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ROYAL ELM PARK SUMMARY OF GROUNDWATER QUALITY & GROUND GAS RESULTS

**SUMMARY OF GROUNDWATER QUALITY & GROUND GAS RESULTS
ROYAL ELM PARK**

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1. INTRODUCTION

1.1 General Introduction

This report presents a summary of periodic groundwater and ground gas monitoring undertaken at Royal Elm Park ('the Site') near Select Car Leasing Stadium, Reading RG2 0FL. The assessment was undertaken by Ramboll UK Ltd. ('Ramboll') on behalf of RFC PropCo Ltd, in accordance with Ramboll's proposal dated October 2021 (Ref. 1620013486).

A map showing the location of the Site is presented in Figure 1 (Appendix A), with a Site layout plan presented in Figure 2.

1.2 Key Project Objective

The key objective of the review detailed herein was to:

- review available groundwater monitoring data for the Site to understand current groundwater and leachate quality conditions;
- determine groundwater trigger level values in advance of intended development works at the Site, using the methodology defined by Ove Arup & Partners Ltd. ('Arup'); and
- review available ground gas monitoring data for the Site to understand current ground gas conditions.

1.3 General Limitations

The conclusions presented in this report represent Ramboll's best professional judgment based upon the information available and conditions existing as of the date of this report. In performing its assignment, Ramboll must rely upon publicly available information, information provided by the Client and information provided by third parties. Accordingly, the conclusions in this report are valid only to the extent that the information provided to Ramboll was accurate and complete. This review is not intended as legal advice, nor is it an exhaustive review of Site conditions or facility compliance. Ramboll makes no representations or warranties, expressed or implied, about the conditions of the Site.

Ramboll's scope of work for this assignment did not include a site visit or the collection of samples of any environmental media. As such, this review cannot rule out the existence of latent conditions including contamination not identified and defined by the data and information available for Ramboll's review; however, this report is intended, consistent with normal standards of practice and care, to assist the Client in identifying the risks of such latent conditions.

Furthermore, the sample data reviewed by Ramboll was provided by third parties and, therefore, we have assumed that such samples were obtained in accordance with appropriate guidance and standards.

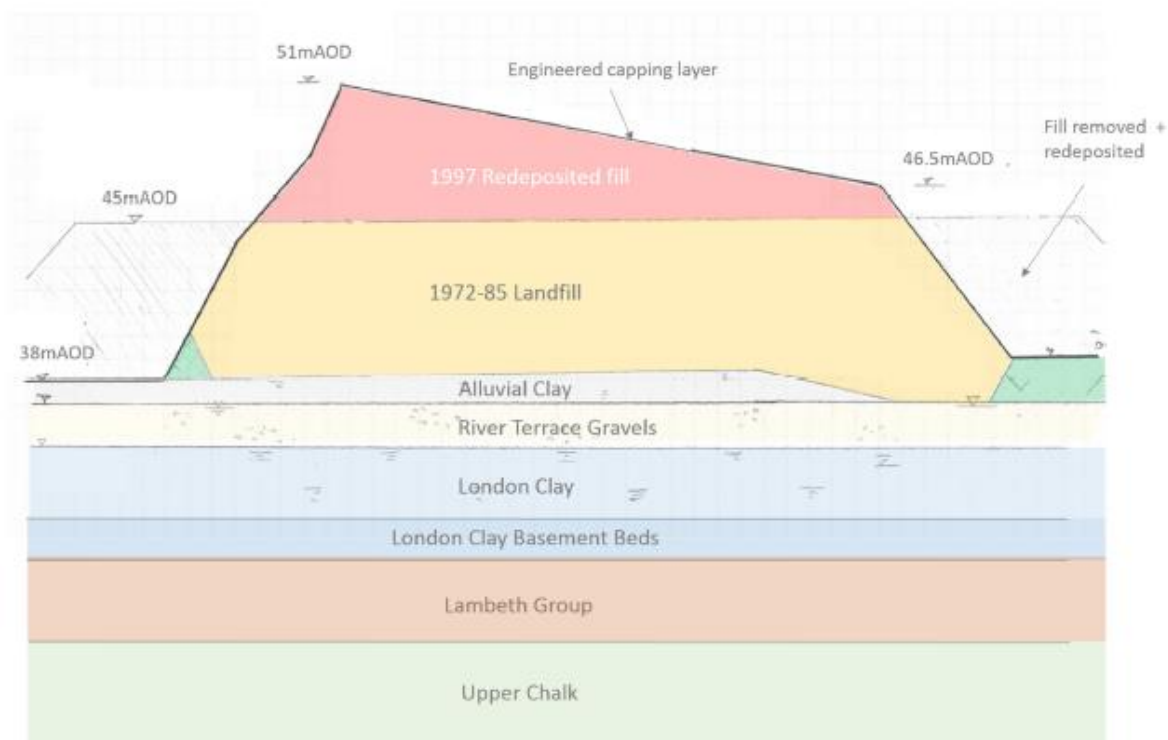
2. DATA AVAILABILITY AND MONITORING WELL NETWORK

2.1 Data Provided

Groundwater monitoring results were received from RFC's subcontractor, Miles German. These data were provided to Ramboll in raw state from the laboratory, without collation. The consolidation of these data required significant effort, particularly because some well designations varied slightly between monitoring rounds.

2.2 Ground Conditions

A network of groundwater monitoring wells at the Site was installed at various stages, which are screened in the various landfill deposits and geological formations beneath the site. A simplified schematic cross section is presented below (taken directly from Arup¹) and summarises the relationships between these formations.



The table below is extracted from Arup⁽¹⁾ and summarises the proven ground conditions:

Strata	Thickness (m)	Typical level of base (mAOD)
Made Ground (engineered clay cap)	1-1.3	42.4
Made Ground (waste soils)	6-8	37.7
Alluvial Clays	0 - 2.0	37.2
River Terrace Gravels	0.3 - 2.0	36.2
London Clay - Soft to Firm becoming Stiff sandy Clay	1.0 - 7.5	30.3

¹ Ove Arup & Partners Ltd., Proposed Redevelopment at Madejski Stadium, Environmental Strategy, on behalf of Reading Football Club, Ref. REP-240524-E002, 2 November 2017;

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Strata	Thickness (m)	Typical level of base (mAOD)
London Clay Basement Bed - Dense grey silty fine sand locally cemented to form a strong grey green conglomerate	2.0 - 4.0	27.2
Lambeth Group (formerly Reading Beds) - Stiff to very Stiff mottled blue grey and red slightly sandy Clay	~ 20	~7.2
Seaford Chalk Formation & Newhaven Chalk Formation		

2.3 Monitoring Well Network

Monitoring wells have been installed at various stages of investigation across the Site by Arup and other parties. Some wells have been 'lost' over time due to various works, such as resurfacing activities, across the Site. Therefore, the monitoring well network has changed significantly over time.

The key elements of the well network relevant to the assessment herein include:

- **Leachate Wells (LW01 to LW03)** – which are installed with dual screens to separately monitor older landfill waste and the overlying redeposited materials.
- **Wells A to O, U and V** – screened in River Terrace Gravel ('RTG') deposits.
- **'300-series' Wells & BH1-3** – Screened in a mixture of River Terrace Gravel and the bed-rock formations underlying the London Clay i.e. the Lambeth Group and the Chalk Seaford Chalk Formation & Newhaven Chalk Formation ('Chalk').

3. DETERMINATION OF GROUNDWATER TRIGGER VALUES

Arup⁽ⁱ⁾ developed a methodology for the determination of contaminant trigger concentrations, following requests made by the Environment Agency ('EA'), during a meeting on 6 October 2015 and in a letter of 29 October 2017.

The key objective of the agreed methodology was to determine reference concentrations ('trigger levels') for selected contaminants groundwater during the proposed construction works. If these trigger levels are exceeded during the course of the construction programme, particular actions will need to be implemented.

The following general principles were agreed by Arup with the Environment Agency and form the basis of the methodology for determining the trigger levels:

- The overall technical objective for adopting trigger levels is to minimise worsening of existing groundwater contamination in the Chalk aquifer.
- There will be a pre-construction monitoring period of three months.
- The leachate sumps (LD series) and leachate monitoring wells (LW series) will be pumped out prior to construction.
- Additional dewatering wells will be constructed into the landraise to extract leachate from the base of the landraise prior to construction. These new wells will be used to dewater leachate prior to construction and leachate will be disposed of to the foul sewer.
- Ammoniacal nitrogen is the only contaminant of concern for which trigger levels are required.
- It is acknowledged that concentrations of ammoniacal nitrogen in groundwater at the site have been rising, since the nearby brewery abstraction well ceased in 2009/10.
- Groundwater flow directions at the site will be established from review of data from existing boreholes. This is to confirm which boreholes require trigger levels i.e., those in the River Terrace Gravel ('RTG') aquifer that are down-hydraulic gradient of the construction works.

