CEMEX UK Materials Limited
Whitehall Landfill
Permit number: MP3036SS
Variation number: LP3630MR

Annual environmental monitoring report for 2024

Contents

Figures

Tables

Appendices

1 Introduction

The Environmental Permit (EP) for Whitehall Landfill (the Site), no. MP3036SS (variation notice LP3630MR dated 22 June 2007) specifies under condition 4.2.1 that:

"A report or reports on the performance of the activities over the previous year shall be submitted to the Agency by 31 January (or other date agreed in writing by the Agency) each year. The report(s) shall include as a minimum:

(a) a review of the results of the monitoring and assessment carried out in accordance with this permit against the relevant assumptions, parameters and results in the risk assessments submitted with the Application;

(b) where the operator's management system encompasses annual improvement targets, a summary report of the previous year's progress against such targets;

(c) the annual production/treatment set you in schedule 5 table S5.2

(d) details of any contamination or decontamination of the site which has occurred

(e) the topographical surveys required by condition 3.6.3 other than those submitted as part of a CQA validation report;

(f) the volumetric difference (reported in cubic metres) between the most recent topographical survey and the previous annual topographical survey i.e. the additional volume of the landfill void that is occupied by waste;

(g) an assessment of the settlement behaviour of the landfill body based on the difference between the most recent topographical survey and previous annual topographical survey for the areas of the landfill which did not receive waste between the surveys;

(h) a calculation of the remaining capacity (reported in cubic metres) derived from the pre-settlement contours and the most recent topographical survey;

(i) the compliance testing undertaken in the period."

This report is presented in compliance with this condition.

The installation is a landfill site and associated infrastructure, for disposal of inert waste. The Site covers an area of 5.2 ha and lies in a closed limestone quarry to the northwest of Wenvoe, approximately six miles southwest of Cardiff City Centre, South Glamorgan, at NGR 311700 173450.

The Site is surrounded by fields and woodland to the north and woodland to the east (Figure 2.1). To the west of the site are fields crossed by footpaths and containing a small pond. The southern part of the site is mostly bounded by fields and a track, with woodland towards the eastern part. The south eastern tip of the site is bounded by the houses and gardens along Walston Road in Walston, which is at the north western edge of Wenvoe.

2 Site Description and History

The Site is currently permitted to accept inert waste; however it stopped accepting waste at the end of October 2018 as filling is complete. In-waste gas monitoring wells (GF01-GF11) were installed from May-June 2021. The Site is now fully restored, and a Closure Plan was submitted to Natural Resources Wales (NRW) for review (Stantec, 2021a) in September 2021. NRW have provided comments which Cemex are addressing. Once the Closure Plan has been approved an application will be made to put the Site into formal aftercare, and once sufficient monitoring data has been obtained, a surrender application will be submitted to NRW.

The landfill occupies a former limestone quarry that was operational from around 1930 until 1976. After cessation of operations, the Site lay dormant for 20 years. In 1984, a planning application for disposal of inert waste was approved. Following this, in 1996, a Waste Management Licence was granted (by the Waste Regulatory Authority, the Vale of Glamorgan Borough Council at the time) and landfill operations at the site began.

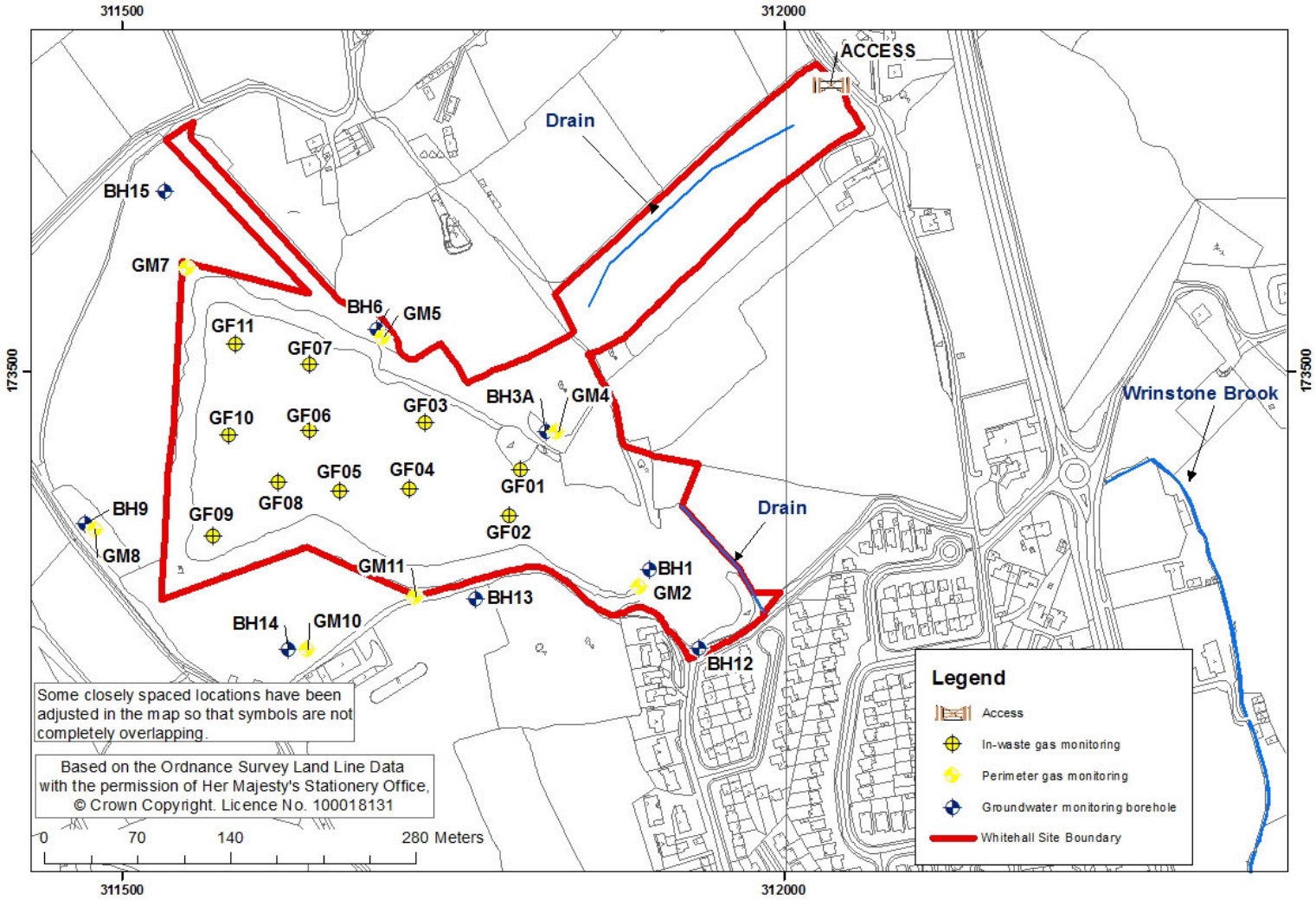
Waste was first accepted at Whitehall Landfill in November 1998. The Site formally operated under Waste Management Licence Number WM130189. Under this WML, the site was licensed to accept solid inert wastes including soils (topsoil, sub-soil and overburden), brickwork, stone, concrete, sand (excluding foundry sand), cement, plastics, glass and fired pottery/ceramics. Certain other materials could also be accepted into the landfill provided that in total they made up no more than 1% by volume of any one load. These included plaster, wood, wood products, cardboard and paper products. Following transition to a Pollution Prevention and Control (PPC) Permit (now 'Environmental Permit') in 2006 the range of wastes that could be accepted was restricted to inert waste as defined by the Landfill Regulations.

The principal waste streams that arrived at Whitehall Quarry were all of construction and demolition waste, originating from various districts within Wales. The Site is certified to the environmental management standard ISO 14001:2015.

There are three closed landfills situated to the north, up-gradient of Whitehall Quarry. The most northerly of these, Greenwood Quarry, located approximately 500 m from Whitehall Quarry (Drawing ESID 2 within ESI/Arup (2005)), was licensed to receive inert and semi-inert material (Wildgust, 1998. Lafferty, 1998). Operations at Greenwood Quarry ceased in 1988. Greenwood Old Quarry lies immediately south of Greenwood Quarry and was licensed to accept solid non-toxic wastes although Wildgust (1998) and Lafferty (1998) suggest that material outside this classification was also accepted.

The most southerly of these sites, Blue Pool, located approximately 130 m from Whitehall Quarry (Drawing ESID 2 within ESI/Arup (2005)), accepted solid non-toxic wastes and asbestos. Again, Wildgust (1998) and Lafferty (1998) suggest other materials were accepted at this site.

Figure 2.1 Site location plan



3 Review of Monitoring Data

Schedule 4 of the EP specifies that monitoring of landfill gas and groundwater level and quality is required to assess any potential impact of the landfill on the surrounding environment. The following sections review the data collected from January to the end of the calendar year in December 2024. The locations of the monitoring points are shown on Figure 2.1.

3.1 Gas Monitoring

3.1.1 In-waste Gas Monitoring

11 in-waste wells were drilled in May and June 2021, and monitoring commenced in July 2021. These have been monitored monthly as specified in the EP and detailed in Table 3.1.

Monitoring requirements for the in-waste gas wells are detailed in the Closure Plan (Stantec, 2021a). Whilst not formally adopted within the permit, the data obtained from these wells is presented in this section for information.

Appendix A presents all in-waste gas concentrations collected during 2024. No data was collected at GF01 in March owing to inaccessibility and February, April and June due to instrument problems.

Table 3.1 Monitoring requirements at in waste gas wells

Monitoring Locations	Parameter (units)	Frequency
GF1-GF11	Methane (% v/v)	Monthly
	Carbon dioxide (% v/v)	
	Oxygen (% v/v)	
	Atmospheric Pressure (mb)	
	Differential Pressure (mb)	
	Flow Rate (l/hr)	

Methane varied between 0 %v/v and 56 %v/v in the in-waste gas wells in 2024 (Figure 3.1). Most concentrations remain below 30 %v/v, although results from GF02 and GF06 regularly exceed 30 %v/v. There is some evidence of an overall falling trend in the concentrations recorded in GF02 and GF06. Concentrations in 2024 were generally in the range of historic results at each location, excluding GF01 (52.2% v/v in August compared to previous maximum of 32.7% v/v). GF01 last reached concentrations of over 30%v/v in December 2021/February 2022. Concentrations recorded in GF01 have on average remained stable since the beginning of monitoring in 2021. The locations with the highest carbon dioxide concentrations generally have the lowest methane concentrations and vice versa. There are no other obvious temporal trends in the data.

Carbon dioxide concentrations are presented in Figure 3.2 and show that carbon dioxide is typically recorded at much lower concentrations than methane, and predominantly less than 5 %v/v. Carbon dioxide concentrations are highest in GF11, with concentrations reaching 6.6 %v/v in 2024, the highest concentration recorded in any of the in-waste wells since records began in 2021. There is an overall rising trend in the concentrations recorded in GF11, albeit with some evidence of seasonal variation.

Carbon dioxide is lowest in GF01, GF02 and GF03 with most results less than 2 %v/v. There are slight increasing trends in GF05, GF06, GF08 and GF09; further time series data will indicate whether this is a seasonal trend. There are no other visible trends.

Flow rates are presented in Figure 3.3 with rates in 2024 varying between -5l/h at GF01 to 0.5 l/h in GF06. Excluding the 2024 results from GF01 of -1.5l/hr (October 2024) and -5 l/hr (December 2024) that are anomalous, flow rates are generally in a narrow range between -0.2 l/h and 0.3 l/hr. Gas flow rates of this magnitude are not indicative of significant motive pressure driving gas off-site. Flow rates are similar at all locations with the exception of the above readings from GF01, and all locations show similar variations throughout the year. Gas flow rates have been tending toward zero since 2021.

Figure 3.1 In-waste stable methane concentrations since gas wells were drilled (July 2021)

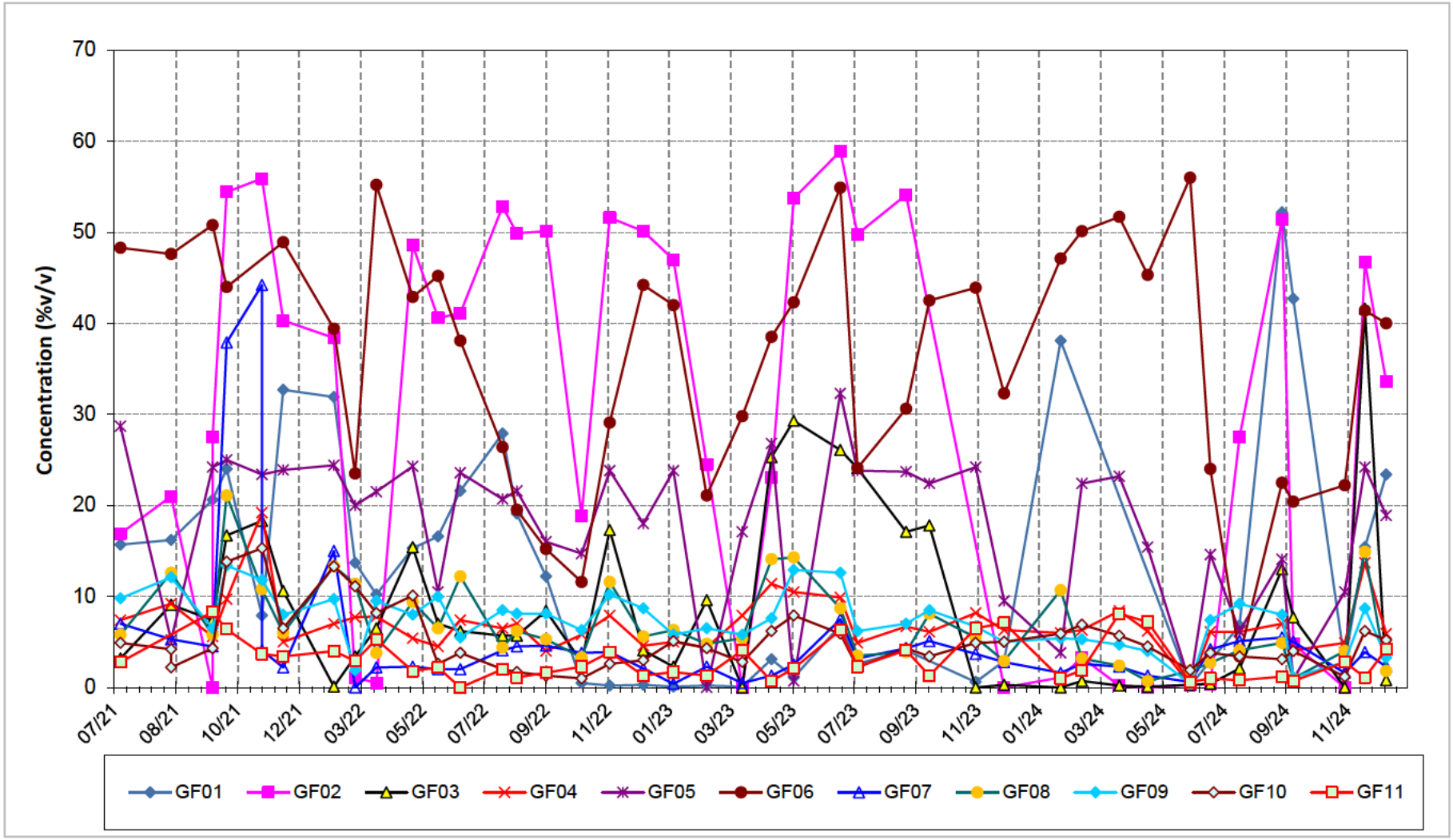


Figure 3.2 In waste carbon dioxide concentrations in since gas wells were drilled (July 2021)

