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Ground Gas Risk Assessment

Lidl, Birstall

Client: Lidl Great Britain Limited

000976
23 October 2026
Version 1

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Contents

Summary **4**
1 Introduction **5**
1.1 Background 5
1.2 Competence 5
1.3 Information 5
2 Risk assessment **7**
2.1 Risk assessment model 7
2.2 Source of ground gas 7
2.3 Pathways for and barriers to gas movement 14
2.4 Receptor 18
2.5 Conceptual site model 18
2.6 Semi qualitative risk screening 19
2.7 EPG Internal gas monitoring 24
2.8 Quantitative modelling of ground gas migration 29
3 Conclusions **32**
4 Recommendations **33**

Appendix A
Foundation drawings

Appendix B
EPG internal monitoring results

Appendix C
Gound gas DQRA model results

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Summary

This ground gas risk assessment has been completed by EPG post completion of the buildings and developments. It considers all of the previous site investigation and gas monitoring data holistically. It also considers the building floor construction and post remediation gas monitoring by Remada. It includes detail of post construction gas monitoring undertaken by EPG to confirm the results of the assessment. This risk assessment superseded all previous gas risk assessments and recommendations for the site.

Previous risk assessment by SIRIUS and Curtins did not consider the conceptual site model and the influence of monitoring well construction on the gas monitoring results. This resulted in the incorrect classification of the site as Characteristic Situation CS4.

There is no landfill waste or ungrouted unflooded mine workings below Home Bargains. Landfill is only present below Lidl.

Correct assessment of the data, considering the conceptual site model and the influence of monitoring well construction on flow rates shows that the site can be classified as CS1 for Home Bargains and CS2 for Lidl.

The raft foundation at Lidl provides and effective barrier to gas migration into the building on its own.

Both Home Bargains and Lidl have been provided with gas membranes.

This revised risk assessment has demonstrated that there is very low risk posed be the presence of the gas in the ground to the buildings.

EPG has undertaken internal gas monitoring and this has identified some minor gas ingress into both buildings but it is very localised and well below minimal risk levels.

The buildings are safe for occupation. There is no justification for requiring gas alarms inside the buildings.

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1 Introduction

1.1 Background

EPG has been appointed by LIDL to provide advice on the need for a landfill gas alarm system at the new LIDL store in Birstall. Lidl are close to completing the store which is located off Bankwood Way in Birstall, West Yorkshire. The development also includes a separate retail unit to be occupied by Home Bargains along with associated access roads, car parking and service areas for deliveries.

The site is located on a former landfill from the 1970s and 1980s with evidence of historical shallow coal mining features encountered below the site. The site has also been subjected to cut and fill as part of the site preparation works, exposing natural ground in the area of Home Bargains and raising ground levels in the area of Lidl.

The development has been constructed with gas protection based on Characteristic Situation 2 which comprises a gas membrane and the floor construction. The Lidl store has a raft foundation and Home Bargains has a ground bearing floor and pad footings. There is controlled modulus column ground improvement below both buildings.

The Remediation Strategy, including gas protection measures, has not been agreed by the Local Authority. The definitive Remediation Strategy is the Remada one, dated June 2026 This is the one that has been followed on site and the works verified by Remada.

Previous risk assessment by SIRIUS and Curtins did not consider the conceptual site model and the influence of monitoring well construction on the gas monitoring results. This resulted in the incorrect classification of the site as Characteristic Situation CS4.

This ground gas risk assessment has been completed post completion of the buildings and developments. It considers all of the previous site investigation and gas monitoring data holistically. It also considers the building floor construction and post remediation gas monitoring by Remada. It includes detail of post construction gas monitoring undertaken by EPG to confirm the results of the assessment.

1.2 Competence

This technical note has been prepared by Steve Wilson. Steve is a Chartered Engineer, Member of the Institution of Civil Engineers and Registered Ground Engineering Advisor with over 35 years' experience in geotechnical design and the investigation and assessment of ground gas (including mine gas, landfill gas, natural methane emissions and leaking natural gas wells). He is a SoBRA Accredited Risk Assessor (permanent gas and vapour intrusion). He has contributed to most of the recent guidance on ground gas risk and mitigation design, including various CIRIA and CL:AIRE Reports and BS8485. He is lead author of the CL:AIRE guidance on good practice in mine gas risk assessment.

1.3 Information

A summary of the previous site investigations and reports is provided below. The data and information in these reports has been relied upon for this risk assessment.

- Deltasimons, 24 July 2018, Geo-Environmental Assessment, Centre 27, Birstall
- Curtins, 16 October 2020, Bankwood Way, Birstall, Combined Phase 1 & Phase 2 Ground Investigation Report
- GB Card and Partners, 11 December 2020, Proposed Lidl Store, Bankwood Way, Birstall, West Yorkshire
- Curtins, 18 December 2020, Bankwood Way, Birstall, Combined Phase 1 & Phase 2 Ground Investigation Report
- Sirius, 28 October 2021, RE: Detailed Coal Mining Risk Assessment for Land at Centre 27, off Bankwood Way, Birstall, Batley (Planning Application Ref: 2021/62/92528/E)
- GB Card and Partners, 29 October 2021, Proposed development at Centre 27, off Bankwood Way, Birstall, Batley, Planning Application Ref: 2021/62/92528/E, Coal mining risk assessment
- Sirius, 28 March 2022, RE: Supplementary Coal Mining Investigation for Land at Centre 27, off Bankwood Way, Birstall, Batley (Planning Application Ref: 2021/62/92528/E)
- Sirius, 6 May 2022, Re: Hazardous Ground Gas Risk Assessment for Land at Centre 27, off Bankwood Way, Birstall, Batley (Planning Application Ref: 2021/62/92528/E)
- Sirius, May 2022, Strategy for remedial and preparatory works. (**NOTE** this was superseded by the Remada strategy).
- Remada, October 2022, Remediation Strategy, Client: Lidl Great Britain Ltd, Lidl Birstall (**Note** this was suoerseded by the June 2026 Remada strategy).
- Remada, October 2022, Drill & grout specification, Client: Lidl Great Britain Ltd, Lidl Birstall
- Remada, 24 February 2026, Post Remediation Ground Gas Assessment, Lidl Birstall, West Yorkshire
- Remada, February 2026, Verification Report, Client: Stonedale Construction Ltd, Lidl Birstall (Note this includes:
    - Soil Engineering, 19 November 2025, Report on consolidation of mine workings at new Lidl store, Birstall and
    - Menard, November 2025, Lidle Store, Birstall, Ground improvement by controlled modulus columns (CMC).
- Remada, June 2026, Combined Remediation Strategy ,Drilling & Grouting Plan, Client: Lidl Great Britain Ltd, Lidl Birstall
- Remada, 22 June 2026, Post Remediation Ground Gas Assessment, Lidl Birstall, West Yorkshire (Re-issue)

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2 Risk assessment

2.1 Risk assessment model

Ground gas risk assessment is based on the source - pathway - receptor (SPR) model. This is a framework used to analyse how environmental hazards move from their origin (source) through a medium (pathway) to affect people, ecosystems, or property (receptor)..

The following sections discuss each part of the SPR linkage for ground gas at this site.

2.2 Source of ground gas

There were two sources of ground gas below the site prior to redevelopment:

1. The former land fill that is on site; and
2. The former mine workings below the site.

There are also off-site landfills and filled ground, the closet of which is 53m to the east of the site. However, given the locations, age, topography and distance to this site, none of them are considered to be a potential source of gas at this site. They are not considered further.

VOCS and radon were not considered to be ground gas risk drivers at the site by previous consultants or the local authority and are not considered further.

2.2.1 Landfill

The desk study for the site has identified the following key points:

- British Geological Survey (BGS) maps show the site to be underlain by Made Ground. No superficial deposits are shown to be present on-site. The bedrock or solid geology comprises the Pennine Lower Coal Measures Formation.
- The earliest available (1850s) indicate the site as agricultural fields and woodland. Coal Authority Abandonment Plans indicate historical coal workings in the northeast of the site, extending offsite to the northeast until the 1911. Curtins refer to a '*highwall' is shown running north to south in the centre of the site on historical mapping dated [*1893-4*]*". This is incorrect. The feature shown indicates filling and not excavations. It is most likely placement of colliery spoil from the nearby Howden Clough Colliery.
- A historical landfill is indicated to have been present across the majority of the site and extending offsite to the southeast in 1970. Operations are considered to have continued until c.1986. The landfill was a land raise placed above the existing valley side slopes.
- In 1992, eight commercial office buildings are present across the site. These remained onsite until 2018 before being demolished. Because it suffered from settlement of the landfill material. This would have occurred as the results of self-weight compaction and also degradation of organic material in the waste.
- Offsite, extensive coal and mineral mining had occurred within close proximity to the site and within the surrounding area.
- The Envirocheck Repot included in the Curtons report indicates a historical landfill, namely Nab Lane Refuse Disposal Tip, extending across the southern, northeastern and eastern portions of the site. The landfill was authorised to accept inert, industrial, commercial and

household waste, and liquid sludge, with operations commencing in November 1970. The last input date is not indicated. A further entry pertaining to the site lists the site as a registered landfill which was operational from March 1982. It is not known when operations ceased but given the presence of buildings by the 1992 map it is likely to have been around 1990 at the latest. Thus the most recent landfill material is 36 years old and much of it will be between 36 and 56 years old.

The site investigations across the site have determined the following in relation to the landfill material:

- Prior to remediation and earthworks ground conditions generally comprised a sequence of:
    - **Outside the landfill area** - reworked natural cohesive clay overlying mudstone and siltstone with minor bands of sandstone of the Pennine Lower Coal Measures. Between 0.4m and 5.2m thick.
    - **Landfill area** – variable thickness of reworked natural clay or sandy gravel overlying decomposed waste materials.
- The landfill is in excess of 15.8m at its deepest point.
- The landfill depth shallows from east to west which reflects the previous valley slope. Therefore, the average thickness is much less than the maximum. The waste material is predominantly confined to the south west of the site.
- The landfill material has previously been capped with reworked natural clay which is of significant thickness in some areas. In the southern part of the site there was about 2m of sandy gravel over the landfill.
- Outside the footprint of the historic landfill, bedrock (including shallow coal) was generally encountered at shallow depth below a thin layer of Made Ground that comprises mainly reworked natural soils. The Curtins investigation found an average depth of 1.75mbgl.
- Perched water levels within the landfill waste materials were highly variable, with levels fluctuating rapidly over relatively short temporal scales. Perched water levels were generally greater than 3mbgl.
- The made Ground is a mix of greenish brown clay with rare timber fragments; dark blackish brown slightly sandy slightly gravelly organic CLAY. Gravel is of roots, branches, plant fibres and plastic bagging; and creamish brown to greyish brown slightly sandy clayey angular to subangular fine to coarse GRAVEL of sandstone, limestone and variably concrete.
- The Made Ground on the site has been recorded to typically contain organic matter concentrations of between 0.5% and 4.6%. Although one sample of cohesive made ground obtained from the eastern part of the site had a recorded organic matter content of 20%.
- The landfill material comprises a black clayey matrix with textiles, plastics, refuse plastic bagging, metal, brick, glass carpet, rubber, tyres, timber, wire, concrete and sandstone cobbles, fragments of bone.
- The landfill material recorded organic matter concentrations of between 4.4% and 9.9%. Typically organic wastes such as grass clippings and vegetables have between 50% and 60%

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total organic carbon and composted domestic waste is around 30%[1]. Thus the organic matter content of the waste at this site is representative of degraded waste that cannot generate large volumes of landfill gas.

- Strong putrid/organic odours associated with a black sludge matrix to the landfill waste materials were noted. Gas bubbling was noted within the perched waters during the drilling of one borehole and subsequent gas monitoring in the well. This is caused by gas trapped a thickness of reworked natural soil or below less permeable layers in the waste below groundwater. The drilling reduces the total pressure on the gas and allows it to escape. This only happens because the borehole is drilled and shows that gas migration to the surface is limited (if it was significant the gas would not become trapped). It is not an indication of current gas generation.
- There is no reference to fresh non degraded waste in the landfill material or the Made Ground. There are reference to putrid and organic odours.

2.2.2 Mine gas

The following is relevant to mine gas below the site:

- Bedrock of the Lower Pennine Coal Measures comprises predominantly comprised extremely weak to medium strong (becoming slightly stronger with depth) thinly laminated orangish brown mottled grey mudstone and siltstone, with minor/occasional bands of medium strong to strong grey fine-grained sandstone up to a depth of 30mbgl.
- The bedrock is completely weathered at the surface to a clay which will act as a barrier to mine gas migration upwards.
- The geological maps shows the Flockton Thin (or Black Bed Coal) is conjectured to outcrop within the site, trending approximately south to north from the southern corner of the site, before turning abruptly in an approximately easterly direction, crossing the site boundary in the area of the eastern corner. The thickness of the Flockton Thin coal seam is recorded to range between 0.3m and 0.8m.
- Coal attributed to the Flockton Thin coal seam was encountered in the site investigations between depths of 2.8mbgl and 8.4mbgl across the northeastern, northwestern and western areas of the site. No other coal seams were encountered within 30mbgl.
- The Flockton Thin is recorded to have been mined at a depth of 10m bgl, with an extraction thickness of 0.91m (last worked in 1877). Potential collapsed mine workings and voids have been encountered during the site investigation at shallow depths across the site. Voids and collapsed ground suggestive of bell pits was encountered in the western areas of the site.
- Sirius report refers to shallow coal Flockton Thin Coal Seam being removed by historic excavations but there is no evidence on maps of excavations. If coal was removed by open cast excavation it predates mapping and the fill would simply be overburden that was replaced, not landfill, or colliery spoil. The contours on the maps indicate that there has not

[1] Diacono M et al (2019). Recycling agricultural wastes and by products in organic farming: Biofertlizer production, yield performance and carbon footprint analysis. Sustainability July 2019.

been any prior excavation before the earliest maps and it is likely that any excavations would have been where the coal was very close to surface.

- The intrusive ground investigations suggest that the deeper coal seam anticipated below the site (Third Brown Metal) is intact and unworked beneath the Site and with a maximum proven thickness of 0.3 m.
- An adit was shown on records to be present at the eastern end of the site and heading off site to the north east (ie away from the proposed buildings). Sirius undertook a comprehensive investigation to find the adit. It was determined that it was not present. It does not therefore pose amine gas risk to the buildings.

2.2.3 Remediation works

The remediation works that have been completed have changed the conceptual model. The works (as described in the most recent and applicable remediation strategy and drilling and grouting plan by Remada, dated June 2026) comprised:

- Cut and fill earthworks operations with site levels raised in the east and cut in the west.
- Removal of about 1800m^3 of surplus Made Ground
- Controlled modulus columns and associated load transfer platform below buildings foot prints
- Grouting of shallow mine workings

The cut and fill works generally involved lowering ground levels (cut) in the western part of the site and raising ground levels (fill) in the eastern part of the site. The cut and fill is shown in Figure 1. Below the Home Bargains footprint, pre-construction ground levels (excluding stockpiles) were 150.5 +/- 0.5m mAOD and the store formation level is 150.7 mAOD. Below the Lidl store footprint, pre-construction ground levels (excluding stockpiles) increase from approximately 148.0 mAOD at the site boundary to 149.7 m AOD in the centre of the site. The store formation level is 150.18mAOD.

The cut and fill does not include the additional 6F2 capping and sub-base below the car parks and the load distribution mat below the buildings. This is 750mm in total below car parks (Figure 2), 650mm below Home Bargains (Figure 5) and a minimum of 500mm below Lidl.

No landfill waste was exposed, excavated or removed from site, thus its gas generation properties should not have been significantly altered by the works.

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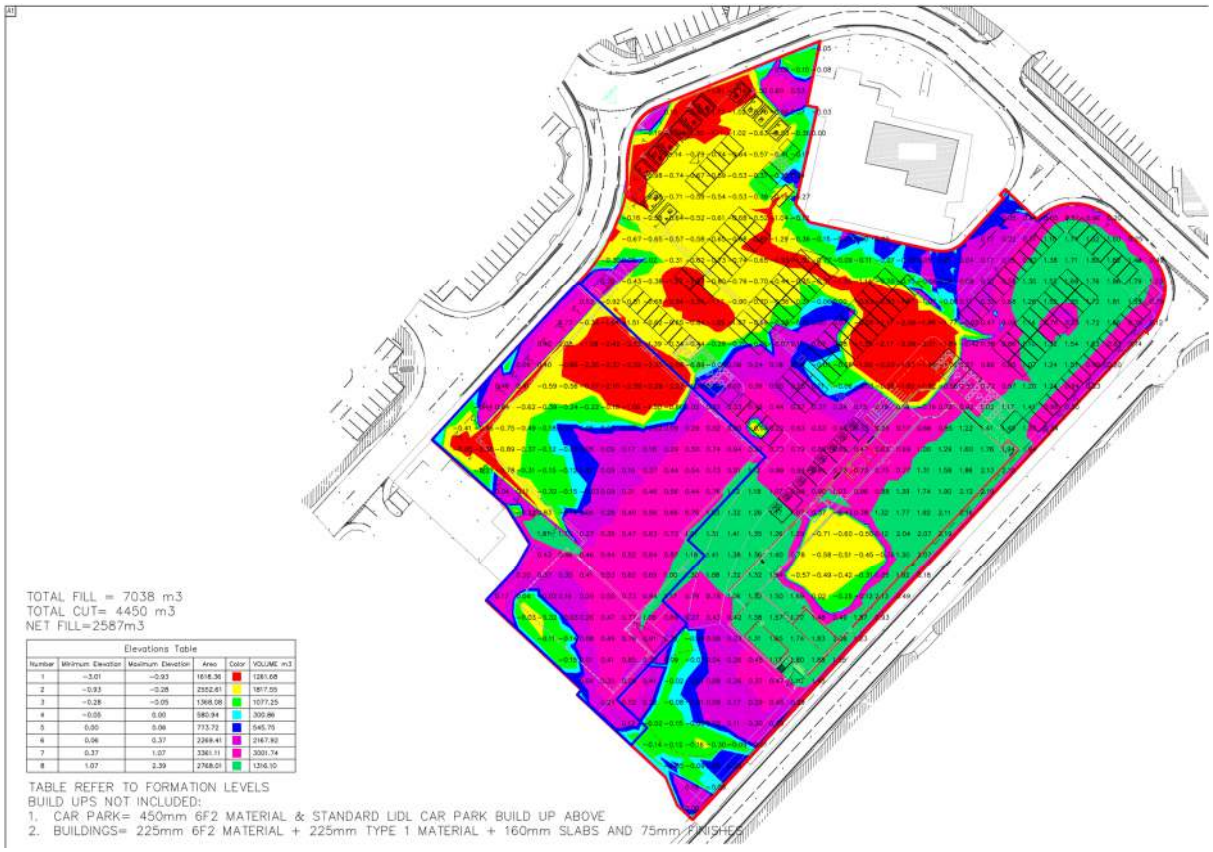


Figure 1 Earthworks cut and fill plan

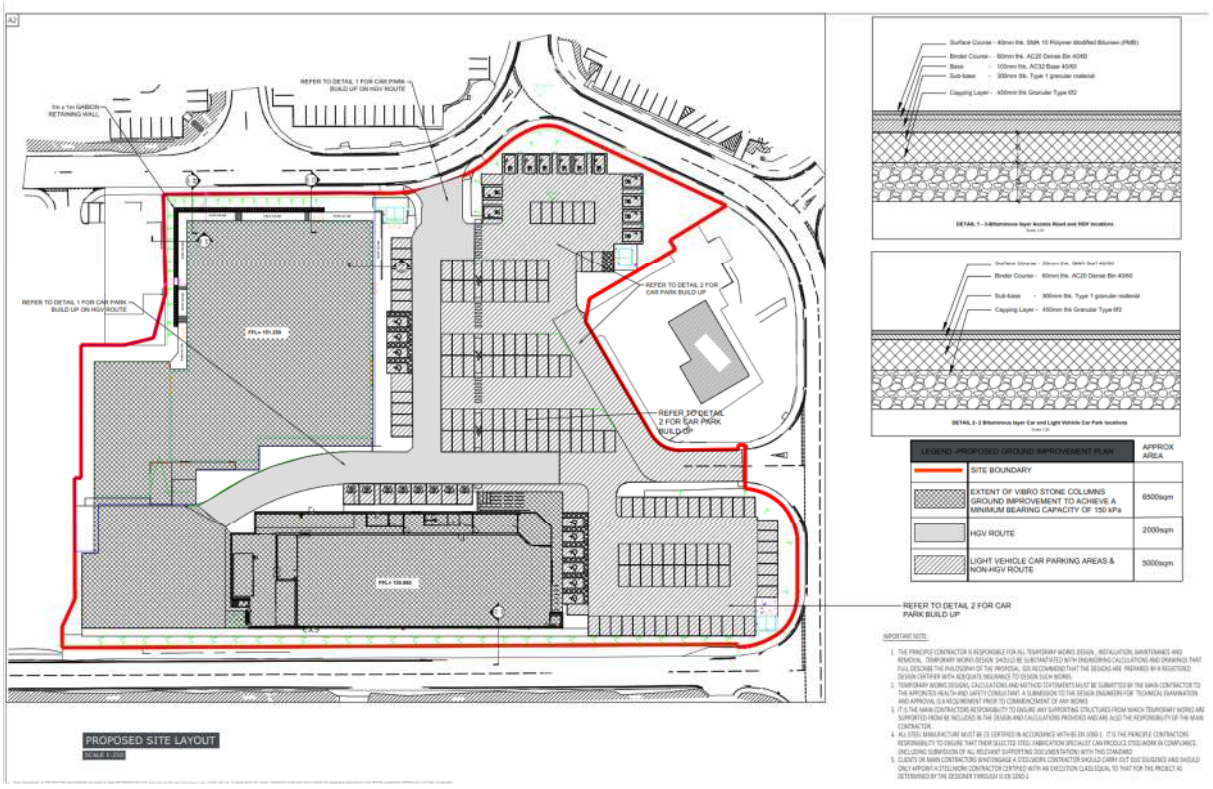


Figure 2 Capping and sub-base thickness below car parks (note reference to vibro stone columns is incorrect and these have been replaced with controlled modulus columns)

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The remediation strategy also proposed gas protection measures within the proposed buildings.

