Regulation of Walleys Quarry landfill site

Plan to reduce hydrogen sulphide emissions

Second Review

Updated 30 September 2022
Environment Agency: West Midlands Area

Environment Agency

Background

Walleys Quarry Ltd (WQL) is the operator of Walleys Quarry Landfill. Decomposition of previously deposited waste has led to elevated emissions of hydrogen sulphide ("H_2S") unacceptably affecting residents and businesses. The Environment Agency (EA) has been applying an increased level of regulatory scrutiny to the site operator for a number of years. Previous air quality monitoring exercises showed no cause for health concerns. See link for further information.

Air Quality Monitoring

Air Quality monitoring, which began in March 2021, found considerably elevated H_2S levels. This generated two urgent courses of action:

1. Further increased regulation of the site to understand the cause of the elevated levels and put measures in place to rectify this as quickly as possible.
2. The EA sought advice from the UK Health Security Agency (UKHSA) (formerly Public Health England or PHE) as well as Staffordshire County Council and Newcastle-under-Lyme Borough Council (Local Authorities with public and environmental health responsibilities respectively); partners who are best placed to provide expert advice on the risks to health. Data from the four air-quality mobile monitoring facilities (MMFs) around the site has been shared with partner organisations.

The most recent UKHSA assessment of the MMF data from March 2021 to July 2022 states:

> "The hydrogen sulphide data up to the end of July 2022 shows continuing low-level exposure to the population around the landfill site. All four MMF sites (MMF1, MMF2, MMF6 and MMF9) show a monthly average concentration in July below the long-term (lifetime) health-based guidance value. The cumulative average concentrations for MMF1, MMF2 and MMF6 are below the long-term (lifetime) health-based guidance value. At MMF9, the cumulative average concentration remains above the US EPA RfC.
>
> The risk to long-term (lifetime) health cannot be excluded where the cumulative average concentrations continue to be above the US EPA RfC. Currently, this risk is likely to be small, and as long as the monthly average concentrations remain below or close to the long-term health-based guidance value and the cumulative average concentration continues to fall towards that value, this would remain the case.
>
> UKHSA recommends that all appropriate measures continue to be taken to reduce the off-site odours from the landfill site, to reduce the health impacts experienced in the local community and maintain concentrations in the local area to levels below the health-based guidance value used to assess long-term exposure."

Environment Agency

Background

The EA has required WQL to continue to implement measures identified as quickly as possible. We remain determined to bring about a sustained long-term reduction in exposure to H_2S in the community through our Contain, Capture and Destroy approach.

We have already seen success in implementing this approach and intend to continue building on it to secure long-term improvements for the community.

This is the second review of our plan, first published on 14 October 2021. This review details the actions completed, those ongoing, and future measures identified since February 2022, when the last review took place. This review takes into account the published sets of MMF data up to August 2022.

The original plan is available here and the previous review is available here.

In this plan the EA has continued to assess the impact of the measures it has already required WQL to implement and sets out the next steps that WQL must take to continue to achieve a reduction in ambient H_2S levels, based on the recommendations of the UKHSA. The plan is a live document, which is kept under review to ensure that it adapts to the latest evidence from the site regarding the impact key measures have on landfill gas levels.

From March 2021 to December 2021, the data showed a reduction in H_2S emissions outside the site boundary. Although a reduction has not been recorded every month after December 2021, there has been a decline from levels recorded in March and April 2021.

Our focus continues to be on securing and maintaining a reduction in the concentration of H_2S in emissions from the site to below the long-term (lifetime) health-based guidance value, as recommended by the UKHSA.

Further information and any additional remedial measures identified will be included in our next review. We will continue to make our plan available to the public and provide updates on the actions we have required WQL to take, along with future measures.

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The strategy

Objectives

There are three key objectives underpinning this plan:

- ***Contain*** landfill gas emissions from the site;
- ***Capture*** as much of that gas as possible;
- ***Destroy*** it by combustion through the gas utilisation plant (GUP).

The objectives are expected to deliver the current recommendation of the UKHSA:

> *"UKHSA continues to strongly recommend that all appropriate measures are taken as early as possible to reduce the off-site odours from the landfill site, to reduce the health impacts experienced in the local community; and maintain the concentrations in the local area to levels below the health-based guidance value used to assess long-term exposure."*

To ensure **effective delivery** of this plan we will continue with:

- Our intensive programme of announced and unannounced inspections.
- Off-site odour assessments.
- Work to ensure that WQL is effectively preventing future inputs of gypsum-bearing waste through its waste acceptance procedures.
- Audits of the sites which produce waste consigned to Walleys Quarry Landfill.

Whilst ultimate success will deliver reduced H_2S concentrations, steps along the way will be measured by:

- Increased areas of capping and reduction in the fugitive surface gas emissions proving that gases are being ***contained.***
- Increased volumes of gas ***captured*** and transferred to the GUP.
- Efficient and effective operations of the engines and flares to ***destroy*** these gases as validated by telemetry in the GUP and off-site monitoring data.

Whilst there were temporary increases in H_2S concentrations and associated complaints in January, March and April 2022 during periods of cold, still weather and site infrastructure works, our view remains that the 'Contain, Capture and Destroy' strategy is the most effective way to secure a long-term reduction of exposure to H_2S in the community (supported by the most recent data).

Environment Agency

Measures completed

Measures taken on site by WQL **between February 2022 and August 2022.**

	* Measure Reference O	1	2	Key measures required of WQL (unless specified)	Timescale	Reasoning & impact
Contain	13	13	1	Surface emissions survey undertaken bi-monthly.	March and May 2022	This action helps to identify any failures in temporary and permanent caps so that repairs can be made when necessary. The revised Gas Management Plan now applies a lower threshold of >50ppm methane (guidance level is >100 ppm methane) as a trigger for WQL to take remedial action on permanent and temporary capping.
	12	22	2	EA approved an updated capping and phasing plan submitted by WQL in January 2022.	February 2022	The approved plan contains commitments from WQL to meet appropriate standards for permanently capping Phase 1 and temporarily capping Phase 2 of the landfill. Phase 1 is the largest phase of the landfill. Capping will lead to reductions in the escape of landfill gas. The plan also reduces the size of future phases of waste deposits. *See Appendix 1.*
	12	23	3	Permanent capping of Phase 1 (over 26,000m²).	August 2022	This will reduce fugitive emissions and improve gas containment. Restoration soils continue to be imported and placed over the installed geomembrane cap.
	12	23	4	Temporary capping on Phase 2. Imported clay was stockpiled on site from April 2022.	August 2022	Temporary capping of this area will reduce fugitive emissions and improve gas containment.