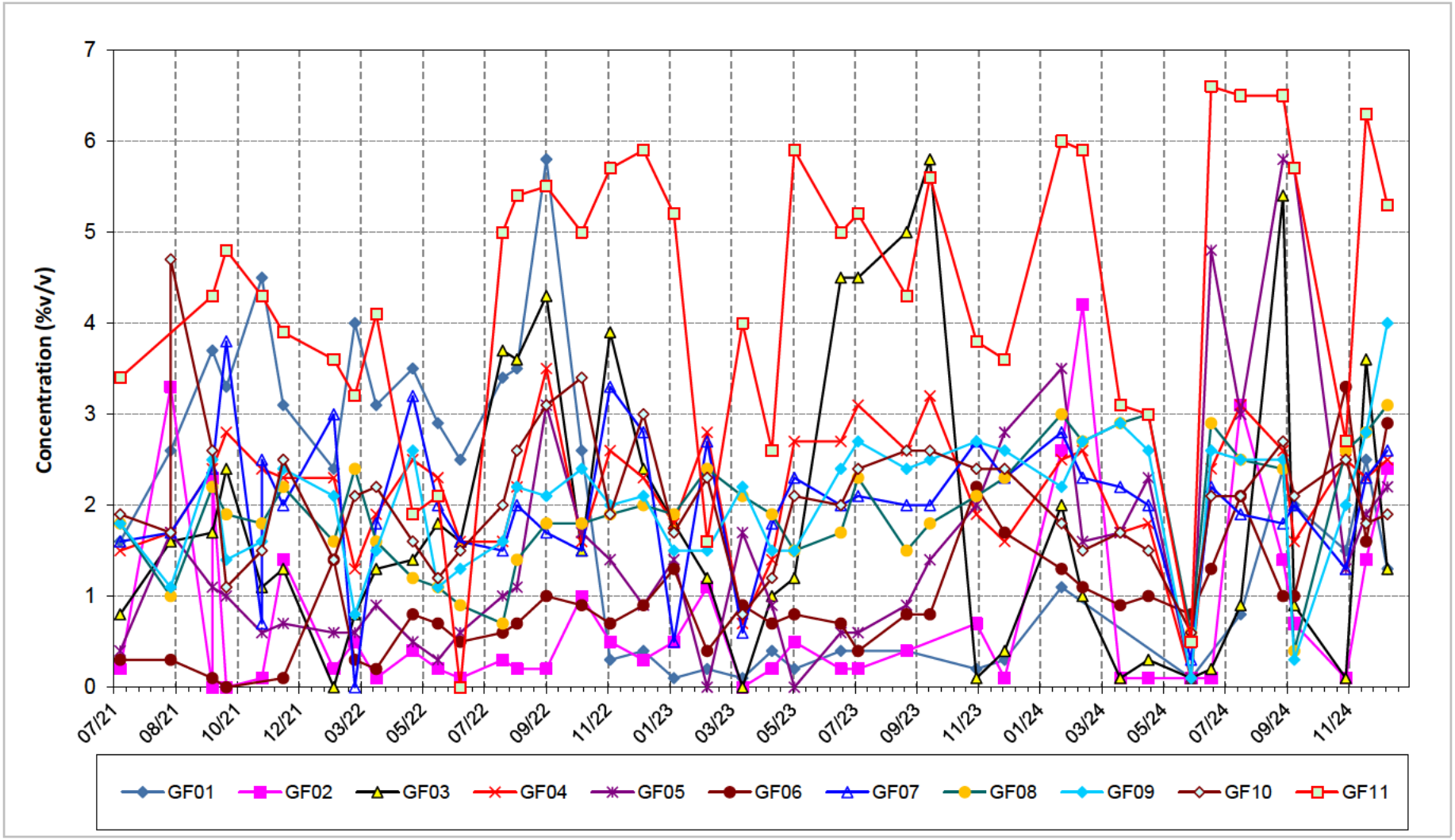
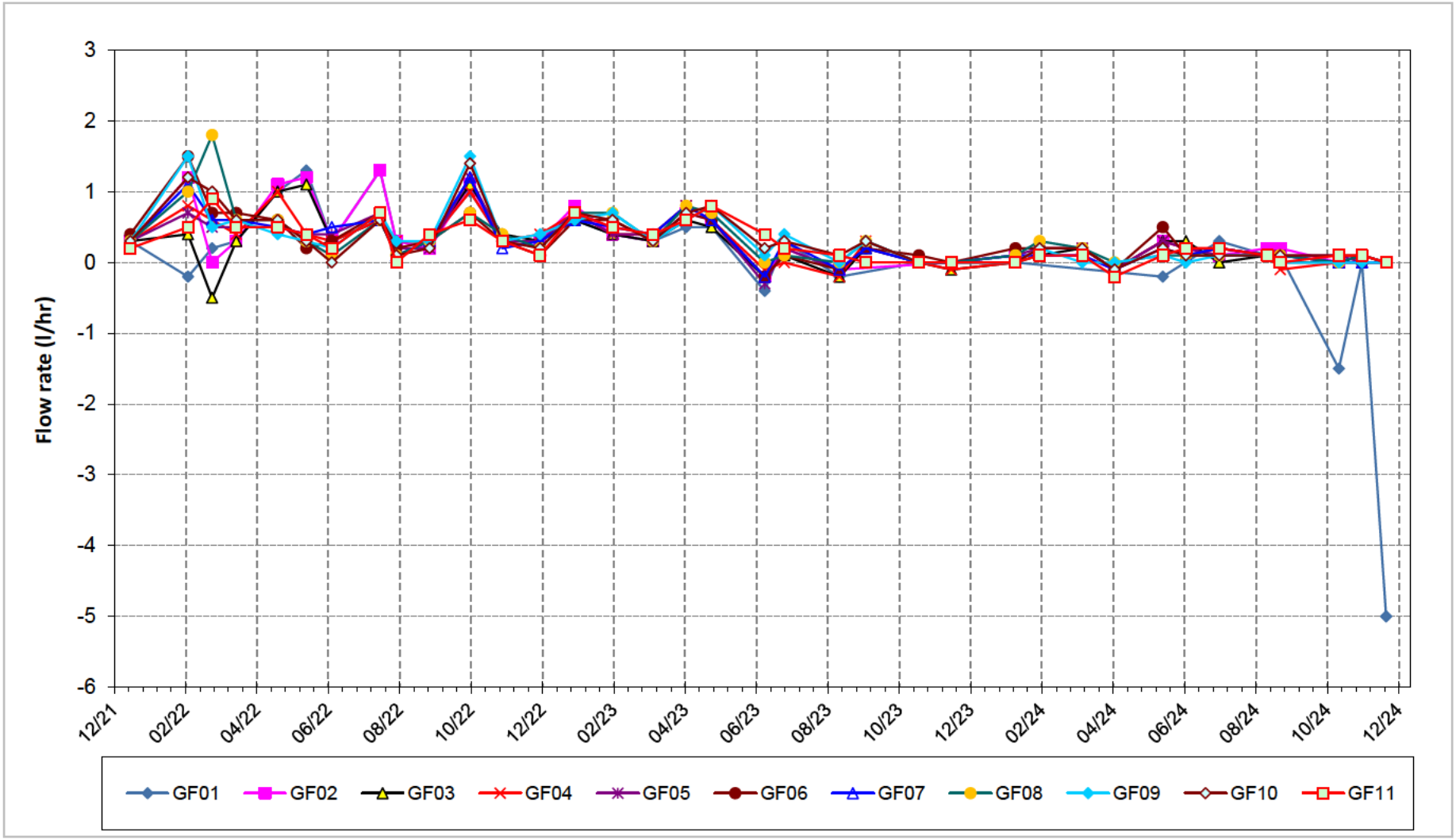


Figure 3.3 Flow rate in gas wells since December 2021 (first reading taken)



3.1.2 Perimeter Gas Monitoring

Landfill gas has been monitored in seven perimeter gas monitoring boreholes on a monthly frequency in accordance with the requirements specified in Table S4.2 of the EP variation LP3630MR. The monitoring requirements and compliance limits are given in Table 3.2.

Appendix B presents all perimeter gas monitoring data collected during 2024. GM4 has no data for January, and GM5 has no data for January or June, as they were missed by the technician carrying out the monitoring.

One of the stipulated gas monitoring locations, GM7, was lost in 2007. It was replaced by BH15, and gas monitoring was undertaken at this location (with some interruptions due to accessibility issues) from December 2007 until March 2017 when GM7 was located again and monitoring resumed.

Compliance limits for stable methane and carbon dioxide of 1 %v/v and 6 %v/v respectively have been derived to provide threshold criteria and allow quantitative assessment of emissions from the landfill. These are presented in Table 3.2.

Table 3.2 Monitoring requirements and compliance limits for landfill gas monitoring in perimeter gas boreholes

Monitoring Locations	Parameter (units)	Frequency	Compliance limit (% v/v)
GM2, GM4, GM5, GM7, GM8, GM10, GM11	Methane (% v/v)	Monthly	1
	Carbon dioxide (% v/v)		6

Methane has been detected on 40 of the 76 occasions (compared to 29 of 64 in 2023) at relatively low concentrations of between 0.1 %v/v and 0.6 %v/v in predominantly May to September, as presented in Table 3.3. However, there were two detections above the compliance limit at 2.8 %v/v (GM8 and GM10, both in May). Concentrations in both locations fell back to zero by the end of the year. There have been increased detections of methane in many perimeter monitoring points since 2021, as seen in Figure 3.6.

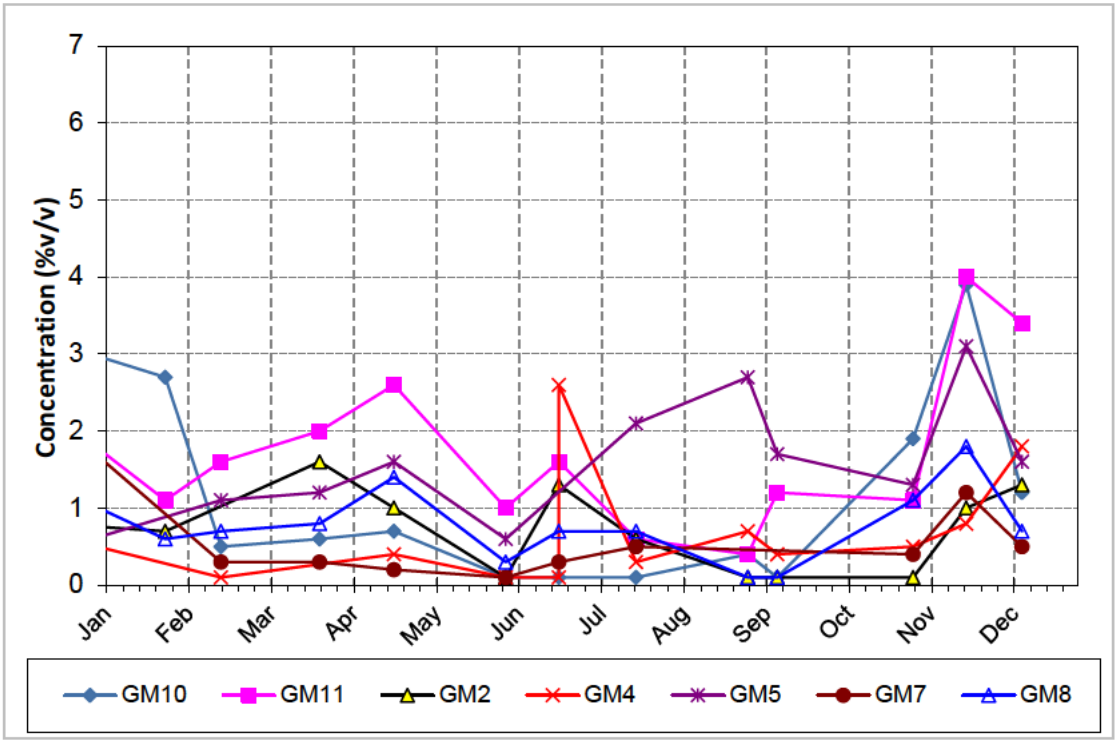
Table 3.3 Location of methane detections in perimeter gas boreholes 2024

Location	Date of Detection	Reading (%v/v)
GM10	21/03/2024	0.2
GM10	30/05/2024	2.8
GM10	19/06/2024	0.5
GM10	18/07/2024	0.5
GM10	29/08/2024	0.6
GM10	09/09/2024	0.5
GM11	21/03/2024	0.1
GM11	30/05/2024	0.4
GM11	19/06/2024	0.4
GM11	18/07/2024	0.6
GM11	29/08/2024	0.6
GM11	09/09/2024	0.5

Location	Date of Detection	Reading (%v/v)
GM2	21/03/2024	0.2
GM2	18/04/2024	0.1
GM2	30/05/2024	0.4
GM2	19/06/2024	0.5
GM2	18/07/2024	0.6
GM2	29/08/2024	0.6
GM2	09/09/2024	0.5
GM4	30/05/2024	0.3
GM4	19/06/2024	0.5
GM4	18/07/2024	0.5
GM4	29/08/2024	0.5
GM4	09/09/2024	0.4
GM5	30/05/2024	0.4
GM5	18/07/2024	0.6
GM5	29/08/2024	0.6
GM5	09/09/2024	0.4
GM7	13/02/2024	0.1
GM7	21/03/2024	0.2
GM7	30/05/2024	0.3
GM7	19/06/2024	0.4
GM7	18/07/2024	0.5
GM8	13/02/2024	0
GM8	21/03/2024	0.2
GM8	30/05/2024	2.8
GM8	19/06/2024	0.5
GM8	18/07/2024	0.5
GM8	29/08/2024	0.6
GM8	09/09/2024	0.5

The carbon dioxide compliance limit was not exceeded during 2024, with a maximum concentration of 4.0 %v/v recorded in GM11 in November as shown on Figure 3.4 (compared to a maximum of 4.8 %v/v at GM7 in 2023). Historic carbon dioxide concentrations remain at generally below the 6 %v/v compliance limit with most results <3% v/v; some evidence of increasing long-term trends in the data in GM7 and GM11 were identified in 2023 (Cemex 2024); concentrations at GM7 have fallen since 2023 to a maximum of 1.2%v/v in 2024, and while GM11 peaked at a historical high in November, concentrations declined again in December, and were generally consistent with data from 2021-2023 for the rest of the year (Figure 3.5). Concentrations recorded in GM10 (along with GM5 and GM7) mainly rose through the second half of 2022 and again in 2023 and 2024 but there is no overall rising trend in GM5 and GM10 in the context of the historic data.

Figure 3.4 Stable carbon dioxide concentrations in perimeter gas boreholes, 2024



Gas flow rates in the perimeter boreholes are shown in Figure 3.7. They are generally comparable to those in the in-waste boreholes and have shown a similar overall declining trend since 2021 however appear to be stabilising since June 2023. During 2024, the greatest variation between the locations was recorded in the first half of the year. The highest gas flow readings in a perimeter borehole for 2024 were at GM8 and GM5 in May (0.5 l/hr). Again, flow readings of this magnitude of not indicative of significant motive pressure driving gas off-site.

