**WITHYHEDGE LANDFILL**

# AIR QUALITY MONITORING INTERIM SUMMARY REPORT 6

*Report Number 2423r6v1d0924*

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# Executive Summary

This sixth interim report has considered all of the monitoring data gathered since the start of monitoring in February 2024.

It is evident from the frequent and repeated use of the Jerome at monitoring positions in the community around the landfill that concentration levels of Hydrogen Sulphide have fallen from higher levels observed earlier in the year with few occurrences of detectable levels in recent months. At the same time, the incidence of odour considered to be related to landfill gas has declined as has the number of complaints. The concentration of Hydrogen Sulphide and Volatile Organic Compounds detected by diffusion tubes has remained below guidance values for intermediate/lifetime exposure throughout the monitoring to date.

This sixth interim report has provided opportunity for review of all the monitoring data gathered since February 2024 to be considered.

In this context, the community monitoring programme will therefore focus on the measurement of Hydrogen Sulphide using diffusion tubes at D1-D12 along with the data gathered by Pembrokeshire County Council at the fixed position monitor located at Spittal School. This flexible strategy will be subject to continual review.

# 1 SCOPE

Over the past nine months, the operator of Withyhedge Landfill has implemented a series of measures agreed with NRW to address odours emanating from the site including re-profiling, capping and additional landfill gas extraction. The site has also not received waste since mid-May 2024. 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 sixth interim report summarises data gathered from the ongoing monitoring that commenced in February 20024. The monitoring 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.

As the monitoring programme has now been in place for six months this review considers how the programme will evolve and other aspects related to the odour incident.

# 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, TENAX diffusion tubes designed to allow the analysis of Volatile Organic Compounds (VOCs) have been used since 8 March 2024 at the same positions 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 DIFFUSION TUBE MONITORING

## 3.1 Hydrogen Sulphide Monitoring

Diffusion tubes monitoring Hydrogen Sulphide have been set at twelve off-site locations at various compass directions around Withyhedge Landfill with additional tubes on-site, as shown on Figures 3-1 and 3-2.

The tubes are positioned to enable free air movement, safety during maintenance and consideration of potential damage, theft or vandalism. The suitability of the monitoring positions is being reviewed as the programme develops, hence, on 4 June 2024, two additional monitoring positions were added to the network; D11 in Prendergast and D12 in Crundale.

As highlighted in summary report 5, on 11 July 2024 an additional tube (referred to as SCH1) was located alongside the permanent monitoring station positioned by Pembrokeshire County Council (PCC) at Spittal School.

To assist with putting the results from D1-D12 into wider context, diffusion tubes were also positioned at four off-site positions during the latest monitoring period. These positions were:

- Pembroke Dock, between the Aldi supermarket and adjacent church (tube D13),
- St David's, close to the primary school (tube D14)
- Saron Road, Ammanford, ~100m west of the primary school (tube D15)
- Ffordd Coed Darcy, Llandarcy off Junction 43 of the M4 (tube D16)

Details of each position are summarised in Table 3-1.

In addition to the off-site monitoring, diffusion tubes have also been placed on-site at Withyhedge Landfill. These positions are summarised in Table 3-2 and shown in Figure 3-2.

## Table 3-1 Off-site Monitoring positions

| Figure 3-1 & 3-2 reference | Location Description | Position | Height above ground/m |
|---|---|---|---|
| **Community monitoring locations** | | | |
| D1 | Spittal Cross cross-roads west of Spittal | Street furniture at cross-roads | 0.6 (old & new positions) |
| D2 | Adjacent Spittal School | Lamp post | 2.1 |
| D3 | Corner of spring gardens and Castle Rise, Spittal. Adjacent to 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 to properties at Poyston Water | Lamp post | 2.1 |
| D9 | Rudbaxton Water Bridge | Northern side of bridge | 1.2 |
| D10 | Adjacent to Junction with A40 near Corner Piece Inn | Lamp post | 1.9 |
| D11 | Withybush Road, Prendergast | Sign post | 1.8 |
| D12 | B4329 Crundale near junction with Cross Lane | Sign post | 1.8 |
| D13 | Pembroke Dock, between Aldi and church | Sign post | 1.8 |
| D14 | St David's, adjacent primary school | Sign post | 1.8 |
| D15 | Saron, Ammanford | Sign post | 1.8 |
| D16 | Llandarcy | Lamp post | 1.8 |
| SCH1 | Adjacent council monitor at Spittal school | On fence next to Council monitor air intake | 1.8 |

## Table 3-2 Monitoring positions

| **On-site monitoring locations** | | | |
|---|---|---|---|
| Access ramp (WL1) | Eastern side of access ramp | Metal post | 2.1 |
| Eastern 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 |
| Western 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 |

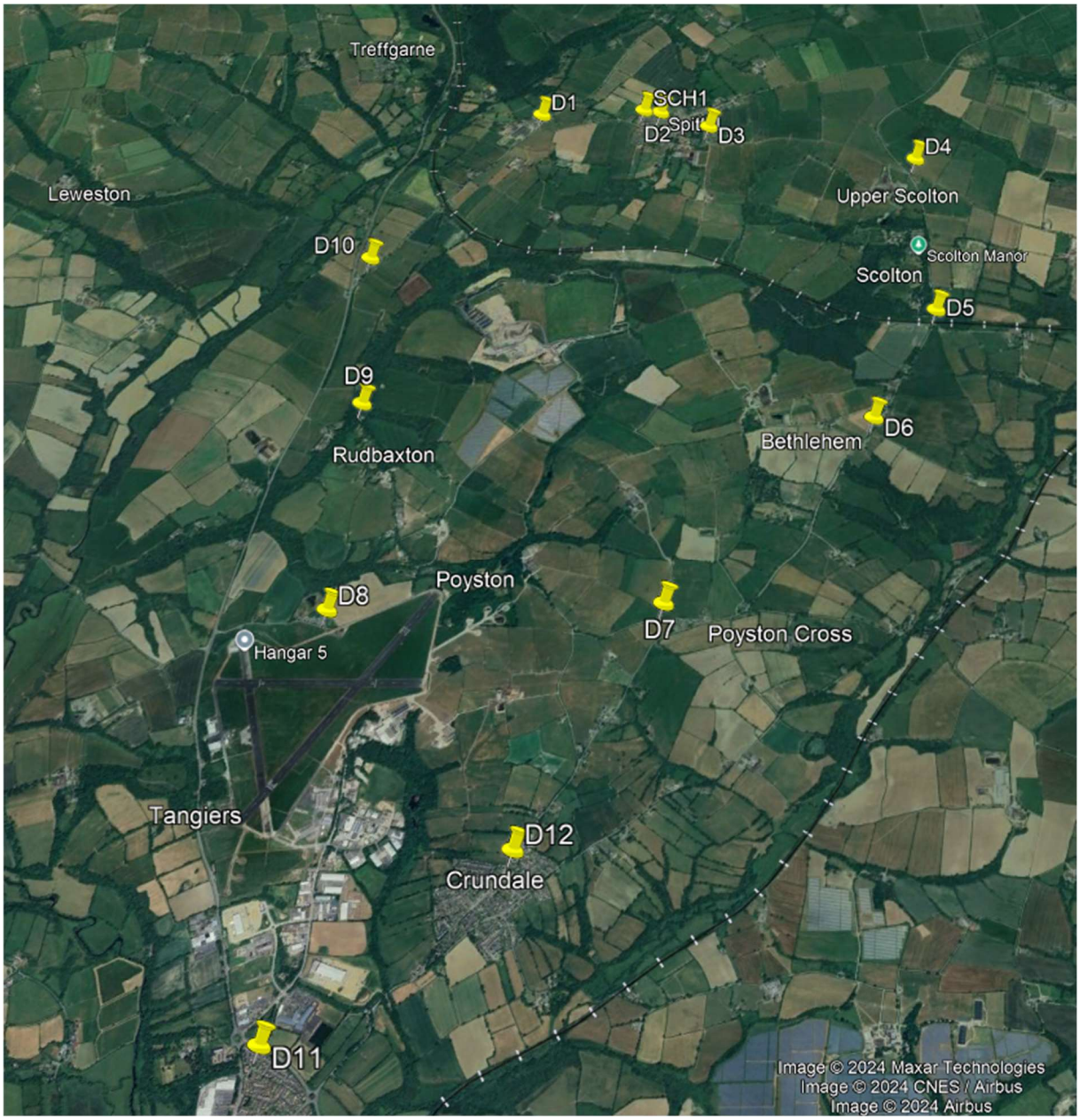



**Figure 3-1 Community Monitoring Positions D1- D12 and SCH1**

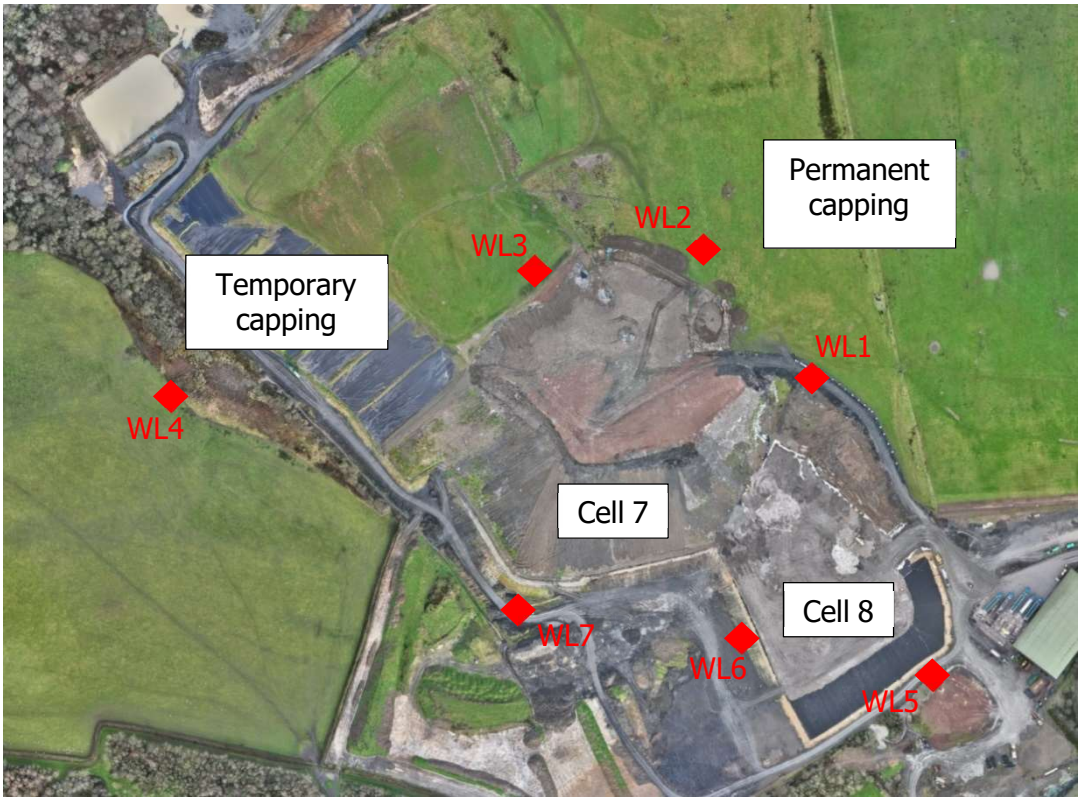



**Figure 3-2 On-site Monitoring Positions**

### 3.1.1 Review of Hydrogen Sulphide Results

The results of the Hydrogen Sulphide diffusion tube monitoring are summarised in Tables 3-3 and 3-4. The original laboratory certificates from the latest monitoring are included in Appendix 1. 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).

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 and third exposure periods capping works were continuing and gas extraction extending to newly capped areas. In the subsequent periods, capping works were completed and being actively maintained.

## Table 3-3 Hydrogen Sulphide results from Community Monitoring Positions

| | Exposure Period | | | | | |
|---|---|---|---|---|---|---|
| | **5 Feb-1 Mar** | **1 Mar-3 Apr** | **3 Apr-7 May** | **7 May-4 Jun** | **4 Jun–9 Jul** | **12 Jul–13 Aug** (1) |
| | **$H_2S$** | **$H_2S$** | **$H_2S$** | **$H_2S$** | **$H_2S$** | **$H_2S$** |
| **Location** | **ppb** | **ppb** | **ppb** | **ppb** | **ppb** | **ppb** |
| Laboratory Blank | 0.05 | 0.04 | 0.05 | 0.06 | 0.04 | 0.03 |
| **Community monitoring positions** | | | | | | |
| Junction west of Spittal - D1 | <0.08 | Removed | 0.12 | <0.07 | <0.06 | <0.06 |
| Spittal School - D2 | <0.08 | <0.06 | 0.14 | <0.07 | <0.06 | <0.06 |
| Spittal - D3 | <0.08 | <0.06 | 0.07 | <0.07 | 0.06 | <0.06 |
| Upper Scolton - D4 | <0.08 | <0.06 | 0.14 | <0.07 | 0.06 | <0.06 |
| Scolton Road - D5 | <0.08 | <0.06 | <0.06 | <0.07 | <0.06 | <0.06 |
| Bethlehem - D6 | <0.08 | <0.06 | <0.06 | <0.07 | <0.06 | <0.06 |
| Poyston Cross - D7 | <0.08 | <0.06 | <0.06 | <0.07 | <0.06 | <0.06 |
| Poyston Water - D8 | <0.08 | <0.06 | 0.06 | 0.09 | 0.28 | <0.06 |
| Rudbaxton - D9 | 0.1 | 0.07 | 0.07 | 0.1 | <0.06 | <0.06 |
| A40 Junction - D10 | <0.08 | 0.07 | Removed | <0.07 | <0.06 | <0.06 |
| Withybush Road - D11 | | | | | <0.06 | 0.16 |
| Crundale - D12 | | | | | <0.06 | <0.06 |
| Spittal School – SCH1 | | | | | | <0.06 |
| **Other off-site positions** | | | | | | |
| Pembroke Dock – D13 | | | | | | <0.06 |
| St David's – D14 | | | | | | <0.08 |
| Saron, Ammanford - D15 | | | | | | <0.06 |
| Llandarcy – D16 | | | | | | <0.06 |

Note:
(1) Exposure for each tube was D1-D12 exposed 12 July – 13 August, SCH1 11 Jul – 13 August, D13 and D14 17 July-13 August, D15 11 July – 14 August, D16 12 July – 14 August.

