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

Annual environmental monitoring report for 2023

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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.

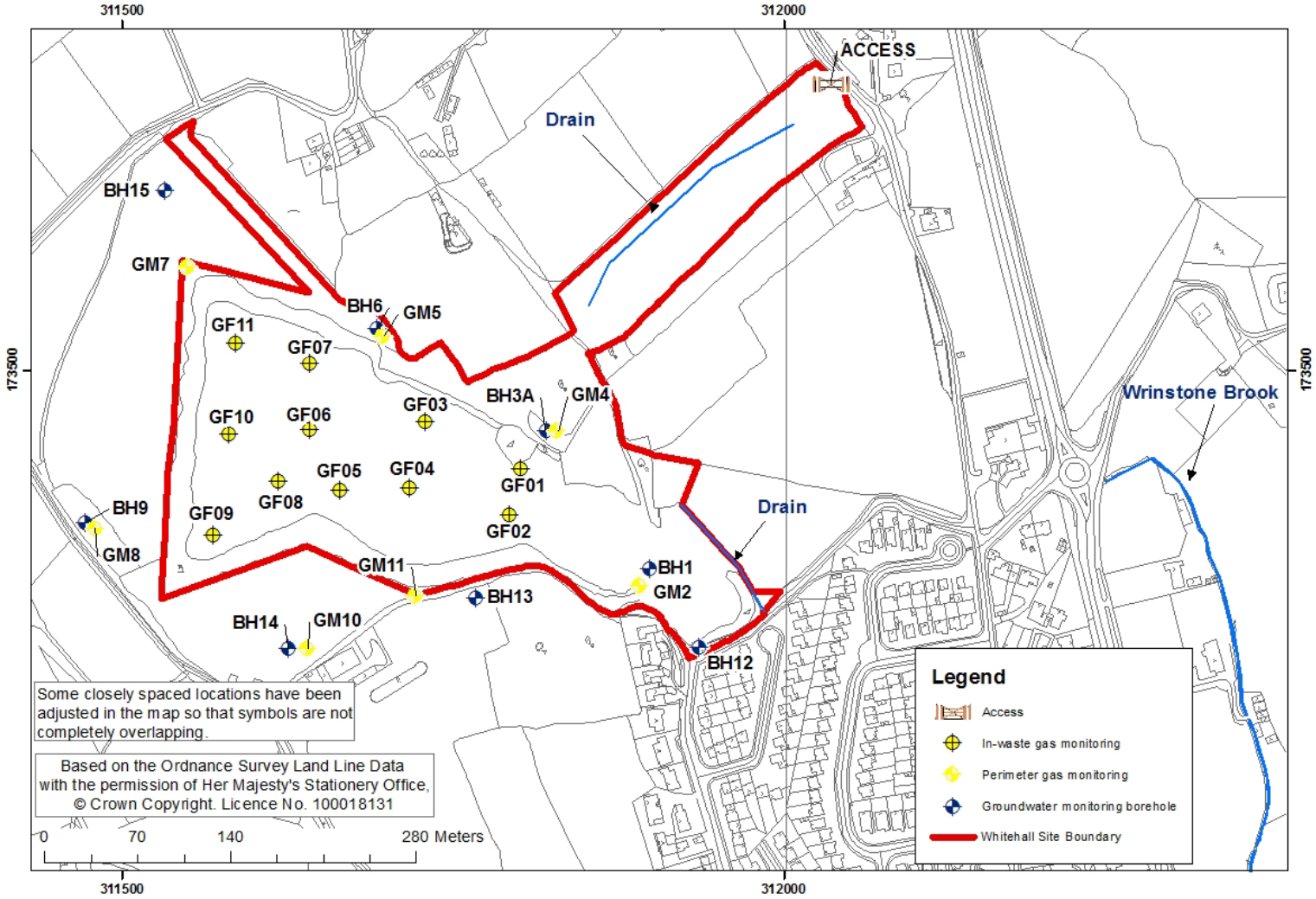
Waste was first accepted at Whitehall Landfill in November 1998. The Site formally operated under Waste Management Licence Number WM130189. Under this WML, the site was licensed to accept solid inert wastes including soils (topsoil, sub-soil and overburden), brickwork, stone, concrete, sand (excluding 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 an 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, 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, 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 2023. 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 boreholes 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 2023. No readings were taken in December for in-waste gas boreholes. This is due to a change in the monitoring technician provider on 1st October 2023, some locations were missed during the 4th Quarter of 2023 whilst the technicians have become familiar with the sites.

Table 3.1 Monitoring requirements at in waste boreholes.

Monitoring Locations	Parameter	Frequency
GF1-GF11	Methane	Monthly
	Carbon dioxide	
	Oxygen	
	Atmospheric Pressure	
	Differential Pressure	
	Flow Rate	

Methane varies between 0 %v/v in GF02, GF03 and GF05 and 58.9 %v/v in GF02 (Figure 3.1). Most concentrations remain below 30 %v/v, although results from GF02 and GF06 regularly exceed 30 %v/v. Concentrations are generally in line with those from previous years, although results from GF02 and GF03 appear to be higher than in 2021/22 and there is some evidence of a rising trend in these locations. GF02 and GF06 have previously been noted as locations with higher than typical concentrations (Cemex, 2023) although based on the latest data there is some evidence of an overall falling trend in the concentrations recorded in GF06. 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 <5% v/v. Carbon dioxide concentrations are highest in GF11, with concentrations

reaching 5.9% v/v in 2023. There is an overall rising trend in the concentrations recorded in GF11, albeit with some evidence of seasonal variation. Carbon dioxide is lowest in GF02 and GF01 with most results less than 1% v/v. There are slight increasing trends in GF03, GF05 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 2023 varying between -0.4 l/h at GF01 to 0.8 l/h in eight of the boreholes. Gas flow rates of this magnitude are not indicative of significant motive pressure driving gas off-site. Flow rates are similar at all locations which show similar variations throughout the year. Gas flow rates have shown a generally decreasing trend throughout 2023, with flow rates being typically lower than in previous reporting years.

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

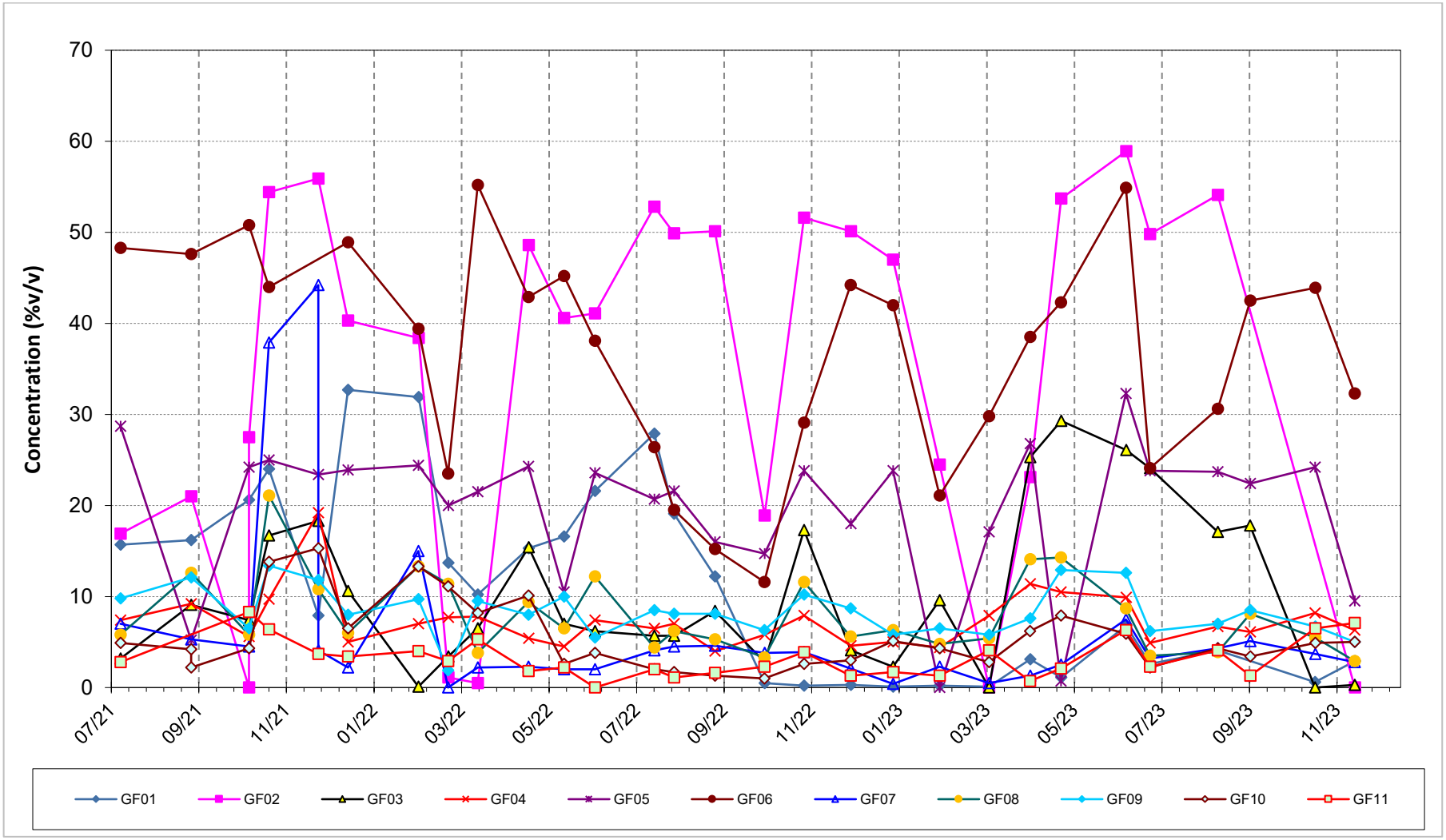


Figure 3.2 In waste carbon dioxide concentrations in since boreholes were drilled (July 2021)