The Remada strategy indicates that the gas protection will comprise a passive sub floor ventilation layer comprising and expanded polystyrene (EPS) vent strips in a no fines gravel layer with ground level vent boxes. This has not been provided but in any even it would not have provided effective sub slab ventilation on this site. It would only have acted as a passive relief rather than a ventilation layer. A gas membrane was also to be provided below the floor slabs. The strategy also states that the local authority requires a gas alarm system but there is no justification or risk assessment that demonstrates this is necessary (which it is not).

The buildings are now completed with gas membranes installed and this risk assessment supersedes the requirements in the Remada strategy. The building gas protection comprises the floor slabs or raft foundation and the gas membranes.

The shallow mine workings were probed/grouted below building footprints which will minimises the risk of emissions because there are no voids in which gas can accumulate to hazardous volumes.

The grouting used a PFA: cement mix which is routinely used in this kind or work and it significantly reduces the volume of gas that can accumulate and removes connected open pathways for migration. There are two proposed building footprints within the overall site area as indicated on the attached

The Remada strategy required the shallow mine seams are to be probed/grouted to a depth of 30m bgl. The holes were to be on a grid as follows:

- Primary grouting of probeholes on a 6m x 6m grid to a depth of 30m bgl.
- Secondary grouting of probeholes where necessary to form a 3m x 3m grid.

The actual grouting that was completed is less than this. Only selected holes were drilled because as the works progressed it was shown that there is no shallow coal seam present below LIDL and no voids below Home Bargains (Figure 3). There was limited grout take in all holes indicating no voids (figure 4).

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Figure 3 Mine consolidation works – completed holes



Figure 4 Mine consolidation works – grout takes in each hole

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On completion of remediation works Remada drilled 6 boreholes on the site. These boreholes confirmed that there is no landfill below Home Bargains and therefore landfill is no longer a source below that building. There is a thin layer of Made Ground that is predominantly slightly sandy slightly gravelly clay which does not contain any significant degradable organic carbon. This not a source of ground gas.

Mine workings have been grouted (the grouting works did not find any voids below either building and grout takes were minimal). Therefore, there are no voids where large volumes of gas could accumulate and not open pathway for migration. Thus, mine gas is no longer a source at the site.

In summary there is no longer any source of ground gas under the majority of the Home Bargains building. Landfill is still present below Lidl and a very small localised area at southern edge of Home Bargains. This is the only remaining source of gas at the site. The landfill material is predominantly non or slowly degradable material which is consistent with its age. Gas that has been recorded in monitoring wells is predominantly trapped gas from historic generation.

2.3 Pathways for and barriers to gas movement

The following pathways are relevant to this site:

- Vertically upwards from the landfill material to the underside of the Lidl raft foundation.

GB Card and Partners noted that the landfill waste was described as being within a clay matrix that would generally dominate the geotechnical engineering behaviour of the waste, though variation was predicted given the heterogeneity of the material. This is also relevant to gas migration and the clay will be of lower permeability and limit the rate of gas migration through the degraded waste.

Lateral gas migration of gas from the landfill though coal measures towards Home Bargains is not considered to be a credible pathway. This is for the following reasons:

The waste is sufficiently old that current generation rates are too low to support lateral gas migration. Lateral gas migration requires constant replenishment to support and maintain it which will not occur here.

The landfill sits over the old valley side and the Coal Measures will be weathered at previous ground surface over sides of valley which limits the potential for migration

The shallow angle of interface limits potential migration. The greatest risk of gas migration is where there are sub vertical quarry faces with a significant depth of waste in contact, which are not present here.

Pre remediation gas monitoring results show that gas is not present on the red migration line on the ternary plot discussed later in this report.

Horizontal migration of ground gas due to the presence of extensive hardstanding is also not a consideration and there is no risk of this occurring (it requires large scale gas generation, for example from a recent actively gassing landfill site).

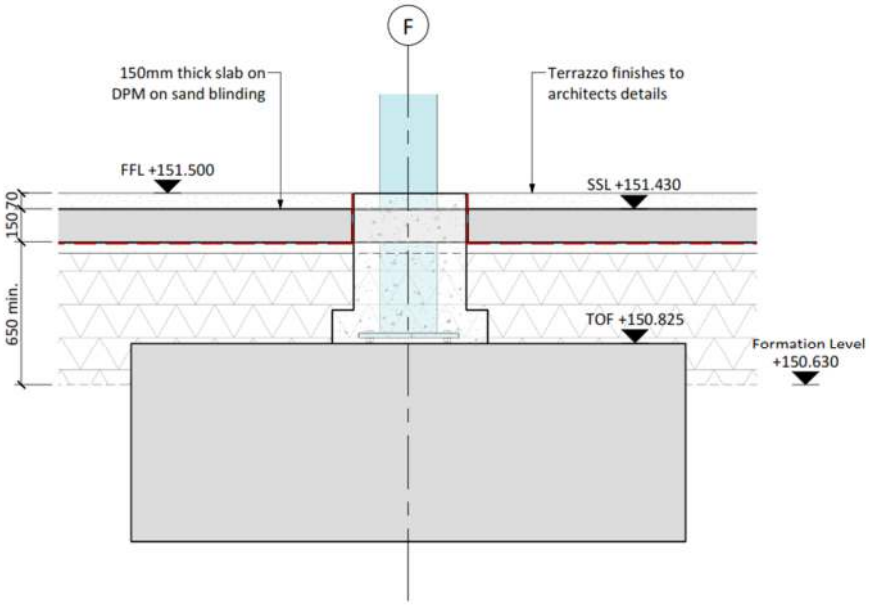
Controlled modulus columns are not a preferential pathway (note that previous remediation strategies refer to stone columns and bi modulus columns. The verification report is clear that controlled modulus columns have been installed. These are concrete inclusions in the ground that

do not create a preferential pathway for gas (CLAIRE, 2025, Piling and Penetrative Ground Improvement methods on land affected by contamination: guidance on pollution prevention).

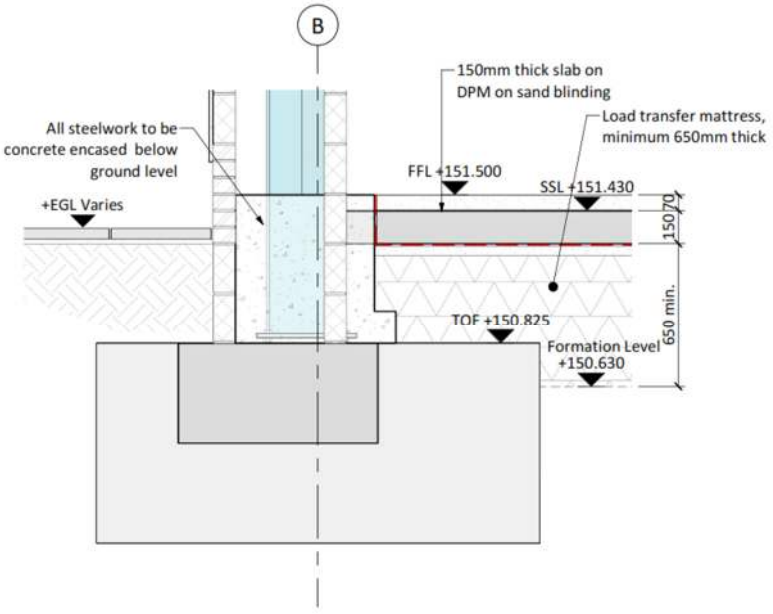
The floor construction of the buildings will provide a barrier to gas migration and is considered as part of the overall gas protection design. The Home Bargains floor slab is a 150mm thick reinforced concrete ground bearing slab on controlled modulus columns (Figure 5). The columns penetrate the slab and there will be isolation and movement joints as well as service ducts that penetrate it. These are the main gas migration pathways from the ground into the building. The main concrete area of the slab itself provides a good barrier to gas migration and will effectively prevent it. The gas membrane and sealing of the joints in the floor slab, combine with floor covering in the main store will also provide a further barrier to gas migration.

The building foundation drawings are provided in Appendix A.

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F1 Typical Internal Pad Footing
1 : 20



F2 Typical External Pad Footing
1 : 20

Figure 5 Floor slab details for Home Bargains

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Lidl is constructed with a raft foundation and the walls and columns are located over thickenings in the raft slab (Figure 6). They do not penetrate through the floor. There are limited construction joints and no open movement or isolation joints. Engineered raft foundations will provide an attenuation factor of at least 1000 for ground gas that is flowing from the ground under diffusive forces[2]. This means that even if 100% in the ground it would only reach 0.1% inside the building. The floor covering in the main store area will also provide an additional barrier to gas ingress.

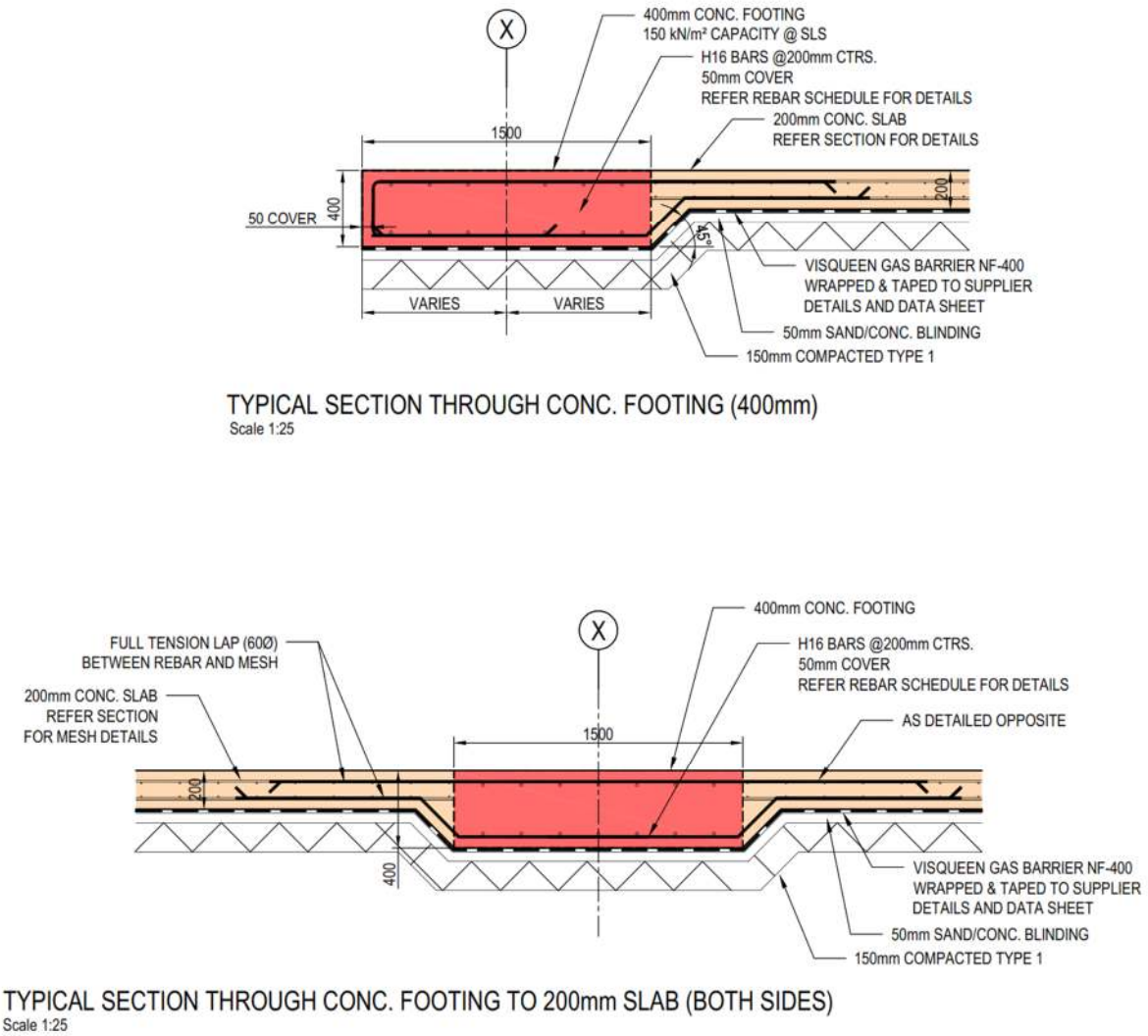


Figure 6 Raft foundation for Lidl

[2] Focused Remediation Seminar, Hydrogen generation from sub-base below residential houses – investigation and remediation, S Wilson, 2026

2.4 Receptor

The receptors in this case are the buildings, and occupiers/users.

2.5 Conceptual site model

The conceptual site model based on the above is provided in Figures 7 and 8.

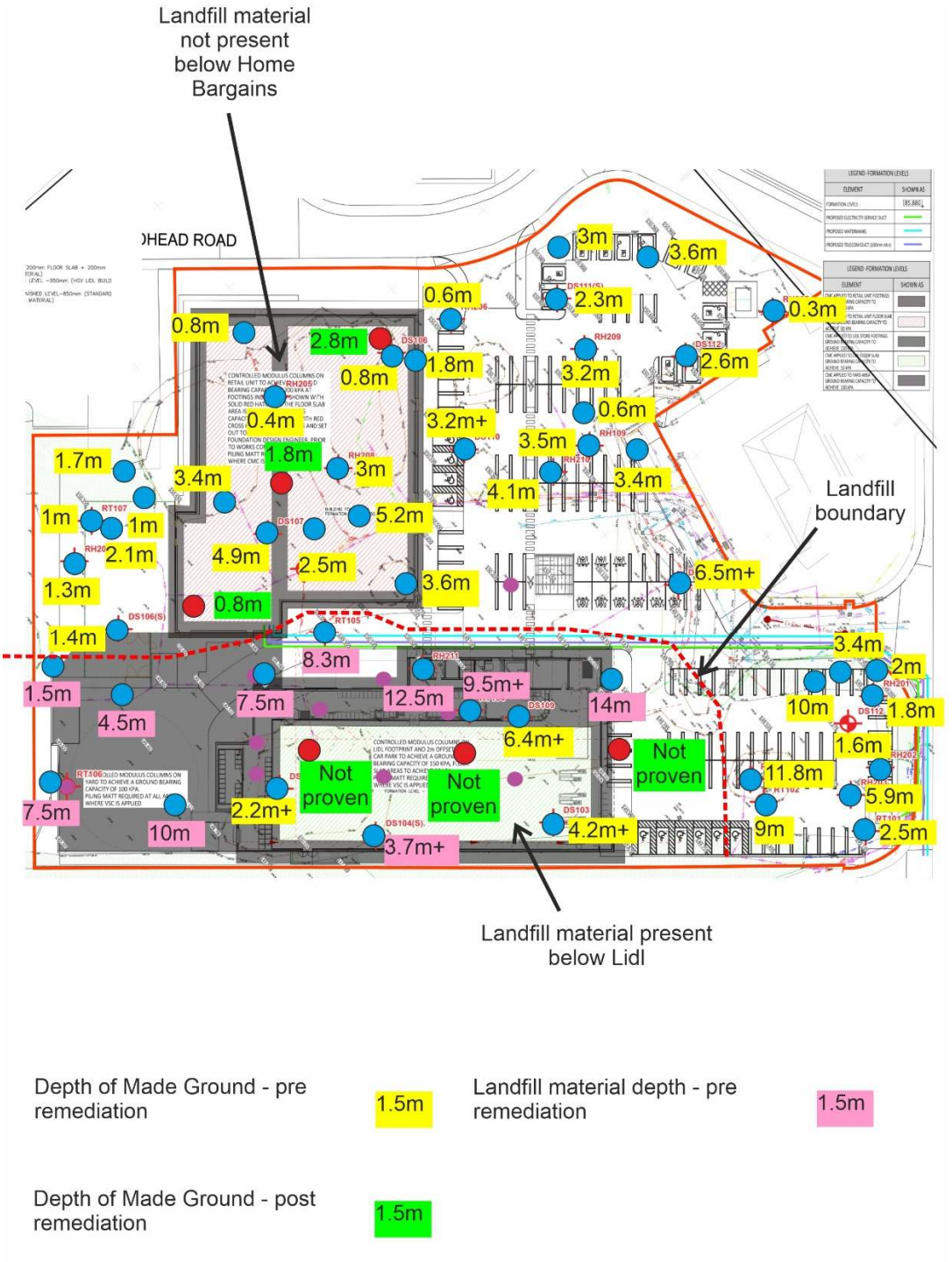


Figure 7 Conceptual model for ground gas - plan

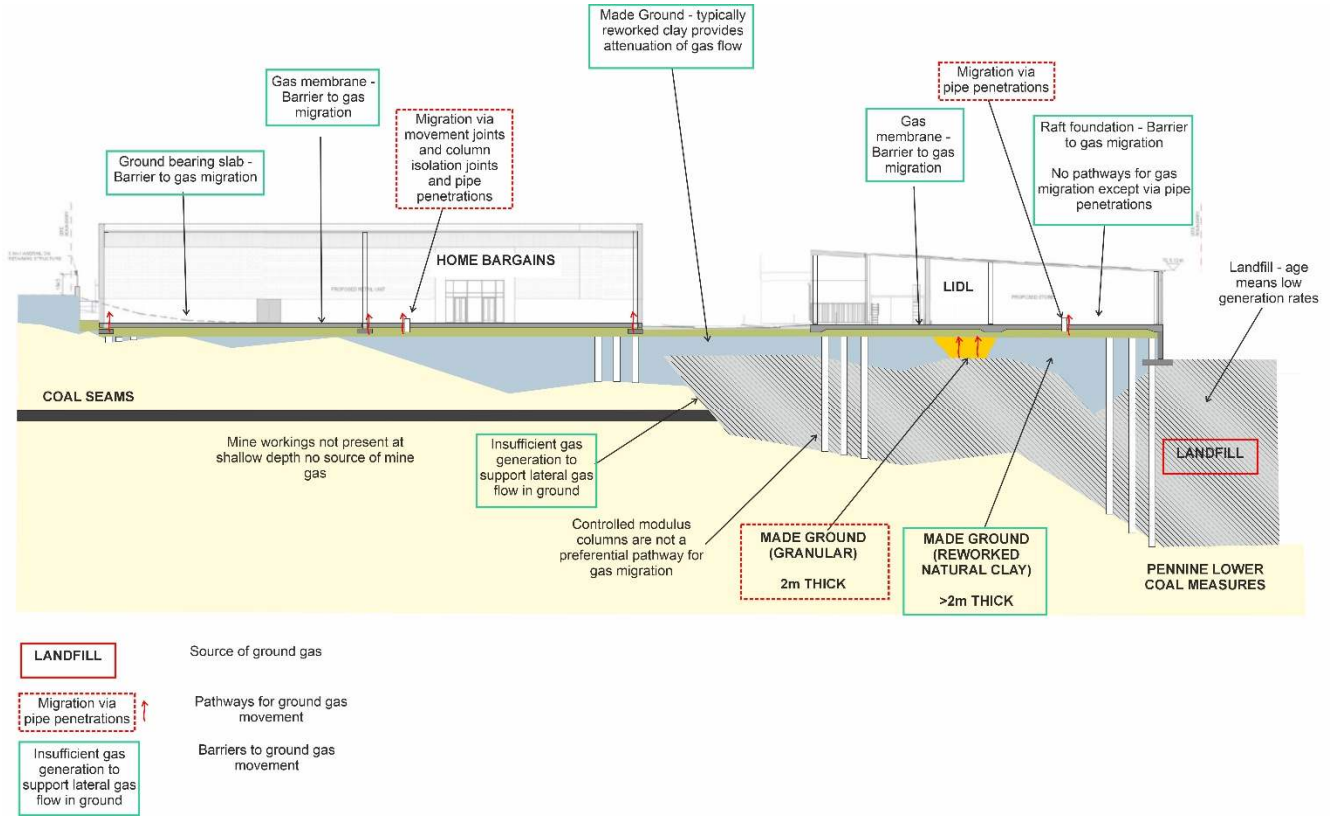


Figure 8 Conceptual model for ground gas - section

In summary the conceptual models shows:

- The only source of ground gas at the site is the landfill material which is mainly below Lidl
- There is no significant source of ground gas below Home Bargains
- The raft foundation to the Lidl provides a robust barrier to gas migration with the only minor pathways through it via pipe penetrations or similar
- The ground bearing slab to Home Bargains provides an effective barrier to widespread gas migration into Home Bargains. It will allow gas migration via pipe penetrations and movement or isolation joints.