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Environment Agency

Measures completed

	* Measure Reference O	1	2	Key measures required of WQL (unless specified)	Timescale	Reasoning & impact
	3	-	5	EA assessed results for the performance of the Posi-Shell temporary capping and concluded that the results did not comply with the required standard.	March 2022	WQL was required to replace areas temporarily capped with Posi-Shell by 31 March 2022 to ensure that fugitive emissions could not escape.
	-	-	6	EA issued permit variation authorising the use of geotextile membrane as a capping method.	April 2022	Provides effective final capping cover where the landfill has reached final levels, which will prevent fugitive gas emissions and odour. The membrane provides at least equivalent, or better, protection from rain ingress than the permanent clay cap.
Capture	19	26	7	EA approved an updated version of WQL's gas management plan after requiring additional updates.	February and May 2022	Provides confidence that the planned and installed gas infrastructure is sufficient to capture the quantity of gas that the landfill is likely to produce, ensuring that as much gas as possible is captured.
	-	-	8	EA approved WQL's revised gas management plan for Phase 3 - the new phase and current tipping area.	May 2022	Ensures that gas infrastructure is adequately planned and designed in the current operational cell so that it is ready to be used when gas production begins, reducing the chances of future gas emissions.
	-	22	9	Construction Quality Assurance (CQA) plan for permanent capping on Phase 1 submitted. Agreed by EA.	April 2022	Differential settlement is considered in the design. As a result, a preparatory subgrade (formation) layer using a geotextile will be placed under the geomembrane to protect against puncture. This will reduce fugitive emissions and improve gas containment.

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Measures completed

	* Measure Reference O	1	2	Key measures required of WQL (unless specified)	Timescale	Reasoning & impact
	-	-	10	EA approved WQL's proposal to install 18 gas extraction wells in phases 1 and 2.	April 2022	Increasing the quantity of gas that can be extracted, reducing emissions and enabling destruction at the gas utilisation plant. This has led to an increase in the quantity of gas directed to the gas utilisation plant.
	-	-	11	Installation of 17 leachate pumps in gas wells following a review of individual gas wells.	May 2022	Improves efficiency of individual gas wells as level of perched leachate within these wells is reduced, which improves their ability to extract gas from the landfill.
	-	-	12	Implementation of recommendations from WQL's landfill gas consultant to improve gas collection from each individual gas well.	May 2022	Implementation of the recommendations has resulted in a sustained increase in gas capture.
	-	-	13	Further improvements to gas collection system.	May – July 2022	Phased installation of a series of 12 horizontal gas wells in the operational phases to alleviate fugitive gas emissions. Extraction from some of these wells commenced at the end of May 2022. Four additional gas wells were installed in the southern flank by 28 July 2022.
Destroy	-	-	14	Separation of landfill gas with high levels of H_2S. The gas collection system was redesigned to separate landfill gas wells to manage high H_2S concentrations, which may be taken directly to flare to avoid damage to engines.	January 2022	This separation process was used between October 2021 and January 2022. The reduced H_2S levels from January 2022 have not required the use of this separate flare, although it remains on standby.

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Measures completed

	* Measure Reference O	1	2	Key measures required of WQL (unless specified)	Timescale	Reasoning & impact
	-	-	15	Trace gas monitoring on the bulk landfill gas carried out.	May and August 2022	To understand the trace components and their concentrations within landfill gas and how this is changing over time. The results can be compared to gas modelling assumptions. EA has reviewed the submitted data and no issues have been identified.
	16	16	16	Review of back-up power supply available to ensure uninterrupted gas treatment.	August 2022	A back-up generator has been deployed as a permanent arrangement to ensure uninterrupted power supply and as the maintenance shutdown power supply.
Other	-	-	17	EA undertook audits at waste management sites that were identified as sending wastes to WQL.	From December 2021- March 2022	Waste producers have been required to implement procedures to reduce the concentration of sulphates in waste sent to WQL. This should reduce the amount of H_2S produced in the landfill by future waste deposited at the site.
	-	-	18	EA served a Regulation 36 Enforcement Notice requiring improvements to WQL's waste acceptance procedures.	May 2022	Implementation of the revised procedures (from 01 August 2022) is expected to improve rate of rejection of potentially high sulphate-bearing waste.
	-	-	19	The gas collection system was managed through the extreme hot weather.	June – August 2022	Gas engines were derated when applicable and a chiller cabinet was added on the invertor panel to help cope with high ambient temperatures, to reduce the potential for future engine shutdowns.

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	18	18	20	EA's Air Quality Modelling and Assessment Unit has reviewed WQL's dispersion modelling data and confirmed that it broadly accepts both the methodology used and the findings regarding existing and future gas flare and engine emissions and surface emissions.	December 2021	Air quality modelling will provide an accurate picture of emissions on site against air quality standards over a variety of scenarios.