## Table 3-4 On-site Hydrogen Sulphide monitoring results

| | Exposure Period | | | | | |
|---|---|---|---|---|---|---|
| | **8 Feb-1 Mar** | **1 Mar-3 Apr** | **3 Apr-7 May** | **7 May-4 Jun** | **4 Jun–9 Jul** | **1 Jul–14 Aug** |
| | **$H_2S$** | **$H_2S$** | **$H_2S$** | **$H_2S$** | **$H_2S$** | **$H_2S$** |
| **Location** | **ppb** | **ppb** | **ppb** | **ppb** | **ppb** | **ppb** |
| Laboratory Blank | 0.05 | 0.04 | | | | |
| Access ramp (WL1) | 1.48 | Lost | | | | |
| Fence posts (WL2) | 1.82 | | | 0.27 | 0.1 | <0.06 |
| Litter skids (WL3) | 2.04 | | | | | |
| Field fence post (WL4) | 0.29 | 1.38 | 0.31 | 0.12 | <0.06 | <0.06 |
| CCTV tower (WL5) | 0.6 | 4.4 | 9.24 | 2.16 | 1.11 | 0.09 |
| IBC cell 8 (WL6) | 1.04 | | | | | |
| Cell 7 IBC corner (WL7) | 1.8 | 6.54 | 3.97 | | | |

Comparison of the concentrations detected using diffusion tubes in the community with the health-based evaluation criteria in Table 3-5 indicates that the concentrations continue to fall below these guidance values for intermediate/lifetime exposure.

The concentrations observed in the community around the landfill site are also the same as those detected at the other 4 positions in South Wales (D13-D16).

**Table 3-5 Referenced health based guidance values**

(Values taken from references 1 and 2)

| | **Intermediate exposure criteria (up to 1 year)** | **Lifetime exposure criteria** |
|---|---|---|
| **Hydrogen Sulphide concentration** | 20 ppb (30 µg/$m^3$) | 1 ppb (2 µg/$m^3$) |

Concentrations of hydrogen sulphide reported from the tubes exposed on-site have continued to fall, with the most recent results being comparable to those recorded at the off-site monitoring locations.

These on-site concentrations are several orders of magnitude below the workplace exposure limit of 5000 ppb for an 8-hour time-weighted average reference period (Ref 3). This suggests that the ambient levels on site do not pose a long-term risk to site workers and help place the concentration levels detected into context.

## 3.2 Volatile Organic Compound Monitoring

Monitoring of Volatile Organic Compounds (VOC) in air using diffusion tubes has been undertaken between 8 March 2024 and 13 August 2024. The diffusion tubes used for this monitoring are called TENAX tubes and were provided by the same laboratory providing the Hydrogen Sulphide tube analysis.

During the latest exposure period, tubes were positioned alongside the Hydrogen Sulphide tubes at the community locations, with the exception of positions D3, D5, D9, D11 and D12. Tubes were also positioned at D13 (Pembroke Dock), D14 (St David's), Saron (D15) and Llandarcy (D16).

On site, they were positioned at locations WL2, WL4 and WL5 alongside the Hydrogen Sulphide tubes.

VOC diffusion tubes work in the same way as Hydrogen Sulphide diffusion tubes, 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.

### 3.2.1 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.

The VOC laboratory certificate for the latest exposure period is presented in Appendix 2. Each of the tubes were analysed for the top 20 VOCs found to be present. 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 these data, the concentration data expressed in units of $\mu g/m^3$ (micro grammes per cubic meter of air) has been extracted from the last column of the certificate and repeated in Table 3-6 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 3-6 are criteria used to assess air quality. These come from a range of sources and are intended to provide a yardstick against which the reader can better appreciate the levels reported from the diffusion tubes. As noted in all previous monitoring reviews, it is evident from this comparison that the concentration levels estimated from the tubes are many times 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 continue to be found at very low levels just above the level of detection in many cases.
- some compounds are detected at higher concentration off-site compared to the tubes located on-site, and vice versa.
- The off-site positions in South Wales (D13-D16) have higher recorded levels of certain VOCs compared to the community positions (D1-D12) around the landfill site. The levels still fall below the evaluation criteria

## Table 3-6 Results from VOC Diffusion Tubes (µg/m³) - continues over several pages

| VOC | Community Positions | | | | | | | | | | | On-site positions | | | Evaluation Criteria |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D1 | D2 | D4 | D6 | D7 | D8 | D10 | D13 | D14 | D16 | D15 | WL2 | WL4 | WL5 | EAL and EA Study 2010 |
| 1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester | | | | | | 2.6 | | | | | | | | | |
| 1,4-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester | 20 | 47 | 27 | | | 124 | 38 | 63 | | 33 | 50 | 69 | 45 | 55 | |
| 1-Butanol | | 0.7 | | | <0.2 | | | | | | | | | | |
| 1-Hexanol, 2-ethyl- | 0.8 | 2.6 | 0.8 | 0.6 | 0.5 | 1.1 | 1.2 | 0.7 | 1.6 | 0.7 | 1.1 | 1.0 | 1.0 | 1.3 | 570 |
| *1-Propanone, 2-bromo-1-phenyl-* | | | | <0.5 | | | | | | | | | | | |
| Acetic acid | 0.4 | 0.4 | 0.4 | 0.2 | 0.2 | | 0.2 | 0.4 | 0.5 | 0.5 | 0.5 | | 1.2 | | 3700 |
| Acetophenone** | 0.9 | 1.3 | 1.7 | 1.8 | <0.3 | 2.3 | 1.7 | 1.8 | 1.9 | 2.2 | 1.8 | 1.6 | 1.8 | 2.0 | |
| *Behenyl benzoate* | | | | | | | | | | | | | | 27 | |
| Benzaldehyde** | 1.2 | 1.4 | 1.8 | 1.4 | 0.6 | 2.1 | 1.8 | 2.0 | 1.9 | 2.2 | 2.2 | 1.6 | 2.0 | 1.8 | 350 |
| Benzene | 1.1 | 0.4 | 0.5 | 0.3 | 0.4 | | 0.4 | 0.4 | 0.4 | | 0.4 | | 0.4 | | 5/30 |
| Benzeneacetaldehyde** | | | | <0.3 | | | | | | | | | | | |
| Benzenecarbothioic acid | | | 0.6 | | | | 0.6 | | 0.6 | 0.9 | 0.6 | | 0.7 | | |
| Benzenesulfonamide, N-butyl- | | | | | | 3.8 | | 1.5 | | | | | | | |
| Benzoic acid | 2.3 | 1.8 | 3.4 | 2.0 | <0.3 | 5.9 | 4.4 | 3.5 | 2.5 | 7.3 | 4.6 | 4.1 | 4.6 | 5.2 | |
| *Benzoic acid, tetradecyl ester* | | | | | | | | | | | | 10 | | | |
| Benzothiazole | | | | | | | 1.0 | | | | | | | | |
| Benzoylformic acid | | | | | | | | | | 0.7 | | | | | |
| Butane | 0.7 | 0.5 | | | | | | 0.5 | 0.4 | | 0.5 | | | | |
| Cyclohexane, isothiocyanato- | | | | | <0.4 | | | | | | | | | | |
| Cyclopentasiloxane, decamethyl- | | 1.5 | | 1.3 | <0.9 | | | | | 1.9 | 2.0 | | | | |
| Cyclotetrasiloxane, octamethyl- | 1.6 | 2.8 | 1.7 | 2.1 | 1.3 | | 1.7 | | 1.8 | 2.2 | 1.8 | 2.3 | 2.0 | 2.4 | |
| Cyclotrisiloxane, hexamethyl- | 2.9 | | 3.7 | 4.8 | 3.3 | 5.5 | 3.5 | 2.7 | 5.0 | 5.2 | 4.7 | 5.5 | 5.2 | 4.9 | |
| Decanal** | 0.6 | | 0.8 | 0.6 | 0.4 | | | | 0.9 | | | | | | |
| Dibutyl adipate | | | | | | | | | | | | 1.7 | | 2.7 | |
| Dibutyl phthalate | | | | | | 9.6 | | | | | | | | | |
| Diethyl Phthalate | | | | 3.9 | | 46 | 3.6 | 11 | | | | | | 6.1 | |
| Diphenyl sulfide | | | | | | 1.8 | | | | | | | | | |
| *Docosane* | | 20 | | | | 25 | | 14 | | | 29 | 8.8 | | 17 | |
| Eicosane | | | | | | | | 32 | | 44 | | | | 13 | |

| VOC | Community Positions | | | | | | | | | | | On-site positions | | | Evaluation Criteria |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D1 | D2 | D4 | D6 | D7 | D8 | D10 | D13 | D14 | D16 | D15 | WL2 | WL4 | WL5 | EAL and EA Study 2010 |
| Heptadecane, 9-octyl- | | | | | | | | | | | | 61 | | | |
| Heptanal | | | | | <0.3 | | | | | | | | | | |
| Hexanal** | | | | | 0.4 | | | | 0.5 | | | | | | |
| Hexane, 2,4-dimethyl- | | | 1.0 | 0.3 | | | | | | | | | 1.0 | | |
| Isopropyl palmitate | | | | | | | | | | | | 7.1 | | 8.7 | |
| Methane, iodo- | 1.5 | | | | | | | | | | | | | | |
| Nonanal** | 9.4 | 6.3 | 9.3 | 3.1 | 2.1 | 11 | 12 | 2.1 | 4.2 | 7.9 | 4.2 | 4.9 | 13 | 8.4 | |
| *Nonanoic acid* | | | | | | | 0.9 | | | | | | 1.0 | | |
| Octacosane | | | | | | | | 28 | | | | | 19 | | |
| *Octadecane* | | | | | | | | | | | 12 | | | | |
| Octanal** | 0.7 | 0.6 | 0.9 | 0.4 | 0.4 | 1.1 | 1.2 | | 0.8 | 0.7 | | 0.6 | 1.2 | | |
| Octane | 0.8 | 0.5 | | | | | 1.1 | | | 0.7 | | | | | |
| *Pentacosane* | 4.0 | 2.5 | 7.4 | | | 7.2 | | 3.0 | 11 | 3.2 | | 3.4 | 5.8 | 6.8 | |
| Phenol | 0.5 | 0.6 | 0.6 | 0.3 | 0.3 | 0.9 | 0.7 | 0.6 | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 | 0.6 | 200/3900 |
| Phenylmaleic anhydride | 0.9 | 0.7 | 1.6 | 0.5 | | 2.6 | 1.6 | 2.0 | 1.7 | 2.8 | 1.9 | 1.8 | 1.7 | 2.2 | |
| Several compounds. Identity not confirmed | | | | | | | | | | | | | | | |
| Silanediol, dimethyl- | 0.7 | 0.5 | 1.0 | | <0.2 | 0.8 | 0.7 | | 0.5 | 0.4 | 0.5 | 0.6 | 0.7 | 0.6 | |
| *Tetracosane* | 9.4 | 35 | 9.1 | | | 22 | 13 | | 3.8 | | 48 | 12 | | 29 | |
| Tetrahydrofuran | | | | | 0.2 | | | | | | | | | | |
| Toluene | | | | <0.2 | <0.2 | | | 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 2024 based on review of photographs.

Evaluation Criteria:
EAL / EA 2010 – Environmental Assessment Level. EALs represent a pollutant concentration ($\mu gm^3$) 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.