The methodology involves establishing the background concentration of ammoniacal nitrogen in each of down-hydraulic gradient wells that are screened in the RTG. The background concentrations are defined as the highest concentration measured in that particular borehole, over the previous five years (i.e., five years prior to the planned start of construction). The following methodology for determining the trigger levels is proposed:

- wells screened in the RTG (excluding BHM) where ammoniacal nitrogen was previously detected will have a trigger value of 30% above the identified background concentration for each well,
- wells screened in the RTG with 'low' or below detection limit concentrations of ammoniacal nitrogen will have a trigger level of 10mg/l;
- wells screened in the Chalk (excluding BHX) where ammoniacal nitrogen was previously detected will have a trigger value of 20% above the identified background concentration for each well; and
- wells screened in the Chalk with 'low' or below detection limit concentrations of ammoniacal nitrogen will have a trigger level of 3mg/l.

These criteria are summarised in the table below:

Summary of Trigger Level Methodology

Screened Formation	Historical Monitoring Results	
	Previously detected at significant concentrations	Low or below detection limits
River Terrace Gravels	30% above the identified background concentration	10mg/L
Chalk	20% above the identified background concentration	3mg/L

In agreement with the EA, the following should be noted:

- Borehole M is excluded as the response zone is partially in the Made Ground. This was replaced in 2016 with BH02, which will be assigned a trigger value.
- Borehole X is excluded, as it is inaccessible and was replaced in 2016 by BH01, which will be used to monitor ammoniacal nitrogen concentrations in the Chalk and will be assigned a trigger value.
- Borehole 328 is excluded, as it is inaccessible and this was replaced in 2017 by BH03, which will be used to monitor ammoniacal nitrogen concentrations in the Chalk and will be assigned a trigger value.

A list of the proposed trigger values for each borehole recording groundwater data will be drawn up and agreed with the EA.

4. SUMMARY OF MONITORING RESULTS 2016-2021

4.1 Leachate Wells

Wells screened in leachate (LW01, LW02 and LW03) have not been monitored since 11 September 2018. These wells are dual installations, with lower parts screened across 'old' waste at the bottom of the landfill and upper parts screened in the newer, re-deposited wastes above.

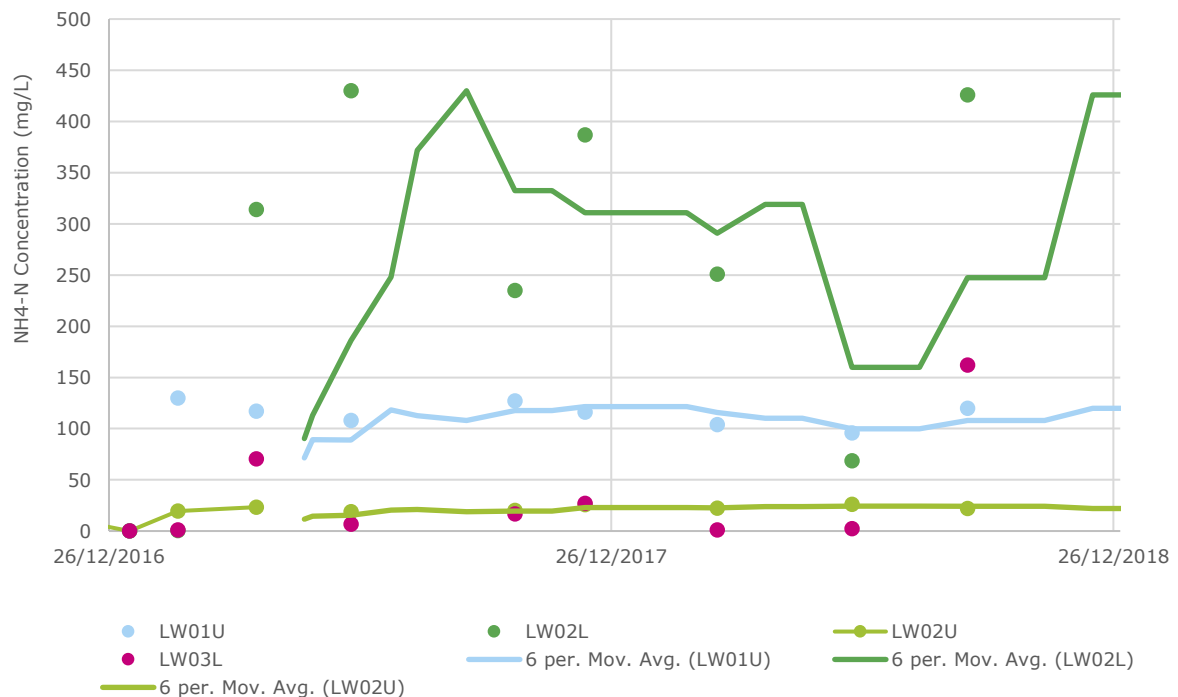
According to the Environment Agency, the measurement of trigger levels in these wells is not required, however the available historical data have been considered below to provide an assessment of concentration trends within the landfill mass.

A summary of the monitored concentrations between 2016 and 2018 is provided in the table and graph below.

Table 4.1 – Summary of Ammoniacal Nitrogen Concentrations in Leachate Wells

Well	No. Samples	Summary of Results 2016-2021 (mg/L)			
		Minimum	Average	Maximum	Standard Deviation
LW01U	9	95.7	114	130	47.2
LW02L	9	0.5	250	430	172.2
LW02U	9	15.0	21	26	9.2
LW03L	9	0.9	32	162	49.7

Graph 4.1 – Summary of Ammoniacal Nitrogen Concentrations in Leachate Wells



These results indicated that concentrations of ammoniacal nitrogen remained broadly similar over the monitored period, although concentrations demonstrated some seasonal fluctuation, particularly in LW02U.

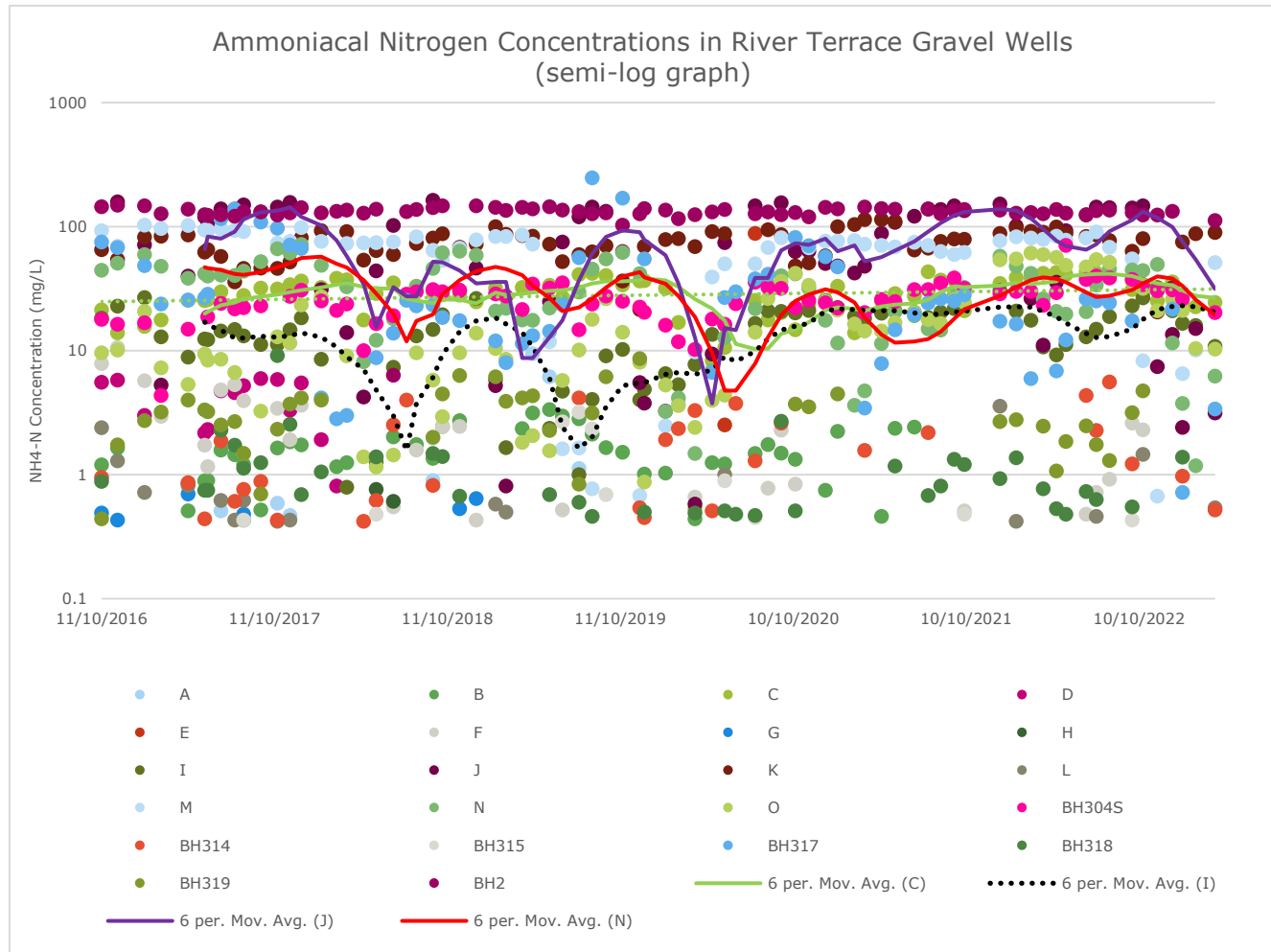
4.2 Wells Screened in River Terrace Gravel

Wells A to O, and BH2, BH304s, 314-319 are screened in the River Terrace Gravels beneath the Site. A summary of the monitored concentrations between 2016 and February 2023 is provided in the table and graph below.