2.6 Semi qualitative risk screening

2.6.1 Predevelopment gas monitoring

Several phases of gas monitoring were completed prior to development. The Made Ground and waste deposits are some 30 to 50 years old and as such the majority of degradable waste within these materials will have significantly reduced and hence also reduced the potential for any significant ground gas generation. It is therefore not a high risk site and is more reasonably defined as moderate generation in accordance with BS8576: 2013.

In total there was sufficient gas monitoring over the phases of investigation and monitoring to adequately and robustly characterise the site. This included periods of continuous gas monitoring.

Overall the gas monitoring meets the requirements of BS8576: 2013 which is the applicable standard and not CIRIA C665 which the local authority has referred to. BS8576 has guidance which supersedes the guidance in C665 on the required duration and frequency of gas monitoring and is less prescriptive.

Delta Simons completed continuous monitoring for a period of approximately two weeks in each of nine shallow monitoring wells installed into the Pennine Lower Coal Measures or the reworked natural clay Made Ground. The overall monitoring period spanned a total of six weeks.

Maximum methane concentration recorded was 2.02 % and carbon dioxide 6.3%. The maximum flow rate was 0.25l/h. There was no evidence of any significant landfill gas generation or mine gas emissions. All the hazardous gas flow rates (HGFR) were <0.07l/h (ie which is equivalent to Characteristic Situation CS1). With the other evidence (ie no evidence of fresh degradable waste and low methane concentrations less than 30% (as per ASTM E2993- 23[3]) it was not absolutely necessary to increase to CS2. It was increased on the basis of parts of the site are underlain by relatively recent landfill waste which has the potential to generate ground gas and is adjacent to a former landfill which is known to be generating ground gas Also limited ground gas monitoring was undertaken within the landfill waste.

The gas monitoring was appropriate for the Home Bargains building and given the absence of waste in that area and no evidence of significant migration it could have remained CS1. Increasing area of Lidl to CS2 was valid.

Curtins completed gas monitoring that targeted the landfill waste with monitoring wells. Bubbling of methane gas was noted within the perched waters during the drilling of one borehole RH 211. Bubbling/effervescing was further reported during the second round of gas monitoring in the same borehole. However this well penetrated a black clayey matrix (decomposed waste) below 7.2m of reworked natural clay. The response zone was sealed into this stratum. A flow rate of 4.5l/h was recorded. Whilst gas bubbling may appear alarming to the inexperienced it is only occurring because the overlying confining pressure has been removed by drilling the hole. It is not indicative of large scale gas migration or gas generation in the surrounding ground. The gas has been confined in the ground in the past which demonstrates the effective barrier to gas migration provided by the reworked natural clay Made Ground.

It is incorrect to use gas Screening Values (GSVs) for data from a well such as this which is acting as a chimney and is not representative of gas emissions in the surrounding ground. The closest shallow wells to RH211 (DS107 and DS109) at shallow depth of 5m in the clay above the waste show no gas being present so gas is not migrating vertically in large volumes.

The monitoring results from wells installed into landfill are shown on the ternary plot in Figure 9. This shows that there is no current large scale gas generation below the site. Flow rates were generally less than detection with a maximum of 0.5l/h apart from the single well discussed above and also in CP301 and CP302, both of which are deep (8.7m and 10.0m respectively).

[3] ASTM E2993-23, Standard Guide for Evaluating Potential Hazard in Buildings as a Result of Methane in the Vadose Zone. ASTM International

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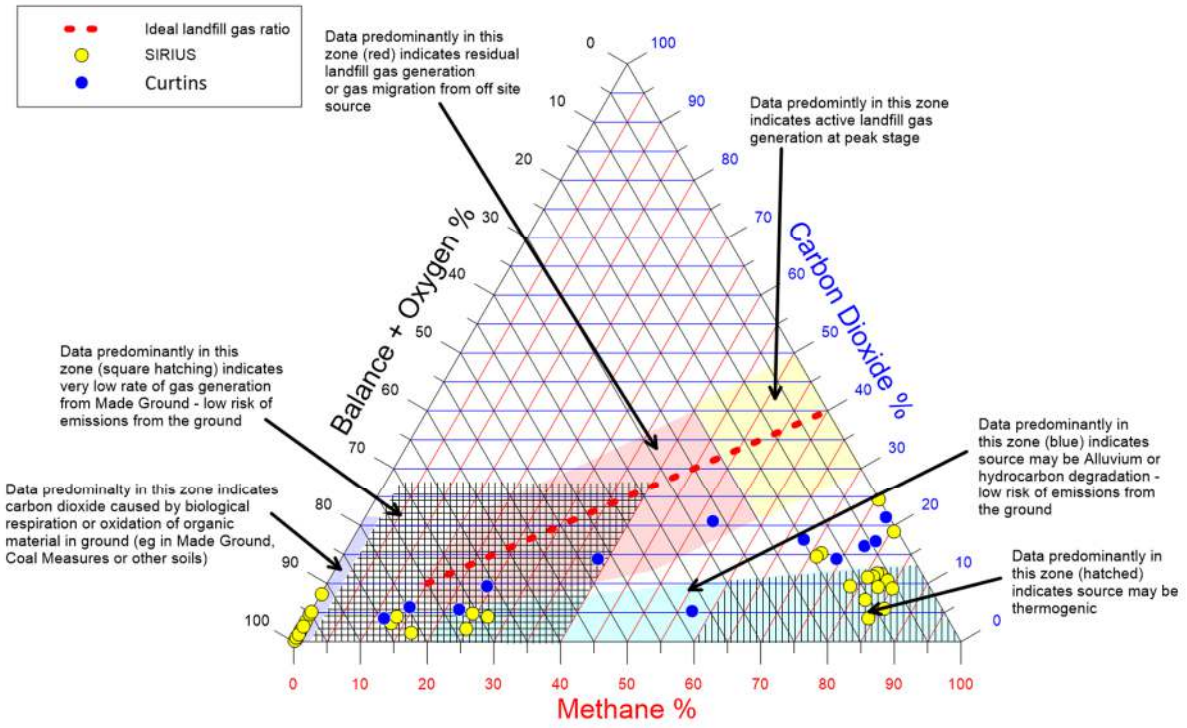


Figure 9 Ternary plot of monitoring data for wells installed in the landfill waste

The waste is below 2m of granular fill at these locations. The depth of the wells means that they are acting as chimneys giving artificial flow rates that are not representative of surface emissions at the ground surface. The chimney effect can be seen in the continuous monitoring data from SIRIUS (Figures 10 and 11) which shows that when barometric pressure rises there is oxygen ingress to the wells and methane and carbon dioxide reduce to very low levels as fresh air flows into the well. Negative flow rates occur at the same time. If there was any significant underlying pressure this would not occur. It was therefore inappropriate for Sirius to use GSVs to assess the data. The SIRIUS gas risk assessment only considered the results in the two deep wells and did not consider the conceptual model for the site when assessing the data. Therefore the CS4 classification was incorrect and should not have been applied to the site.

The landfill waste in these wells was described as 65% plastic, 20% decomposed material, 5% wood, 5% metal and 5% glass. There is no fresh degradable material and the decomposed waste does not produce large volumes of gas. The gas being detected is gas that was generated over the past 30 years since filling and is trapped in the ground. As gas is generated the source is used up. Gas generation cannot continue at hazardous rates indefinitely.

Sirius completed gas monitoring in wells with response zones in the Coal Measures or cohesive Made Ground. Methane concentrations were <1% and carbon dioxide was recorded at a maximum of 2.7%. Maximum flow rates was 0.09l/h. This indicates CS1 conditions where landfill is not present.

Concentrations up to 80% methane were recorded in wells installed into the landfill material.

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FIGURE 1 – TIME SERIES DECOMPOSITION – ATMOSPHERIC PRESSURE & METHANE CONCENTRATIONS

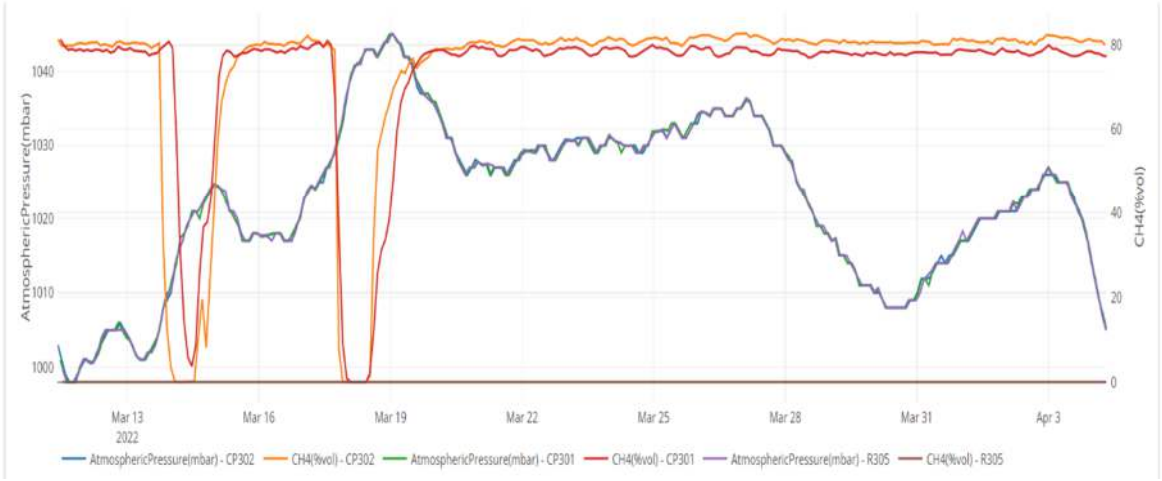


Figure 10 SIRIUS continuous monitoring data methane

FIGURE 4 – TIME SERIES DECOMPOSITION – ATMOSPHERIC PRESSURE & GAS FLOW RATES

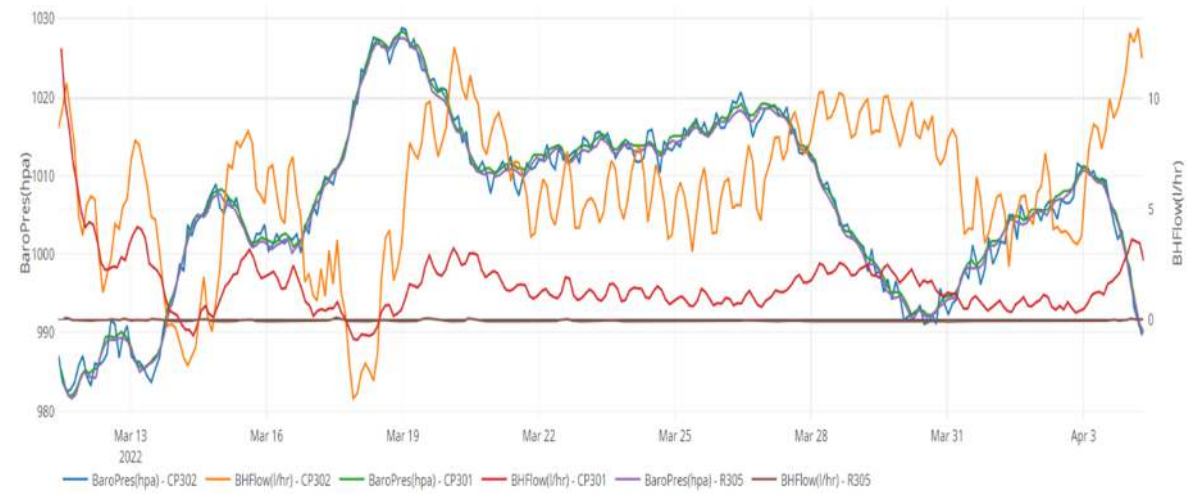


Figure 11 SIRIUS continuous monitoring data flow rate

2.6.2 Post remediation gas monitoring

The Remada remediation strategy indicated that a minimum of three ground gas monitoring wells would be installed within each proposed building footprint to a depth of 5m below the proposed formation level. The concentrations of methane, carbon dioxide, oxygen and the gas flow rate are to be measured at each well for a minimum of four monitoring events over a four week period during periods of low and high atmospheric pressure.

The location of the monitoring wells that have been installed are shown in Figure 12.

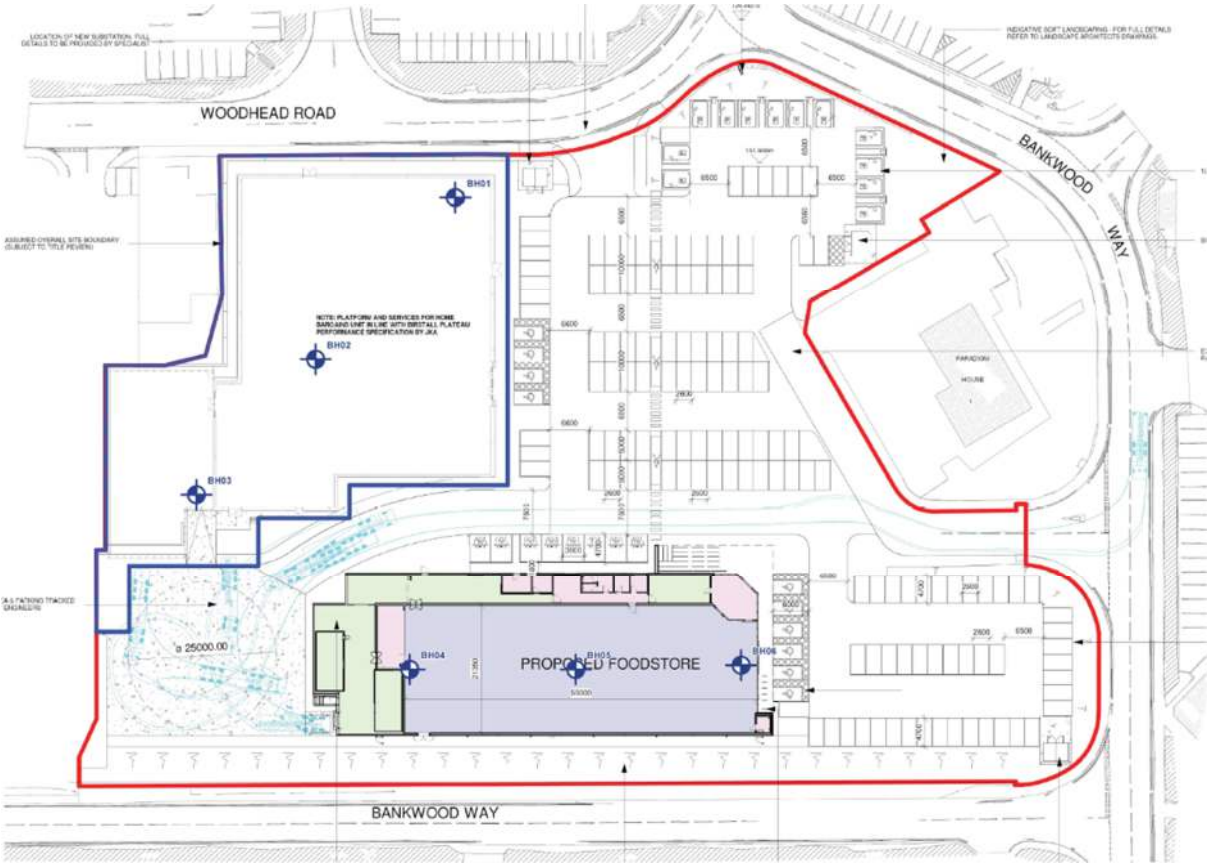


Figure 12 Post remediation monitoring wells

The wells were installed post grouting and post earthworks. The wells that have been installed are between 1.5m and 4m deep at Home bargains and 1m deep at Lidl. The wells at Lidl are shallow and not sufficient to fully characterise gas risk. However the data from them does provide one line of evidence on potential gas migration from depth to the shallow soils. This data gap has been addressed by the additional internal monitoring completed by EPG (see below).

Five gas monitoring visits were completed during January 2026 with atmospheric pressure below 1000mb. The results gave HGFRs for methane and carbon dioxide less than 0.07l/h.

There was slightly elevated methane in BH3 (3.8%, Home Bargains) and BH4 (27.4%, Lidl). BH3 was installed into Coal Measures and the methane is representative of natural concentrations that occur in this stratum. The low flow rates show that it is not mine gas related.

The result in BH4 shows there is some vertical migration from the deeper landfill materials but it is being attenuated.

The data has been plotted in a ternary plot in Figure 13. The ternary plot shows that the elevated methane is not in a high risk area indicative of active large scale gas generation. It is result of diffusive flow from depth. Carbon dioxide concentrations were all less than 5%. The implications of the post construction gas monitoring are as follows:

Home Bargains – There is no landfill below Home Bargains. No significant ground gas has been detected, remains at CS1.

Lidl – located over landfill but gas monitoring data shows low risk, remains at CS2.

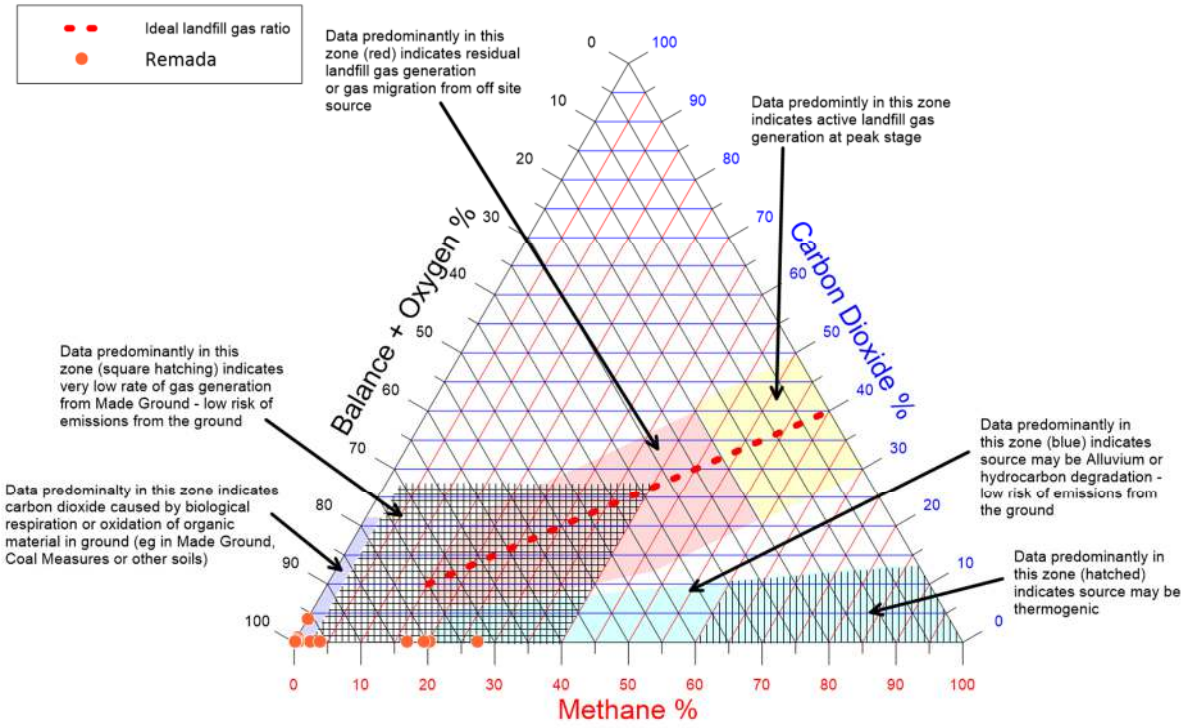


Figure 13 Post remediation gas monitoring by Remada

2.7 EPG Internal gas monitoring

EPG has completed internal gas monitoring using a tuneable laser diode instrument that can detect methane at 1ppm. The instrument is not affected by any cross interference. Monitoring also used a GFM 226 carbon dioxide meter that has a limit of detection of 1ppm carbon dioxide.