**Chart 3-1 VOC's detected at D1**

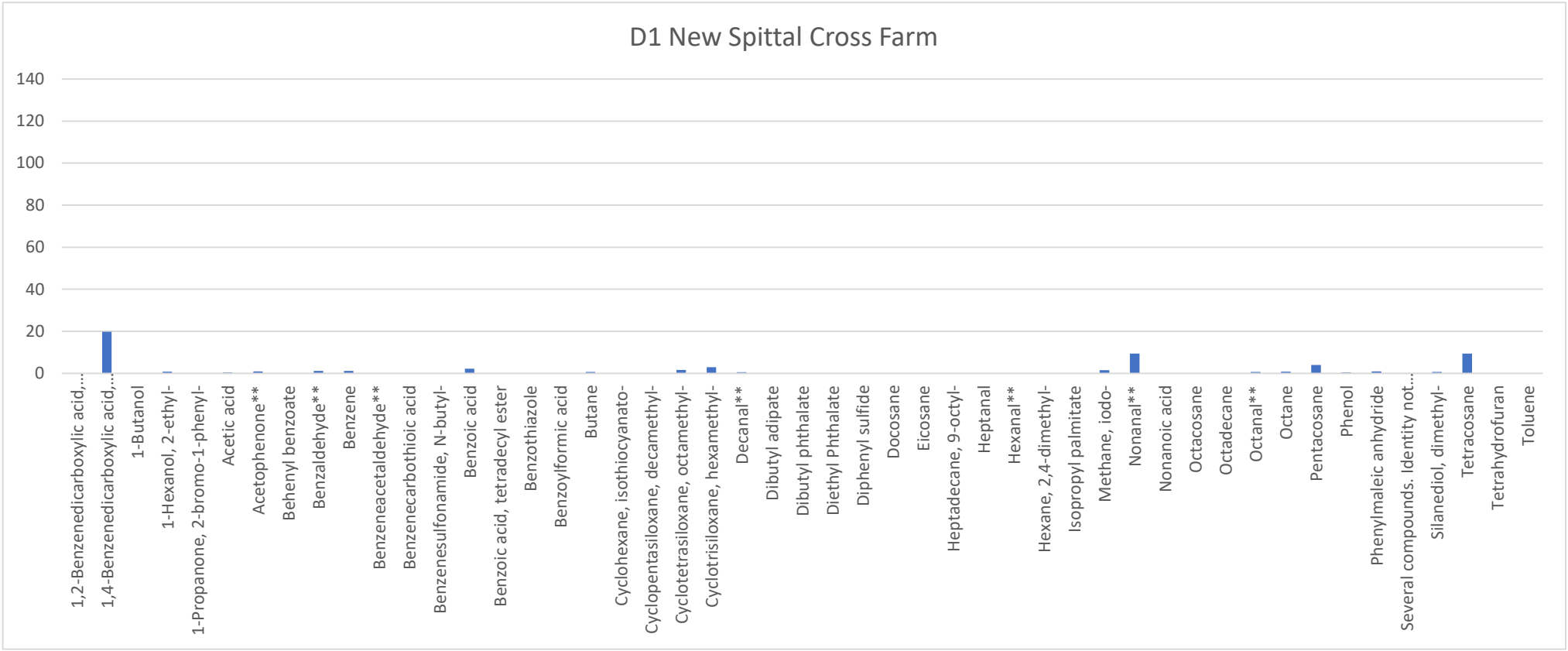


**Chart 3-2 VOC's detected at D2**

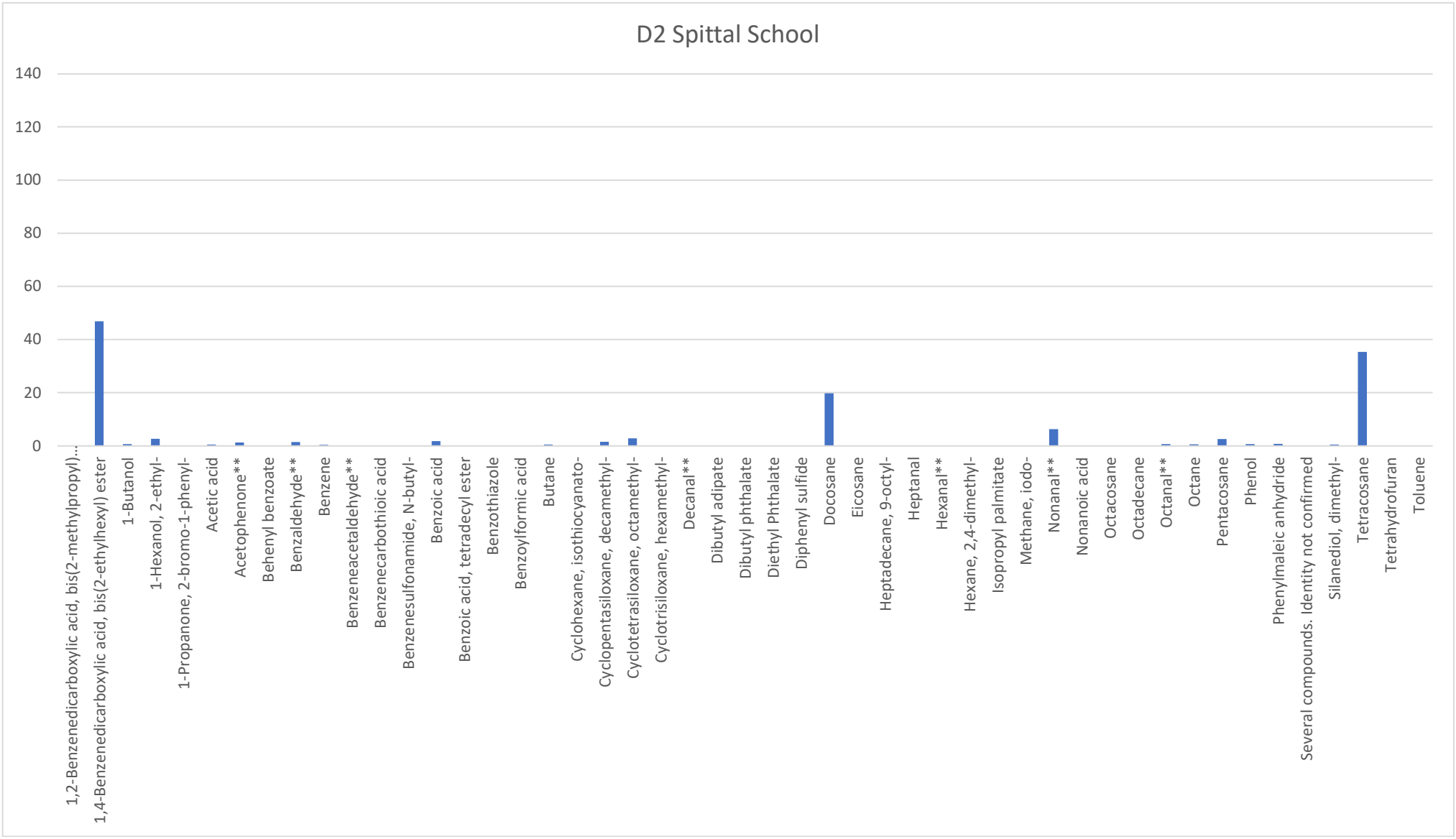


**Chart 3-3 VOC's detected at D4**

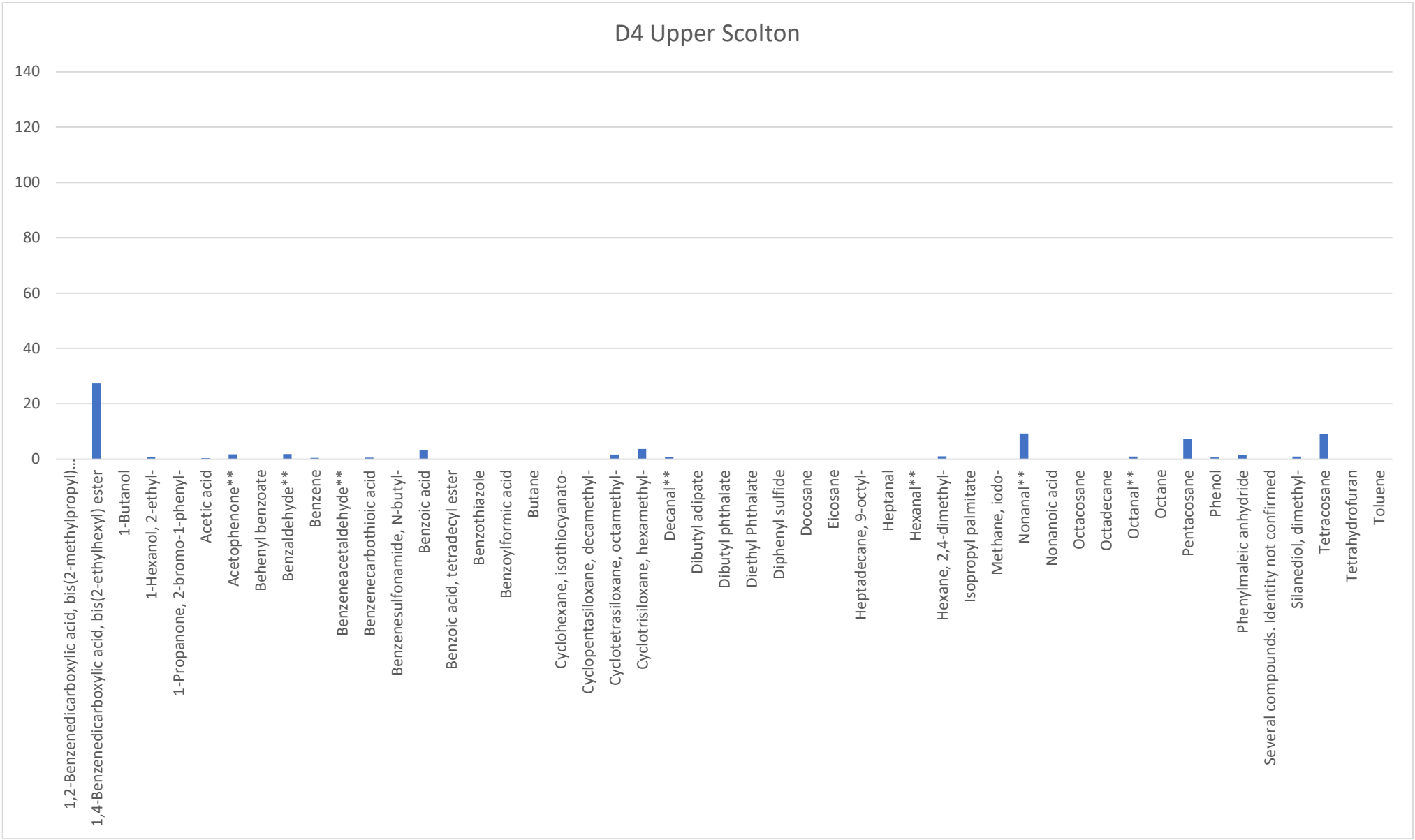


**Chart 3-4 VOC's detected at D6**

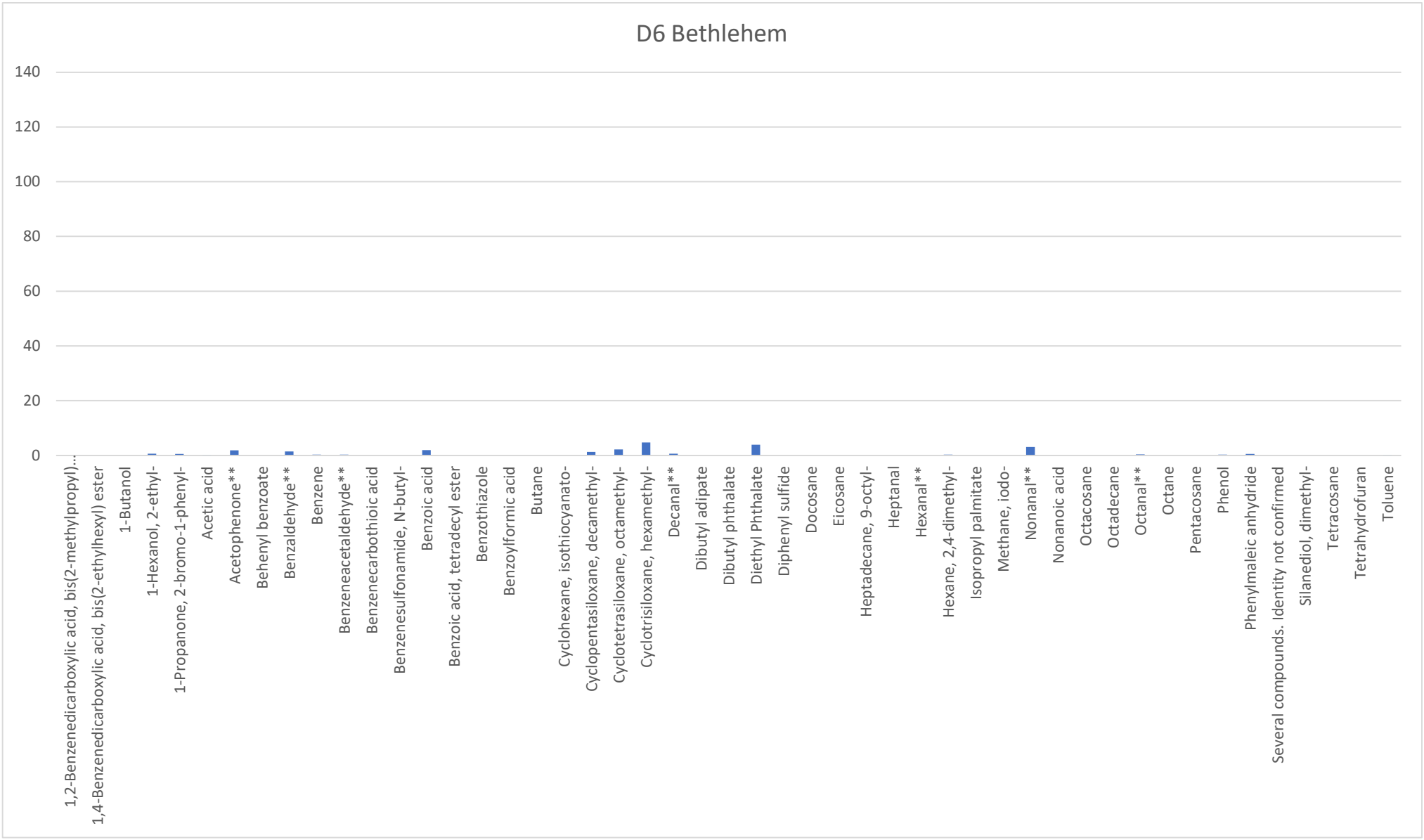


**Chart 3-5 VOC's detected at D7**

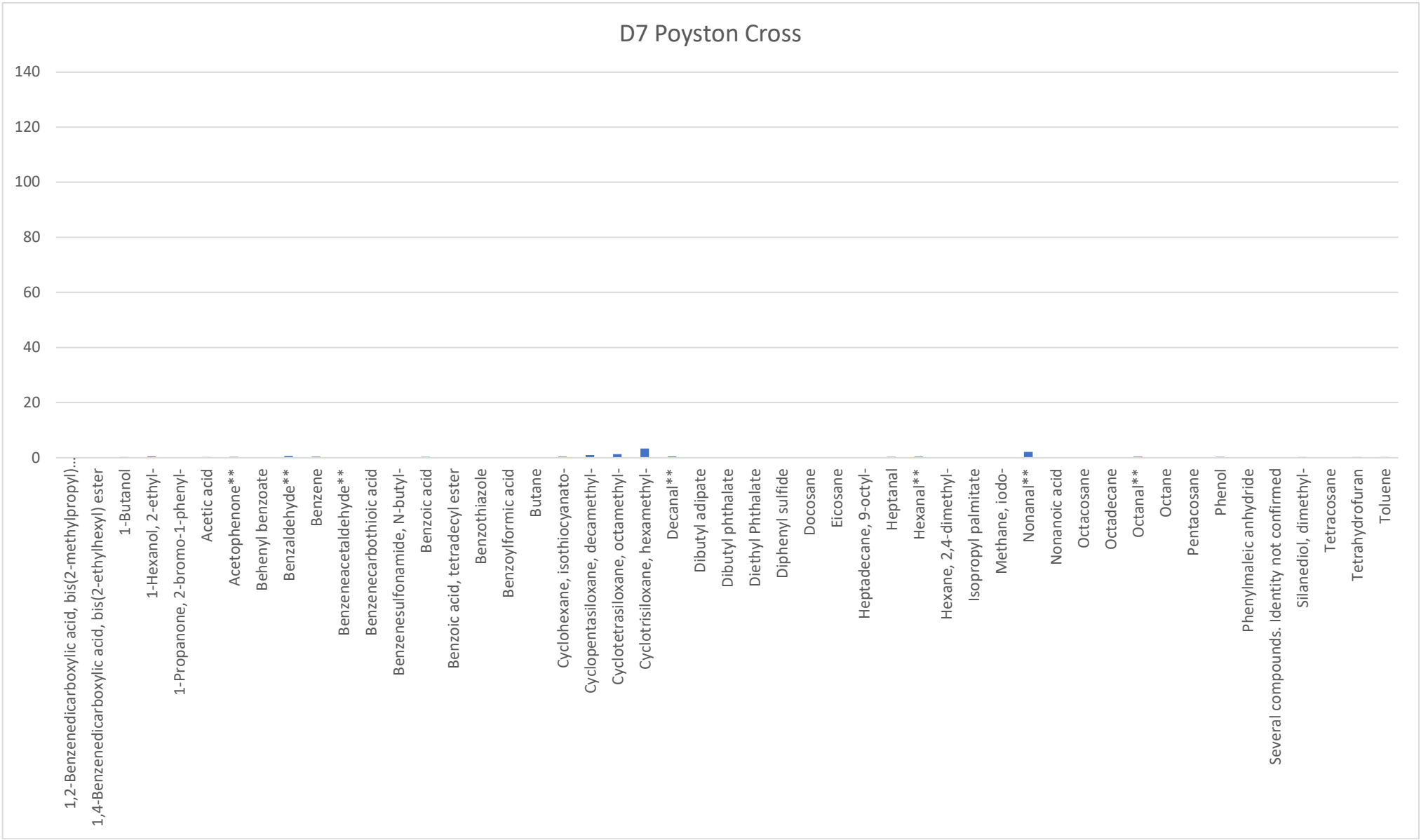


**Chart 3-6 VOC's detected at D8**

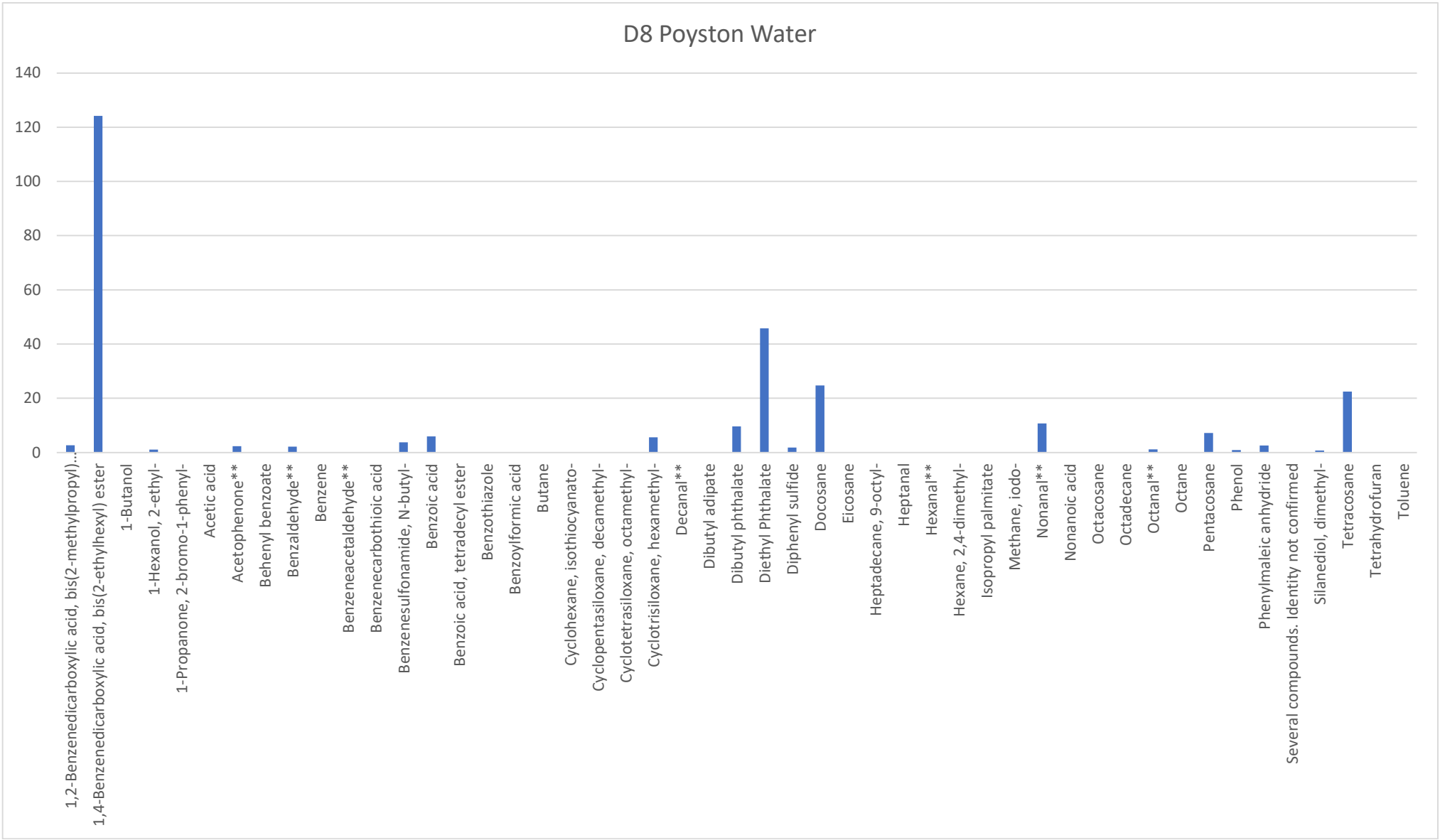