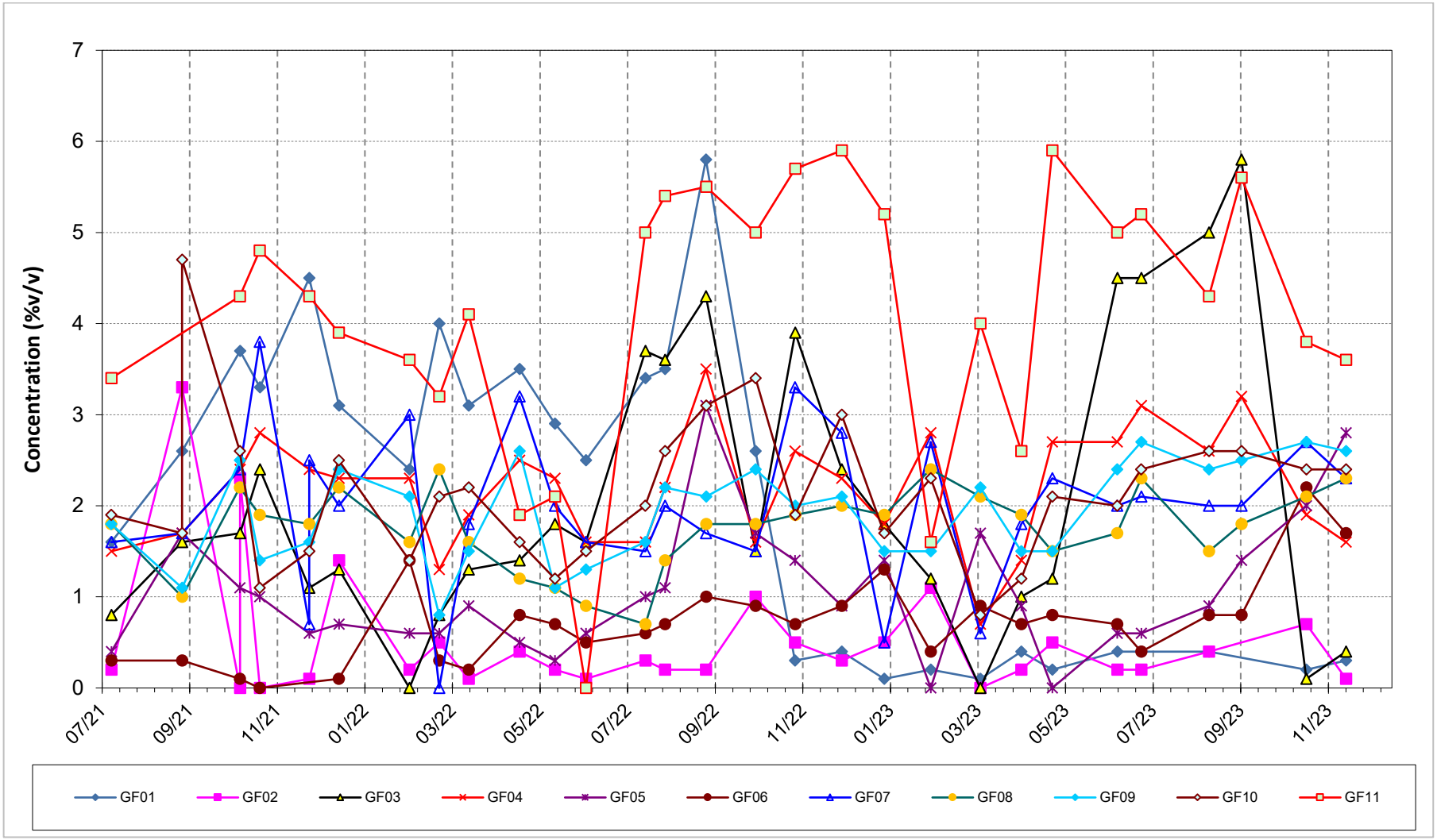
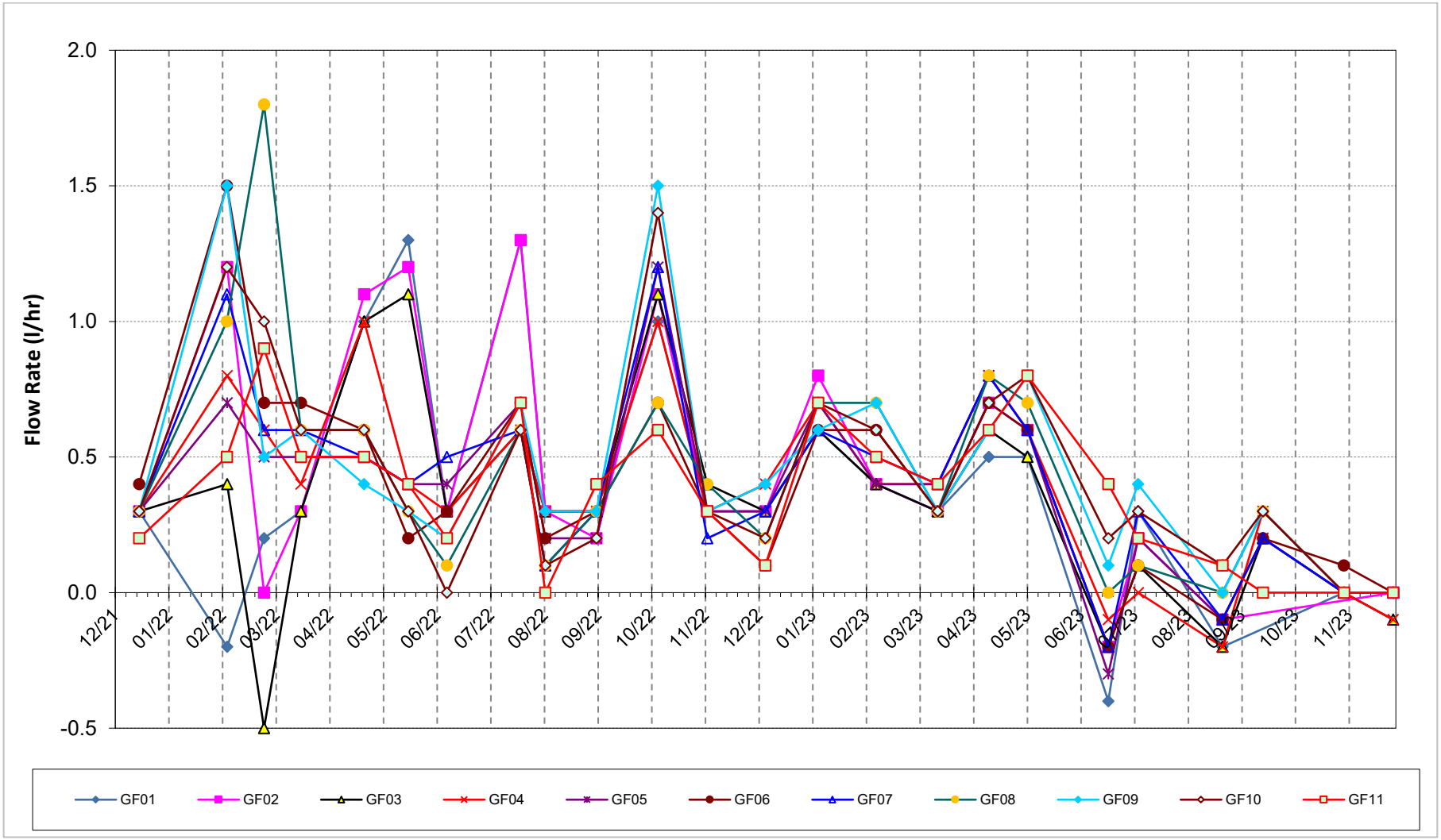


Figure 3.3 Flow rate in gas boreholes since December 2021 (first reading taken)



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 2023. A number of locations (including GM2, GM4, GM5, GM7 and GM10) were inaccessible in October, November and December since the new monitoring company took over 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 any potential harmful 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 boreholes

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

Methane has been detected at 24 of the 64 occasions at low concentrations of between 0.1 %v/v and 0.6 %v/v in predominantly May, August, September and November, as presented in Table 3.3. These detections occurred at all the locations over the course of the year. There have been no exceedances of the 1% v/v compliance limit.

Table 3.3 Location of methane detections

Location	Date of detection	Reading (%v/v)
GM10	22/08/2023	0.2
	15/09/2023	0.3
	28/11/2023	0.1
GM11	03/05/2023	0.5
	22/08/2023	0.2
	15/09/2023	0.4
	28/11/2023	0.1
GM2	03/05/2023	0.6
	22/08/2023	0.2
	15/09/2023	0.4
GM4	03/05/2023	0.5

Location	Date of detection	Reading (%v/v)
	22/08/2023	0.2
GM5	03/05/2023	0.6
	22/08/2023	0.1
	15/09/2023	0.3
	28/11/2023	0.5
GM7	12/04/2023	0.1
	03/05/2023	0.6
	22/08/2023	0.2
	15/09/2023	0.3
GM8	03/05/2023	0.5
	22/08/2023	0.2
	15/09/2023	0.3
	28/11/2023	0.1

The carbon dioxide compliance limit was not exceeded during the reporting period, with a maximum concentration of 4.8%v/v recorded in GM7 in September (Figure 3.5). Carbon dioxide concentrations remain at generally below the 6% v/v compliance limit, although there is some evidence of increasing lpg10ong-term trends in the data in GM7 and GM11 (Figure 3.6). Concentrations recorded in GM10 (along with GM5 and GM7) mainly rose through the second half of 2022 but there is no overall rising trend in GM5 and GM10 in the context of the historic data.

Gas flow rates in the perimeter boreholes are shown in Figure 3.4. They are generally comparable to those in the on site boreholes, and have a shown a similar declining trend since 2021, with a sharp drop in July 2023 followed by a slow rise again toward the end of the year. The highest gas flow reading in a perimeter borehole for 2023 was at GM11, in May (0.8 l/hr).

Figure 3.4 Flow rate in perimeter gas boreholes since December 2021 (first reading taken)