Figure 3.5 Historical stable carbon dioxide concentrations in perimeter gas boreholes

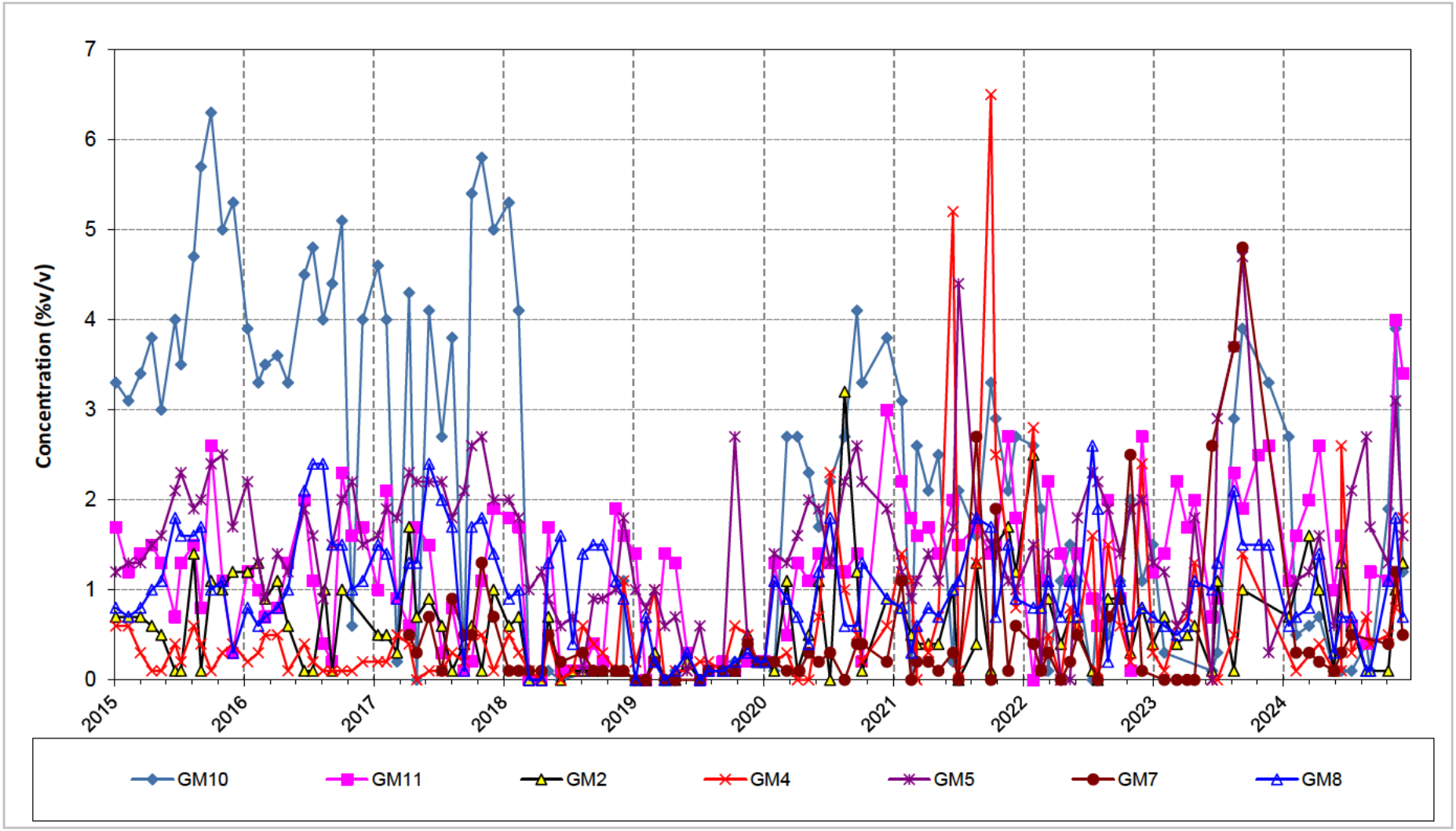


Figure 3.6 Historical stable methane concentrations in perimeter gas boreholes

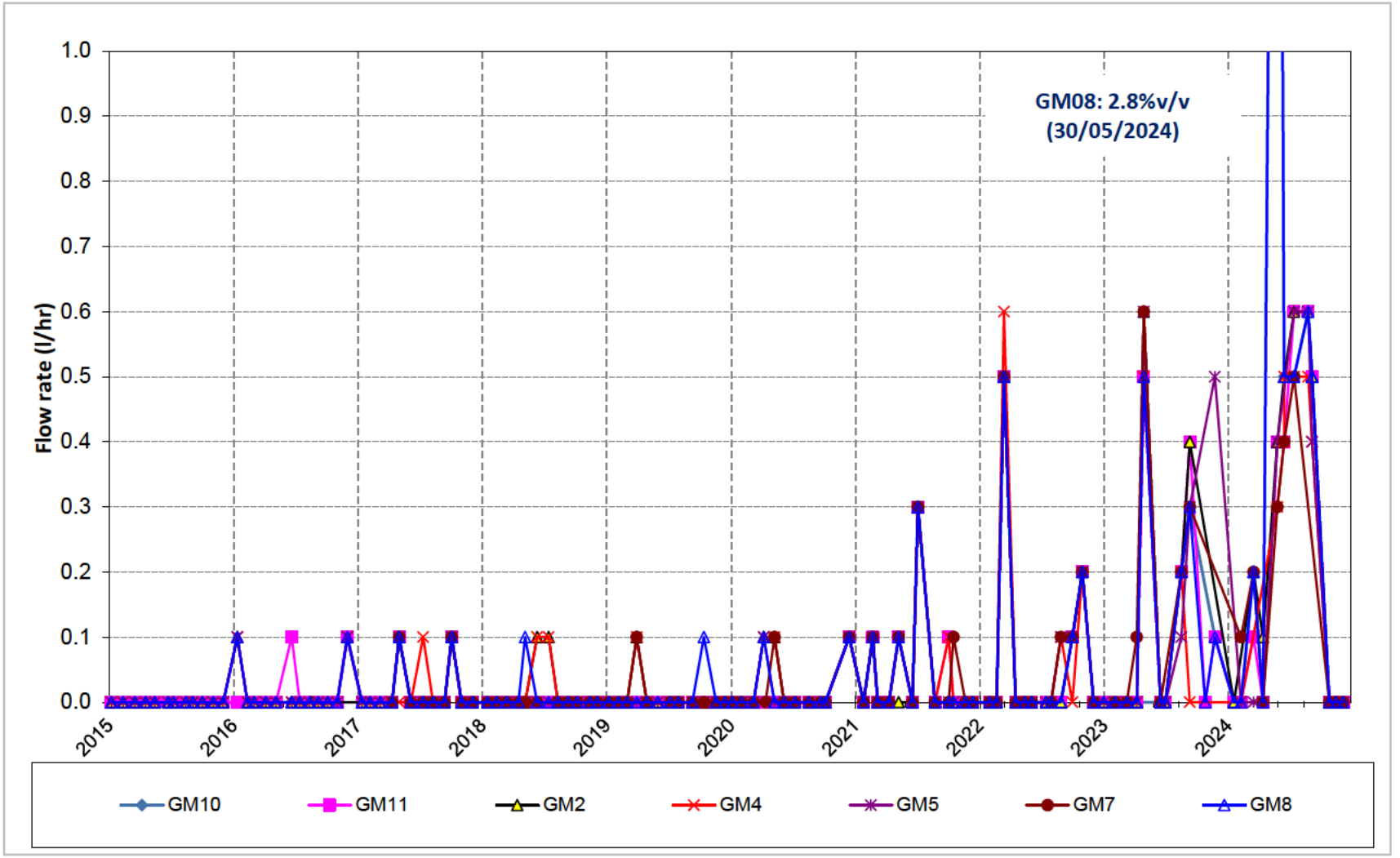
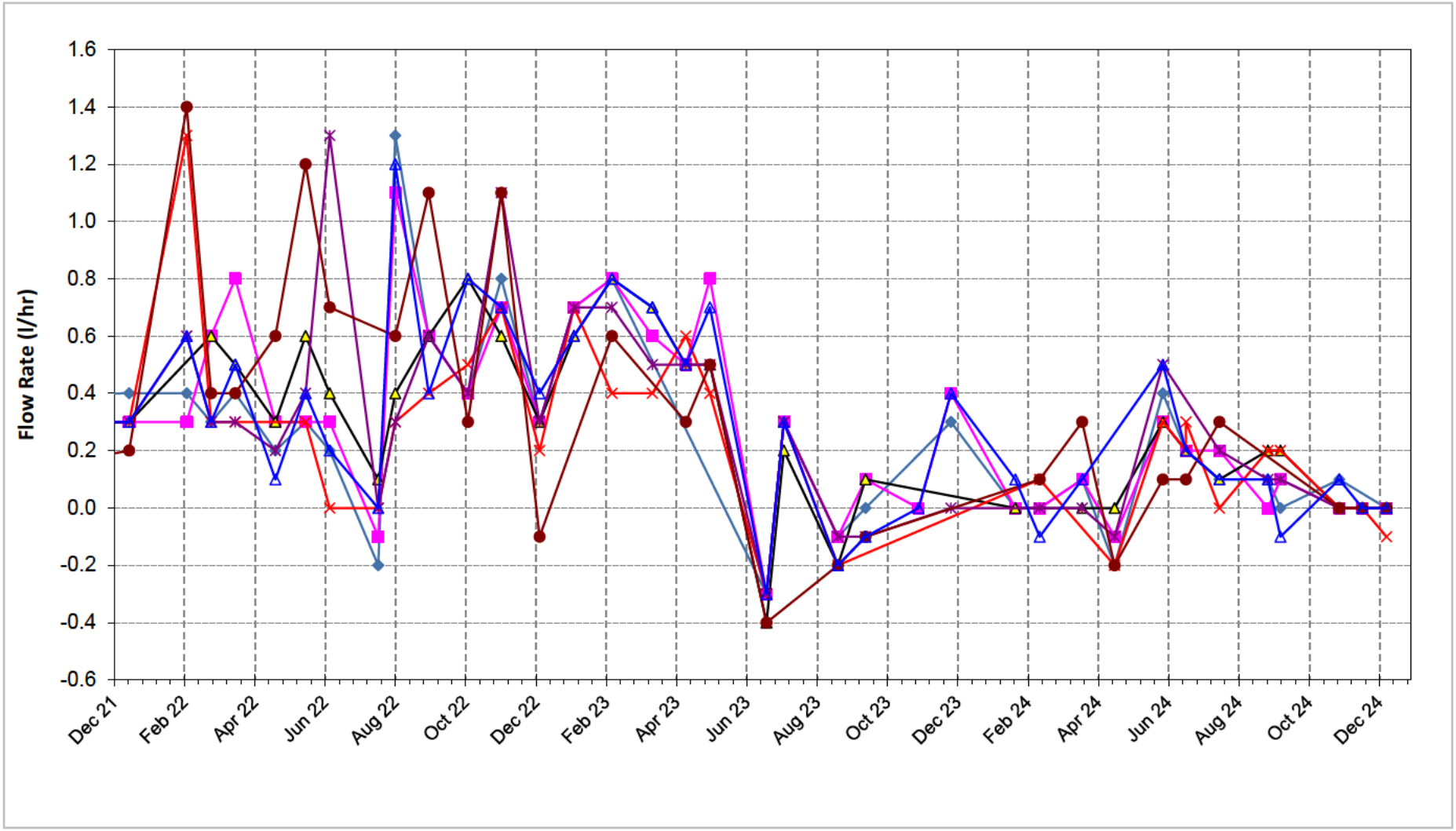


Figure 3.7 Flow rate in perimeter gas boreholes since December 2021 (first reading taken)



3.2 Groundwater Monitoring

Schedule 4 of the EP requires monitoring of groundwater quality and levels at four down-gradient perimeter boreholes, BH1, BH12, BH13 and BH14, which have compliance limits set, and at five up-gradient boreholes BH3, BH3A, BH6, BH9 and BH15, which do not have any compliance limits. The required parameters are listed in Table S4.4 of the EP and are summarised in Table 3.4. These locations were sampled on a quarterly and annual frequency for relevant determinands during 2024. The locations of the monitoring boreholes are shown on Figure 2.1. Most locations were sampled as scheduled, although BH13 was inaccessible (overgrown) during May and June for water level readings, and BH3 and BH9 were dry in July and BH3 again in September.

The following groundwater quality monitoring was unable to be undertaken during 2024:

- BH1 in April – technician did not purge the borehole before sampling therefore results are unreliable and not reported
- BH12 in January – borehole blocked with 'Waterra' tubing – monitored in March instead for Q1
- BH13 in January – insufficient liquid to obtain sample – monitored in March instead for Q1
- BH15 in March and October – borehole blocked with 'Waterra' tubing / no discharge occurring
- BH3 in January (monitored in March instead for Q1), July and October - borehole blocked / location dry / instrument failure
- BH6 in March (monitored in January instead for Q1) and July - borehole blocked with 'Waterra' tubing / no discharge occurring
- BH9 in April and July - insufficient liquid to obtain sample / location dry

We note that BH3 and BH3A are located very close to each other. The Closure Plan (Stantec, 2021a) recommends that BH3 is removed from the monitoring network. Since the Closure Plan has yet to be accepted, BH3 is still being monitored.

Table 3.4 Groundwater monitoring requirements

Borehole	Parameter	Frequency
BH1, BH3, BH3A, BH6, BH9, BH12, BH13, BH14, BH15	Water level, pH, Electrical conductivity, Ammoniacal Nitrogen as N, Chloride, Sulphate as SO4, Alkalinity, total organic nitrogen (TON), total organic carbon (TOC), Sodium, Potassium, Calcium, Magnesium, Iron	Quarterly[1]
	Manganese, Cadmium, Chromium, Copper, Nickel, Lead, Zinc, Naphthalene	Annually

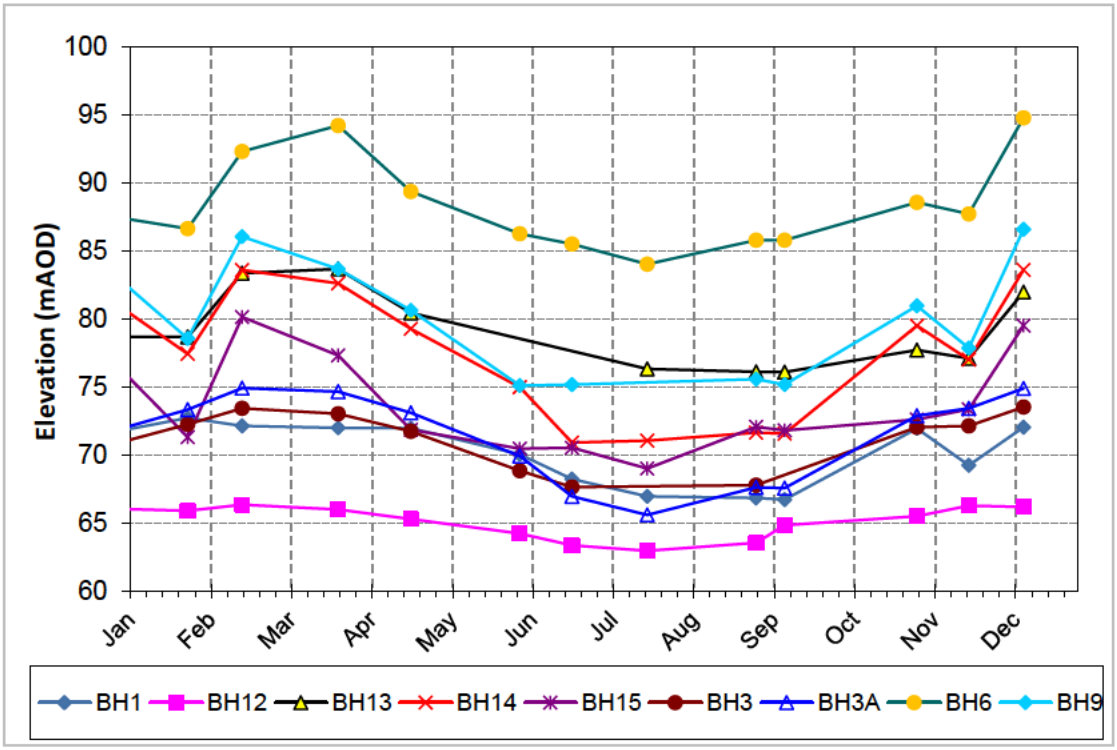
[1] Frequency reduced from monthly to quarterly in mid-2015.

3.2.1 Groundwater Levels

Monthly groundwater level data collected during 2024 are presented in Figure 3.8. The full dataset for 2024 is presented in Appendix C.

In 2024, groundwater levels generally rose between February and March then declined through to July before stabilising and then rising again into December. The least fluctuation is recorded in BH12 at less than 3.5 m; all other locations recorded fluctuating levels throughout 2024 with the greatest in BH14 of around 12.7 m. BH6 (north of the Site) recorded the highest groundwater levels during 2024 and BH12 (south-east of the Site) recorded the lowest groundwater levels, which is consistent with previous years.

