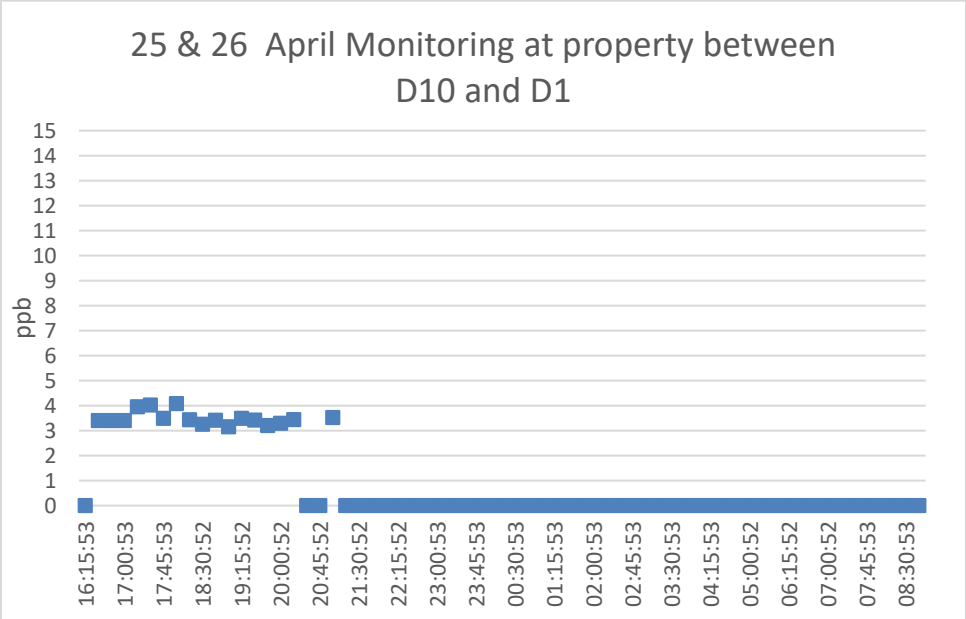
07:15:52
08:00:52
08:45:52


25 & 26 April Monitoring at property between D10 and D1
ppb
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
16:15:53
17:00:53
17:45:53
18:30:52
19:15:52
20:00:52
20:45:52
21:30:52
22:15:52
23:00:53
23:45:53
00:30:53
01:15:53
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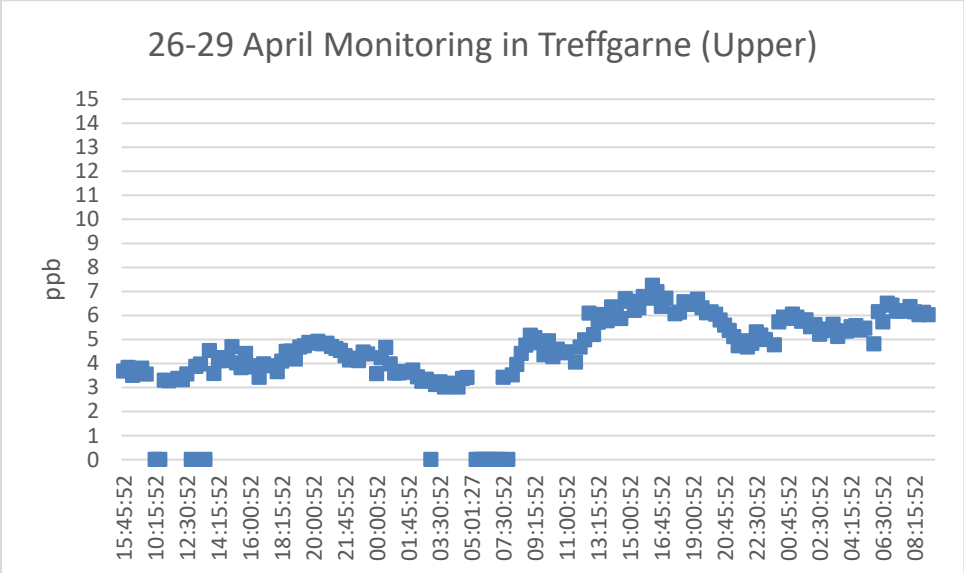
04:15:53
05:00:52
06:15:52
07:00:52
07:45:53
08:30:53