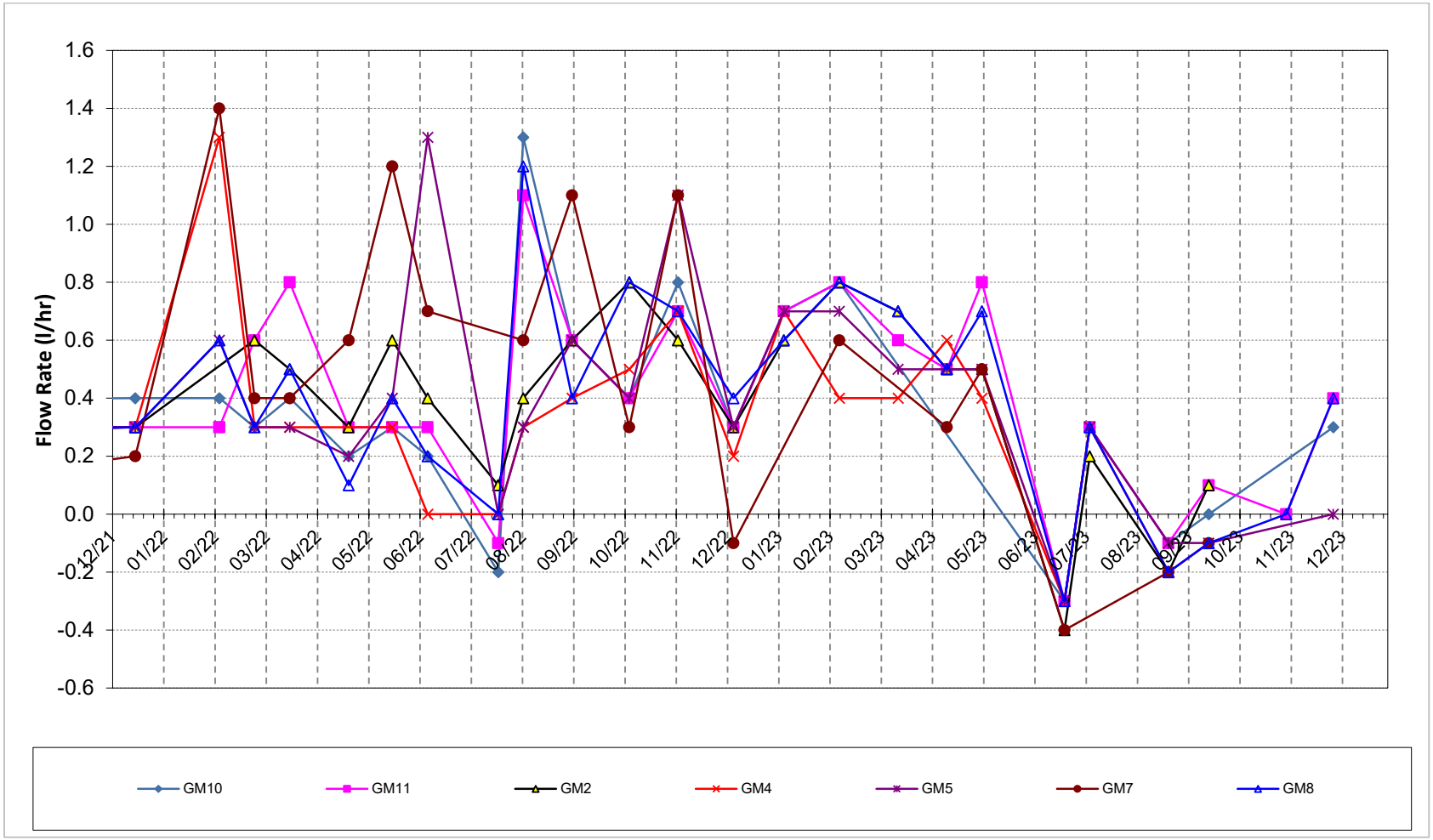


Figure 3.5 Stable carbon dioxide concentrations in 2023

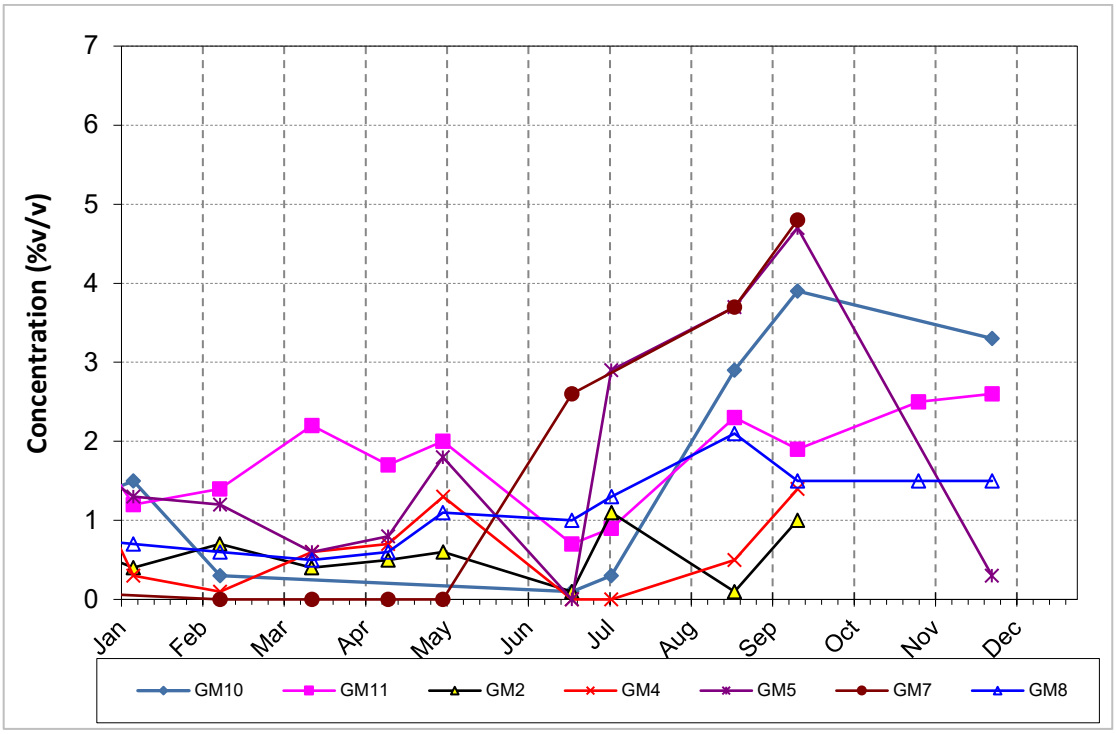
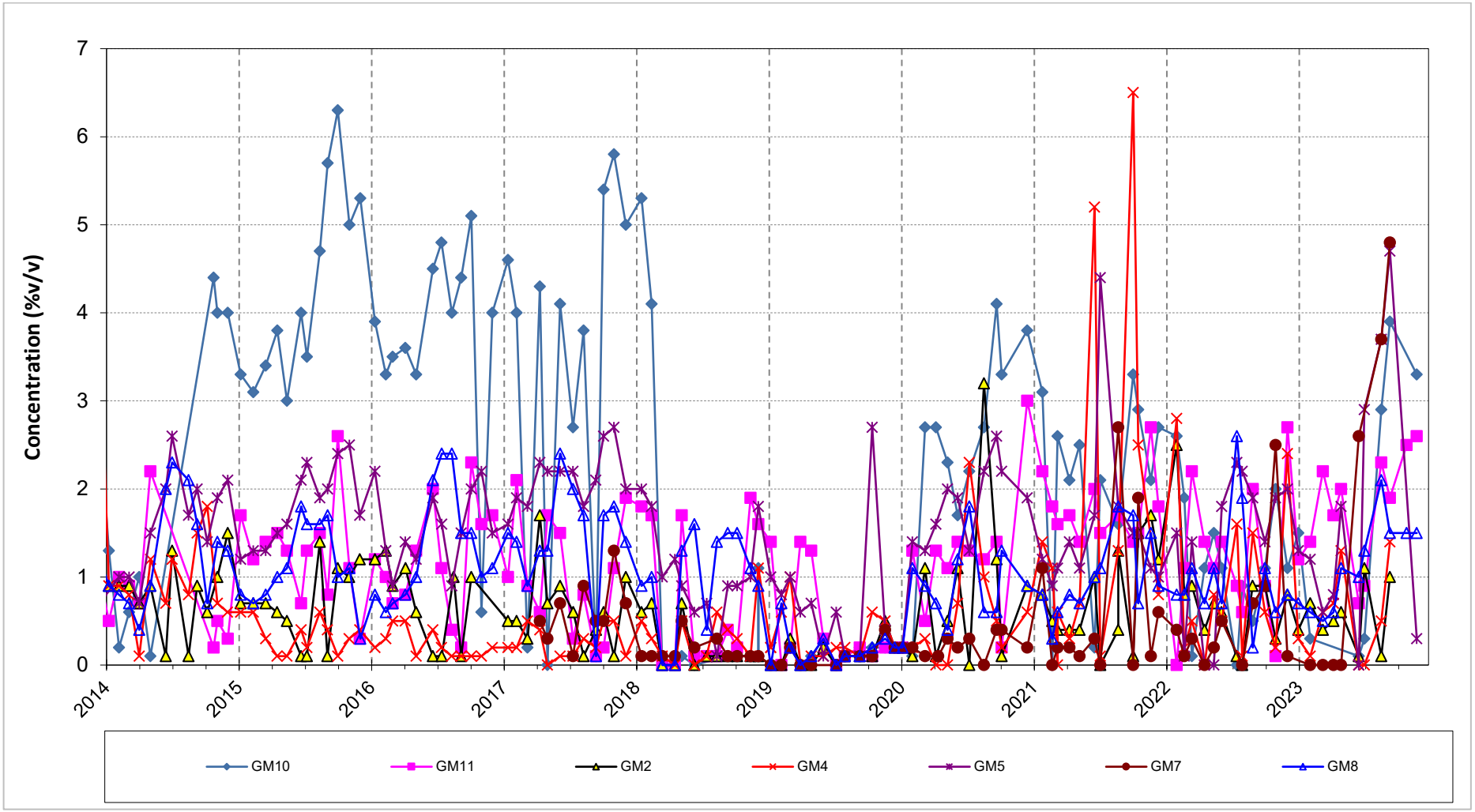


Figure 3.6 Historical stable carbon dioxide concentrations



3.2 Groundwater Monitoring

Schedule 4 of the EP requires monitoring of groundwater quality 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 2023. The locations of the monitoring boreholes are shown on Figure 2.1. A number of locations (including BH1, BH3, BH3A and BH13) were inaccessible in October, November and December when Socotec took over the monitoring.

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, TON, 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.

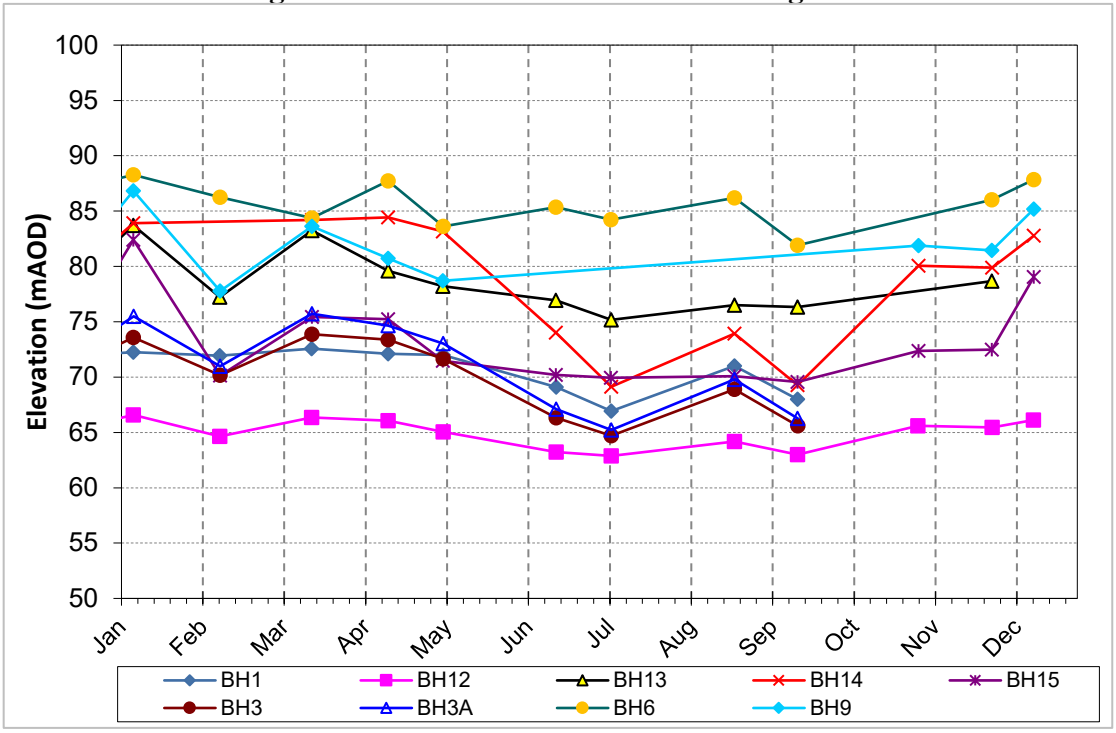
3.2.1 Groundwater Levels

Monthly groundwater level data collected during 2023 are presented in Figure 3.6. The full dataset for 2023 is presented in Appendix C.

BH9 was dry from June to September so no groundwater levels were recorded.

In 2023, groundwater levels generally rose between February and March then fell through to July. The least fluctuation is recorded in borehole BH12 at less than 5m; all other locations recorded fluctuating levels throughout 2023 with the greatest in BH14 of around 15m. BH6 (north of the Site) recorded the highest groundwater levels during 2023 and BH12 (south-east of the Site) recorded the lowest groundwater levels, which is consistent with previous years.