**Chart 3-7 VOC's detected at D10**

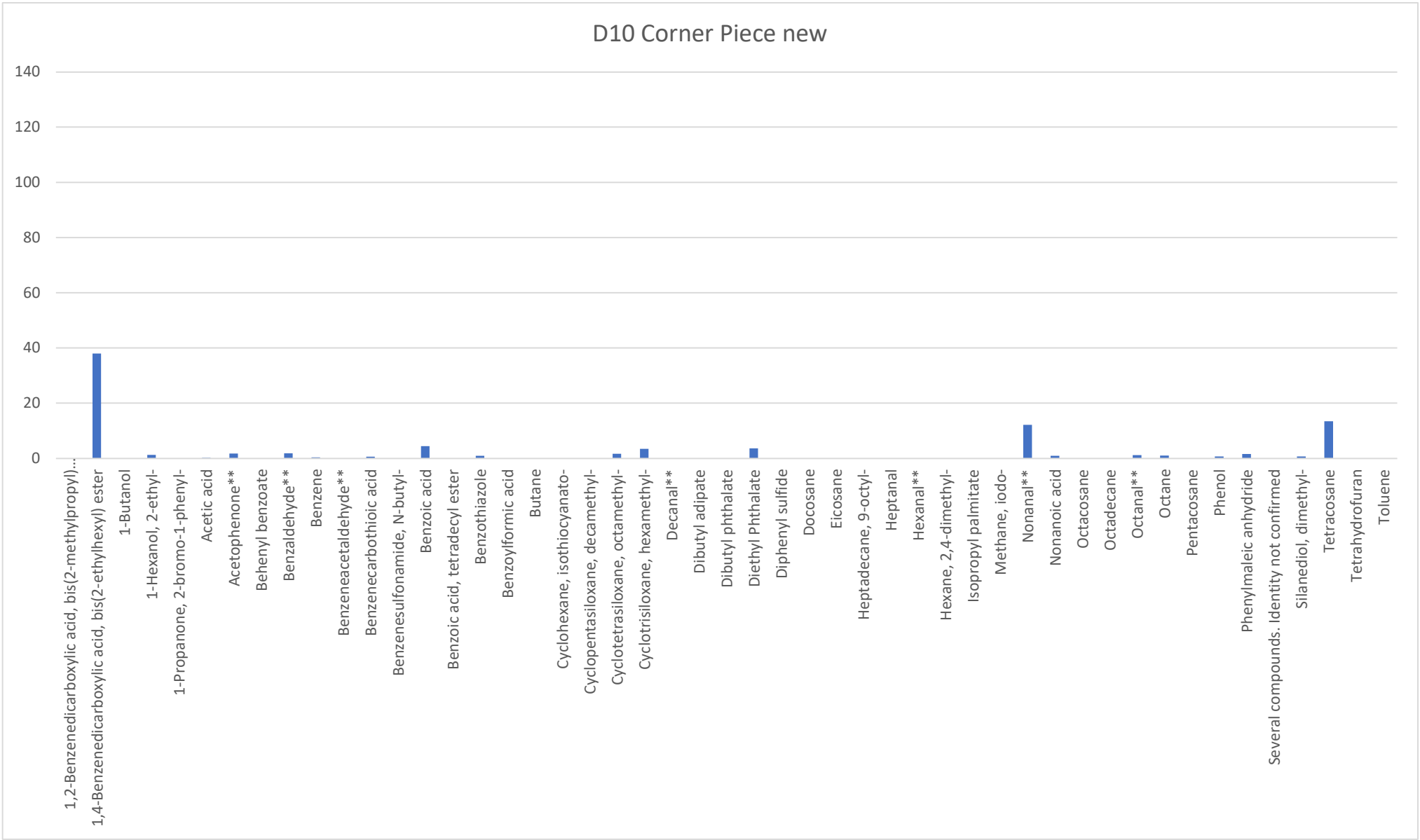


**Chart 3-8 VOC's detected at D13**

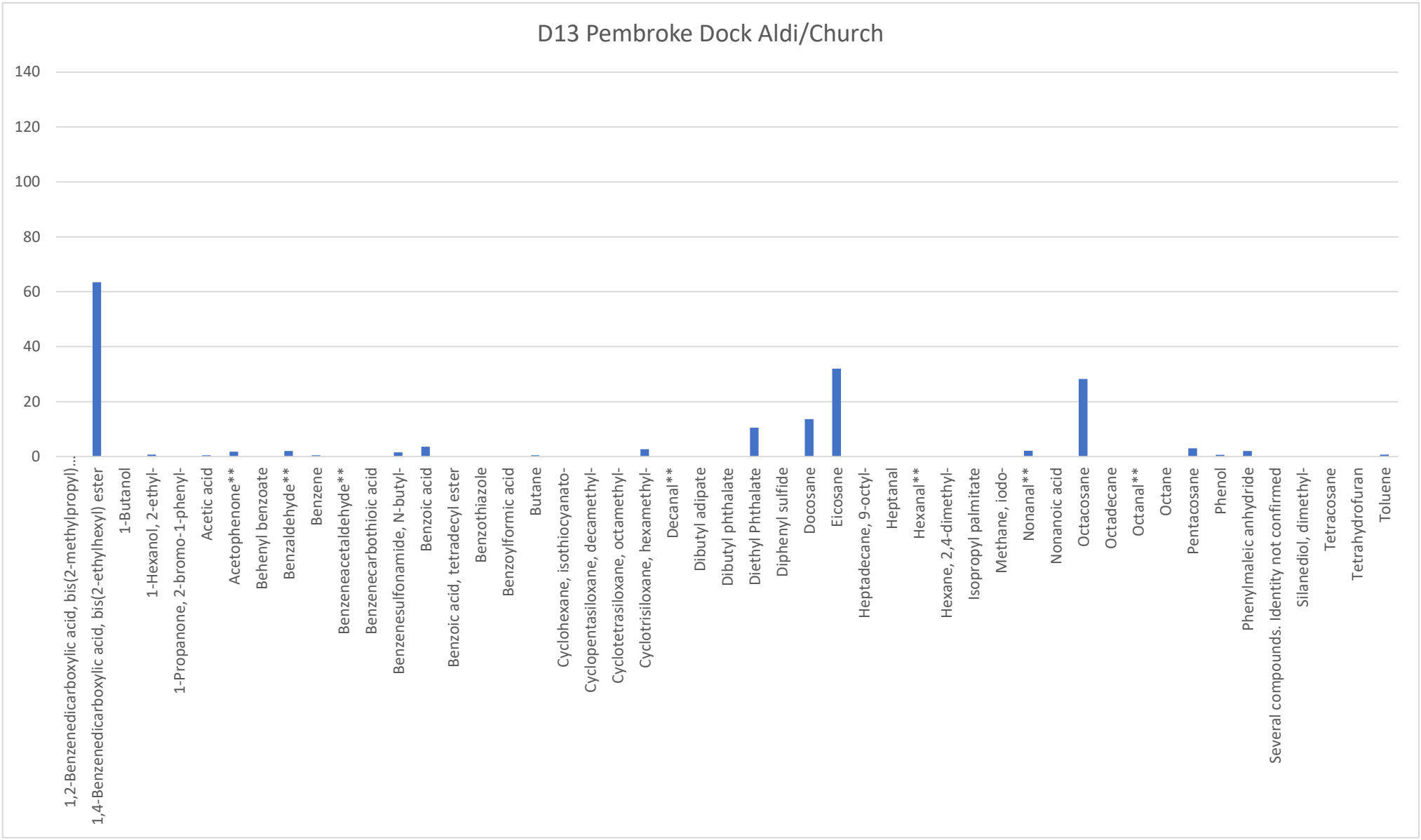


**Chart 3-9 VOC's detected at D14**

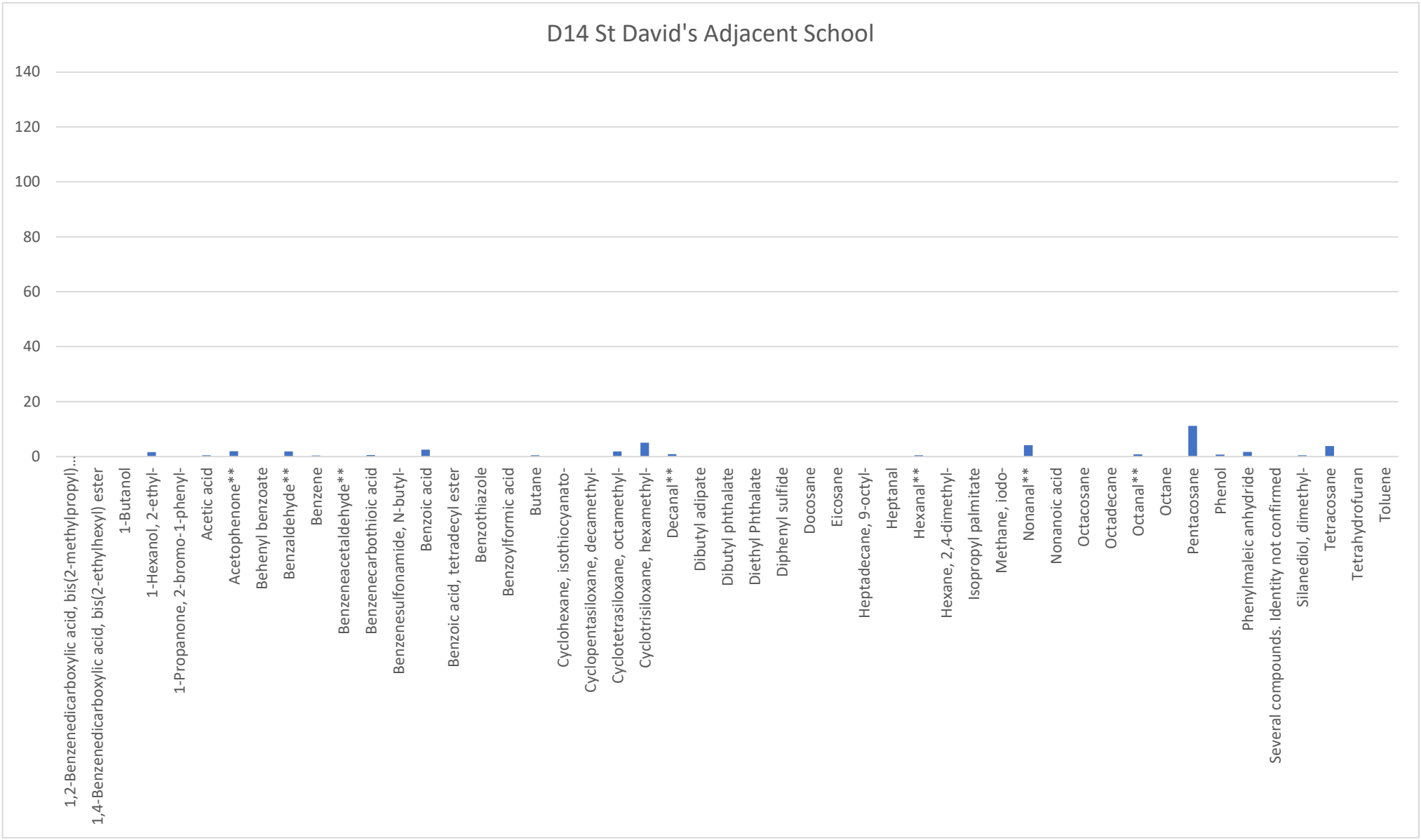


**Chart 3-10 VOC's detected at Saron (D15)**

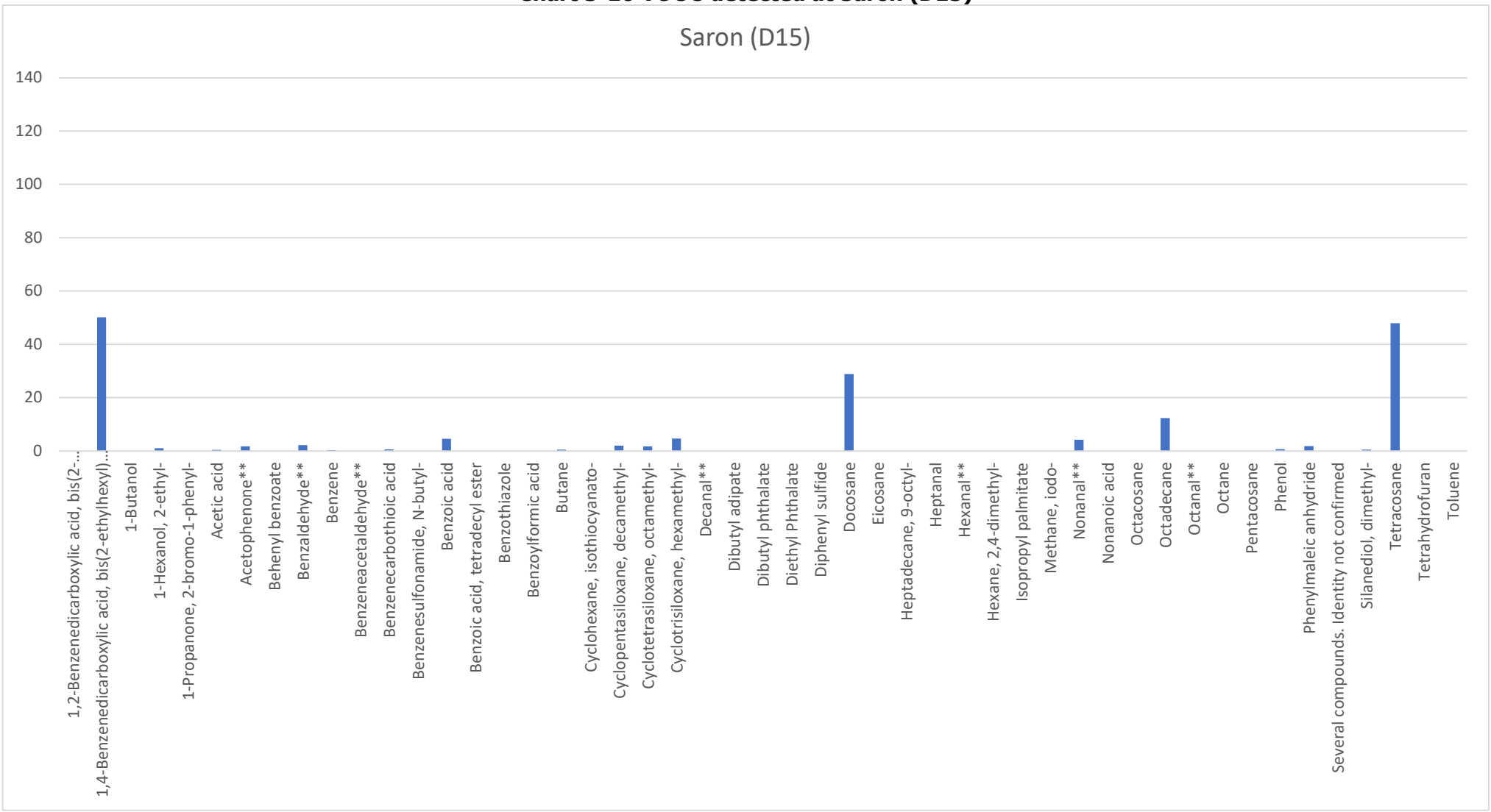
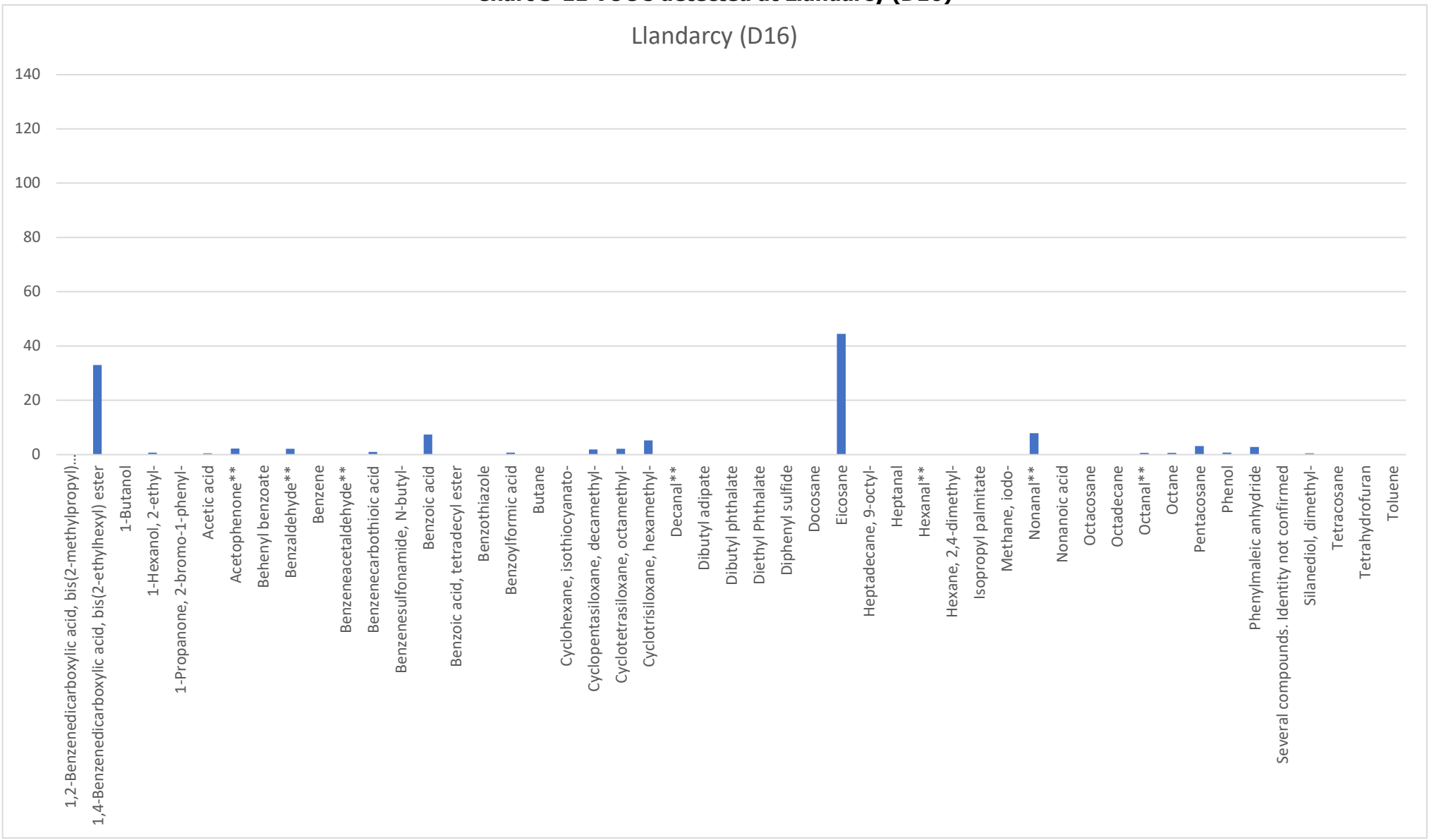
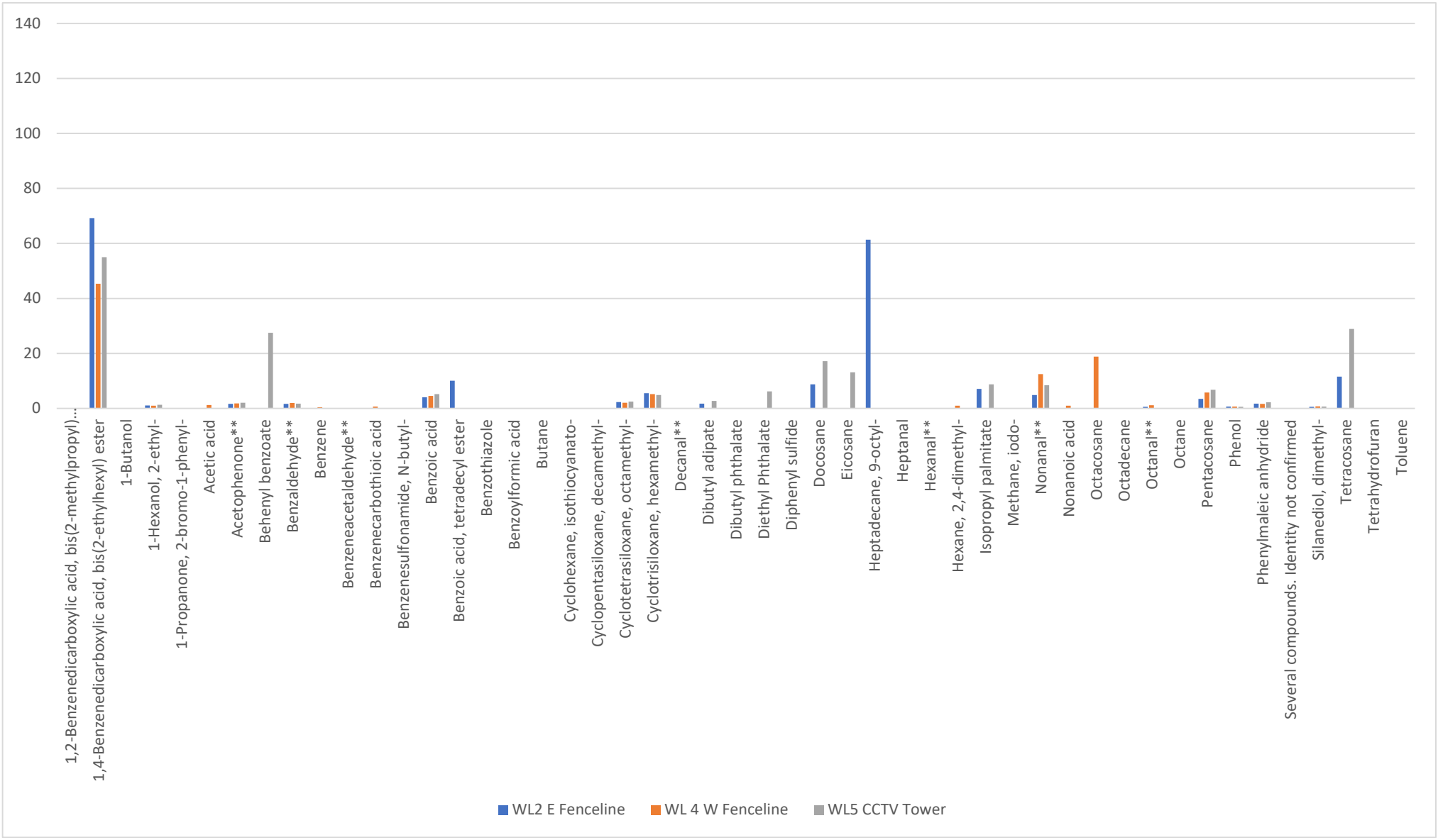


**Chart 3-11 VOC's detected at Llandarcy (D16)**



## Chart 3-12 VOC's detected on site



# 4 INSTANTANEOUS MONITORING OF HYDROGEN SULPHIDE

## 4.1 Monitoring using a Jerome Analyser

A Jerome® J605 Hydrogen Sulphide analyser has been used since 14 March 2024. The hand-held 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 5ppb the instrument has an accuracy of ±1ppb and a precision of 10%. In practice, this means a displayed value of 0ppb is <3ppb and a reported value of 5ppb is equivalent to an actual concentration of about 4-6ppb. The calibration certificate for the Jerome used is included in Appendix 3.