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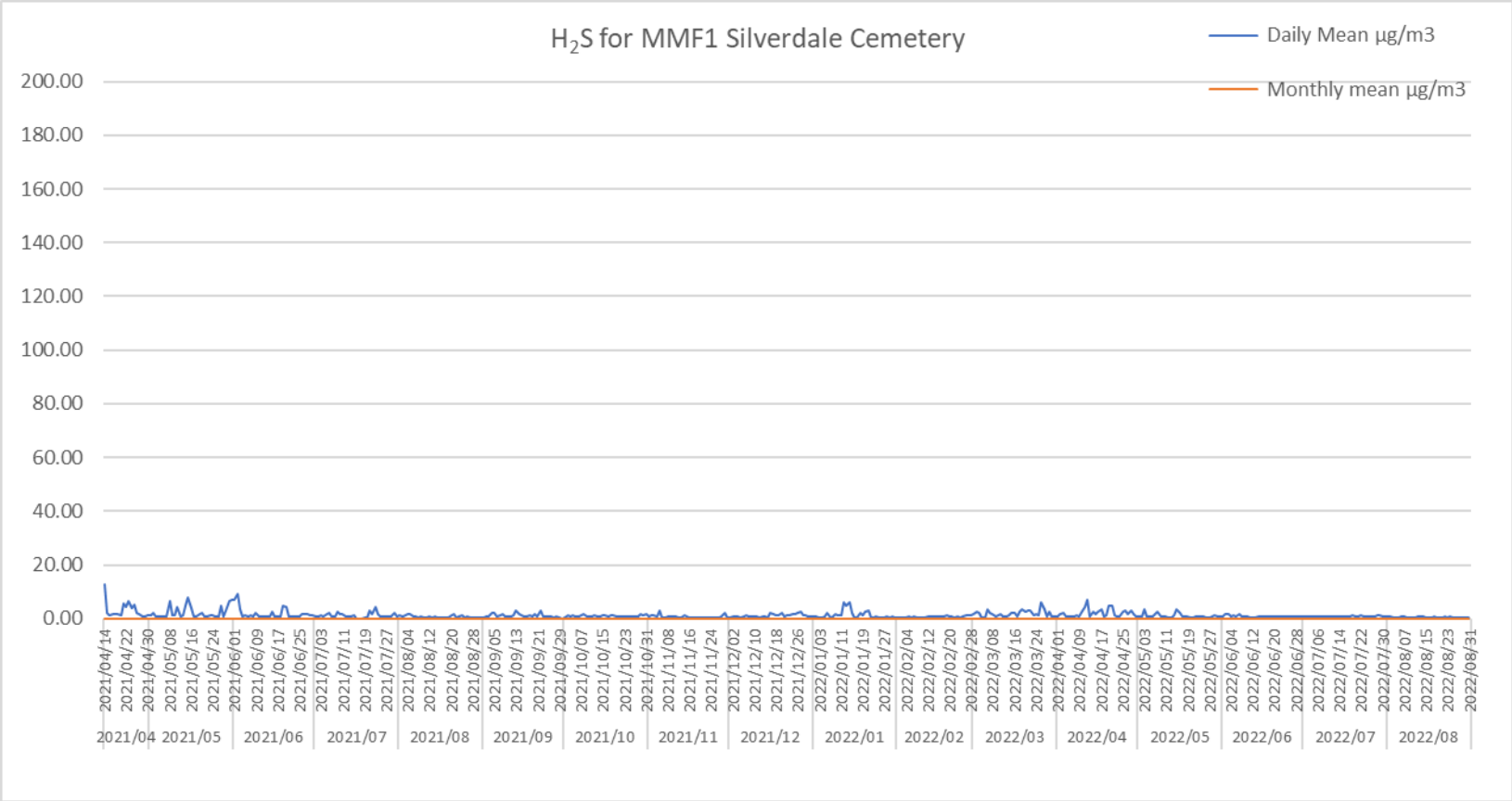
Evidence of progress to date

These charts show the H_2S monitoring results for the four MMF units for the period to the end of August 2022.

MMF1 Silverdale Cemetery H_2S Levels



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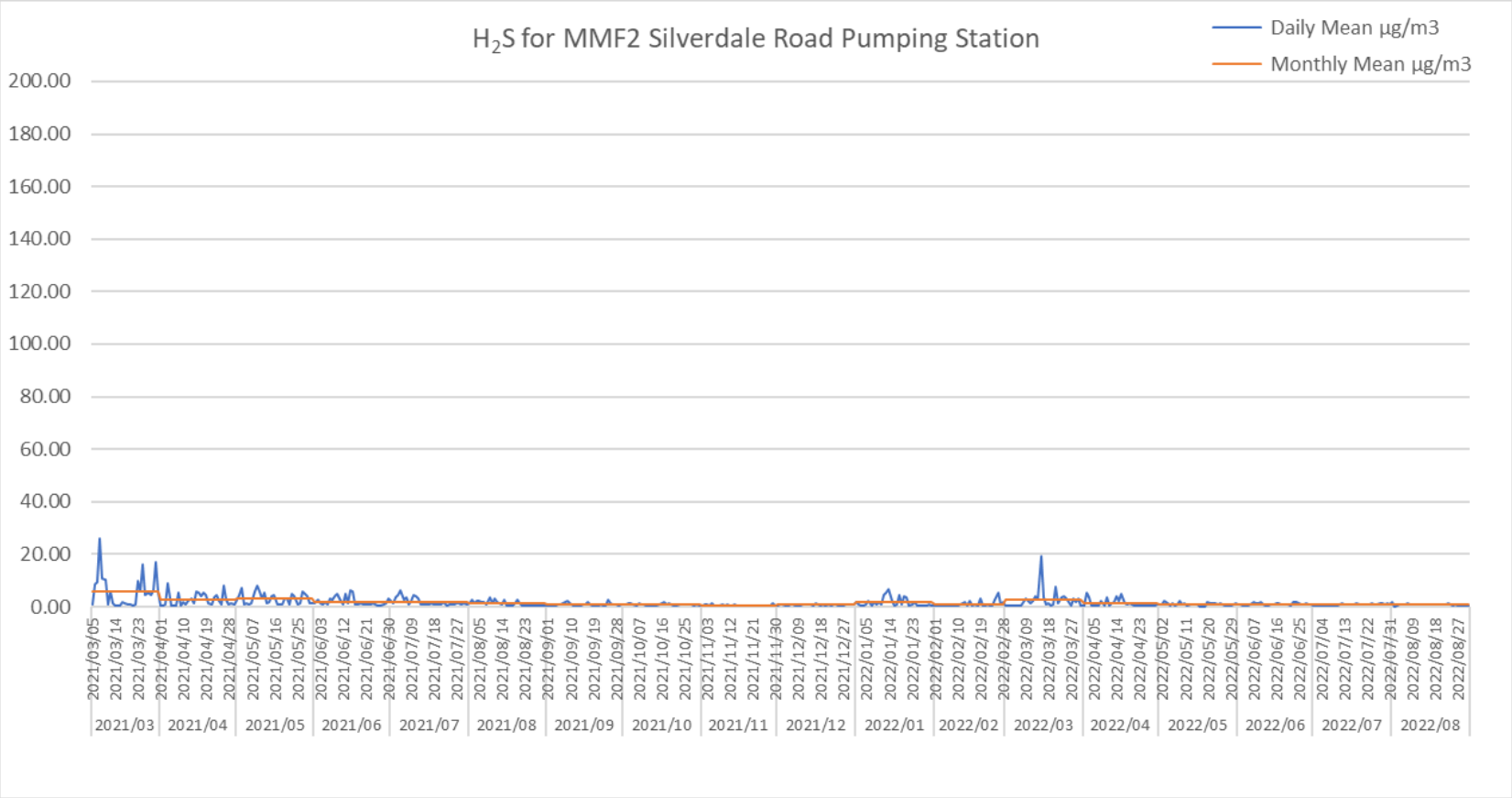
Evidence of progress to date