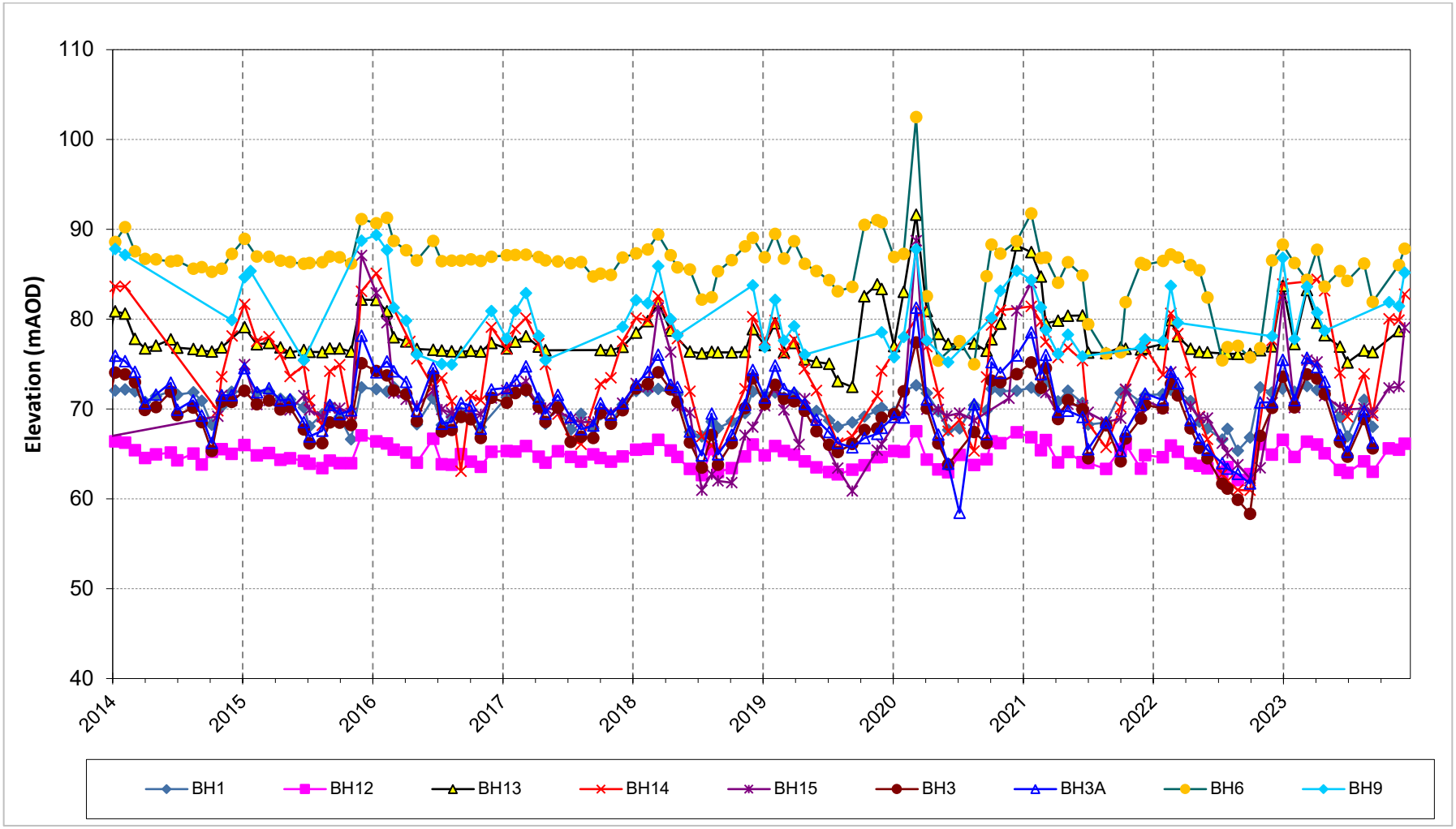
Figure 3.7 Groundwater elevation during 2023



Historical observed groundwater levels for the past decade for all monitoring locations are shown in Figure 3.7. Overall, the groundwater levels are generally consistent with historical trends. 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.

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 2023.

Figure 3.8 Historical groundwater elevation (2014-2023)



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 quarterly dataset for 2023 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 upgradient 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 2023 for sulphate and ammoniacal nitrogen. One sulphate result (5% of samples) was above the UK DWS of 250 mg/l at BH12 in July (252mg/l). One ammoniacal nitrogen result (5% of samples) at BH13 in January, at 0.64 mg/l, was above the UK DWS of 0.39 mg/l.

Table 3.6 Statistical summary of groundwater quality in 2023

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
Field / lab parameters														
Conductivity- Electrical (Field)	22	µS/cm	674	2410	1141	1106	420	752	2109	22	100	0	0	2500
Conductivity- Electrical 20deg	22	µS/cm	291	1160	672	605	228	392	1049	22	100	0	0	2500
pH	22	pH	7.1	8.2	7.62	7.5	0.31	7.21	8.2	22	100	0	0	6.5-9.5
pH (Field)	22	pH	7.4	8.54	7.95	7.95	0.28	7.51	8.36	22	100	0	0	6.5-9.5
Major ions														
Alkalinity as CaCO3	22	mg/l	144	445	301	301	73.2	175	389	22	100	0	0	-
Calcium	22	mg/l	54.5	190	104	100	33.2	59.5	160	22	100	0	0	-
Chloride	22	mg/l	7	70.9	29.1	27.4	18.1	7.26	64.3	22	100	0	0	250
Magnesium	22	mg/l	6	55.7	27.4	27.8	12.5	9.49	47	22	100	0	0	-
Potassium	22	mg/l	0.72	16	5.18	4.82	4.01	0.877	11.9	22	100	0	0	-
Sodium	22	mg/l	4.38	52	18.3	20.1	11.2	5	29.9	22	100	0	0	200
Sulphate as SO4	22	mg/l	<4.4	252	53.5	21.2	69.8	n.d.	177	18	81.8	1	4.55	250
Minor ions														
Cadmium	7	µg/l	<0.07	<0.07	n.d.	n.d.	n.d.	n.d.	n.d.	0	0	0	0	5
Chromium	7	µg/l	<0.51	1.4	0.543	n.d.	0.491	n.d.	1.31	2	28.6	0	0	50
Copper	7	µg/l	<1.8	7.3	3.23	2.9	2	n.d.	6.22	6	85.7	0	0	2000

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
Iron	22	mg/l	<0.025	0.125	0.0218	n.d.	0.0245	n.d.	0.0388	5	22.7	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	1	8.4	4.71	3.8	2.93	1.36	8.31	7	100	0	0	50
Nickel	7	µg/l	<1	2.9	1.46	1.5	0.983	n.d.	2.69	4	57.1	0	0	20
Zinc	7	µg/l	<6	14	6	n.d.	5.13	n.d.	13.7	2	28.6	0	0	-
Nitrogen species														
Ammoniacal Nitrogen as N	22	mg/l	<0.06	0.64	n.d.	n.d.	n.d.	n.d.	0.116	2	9.09	1	4.55	0.39
Nitrogen (total oxidised) as N	22	mg/l	<0.7	5.6	1.85	0.9	1.75	n.d.	5.33	11	50	0	0	-
Landfill parameters														
TOC (filtered)	22	mg/l	1.2	11.7	4.05	3.3	2.59	1.41	9.01	22	100	0	0	-
PAHs														
Naphthalene	22	µg/l	<0.01	0.111	0.0115	n.d.	0.0226	n.d.	0.0216	5	22.7	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 two exceedances of the compliance limits during 2023, a decrease from nine during the previous reporting period. The exceedances are shown below in Table 3.7

Table 3.7 Groundwater compliance limit exceedances 2023

Location	Date	Determinand	Compliance level (mg/l)	Result (mg/l)
BH12	06/07/2023	Naphthalene	0.00005	0.000111
BH13	05/01/2023	Ammoniacal nitrogen	0.39	0.64

A statistical summary of groundwater quality compliance parameters is presented in Table 3.8. The data for potassium has been split over three rows, as there are separate compliance limits.

Groundwater ammoniacal nitrogen concentrations for the last decade are presented in Figure 3.8 and Figure 3.9. 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 twice during the reporting period in the downgradient boreholes. This includes once in BH1, fewer occasions than the previous reporting period, and remaining below the compliance limit of 0.39 mg/l (0.12 mg/l in July). The other detection was in BH13 (0.64 mg/l in January); this is much less than the peak concentration of 3.9 mg/l recorded at this location (October 2022). No other detections are noted in the current reporting period, but it should be noted that none of these boreholes have data reported past July in 2023, when issues with access to boreholes prevented sampling. The recent data that is available maintains the same trends as the historical data with most results below the detection limit with occasional isolated peaks. The presence of these isolated peaks at up and down hydraulic gradient wells indicates that the landfill is not the source of the ammoniacal nitrogen.

Potassium concentrations in groundwater during the last decade are presented in Figure 3.10 and Figure 3.11. 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 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 28.1 mg/l, though no exceedances have been reported in 2023, with the highest concentration recorded in July at 7.0 mg/l. Historical potassium concentrations in BH9 (up-hydraulic-gradient) were higher (Figure 3.11) but stabilised around 15 mg/l from 2014 and by 2020 results were typically below 10 mg/l which has continued into 2023 (up to 9.2 mg/l). No sampling was carried out at BH9 post April 2023 as it was dry or there was insufficient water to obtain a sample. 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 2023 and reviewed again in the next annual report.

Historical iron concentrations are plotted on Figure 3.12. Iron concentrations peaked in 2023 at 125 µg/l at BH1. All other results are broadly consistent with previous years, and no exceedances of the 200 µg/l compliance limit were recorded.

There was one naphthalene exceedance during the reporting period (see Table 3.7). This is a decrease from the previous year when four exceedances were recorded.

In summary, there were two compliance limit exceedances recorded in 2023, for naphthalene in July 2023 (BH12) and for ammoniacal nitrogen in January (BH13). However, it should be noted that no samples are recorded after July 2023 owing to issues with access to gaining samples from the boreholes.

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 Limit: No. Exceeding	Compliance Limit: % Exceeding	Compliance Limit: Action Level
Major ions														
Chloride	12	mg/l	7	65.2	26.3	22.5	19.2	7.11	54.5	12	100	0	0	250
Potassium (BH1)	3	mg/l	5.83	8.7	6.98	6.4	1.52	5.89	8.47	3	100	0	0	27
Potassium (BH12)	3	mg/l	7.52	16	11.8	12	4.24	7.97	15.6	3	100	0	0	24.7
Potassium (BH13, BH14)	6	mg/l	0.72	7	3.72	3.55	3.14	0.758	6.91	6	100	0	0	12
Minor ions														
Iron	12	µg/l	<25	125	25.9	n.d.	32.3	n.d.	77.7	3	25	0	0	200
Nitrogen species														
Ammoniacal Nitrogen as N	12	mg/l	<0.06	0.64	0.0883	n.d.	0.176	n.d.	0.354	2	16.7	1	8.333	0.39
PAHs														
Naphthalene	12	µg/l	<0.01	0.111	0.0163	n.d.	0.0303	n.d.	0.062	4	33.3	1	8.333	0.05

Figure 3.9 Historical ammoniacal nitrogen in groundwater at boreholes with compliance limits (downgradient)