Monitoring was completed on four occasions, (23 September, 5 October, 23 October and 26 October 2026). The results are provided in Appendix B and summarised in Table 1.

Barometric pressure variations prior to monitoring are shown in Figure 14. All the monitoring events were during or slightly after falls in barometric pressure. The last two visits after significant falls can be considered worst case.

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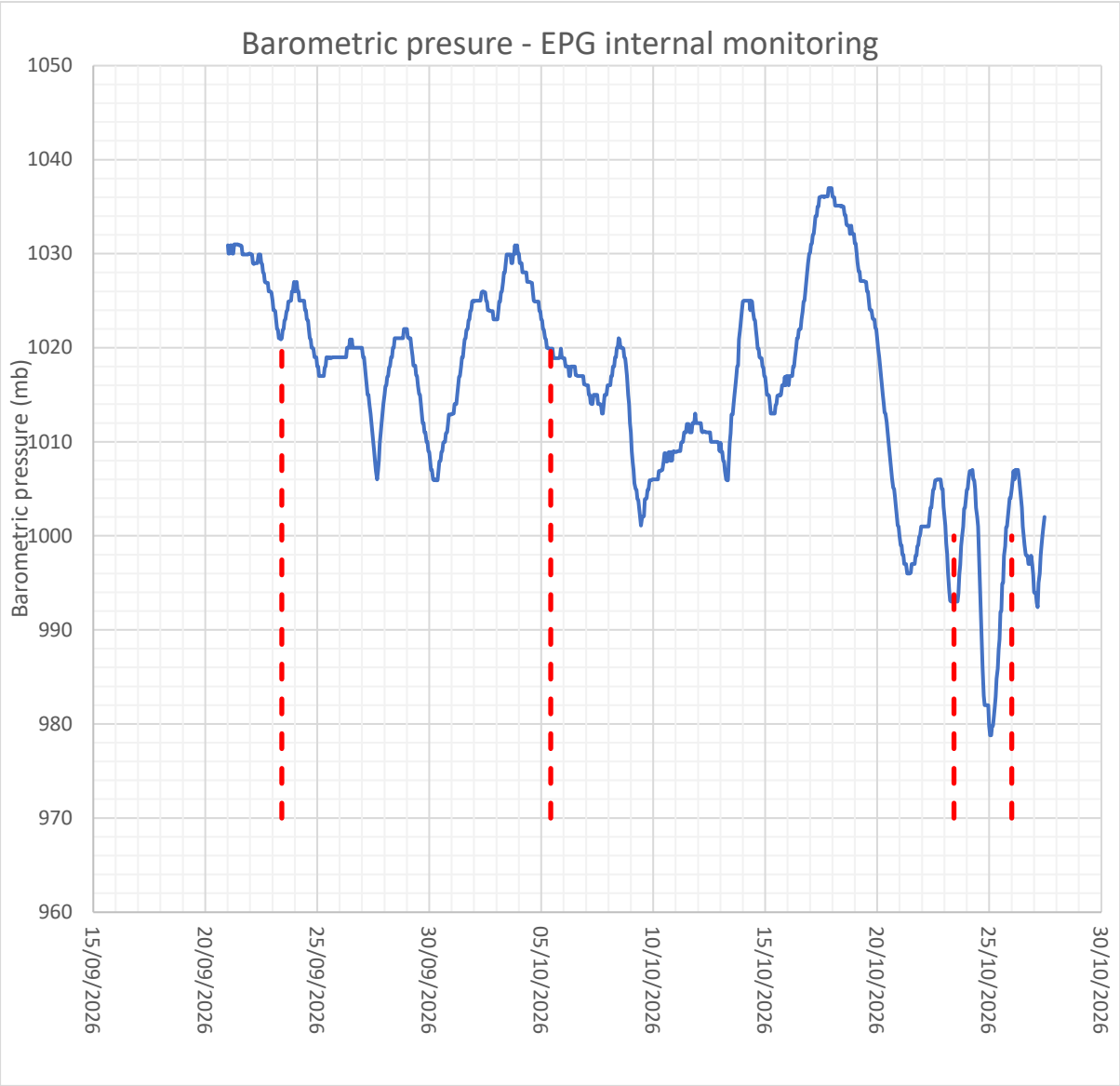


Figure 14 Barometric pressure – EPG internal monitoring

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Table 1 Summary of EPG internal monitoring

Date	Methane (ppm)		Carbon dioxide (ppm)		Comments
	Maximum ambient	Maximum at floor level	Maximum ambient	Maximum at floor level	
Lidl					
23 September 2026	6	General 7.7 Local 470	380	520	Local slightly elevated at pipe pop ups maximum of 30ppm at slab level. One isolated area at three points near fire exit on southern side – up to 470ppm reduced to 10ppm at 50mm above slab. No associated carbon dioxide so gas migration is via diffusion.
5 October 2026	12	General 22.1 Local 500	368	439 One room 600	Peak results quickly dissipated with height above slab.
23 October 2026	52.5	85	372	561 655 in two rooms	Toilet in use 719ppm
26 October 2026	35.5	62.3	358	422	Fire exit above cored holes 20.6ppm
Home Bargains					
23 September 2026	1.4	General 2.7 Local 24	350	360	Methane in one joint at 4.6ppm and one column at 24ppm quickly dropped at 10ppm at 50mm height
5 October 2026	2.9	Local 397	349	349	At floor level around isolated columns up to 250pm was recorded at one location. This immediately dropped to 20ppm in 30 seconds. At joints 397ppm was recorded in isolated locations but dissipated to 7ppm 100mm above the slab.
23 October 2026	3.9	47.7	335	344	Localised peaks reduced, 47.7ppm to 17.5ppm at 200mm above slab
26 October 2026	3.1	General 3.8 Local 30	327	350	Localised peaks reduce to 6.5ppm at 200mm above slab

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Lidl

In summary for the Lidl building there is no evidence of carbon dioxide ingress into the building. All results are below the CIRIA C795[4] minimal risk level of 1,000ppm.

On 5 October 2026 methane was detected at four locations at floor level. At the edge of building there were concentrations up to 143ppm by a fire escape on the southern side of building which reduced to 20ppm at 150mm above slab level. Minor ingress to west of this was recorded at 33ppm at ground level.

On the northern western corner peaks occurred at two points of 500ppm and 437ppm. The 500ppm reduced immediately to 89ppm in less than 10 seconds which indicates the volume of gas is minimal. At 50mm above ground level the concentration reduced to 13ppm.

The 437ppm result averaged at 370ppm and at 50mm above ground level was 40ppm. The spot was monitored again in the afternoon and the methane was present at 12ppm peak and steady at 8.9ppm. There was no elevated carbon dioxide at these points. This demonstrates that migration into the building is via diffusion (if pressure driven flow was occurring it would suck a volume of gas from the ground containing methane and carbon dioxide, not just the methane on its own).

Ambient methane concentrations have remained below the CIRIA C795 minimal risk concentration of 100ppm. Therefore, the minor gas ingress is well below acceptable levels and does not pose a risk to the building or occupants.

The internal monitoring at the Lidl Building has found minor gas ingress through the gas membrane and floor slab at one location at the edge of the building where the retaining wall is present. Any ground gas at this location is migrating upwards and getting trapped in the corner formed by the retaining wall and the raft foundation. It cannot move out sideways to vent to the air and there is clearly a preferential route into the building at this point. The gas ingress is minor and does not pose any significant risk to the building where ambient concentrations are well below minimal risk levels.

However, to reduce that risk further and try and minimise the ingress or prevent it, holes three 75mm diameter holes have been cored through the retaining wall to act as a relief pathway and dissipate any gas already present. Gas will always take the easiest route and the core holes provide that. The holes also allow diffusion of fresh air into the fill behind the wall which will dilute gas. This has been completed on other sites to reduce gas ingress from below raft foundations.

The gas membrane on the back of the retaining wall should have been self adhesive and therefore there the core hole should not have any impact on its performance. If it has been installed correctly there should not be a pathway for gas to track up the wall between membrane and concrete. The easiest route is out of the core holes.

Three 75mm core holes have be drilled through the retaining wall as shown in Figure 14.

[4] CIRIA C795, Retrofitting hazardous ground gas protection measures in existing or refurbished buildings.

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This is summarised on the diagram attached.

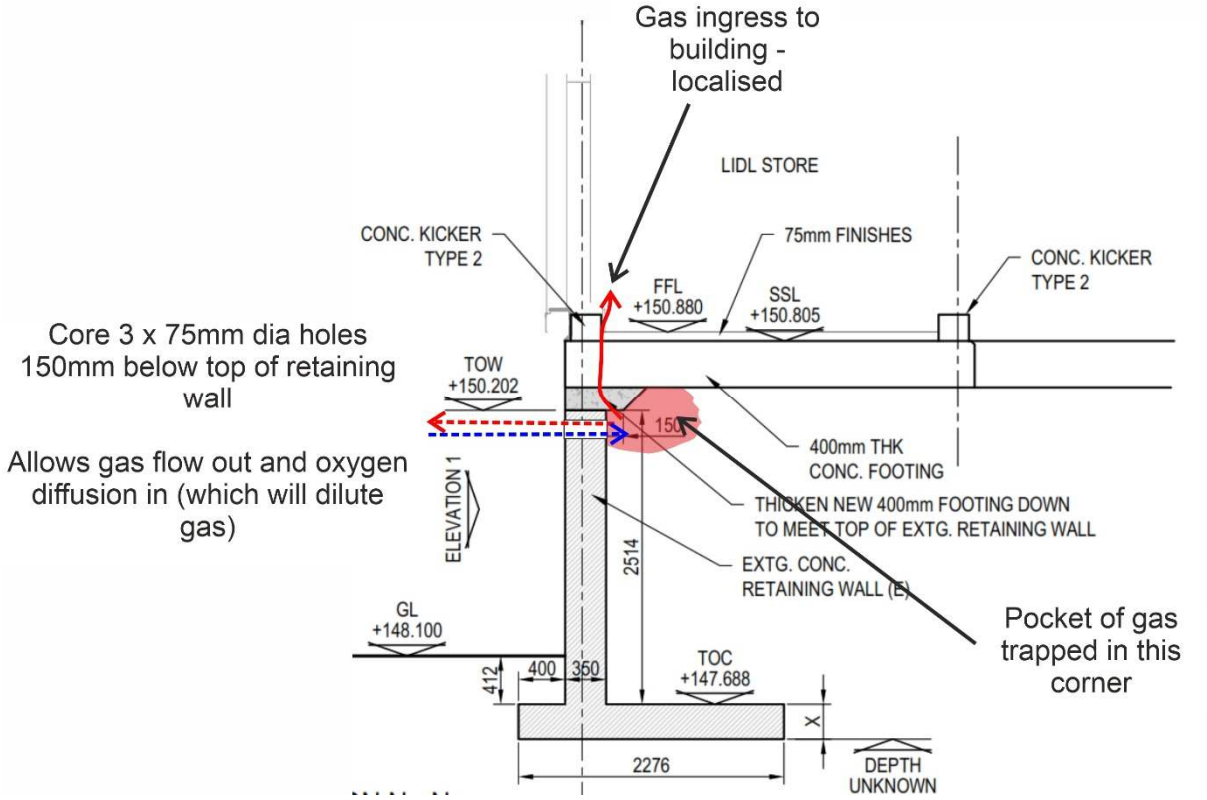


Figure 15 Remedial coring in the retaining wall

The monitoring visit on 26 October did not detect any methane ingress at the fire escape after the holes had been cored.

Home Bargains

In summary there is no evidence of significant gas migration from the ground into building all results in ambient air are below CIRIA C795 minimal risk levels. Carbon dioxide is not elevated where methane detected so methane ingress is via diffusion.

The results all indicate very small volumes of methane and this may well be being generated within the joints themselves, as a result of gas generation from debris that has entered or from degradation of concrete curing compounds that have over sprayed during construction. There is no evidence of large scale methane ingress from the ground and ambient concentrations are at background minimal risk concentrations.

Summary

In both buildings gas ambient gas concentrations have remained below minimal risk levels on four different monitoring events during worst case falls in barometric pressure. There is some minor ingress which results in slightly elevated concentrations at floor slab level. These do not pose a risk of hazardous conditions. For hazardous conditions to exist in the concentration in the ambient air must exceed 50,000ppm methane. This is shown in Figure 16 where the small bubble of gas is

compared to the large cloud of gas required for hazardous conditions. This can only occur where there are large open pathways through the ground and slab and pressure driven from the ground. Those are not present at this site.

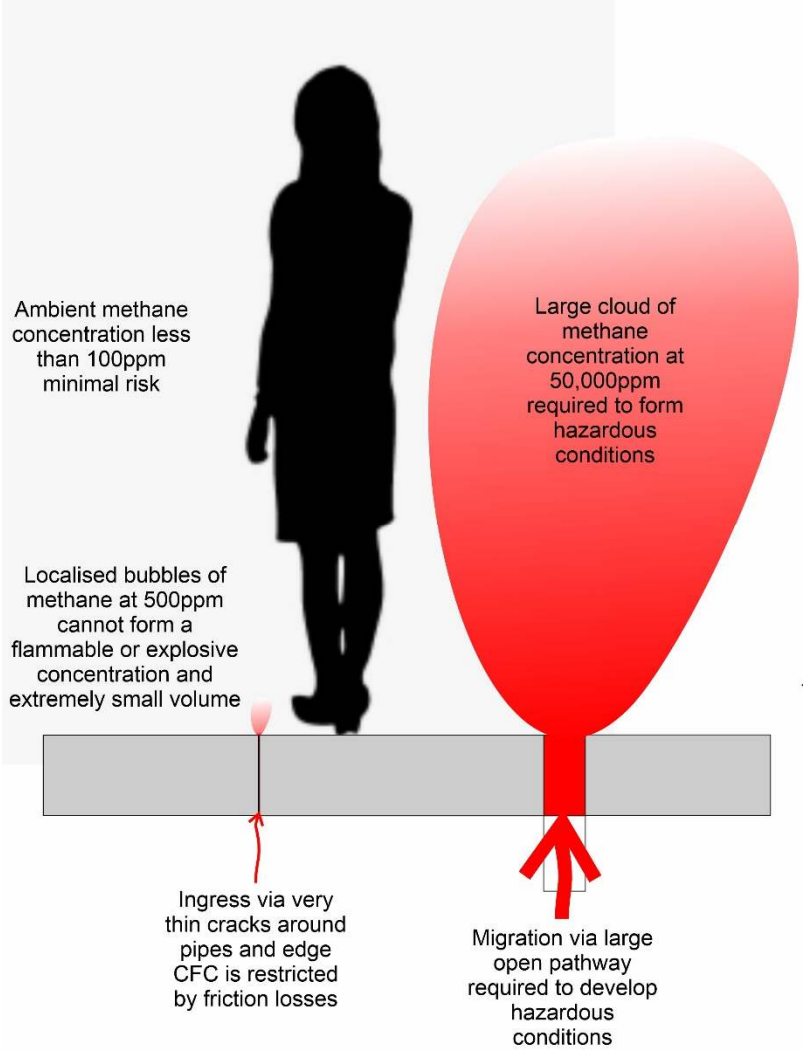


Figure 16 Methane bubble and hazardous gas cloud

Detection and alarm systems use sensors that can only detect down to 0.1% flammable gas (ie 1,000ppm methane). They are normally specified to alarm at 0.5% flammable gas (5,000ppm). None of the recorded gas concentrations in the buildings are anywhere near that level.

2.8 Quantitative modelling of ground gas migration

Modelling of gas emissions into the building from the sub-slab has been completed. This assumes advective flow from the underside of the slab into the building (even though all the preceding information indicates that flow is caused by diffusion). It is therefore very conservative

The model is an adaptation of the commonly applied Johnson and Ettinger model used for vapor intrusion assessment (e.g. in CLEA) as described by Wilson, 2008[5]. The results and input parameters are provided in Appendix C.

The results show that predicted methane and carbon dioxide concentrations are 3.6ppm and 0.8ppm respectively. This is around two orders of magnitude below the minimal risk values of 100ppm and 1,000ppm respectively.

Barometric pressure changes will not be a key driver for gas ingress to this site. This is shown in Figure 17.

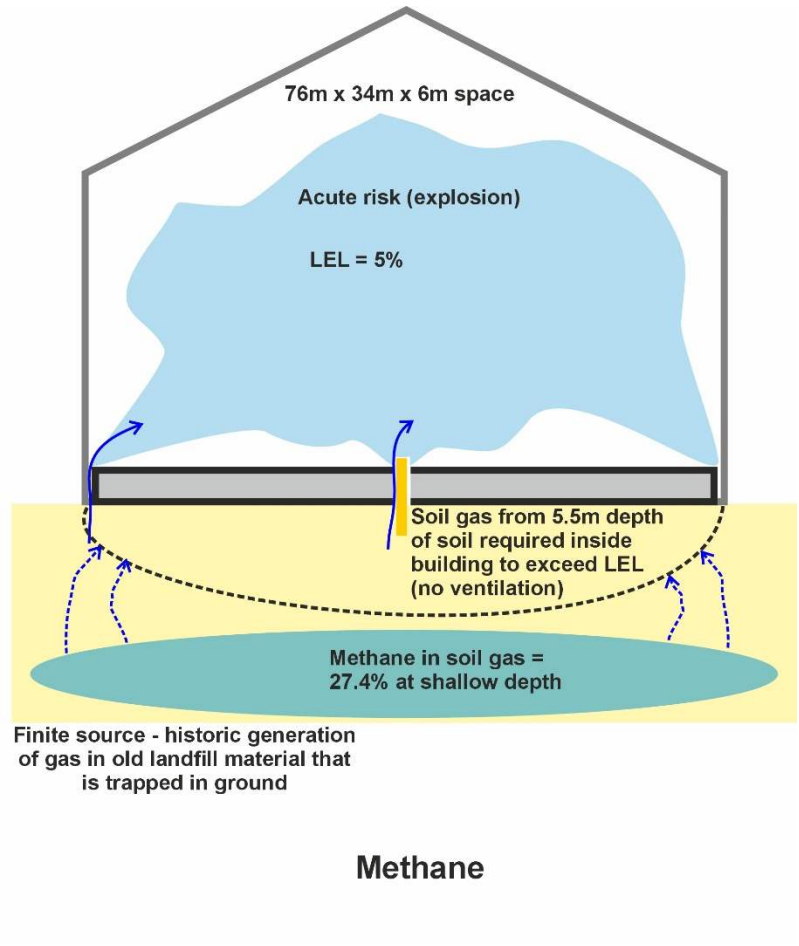


Figure 17 Extent of baromteric pressure intrusion into ground below a slab

Research by EPG has shown that there is significant friction to air flow in sub-base materials and soils. This results in head losses and means that the pressure front below cracks in the slab due to barometric pressure drops cannot extend more than 0.5m into the ground.

If the maximum methane concentration below the slab is assumed to be present in a 500mm layer below the whole building (3.8% below Home Bargains) over an area of approximately 44m by 52m),

[5] Wilson S (2008) Modular approach to analysing vapour migration into buildings in the UK. July 2008 Land Contamination & Reclamation 16(3):223-236

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and all that methane entered the building instantly it would not be sufficient to cause an explosive atmosphere (even without any ventilation). This very conservative assessment is demonstrated in the box below. The same also applies to Lidl.