MMF2 Silverdale Road Pumping Station H_2S Levels



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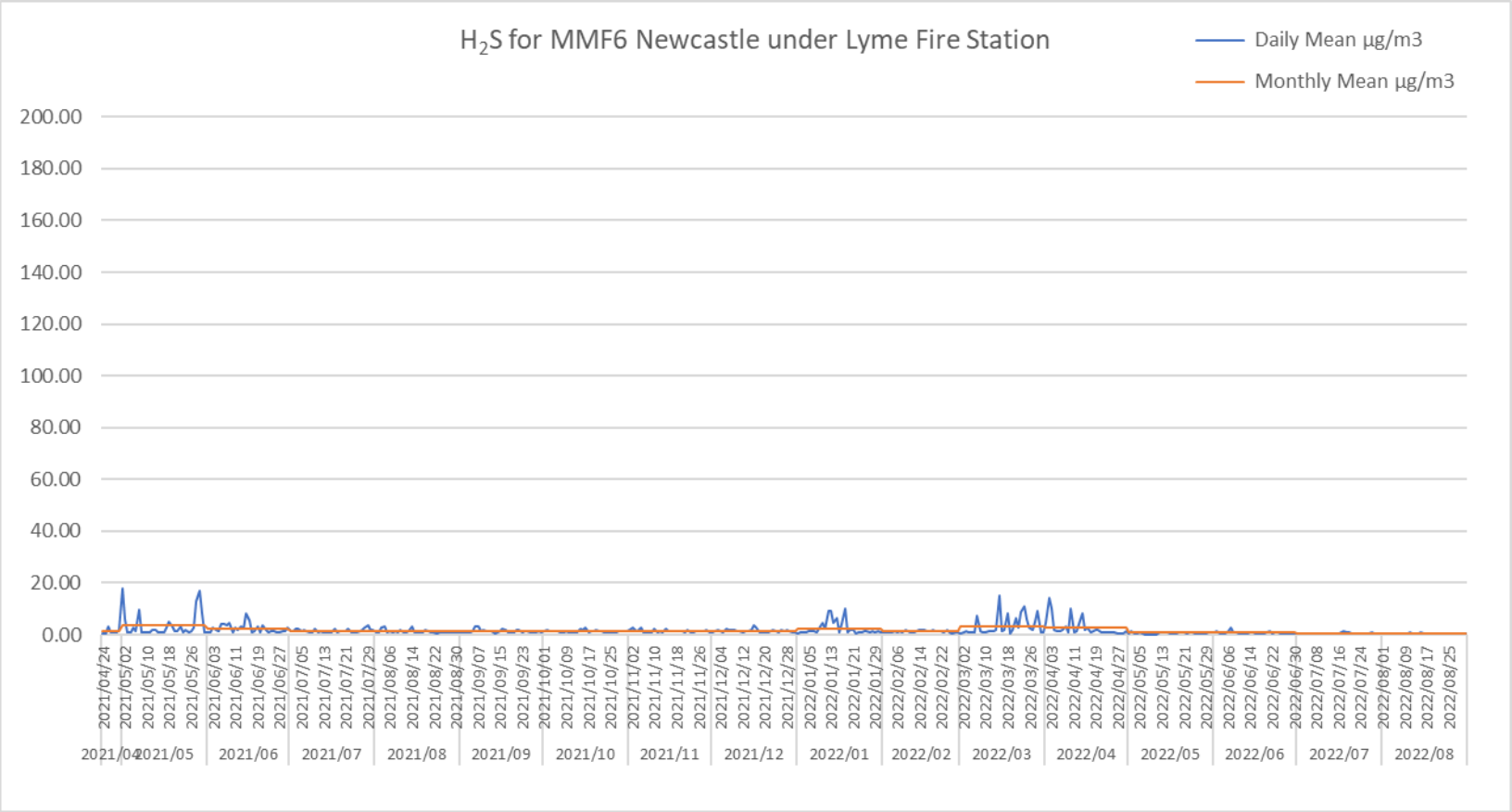
Evidence of progress to date