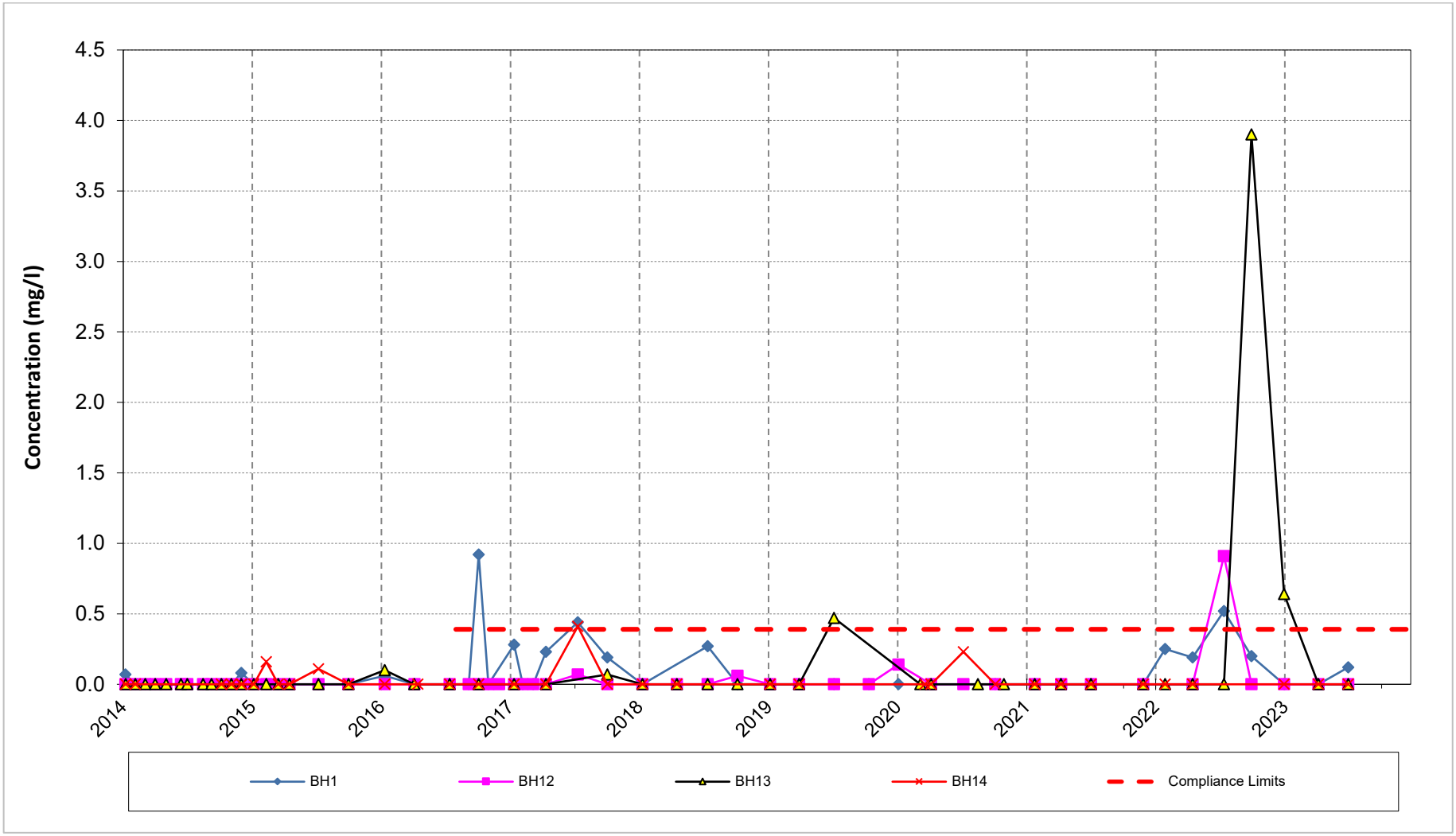


Figure 3.10 Historical ammoniacal nitrogen concentrations in groundwater at boreholes without compliance limits (upgradient)

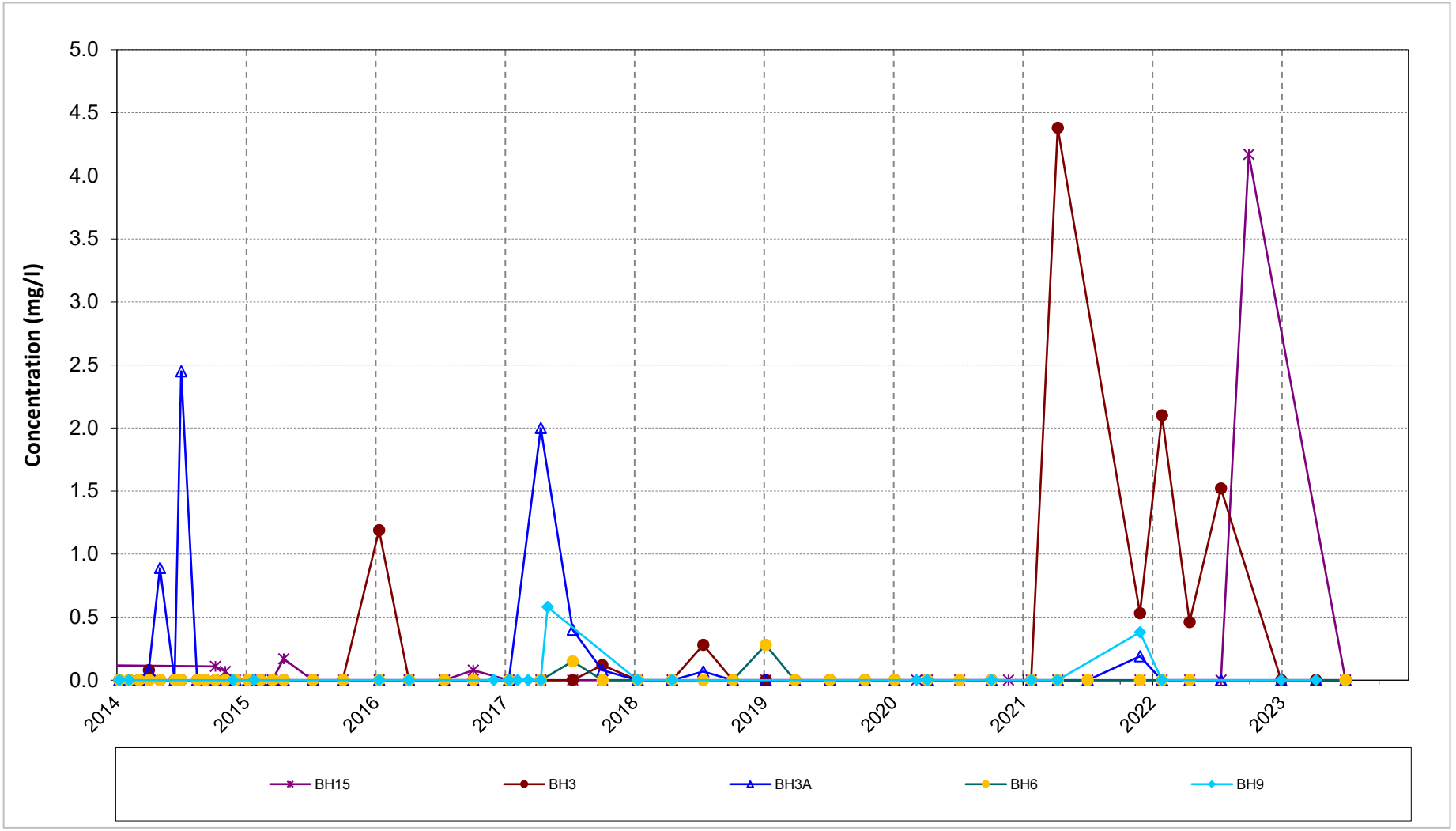


Figure 3.11 Historical potassium concentrations in groundwater at boreholes with compliance limits (downgradient)

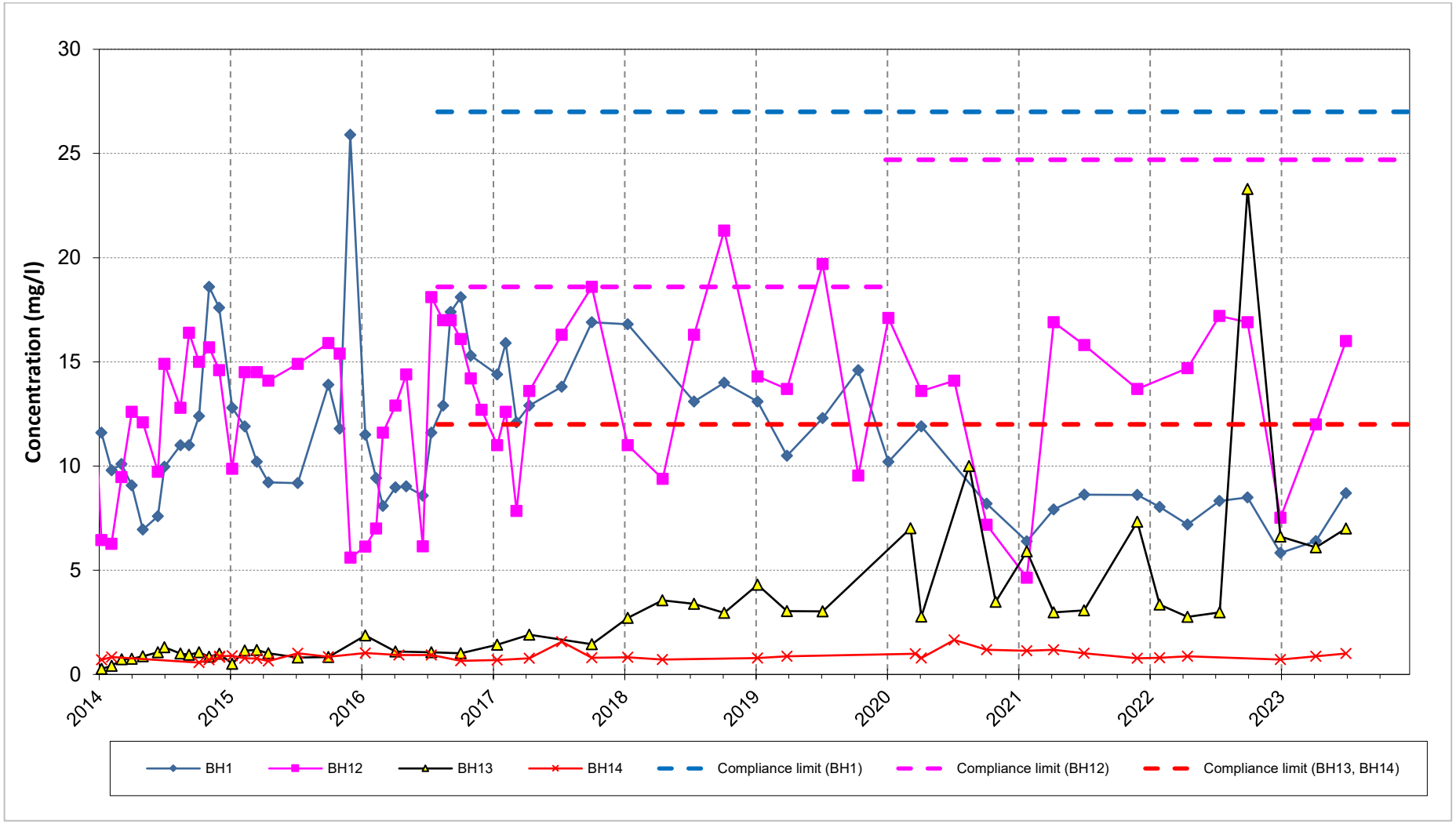


Figure 3.12 Historical potassium concentrations in groundwater at boreholes without compliance limits (upgradient)