Table 4.2 – Summary of Ammoniacal Nitrogen Concentrations in River Terrace Gravel Wells

Summary of Results 2016 - February 2023 (mg/L)					
Well	No. Samples	Minimum	Average	Maximum	Standard Deviation
A	39	0.0	1	9	1.3
B	54	0.0	1	3	1.0
C	74	0.5	29	43	10.2
D	19	0.0	3	6	1.7
E	8	0.0	11	88	10.1
F	73	0.0	1	11	1.9
G	65	0.0	0	1	0.2
H	74	0.0	0	1	0.2
I	73	0.0	14	32	8.4
J	67	0.0	76	163	59.9
K	72	20.5	74	114	25.9
L	72	0.0	0	4	0.6
M	71	0.0	61	103	34.5
N	72	1.2	32	72	19.6
O	74	0.0	18	61	16.6
BH304S	71	4.4	26.1	70	11.0
BH314	73	0.0	0.7	6	1.3
BH315	73	0.0	0.2	3	0.6
BH317	65	0.0	38.4	247	43.4
BH318	73	0.0	0.6	9	1.2
BH319	58	0.0	2.2	9	2.0
BH2	70	6.35	130.8	149	39.2

Table 4.2 – Summary of Ammoniacal Nitrogen Concentrations in River Terrace Gravel Wells (semi-log graph)



Note that the screen of Well M reportedly intersects waste materials, therefore the detected concentrations are unlikely to be representative of those in the RTG. Therefore, this well has not been considered further in the assessment of ammoniacal concentration trends in the RTG.

Key observations include:

- There is clear seasonal variation in many wells, with a decrease in concentrations during spring and summer months.
- Notwithstanding the seasonal fluctuation, concentrations appear to have been relatively stable over the monitoring period.

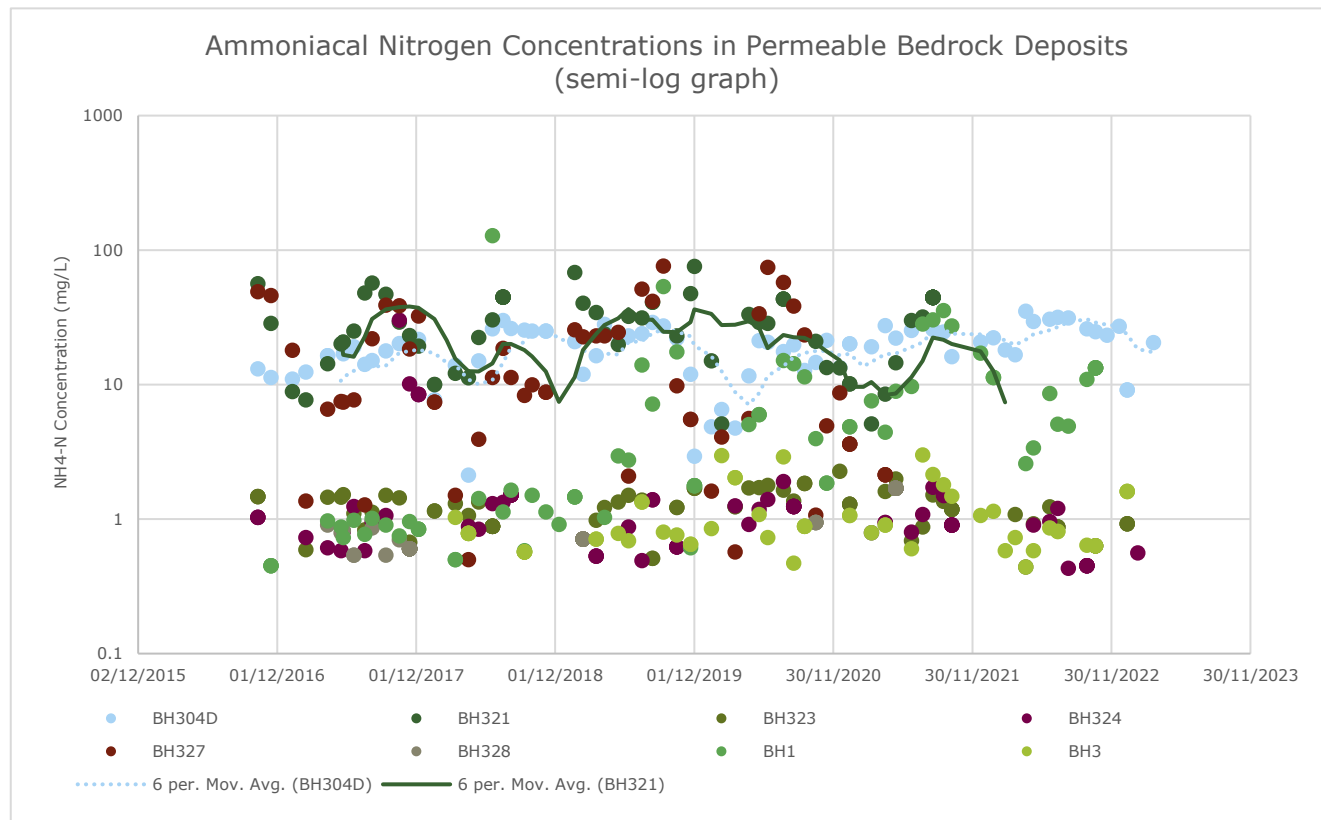
4.3 Wells Screened in Permeable Bedrock Deposits

Wells from the '300' series (BH304d, 321, 323, 324, 327, 328) were reportedly installed into more the more permeable bedrock deposits (i.e. the Lambeth Group and the Chalk) which underlie the less permeable London Clay. A summary of the monitored concentrations between 2016 and February 2023 is proved in the table and graph below.

Table 4.3 – Summary of Ammoniacal Nitrogen Concentrations in Permeable Bedrock Deposits (Reading Beds & Chalk)

Summary of Results 2016 – February 2023 (mg/L)					
Well	No. Samples	Minimum	Average	Maximum	Standard Deviation
BH304D	71	2.1	19.6	35	8.7
BH321	48	1.2	27.5	75	18.8
BH323	72	0.0	0.8	2	0.7
BH324	58	0.0	5.7	248	28.6
BH327	52	0.0	34.9	876	100.7
BH328	16	0.0	0.6	2	0.3

Graph 4.3 – Summary of Ammoniacal Nitrogen Concentrations in Permeable Bedrock Deposits (Reading Beds & Chalk) (semi-log graph)



Note - to permit clarity of lower concentrations, -the graph above excludes the concentration of 876mg/L of ammoniacal nitrogen that was detected in BH327 in July 2021. The concentration is considered to be an anomaly (possibly a record error) since it exceeds all other recordings by a factor of 8.

Key observations include:

- There is clear seasonal variation in many wells, with a decrease in concentrations during spring and summer months.
- Notwithstanding the seasonal fluctuation, concentrations appear to have been relatively stable over the monitoring period.

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5. CALCULATION OF TRIGGER LEVELS

Based on the criteria detailed in Section 3, the following trigger levels have been determined for the monitoring well network.

Table 5.1 – Summary of Trigger Levels for Leachate Wells

Well	Maximum Detected Concentration (2016 - February 2023)	Recommended Trigger Level
LW01U	130 mg/L	169 mg/L
LW02L	430 mg/L	559 mg/L
LW02U	26.2 mg/L	34.06 mg/L
LW03L	162 mg/L	210.6 mg/L

Table 5.2 – Summary of Trigger Levels for Wells Screened in River Terrace Gravel

Well	Maximum Detected Concentration (2016-2021)	Recommended Trigger Level
A	9.42 mg/L	10 mg/L
B	3.35 mg/L	10 mg/L
C	43.3 mg/L	56.29 mg/L
D	5.96 mg/L	10 mg/L
E	87.9 mg/L	114.27 mg/L
F	10.6 mg/L	13.78 mg/L
G	0.7 mg/L	10 mg/L
H	0.85 mg/L	10 mg/L
I	32.3 mg/L	41.99 mg/L
J	163 mg/L	211.9 mg/L
K	114 mg/L	148.2 mg/L
L	3.57 mg/L	10 mg/L
N	71.7 mg/L	93.21 mg/L
O	61 mg/L	79.3 mg/L
BH304S	70.4 mg/L	91.52 mg/L
BH314	5.6 mg/L	10 mg/L
BH315	3.2 mg/L	10 mg/L
BH317	247 mg/L	321.1 mg/L
BH318	9.12 mg/L	10 mg/L
BH319	8.6 mg/L	10 mg/L
BH2	149 mg/L	193.7 mg/L
Notes:		
M is excluded as the response zone is partially in the Made Ground, this is replaced by BH02.		