MMF6 Newcastle-under-Lyme Fire Station H_2S Levels



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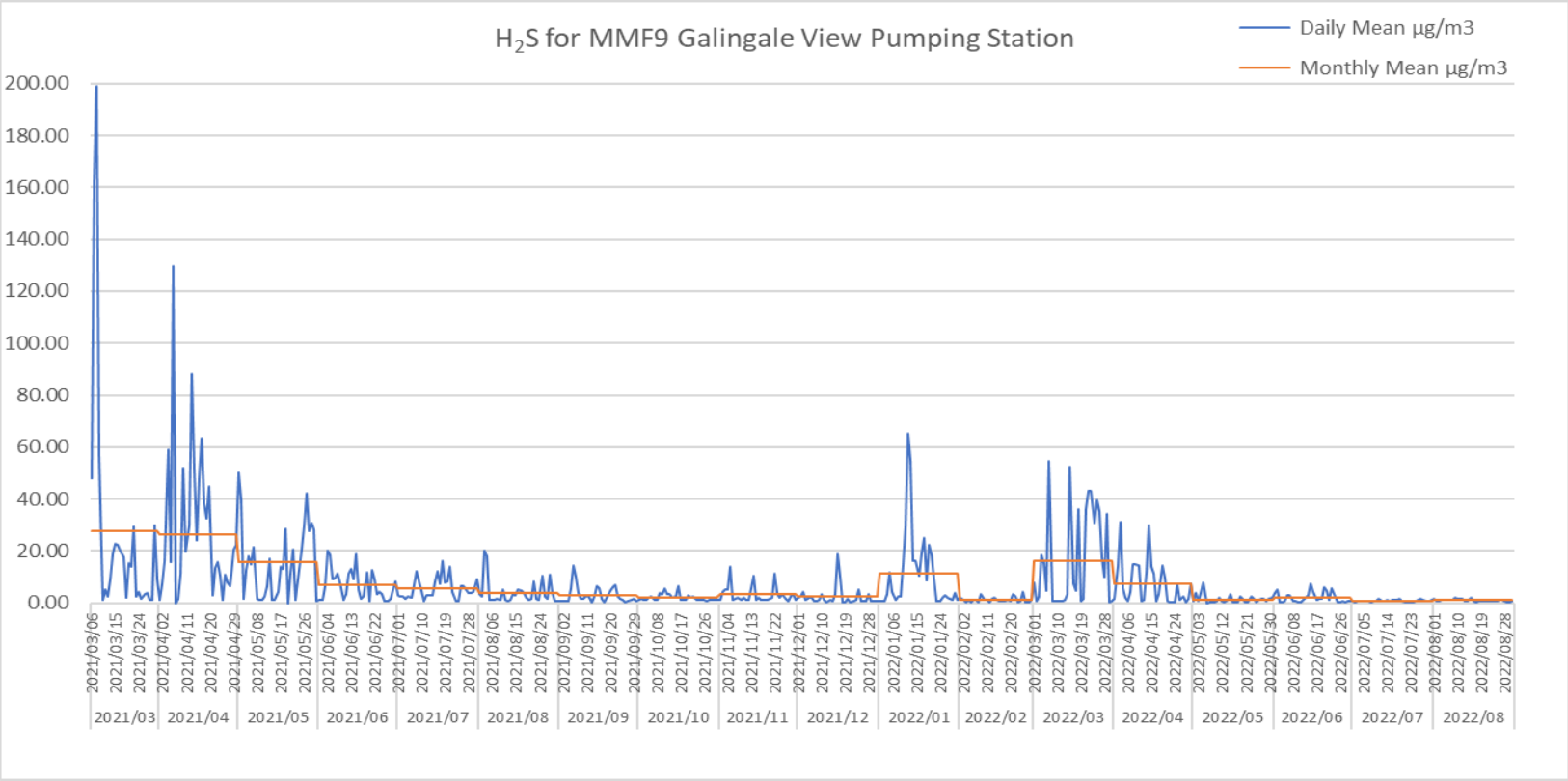
Evidence of progress to date

MMF9 Galingale View H_2S Levels



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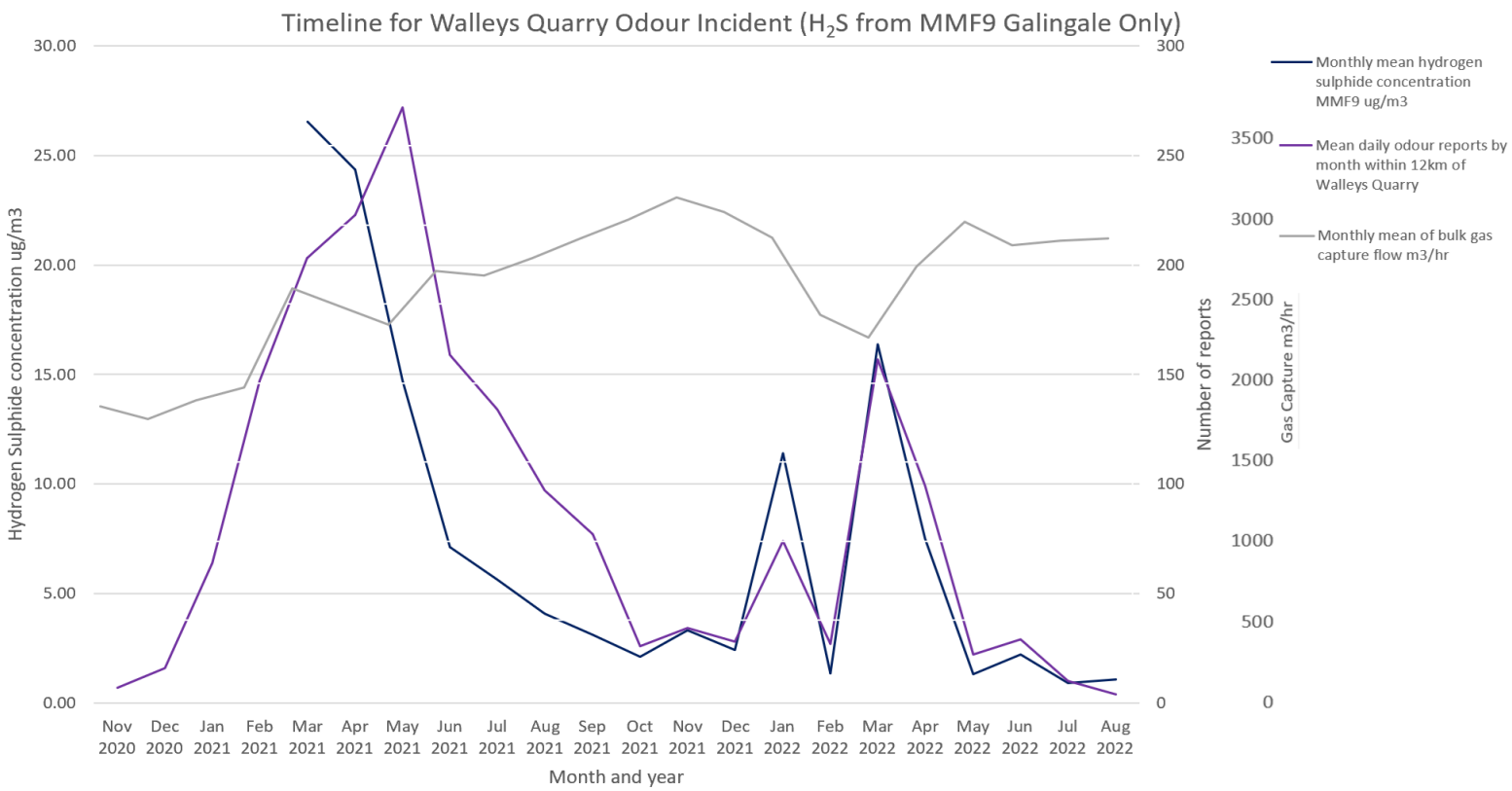
Evidence of progress to date

H_2S emissions outside the site boundary at Galingale View (MMF9) are shown in the blue line on the image below. This is the MMF which is the closest to the site boundary and has had the highest readings to date. The volume of gas captured is shown below (grey line). A decline in gas capture was reported in early 2022. WQL was asked to investigate the general decline. There was an increase in total volume of gas being captured primarily due to the installation of 18 new wells in April 2022 and capping works beginning, along with other actions detailed in the completed and ongoing measures. There were further improvements at the same time as the capping works in Phase 1 and Phase 2 progressed.