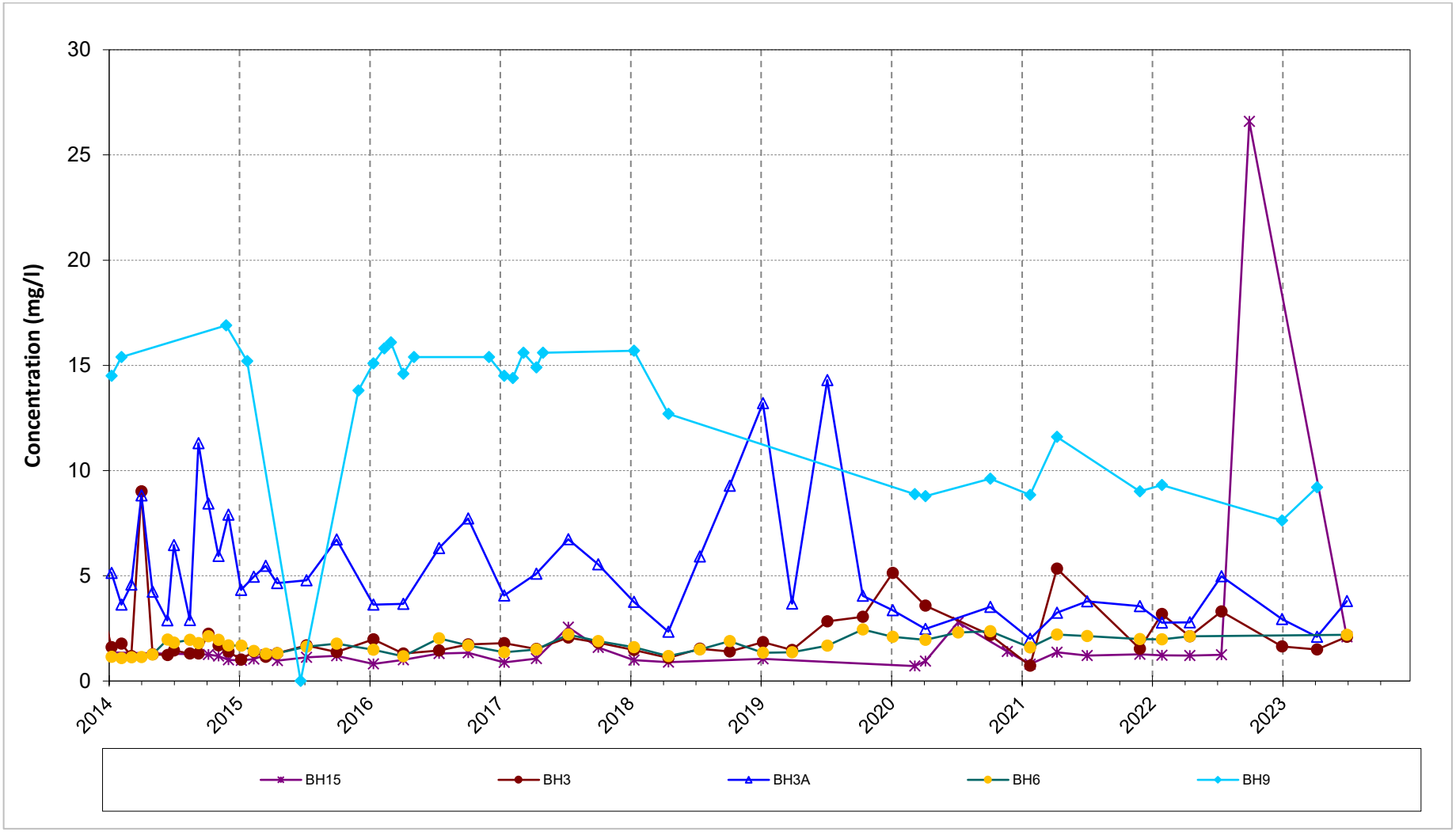
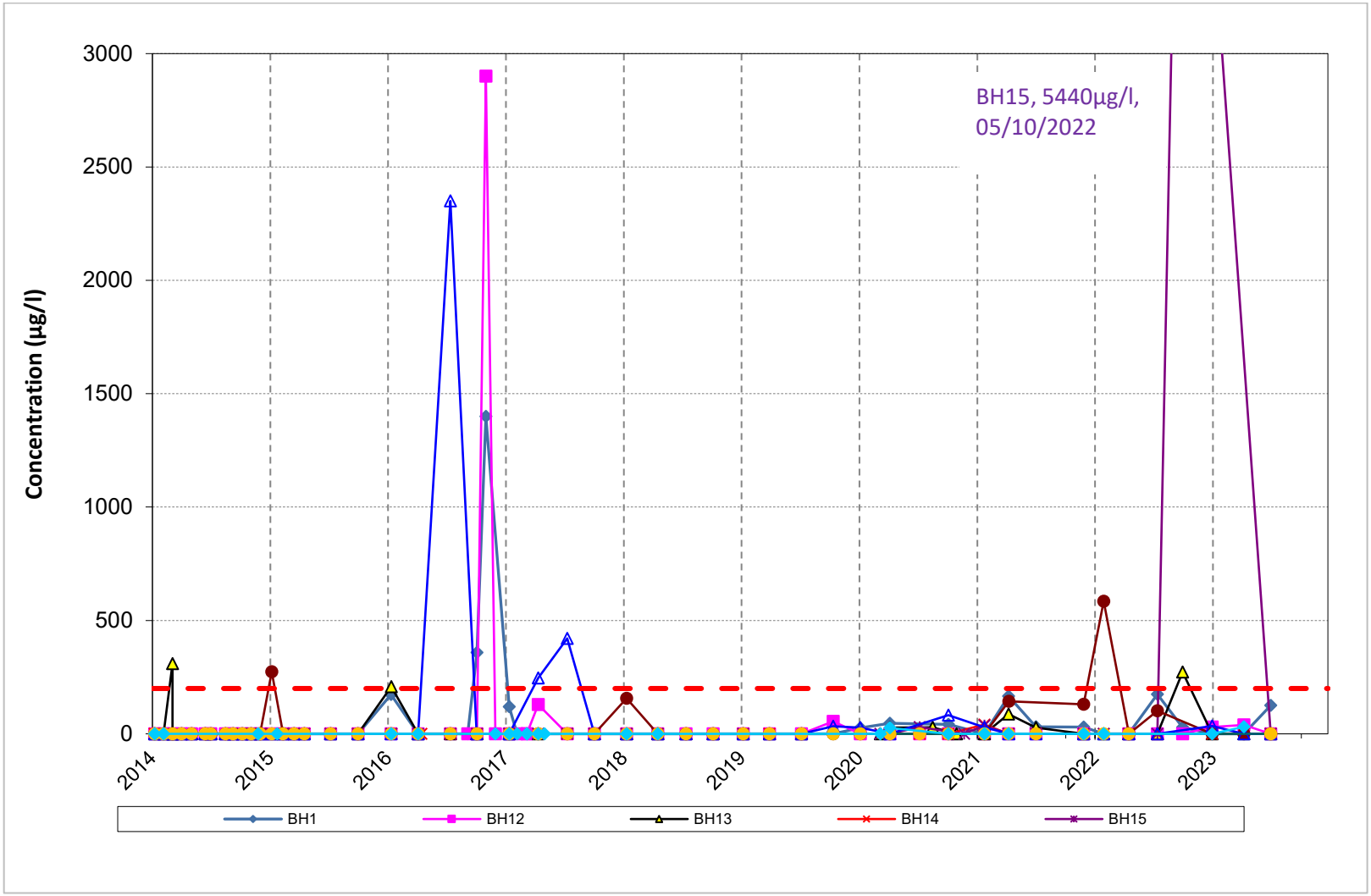


Figure 3.13 Historical iron concentrations at all groundwater locations



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 2023.

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 2023 survey compared to those in the previous 2022 survey. No significant differential settlement is shown at the Site.

4.4 Compliance Testing and Other Details

No waste has been accepted in 2023 since filling ceased in October 2018.

5 Summary

This review covers the period between January and December 2023 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 58.9 %v/v in 2023 with carbon dioxide varying from 0 %v/v to 5.9 % v/v.
- Since December 2021, gas flow has varied since December 2021 from -0.5 l/h to 1.8 l/h. Flow follows similar patterns at each location with peaks occurring every two to three months. In 2023, the gas flows were generally lower than in previous years, with a generally declining trend. In 2023, peak gas flow was 0.8 l/hr, lower than in previous reporting. Gas flow rates of this magnitude are not indicative of significant motive pressure driving gas off-site.
- 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. There have been no exceedances of the 1% v/v compliance limit for methane in perimeter boreholes. Methane was detected 24 times out of 64 in 2023, at relatively low concentrations of between 0.1 and 0.6 %v/v.
- Carbon dioxide concentrations in perimeter boreholes did not exceed the 6 %v/v compliance limit during the reporting period but with an increasing trend in a number of boreholes from May/June 2023. Carbon dioxide concentrations peaked at 4.8 %v/v in GM7. Data is incomplete for October – December but appears to be declining or levelling off in those boreholes with available data.
- Groundwater levels are generally consistent with historic results. The groundwater elevation 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 limited sulphate and ammoniacal nitrogen concentrations above the UK DWS.
- There were only two exceedances of the compliance limits for groundwater have been recorded. One for naphthalene, at BH12 in July (0.000111 mg/l, cf. the compliance limit of 0.00005 mg/l) and one at BH13, in January for ammoniacal nitrogen (0.64 mg/l, cf. compliance limit of 0.39 mg/l). This is down from nine exceedances in 2022.

6 References

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Appendix A
In-waste Gas Monitoring Data

Appendix A Table 1 In waste gas monitoring data for 2023

Note: December monitoring round at all locations missed due to new company taking over the monitoring; some sites were missed while technicians became familiar with the sites.

Location	Date	Baro mb	CH4Stable %	CO2Stable %	DiffPress mb	FlowrateVol l/h	O2Stable %	Ground conditions
GF01	05/01/2023	1007	0.1	0.1	-0.38	0.6	21.1	Waterlogged
GF01	07/02/2023	1028	0.2	0.2	-0.13	0.4	20.7	Damp
GF01	14/03/2023	999	0.1	0.1	-0.06	0.3	21.1	
GF01	12/04/2023	977	3.1	0.4	-0.37	0.5	19.8	Damp
GF01	04/05/2023	1001	1.1	0.2	-0.19	0.5	20.3	Damp
GF01	19/06/2023	999	6.8	0.4	0.46	-0.4	19.1	Dry
GF01	06/07/2023	1005	2.6	0.4	-0.16	0.3	19.5	Dry
GF01	23/08/2023	1013	4.1	0.4	0.12	-0.2	19.2	Damp
GF01	15/09/2023	IA	IA	IA	IA	IA	IA	Dry
GF01	31/10/2023	AT	AT	AT	AT	AT	AT	
GF01	31/10/2023	990	0.6	0.2		0	20.7	Waterlogged
GF01	28/11/2023	999	2.9	0.3	0.18	0	20.5	Damp
GF02	05/01/2023	1007	47	0.5	-0.4	0.8	0.9	Waterlogged
GF02	07/02/2023	1028	24.5	1.1	-3.74	0.4	4.4	Damp
GF02	14/03/2023	999	0	0	-1.62	0.3	21.1	Waterlogged
GF02	12/04/2023	976	23.1	0.2	-0.39	0.7	12.7	Damp
GF02	04/05/2023	1000	53.7	0.5	-0.12	0.6	0.7	Damp
GF02	19/06/2023	999	58.9	0.2	0.4	-0.2	1.9	Dry
GF02	06/07/2023	1004	49.8	0.2	0.33	0.2	0.3	Dry
GF02	23/08/2023	1012	54.1	0.4	0.23	-0.1	0.6	Damp
GF02	15/09/2023	IA	IA	IA	IA	IA	IA	Dry
GF02	31/10/2023	990	AT	0.7	AT	AT	16.9	Waterlogged

Location	Date	Baro mb	CH4Stable %	CO2Stable %	DiffPress mb	FlowrateVol l/h	O2Stable %	Ground conditions
GF02	28/11/2023	999	0	0.1	0.12	0	21.6	Damp
GF03	05/01/2023	1006	2.3	1.8	-0.34	0.6	12.2	Damp
GF03	07/02/2023	1026	9.6	1.2	-0.14	0.4	11.4	Damp
GF03	14/03/2023	998	0	0	-0.14	0.3	21.1	Damp
GF03	12/04/2023	976	25.3	1	0.16	0.6	10.4	Damp
GF03	04/05/2023	1000	29.3	1.2	0.1	0.5	10.3	Damp
GF03	19/06/2023	997	26.1	4.5	0.34	-0.2	4.8	Dry
GF03	06/07/2023	1005	24.1	4.5	0.28	0.1	0.6	Dry
GF03	23/08/2023	1012	17.1	5	0.16	-0.2	1.9	Damp
GF03	15/09/2023	1003	17.8	5.8	0.54	0.2	7.3	Dry
GF03	31/10/2023	989	0	0.1		0	21.2	Waterlogged
GF03	28/11/2023	999	0.3	0.4	0.21	-0.1	20.6	Damp
GF04	05/01/2023	1005	5	1.8	0.03	0.7	7.1	Damp
GF04	07/02/2023	1026	4.4	2.8	-0.9	0.4	2.4	Damp
GF04	14/03/2023	997	7.9	0.7	-0.02	0.4	5.9	Damp
GF04	12/04/2023	975	11.4	1.4	0.47	0.8	2.4	Damp
GF04	04/05/2023	999	10.5	2.7	-0.34	0.6	0	Damp
GF04	19/06/2023	997	9.9	2.7	4.27	-0.1	0.1	Dry
GF04	06/07/2023	1003	4.9	3.1	0.28	0	0.3	Dry
GF04	23/08/2023	1011	6.7	2.6	0.14	-0.2	0.7	Damp
GF04	15/09/2023	1002	6.1	3.2	0.28	0.3	0.3	Dry
GF04	31/10/2023	989	8.2	1.9		0	0.3	Damp
GF04	28/11/2023	1000	6.3	1.6	0.25	-0.1	5.4	Damp
GF05	05/01/2023	1005	23.8	1.4	-0.41	0.7	1.2	Damp
GF05	07/02/2023	1025	0	0	-0.2	0.4	20.7	Damp
GF05	14/03/2023	996	17.1	1.7	0.77	0.4	3.8	Damp
GF05	12/04/2023	975	26.8	0.9	0.87	0.8	1.9	Damp
GF05	04/05/2023	999	0.7	0	1.73	0.6	20.7	Damp
GF05	19/06/2023	996	32.3	0.6	0.57	-0.3	0.2	Dry