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Table 5.3 – Summary of Trigger Levels for Wells Screened in Permeable Bedrock

Well	Maximum Detected Concentration (2016-2021)	Recommended Trigger Level
BH304D	35.1 mg/L	42.12 mg/L
BH321	75.4 mg/L	98.48 mg/L
BH323	2.27 mg/L	3 mg/L
BH324*	30 mg/L*	3 mg/L
BH327*	75.8 mg/L*	90.96 mg/L
BH1	128 mg/L	3 mg/L
BH3	3 mg/L	3 mg/L
Notes: BH328 is excluded, as inaccessible, and is replaced by BH03. X is excluded, as inaccessible, and is replaced by BH01. The trigger level calculations for BH324 and BH328 are revised to excluded data that are considered to be inaccurate.		

6. REVIEW OF GROUND GAS MONITORING DATA

Ground gas monitoring has been undertaken on the site since July 1996, prior to the development of the Select Car Leasing Stadium. Ground gas analysis has been undertaken for a range of compounds including methane, carbon dioxide, oxygen, carbon monoxide and hydrogen sulphide.

The ground gas monitoring wells are located around the periphery and within the landfill with monitoring undertaken under the Environmental Permit. Over the period the monitoring programme has been reviewed, rationalised and amended with a range of monthly and quarterly monitoring.

6.1 Monitoring Well Network

Monitoring wells have been installed at various stages of investigation across the Site by Arup and other parties. Some wells have been 'lost' over time due to various works, such as resurfacing activities, across the Site. Therefore, the monitoring well network has changed significantly over time, since 2017 the gas monitoring wells have included the following locations.

The key elements of the well network relevant to the assessment herein include:

- **Perimeter wells (A to O and V)** – primarily screened in River Terrace Gravel ('RTG') deposits along the perimeter of the site, although BHM noted to intersect the waste material. Monitoring data is available between February 2017 and February 2023 (up to 69 monitoring rounds). It should be noted that only two rounds of monitoring were undertaken at BHV due to frequent inaccessibility.
- **Wells R, S, T and U** – screened in the re-deposited landfill material. Monitoring data is available between February 2017 and February 2023 (up to 69 monitoring rounds).
- **Groundwater Wells (GW01 to GW09)** – some of which are installed with dual screens and primarily screened within the landfill waste material. The bulk of the monitoring data for these wells (from July 2017 to June 2018) has been included within the ground gas assessment.

6.2 Historical Ground Gas Data

Historically the methane and carbon dioxide has been elevated within the waste material in three boreholes BHR, BHS, BHT and BHU. Boundary monitoring wells are predominantly installed in the underlying river terrace gravels, although boreholes BHL and BHM have response zones which also intercept waste material. Methane was not measured in the boundary wells although slightly elevated carbon dioxide concentrations have been recorded in boreholes BHL, BHM and BHN.

Prior to the re-location of the waste from the retail park the gas composition comprised approximately 65% v/v CH₄ and 35% v/v CO₂. Concentrations of methane and carbon dioxide are elevated but consistent. These concentrations and the occasional occurrence of H₂S are indicative of aerobic and anaerobic degradation occurring within the waste mass.

6.3 ARUP Additional Site Characterisation

Additional site characterisation was undertaken by Arup in 2016/2017 with additional ground gas data collection from the waste below the proposed residential buildings and validation of gas readings from Boreholes R, S and T. This work included the installation of gas monitoring wells

GW01 to GW09 (with boreholes terminated at the interface between the waste and the natural ground) and the replacement of BH328 (with a response zone within the Chalk). Continuous gas monitoring was undertaken from GW04 to GW09 to assess concurrent in situ and continuous data.

Gas monitoring results from Boreholes R, S and T were noted to have ground gas flow typically around 0.3-0.4 L/h with a maximum rate of 0.9 L/h in BHS in August 2016. Methane and carbon dioxide were consistently elevated with maximum concentrations of 79%v/v in BHT. It was also noted that GW05 recorded gas data from the waste, immediate adjacent to R, S and T and showed good correlation, confirming that R, S and T are yielding gas results from the waste material.

Gas monitoring results from GW01 to GW09 whose highest flow rates up to 6.6 L/h and methane at 76.1%v/v in GW02 and 82.8%v/v in GW03, elevated flows are also present in GW04, GW06 and GW09. These were noted to be consistent with historical gas data obtained from the other boreholes in the vicinity and the previously collected data.

6.4 Environmental Permit

Following the redeposition of the waste material environmental monitoring of the landfill site is undertaken under the Waste management Licence (Environmental Permit). Gas monitoring is required on a monthly programme, although with the redevelopment of the site the monitoring well network has changed significantly over time from the original permit details.

Requirements for gas monitoring include the following analysis:

- CH₄, CO₂, O₂, atmospheric/standpipe pressures, gas temperatures/flow rate, weather conditions. Monitoring is required monthly across Borehole A to V series and BH310.
- CH₄, CO₂, O₂, N₂, H₂, H₂S (H₂S in-situ). Monitoring is required monthly at 3 of the above locations selected at random.

6.5 Ground Gas Monitoring Data 2017-February 2023

Ground gas monitoring was undertaken monthly between 2017 and February 2023 across a range of boreholes present on the site. A summary of the concentrations is presented below. Gas concentrations and flow rates are provided as steady state.

6.5.1 GW Series

A summary of the ground gas results for the GW series are presented in Table 6.1 and following graphs below. Methane concentrations are consistent with the historic concentration pattern across the site. Assessment is restricted to between July 2017 to June 2018, during the main monitoring period for these wells.