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

- 30 minute logging of airborne Hydrogen Sulphide at 5-minute intervals – in this mode the instrument takes a measurement automatically every 5 minutes.
- 30 minute logging of airborne Hydrogen Sulphide at 1-minute intervals from 17 June 2024 – in this mode the instrument takes a measurement automatically every 1 minute.
- 24-hr (or more) of logging airborne Hydrogen Sulphide at 1, 5 and 15-minute intervals
- Spot levels – where measurements have been made in real-time at different locations.

These data are 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, as dictated by the sensor saturation. At the start of each monitoring interval a 5-minute 'warm-up' routine with a Zero Air Filter is also undertaken.

## 4.2 Monitoring in Community

Appendices 4 and 5 contain the results of 30-minute logging undertaken around the Withyhedge Landfill site. This includes the positions referenced D1-D12 and also other positions which are identified. Also included is commentary related to the observation of odour at the time of monitoring including wind speed, wind direction, odour type/source and perceived intensity.

The data reveals very few occurrences of detectable levels of Hydrogen Sulphide or odour perceived to be associated with the landfill in recent weeks.

In addition to the 30-minute measurements, spot measurements have also been made and this data is presented in Appendix 6. During the most recent monitoring period, spot measurements were taken at locations from which complaints had been received by the landfill operator. Measurements were also made at other off-site positions around the landfill. At all of these positions, the Jerome reported zero (<3ppb) except at 11:58 and 12:20 on 2 September when readings of 3.73 and 4.15 ppb were recorded during a thirty-five minute period of sampling close to a position from where a complaint of landfill odour had been received by the operator. Observations at the time noted a gentle breeze of 0.4ms$^{-1}$ blowing

towards Withyhedge Landfill (260 degrees). Additionally, a noticeable odour of horse manure was apparent.

### 4.2.1 Spittal School

Pembrokeshire Council has recently established a fixed position air quality monitoring instrument in the grounds of Spittal School, as shown in Plate 4-1.

**Plate 4-1 Monitor at Spittal School**

With the permission of the Council, a Hydrogen Sulphide diffusion tube was placed directly adjacent to the instrument on 11 July 2024; the tube is visible just to the left of the red inverted funnel in Plate 4-1, attached to the fence behind the monitoring unit. As shown in Table 3-2, analysis of the tube (SCH1) failed to detect Hydrogen Sulphide above 0.06 ppb (<0.06 ppb reported).

From 13:25 on 9 August to 0830 on 10 August, the Jerome instrument was set up to automatically log every 5 minutes at the same position as the fixed unit. This was also

repeated on 13 August between 13:49 and 14:22 on 13 August at 1-minute intervals. During both periods all values were reported as zero (<3 ppb).

Repeated monitoring from 17:33 on 16 August to 17:31 on 17 August at 1-minute intervals also reported zero (<3 ppb) with the exception of a short period between 07:01 and 07:03 on 17 August 2024 when three consecutive readings of 3.29, 4.03 and 3.42 ppb were recorded, i.e. just above the detection level of the instrument.

All of this data will be discussed in a future report if the data from the monitoring unit is available for comparison.

## 4.3 Monitoring at Withyhedge Landfill

Alongside the measurement of Hydrogen Sulphide in the community areas, the Jerome has also been used to take spot measurements at positions around the landfill site. This data is also presented in Appendix 6.

Throughout the latest monitoring period during August and early September, Hydrogen Sulphide levels fell below the detection limit of the instrument (3 ppb). Two notable instances where this was not the case and a landfill odour was perceptible were on 16 August and 2 September, directly adjacent to Cell 8. To assess the concentrations present at the time the Jerome was set up to log at 1-minute intervals. The results from this monitoring found levels up to 45 ppb, as shown in Charts 4-1 and 4-2.

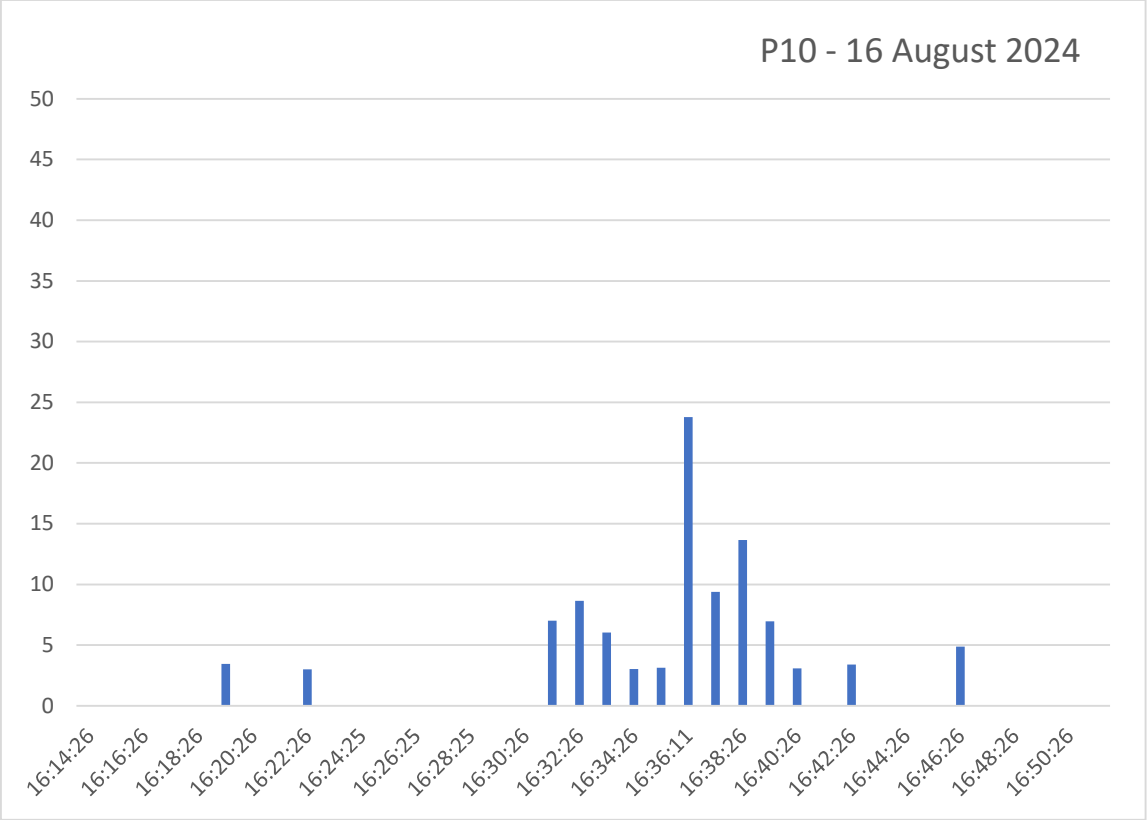



**Chart 4-1 Logged results at on-site position P10 on 16 August**

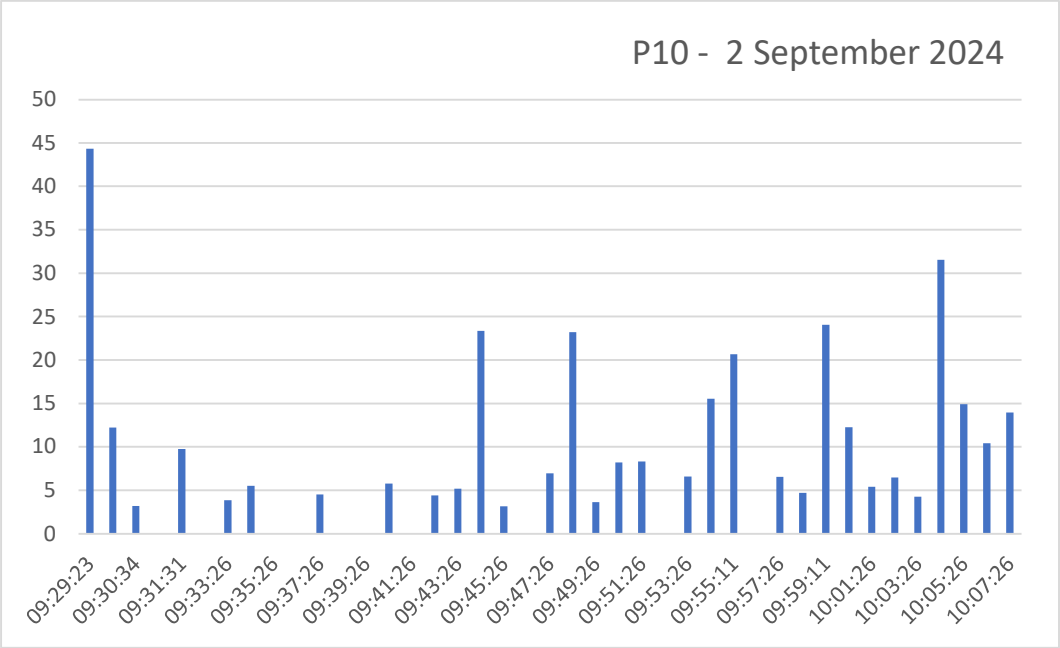



**Chart 4-2 Logged results at on-site position P10 on 2 September**

## 4.4 Review of Data

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 3-5. Such short-term criteria are sometimes referred to as acute criteria. In the absence of specific UK guidelines, an example of such criteria is presented in Table 4-1 which have been developed by the World Health Organisation (WHO).

**Table 4-1 WHO Air Quality Guidelines**

| 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. |

The monitoring in the community to date indicates that there are several different types of odour present including odour suspected to be from the landfill and odours suspected to be related to a range of agricultural and equine activities.

Many readings of Hydrogen Sulphide reported by the Jerome analyser have been close to or below the detection limit during the latest monitoring period. During monitoring undertaken between 5 August and 04 September 2024 in the community, including the overnight monitoring at Spittal School and 99 local area spot checks, over 2500 measurements of Hydrogen Sulphide were recorded by the Jerome analyser. Of these values, all were zero (<3ppb) apart from eight:

- 16 August - one measurement at location D9 and one at D12 of between 3 and 5 ppb during thirty minute sampling at one minute intervals. No odour was perceptible.
- 17 August - three measurements between 3 and 5 ppb were logged during automated monitoring at Spittal School.
- 26 August - one measurement of 5.83ppb was detected at D3 followed by a measurement below 5ppb one minute later. All other one-minute readings at that location were zero (<3ppb) and the 30 minute average less than 5ppb. An odour perceived to be associated with slurry was also perceptible at the time of monitoring.
- 2 September - two measurements below 4.15ppb during spot checks. An odour characteristic of horse manure was discernible.

Far lower levels of Hydrogen Sulphide have also been detected at the landfill site in recent weeks with the majority of values reported as zero (<3ppb) and the maximum <45ppb.

It is evident from the repeated use of the Jerome and recording of odour observations since March 2024 at different times of the day over several sequential days and weeks that odours and the detection of Hydrogen Sulphide are not persistent over such time-frames. In recent weeks, at many monitoring positions on different occasions, the Jerome was not able to detect Hydrogen Sulphide above the level of detection in the community.

All of the Jerome data gathered to date is collectively shown in Charts 4-3 to 4-14. In these time-series charts all of the data gathered at D1-D12 is presented which includes the elevated concentration (117ppb) reported at D2 on 21 March and the elevated values found at D11 on 19 June. These latter values were considered to be associated with vehicular exhaust. When the individual time series plots for each position are considered, it is evident that higher concentrations were detected by the Jerome earlier in the year and during recent weeks very few detectable levels of Hydrogen Sulphide have been detected. At the same time, the occurrence of perceptible levels of odour considered to be associated with landfill gas have fallen. This pattern is also reflected in the total number of complaints received by the operator, as indicated in Chart 4-15