Home Bargains

Area of building = 44m by 52m (site specific, measured)

Depth of pressure influence = 0.5m (distance of pressure response)

Porosity of sub-base/ground = 20% (conservative value assumed)

Methane concentration below slab = 3.8% (conservative, maximum value measured)

Therefore, volume of methane in soil pores = 44 x 52 x 0.5 x 0.2 x 0.038 = **8.7m³**

Assume whole building has a ceiling height of 8m

Volume of air space in building = 44 x 52 x 8 = **18304m³**

Concentration of methane = 8.7/18304 = 0.0005 or **0.05%**. Assumes no ventilation to dilute the gas.

Lidl

Area of building = 76m by 34m (site specific, measured)

Depth of pressure influence = 0.5m (distance of pressure response)

Porosity of sub-base/ground = 20% (conservative value assumed)

Methane concentration below slab = 27.4% (conservative, maximum value measured)

Therefore, volume of methane in soil pores = 76 x 34 x 0.5 x 0.2 x 0.274 = **70.8m³**

Assume whole building has a ceiling height of 6m

Volume of air space in building = 76 x 34 x 6 = **15504m³**

Concentration of methane = 70.8/15504 = 0.0045 or **0.45%**. Assumes no ventilation to dilute the gas.

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3 Conclusions

Prior to remediation there were two sources of ground gas below the site:

1. Landfill
2. Former coal workings.

Remediation works have resulted in the following sources remaining:

- Home Bargains – Limited localised sources of gas because coal workings are grouted (no voids present)and there is only very localised landfill present below 2m or more of overlying soils.
- Lidl – Landfill below the building. There is no mine gas source because workings are grouted.

The preconstruction site investigations and gas monitoring provided sufficient data to adequately characterise the site with respect to ground gas risk. The data meets the requirements in BS8756: 2013.

Prior to remediation risk assessments incorrectly concluded that the site was Characteristic Situaion CS4. This risk assessment has assessed the data following BS8485 and importantly has considered the conceptual site model and influence of monitoring wells on gas data. This risk assessment (which supersedes all others) shows that the Home Bargains site was reasonably classified as CS1 and Lidl CS2 prior to construction.

Post construction gas monitoring in monitoring wells and internal space surveys by EPG have been completed. This again meets the requirements of BS8576: 2013.

The post construction borehole gas monitoring shows that the Home Bargains is CS1 and the Lidl CS2. This fits with the conceptual model where there is only a very limited low to moderate generation source of ground gas below a small part of the Home Bargains.

Both buildings have gas membranes installed below the floor slabs. In addition, the Lidl has a raft foundation in which columns do not penetrate the concrete construction and all pipes, etc are cast into the concrete. The floor coverings in the store area also provide additional gas resistance (actually more gas resistant and durable than the underlying gas membrane).

Post construction internal monitoring has not detected any significant gas ingress into Home Bargains. There was generally no gas ingress to Lidl apart from localised minor points. The most consistent was by a fire escape on the southern side adjacent to the retaining wall. The gas was present within the floor construction itself and at 100mm or so above the slab it had reduced to background concentrations. This is minimal risk with respect to ground gas. Remedial works comprising coring holes in the retaining wall below the point of ingress to allow gas a route to air have been completed. This has resulted in the gas ingress at that point stopping.

There is no requirement for gas alarms. Provision of gas alarms is unreasonable and is not supported by the evidence for the site, nor any guidance document. Alarms should never have been a consideration for this site.

The design of the gas protection is in accordance with the BS8485: 2015 +A1: 2109 which is the document that should be followed for new buildings.

4 Recommendations

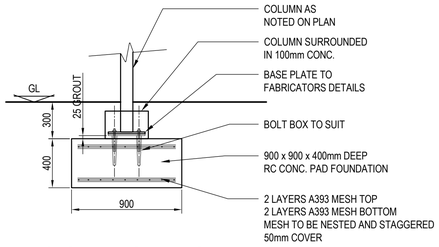
All service ducts in both buildings should be sealed internally with JUTA Ductseal.
On completion of duct sealing both buildings at the site are safe for occupation.
No further works are necessary to mitigate ground gas risk and internal gas alarms are not required (and there is no justification for requiring them).

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Appendix A

Foundation drawings



SECTION THROUGH PAD FOUNDATION
Scale 1:25

0m 0.5m 1m 1.5m 2m 3m 4m 5m

SCALE 1:50 - ENSURE PDF'S ARE PRINTED AT 1:1

CDM 2015 RISK NOTES

THE PROJECT HAS BEEN ASSESSED FOR SPECIFIC CONSTRUCTION RISK. THOSE RISKS THAT A COMPETENT CONTRACTOR SHOULD BE AWARE OF ARE NOT LISTED HERE. RISKS THAT ARE INHERENT IN THE DESIGN DECISIONS TAKEN THAT A CONTRACTOR NEEDS TO BE AWARE OF ARE HIGHLIGHTED BELOW AND REFERENCED IN LOCATION ON THE DRAWING PLANS BY THE NOTED SYMBOL.

⚠1 NO SPECIFIC ISSUES TO HIGHLIGHT. CONTRACTOR TO REVIEW SEQUENCE OF WORKS AND DISCUSS WITH THE ENGINEER.

SITE & DRAWN MEASUREMENTS

1) DRAWN DIMENSIONS ARE BASED ON ARCHITECTS DRAWINGS OR INTERPOLATED FROM ELECTRONIC FILES. THE CONTRACTOR SHOULD TAKE SITE MEASUREMENTS AS REQUIRED TO ENSURE THE SET-OUT OF THE BUILDING IS CORRECT AND STRUCTURAL ITEMS ARE PLACED IN THE CORRECT POSITION, ARE THE CORRECT LENGTH AND PROPORTIONS.

2) IF IN DOUBT ASK.

3) SITE MEASUREMENTS ARE TO BE TAKEN BY THE CONTRACTOR PRIOR TO MATERIAL ORDER. ANY DISCREPANCIES ARE TO BE REPORTED TO THE DESIGNER FOR REVIEW.

NOTES:
DO NOT SCALE FROM THIS DRAWING, UTILISE ONLY NUMBERED DIMENSIONS.
THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS, NOTIFY JAMESON CONSULTING LTD, IMMEDIATELY OF ANY DISCREPANCIES. UNLESS NOTED OTHERWISE.
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DRAWING STATUS
AS BUILT STATUS

GENERAL NOTES

1. DO NOT SCALE FROM THIS DRAWING.
2. ALL DIMENSIONS ARE SHOWN FOR DESIGN AND TENDER PURPOSES ONLY. ACTUAL SURVEY OR ARCHITECTS DIMENSIONS SHOULD BE USED IN ALL CASES. BUILDER/CONTRACTOR TO SATISFY THEMSELVES THAT DIMENSIONS ARE CORRECT PRIOR TO MATERIAL ORDER.
3. REFER ARCHITECTS DRAWINGS FOR CONSTRUCTION AND FINISH REQUIREMENTS.
4. NOTIFY JAMESON CE LTD IMMEDIATELY IF ANY DISCREPANCY ARISES.

CONCRETE NOTES

1. ALL CONCRETE WORK IS TO BE IN ACCORDANCE WITH JCE-LTD NBS-SECTION E
2. RELEVANT CONCRETE MIX DESIGN :-

CONCRETE ELEMENT	DESIGN CHEMICAL CLASS	SPEC. CLAUSE No.
SLAB	DC-1	130 O
RETAINING WALLS	DC-1	130 O
FOUNDATIONS	DC-1	130 C

3. SURFACE FINISH TO CONCRETE TO BE IN ACCORDANCE WITH SECTION 600. ALL FACES TO BE "AS CAST" UNLESS SPECIFIED BELOW :-

CONCRETE ELEMENT	SURFACE FINISH			
	TOP	BOTTOM	SIDE	END
SLAB	FLOATED	---	SHUTTER	SHUTTER

4. ALL SERVICE ACCESSES TO BE RAISED TO NEW LEVEL.
5. ALL SURFACE MOUNTED KIT TO BE REMOVED, STORED AND REFITTED.
6. REFER JCE SPECIFICATION FOR CONCRETE CURING PROVISION. CARE TO BE TAKEN TO CURE TOPPING TO PREVENT EARLY SHRINKAGE CRACKS.
7. FORMED JOINTS AS PROPOSED ON PLAN TO BE FOLLOWED UNLESS PRIOR AGREEMENT SOUGHT FROM JCE LTD.

DRAWING KEY - PRINT IN COLOUR
- 400mm THK CONC. FOOTING
- 300mm THK CONC. SLAB
- 200mm THK CONC. SLAB
- RECESSED 200mm THK CONC. SLAB

REV	DESCRIPTION	BY	CHK	APP	DATE
E	DRAWING STATUS REVISED TO AS BUILT	RL	CM	CM	02.09.26
D	FREEZER RECESS EXTENT AMENDED IN LINE WITH SITE CHANGES.	RL	CM	CM	25.03.26
C	SLAB DETAILS MIGRATED ACROSS TO DRAWING 4529 JCE S(20)07	RL	CM	CM	19.03.26
B	SLAB CONSTRUCTION DAY JOINT SHOWN	RL	CM	CM	12.03.26
A	MINOR CHANGES	RL	CM	CM	02.03.26

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0113 8231 915 info@jamesonconsulting.co.uk

Client:

Project:
LIDL BIRSTALL
LEEDS

Drawing Title:
PROPOSED NEW STORE
FOUNDATION GA

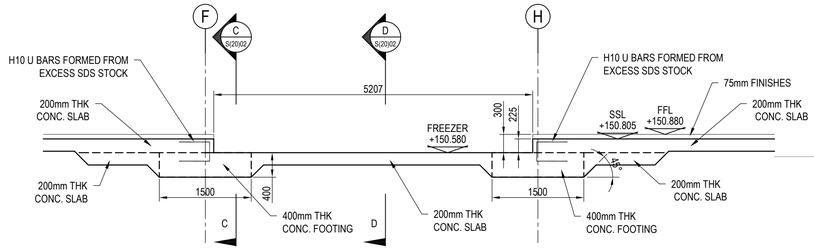
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Drawing No. 4529 JCE S (20) 01
Revision E

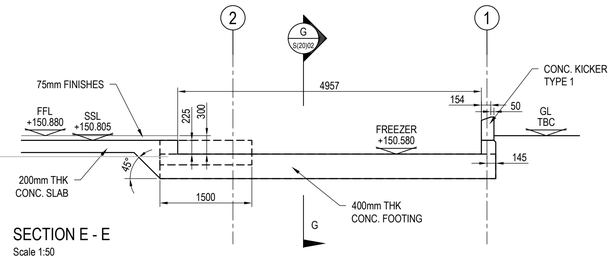
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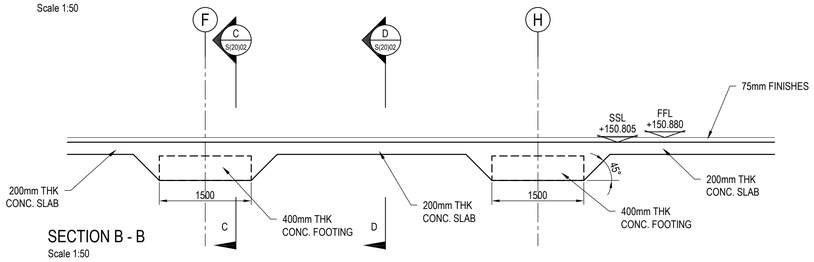
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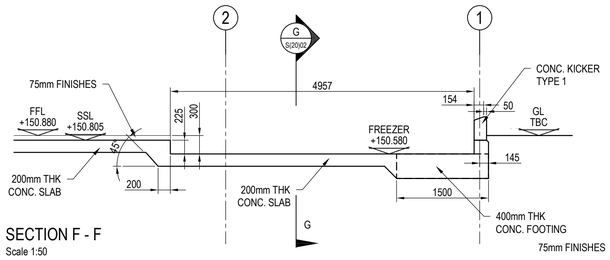
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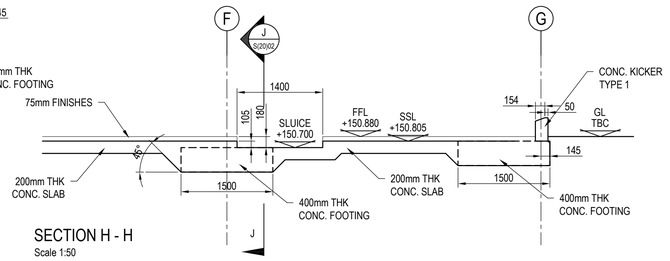
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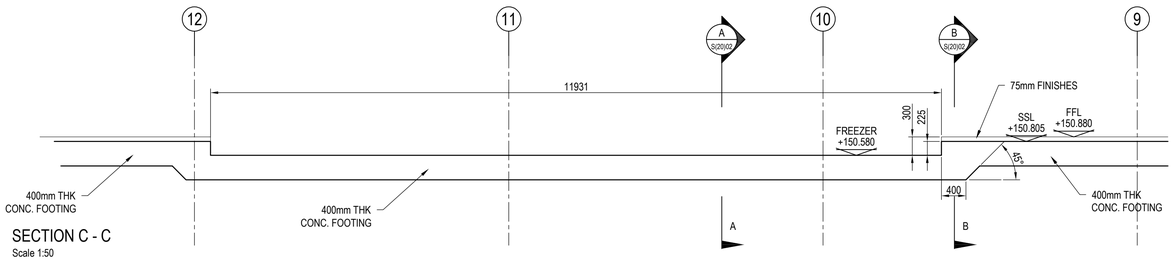
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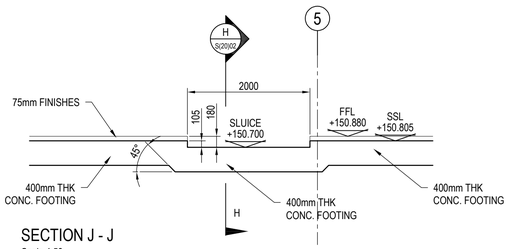
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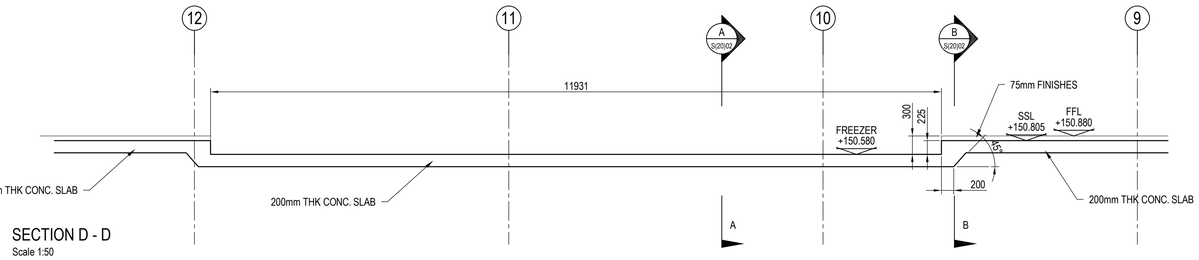
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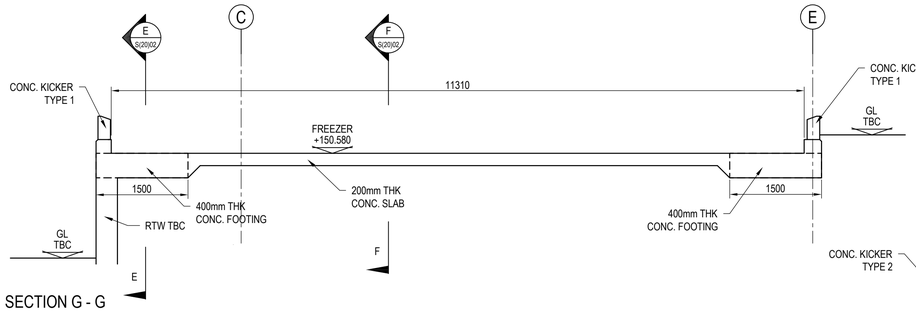
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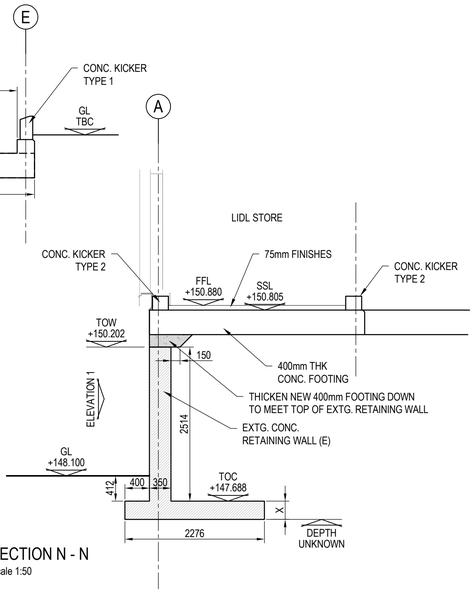
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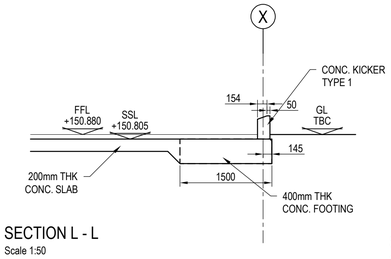
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SECTION G - G
Scale 1:50

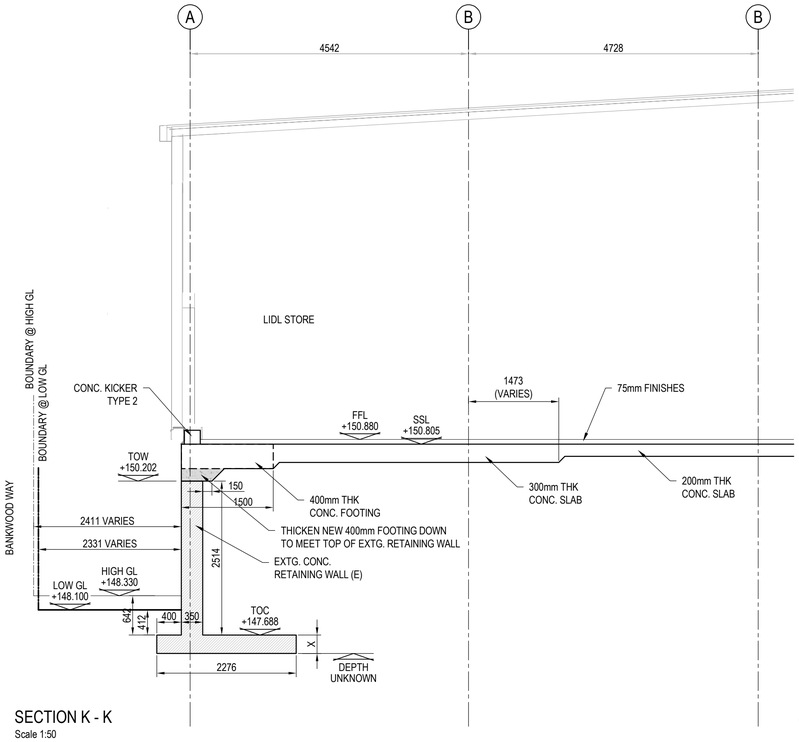


SECTION N - N
Scale 1:50



SECTION M - M
Scale 1:50

SECTION L - L
Scale 1:50



SECTION K - K
Scale 1:50

0m 0.5m 1m 1.5m 2m 3m 4m 5m

SCALE 1:50 - ENSURE PDF'S ARE PRINTED AT 1:1

CDM 2015 RISK NOTES

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NOTES:
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DRAWING STATUS

AS BUILT STATUS

GENERAL NOTES

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3. REFER ARCHITECTS DRAWINGS FOR CONSTRUCTION AND FINISH REQUIREMENTS.
4. NOTIFY JAMESON CE LTD IMMEDIATELY IF ANY DISCREPANCY ARISES.