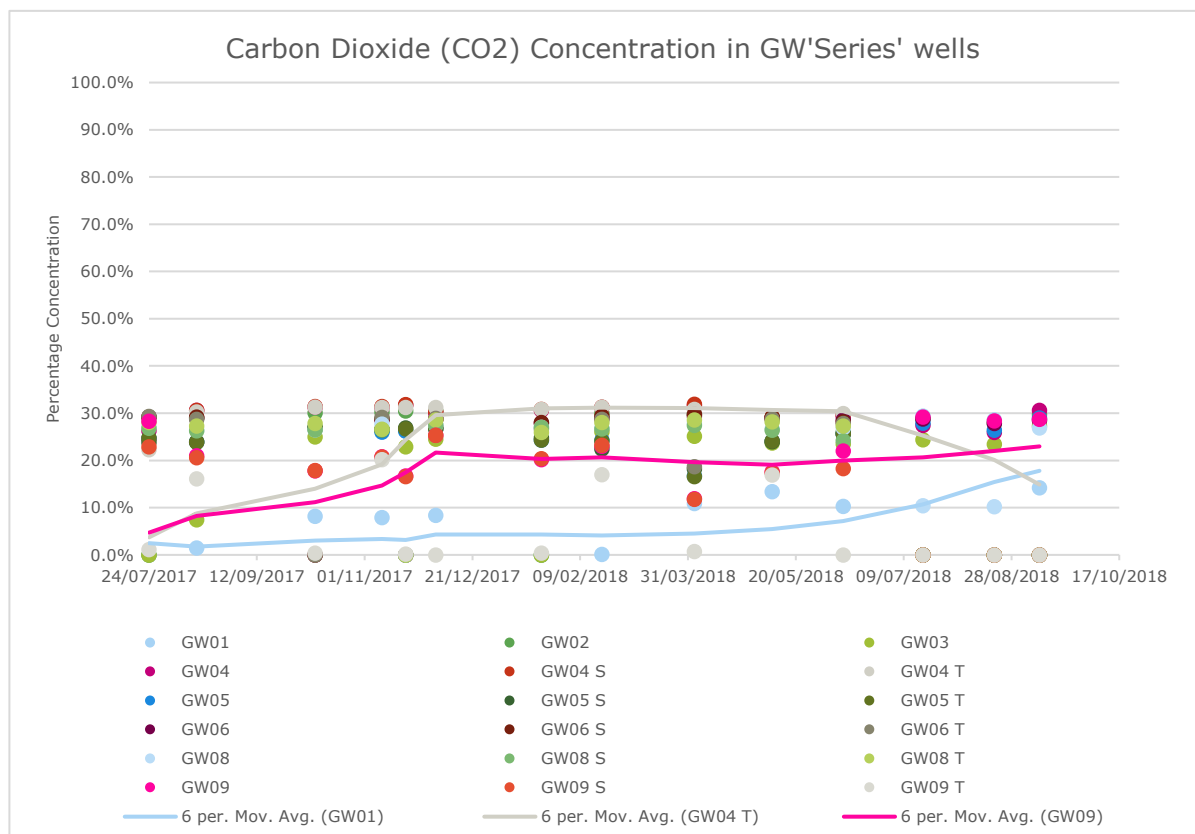
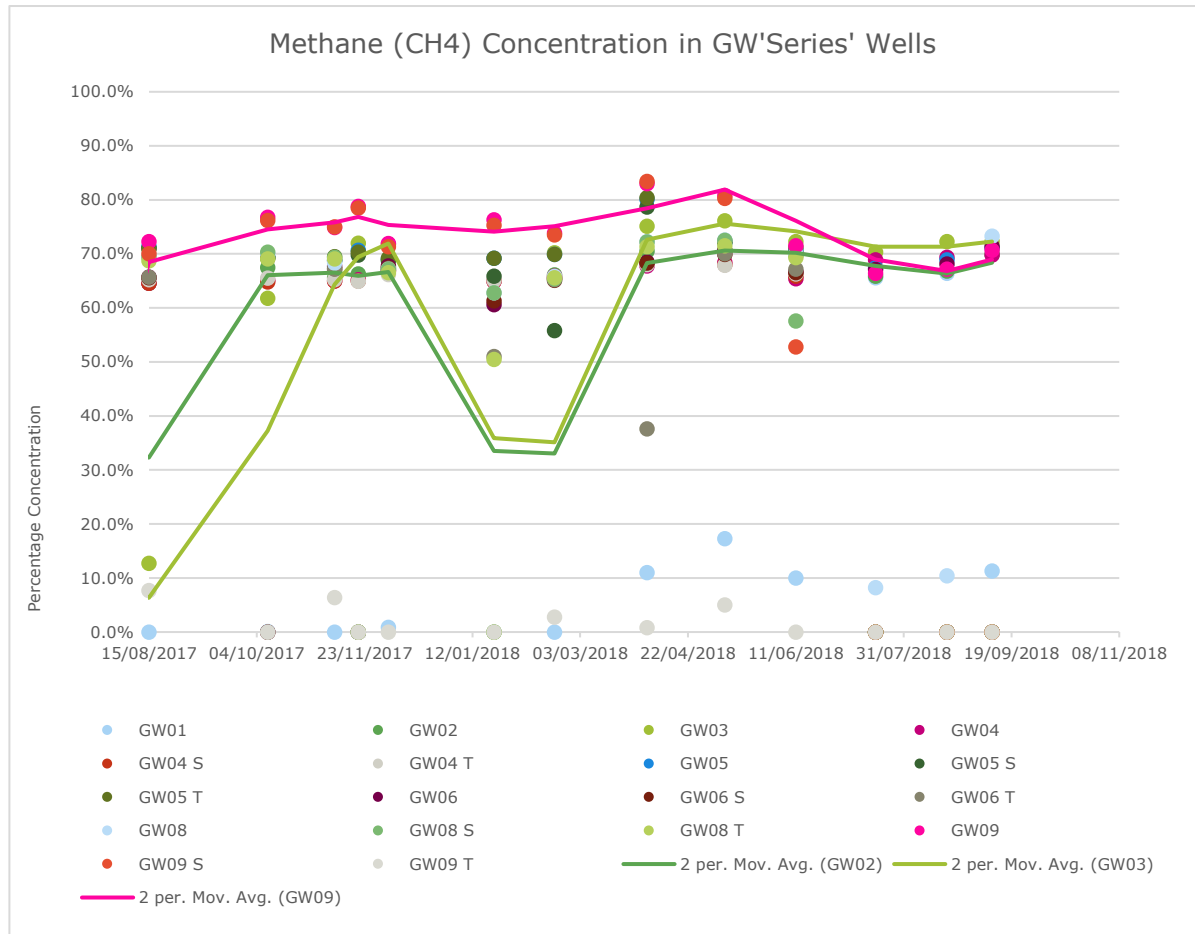
- Methane concentrations were noted to range from 0% to 83.4% with typically concentrations over 60%.
- Carbon dioxide concentrations were noted to range from 0% to 31.9%.
- Gas flow was noted to range from -24.7L/hr to 2L/hr. It is noted that one high flow rate was identified in August 2018 (outside the assessment period) at 32L/hr for GW02.

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Table 6.1 Summary of Ground Gas Monitoring Results (GW series) July 2017-June2018

Well	No. of Monitoring Rounds	Steady State Methane (% v/v)	Carbon Dioxide (% v/v)	Flow (l/hr)
GW01	8	0-66.4	0.1-13.4	-24.7-0.8
GW02	9	64.6-70.7	26-30.5	0.3-0.8
GW03	9	12.7-76.1	7.4-26.4	0-0.9
GW04	11	49.6-69.8	26.3-31.7	-0.2-1.5
GW04 S	11	46.3-68.2	24.6-31.9	0-1.3
GW04 T	11	32.9-68	22.3-31.3	0.1-1.3
GW05	11	67.4-80.1	16.7-27	-0.6-1
GW05 S	11	55.8-78.7	18.2-27	-0.3-1
GW05 T	11	69.1-80.4	16.6-27	-0.7-1.1
GW06	9	60.6-71.4	27.9-29.4	0.2-0.9
GW06 S	9	61.3-69.9	28-29.8	0.2-0.8
GW06 T	9	37.6-70	18.7-29.3	0.2-1
GW08	10	8.2-73.3	26.4-27.8	0.3-1
GW08 S	10	57.6-72.5	24.2-27.5	0-0.8
GW08 T	10	50.5-71.5	25.9-28.6	0.3-1.3
GW09	11	64.7-83	11.9-28.3	0.4-2
GW09 S	11	52.8-83.4	11.8-25.3	0.1-2
GW09 T	11	0-77	0.2-20.2	-5-0.8

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6.5.2 R, S, T and U

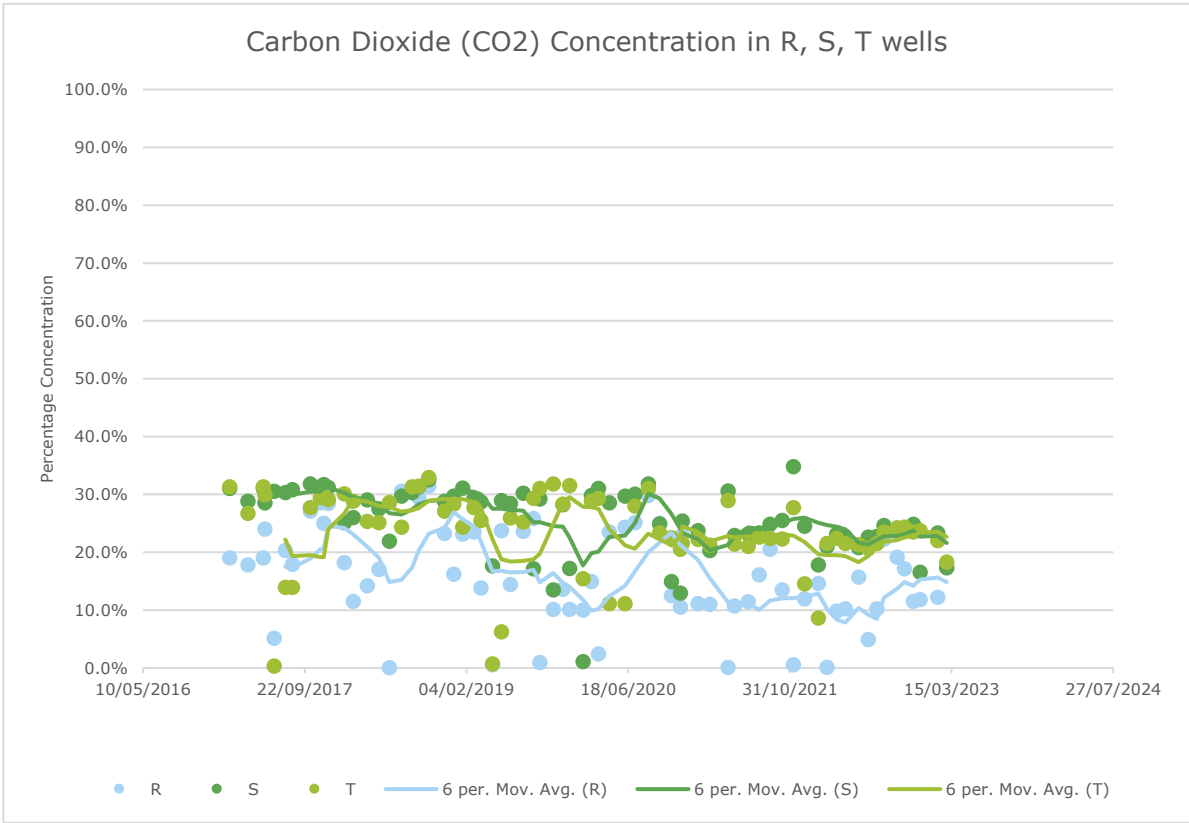
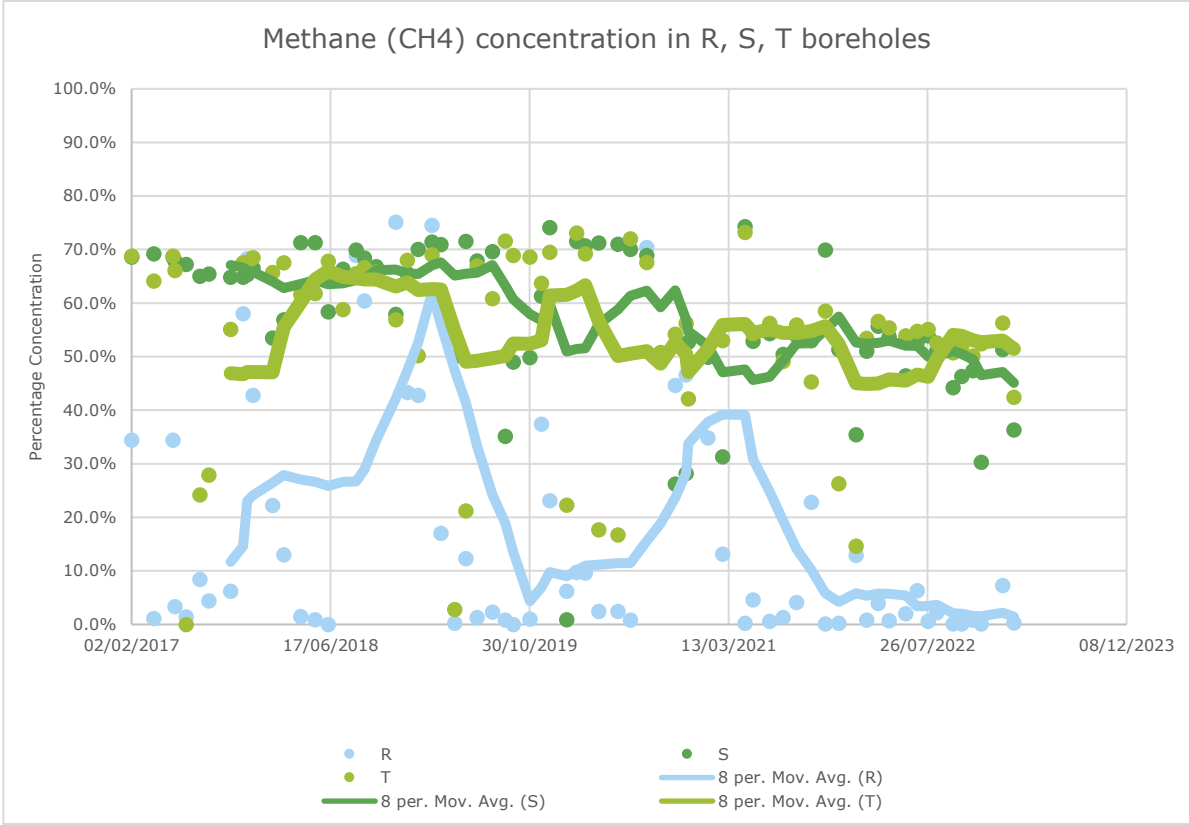
A summary of the ground gas results for the GW series are presented in Table 6.2 and following graphs below. Methane concentrations are consistent with the historic concentration pattern across the site.