26-29 April Monitoring in Treffgarne (Upper)
ppb
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
15:45:52
10:15:52
12:30:52
14:15:52
16:00:52
18:15:52
20:00:52
21:45:52
00:00:52
01:45:52
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09:15:52
11:00:52
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15:00:52
16:45:52
19:00:52
20:45:52
22:30:52
00:45:52
02:30:52
04:15:52
06:30:52
08:15:52

5.5 Monitoring in Other Areas

As Hydrogen Sulphide can be generated by a range of natural and man-made activities, measurements have been made using the Jerome in a number of different locations across South Wales. The aim of this monitoring is to try and start to understand if there are background levels of Hydrogen Sulphide. This monitoring has been undertaken at several positions:

- Inside and outside a residential property in the Amman Valley. Property is located adjacent to the main road and open fields used for horse and sheep grazing.
- Outside Cardiff university
- On beach at Barry Island
- Penblewin Car Park off the A40, near Narbeth
- Residential development site on outskirts of Cowbridge. Adjacent A48 and agricultural area.

This data is presented in Appendix 5. At each of these positions no odour was discernible.

5.6 Summary

As the data from the Jerome monitor is gathered over short timescales, it is considered appropriate, at this stage, to evaluate the data against criteria intended to enable the assessment of such short-term exposure rather than the longer-term exposure criteria summarised in Table 4-4. Such short-term criteria are sometimes referred to as acute criteria. In the absence of specific UK criteria, an example of such criteria is presented in Table 5-2 which have been developed by the World Health Organisation (WHO).

Short-term WHO air quality guideline	**Hydrogen Sulphide guideline value / ppb**	**Note**
30-minute (average)	5	Short-term odour value protective of odour annoyance. The guideline was developed by a panel of experts following a review of available information and consideration of the odour threshold for hydrogen sulphide which was reported to be in range 0.5 ppb – 130 ppb based on experimental studies at the time.
24-hour (average)	107	This value was derived from studies of eye irritation in humans.

Table 5-2 WHO Air Quality Guidelines

Initial comparison of the data gathered in the community using the Jerome with these criteria indicates that the only data found to be above the 24-hr average are the few peaks sometimes observed at the start of a monitoring interval which are thought to be related to sensor stability. All other data has been recorded at levels well below the 107ppb guideline value.

Ongoing monitoring using the Jerome is focussing on logging data for 30-minutes at 5-minute sampling intervals at the same position as the diffusion tubes. This data will be presented in

the next summary and will be evaluated within the context of the short-term criteria. Initial consideration of the data presented in this report against the 5ppb guideline value indicates that many readings reported by the Jerome are close to the detection limit of the instrument and also close to the 5ppb guideline value. Interestingly, values reported above and below the 5ppb guideline value have been recorded at times where there has not been an odour detectable / reported and at times when an odour has been detectable. This suggests that the absolute values reported by the Jerome are most usefully interpreted when considered alongside other lines of evidence. To inform this assessment, as part of the next data summary a comparison of the results gathered by different Jerome monitors will be made.

6 SUMMARY

The recorded concentrations of hydrogen sulphide measured at each diffusion tube placed within surrounding communities have averaged 0.1ppb or less since the start of monitoring in early February 2024. These time integrated average concentrations are lower than the lifetime exposure criteria.

With the benefit of the data gathered from the Jerome monitor, it is now evident that the instantaneous concentration of Hydrogen Sulphide may rise and fall although the dataset is complex and many readings are close to the detection limit of the instrument. The higher values of Hydrogen Sulphide reported by the instrument are associated with the presence of odour but positive values are also reported by this instrument where there is no odour discernible.

During this monitoring period, diffusion tubes have been used to assess for the presence of VOCs for the first time. As the initial full scan has revealed VOCs to be present at very low levels, the next analysis will focus on the top 20 compounds. At this stage, the data suggests that Hydrogen Sulphide is still a useful target compound for trying to detect the presence of landfill gas.

The next summary is planned for late May/early June following receipt of laboratory data from the latest exposure period.

Acknowledgements

Some of the monitoring would not have been possible without the ongoing support and access provided by local residents. Thank you for assistance.

References

Ref 1. U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological profile for Hydrogen Sulphide, 2006.
Ref 2. U.S. Environmental Protection Agency Reference Concentration for Hydrogen Sulphide.
Ref 3. EH40/2005 Workplace exposure limits (Fourth Edition 2020)