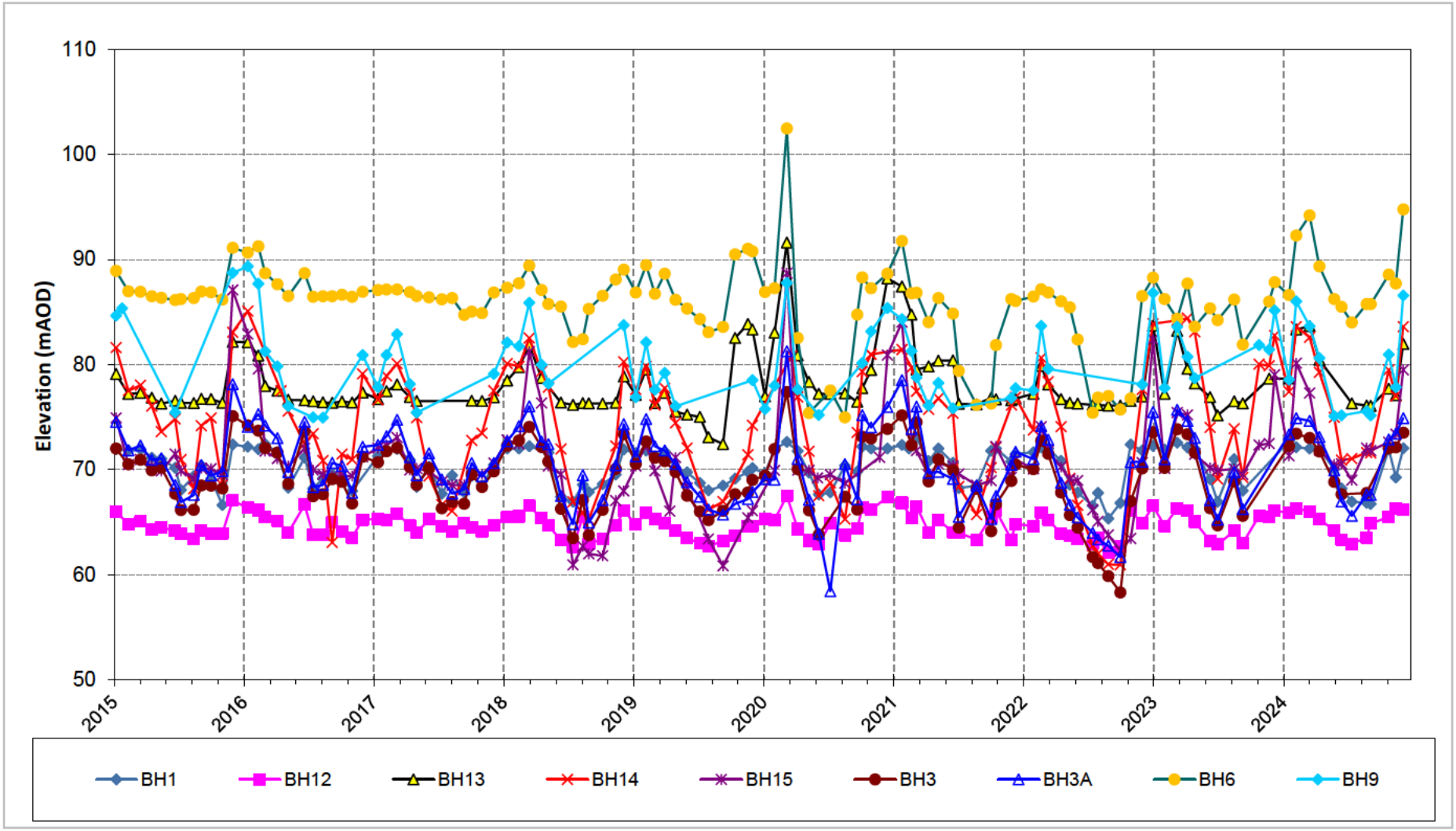
Figure 3.8 Groundwater elevation during 2024



Historical observed groundwater levels for the past decade for all monitoring locations are shown in Figure 3.9. The groundwater elevations at all monitoring locations show a degree of seasonality (higher during the winter and lower during the summer). BH12 records the least variation and BH6 the most. Levels in BH6 have varied much more since 2018 than previously, from typically around 85-90 mAOD to more recently in the range of around 75-105 mAOD. With the exception of BH6, which recorded generally higher levels in 2024 compared to 2021, 2022 and 2023, the groundwater levels overall are generally consistent with historical trends.

Groundwater levels are generally also more variable to the south-west where, historically, the variation in groundwater level is markedly greater in BH14, which has continued to be the case during 2024.

Figure 3.9 Historical groundwater elevation (2015-2024)



3.2.2 Groundwater Quality

Groundwater quality monitoring has been conducted in accordance with conditions specified in Schedule 4 of the Permit Variation Notice LP3630MR as outlined in Table 3.4.

The groundwater quality dataset for 2024 is presented in Appendix D.

Compliance limits for selected groundwater quality parameters have been derived in order to quantitatively assess landfill performance. A review of defined compliance limits was conducted by Cemex in 2008 and submitted to the Environment Agency, as the regulating authority at the time, which approved the revised levels. These came into effect in October 2008.

Compliance limits were subsequently revised as part of the 2016 HRA review (ESI, 2016) and these were agreed with NRW in July 2016 as detailed in Table 3.5.

The compliance limit for potassium at BH12 was updated in the revised 2019 annual report (Cemex, 2020) to reflect the increase in concentrations due to a potassium-rich plume originating up-gradient of the landfill (Cemex, 2016). A new compliance limit of 24.7 mg/l was calculated (included in Table 3.5) as well as a control limit of 19.7 mg/l. There are no compliance limits specified for up-gradient boreholes BH3, BH3A, BH6, BH9 or BH15.

Table 3.5 Groundwater quality compliance limits

Location	Determinand				
	Ammoniacal Nitrogen (mg/l)	Chloride (mg/l)	Iron as Fe (µg/l)	Potassium (mg/l)	Naphthalene (µg/l)
BH1	0.39	250	200	27	0.05
BH12	0.39	250	200	24.7	0.05
BH13, BH14	0.39	250	200	12	0.05

A statistical summary of general groundwater quality for all determinands that are monitored at the Site is presented in Table 3.6. Determinands have been compared to the UK Drinking Water Standards (UK DWS) for reference.

Groundwater quality at the Site is generally good, with concentrations above the UK DWS only recorded during 2024 for ammoniacal nitrogen. Two results for ammoniacal nitrogen were above the UK DWS in 2024, both at BH1 – these were in July (1.44 mg/l) and October (1.06 mg/l).

Table 3.6 Statistical summary of groundwater quality in 2024

Determinand	No. of Results	Unit	Min	Max	Mean	Median	Standard Deviation	5th Percentile	95th Percentile	# > LOD	% > LOD	UKDWS No. Exceeding	UKDWS % Exceeding	UKDWS Action Level	UKDWS Action Level Min
Field / lab parameters															
Conductivity- Electrical (Field)	32	µS/cm	311	1480	827	764	223	632	1229	32	100	0	0	2500	-
Conductivity- Electrical 20deg	32	µS/cm	275	1170	718	657	183	540	1006	32	100	0	0	2500	-
pH	32	pH units	6.9	7.6	7.27	7.25	0.171	7.06	7.6	32	100	0	0	9.5	6.5
pH (Field)	32	pH units	6.54	8.33	7.41	7.36	0.431	6.84	8.09	32	100	0	0	9.5	6.5
Major ions															
Alkalinity as CaCO3	32	mg/l	124	511	348	356	65.3	267	424	32	100	0	0	-	-
Calcium	32	mg/l	44.5	176	110	106	27.7	75.6	154	32	100	0	0	-	-
Chloride	32	mg/l	4	41.4	20.3	22.3	9.58	8.31	35.8	32	100	0	0	250	-
Magnesium	32	mg/l	5.46	71.4	31.8	30.7	12.7	18.9	54.9	32	100	0	0	-	-
Potassium	32	mg/l	0.92	13.5	5.06	3.75	3.93	0.997	11.4	32	100	0	0	-	-
Sodium	32	mg/l	5.5	39.7	17.3	20.5	9.17	5.82	28.9	32	100	0	0	200	-
Sulphate as SO4	32	mg/l	<4.4	198	58	28.6	64.4	n.d.	186	27	84.4	0	0	250	-
Minor ions															
Cadmium	7	µg/l	<0.07	0.1	n.d.	n.d.	n.d.	n.d.	0.082	1	14.3	0	0	5	-
Chromium	7	µg/l	<0.51	1.23	0.437	n.d.	0.364	n.d.	1.02	2	28.6	0	0	50	-
Copper	7	µg/l	<1.8	6.7	3.37	3.1	2.34	n.d.	6.52	5	71.4	0	0	2000	-
Iron	32	mg/l	<0.025	0.052	n.d.	n.d.	n.d.	n.d.	0.0367	3	9.38	0	0	0.2	-
Lead	7	ug/l	<0.3	<0.3	n.d.	n.d.	n.d.	n.d.	n.d.	0	0	0	0	10	-
Manganese	7	ug/l	3.5	47.3	12.4	6.8	15.5	3.77	36.1	7	100	0	0	50	-
Nickel	7	µg/l	<1	3.9	2.24	2.2	1.54	n.d.	3.87	5	71.4	0	0	20	-

Determinand	No. of Results	Unit	Min	Max	Mean	Median	Standard Deviation	5th Percentile	95th Percentile	# > LOD	% > LOD	UKDWS No. Exceeding	UKDWS % Exceeding	UKDWS Action Level	UKDWS Action Level Min
Zinc	7	µg/l	<6	10.7	n.d.	n.d.	n.d.	n.d.	8.39	1	14.3	0	0	-	-
Nitrogen species															
Ammoniacal Nitrogen as N	32	mg/l	<0.06	1.44	0.146	n.d.	0.3	n.d.	0.604	13	40.6	2	6.25	0.39	-
Nitrogen (total oxidised) as N	32	mg/l	<0.7	11.4	2.66	2.55	2.3	n.d.	5.22	25	78.1	0	0	-	-
Landfill parameters															
TOC (filtered)	32	mg/l	1.4	9.5	4.12	3.5	2.1	1.51	7.91	32	100	0	0	-	-
PAHs															
Napthalene	32	µg/l	<0.01	0.332	0.039	n.d.	0.0735	n.d.	0.148	7	21.9	0	0	-	-

Note: if significant number of results exceed action limit row is coloured as follows: 10 – 25% pale red, 25 – 50% darker red, >50% dark red. n.d. statistic not determinable. Mean statistics for non-detects are calculated at half the limit of detection.
If significant number of results exceed action limit where some are non-detects the '% Exceeding' column is coloured as follows: 10 - 25% pale blue, 25 - 50% darker blue, >50% dark blue. n.d. statistic not determinable.

There were 7 exceedances of the compliance limits during 2024, an increase from 2 in 2023, and more comparable to the 9 during the 2022 reporting period. The exceedances, at BH1, BH12 and BH13 are shown below in Table 3.7.

Table 3.7 Groundwater compliance limit exceedances 2024

Location	Date	Determinand	Compliance level	Result
BH1	23/01/2024	Naphthalene	0.05 (µg/l)	0.137(µg/l)
BH1	30/10/2024	Naphthalene	0.05 (µg/l)	0.113(µg/l)
BH1	18/07/2024	Ammoniacal Nitrogen	0.39 (mg/l)	1.44(mg/l)
BH1	30/10/2024	Ammoniacal Nitrogen	0.39 (mg/l)	1.06(mg/l)
BH12	30/10/2024	Naphthalene	0.05 (µg/l)	0.150(µg/l)
BH13	18/07/2024	Naphthalene	0.05 (µg/l)	0.122(µg/l)
BH13	30/10/2024	Naphthalene	0.05 (µg/l)	0.122(µg/l)

Schedule 6 submissions have been raised for these exceedances following quarterly reports to the regulator.

A statistical summary of groundwater quality compliance parameters is presented in Table 3.8.

Groundwater ammoniacal nitrogen concentrations for the last decade are presented in Figure 3.10 and Figure 3.11. This shows that in the last ten years, the majority of samples at down-gradient boreholes are at or below the detection limit. Ammoniacal nitrogen was detected in all downgradient boreholes during the reporting period. This includes in BH1, where it was above the compliance limit on two occasions. The other detections have remained below the compliance limit, and overall, with the exception of BH1, the concentrations of ammoniacal nitrogen are in keeping with long term historical data, and are lower than peaks seen in the period from 2020 to late 2022.

Potassium concentrations in groundwater during the last decade are presented in Figure 3.12 and Figure 3.13. Potassium concentrations have rising in BH13 since around 2017. Concentrations in BH1 were recorded at up to 25.9 mg/l in 2015 but since 2021 have generally been below 10 mg/l. CEMEX (2016) suggested that a plume containing potassium had originated from up-hydraulic-gradient of the Site and is currently passing through it. The increasing trend at BH13 led to a sample in October 2022 exceeding the compliance limit recording 23.3 mg/l, though no exceedances have been reported in 2023 and 2024. Historical potassium concentrations in BH9 (up-hydraulic-gradient) were higher (Figure 3.13) but stabilised around 15 mg/l from 2015 and by 2020 results were typically about or below 10 mg/l which has continued into 2024 (maximum 10.8 mg/l). This issue was discussed previously in CEMEX (2016). Most other potassium results show consistency with previous years data, with no observable long term trends.

In the HRA Review (Stantec, 2021b) it was recommended that the compliance limits for potassium were reviewed annually at BH1 and BH12. On the basis of the current data, it is recommended that the compliance limits at BH1 and BH12 are maintained at their current levels for 2024 and reviewed again in the next annual report.

Historical iron concentrations are plotted on Figure 3.14. Iron concentrations peaked in 2024 at 52 µg/l at BH1 (c.f. 125 µg/l in 2023). All other results are broadly consistent with previous years; there were no exceedances of the compliance limits.

Historical naphthalene concentrations are plotted on Figure 3.15. There were five naphthalene exceedances during the reporting period (see Table 3.7). This is an increase from the previous year when one exceedance was recorded.

In summary, there were seven compliance limit exceedances recorded in 2024, for naphthalene (BH1, BH12, and BH13) and ammoniacal nitrogen (BH1).