- Methane concentrations were noted to range from 0% to 75.1% with typically concentrations in S and T over 50%.
- Carbon dioxide concentrations were noted to range from 0.1% to 34.8%.
- Gas flow was noted to range from -0.6L/hr to 1L/hr.

Table 6.2 Summary of Ground Gas Monitoring Results (R, S, T, U series)

Well	No. of Monitoring Rounds	Steady State Methane (% v/v)	Carbon Dioxide (% v/v)	Flow (l/hr)
BHR	68	0-75.1	0.1-31.4	-0.6-0.7
BHS	69	0.9-74.3	1.1-34.8	-0.3-0.9
BHT	69	0-73.2	0.3-32.9	-0.6-1
BHU	6	0-68.4	0.6-29.9	-0.2-0.4

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6.5.3 Perimeter Wells

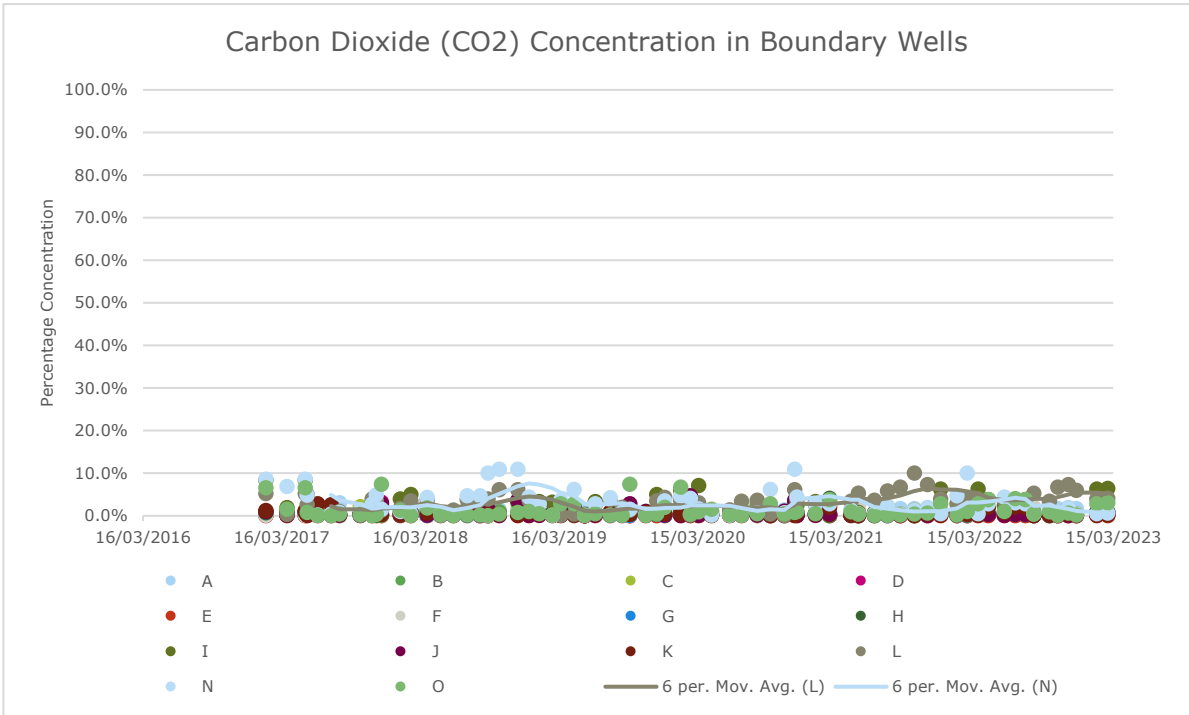
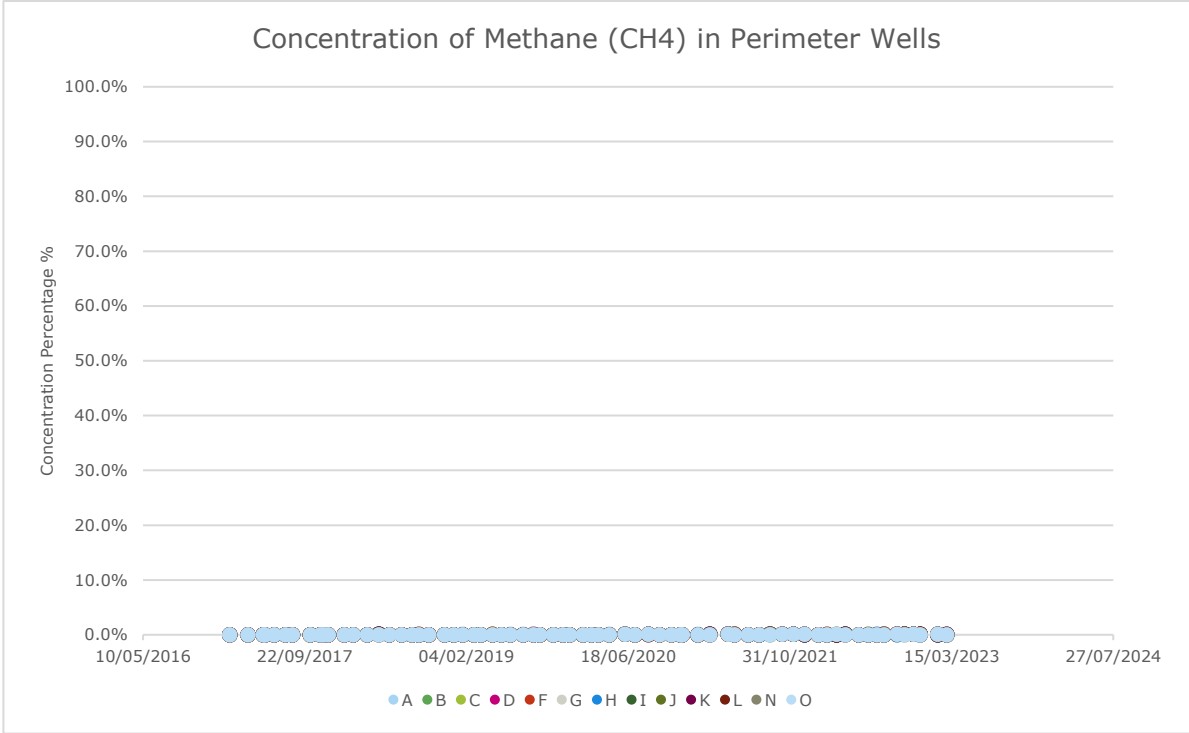
A summary of the ground gas results for the Perimeter Wells are presented in Table 6.3 and following graphs below. Methane concentrations are consistent with the historic concentration pattern across the site.