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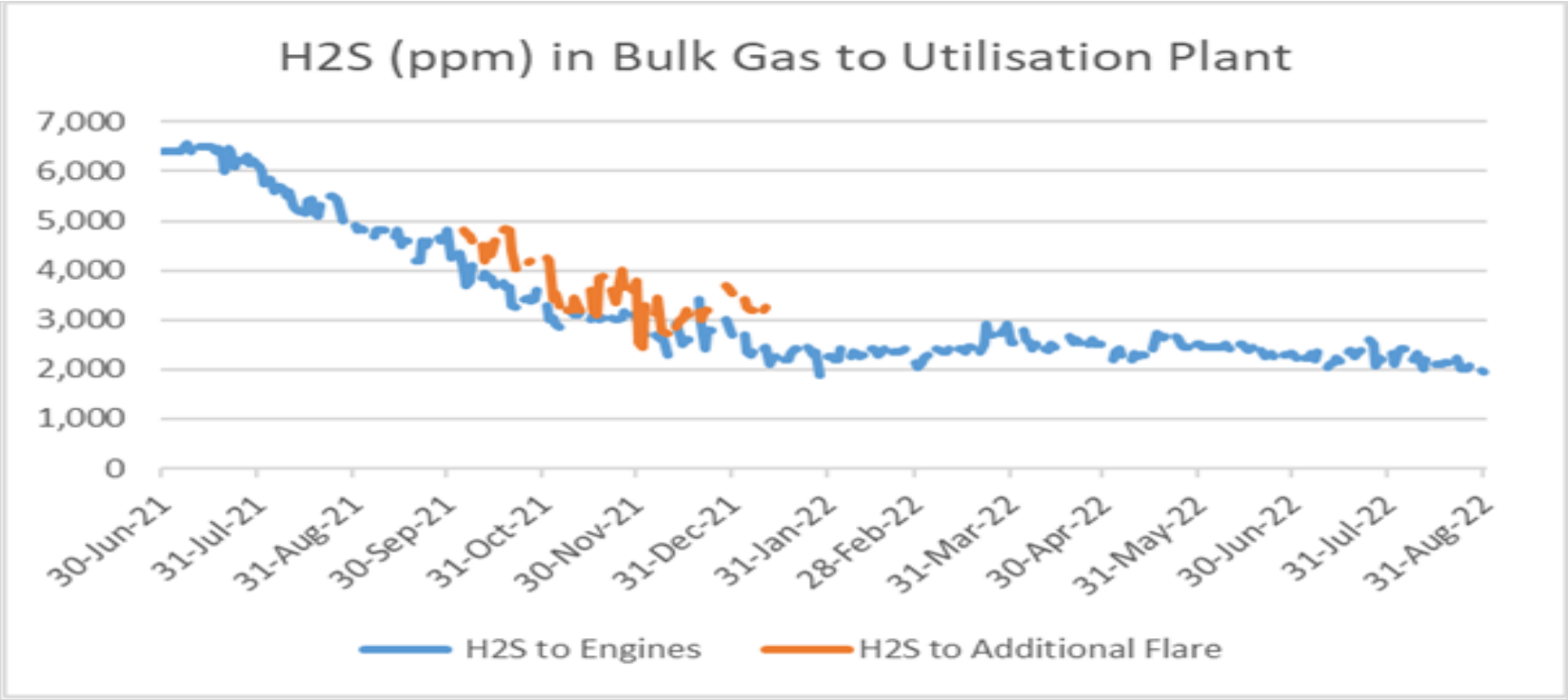
Evidence of progress to date

Evidence of progress to-date validates the '***contain, capture, destroy***' strategy adopted by the EA.

The measured H_2S concentrations in the bulk gas at the GUP had steadily declined to a level of 2500ppm in January 2022. The H_2S concentration remained around this figure until May 2022 when it began to decline again gradually. On 31 August 2022 H_2S was recorded at 1,960 ppm (prior to treatment) in the bulk gas line (which is sent to the gas engine).



The EA is undertaking increased site inspections, including taking samples. The purpose of this activity is to review WQL's acceptance procedures, and the correct classification and description of all waste being accepted. This is to ensure sulphate-bearing waste is not accepted at the site.

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Ongoing and future measures

Table below includes update on ongoing measures and future measures to be taken by WQL **since February 2022**

	* Measure Reference O	1	2	Key measures required of WQL (unless specified)	Timescale	Reasoning & impact
Contain	13	13	19	Surface emissions survey undertaken bi-monthly.	Ongoing from October 2021	The latest surface emission survey was undertaken in July 2022. The EA will review the submission to assess the performance of the capping and gas infrastructure. The surveys identify whether any remedial works are necessary. WQL will be required to take remedial action where a need is identified.
	-	23	20	Submission of CQA report for permanent capping of Phase 1.	Autumn 2022	This will assure the quality of the geomembrane installation.
	-	24	21	EA to undertake inspections using own monitoring equipment, to validate WQL fugitive emissions reporting.	From October 2021	To identify issues on site and require WQL to take remedial actions, if required, to prevent fugitive emissions.
	-	23	22	Submission CQA Report for temporary capping on Phase 2.	Autumn 2022	This will assure the quality of the clay installation.
	-	-	23	Further temporary capping on an area on the flank of Phase 1 (approx. 5000m²). The area will not have waste deposited against it while Phase 3 is filled and raised.	End of September 2022	Covering this this area with waste or temporary capping will reduce fugitive emissions and improve gas containment. Approximately 600m² is outstanding.
			24	Submission of revised Phasing and Capping Plan.	September 2022	Continual review of capping and phasing to minimise fugitive emissions.