Table 3.8 Statistical summary for compliance levels

	Determinand	No. of Results	Unit	Min	Max	Mean	Median	Standard Deviation	5th Percentile	95th Percentile	# > LOD	% > LOD	Compliance Limits		
													No. Exceeding	% Exceeding	Action Level
Major ions															
Chloride (BH1)		3	mg/l	11.4	24.1	17.5	17	6.36	11.96	23.39	3	100	0	0	250
Chloride (BH12)		5	mg/l	22.1	41.1	29.4	28.5	7.17	22.8	38.8	5	100	0	0	250
Chloride (BH13)		6	mg/l	26.2	31.4	27.5	26.9	1.93	26.3	30.4	6	100	0	0	250
Chloride (BH14)		5	mg/l	4	10.4	8.38	9.5	2.55	4.88	10.2	5	100	0	0	250
Potassium (BH1)		3	mg/l	4.79	9.62	7.76	8.87	2.60	5.198	9.545	3	100	0	0	27
Potassium (BH12)		5	mg/l	9.66	13.5	11.2	10.8	1.59	9.73	13.2	5	100	0	0	24.7
Potassium (BH13)		6	mg/l	3.99	6.59	5.78	6.3	1	4.29	6.52	6	100	0	0	12
Potassium (BH14)		5	mg/l	0.92	1.2	1.04	1.01	0.108	0.932	1.18	5	100	0	0	12
Minor ions															
Iron (BH1)		3	µg/l	<25	52	33	34	19.52	n.d.	50.2	2	66.7	0	0	200
Iron (BH12)		5	µg/l	<25	<25	n.d.	n.d.	n.d.	n.d.	n.d.	0	0	0	0	200
Iron (BH13)		6	µg/l	<25	<25	n.d.	n.d.	n.d.	n.d.	n.d.	0	0	0	0	200
Iron (BH14)		5	µg/l	<25	<25	n.d.	n.d.	n.d.	n.d.	n.d.	0	0	0	0	200
Nitrogen species															
Ammoniacal Nitrogen as N (BH1)		3	mg/l	0.06	1.44	0.853	1.06	0.7128	0.16	1.402	3	100	2	66.67	0.39
Ammoniacal Nitrogen as N (BH12)		4	mg/l	<0.06	0.16	0.0625	n.d.	0.065	n.d.	0.1405	1	25	0	0	0.39
Ammoniacal Nitrogen as N (BH13)		6	mg/l	<0.06	0.23	0.122	0.11	0.0886	n.d.	0.228	4	66.7	0	0	0.39
Ammoniacal Nitrogen as N (BH14)		5	mg/l	<0.06	0.13	0.05	n.d.	0.0447	n.d.	0.11	1	20	0	0	0.39
PAHs															
Napthalene (BH1)		3	µg/l	<0.01	0.137	0.085	0.113	0.0703	n.d.	0.1346	2	66.7	2	66.67	0.05
Napthalene (BH12)		5	µg/l	<0.01	0.15	0.034	n.d.	0.0648	n.d.	0.121	1	20	1	20	0.05
Napthalene (BH13)		6	µg/l	<0.01	0.122	0.044	n.d.	0.0604	n.d.	0.122	2	33.3	2	33.33	0.05
Napthalene (BH14)		5	µg/l	<0.01	<0.01	n.d.	n.d.	n.d.	n.d.	n.d.	0	0	0	0	0.05

Figure 3.10 Historical ammoniacal nitrogen in groundwater at boreholes with compliance limits (down-gradient)

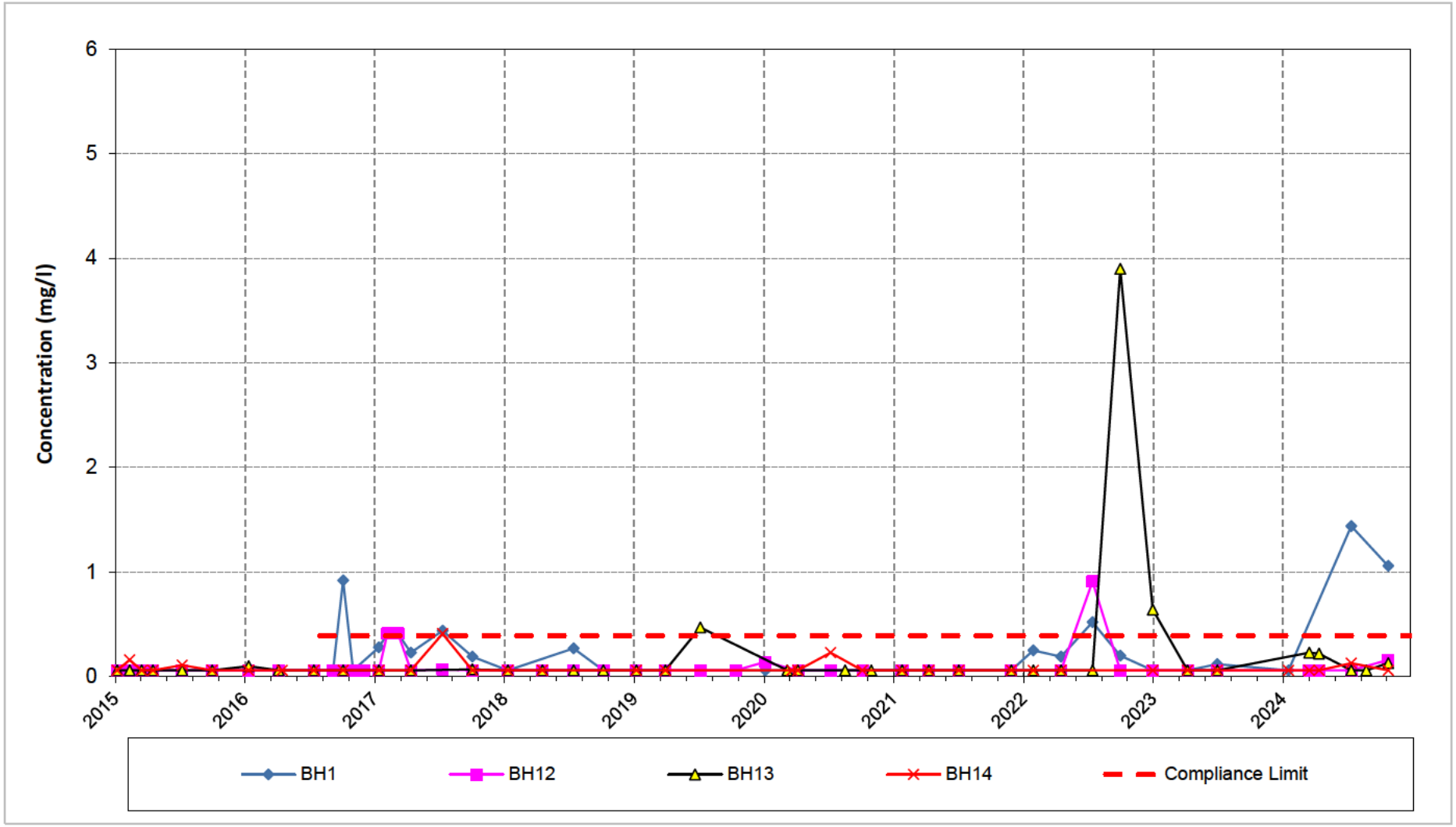


Figure 3.11 Historical ammoniacal nitrogen concentrations in groundwater at boreholes without compliance limits (up-gradient)

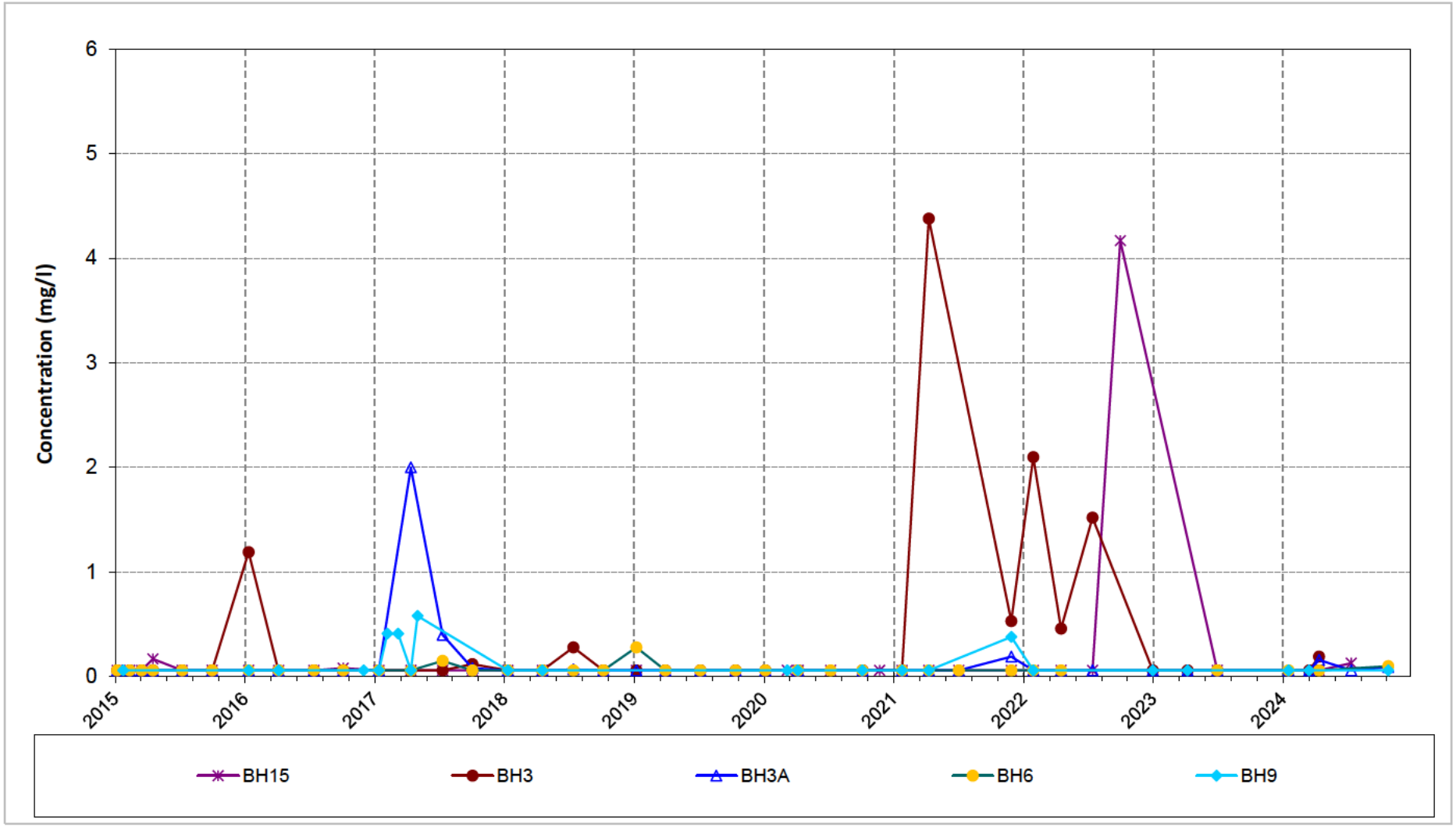


Figure 3.12 Historical potassium concentrations in groundwater at boreholes with compliance limits (down-gradient)

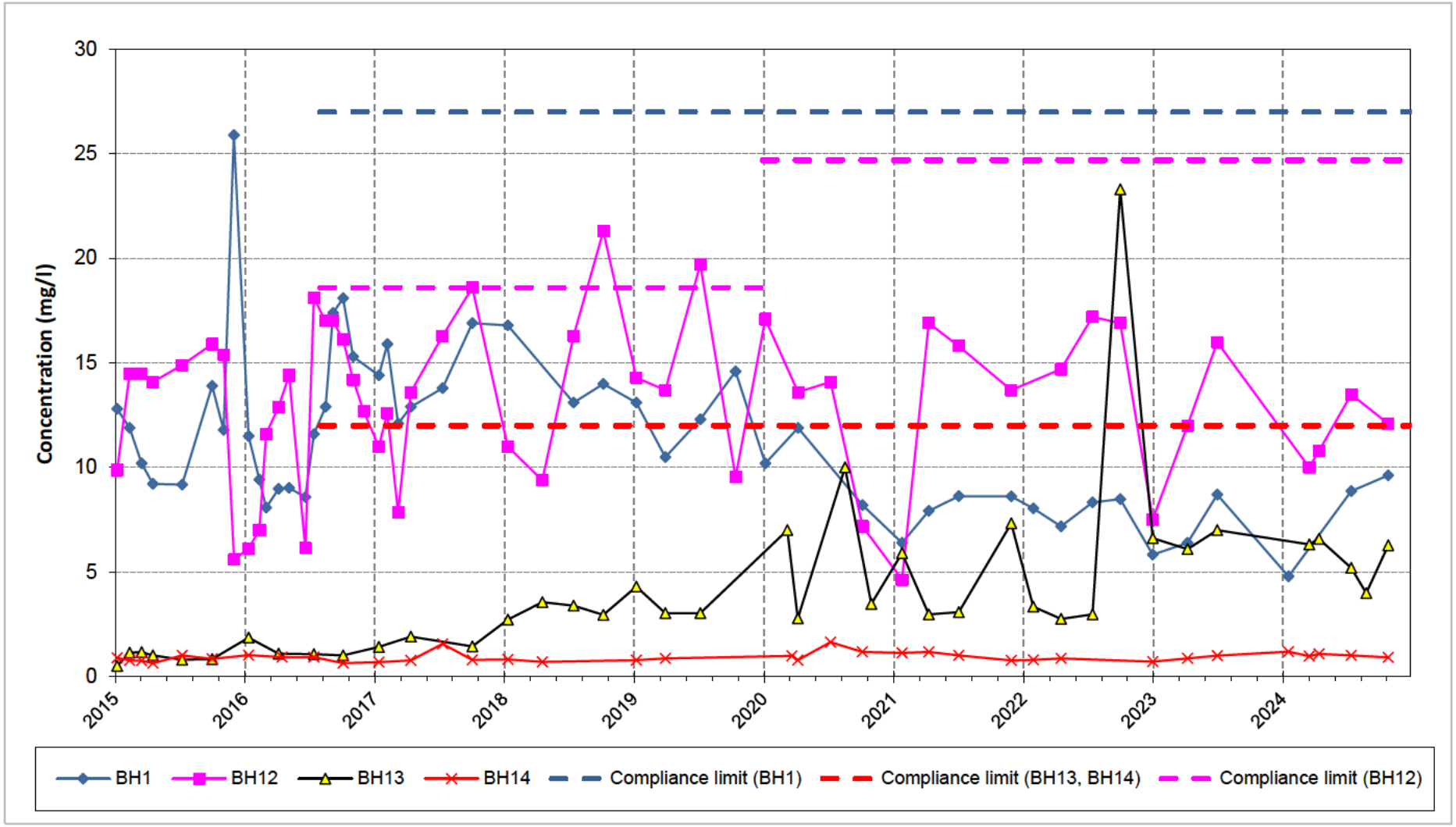


Figure 3.13 Historical potassium concentrations in groundwater at boreholes without compliance limits (up-gradient)