CONCRETE NOTES

1. ALL CONCRETE WORK IS TO BE IN ACCORDANCE WITH JCE-LTD NBS-SECTION E
2. RELEVANT CONCRETE MIX DESIGN :-

CONCRETE ELEMENT	DESIGN CHEMICAL CLASS	SPEC. CLAUSE No.
SLAB	DC-1	130 O
RETAINING WALLS	DC-1	130 O
FOUNDATIONS	DC-1	130 C

3. SURFACE FINISH TO CONCRETE TO BE IN ACCORDANCE WITH SECTION 600. ALL FACES TO BE "AS CAST" UNLESS SPECIFIED BELOW :-

CONCRETE ELEMENT	SURFACE FINISH			
	TOP	BOTTOM	SIDE	END
SLAB	FLOATED	---	SHUTTER	SHUTTER

4. ALL SERVICE ACCESSES TO BE RAISED TO NEW LEVEL.
5. ALL SURFACE MOUNTED KIT TO BE REMOVED, STORED AND REFITTED.
6. REFER JCE SPECIFICATION FOR CONCRETE CURING PROVISION. CARE TO BE TAKEN TO CURE TOPPING TO PREVENT EARLY SHRINKAGE CRACKS.
7. FORMED JOINTS AS PROPOSED ON PLAN TO BE FOLLOWED UNLESS PRIOR AGREEMENT SOUGHT FROM JCE LTD.

REV	DESCRIPTION	BY	CHK	APP	DATE
C	DRAWING STATUS REVISED TO AS BUILT	RL	CM	CM	02.09.26
B	FREEZER RECESS SECTION A - A AMENDED IN LINE WITH SITE CHANGES.	RL	CM	CM	25.03.26
A	MINOR CHANGES	RL	CM	CM	02.03.26

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Pure Offices, 4100 Park Approach, Thorpe Park, Leeds LS15 8GB
0113 8231 915 info@jamesonconsulting.co.uk

Client:

Project:
LIDL BIRSTALL
LEEDS

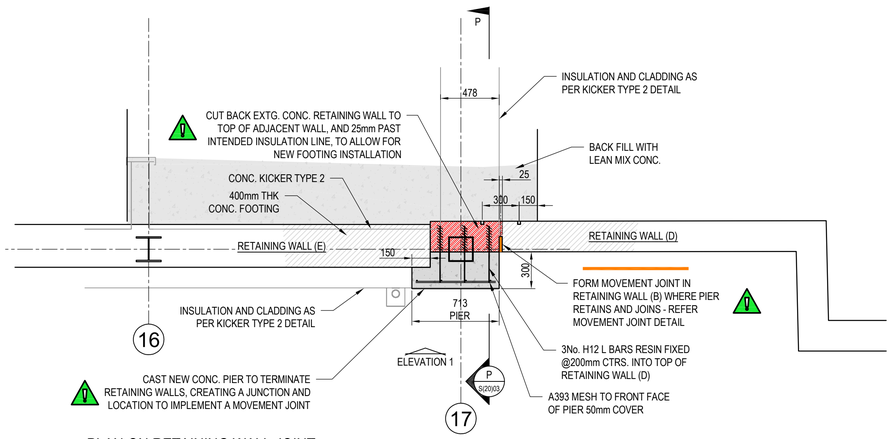
Drawing Title:
PROPOSED NEW STORE
FOUNDATION SECTIONS 01

Scale	Drawn	Date	Checked	Date	Approved	Date
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Drawing No. 4529 JCE S (20) 02
Revision C

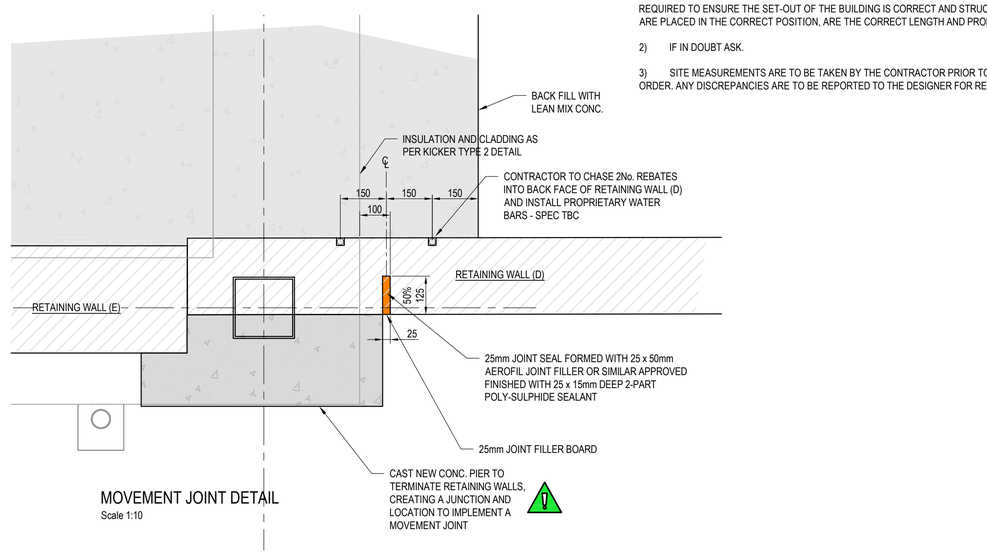
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SHEET SIZE : A1 LANDSCAPE

E:\JAME...\DRAWINGS\ENGINEERING\PROJECTS\...\DOCUMENTS\...\...AND VERSIONS\...\DRAWINGS\...\FOUNDATIONS.RVT | PLOTTED BY: RICHARD.WATSON | PLOTTED DATE: 25/March/2026 09:53:33



PLAN ON RETAINING WALL JOINT

Scale 1:25



MOVEMENT JOINT DETAIL

Scale 1:10

0m 0.5m 1m 1.5m 2m 3m 4m 5m

SCALE 1:50 - ENSURE PDF'S ARE PRINTED AT 1:1

CDM 2015 RISK NOTES

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DRAWING STATUS

AS BUILT STATUS

GENERAL NOTES

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2. ALL DIMENSIONS ARE SHOWN FOR DESIGN AND TENDER PURPOSES ONLY. ACTUAL SURVEY OR ARCHITECTS DIMENSIONS SHOULD BE USED IN ALL CASES. BUILDER/CONTRACTOR TO SATISFY THEMSELVES THAT DIMENSIONS ARE CORRECT PRIOR TO MATERIAL ORDER.
3. REFER ARCHITECTS DRAWINGS FOR CONSTRUCTION AND FINISH REQUIREMENTS.
4. NOTIFY JAMESON CE LTD IMMEDIATELY IF ANY DISCREPANCY ARISES.

CONCRETE NOTES

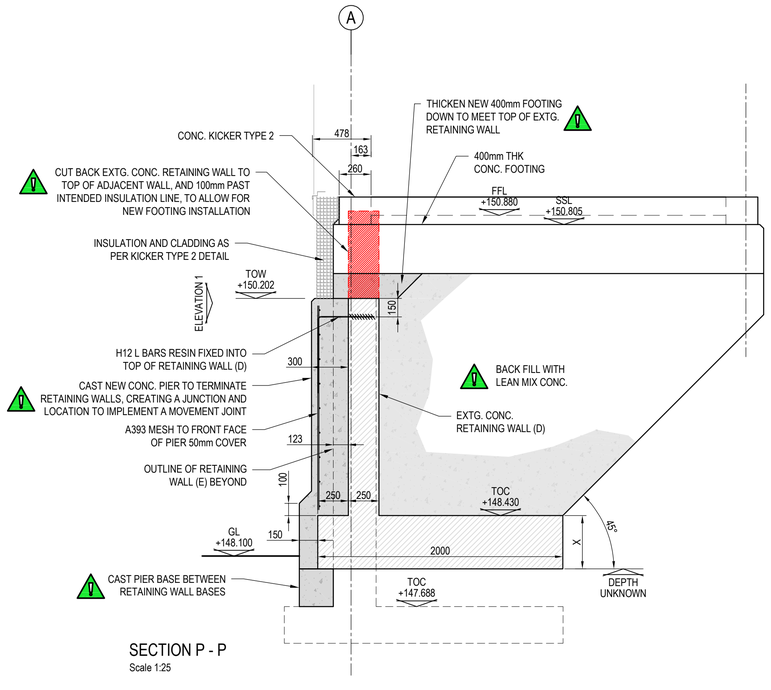
1. ALL CONCRETE WORK IS TO BE IN ACCORDANCE WITH JCE-LTD NBS-SECTION E
2. RELEVANT CONCRETE MIX DESIGN :-

CONCRETE ELEMENT	DESIGN CHEMICAL CLASS	SPEC. CLAUSE No.
SLAB	DC-1	130 D
RETAINING WALLS	DC-1	130 O
FOUNDATIONS	DC-1	130 C

3. SURFACE FINISH TO CONCRETE TO BE IN ACCORDANCE WITH SECTION 600. ALL FACES TO BE "AS CAST" UNLESS SPECIFIED BELOW :-

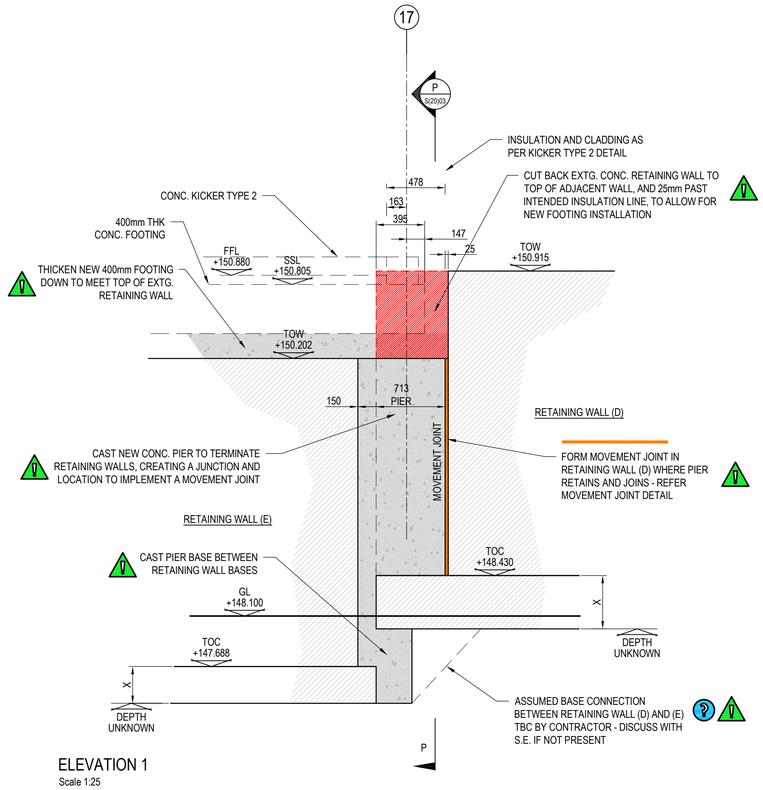
CONCRETE ELEMENT	SURFACE FINISH			
	TOP	BOTTOM	SIDE	END
-	-	-	-	-

4. ALL SERVICE ACCESSES TO BE RAISED TO NEW LEVEL.
5. ALL SURFACE MOUNTED KIT TO BE REMOVED, STORED AND REFITTED.
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7. FORMED JOINTS AS PROPOSED ON PLAN TO BE FOLLOWED UNLESS PRIOR AGREEMENT SOUGHT FROM JCE LTD.



SECTION P - P

Scale 1:25



ELEVATION 1

Scale 1:25

REV	DESCRIPTION	BY	CHK	APP	DATE
B	DRAWING STATUS REVISED TO AS BUILT	RL	CM	CM	02.09.26
A	PIER WIDTH REDUCED. DRAWING STATUS REVISED.	RL	CM	CM	04.03.26

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Client:

LIDL

Project:

LIDL BIRSTALL
LEEDS

Drawing Title:

PROPOSED NEW STORE
FOUNDATION SECTIONS 02

Scale	Drawn	Date	Checked	Date	Approved	Date
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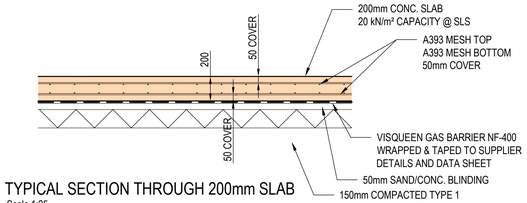
Drawing No.
4529 JCE S (20) 03

Revision
B

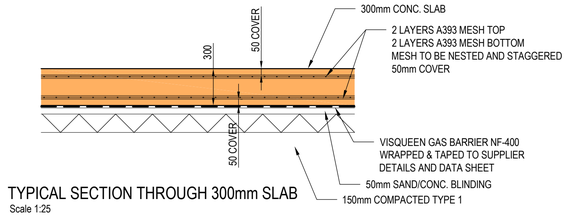
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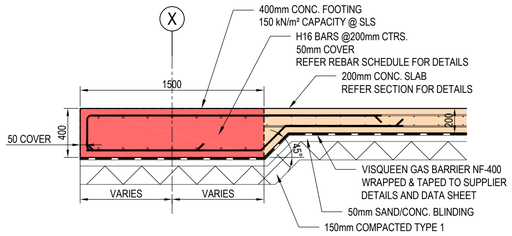
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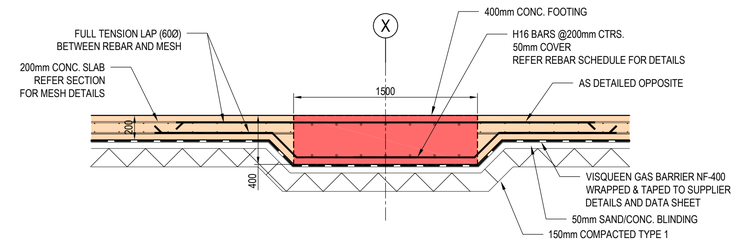
TYPICAL SECTION THROUGH 200mm SLAB
Scale 1:25



TYPICAL SECTION THROUGH 300mm SLAB
Scale 1:25

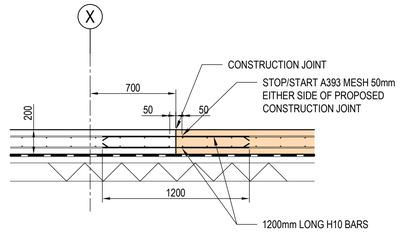


TYPICAL SECTION THROUGH CONC. FOOTING (400mm)
Scale 1:25

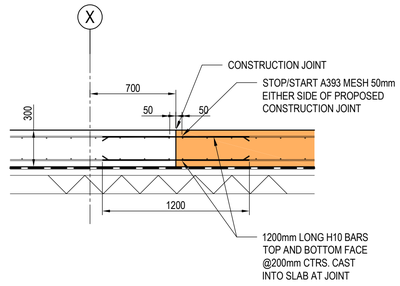


TYPICAL SECTION THROUGH CONC. FOOTING TO 200mm SLAB (BOTH SIDES)
Scale 1:25

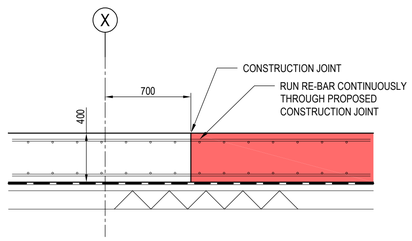
CONSTRUCTION JOINT DETAILS



CONSTRUCTION JOINT THROUGH 200mm SLAB
Scale 1:25



CONSTRUCTION JOINT THROUGH 300mm SLAB
Scale 1:25



CONSTRUCTION JOINT THROUGH CONC. FOOTING (400mm)
Scale 1:25



SCALE 1:50 - ENSURE PDF'S ARE PRINTED AT 1:1

CDM 2015 RISK NOTES

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SLAB	DC-1	130 O
RETAINING WALLS	DC-1	130 O
FOUNDATIONS	DC-1	130 C

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CONCRETE ELEMENT	SURFACE FINISH			
	TOP	BOTTOM	SIDE	END
SLAB	FLOATED	---	SHUTTER	SHUTTER

4. ALL SERVICE ACCESSES TO BE RAISED TO NEW LEVEL.
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DRAWING KEY - PRINT IN COLOUR
- 400mm THK CONC. FOOTING
- 300mm THK CONC. SLAB
- 200mm THK CONC. SLAB
- RECESSED 200mm THK CONC. SLAB

REV	DESCRIPTION	BY	CHK	APP	DATE
A	DRAWING STATUS REVISED TO AS BUILT	RL	CM	CM	02.09.26

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Client: LIDL

Project:
LIDL BIRSTALL
LEEDS

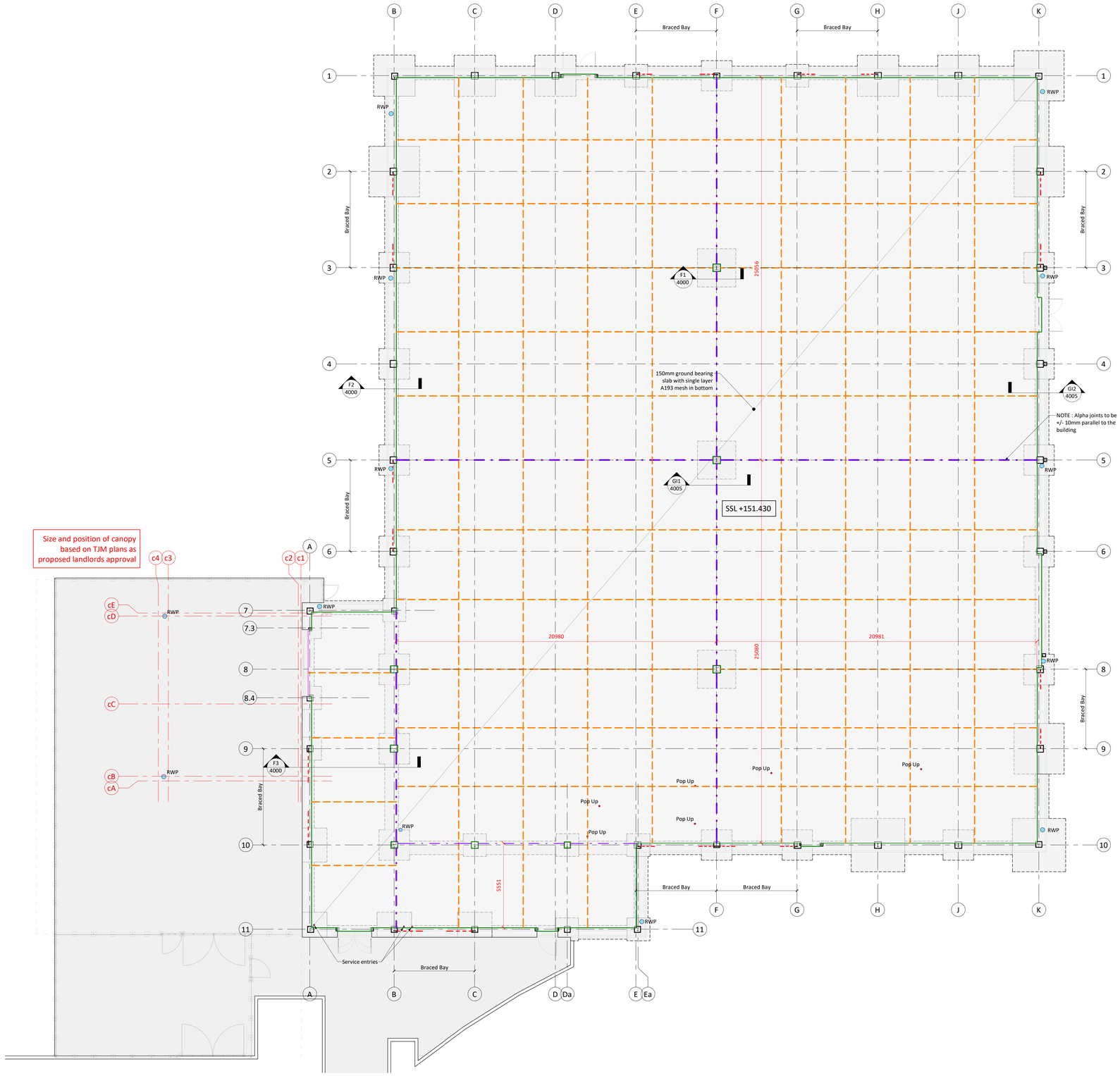
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PROPOSED NEW STORE
FOUNDATION SECTIONS 03

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Drawing No. 4529 JCE S (20) 07
Revision A

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SHEET SIZE : A1 LANDSCAPE

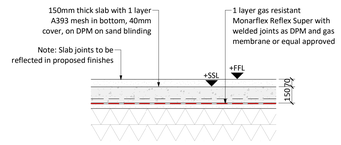
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GF Ground Floor Slab Plan
1 : 100

Slab Joint Key:

- Armoured Alpha Joint (AJ)
- Isolation Joint (IJ)
- Cut Joint (CJ)
- Armoured Edge Joint (AEJ)



S1 Section Through Slab
1 : 20

Do Not Scale

Drawing Notes

1. For general notes refer to Adept drawings 0151 & 0152.
2. This drawing is to be read in conjunction with all Architect's drawings from which all setting out details, dimensions, levels & waterproofing should be confirmed.
3. The Contractor is to check all drawings and report any discrepancies immediately.
4. All work is to be carried out in accordance with current edition of The Building Regulations and to the satisfaction of the Local Authority Building Inspector.
5. The symbols represented on Adept drawings should be read in conjunction with BS8541-2.
6. DPM and insulation to architects details.
7. All levels are in metres to ordnance datum.
8. Ground gas protection measures in accordance with BS8485:2019 to the below CS2 ground protection scores.
   - 150mm Slab, Type D = 1.5 pts
   - 150mm Slab, Type C = 2.5 pts
9. All gas protection details indicative and to be designed by a specialist.