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Ongoing and future measures

	* Measure Reference O	1	2	Key measures required of WQL (unless specified)	Timescale	Reasoning & impact
Capture	-	-	25	Implementation of approved design of gas control infrastructure for the new operational area (Phase 3) and future operational areas (Phases 4 to 8) contained in a schedule of works.	From May 2022	The schedule of works will lead to an improved system of gas collection, ready for the generation of landfill gas as each new cell is filled. This will reduce fugitive emissions and improve gas collection. The gas collection system continues to be reviewed as the site is filled.
Capture	-	-	26	A review of the performance of each gas well will be routinely undertaken by the landfill gas contractor to ensure efficient gas collection.	From May 2022	This will maximise the amount of gas the wells extract.
Capture	-	-	27	Review of landfill site gas balancing.	From August 2022	To ensure the gas field is operating efficiently.
Capture	-	-	28	Installation of the Northern extension of the 315 mm main line (gas transmission pipework).	From August 2022	To improve gas collection efficiency and condensate drainage.
Destroy	21	21	29	Weekly provision of real-time telemetry data by the landfill gas contractor and review by EA.	From October 2021	By analysing the data, the EA can confirm the operational status and performance of site gas management equipment and identify any issues which need to be rectified.

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Ongoing and future measures

	* Measure Reference O	1	2	Key measures required of WQL (unless specified)	Timescale	Reasoning & impact
Other	-	-	30	Improvements to site surface water drainage.	Ongoing	This will result in reduced leachate generation and improved site conditions following heavy rainfall events.
	-	-	31	Additional and replacement leachate collection infrastructure to be installed, including installation of 5 new leachate wells in Spring 2023.	Ongoing	Reducing leachate levels should allow optimal gas collection in gas wells and minimise conditions likely to increase H_2S production.
	-	-	32	EA is undertaking more frequent site inspections, specifically reviewing waste acceptance, including taking samples.	From May 2022	To ensure compliance with waste acceptance requirements to prevent the generation of H_2S within new waste deposits.
	-	-	33	EA will share data from a diffusion tube monitoring pilot study with the UKHSA and publish it on the Citizen Space webpage.	Autumn 2022	To provide additional understanding of the flow and concentrations of H_2S surrounding the site.
	-	-	34	EA to assess implementation of WQL's revised waste acceptance procedures.	Autumn 2022	To ensure any high-sulphate bearing waste (in trommel fines) is rejected.

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Ongoing and future measures

	* Measure Reference			Key measures required of WQL (unless specified)	Timescale	Reasoning & impact
	O	1	2			
	-	-	35	Follow-up of audit work at waste producer sites.	Ongoing	To prevent high-sulphate bearing waste (in trommel fines) being sent to the landfill and ensure required remedial action has been taken where necessary.

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Temporary increases in H_2S concentrations and odour reports

January 2022
The highest average H_2S concentration during January was 11.4µg/m3 (7.6ppb) at MMF 9 Galingale View and on 6 days in January the EA received over 100 odour reports in 24 hours. The volume of gas captured fell. WQL was required to investigate this decline and take remedial action to improve the gas collection system. January saw periods of heavy rainfall, coupled with periods of cold still weather. WQL is developing proposals to improve surface water management in the longer-term.

March and April 2022
The highest average H_2S concentration during March 2022 was 16.4µg/m3 (10.9ppb) at MMF 9. On 18 days in March the EA received over 100 odour reports in 24 hours. The average H_2S concentration during April 2022 was 7.6µg/m3 (5.0ppb) at MMF 9. On 9 days in April the EA received over 100 odour reports in 24 hours. Wind speeds in March and April 2022 were significantly lower than in February 2022.

During this period, there was a higher potential for fugitive emissions for a number of reasons:

- Phase 1 was at its maximum capacity for waste and was uncapped, which meant gas collection could not be increased.
- Profiling to achieve final levels was also being undertaken in Phase 1.
- The deposit of waste in Phase 2 was occurring simultaneously, and so it was also uncapped.
- Gas capture was reduced due to the development of aerobic conditions, with a reduction in gas generation continuing in some areas of the landfill (as seen in January and February 2022).
- It was necessary for gas wells to be disconnected to allow tipping to progress to final levels.
- Periods of wet weather in the previous months continued to adversely affect the site and gas collection, with reports of perched leachate in gas wells.

Wind speed data indicates a higher frequency of low wind speeds <1 m/s in March - April 2022 than in March and April 2021. As set out in Comparisons of Ambient Air Quality Data at MMF9 Galingale View, Silverdale the mean H_2S levels were lower in 2022 than in 2021 (27.2 ug/m^3 vs 12.4 ug/m^3). However, it is not possible to quantify how much the differences in H_2S concentrations between the two years is influenced by the required operational improvements, and other variables such as meteorology, including wind direction, which have a strong influence on the concentrations measured.

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June 2022

The average H_2S concentration during June 2022 was 2.2µg/m^3 (1.5 ppb) at MMF 9 Galingale View. This is very close to the US EPA RfC. There were no days in June when the EA received over 100 odour reports in 24 hours. The highest total of reports registered on a single day in the month of June was 95 reports on 15 June 2022.

We consider the slight increase was due to the fact that capping works had not been completed, and while landfilling operations had commenced in Phase 3, gas collection was not possible as gas generation was insufficient in this area.

As a result of the steps taken by WQL to date and those currently being taken, in particular limited phase size and progressive installation of gas infrastructure, we do not expect to see a repeat of levels seen in January, March and April 2022. Whilst a slight increase in average H_2S concentration occurred in June 2022, subsequently there has been a return to lower levels in July (0.9µg/m$^{3)}$ and August (1.1µg/m$^{3)}$

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Adapting the plan

This plan sets out and explains the measures we have required and continue to require WQL to implement. It is based on our experience of regulating landfills across the country. Unforeseeable future events may have an impact upon the on-site improvements (or the outcome they are designed to achieve). Where this occurs, we will revise the plan accordingly as quickly as possible. Should the measures set out in the plan not have the desired outcome, we will continue to press WQL to take further appropriate measures.

Biochemical reactions, which produce H_2S, are subject to a range of environmental factors which will continually change the amount of landfill gas produced. Factors such as atmospheric pressure above the landfill will have an impact on the emission rate from the surface, and the wind-speed/direction will affect levels recorded at the four MMFs. It is therefore necessary to assess the monitoring results over an extended period before drawing firm conclusions.

Whilst it is not possible to precisely predict the effect that each individual measure the EA has required WQL to take will have, or exactly how much an individual gas well will collect, or how H_2S production rates inside the site will change in the future, '***contain, capture, destroy***' remains the most effective strategy.