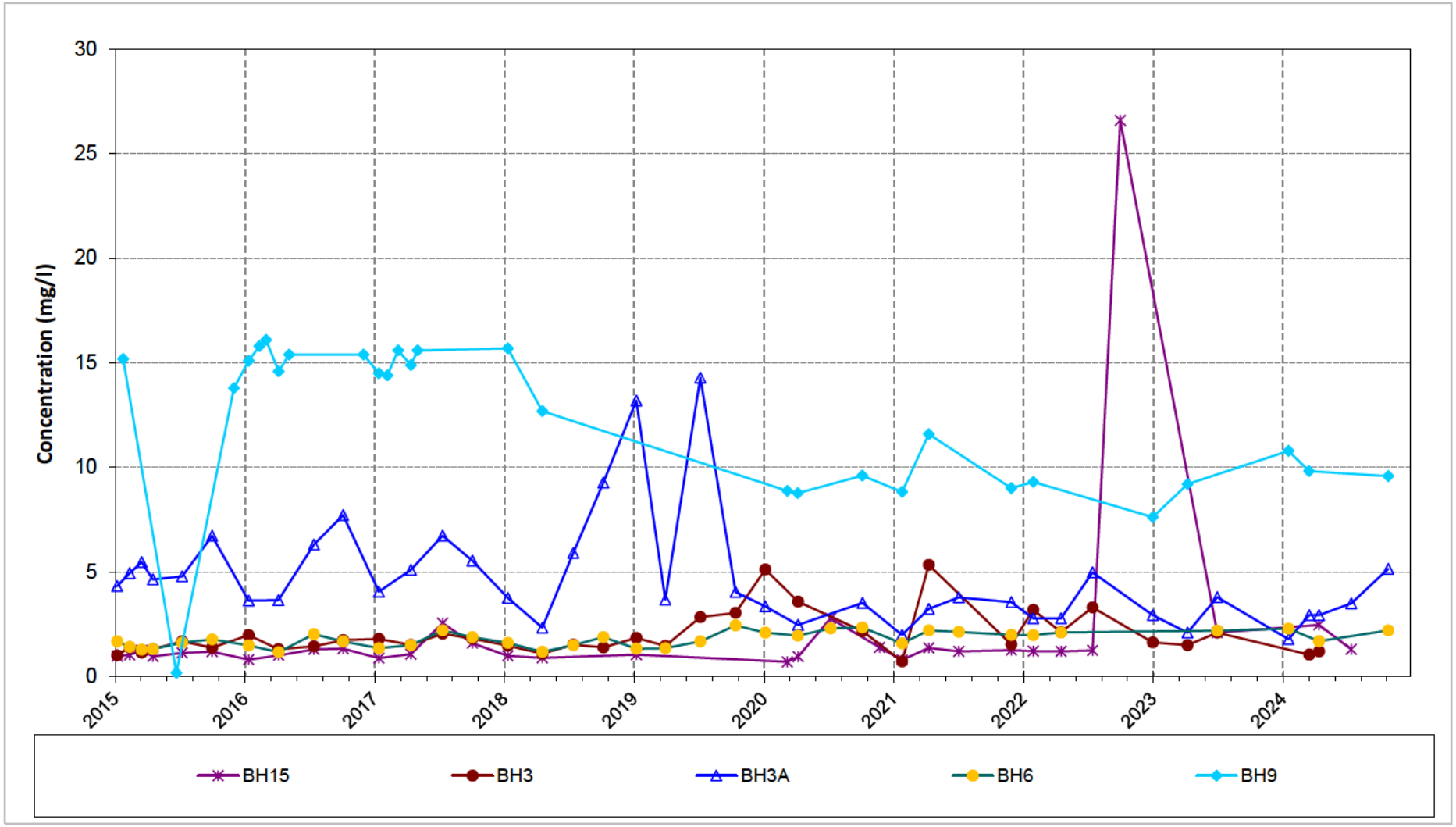


Figure 3.14 Historical iron concentrations at all groundwater locations

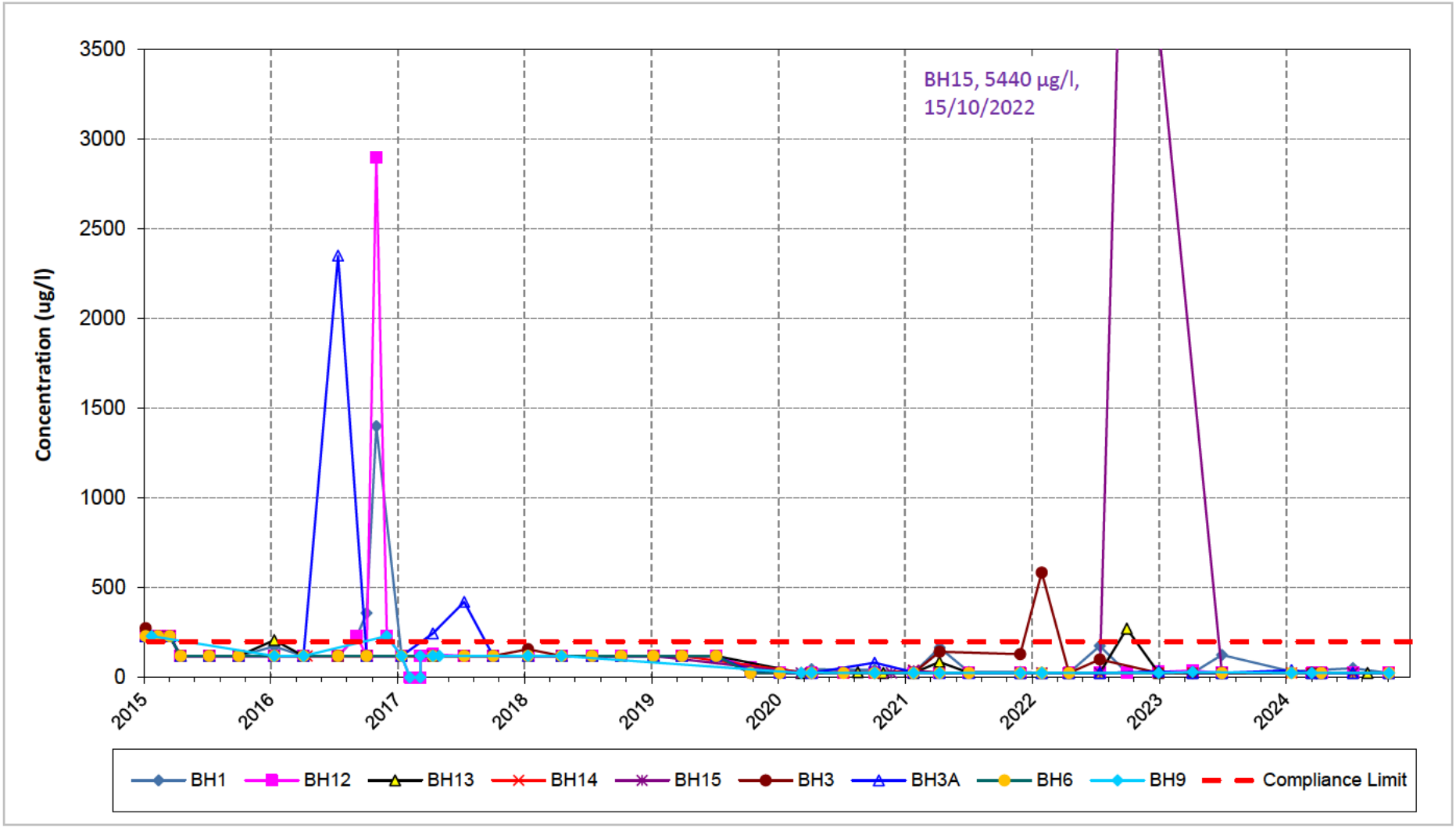
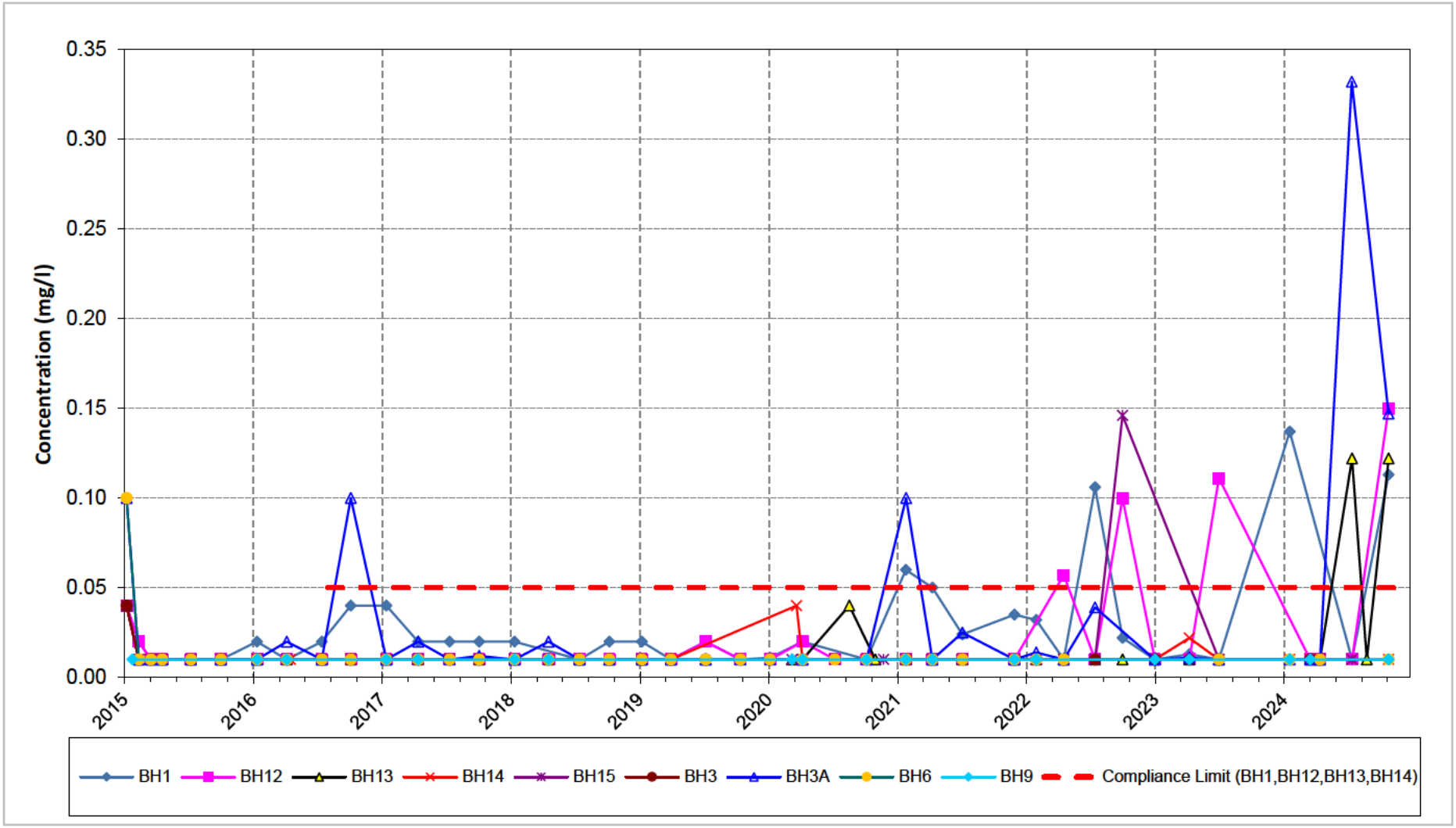


Figure 3.15 Historical naphthalene concentrations at all groundwater locations



4 Other Reporting Requirements

4.1 Production and Treatment

No surface water or groundwater has been taken off site or disposed of to any effluent treatment plant, thus no return is reported for 2024.

The CEMEX UK environmental management system sets targets to reduce energy, water and waste production on all sites, however as Whitehall is a closed inert site these figures are already zero so we do not have any improvement progress to report.

4.2 Contamination/Decontamination

There has been no contamination or decontamination of the site within the reporting period.

4.3 Topographical Survey

An up to date topographical survey is included in Appendix E. This shows contours in the most recent January 2025 survey compared to those in the previous November 2024 survey. No significant differential settlement is shown at the Site.

4.4 Compliance Testing and Other Details

No waste has been accepted in 2024 since filling ceased in October 2018.

5 Summary

This review covers the period between January and December 2024 and reviews the landfill gas, groundwater level and groundwater quality dataset at the Site.

The review has shown the following:

- Eleven in waste gas wells were installed in May and June 2021 with data first recorded in July 2021. Methane varies from between 0 %v/v to 56 %v/v in 2024 with carbon dioxide varying from 0 %v/v to 6.6 % v/v.
- Since December 2021, in-waste gas flow has varied from -5 l/h to 1.8 l/h, however, if the anomalous readings of -5 l/h and -1.5 l/h in 2024 are excluded, flow rates are generally in a narrow range between -0.2 l/h and 0.3 l/hr. Gas flow rates of this magnitude are not indicative of significant motive pressure driving gas off-site. Gas flow rates have been tending toward zero since 2021.
- Landfill gas has been monitored on an approximately monthly basis in seven perimeter gas boreholes in accordance with the requirements specified in the variation notice. Methane was detected 40 times out of 76 in 2024, mostly at relatively low concentrations of between 0.1 and 0.6 %v/v. There has been two exceedances of the 1 %v/v compliance limit for methane in perimeter boreholes, at GM8 and GM10 in May, when the methane reading reached 2.8 %v/v. Both locations have seen a decline to 0 %v/v following this.
- Carbon dioxide concentrations in perimeter boreholes did not exceed the 6 %v/v compliance limit during 2024. Carbon dioxide concentrations peaked at a maximum concentration of 4.0 %v/v recorded in GM11 in November.
- Gas flows in the perimeter boreholes are generally comparable to those in the in-waste boreholes and have shown a similar overall declining trend since 2021 however appear to be stabilising since June 2023. The highest gas flow readings in a perimeter borehole for 2024 were at GM8 and GM5 in May (0.5 l/hr). Again, flow readings of this magnitude are not indicative of significant motive pressure driving gas off-site.
- Groundwater levels are generally consistent with historic results, however BH6 recorded levels approximately 5 m higher than previous recent years. The groundwater levels at all monitoring locations show a degree of seasonality (higher during the winter and lower during the summer). BH12 records the least variation and BH6 the most.
- Groundwater quality is generally good, with two ammoniacal nitrogen detections concentrations above the UK DWS.
- There were 7 exceedances of the compliance limits for groundwater recorded in 2024. This is an increase from 2 in 2023, but down from 9 in 2022. Exceedances were recorded at BH1 (ammoniacal nitrogen and naphthalene), and also at BH12 and BH13 for naphthalene.

6 References

Cemex, 2016. Whitehall Landfill: Annual Environmental Monitoring Report for 2016.

Cemex, 2020. Whitehall Landfill: Annual Environmental Monitoring Report for 2019, Revision 1, June 2020.

Cemex, 2023. Whitehall Landfill: Annual Environmental Monitoring Report for 2022, Revision 1, June 2023.

Cemex, 2024. Whitehall Landfill: Annual Environmental Monitoring Report for 2023, Revision 1, June 2024.

ESI/Arup, 2005. Whitehall Landfill Conceptual Model, ESID Report.

ESI, 2016. Whitehall Landfill: Six-year Hydrogeological Risk Assessment Review. Report reference: 60080ADR1.

Lafferty, F. 1998. Landfill Gas Monitoring and Risk Assessment at Whitehall Quarry. M.Sc. Thesis, Applied Environmental Geology, unpublished.

Natural Resources Wales [NRW], 2016. Letter from Gwyn Jones to Gillian Ratcliffe, Re: Whitehall Quarry Hydrogeological Risk Assessment, dated 10 June 2016.

Stantec, 2021a. Whitehall Landfill: Closure Plan. Report No. 330201418R5Rev1. September 2021.

Stantec, 2021b. Whitehall Landfill: Six-year hydrogeological risk assessment review. Report No. 330201418R4D1. September 2021.

Wildgust, N.A., 1998. Hydrogeological Risk Assessment, Whitehall Quarry Landfill, Wenvoe, South Wales. M.Sc. Thesis, Applied Environmental Geology, Dept. of Earth Sciences, University of Cardiff (Unpublished).