FINAL CONSTRUCTION ISSUE

This final construction drawing is based on information supplied to Adept by the Principal Contractor which amends the construction issue and may incorporate instructions and other design information supplied to the Principal Contractor by others. Where future works to elements on this drawing are required it is recommended that adequate investigatory work is carried out to determine the accuracy of the information contained in this drawing. Adept cannot accept any liability for the accuracy of the information as this drawing includes data provided by others.

Date	Description	By	Chk	Rev
27.08.26	Final Construction Issue	GJH	VM	C3
24.07.26	RWP locations updated, slab bay sizes added	GJH	VM	C2
14.05.26	Construction Issue	JW	VM	C1
24.03.26	Pad footings added for canopy, layout updated to suit reduced gas protection requirements	GJH	VM	P7
06.02.26	Floor slab joints added	GJH	VM	P6
03.02.26	RWPs added and slab level updated to suit revised finishes	GJH	VM	P5
15.01.26	Slab thickened between grids 9-11, gas venting system added	GJH	VM	P4
12.12.25	Pop up locations added	GJH	VM	P3
08.12.25	Grid 10-11 floor area extended, gable columns added, steelwork and grids updated to suit	GJH	VM	P2
14.11.25	Initial issue	GJH	VM	P1

ADEPT
CIVIL AND STRUCTURAL CONSULTING ENGINEERS
Web www.adeptcsce.com
Email inbox@adeptcsce.com
Tel 0113 239 4518
Office 1912 Mill, Sunny Bank Mills, Farsley, Leeds LS28 5UJ

Project
Proposed Retail Unit
Birstall, Bankwood Way

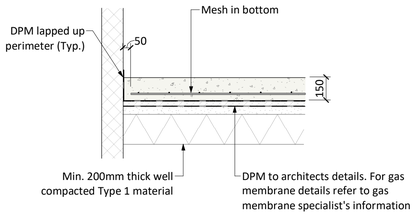
Title
Ground Floor Slab Layout

Client
Cookridge Estates

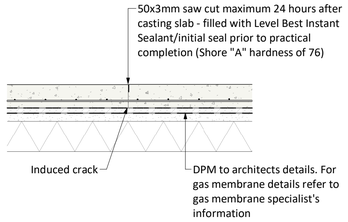
Scale @ A0	Initial author	Initial checker	Approver	Initial Date
As indicated	JW	VM	GS	Nov. '25

Status	Purpose	Adept Project Number
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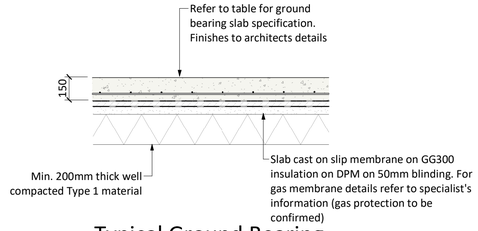
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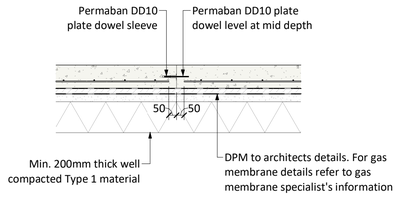
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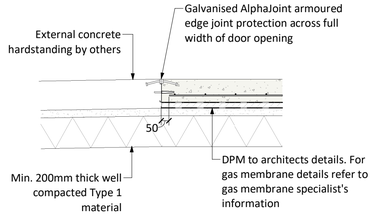
Cut Joint Detail (CJ)



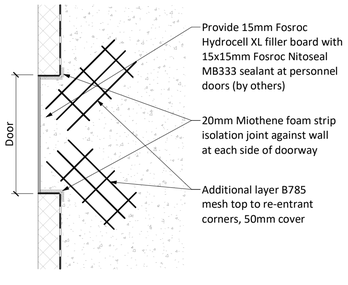
Typical Ground Bearing Slab Construction



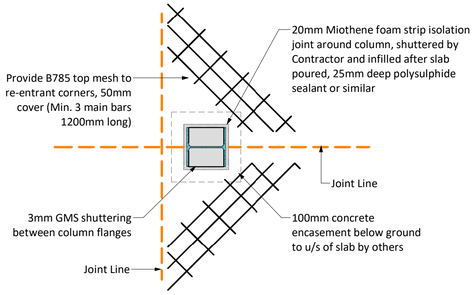
Armoured Alpha Joint (AJ)



Armoured Edge Joint (AEJ)



Indicative Plan on Slab at Door Thresholds



Internal Column Isolation (Typical)

Ground Bearing Slab Details:

Concrete Grade		C32/40
Slab Thickness (mm)		150
Reinforcement	Fibre	N/A
	Mesh	A193
	Cover (mm)	40 (Bottom)
	Min Laps (mm)	450
Aggregates		Refer to Adept Spec. for Details
Nom. Max Size Coarse Aggregate (mm)		20
Min. Cement Content (kg/m³)		300
Max. Free Water / Cement Ratio		0.55
Admixture		Superplasticisers only, refer to Adept Spec.
Slip Membrane/Gas Membrane		Suitable for CS2 ground gas condition.
Insulation		30mm Kingspan GG300
Damp Proof Membrane		1200 Gauge Visqueen.
Sub-base, Thickness and Type		200mm min. granular Sub-base Type 1
Sub-base level		+0mm / -20mm from slab soffit datum
Design Subgrade Modulus of Elasticity, k (N/mm²/mm) To be demonstrated on site with 3No. 750mm dia. plate bearing tests required at natural ground formation level and top of engineered fill level, and in no less than 450mm vertical layers. If fill is deeper than 450mm, additional tests will be required at the same frequency as set out above.		0.05 min.
Surface Finish		Tamped
Surface Tolerance		FM3
Sampling Regime		Testing regime to be 2No. sets of 4 cubes per casting day. 2No. cubes from each set to be tested at 28-day strength.
Dryshake Topping Required?		No
Curing		Application of a sprayed membrane in accordance with the manufacturer's recommendation. Sprayed membrane shall also act as an anti-dusting agent, Proseal or similar approved.
Abrasion Resistance Performance Class		All areas:- AR2
Exposure Class		XC1
Chloride Class		Cl, 0.40
Design Loading (Slab not to be loaded until 28 days after pouring)	UDL	All areas:- 10kN/m²
	Back to Back Load	5kN
	Back to Back Distance Between Legs	300mm
	Racking Leg Distance From Joints	Tenant requirements to be reviewed
	Single Racking Leg Baseplate Size	Tenant requirements to be reviewed
	Forklift truck	FL4
Other Comments		TBC

FINAL CONSTRUCTION ISSUE

This final construction drawing is based on information supplied to Adept by the Principal Contractor which amends the construction issue and may incorporate instructions and other design information supplied to the Principal Contractor by others.Where future works to elements on this drawing are required it is recommended that adequate investigatory work is carried out to determine the accuracy of the information contained in this drawing. Adept cannot accept any liability for the accuracy of the information as this drawing includes data provided by others.

Do Not Scale

Drawing Notes

1. For general notes refer to Adept drawings 0151 & 0152.
2. This drawing is to be read in conjunction with all Architect's drawings from which all setting out details, dimensions, levels & waterproofing should be confirmed.
3. The Contractor is to check all drawings and report any discrepancies immediately.
4. All work is to be carried out in accordance with current edition of The Building Regulations and to the satisfaction of the Local Authority Building Inspector.
5. The symbols represented on Adept drawings should be read in conjunction with BS8541-2.
6. DPM and insulation to architects details.
7. All levels are in metres to ordnance datum.
8. Ground gas protection measures in accordance with BS8485:2019 to the below CS2 ground protection scores
   - 150mm Slab, Type D = 1.5 pts
   - 150mm Slab, Type C = 2.5 pts
9. All gas protection details indicative and to be designed by a specialist.
10. Slab design loading taken from Home Bargains Shell Specification Requirements - Section 1.1

All saw cutting of joints to be done within 24 hours of slab pour.

All columns to be additional layer of B785 top mesh to re-entrant corners, 30mm cover (Min. 3 main bars 1200mm long).

Alternatively, 3No. loose bars can be used in lieu of mesh however it will require to be fixed in top placement to avoid it sinking down into bottom layer.

Date	Description	By	Chk	Rev
27.08.26	Final Construction Issue	GJH	VM	C3
24.07.26	Membrane details and slab thickness updated	GJH	VM	C2
14.05.26	Construction Issue	JW	VM	C1
24.03.26	Slab details and finish updated	GJH	VM	P2
06.02.26	Initial Issue	GJH	VM	P1

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Project

Proposed Retail Unit
Birstall, Bankwood Way

Title

Ground Floor Slab Details

Client

Cookridge Estates

Scale @ A1	Initial author	Initial checker	Approver	Initial Date
1 : 20	JW	VM	GS	Nov. '25

Status	Purpose	Adept Project Number
A	Final Construction	00.20321

Project-Originator-Functional Breakdown-Spatial Breakdown-Form-Discipline-Number: 00.20321-ACE-ZZ-00-D-S-4011 | Rev. C3

NOTE: TEMPORARY WORKS MAY BE REQUIRED TO GABION RETAINING WALLS TO AVOID UNDERPINNING DURING FOUNDATION AND DRAINAGE WORKS

Size and position of canopy based on TJM plans as proposed landlords approval

1 layer A393 mesh in top of all canopy bases, 50mm minimum cover

Pad foundations where service entry ducts are to be cast, to be reinforced top and bottom

Surface water drainage to pass under foundations, refer to Adept drgs 1001 & 1032

Foul drainage to pass under foundations, refer to Adept drgs 1001 & 1032

Service entries

Braced Bay

Drainage Channel

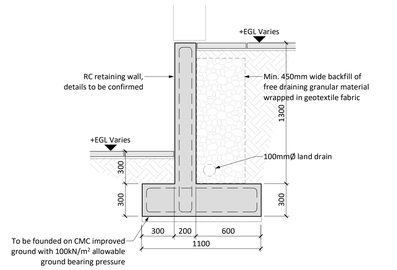
Vegetation

Unable to Survey

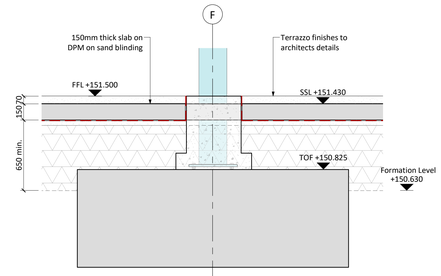
FN Foundation Layout
1 : 100

Pad Foundation Schedule

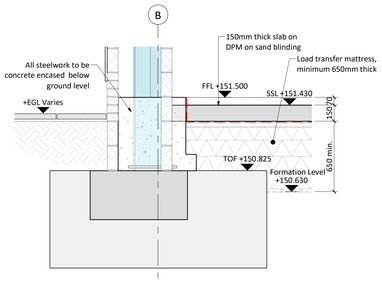
Pad Ref	Count	Volume	Length	Width	Depth
P01	14	28.13 m³	1500	1500	900
P02	18	64.46 m³	2000	2000	900
P03	1	3.38 m³	2500	1500	900
P04	4	18.23 m³	2250	2250	900
P05	3	16.88 m³	2500	2500	900
P06	5	32.81 m³	2700	2700	900
P07	4	39.20 m³	3300	3300	900
P08	2	29.40 m³	3500	3500	1200
Grand total: 51	51	232.47 m³			



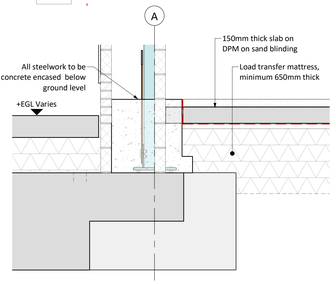
R1 Section at External Retaining Wall
1 : 20



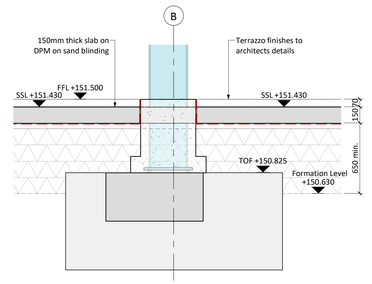
F1 Typical Internal Pad Footing
1 : 20



F2 Typical External Pad Footing
1 : 20



F3 Typical Foundations At Extended
1 : 20



Do Not Scale

Drawing Notes

1. For general notes refer to Adept drawings 0151 & 0152.
2. This drawing is to be read in conjunction with all Architect's drawings from which all setting out details, dimensions, levels & waterproofing should be confirmed.
3. The Contractor is to check all drawings and report any discrepancies immediately.
4. All work is to be carried out in accordance with current edition of The Building Regulations and to the satisfaction of the Local Authority Building Inspector.
5. The symbols represented on Adept drawings should be read in conjunction with BS8541-2.
6. All levels are in metres to ordnance datum.
7. All excavations to be inspected on site by engineer/ building control officer before placing concrete.
8. All columns to be encased below ground level with min. 100mm mass concrete.
9. All concrete pad foundations to be positioned centrally on grid/under column U.N.O.
10. All concrete strip footings/ground beams to be positioned centrally under wall construction over unless noted otherwise.
11. All pad foundations in braced bays to have 1 layer A393 mesh in top.
12. All pad foundations where service entry ducts are to be cast within to have reinforced cage.
13. Installed drainage survey provided by SDS overlaid on foundation plan, final drainage design pending confirmation of gravity rainwater locations and surveyed foul water levels.
14. Refer to Adept 6000 series drawings for RC details.

FINAL CONSTRUCTION ISSUE

This final construction drawing is based on information supplied to Adept by the Principal Contractor which amends the construction issue and may incorporate instructions and other design information supplied to the Principal Contractor by others.Where future works to elements on this drawing are required it is recommended that adequate investigatory work is carried out to determine the accuracy of the information contained in this drawing. Adept cannot accept any liability for the accuracy of the information as this drawing includes data provided by others.

Date	Description	By	Chk	Rev
27.08.26	Final Construction Issue	GJH	VM	C3
24.07.26	RWP locations updated, drainage layout updated to suit	GJH	VM	C2
24.04.26	Construction Issue. Grid 10-11 foundation depths updated to suit external levels	GJH	VM	C1
24.03.26	Drainage layout updated, footings dropped locally to suit, pad footings added for canopy, updated to suit reduced gas protection requirements	GJH	VM	P9
06.02.26	Retaining wall to external yard added	GJH	VM	P8
03.02.26	RWPs added and slab level updated to suit revised finishes	GJH	VM	P7
15.01.26	Site layout and drainage added, notes added	GJH	VM	P6
12.12.25	Door frame added to grid 10	GJH	VM	P5
08.12.25	Columns added to gable ends, footings updated to suit, sections added	GJH	VM	P4
26.11.25	Grid 10-11 floor area extended	GJH	VM	P3
20.11.25	Pad sizes reviewed, strips reduced to suit wall setting out	GJH	VM	P2
14.11.25	Initial Issue	GJH	VM	P1

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Project
Proposed Retail Unit
Birstall, Bankwood Way

Title
Foundation Plan

Client
Cookridge Estates

Scale @ A0	Initial author	Initial checker	Approver	Initial Date
As indicated	JW	VM	GS	Nov. '25

Status	Purpose	Adept Project Number
A	Final Construction	00.20321

Project-Originator-Functional Breakdown-Spatial Breakdown-Form-Discipline-Number: 00.20321-ACE-ZZ-FN-D-S-4000 Rev. C3