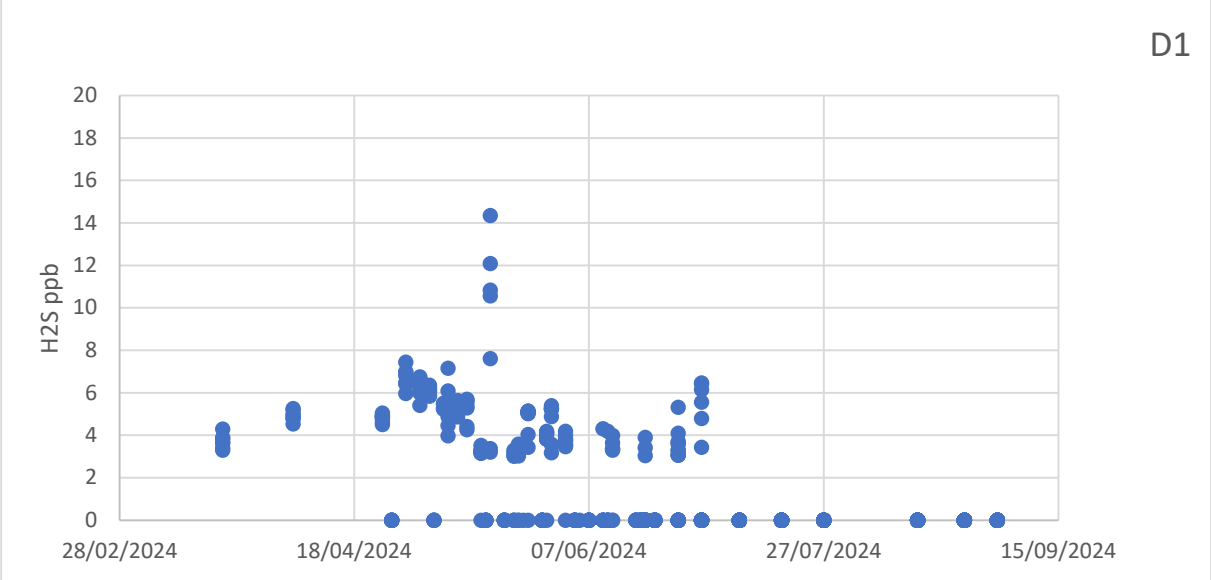



**Chart 4-3 All Jerome data gathered at D1 March and September 2024**

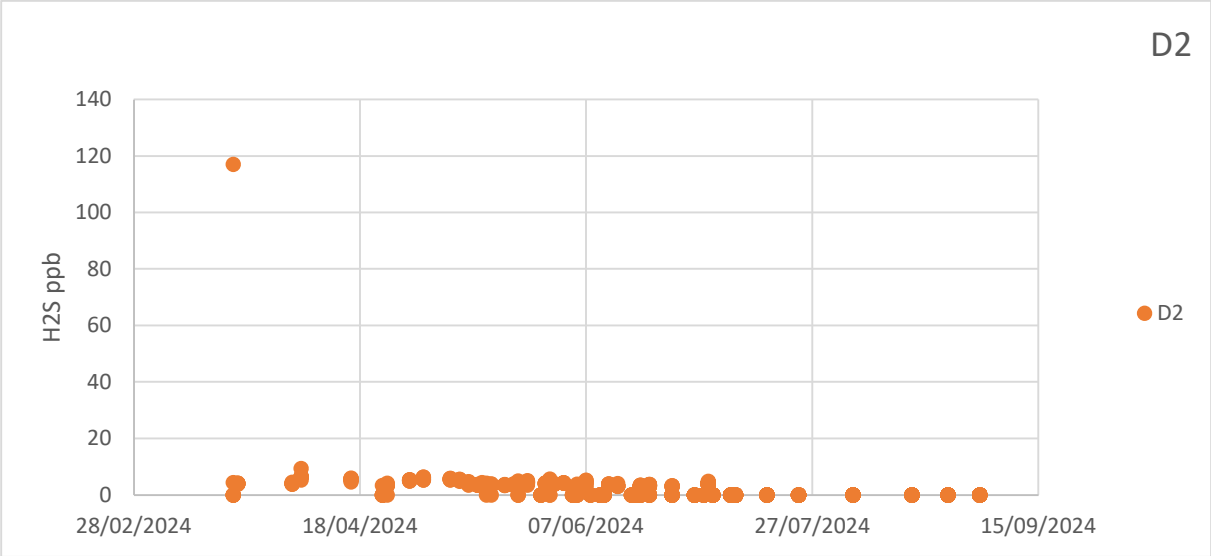



**Chart 4-4 All Jerome data gathered at D2 March and September 2024**

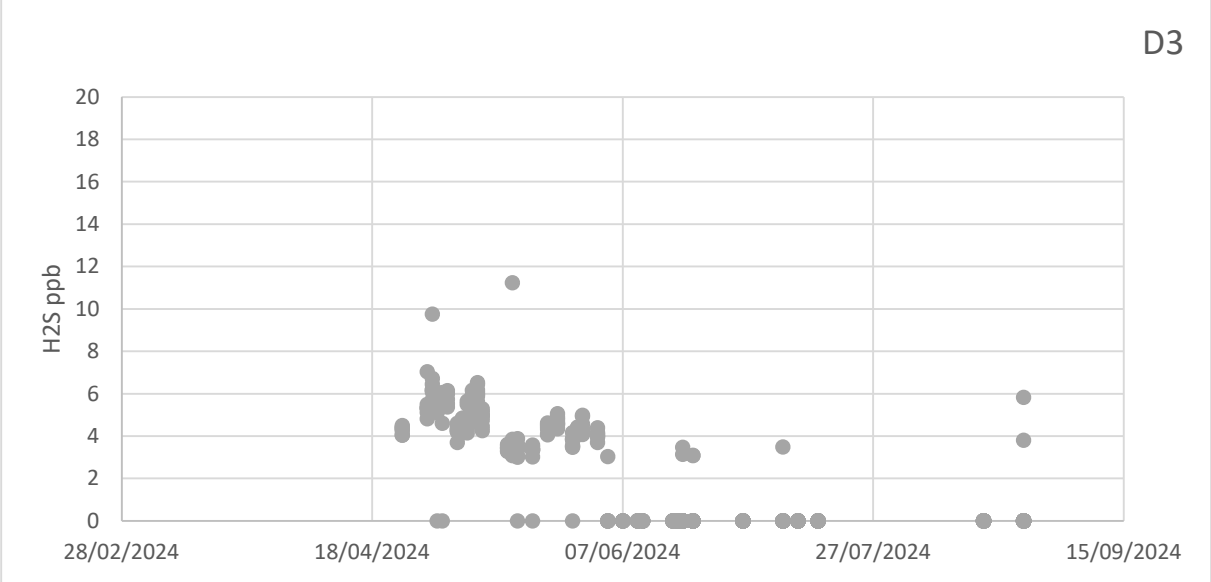



**Chart 4-5 All Jerome data gathered at D3 March and September 2024**

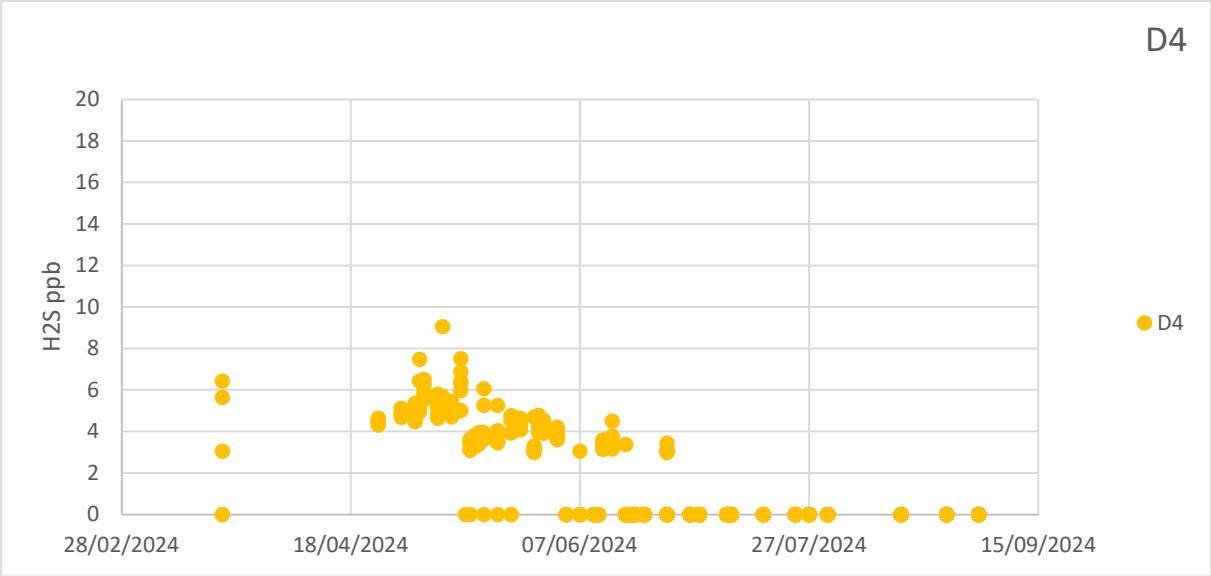



**Chart 4-6 All Jerome data gathered at D4 March and September 2024**

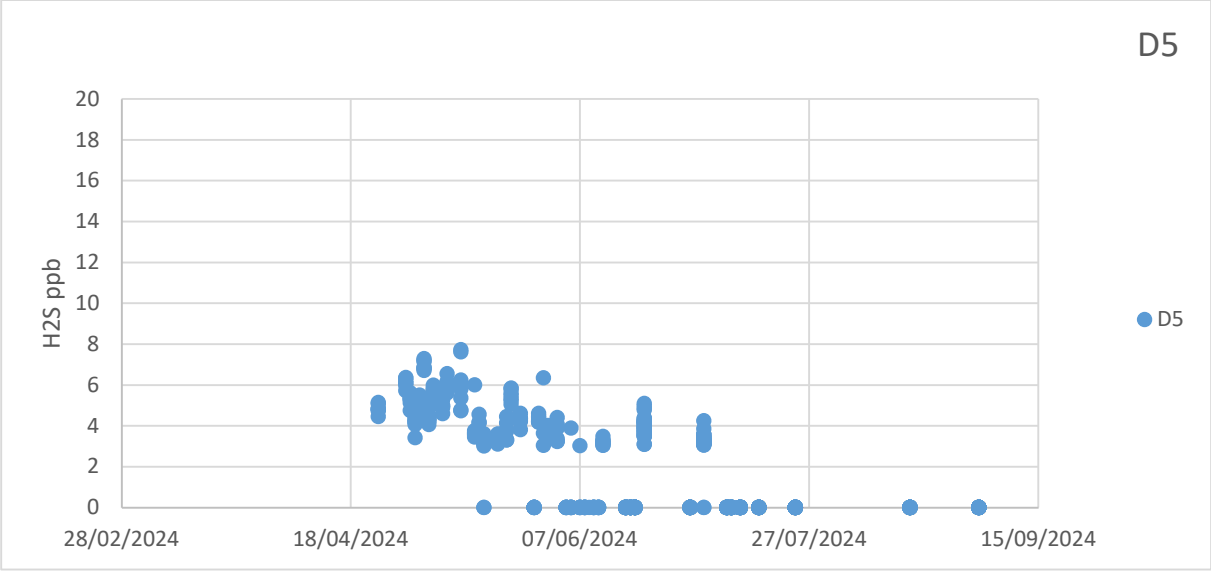



**Chart 4-7 All Jerome data gathered at D5 March and September 2024**

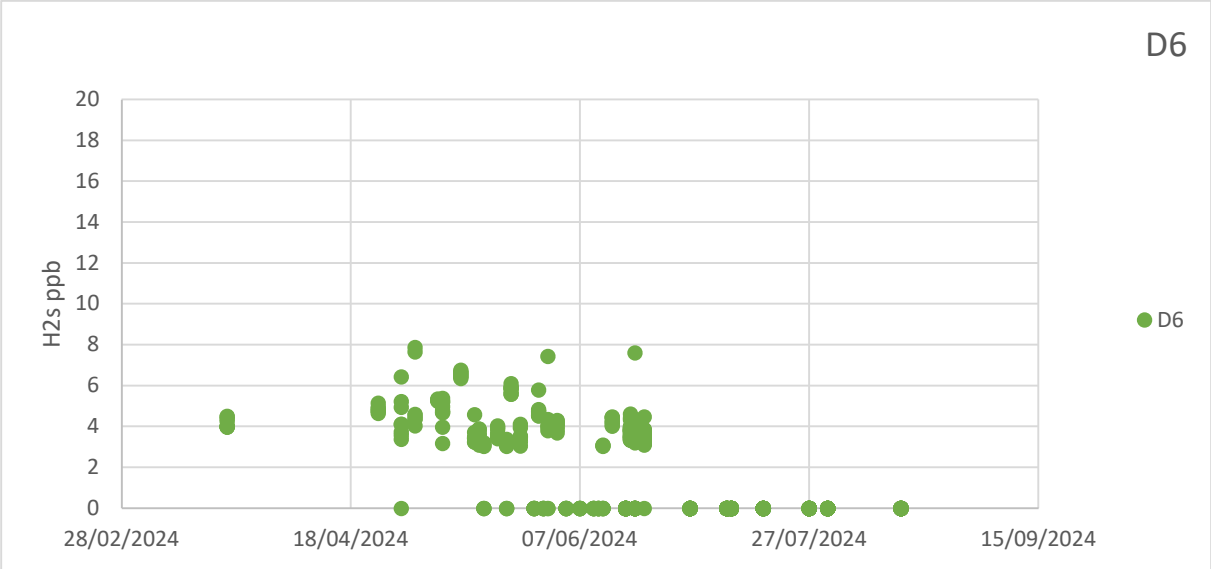



**Chart 4-8 All Jerome data gathered at D6 March and September 2024**

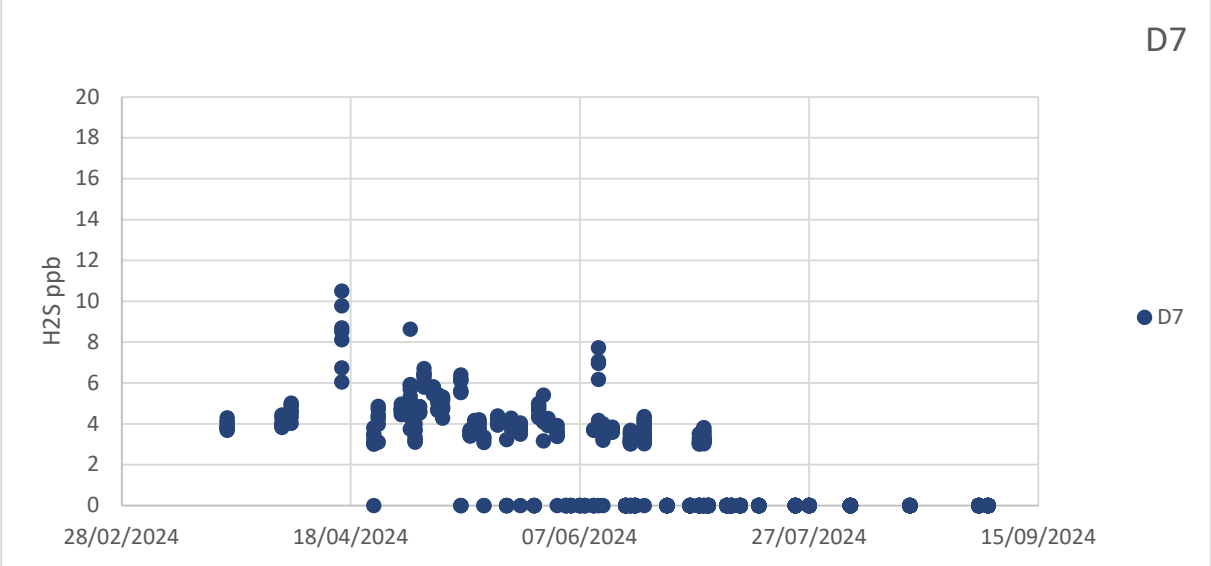



**Chart 4-9 All Jerome data gathered at D7 March and September 2024**

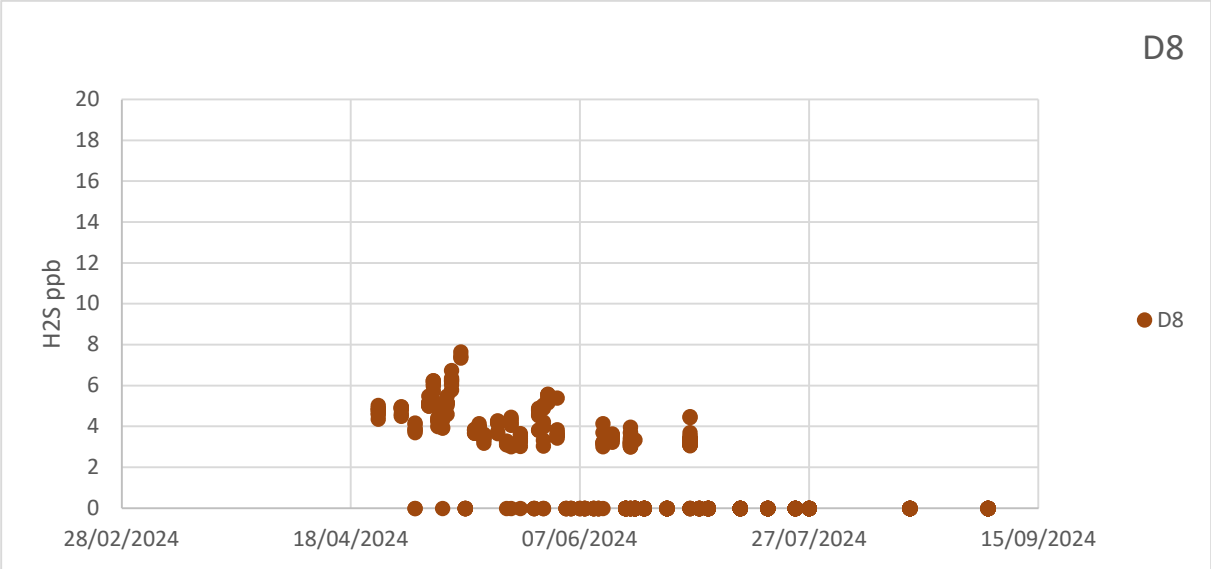



**Chart 4-10 All Jerome data gathered at D8 March and September 2024**

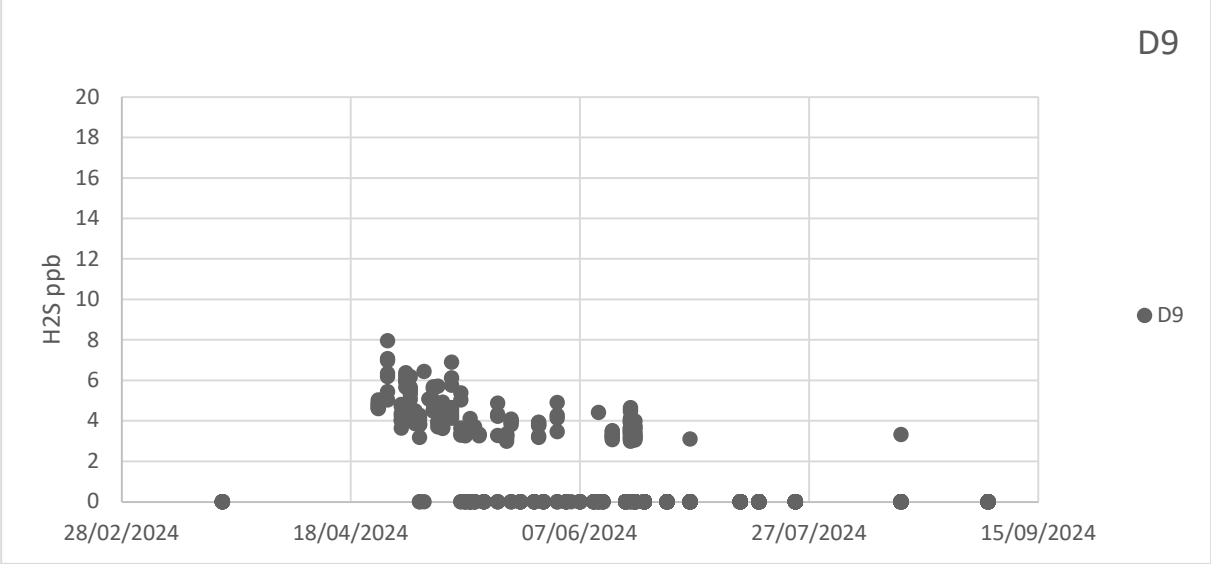



**Chart 4-11 All Jerome data gathered at D9 March and September 2024**

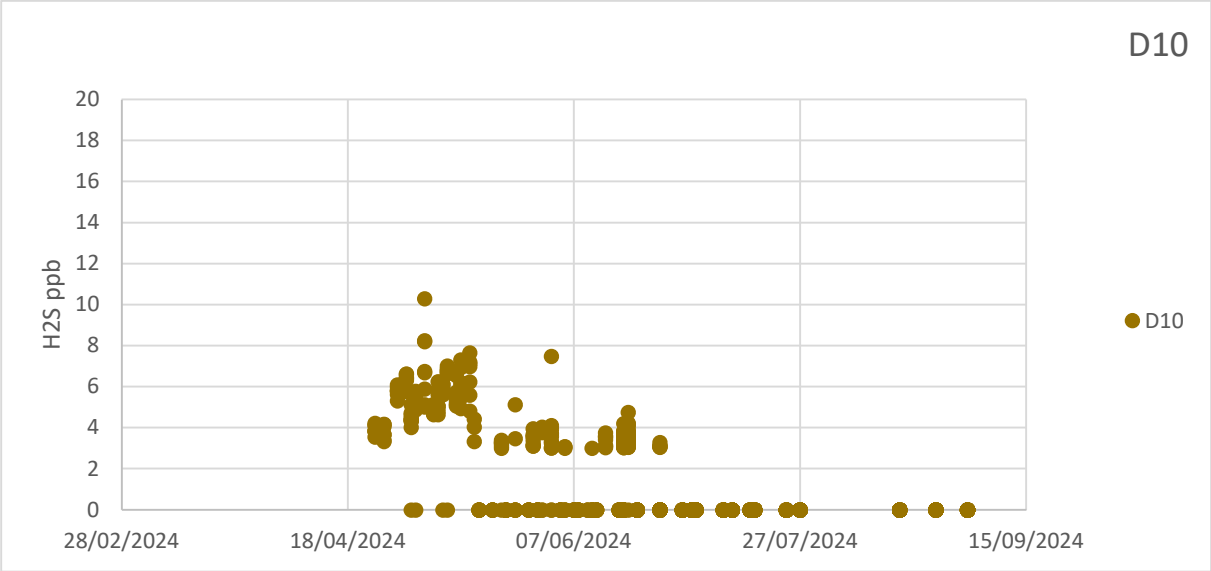



**Chart 4-12 All Jerome data gathered at D10 March and September 2024**

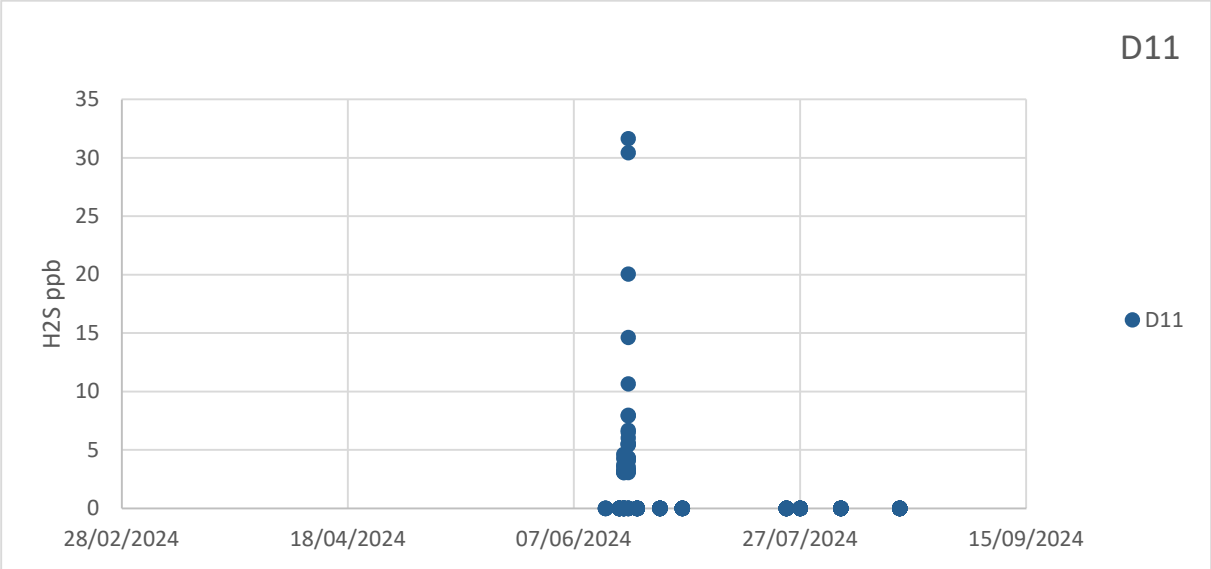



**Chart 4-13 All Jerome data gathered at D11 March and September 2024**

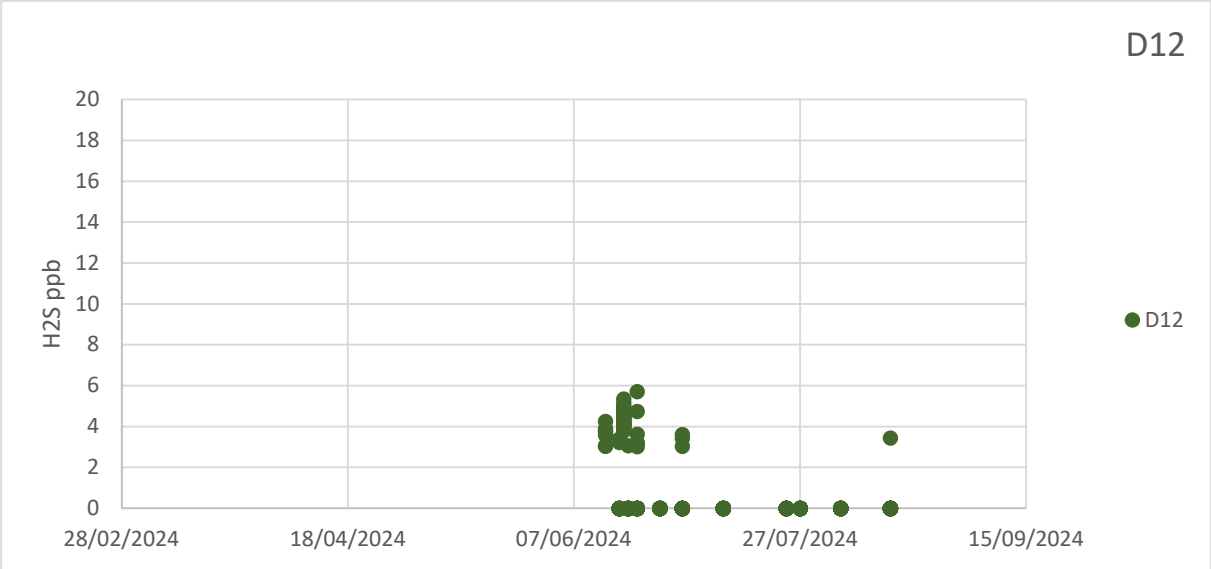



**Chart 4-14 All Jerome data gathered at D12 March and September 2024**

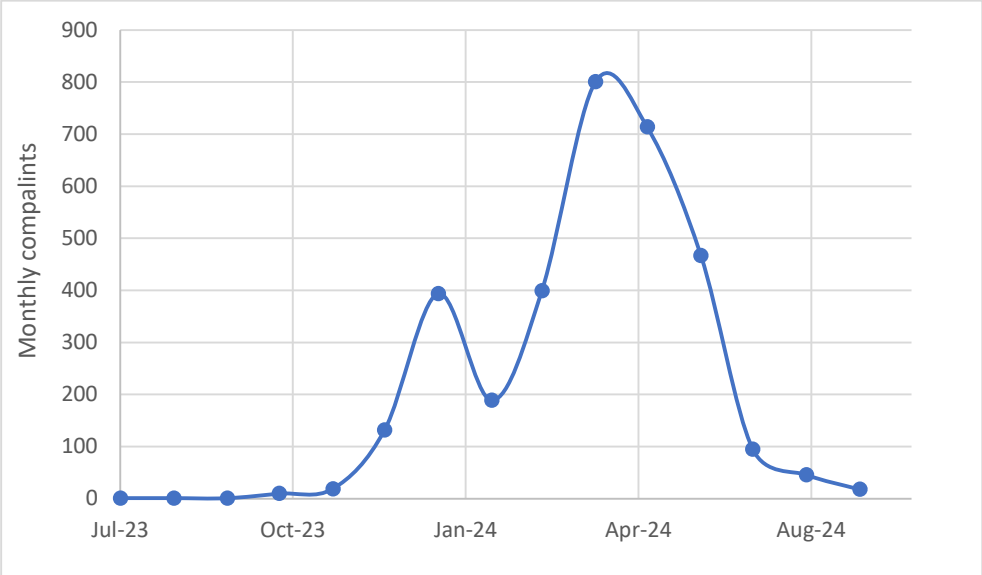



**Chart 4-15 Total number of complaints received by operator**

The reader should note that the record of complaints is compiled from raw data and may include complaints related to other issues and not just the incidence of odour. Other complaints may also have been made to other parties such as the Council or NRW.