Appendix A
In-waste Gas Monitoring Data

Appendix A Table 1 In waste gas monitoring data for 2024

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground conditions
		mb	%	%	mb	l/h	%	
GF01	23/01/2024	1007	38.1	1.1	-3.86	0	5.1	Damp
GF01	21/03/2024	Inaccessible						
GF01	18/04/2024	Flow Fail						
GF01	30/05/2024	1005	0.2	0.1	0.21	-0.2	21	Damp
GF01	19/06/2024	Flow Fail						
GF01	18/07/2024	1010	6.8	0.8	0.12	0.3	16.3	Dry
GF01	29/08/2024	1010	52.2	2.4	0.25	0.1	3.7	Damp
GF01	09/09/2024	1005	42.7	2	0.11	0.1	8	Damp
GF01	30/10/2024	1019	2.7	1.5	-6.64	-1.5	17.3	Damp
GF01	19/11/2024	991	15.4	2.5	0.26	0	7.6	Damp
GF01	10/12/2024	1026	23.4	1.3	-11.22	-5	0.9	Damp
GF02	23/01/2024	1006	1.1	2.6	0.26	0.1	8	Damp
GF02	13/02/2024	1001	3.3	4.2	0.4	0.1	8.7	Damp
GF02	21/03/2024	1018	0.2	0.1	0.4	0.1	21.4	Damp
GF02	18/04/2024	1015	0	0.1	-0.44	-0.1	20.7	Damp
GF02	30/05/2024	1005	0.3	0.1	0.19	0.3	21	Damp
GF02	19/06/2024	1013	0.4	0.1	0.28	0.2	20.8	Dry
GF02	18/07/2024	1011	27.5	3.1	0.12	0.1	0.8	Dry
GF02	29/08/2024	1011	51.4	1.4	0.26	0.2	1.1	Damp
GF02	09/09/2024	1006	4.8	0.7	0.09	0.2	16.7	Damp
GF02	30/10/2024	1018	0	0.1	-0.12	0	20.9	Damp
GF02	19/11/2024	991	46.7	1.4	0.24	0.1	1.4	Damp
GF02	10/12/2024	1025	33.6	2.4	0.36	0	1.1	Damp
GF03	23/01/2024	1002	0	2	0.44	0	16.4	Damp
GF03	13/02/2024	1000	0.7	1	0.4	0.1	15.7	Damp

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground conditions
		mb	%	%	mb	l/h	%	
GF03	21/03/2024	1017	0.2	0.1	0.35	0.2	21.7	Damp
GF03	18/04/2024	1017	0.1	0.3	-0.56	-0.1	19.6	Dry
GF03	30/05/2024	1004	0.3	0.1	0.21	0.3	21	Damp
GF03	19/06/2024	1011	0.4	0.2	0.07	0.3	20.7	Dry
GF03	18/07/2024	1011	2.1	0.9	0.14	0	19.4	Dry
GF03	29/08/2024	1009	13	5.4	0.18	0.1	8.7	Damp
GF03	09/09/2024	1004	7.7	0.9	0.05	0	18	Dry
GF03	30/10/2024	1017	0	0.1	-0.12	0	21	Damp
GF03	19/11/2024	989	41.6	3.6	0.27	0.1	7.3	Damp
GF03	10/12/2024	1024	0.8	1.3	0.21	0	14.7	Damp
GF04	23/01/2024	1006	6	2.5	0.58	0	0.2	Damp
GF04	13/02/2024	1000	6.3	2.6	0.37	0.2	0.2	Damp
GF04	21/03/2024	1017	8.4	1.7	0.33	0.2	0.2	Damp
GF04	18/04/2024	1014	6.2	1.8	-0.44	-0.1	0.2	Dry
GF04	30/05/2024	1003	0.3	0.1	0.25	0.3	20.9	Damp
GF04	19/06/2024	1011	6.1	2.4	0.21	0.2	2.1	Dry
GF04	18/07/2024	1009	6.1	3.1	0.19	0.2	0.6	Dry
GF04	29/08/2024	1008	7	2.6	0.26	0.1	0.9	Damp
GF04	09/09/2024	1003	4.1	1.6	0.14	-0.1	15.5	Damp
GF04	30/10/2024	1017	4.9	2.5	-0.05	0	1.2	Damp
GF04	19/11/2024	988	13.7	2.3	0.5	0	0.7	Damp
GF04	10/12/2024	1023	5.9	2.5	0.44	0	0.3	Damp
GF05	23/01/2024	1005	3.8	3.5	0.49	0.1	0.3	Damp
GF05	13/02/2024	999	22.4	1.6	0.56	0.2	0.2	Damp
GF05	21/03/2024	1016	23.2	1.7	0.28	0.2	0.2	Damp
GF05	18/04/2024	1014	15.4	2.3	-0.4	-0.1	0.2	Dry
GF05	30/05/2024	1002	0.4	0.1	0.23	0.3	20.7	Damp
GF05	19/06/2024	1010	14.6	4.8	0.26	0.2	0.8	Dry

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground conditions
		mb	%	%	mb	l/h	%	
GF05	18/07/2024	1010	6.2	3	0.7	0.1	7.6	Dry
GF05	29/08/2024	1007	14.1	5.8	0.16	0.1	13.9	Damp
GF05	09/09/2024	1003	0.9	5.7	0.26	0.1	12.1	Damp
GF05	30/10/2024	1017	10.5	1.3	-0.14	0.1	10	Damp
GF05	19/11/2024	988	24.2	1.9	0.67	0	0.2	Damp
GF05	10/12/2024	1023	18.9	2.2	0.56	0	0.2	Damp
GF06	23/01/2024	1004	47.1	1.3	0.42	0.2	0.2	Damp
GF06	13/02/2024	999	50.1	1.1	0.49	0.2	0.2	Damp
GF06	21/03/2024	1016	51.7	0.9	0.21	0.2	0.4	Damp
GF06	18/04/2024	1014	45.3	1	-0.33	-0.1	1.9	Dry
GF06	30/05/2024	1003	56	0.8	0.05	0.5	11	Damp
GF06	19/06/2024	1010	24	1.3	0.33	0.1	9.8	Dry
GF06	18/07/2024	1009	3.4	2.1	0.11	0.2	0.8	Dry
GF06	29/08/2024	1007	22.5	1	0.26	0.1	0.6	Damp
GF06	09/09/2024	1003	20.4	1	0.19	0.1	0.9	Damp
GF06	30/10/2024	1016	22.2	3.3	-0.09	0	6.6	Damp
GF06	19/11/2024	988	41.4	1.6	0.87	0	0.4	Damp
GF06	10/12/2024	1023	40	2.9	0.67	0	0.4	Damp
GF07	23/01/2024	1004	1.6	2.8	0.23	0.1	0.3	Damp
GF07	13/02/2024	999	2.6	2.3	0.56	0.1	0.3	Damp
GF07	21/03/2024	1015	2.3	2.2	0.33	0.1	0.5	Damp
GF07	18/04/2024	1014	1.3	2	-0.4	-0.1	0.9	Dry
GF07	30/05/2024	1002	0.6	0.3	0.09	0.2	18.5	Damp
GF07	19/06/2024	1010	4.2	2.2	0.21	0.1	0.7	Dry
GF07	18/07/2024	1009	5.1	1.9	0.05	0.2	1.4	Dry
GF07	29/08/2024	1007	5.5	1.8	0.18	0.1	2.1	Damp
GF07	09/09/2024	1003	5	2	0.12	0.1	4.3	Damp
GF07	30/10/2024	1014	1.6	1.3	0	0	11.2	Damp

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground conditions
		mb	%	%	mb	l/h	%	
GF07	19/11/2024	988	3.9	2.3	0.7	0	1	Damp
GF07	10/12/2024	1023	2.3	2.6	0.56	0	0.4	Damp
GF08	23/01/2024	1004	10.7	3	0.19	0.1	0.2	Damp
GF08	13/02/2024	1000	3.2	2.7	0.32	0.3	0.3	Damp
GF08	21/03/2024	1016	2.4	2.9	0.23	0.2	0.3	Damp
GF08	18/04/2024	1014	0.7	3	-0.3	0	0.3	Dry
GF08	30/05/2024	1001	1.8	0.6	0.37	0.1	15.9	Damp
GF08	19/06/2024	1009	2.7	2.9	0.39	0.1	0.7	Dry
GF08	18/07/2024	1009	4.1	2.5	-0.16	0.1	1.4	Dry
GF08	29/08/2024	1007	4.9	2.4	0.16	0.1	1.8	Damp
GF08	09/09/2024	1003	1	0.4	0.02	0.1	17.6	Damp
GF08	30/10/2024	1017	4	2.6	-0.04	0	1.6	Damp
GF08	19/11/2024	988	14.9	2.8	0.56	0.1	0.9	Damp
GF08	10/12/2024	1023	1.8	3.1	0.6	0	0.4	Damp
GF09	23/01/2024	1005	5.4	2.2	0.4	0	0.3	Damp
GF09	13/02/2024	1000	5.3	2.7	0.25	0.2	0.3	Damp
GF09	21/03/2024	1015	4.7	2.9	0.39	0	0.2	Damp
GF09	18/04/2024	1014	4	2.6	-0.19	0	0.3	Dry
GF09	30/05/2024	1001	0.4	0.1	0.33	0.1	20.9	Damp
GF09	19/06/2024	1010	7.4	2.6	0.4	0	11.1	Dry
GF09	18/07/2024	1009	9.2	2.5	0.14	0.1	0.6	Dry
GF09	29/08/2024	1007	8	2.5	0.26	0.1	0.6	Damp
GF09	09/09/2024	1004	1.1	0.3	0.12	0	18.5	Damp
GF09	30/10/2024	1016	2.8	2	-0.05	0	9.2	Damp
GF09	19/11/2024	988	8.7	2.8	0.65	0	0.8	Damp
GF09	10/12/2024	1023	3.3	4	0.53	0	0.3	Damp
GF10	23/01/2024	1005	5.9	1.8	0.42	0	0.3	Damp
GF10	13/02/2024	1000	6.9	1.5	0.35	0.2	0.5	Damp

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground conditions
		mb	%	%	mb	l/h	%	
GF10	21/03/2024	1015	5.7	1.7	0.48	0.2	0.2	Damp
GF10	18/04/2024	1015	4.5	1.5	-0.76	-0.1	0.4	Dry
GF10	30/05/2024	1001	1.9	0.6	0.28	0.2	15.8	Damp
GF10	19/06/2024	1010	3.8	2.1	0.37	0.1	0.5	Dry
GF10	18/07/2024	1009	3.4	2.1	0.02	0.1	4.1	Dry
GF10	29/08/2024	1007	3.1	2.7	0.18	0.1	0.6	Damp
GF10	09/09/2024	1003	4	2.1	0.11	0.1	0.5	Damp
GF10	30/10/2024	1016	1.2	2.5	-0.05	0.1	6.3	Damp
GF10	19/11/2024	988	6.2	1.8	1.06	0.1	1.1	Damp
GF10	10/12/2024	1023	5.2	1.9	0.94	0	0.4	Damp
GF11	23/01/2024	1005	1	6	0.56	0	0.5	
GF11	13/02/2024	1000	1.9	5.9	0.3	0.1	0.5	Damp
GF11	21/03/2024	1015	8.1	3.1	0.33	0.1	0.3	Damp
GF11	18/04/2024	1015	7.2	3	-0.84	-0.2	0.4	Dry
GF11	30/05/2024	1001	0.6	0.5	0.3	0.1	19	Damp
GF11	19/06/2024	1010	1	6.6	-0.02	0.2	1.4	Dry
GF11	18/07/2024	1008	0.8	6.5	0.21	0.2	1.2	Dry
GF11	29/08/2024	1007	1.2	6.5	0.21	0.1	2.2	Damp
GF11	09/09/2024	1003	0.7	5.7	0.05	0	5.3	Damp
GF11	30/10/2024	1015	2.8	2.7	-0.07	0.1	9.4	Damp
GF11	19/11/2024	988	1.1	6.3	0.75	0.1	2.1	Damp
GF11	10/12/2024	1023	4.2	5.3	0.7	0	0.8	Damp

Appendix B
Perimeter Gas Monitoring Data

Appendix B Table 1 Gas monitoring data for 2024

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground Condition
		mb	%	%	mb	l/h	%	
GM10	23/01/2024	1003	0	2.7	0.25	0	18.3	Damp
GM10	13/02/2024	998	0	0.5	0.4	0	21.1	Damp
GM10	21/03/2024	1016	0.2	0.6	0.18	0.1	20.2	Dry
GM10	18/04/2024	1015	0	0.7	-0.6	-0.2	19.3	Dry
GM10	30/05/2024	1004	2.8	0.1	0.21	0.4	20.2	Dry
GM10	19/06/2024	1011	0.5	0.1	0.3	0.2	20.9	Dry
GM10	18/07/2024	1010	0.5	0.1	0.21	0.1	20.8	Dry
GM10	29/08/2024	1008	0.6	0.4	0.25	0.1	20.7	Dry
GM10	09/09/2024	1004	0.5	0.1	0.14	0	20.7	Dry
GM10	30/10/2024	1015	0	1.9	-0.11	0.1	18.1	Damp
GM10	19/11/2024	989	0	3.9	0.32		16.3	Damp
GM10	10/12/2024	1023	0	1.2	0.26	0	19.4	Damp
GM11	23/01/2024	1003	0	1.1	0.49	0	20.5	Damp
GM11	13/02/2024	998	0	1.6	0.72	0	17.8	Damp
GM11	21/03/2024	1016	0.1	2	1.27	0.1	18.4	Damp
GM11	18/04/2024	1015	0	2.6	-0.79	-0.1	18	Dry
GM11	30/05/2024	1004	0.4	1	-0.12	0.3	20.2	Damp
GM11	19/06/2024	1011	0.4	1.6	0.26	0.2	19.9	Dry
GM11	18/07/2024	1010	0.6	0.6	0.02	0.2	20.4	Dry
GM11	29/08/2024	1009	0.6	0.4	0.25	0	20.7	Damp
GM11	09/09/2024	1004	0.5	1.2	0.39	0.1	19.9	Damp
GM11	30/10/2024	1016	0	1.1	-0.16	0	19.7	Damp
GM11	19/11/2024	991	0	4	0.68	0	18.5	Damp
GM11	10/12/2024	1028	0	3.4	1.16	0	16.2	Damp
GM2	23/01/2024	1005	0	0.7	-0.02	0	20.4	Damp
GM2	13/02/2024	Location Inaccessible						
GM2	21/03/2024	1020	0.2	1.6	1.71	0	19.8	Damp
GM2	18/04/2024	1016	0.1	1	-0.23	0	19.8	Damp
GM2	30/05/2024	1008	0.4	0.1	0.07	0.3	21.2	Damp
GM2	19/06/2024	1016	0.5	1.3	0.23	0.2	19.5	Dry
GM2	18/07/2024	1014	0.6	0.6	0.23	0.1	20.4	Dry
GM2	29/08/2024	1013	0.6	0.1	0.18	0.2	21.1	Damp
GM2	09/09/2024	1008	0.5	0.1	-2.34	0.2	20.7	Damp
GM2	30/10/2024	1020	0	0.1	-0.02	0	21.4	Damp
GM2	19/11/2024	993	0	1	0.07	0	20.4	Damp
GM2	10/12/2024	1026	0	1.3	0.12	0	20.5	Damp
GM4	23/01/2024							
GM4	13/02/2024	1001	0	0.1	0.33	0.1	22.1	Damp
GM4	21/03/2024	Not airtight						
GM4	18/04/2024	1016		0.4	-1.09	-0.2	19.1	Dry
GM4	30/05/2024	1006	0.3	0.1	0.07	0.3	21.1	Damp
GM4	19/06/2024	1012	0.5	1.35	0.3	0.3	19.6	Dry
GM4	18/07/2024	1009	0.5	0.3	0.37	0	20.5	Dry
GM4	29/08/2024	1010	0.5	0.7	0.19	0.2	20.4	Damp
GM4	09/09/2024	1006	0.4	0.4	0.11	0.2	20.5	Damp
GM4	30/10/2024	1019	0	0.5	-0.14	0	20.6	Damp
GM4	19/11/2024	991	0	0.8	-0.09	0	20.9	Damp

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground Condition
		mb	%	%	mb	l/h	%	
GM4	10/12/2024	1026	0	1.8	-1.52	-0.1	19.1	Damp
GM5	13/02/2024	998	0	1.1	0.48	0	20.1	Damp
GM5	23/01/2024	Missing Data – monitoring point missed by technician						
GM5	21/03/2024	1014	0	1.2	0.07	0	18	Damp
GM5	18/04/2024	1014	0	1.6	-0.7	-0.1	16.8	Dry
GM5	30/05/2024	1003	0.4	0.6	0.04	0.5	19.9	Damp
GM5	23/01/2024	Missing Data – monitoring point missed by technician						
GM5	18/07/2024	1009	0.6	2.1	0.32	0.2	18.4	Dry
GM5	29/08/2024	1008	0.6	2.7	0.12	0.1	18.7	Damp
GM5	09/09/2024	1004	0.4	1.7	0.07	0.1	19	Damp
GM5	30/10/2024		0	1.3	0.18	0	19.5	Damp
GM5	19/11/2024	988	0	3.1	0.32	0	15.4	Damp
GM5	10/12/2024	1023	0	1.6	0.27	0	18.6	Damp
GM7	23/01/2024	Location Inaccessible						
GM7	13/02/2024	999	0.1	0.3	0.46	0.1	21.6	Damp
GM7	21/03/2024	1015	0.2	0.3	0.32	0.3	21.3	Damp
GM7	18/04/2024		0	0.2	-0.93	-0.2	20.9	Dry
GM7	30/05/2024	1002	0.3	0.1	0.21	0.1	20.5	Damp
GM7	19/06/2024	1010	0.4	0.3	0.37	0.1	20.5	Dry
GM7	18/07/2024	1008	0.5	0.5	0.18	0.3	20.1	Dry
GM7	29/08/2024	Location Inaccessible						
GM7	09/09/2024	Location Inaccessible						
GM7	30/10/2024	1015	0	0.4	0	0	20.4	Damp
GM7	19/11/2024	987	0	1.2	0.15	0	20.7	Damp
GM7	10/12/2024		0	0.5	0.46	0	20.5	Damp
GM8	23/01/2024	1007	0	0.6	0.42	0.1	21.4	Damp
GM8	13/02/2024	997	0	0.7	0.69	-0.1	21.1	Damp
GM8	21/03/2024	1016	0.2	0.8	0.42	0.1	20.5	Damp
GM8	18/04/2024	1013	0	1.4	-0.28		18.6	Dry
GM8	30/05/2024	1004	2.8	0.3	0.16	0.5	21.3	Damp
GM8	19/06/2024	1012	0.5	0.7	1.37	0.2	20.6	Dry
GM8	18/07/2024	1010	0.5	0.7	0.14	0.1	20	Dry
GM8	29/08/2024	1013	0.6	0.1	0.23	0.1	21.1	Damp
GM8	09/09/2024	1004	0.5	0.1	0.23	-0.1	20.6	Damp
GM8	30/10/2024	1016	0	1.1	-0.02	0.1	19.6	Damp
GM8	19/11/2024	989	0	1.8	0.21	0	20	Damp
GM8	10/12/2024	1023	0	0.7	0.17	0	20.6	Damp