Location	Date	Baro mb	CH4Stable %	CO2Stable %	DiffPress mb	FlowrateVol l/h	O2Stable %	Ground conditions
GF05	06/07/2023	1003	23.8	0.6	0.4	0.2	0.3	Dry
GF05	23/08/2023	1011	23.7	0.9	0.11	-0.1	1.2	Damp
GF05	15/09/2023	1002	22.4	1.4	0.43	0.2	0.4	Dry
GF05	31/10/2023	988	24.2	2		0	0.2	Damp
GF05	28/11/2023	1000	9.5	2.8	0.19	0	1.2	Damp
GF05	14/12/2023	AT	AT	AT	AT	AT	AT	Damp
GF06	05/01/2023	1005	42	1.3	-0.45	0.6	0.8	Damp
GF06	07/02/2023	1026	21.1	0.4	-0.12	0.6	11.4	Damp
GF06	14/03/2023	997	29.8	0.9	1.85	0.3	4.9	Damp
GF06	12/04/2023	975	38.5	0.7	-0.4	0.7	3.4	Damp
GF06	04/05/2023	999	42.3	0.8	0.05	0.6	1.3	Damp
GF06	19/06/2023	997	54.9	0.7	-13.9	-0.2	0.4	Dry
GF06	06/07/2023	1003	24.1	0.4	1.29	0.1	9.4	Dry
GF06	23/08/2023	1011	30.6	0.8	0.19	-0.1	0.8	Damp
GF06	15/09/2023	1002	42.5	0.8	0.5	0.2	0.3	Dry
GF06	31/10/2023	988	43.9	2.2		0.1	2.9	Damp
GF06	28/11/2023	998	32.3	1.7	0.14	0	5.8	Damp
GF07	05/01/2023	1005	0.4	0.5	-0.41	0.6	16.2	Damp
GF07	07/02/2023	1025	2.3	2.7	-0.26	0.5	2.8	Damp
GF07	14/03/2023	997	0.5	0.6	-0.15	0.4	16.1	Damp
GF07	12/04/2023	975	1.3	1.8	-0.19	0.8	5.8	Damp
GF07	04/05/2023	999	2.5	2.3	0.25	0.6	3.6	Damp
GF07	19/06/2023	996	7.5	2	0.89	-0.2	0.7	Dry
GF07	06/07/2023	1003	3.2	2.1	0.49	0.3	3.3	Dry
GF07	23/08/2023	1011	4.3	2	0.19	-0.1	3.4	Damp
GF07	15/09/2023	1002	5.1	2	0.36	0.2	0.9	Dry
GF07	31/10/2023	988	3.7	2.7		0	0.3	Damp
GF07	28/11/2023	999	2.8	2.3	0.19	0	1.8	Damp
GF08	05/01/2023	1005	6.3	1.9	-0.35	0.7	0.8	Damp

Location	Date	Baro mb	CH4Stable %	CO2Stable %	DiffPress mb	FlowrateVol l/h	O2Stable %	Ground conditions
GF08	07/02/2023	1026	4.8	2.4	2.78	0.7	2.4	Damp
GF08	14/03/2023	997	5.4	2.1	-0.06	0.3	2.2	Waterlogged
GF08	12/04/2023	975	14.1	1.9	-0.04	0.8	2	Damp
GF08	04/05/2023	1000	14.3	1.5	-0.25	0.7	0.2	Damp
GF08	19/06/2023	500	8.7	1.7	0.18	0	1	Dry
GF08	06/07/2023	1003	3.5	2.3	0.63	0.1	1.2	Dry
GF08	23/08/2023	1011	3.9	1.5	0.11	0	1.2	Damp
GF08	15/09/2023	1002	8.1	1.8	0.82	0.3	0.3	Dry
GF08	31/10/2023	988	5.5	2.1		0	0.2	Damp
GF08	28/11/2023	999	2.9	2.3	0.14	0	1.4	Damp
GF09	05/01/2023	1005	5.8	1.5	-12.11	0.6	4.1	Damp
GF09	07/02/2023	1026	6.5	1.5	-0.42	0.7	5.3	Damp
GF09	14/03/2023	997	5.8	2.2	-0.15	0.3	2.3	Damp
GF09	12/04/2023	975	7.6	1.5	-0.35	0.6	5.4	Damp
GF09	04/05/2023	1000	12.9	1.5	-0.32	0.8	0.3	Damp
GF09	19/06/2023	997	12.6	2.4	-0.03	0.1	0.1	Dry
GF09	06/07/2023	1002	6.2	2.7	0.68	0.4	0.3	Dry
GF09	23/08/2023	1011	7	2.4	0.25	0	1.3	Damp
GF09	15/09/2023	1002	8.5	2.5	0.92	0.3	0.3	Dry
GF09	31/10/2023	989	6.7	2.7		0	0.2	Damp
GF09	28/11/2023	999	5	2.6	0.12	0	0.7	Damp
GF10	05/01/2023	1005	5.1	1.7	0	0.7	1.8	Waterlogged
GF10	07/02/2023	1026	4.3	2.3	0.18	0.6	0.7	Damp
GF10	14/03/2023	996	2.8	0.8	-0.12	0.3	11.6	Waterlogged
GF10	12/04/2023	974	6.2	1.2	-0.29	0.7	2.3	Damp
GF10	04/05/2023	1000	7.9	2.1	-0.38	0.8	0.1	Y
GF10	19/06/2023	997	5.9	2	0.41	0.2	1.1	Dry
GF10	06/07/2023	1002	2.2	2.4	0.43	0.3	0.9	Dry
GF10	23/08/2023	1011	4.3	2.6	0.11	0.1	2	Damp

Location	Date	Baro mb	CH4Stable %	CO2Stable %	DiffPress mb	FlowrateVol l/h	O2Stable %	Ground conditions
GF10	15/09/2023	1002	3.4	2.6	0.97	0.3	0.6	Dry
GF10	31/10/2023	989	4.9	2.4		0	0.4	Damp
GF10	28/11/2023	999	5	2.4	0.18	0	0.8	Damp
GF11	05/01/2023	1005	1.7	5.2	-0.49	0.7	2.9	Waterlogged
GF11	07/02/2023	1026	1.3	1.6	-0.03	0.5	13.8	Damp
GF11	14/03/2023	996	4.1	4	0.23	0.4	5.2	Damp
GF11	12/04/2023	978	0.7	2.6	-0.47	0.6	11.8	Damp
GF11	04/05/2023	1000	2.1	5.9	-9.4	0.8	1.4	Damp
GF11	19/06/2023	997	6.3	5	1.38	0.4	0.9	Dry
GF11	06/07/2023	1002	2.3	5.2	0.47	0.2	0.9	Dry
GF11	23/08/2023	1011	4.1	4.3	0.55	0.1	4.9	Damp
GF11	15/09/2023	1002	1.3	5.6	1.2	0	1.7	Dry
GF11	31/10/2023	988	6.5	3.8		0	0.8	Damp
GF11	28/11/2023	998	7.1	3.6	0.14	0	0.4	Damp

Note: AT = Tap Left Open; IA = Location Inaccessible

Appendix B
Perimeter Gas Monitoring Data

Appendix B Table 2 Gas monitoring data for 2023

Note: Data from December monitoring round is incomplete due to new company taking over the monitoring; some sites were missed while technicians became familiar with the sites.

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground conditions
		mb	%	%	mb	l/h	%	
GM10	02/05/2013	1011	0	2.9	0.13		17.9	Damp
GM10	05/01/2023	1007	0	1.5	-0.45	0.7	18.7	Damp
GM10	07/02/2023	1027	0	0.3	-0.54	0.8	21.1	
GM10	21/06/2023	1009	0	0.1	0.21	-0.3	20.8	Dry
GM10	06/07/2023	1002	0	0.3	0.31	0.3	20.4	Damp
GM10	22/08/2023	1012	0.2	2.9	0.14	-0.1	15.9	Damp
GM10	15/09/2023	1005	0.3	3.9	0.16	0	17.8	Dry
GM10	28/11/2023	Damaged						
GM10	28/11/2023	1000	0.1	3.3	0.31	0.3	15.4	Dry
GM10	14/12/2023	Damaged						
GM11	05/01/2023	1007	0	1.2	-0.47	0.7	19.6	Damp
GM11	07/02/2023	1027	0	1.4	-0.53	0.8	20	Damp
GM11	14/03/2023	997	0	2.2	-0.38	0.6	17.7	Damp
GM11	12/04/2023	977	0	1.7	-0.33	0.5	18.9	Damp
GM11	03/05/2023	1014	0.5	2	4.5	0.8	18.3	Damp
GM11	21/06/2023	1008	0	0.7	-0.04	-0.3	20.4	
GM11	06/07/2023	1002	0	0.9	0.24	0.3	20.2	Dry
GM11	22/08/2023	1012	0.2	2.3	0.02	-0.1	19.4	Damp
GM11	15/09/2023	1005	0.4	1.9	0.05	0.1	20	Damp
GM11	31/10/2023	989	0	2.5		0	18.9	Damp
GM11	28/11/2023	1000	0.1	2.6	0.58	0.4	17.5	Dry
GM11	14/12/2023	No Data Recorded						
GM2	05/01/2023	1012	0	0.4	2.92	0.6	20.9	Waterlogged
GM2	07/02/2023	1032	0	0.7	2.89	0.8	21.1	Damp
GM2	14/03/2023	1001	0	0.4	3.27	0.7	20.8	Damp
GM2	12/04/2023	981	0	0.5	0.42	0.5	20.7	Damp
GM2	03/05/2023	1018	0.6	0.6	-0.28	0.5	20.3	Damp
GM2	21/06/2023	1012	0	0.1	0.07	-0.4	21.1	
GM2	06/07/2023	1006	0	1.1	-0.07	0.2	19.7	
GM2	22/08/2023	1011	0.2	0.1	0.16	-0.2	21.4	
GM2	15/09/2023	1009	0.4	1	0.56	0.1	20.1	
GM2	31/10/2023	Borehole Not Identified						
GM2	28/11/2023	Borehole Not Identified						
GM2	14/12/2023	Borehole Not Identified						
GM4	05/01/2023	1008	0	0.3	-5.99	0.7	20.9	Damp
GM4	07/02/2023	1028	0	0.1	-10.67	0.4	20.9	Damp
GM4	14/03/2023	999	0	0.6	0.38	0.4	20.4	Damp
GM4	12/04/2023	978	0	0.7	0.75	0.6	20.6	Damp
GM4	03/05/2023	1015	0.5	1.3	1.81	0.4	18.6	Damp
GM4	21/06/2023	1012	0	0	0.16	-0.3	21.3	
GM4	06/07/2023	1005	0	0	-0.02	0.3	20.6	Dry
GM4	22/08/2023	1014	0.2	0.5	0.32	-0.2	20.9	Damp
GM4	15/09/2023	1005	0	1.4	-0.03		19.4	Damp
GM4	31/10/2023	Borehole Not Identified						
GM4	28/11/2023	Borehole Not Identified						
GM4	14/12/2023	Borehole Not Identified						