- Methane concentrations were noted to range from 0% to 0.2%.
- Carbon Dioxide were noted to range from 0% to 10.9%.
- Gas flow was noted to range from -3.4L/hr to 0.1L/hr.

Table 6.3 Summary of Ground Gas Monitoring Results (Perimeter series)

Well	No. of Monitoring Rounds	Steady State Methane (% v/v)	Carbon Dioxide (% v/v)	Flow (l/hr)
BHA	68	0-0.1	0-3	-0.1-1.2
BHB	69	0-0.2	0-2.7	-0.2-0.9
BHC	69	0-0.1	0-2.1	-0.1-0.9
BHD	69	0-0.2	0-3.2	-0.4-0.8
BHE	2	0-0.2	0.5-0.5	0.1-0.1
BHF	67	0-0.1	0-3.2	-0.2-1
BHG	69	0-0.1	0-1.2	-0.2-0.7
BHH	68	0-0.2	0-2.05	-0.1-0.8
BHI	68	0-0.2	0-8.4	-3.4-1
BHJ	69	0-0.1	0-4.9	-0.1-0.7
BHK	68	0-0.1	0-2.8	-2.3-1.1
BHL	69	0-0.1	0-10	-1.4-0.8
BHN	69	0-0.1	0.1-10.9	-3-1.9
BHO	65	0-0.1	0-7.4	-0.3-0.6
BHV	2	0-0.1	0.8-0.9	0-0

SUMMARY OF GROUNDWATER QUALITY & GROUND GAS RESULTS
ROYAL ELM PARK



6.6 Conclusions

Ground gas data has been collected from the site for over 30 years and regularly submitted to the EA for review.

- Monthly ground gas monitoring has been undertaken in line with the Environmental Permit and this review discusses the data from 2017 to February 2023.
- Recent ground gas data has identified gas concentrations and flow rates that are in line with the 30 years of historical data.
- Concentrations of methane and carbon dioxide continue to remain elevated in borehole R, S and T as well as several of the 'GW' borehole series. Highest elevations (84%v/v methane and 35%v/v carbon dioxide) as well as the typical concentration pattern of both compounds are consistent over time between the latest gas data and the historical records.
- Ground gas flow rates are generally positive with a typical flow rate consistent with historic data and maximum flow rate of 2 L/h noted in GW09 which is within the historic range of flow rates.

Overall, the ground gas concentrations and flow rates are considered to be consistent with historic data. No significant changes to the concentrations or flow rates have been observed. The data suggests that the assessment made by Arup in the Geo-environmental Interpretive report their Environmental Report dated 20 October 2016, and Arup Technical Note dated 31 March 2017 remain valid. The assessment of the gas data shows that the Characteristic Situation is within or lower than previously identified on site.

It is considered that the proposed gas protection regime proposed for the development, and the proposed strategy for monitoring remain appropriate as the ground gas conditions have not altered over the intervening period.

APPENDIX A
FIGURES

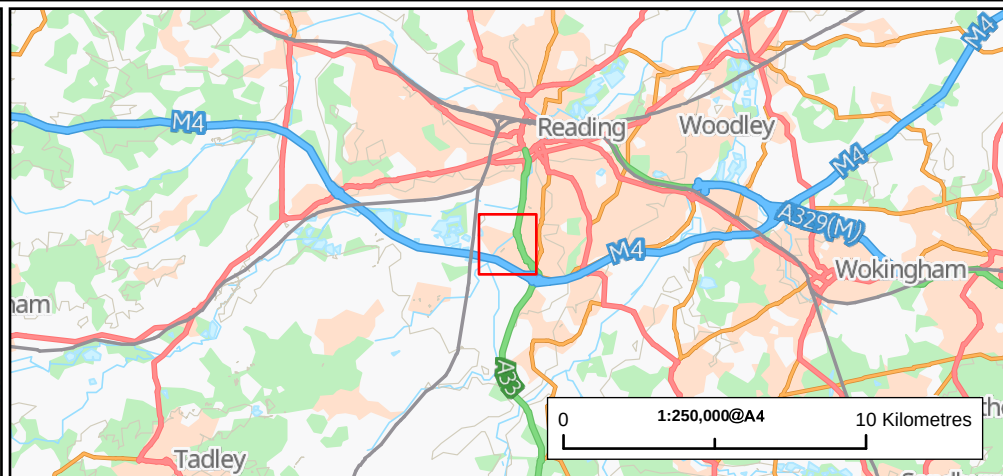


Figure Title Figure 1: Site Location	Project Name Royal Elm Park	Date May 2022 Scale As shown	
Project Number 1620013486	Client RFC PropCo Ltd.	Issue 1	Prepared By AB





Legend

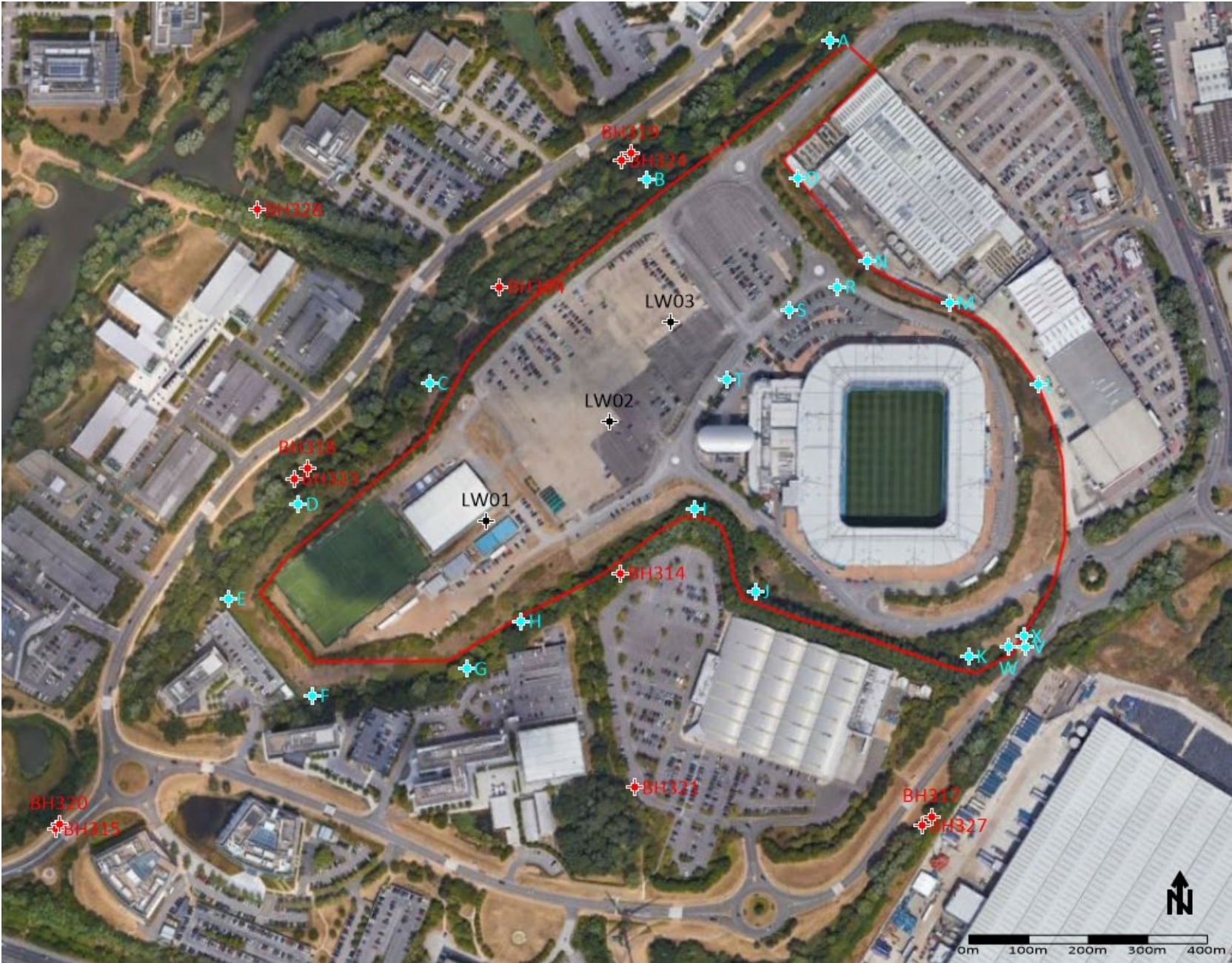
Site Boundary

Figure Title	
Site Layout	
Project Name	
Royal Elm Park	
Project Number	Figure No.
1620013486	2
Date	Prepared By
May 2022	AB
Scale	Issue
1:2,500 @A3	1
Client	
RFC PropCo Ltd.	