Appendix C
Groundwater Level Monitoring Data

Appendix C Table 1 Groundwater level data (mAOD) for 2024

Date	BH1	BH12	BH13	BH14	BH15	BH3	BH3A	BH6	BH9
23/01/2024	72.73	65.91	78.68	77.43	71.33	72.26	73.35	86.64	78.57
13/02/2024	72.14	66.36	83.36	83.61	80.15	73.44	74.91	92.29	86.04
21/03/2024	72.01	66.01	83.66	82.61	77.32	73.03	74.66	94.21	83.66
18/04/2024	71.97	65.29	80.45	79.28	71.87	71.74	73.11	89.35	80.64
30/05/2024	70.05	64.25	IA	74.99	70.49	68.85	69.93	86.25	75.11
19/06/2024	68.23	63.37	IA	70.92	70.55	67.66	66.97	85.50	75.17
18/07/2024	66.96	62.97	76.32	71.07	69.02	Dry	65.60	84.03	Dry
29/08/2024	66.85	63.56	76.12	71.65	72.07	67.79	67.62	85.78	75.58
09/09/2024	66.73	64.86	76.09	71.59	71.83	Dry	67.59	85.78	75.18
30/10/2024	71.96	65.52	77.72	79.50	72.62	72.05	72.89	88.57	80.97
19/11/2024	69.26	66.30	77.10	77.01	73.38	72.15	73.44	87.72	77.85
10/12/2024	72.05	66.19	81.97	83.61	79.52	73.53	74.90	94.78	86.59

Note: IA = Borehole Inaccessible

Appendix D
Groundwater Quality Monitoring Data

Appendix D Table 1 Quarterly groundwater quality data for 2024

Location	Date	Alkalinity as CaCO3	Ammoniacal Nitrogen as N	Calcium	Chloride	Conductivity-Electrical (Field)	Conductivity-Electrical 20deg	Iron	Magnesium	Naphthalene	pH	pH (Field)	Potassium	Sodium	Sulphate as SO4	TOC (filtered)
		mg/l	mg/l	mg/l	mg/l	µS/cm	µS/cm	µg/l	mg/l	µg/l	pH units	pH units	mg/l	mg/l	mg/l	mg/l
BH1	23/01/2024	124	0.06	44.5	11.4	311	275	34	5.46	0.137	7.5	8.33	4.79	6.5	8.7	7.0
BH1	18/04/2024	Borehole not purged before sampling														
BH1	18/07/2024	299	1.44	98.9	17.0	702	610	52	17.4	<0.01	7.1	7.19	8.87	13.0	42.2	5.0
BH1	30/10/2024	352	1.06	117	24.1	1480	782	<25	25.9	0.113	7.0	7.3	9.62	21.3	81.4	6.5
BH12	23/01/2024	Borehole is blocked														
BH12	21/03/2024	384	<0.06	142	28.5	970	885	<25	30.6	<0.01	7.2	6.78	10.0	24.0	118	5.3
BH12	18/04/2024	372	<0.06	151	29.8	1027	871	<25	32.5	<0.01	7.5	6.91	10.8	26.1	115	4.4
BH12	18/07/2024	375	<0.06	149	41.1	1078	994	<25	33.0	<0.01	7.3	7.38	13.5	39.7	163	9.5
BH12	30/10/2024	443	0.16	158	25.6	1178	971	<25	36.1	0.150	7.2	7.37	12.1	29.4	127	8.4
BH13	23/01/2024	Insufficient liquid to obtain a sample														
BH13	21/03/2024	383	0.23	143	26.9	1069	1020	<25	54.4	<0.01	7.1	7.7	6.32	21.6	198	3.2
BH13	18/04/2024	395	0.22	150	26.6	875	956	<25	55.5	<0.01	7.3	6.88	6.6	22.5	181	3
BH13	18/07/2024	405	<0.06	119	27.3	1006	934	<25	45.5	0.122	7.1	7.17	5.20	21.7	136	3.4
BH13	30/10/2024	511	0.13	176	26.2	1292	1170	<25	71.4	0.122	6.9	7.31	6.28	26.9	193	5.6
BH14	21/03/2024	369	<0.06	102	8.4	684	648	<25	34.8	<0.01	7.2	7.84	0.98	5.5	<4.4	1.4
BH14	18/04/2024	362	<0.06	103	10.4	739	621	<25	33.7	<0.01	7.6	6.96	1.1	6	<4.4	1.7
BH14	18/07/2024	398	0.13	105	9.6	766	679	<25	32.6	<0.01	7.3	7.34	1.01	6.4	5.6	1.7
BH14	30/10/2024	363	<0.06	95.6	4.0	669	563	<25	30.8	<0.01	7.6	7.4	0.92	5.6	<4.4	3.3
BH15	23/01/2024	Monitoring point missed by technician														
BH15	21/03/2024	Borehole is blocked														
BH15	18/04/2024	303	<0.06	106	22.7	768	655	<25	26.3	<0.01	7.5	7.03	2.47	16.8	41.9	2.7
BH15	18/07/2024	352	0.13	95.8	15.8	838	670	<25	31.6	<0.01	7.2	7.15	1.30	12.1	21.9	1.4

Location	Date	Alkalinity as CaCO3	Ammoniacal Nitrogen as N	Calcium	Chloride	Conductivity-Electrical (Field)	Conductivity-Electrical 20deg	Iron	Magnesium	Naphthalene	pH	pH (Field)	Potassium	Sodium	Sulphate as SO4	TOC (filtered)
		mg/l	mg/l	mg/l	mg/l	µS/cm	µS/cm	µg/l	mg/l	µg/l	pH units	pH units	mg/l	mg/l	mg/l	mg/l
BH15	30/10/2024	Discharge - None - no discharge occurring														
BH3	23/01/2024	Borehole is blocked														
BH3	21/03/2024	313	<0.06	80.2	21.8	649	583	<25	25.2	<0.01	7.3	7.68	1.05	22.1	10.2	2.5
BH3	18/04/2024	288	0.19	77.1	25.1	658	536	<25	24	<0.01	7.6	7.13	1.21	22.4	8.5	4.2
BH3	18/07/2024	Insufficient liquid to obtain a sample														
BH3	30/10/2024	Instrument Failure														
BH3A	21/03/2024	324	<0.06	95.3	26.9	862	681	<25	27.0	<0.01	7.3	7.94	2.94	24.6	56.0	2.9
BH3A	18/04/2024	310	0.16	93.9	24.2	719	613	<25	27	<0.01	7.3	7.05	2.94	24.3	35.3	5.4
BH3A	18/07/2024	263	<0.06	89.1	23.6	761	667	<25	23.5	0.332	7.2	7.3	3.50	20.0	94.2	5.2
BH3A	30/10/2024	360	0.09	120	18.0	882	797	<25	31.6	0.147	7.2	7.61	5.15	20.9	96.4	7.5
BH6	23/01/2024	333	<0.06	96.0	20.2	659	626	<25	35.6	<0.01	7.3	8	2.30	9.9	14.4	1.7
BH6	21/03/2024	Borehole is blocked														
BH6	18/04/2024	285	<0.06	93.5	11.7	714	543	<25	22.2	<0.01	7.3	7.19	1.7	10.4	5.2	1.6
BH6	18/07/2024	Discharge - None - no discharge occurring														
BH6	30/10/2024	332	0.10	95.2	11.3	709	588	<25	30.4	<0.01	7.2	7.87	2.21	10.3	8.3	5.0
BH9	21/03/2024	349	<0.06	110	8.8	723	620	<25	20.2	<0.01	7.2	7.41	9.83	6.6	<4.4	2.7
BH9	18/04/2024	Borehole/surface water location dry														
BH9	18/07/2024	Borehole/surface water location dry														
BH9	30/10/2024	372	<0.06	114	8.2	767	658	<25	21.8	<0.01	7.1	7.4	9.59	6.7	5.2	3.3

Appendix D Table 2 Annual groundwater quality data 2024

Location	Date	Cadmium µg/l	Chromium µg/l	Copper µg/l	Lead mg/l	Manganese mg/l	Nickel µg/l	Zinc µg/l
BH1	18/04/2024	No Data – borehole not properly purged prior to sampling						
BH12	18/04/2024	0.10	0.53	6.7	<0.0003	0.0044	3.9	10.7
BH13	18/04/2024	<0.07	<0.51	2.0	<0.0003	0.0473	3.6	<6
BH14	18/04/2024	<0.07	1.23	<1.8	<0.0003	0.0035	<1	<6
BH15	18/04/2024	<0.07	<0.51	3.1	<0.0003	0.01000	3.8	<6
BH3	18/04/2024	<0.07	<0.51	3.9	<0.0003	0.0068	<1	<6
BH3A	18/04/2024	<0.07	<0.51	6.1	<0.0003	0.0089	1.2	<6
BH6	18/04/2024	<0.07	<0.51	<1.8	<0.0003	0.0061	2.2	<6
BH9	18/04/2024	Insufficient liquid to obtain a sample						

Appendix E
Topographic Survey

311600E

311700E

311800E

173500N

173400N

7457

GM7
CL:116.65

BH6
CL:113.40
GL:112.69

GM5
CL:112.93
GL:112.34

GF11 (06/2021)
CL:117.31
GL:116.67

GF07 (06/2021)
CL:115.91
GL:115.27

GF08 (06/2021)
CL:114.66
GL:113.90

GF10 (06/2021)
CL:115.90
GL:115.33

GF08 (06/2021)
CL:115.26
GL:114.56

GF09 (06/2021)
CL:113.30
GL:112.66

GF05 (06/2021)
CL:113.09
GL:112.36

GF04 (06/2021)
CL:106.51
GL:105.89

GF03 (06/2021)
CL:104.09
GL:103.39

GF02 (11/2023)
CL:92.54
GL:92.02

GF01 (11/2023)
CL:90.38
GL:89.83

GM4
CL:92.53

BH3
CL:90.69

BH3A
CL:90.04

GM11 (06/2021)
CL:109.80
GL:109.40

BH13 (07/2024 - Replaced)
CL:107.48
GL:107.02

Gate

Ungraded Tipped Material

'Cut' Drainage Grip

Exposed Head of Clay Barrier: Placed 10/07/2020

Stone Filled Grip

Edge of Disturbed Ground @ 23rd November 2023

Infill Placed Since 04/03/2022

Exposed Head of Clay Barrier: 01/2019

Spiked Ramp

Path (um)

Tarmac surface ends

Peg

Survey Legend/Abbreviations

BH	Borehole	MKR	Marker Post
BOL	Bollard	MT	Mercury Telecom Cover
BS	Bike Stand	OHC	Overhead Cable
BT	British Telecoms Cover	OHP	Overhead Pipe
BW	Barbed Wire Fence	OSBM	Ordnance Survey Bench Mark
BWK	Brickwork	PB	Post Box
CATV	Cable TV Cover	PGM	Permanent Ground Marker
CB	Close Boarded Fence	PR	Post & Rail Fence
CCTV	Closed Circuit TV	PW	Post & Wire Fence
CHLK	Chainlink Fence	PWS	Post & Wire Stock Fence
CHPL	Chestnut Paling Fence	RE	Reading Eye
CL	Cover Level	RG	Road Gully
CM	Cable Marker	RN	Road Name
CP	Catch Pit	RS	Road Sign
DIA	Diameter	Ret Wa	Retaining Wall
DK	Drop Kerb	RWP	Rain Water Pipe
EJB	Electricity Junction Box	SAP	Sapling
EP	Electricity Pole	SC	Stop Cock
ER	Earth Rod	SPR	Spread
FH	Fire Hydrant	SV	Stop Valve
FW	Foul Water	SVP	Soil Vent Pipe
G	Gully	SW	Storm Water
GP	Gate Post	TB	Telephone Box
GV	Gas Valve	TJB	Telephone Junction Box
HT	Height	TL	Traffic Light
IC	Inspection Cover	TP	Telephone Pole
IL	Invert Level	UTL	Unable To Lift
IR	Iron Railing Fence	UTT	Unable To Trace
KO	Kerb Outlet	VP	Vent Pipe
LB	Litter Bin	WM	Water Meter
LC	Lamp Column	WV	Water Valve
LP	Lamp Post		
MH	Manhole		

Trees

Ash (3 bole)
Dia:0.60
Spr:18.00
Ht: 14.50

5.000

Notes
1. Species, bole diameter, spread, no. of trunks & height values supplied only upon request. Values left out if not required.
2. If Required, No of trunks assumed to be one (in which case no entry) unless otherwise stated.
3. Bole, Spread and Height Dimensions in metres.

Generic Tree Species Abbreviations.

Aap	= Apple	Lim	= Lime
Ash	= Ash	Map	= Maple
Bee	= Beech	Oak	= Oak
Bir	= Birch	Pin	= Pine
CBee	= Copper Beech	Pop	= Poplar
Ced	= Cedar	Rho	= Rhododendron
Che	= Cherry	Row	= Rowan
Con	= Conifer	SPin	= Scots Pine
Eld	= Elder	SBir	= Silver Birch
Elm	= Elm	Spr	= Spruce
Fir	= Fir	Syc	= Sycamore
FMap	= Field Maple	Unk	= Unknown
Haz	= Hazel	Wal	= Walnut
Hol	= Holly	Wil	= Willow
Hor	= Horse Chesnut	Win	= Wingnut
Lau	= Laurel	Yew	= Yew
Lor	= Larch		
Ley	= Leylandii		

Notes

The plan location of all underground services shown are map indicative only. No attempt has been made to detect individual services. The completeness of the information shown can not be guaranteed. Do not scale off plan.

In the absence of evidence to the contrary, the routes of confirmed connections between inspection chambers has been assumed to be direct.

All Building Eave Levels are taken at base of fascia board unless otherwise stated.

This survey has been transformed to Ordnance Survey National Grid Reference System. All levels are reduced to Ordnance Survey datum.

Revision History

00	24/07/2020	Opening survey of completed restoration, undertaken to OSGB National Grid and Datum, via GPS derived techniques (by Cemex surveyor).
01	03/09/2020	Update (GSurv) to include constructed drainage grips.
02	04/03/2022	Full site settlement survey undertaken (10m grid).
03	23/11/2023	Full site settlement survey undertaken (10m grid). BH's GF01 & GF02 Resurveyed (case extended).
04	31/07/2024	Resurvey of BH13 (Reinstalled)
05	09/01/2025	Full site settlement survey undertaken (10m grid).

gsurv
Chartered Land Surveyors
Siesta, Enborne Row, Wash Water Newbury. Berkshire RG20 0LX
o: 01865 58 98 78
[redacted]
enquiries@gsurv.co.uk

Client
Cemex UK Materials Ltd

Project
Whitehall Landfill Site. Old Port Road, Wenvoe. CF5 6AX

Title
Topographic Site Survey
as Surveyed 09th January 2025

Drawn By	Scale	Date
[redacted]	1:500 @A1	10/10/2025

Drawing No.
dwg 24 615/001_0

Rev.
01