# 5 SUMMARY

This sixth interim report has provided opportunity for review of all the monitoring data gathered since February 2024 to be considered.

The recorded concentrations of hydrogen sulphide measured at each diffusion tube placed within surrounding communities have continued to be recorded well below the lifetime exposure criteria value of 1ppb. The levels currently observed are the same as those found at other points in South Wales. This diffusion tube monitoring will continue.

It is apparent from the repeated use of the Jerome instrument at different times of day over several months that Hydrogen Sulphide is not persistently detectable over such time-frames. At many monitoring positions on different occasions during recent months, the Jerome has not found detectable levels of Hydrogen Sulphide. Given that such low levels are now being found the plan, at this stage, is to cease routine monitoring with the Jerome at the end of September 2024.

During this monitoring period, diffusion tubes have once again been used to assess for the presence of VOCs. Low concentration levels continue to be found and it appears that Hydrogen Sulphide is still the most useful target compound for trying to detect the presence of odours. The use of these tubes will also, therefore, cease.

Moving forward, the community monitoring programme will therefore focus on the measurement of Hydrogen Sulphide using diffusion tubes at D1-D12 along with the data gathered by Pembrokeshire County Council at the fixed position monitor located at Spittal School. This flexible strategy will be subject to continual review.

## 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)

**Acknowledgements**
Many thanks to Pembrokeshire Council for facilitating access to Spittal School.