**APPENDIX B
MONITORING WELL LOCATION PLAN**

SUMMARY OF GROUNDWATER QUALITY RESULTS
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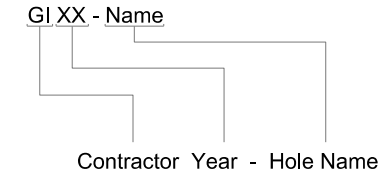
Monitoring Boreholes Location Plan

Notes:

- 1. Topo survey dated 2015-02 by Midland Survey LTD.
- 2. Borehole status pre-planning application (2015):

GIXX-Name	Location Currently Monitored
GIXX-Name	Monitoring Location Lost
GIXX-Name	Historical Location / Not Monitored
-----	Location of Drain

GI Name Description:



- BH response zone in the RTG
- BH response zone in the Lambeth Group, London Clay and Chalk
- BH's R, S, T & U: Ongoing gas monitoring from the land-raise
- SW BH's to be re-monitored for 12 months prior to planned construction.



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Monitoring Boreholes Location Plan

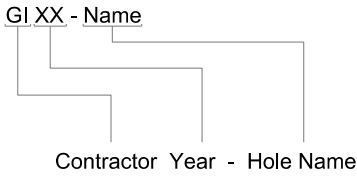


Notes:

- 1. Topo survey dated 2015-02 by Midland Survey LTD.
- 2. Borehole status pre-planning application (2015):

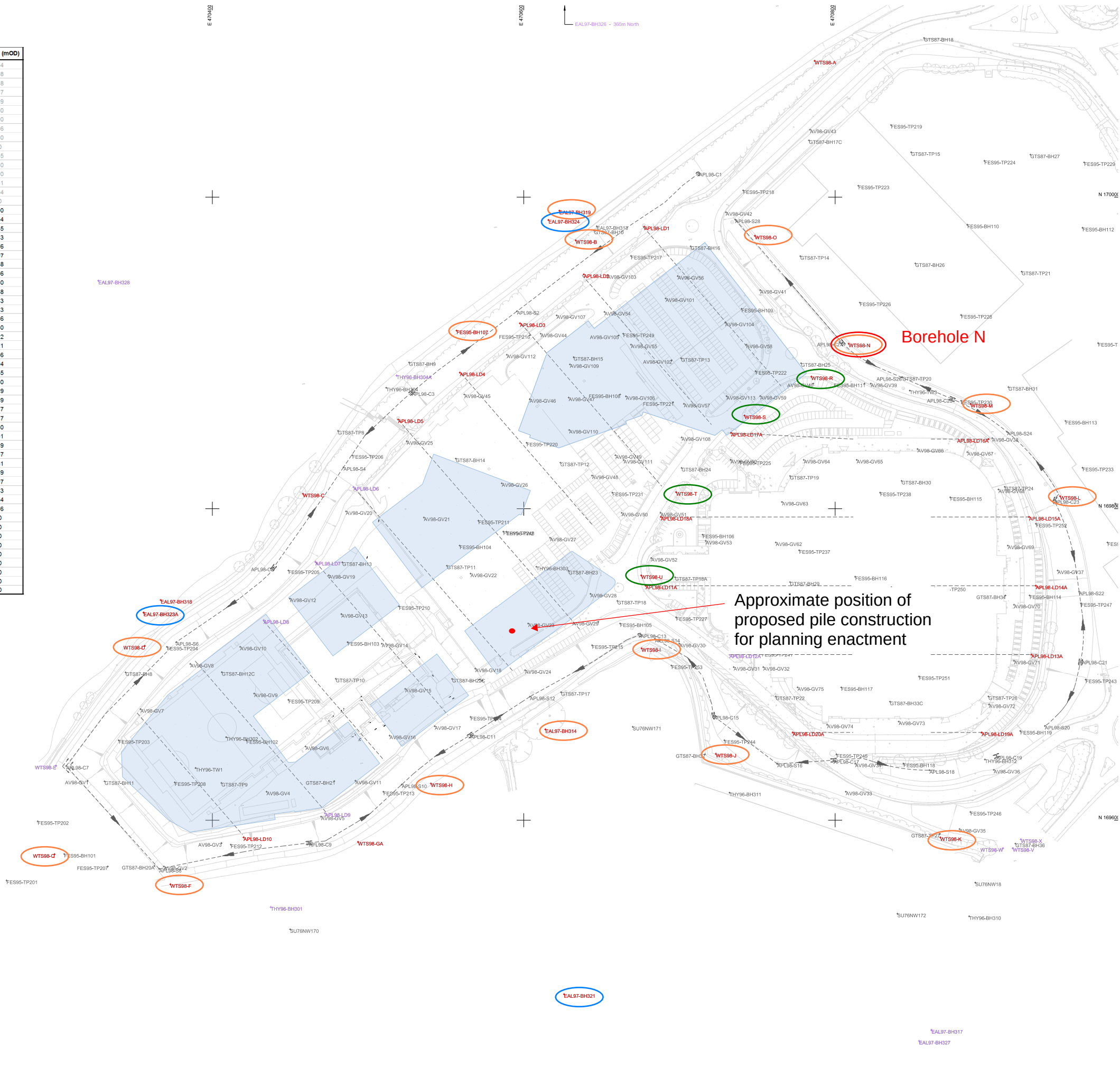
- GIXX-Name Location Currently Monitored
- GIXX-Name Monitoring Location Lost
- GIXX-Name Historical Location / Not Monitored
- Location of Drain

GI Name Description:



- BH response zone in the RTG
- BH response zone in the Lambeth Group, London Clay and Chalk
- BH's R, S, T & U: Ongoing gas monitoring from the land-raise

Name	X	Y	Elevation (mOD)
THY96-BH301	470437.54	169544.23	38.34
THY96-BH304A	470518.32	169885.50	39.08
EAL97-BH317	470861.88	169465.33	37.78
EAL97-BH320	470169.88	169459.33	38.37
EAL97-BH326	470627.88	170486.33	37.99
EAL97-BH327	470853.88	169458.33	37.60
EAL97-BH328	470326.88	169946.33	37.90
WTS98-E	470299.60	169635.00	39.16
WTS98-V	470914.12	169582.05	39.60
WTS98-W	470907.75	169582.05	0.00
WTS98-X	470919.26	169587.71	39.65
APL98-LD6	470490.70	169813.90	46.60
APL98-LD7	470466.20	169765.80	49.90
APL98-LD8	470433.00	169728.40	49.41
APL98-LD9	470472.40	169604.50	51.54
APL98-LD12A	470732.12	169706.39	0.00
FES95-BH107	470556.88	169914.33	39.00
EAL97-BH314	470613.88	169658.33	38.64
EAL97-BH315	470166.88	169455.33	38.45
EAL97-BH316	470366.88	169741.33	38.43
EAL97-BH319	470622.88	169991.33	38.76
EAL97-BH321	470625.88	169488.33	37.97
EAL97-BH323A	470355.88	169733.33	38.38
EAL97-BH324	470615.88	169985.33	38.66
EAL97-BH325	470161.88	169449.33	38.40
WTS98-A	470786.90	170087.50	39.58
WTS98-B	470633.40	169972.30	39.63
WTS98-C	470458.20	169809.60	39.33
WTS98-D	470356.60	169711.90	39.46
WTS98-F	470373.10	169558.90	39.30
WTS98-GA	470493.60	169586.10	39.22
WTS98-H	470540.40	169623.60	39.21
WTS98-I	470675.70	169710.40	39.56
WTS98-J	470723.40	169642.60	38.94
WTS98-K	470867.50	169589.00	38.85
WTS98-L	470944.40	169808.00	39.80
WTS98-M	470887.00	169867.20	39.49
WTS98-N	470808.70	169905.90	39.69
WTS98-O	470748.50	169975.20	39.67
WTS98-Q	470298.70	169578.20	38.67
WTS98-R	470784.72	169884.82	47.40
WTS98-S	470741.82	169859.82	47.51
WTS98-T	470697.92	169810.62	47.49
WTS98-U	470675.42	169757.22	47.57
APL98-LD1	470677.40	169981.10	44.31
APL98-LD2	470638.60	169950.40	44.69
APL98-LD3	470597.60	169919.00	44.07
APL98-LD4	470559.00	169887.40	44.63
APL98-LD5	470519.30	169857.30	44.84
APL98-LD10	470420.10	169589.00	48.76
APL98-LD11A	470678.26	169750.55	0.00
APL98-LD13A	470925.98	169706.39	0.00
APL98-LD14A	470928.87	169750.55	0.00
APL98-LD15A	470924.54	169794.71	0.00
APL98-LD16A	470898.49	169844.71	0.00
APL98-LD17A	470733.13	169848.62	0.00
APL98-LD18A	470688.09	169794.71	0.00
APL98-LD19A	470894.10	169656.39	0.00
APL98-LD20A	470772.75	169656.39	0.00



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