Monitoring since April 2021, together with an overall trend of decreasing numbers of complaints, supports our view that the right measures have been identified and are being implemented to achieve and sustain levels of H_2S and odour outside the site below the health-based guidance values advised by UKHSA. Whilst it is necessary to assess the monitoring results over an extended period before drawing firm conclusions, we continue to review the results on a monthly basis to identify any trends which need to be addressed more immediately. We have seen a continuing increase in gas collection rates since April 2022 following agreed infrastructure improvements.

We have not seen a recurrence of the temporary increases in H_2S levels which occurred between January and April 2022 before completion of capping works and recent gas infrastructure installation. We will continue to require the submission of gas capture data to allow us to identify the reasons for any increases in H_2S levels, and any further necessary improvement measures.

In the last four months, the ambient air quality monitoring data has been near, or below, the monthly average long-term health-based guidance value for H_2S concentrations. Whilst we recognise that factors such as warmer weather leading to increased dispersion may have contributed to this, we consider that the recent improvements to capping and gas collection are having a positive impact and will continue to do so.

We are committed to ensuring that WQL continues to take all appropriate measures to continue to achieve and sustain levels of H_2S and odour at or below levels advised by UKHSA.

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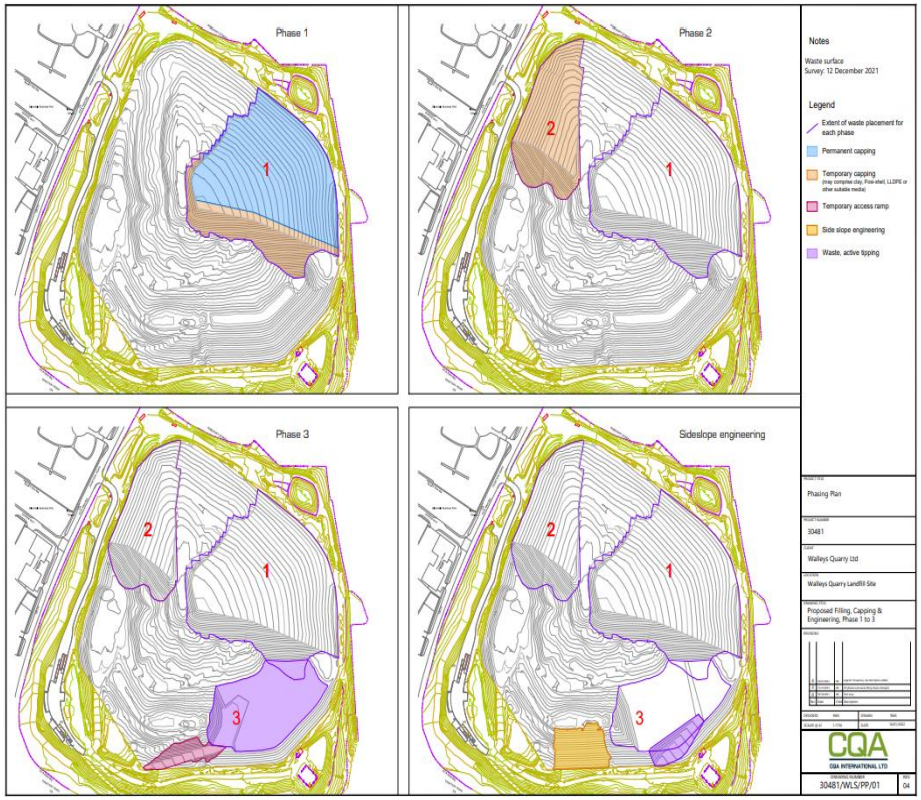
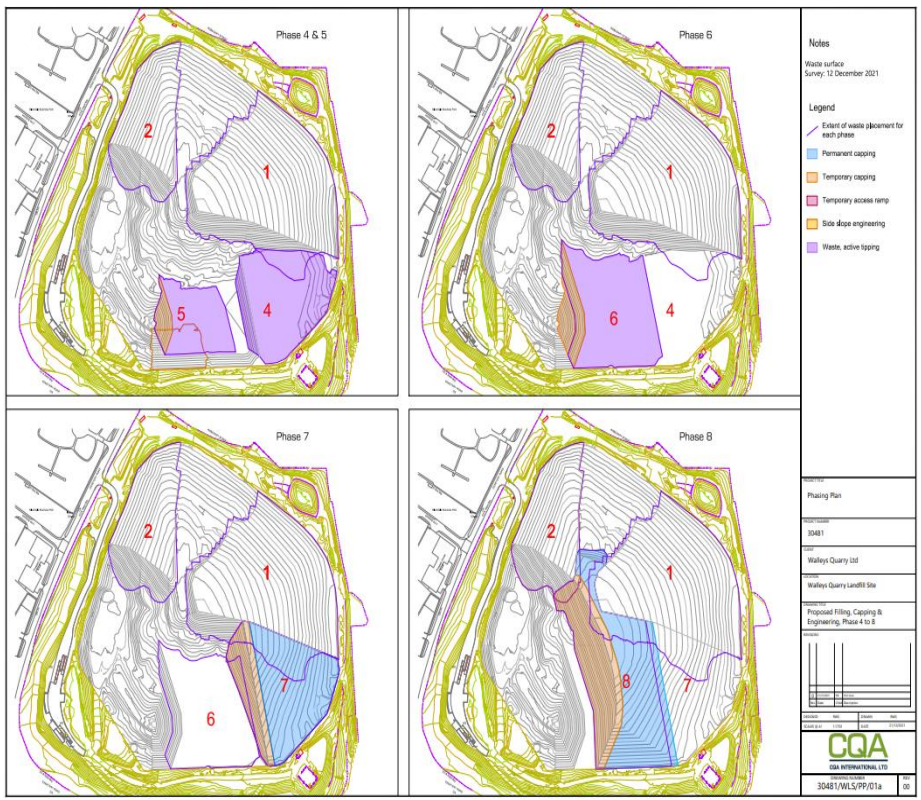
Appendix 1 – Extract from Phasing and Capping Plan

The following plans are taken from the agreed Capping and Phasing Plan (dated February 2022). They show the expected progression of fill of the site until Summer 2023 (phases 1 to 8) and the capping areas (Phases 1, 2, 7 and 8). The plan is currently being reviewed by WQL.





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