Location	Date	Baro	CH4Stable	CO2Stable	DiffPress	FlowrateVol	O2Stable	Ground conditions
		mb	%	%	mb	l/h	%	
GM5	05/01/2023	1006	0	1.3	-0.51	0.7	18.4	Damp
GM5	07/02/2023	1027	0	1.2	-4.91	0.7	19.5	Damp
GM5	14/03/2023	997	0	0.6	-0.36	0.5	19.9	Damp
GM5	12/04/2023	975	0	0.8	-0.3	0.5	19.6	Damp
GM5	03/05/2023	1013	0.6	1.8	-0.02	0.5	16.8	Dry
GM5	21/06/2023	1008	0	0	0.19	-0.3	21.4	
GM5	06/07/2023	1002	0	2.9	0.12	0.3	18.5	Dry
GM5	22/08/2023	1012	0.1	3.7	0.07	-0.1	14.7	Damp
GM5	15/09/2023	1005	0.3	4.7	0.21	-0.1	15	Damp
GM5	31/10/2023	Location is not accessible						
GM5	28/11/2023	998	0.5	0.3	0.18	0	19.7	Damp
GM5	14/12/2023	No Data Recorded						
GM7	07/02/2023	1027	0	0	-0.46	0.6	21.2	Damp
GM7	14/03/2023	997	0	0	-32.84		20.2	Damp
GM7	12/04/2023	974	0.1	0	-5.15	0.3	21.2	Damp
GM7	03/05/2023	1014	0.6	0	-0.37	0.5	20.7	Damp
GM7	21/06/2023	1008	0	2.6	0.18	-0.4	20.4	
GM7	06/07/2023	Location is not accessible						
GM7	22/08/2023	1012	0.2	3.7	0.16	-0.2	15	Damp
GM7	15/09/2023	1005	0.3	4.8	5.33	-0.1	20.2	Damp
GM7	31/10/2023	Borehole Not Identified						
GM7	28/11/2023	Borehole Not Identified						
GM7	14/12/2023	Borehole Not Identified						
GM8	05/01/2023	1007	0	0.7	1.04	0.6	20	Damp
GM8	07/02/2023	1027	0	0.6	-8.6	0.8	20.6	Dry
GM8	14/03/2023	997	0	0.5	-0.33	0.7	20.4	Damp
GM8	12/04/2023	976	0	0.6	-0.02	0.5	20.2	Damp
GM8	03/05/2023	1014	0.5	1.1	2.34	0.7	19.4	Damp
GM8	21/06/2023	1008	0	1	1.76	-0.3	20.2	
GM8	06/07/2023	1002	0	1.3	-0.07	0.3	20.2	Dry
GM8	22/08/2023	1012	0.2	2.1	-0.05	-0.2	19.6	Damp
GM8	15/09/2023	1005	0.3	1.5	0.12	-0.1	19.9	Damp
GM8	31/10/2023	988	0	1.5	-0.05	0	18.9	Damp
GM8	28/11/2023	999	0.1	1.5	0.32	0.4	18.9	Damp
GM8	14/12/2023	No Data Recorded						

Appendix C
Groundwater Level Monitoring Data

Appendix B Table 1 Groundwater level data (mAOD) for 2023

Date	BH1	BH12	BH13	BH14	BH15	BH3	BH3A	BH6	BH9
05/01/2023	72.25	66.58	83.71	83.90	82.41	73.58	75.48	88.29	86.82
07/02/2023	71.92	64.64	77.23	IA	70.14	70.18	70.99	86.24	77.78
14/03/2023	72.56	66.35	83.23	84.21	75.44	73.86	75.71	84.37	83.61
12/04/2023	72.12	66.06	79.61	84.44	75.23	73.38	74.65	87.72	80.74
03/05/2023	71.99	65.06	78.22	83.15	71.48	71.64	73.03	83.62	78.71
15/06/2023	69.1	63.22	76.93	74.03	70.19	66.32	67.11	85.36	Dry
06/07/2023	66.94	62.89	75.18	69.14	69.94	64.70	65.23	84.24	Dry
22/08/2023	71.02	64.18	76.51	73.92	70.08	68.89	69.78	86.19	Dry
15/09/2023	68	63.00	76.33	69.28	69.57	65.61	66.26	81.92	Dry
31/10/2023	IA	65.61	IA	80.05	72.36	IA	IA	N/A	81.87
28/11/2023	IA	65.46	78.67	79.90	72.5	IA	IA	86.02	81.44
14/12/2023	IA	66.12	IA	82.78	79.05	IA	IA	87.85	85.18

Note: IA = Borehole Inaccessible

Appendix D
Groundwater Quality Monitoring Data

Appendix D Table 1 Quarterly groundwater quality data for 2023

Location	Date	Alkalinity as CaCO3	Ammoniacal Nitrogen as N	Calcium	Chloride	Conductivity- Electrical 20deg	Ionic balance	Iron	Magnesium	Naphthalene	Nitrogen (total oxidised) as N	pH	Potassium	Sodium	Sulphate as SO4	TOC (filtered)
		mg/l	mg/l	mg/l	mg/l	µS/cm	%	µg/l	mg/l	µg/l	mg/l	pH units	mg/l	mg/l	mg/l	mg/l
BH1	05/01/2023	144	<0.06	54.5	7	291	5.1	25	6	0.01	0.7	7.4	5.83	4.38	6.3	4.6
BH1	13/04/2023	174	0.12	65.9	8.3	390	3.4	25	9.2	0.013	0.7	7.4	6.4	7.3	24.9	4.5
BH1	06/07/2023	243	<0.06	93.9	13.7	514	4.2	125	15	0.01	0.7	8.2	8.7	12	43	5.3
BH1	31/10/2023	Inaccessible														
BH12	05/01/2023	354	<0.06	157	31.2	940	1.4	30	31.3	0.01	4	7.2	7.52	20.1	140	6.2
BH12	13/04/2023	387	<0.06	160	37.7	1050	-1.3	39	33	0.01	1.6	7.4	12	30	179	7.2
BH12	06/07/2023	389	<0.06	190	65.2	1160	1.7	25	39	0.111	0.7	7.7	16	52	252	11.7
BH12	31/10/2023	Inaccessible														
BH13	05/01/2023	445	0.64	131	45.7	1030	-1.9	25	55.7	0.01	2.4	7.1	6.62	23.1	119	3.4
BH13	13/04/2023	349	<0.06	120	37.8	910	3.8	25	46	0.01	5.4	7.5	6.1	24	83.3	3.2
BH13	06/07/2023	373	<0.06	120	39.5	834	4.4	25	47	0.01	5.6	7.9	7	28	64.7	4
BH13	31/10/2023	Inaccessible														
BH14	05/01/2023	333	<0.06	96	13.3	612	2	25	30.7	0.01	3.1	7.4	0.72	4.95	4.4	1.9
BH14	13/04/2023	330	<0.06	92.4	9	606	5.9	25	28	0.022	3.5	7.3	0.87	24	4.4	1.4
BH14	06/07/2023	334	<0.06	100	7.2	529	4.8	25	31	0.01	3.2	7.9	1	6	4.4	1.6
BH14	31/10/2023	Inaccessible														
BH3	05/01/2023	283	<0.06	100	70.9	712	0.2	25	27.5	0.01	0.7	7.5	1.64	23.2	29.7	2.9

Location	Date	Alkalinity as CaCO3	Ammoniacal Nitrogen as N	Calcium	Chloride	Conductivity- Electrical 20deg	Ionic balance	Iron	Magnesium	Naphthalene	Nitrogen (total oxidised) as N	pH	Potassium	Sodium	Sulphate as SO4	TOC (filtered)
		mg/l	mg/l	mg/l	mg/l	µS/cm	%	µg/l	mg/l	µg/l	mg/l	pH units	mg/l	mg/l	mg/l	mg/l
BH3	13/04/2023	199	<0.06	59.2	23.5	434	1.2	25	17	0.01	0.7	7.7	1.5	14	11.5	2.4
BH3	06/07/2023	296	<0.06	90.4	33.9	603	1.8	25	25	0.01	0.7	8.2	2.1	20	17.4	2.2
BH3	31/10/2023	Inaccessible														
BH3A	05/01/2023	219	<0.06	72.6	47.3	526	1.5	34	15.8	0.01	0.7	7.5	2.94	20.4	4.4	9.1
BH3A	13/04/2023	271	<0.06	78.7	39.6	590	2.5	25	23	0.011	0.7	7.5	2.1	26	6.1	4.7
BH3A	06/07/2023	276	<0.06	110	34	773	-1.6	25	30	0.01	0.7	8.1	3.8	25	142	3.5
BH3A	31/10/2023	Inaccessible														
BH6	05/01/2023	Blocked														
BH6	13/04/2023	Blocked														
BH6	06/07/2023	303	<0.06	84.8	19.9	526	5.4	25	36	0.01	0.7	7.8	2.2	9.6	12.9	1.2
BH6	31/10/2023	Inaccessible														
BH9	05/01/2023	319	<0.06	107	18.9	613	0.7	25	18.4	0.01	3.3	7.5	7.63	6.79	4.9	3
BH9	13/04/2023	294	<0.06	100	15.6	569	2	31	16	0.01	2.8	7.5	9.2	7.9	4.7	2.7
BH9	06/07/2023	Dry														
BH9	31/10/2023	Inaccessible														

Appendix D Table 2 Annual groundwater quality data 2023

Location	Date	Cadmium µg/l	Chromium mg/l	Copper mg/l	Lead mg/l	Manganese mg/l	Nickel mg/l	Zinc mg/l
BH1	13/04/2023	<0.07	0.51	3.2	<0.0003	0.0084	1.5	13
BH12	13/04/2023	<0.07	0.51	7.3	<0.0003	0.0064	2.9	14
BH13	13/04/2023	<0.07	0.51	2.4	<0.0003	0.0031	2.2	<6
BH14	13/04/2023	<0.07	1.1	1.8	<0.0003	0.001	<1	<6
BH15	31/10/2023	Missed Visit						
BH3	13/04/2023	<0.07	0.51	2.2	<0.0003	0.0022	<1	<6
BH3A	13/04/2023	<0.07	0.51	2.9	<0.0003	0.0038	<1	<6
BH6	13/04/2023	Inaccessible						
BH9	13/04/2023	<0.07	1.4	3.7	<0.0003	0.0081	2.1	<6

Appendix E
Topographic Survey

311600E

311700E

311800E

173500N

173400N

7457

BH
116.65

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

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

GF06 (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

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

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

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

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

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

BH6
CL:113.40
GL:112.69

GM5
CL:112.93
GL:112.34

GM4
CL:92.53

BH3
CL:90.69

BH3A
CL:90.04

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

BH13 (06/2021)
CL:106.71
GL:106.28

STN
peg

Ungraded
Tipped Material

Gate

'Cut' Drainage Grip

Stone Filled Grip

Edge of Disturbed Ground

Infill Placed
Since 04/03/2022

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

Exposed Head of
Clay Barrier: 01/2019

Peg

Speed Ramp

Path (um)

Stile

Tarmac
Surface
Ends

Gate

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	Rodding 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

5.090

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.

App	= 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
Lar	= 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).

gsurv
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Client
Cemex UK Materials Ltd

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

Title
Topographic Site Survey
as Surveyed 23rd November 2023

Drawn By	Scale	Date
D Mildenhall	1:500 @A1	04/12/2023

Drawing No.
dwg 23 615/001_0

Rev.
00