Appendix placeholder

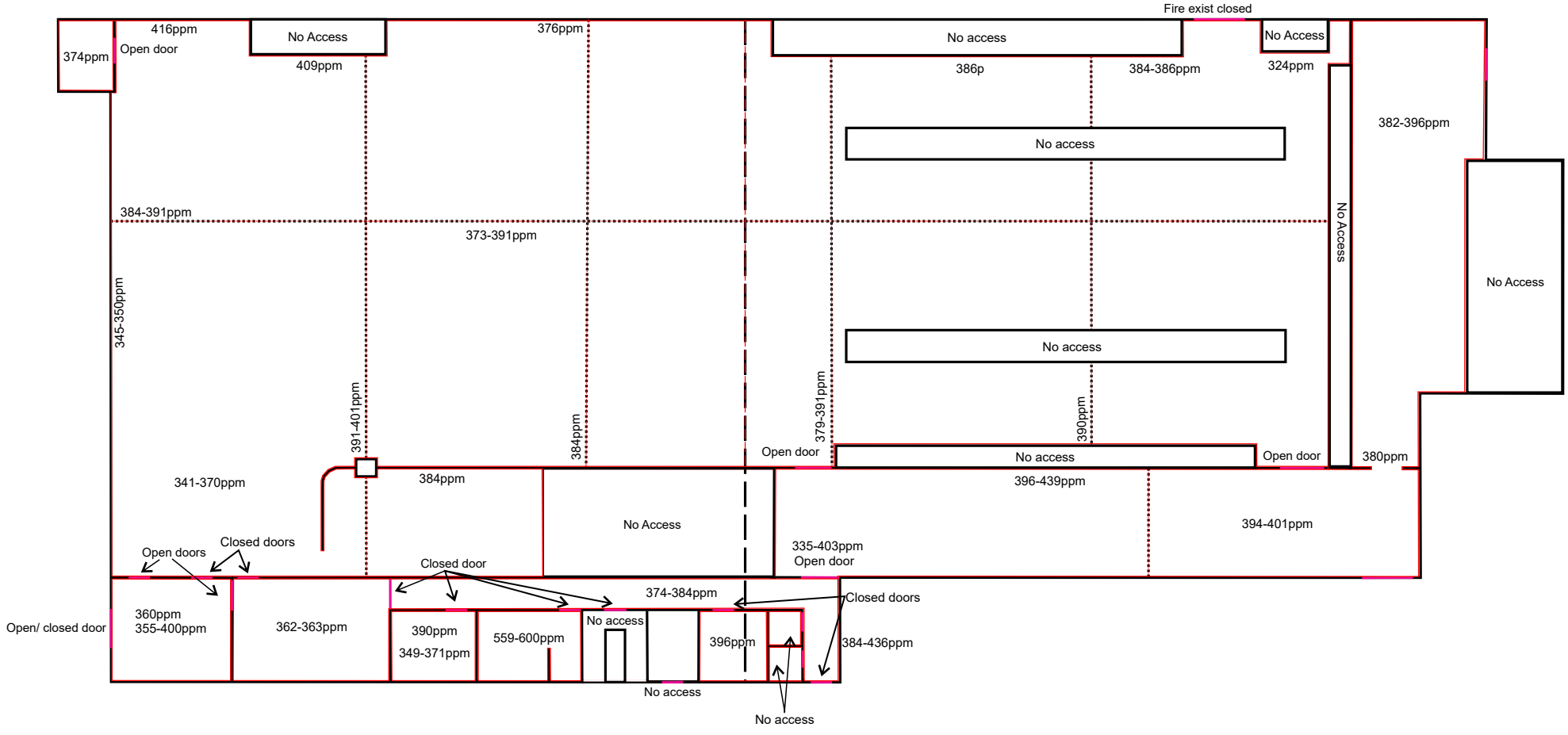
© EPG Ltd



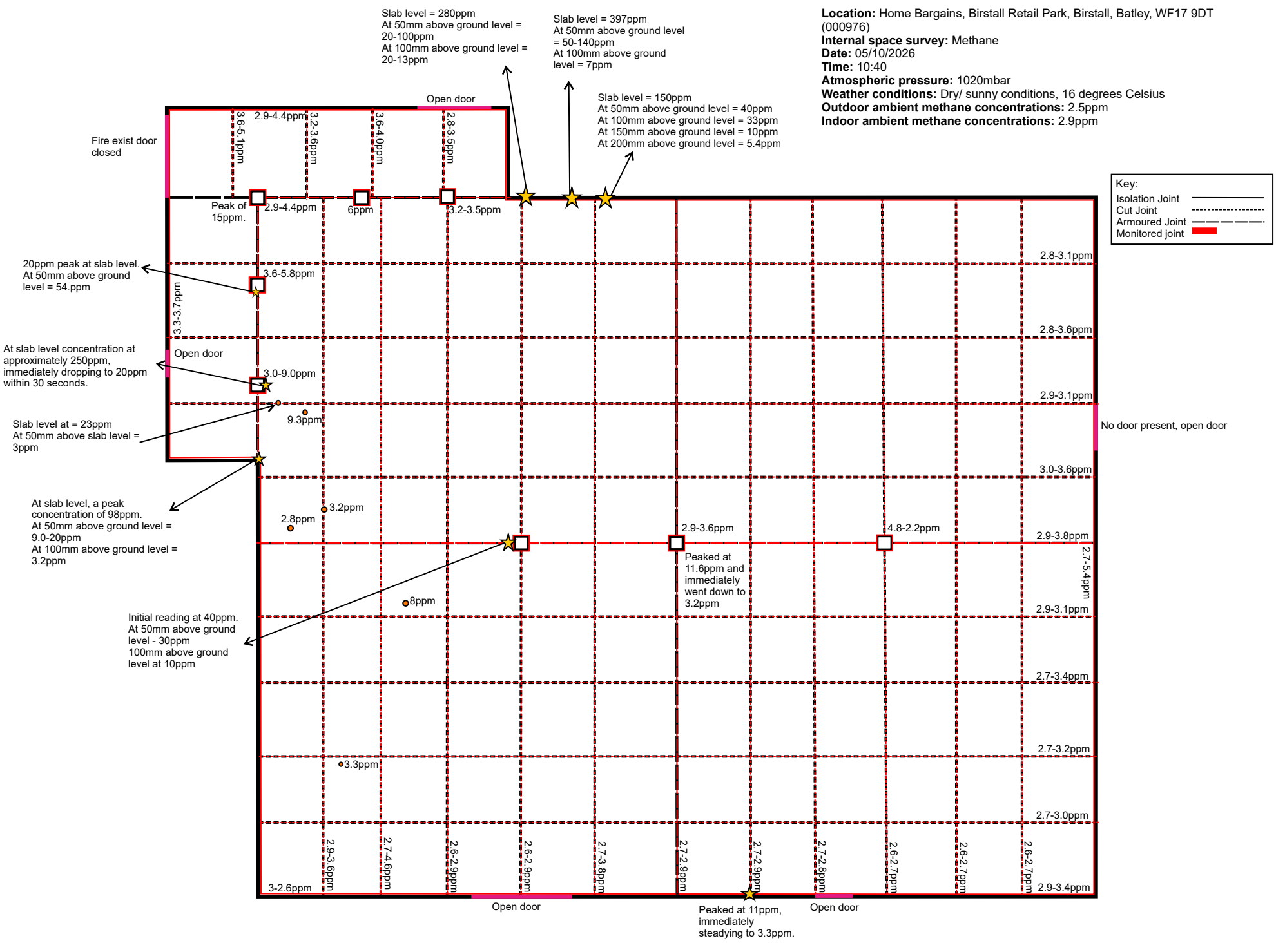
Appendix B

EPG internal monitoring results

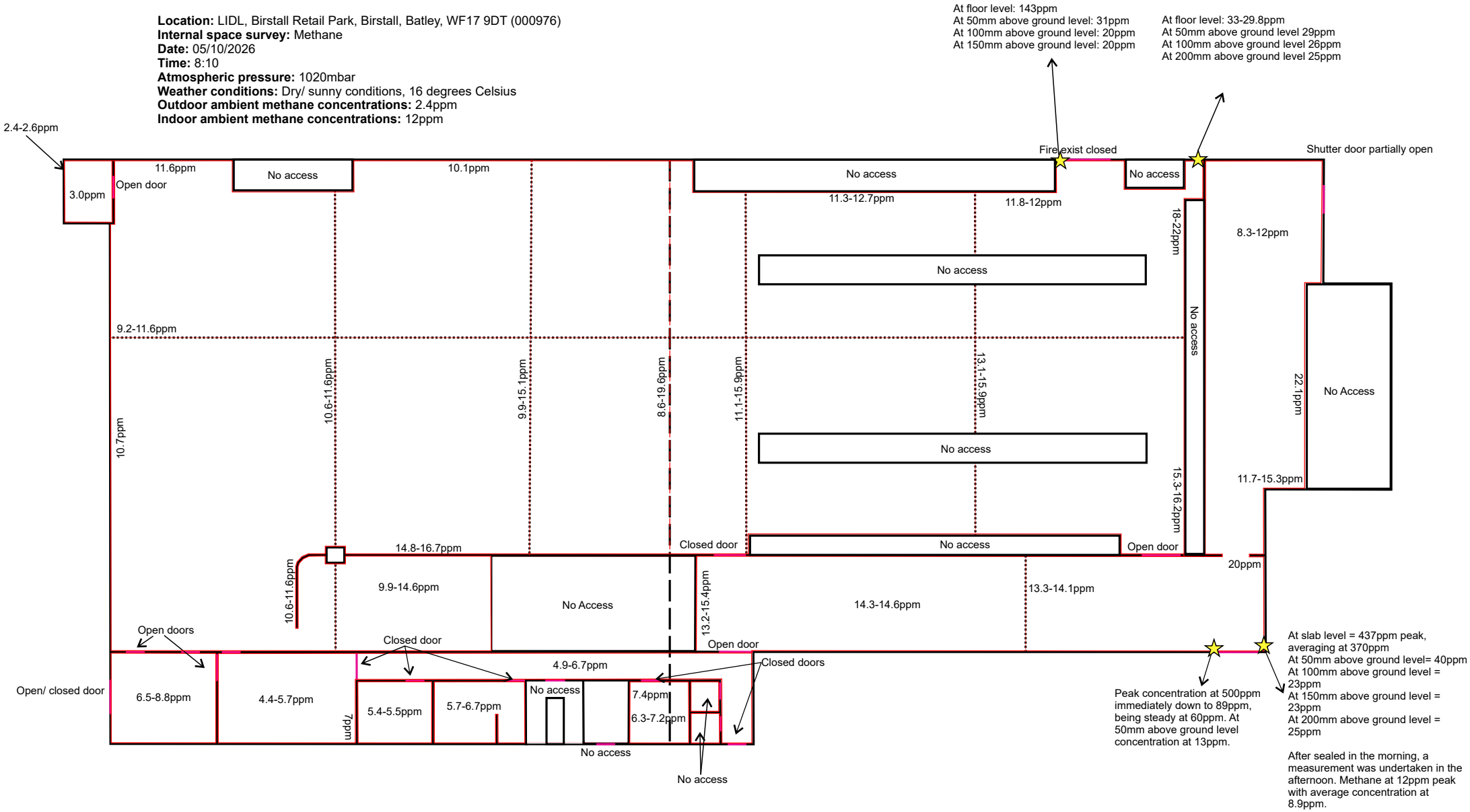
Location: LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Carbon dioxide
Date: 05/10/2026
Time: 9:40
Atmospheric pressure: 1020mbar
Weather conditions: Dry/ sunny conditions, 16 degrees Celsius
Outdoor ambient carbon dioxide concentrations: 368ppm
Indoor ambient carbon dioxide concentrations: 355-360ppm



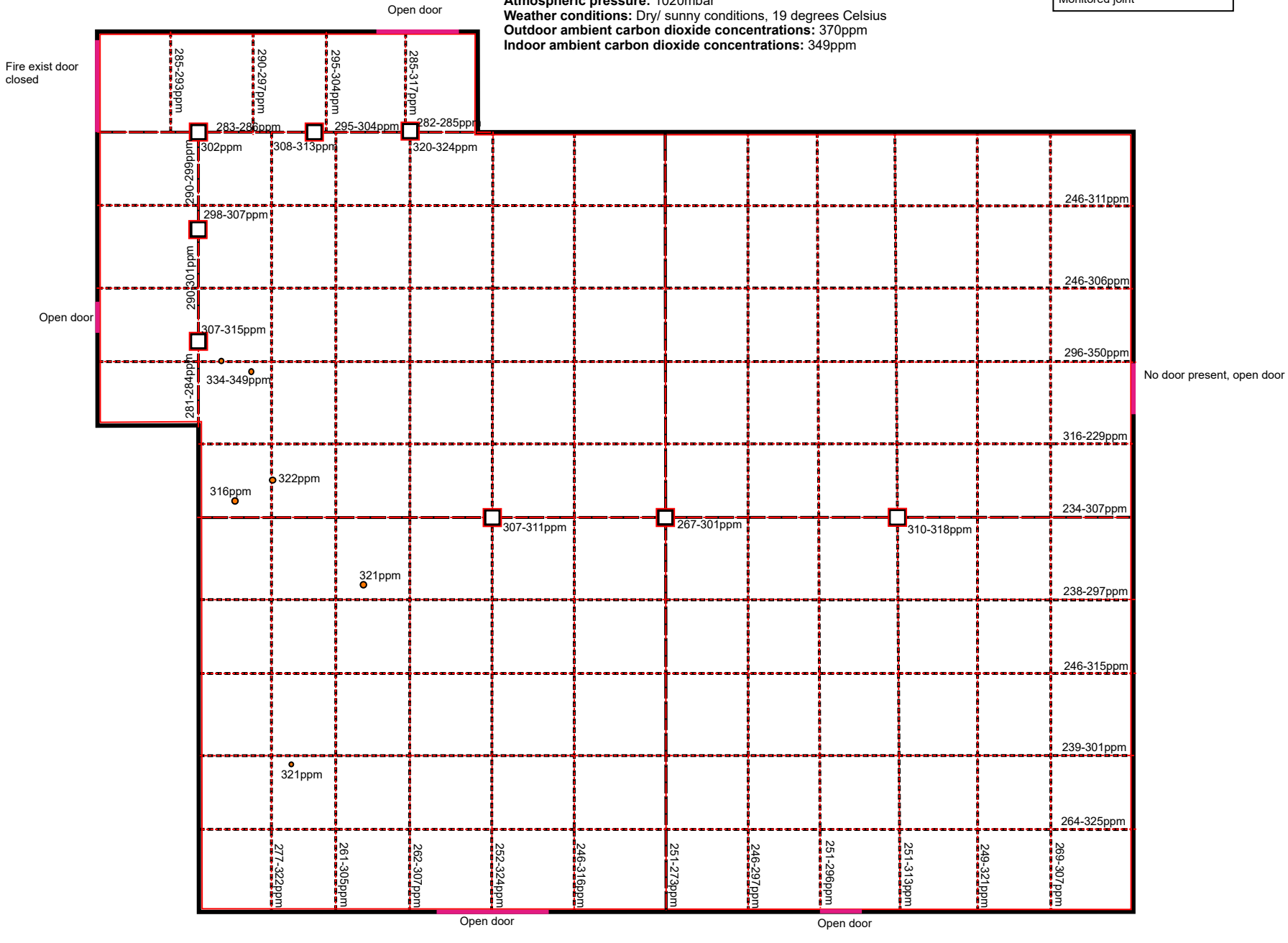
Location: Home Bargains, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Methane
Date: 05/10/2026
Time: 10:40
Atmospheric pressure: 1020mbar
Weather conditions: Dry/ sunny conditions, 16 degrees Celsius
Outdoor ambient methane concentrations: 2.5ppm
Indoor ambient methane concentrations: 2.9ppm



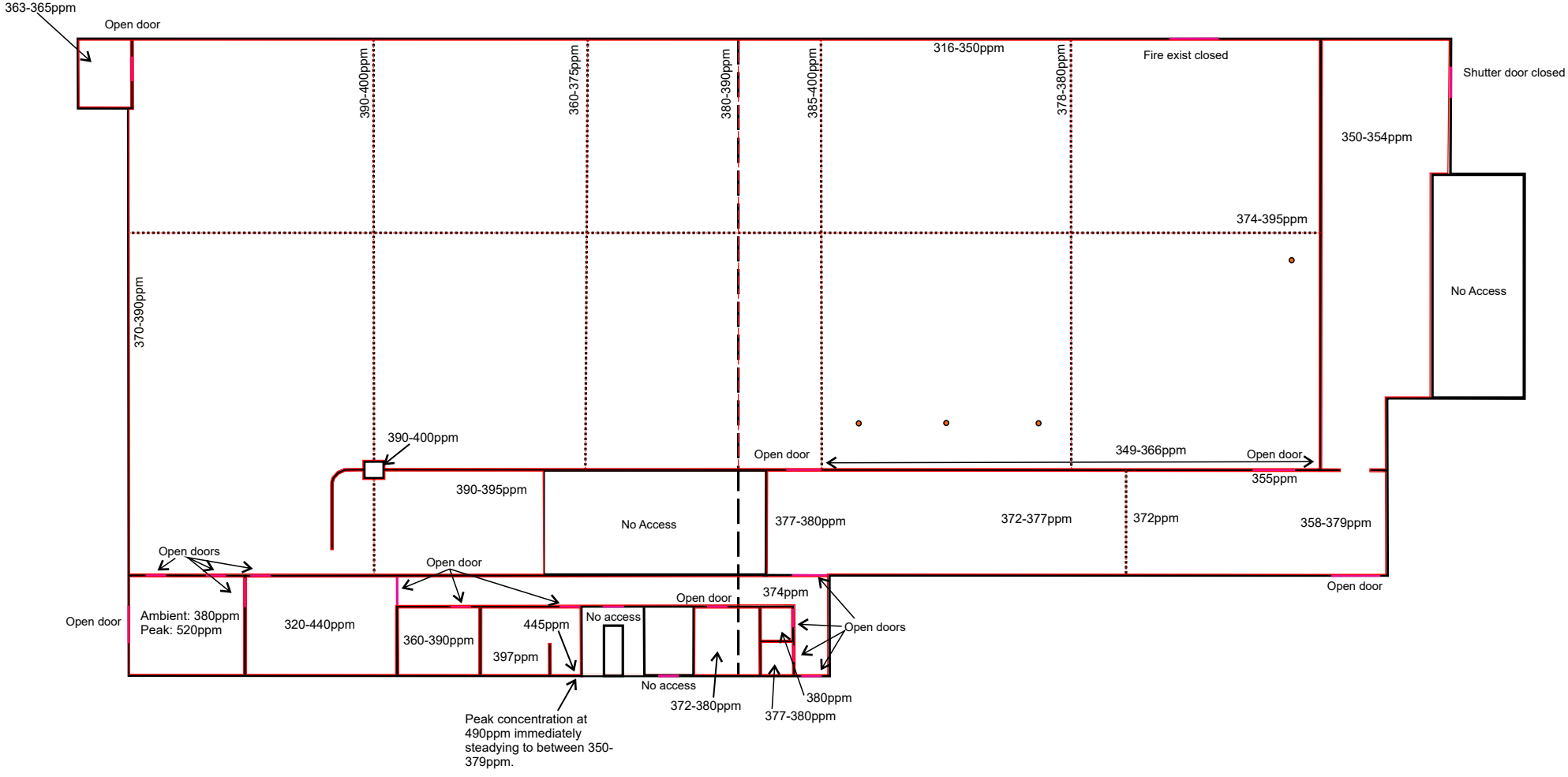
Location: LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Methane
Date: 05/10/2026
Time: 8:10
Atmospheric pressure: 1020mbar
Weather conditions: Dry/ sunny conditions, 16 degrees Celsius
Outdoor ambient methane concentrations: 2.4ppm
Indoor ambient methane concentrations: 12ppm



Location: LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Carbon dioxide
Date: 05/10/2026
Time: 12:30
Atmospheric pressure: 1020mbar
Weather conditions: Dry/ sunny conditions, 19 degrees Celsius
Outdoor ambient carbon dioxide concentrations: 370ppm
Indoor ambient carbon dioxide concentrations: 349ppm

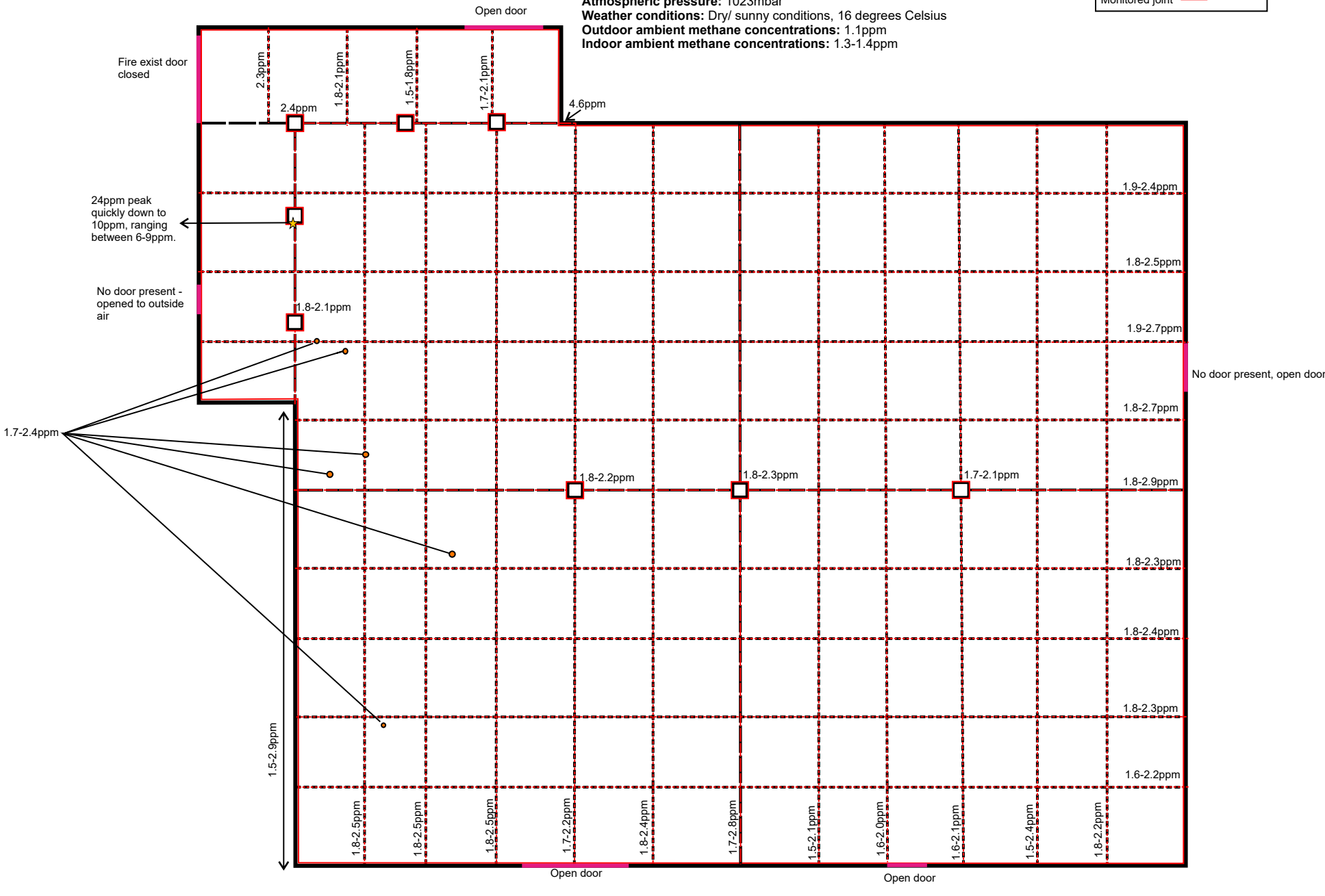


Location: LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Carbon dioxide
Date: 23/09/2026
Time: 10:13
Atmospheric pressure: 1022mbar
Weather conditions: Dry/ sunny conditions, 16 degrees Celsius
Outdoor ambient carbon dioxide concentrations: 349ppm
Indoor ambient carbon dioxideconcentrations: 380pm

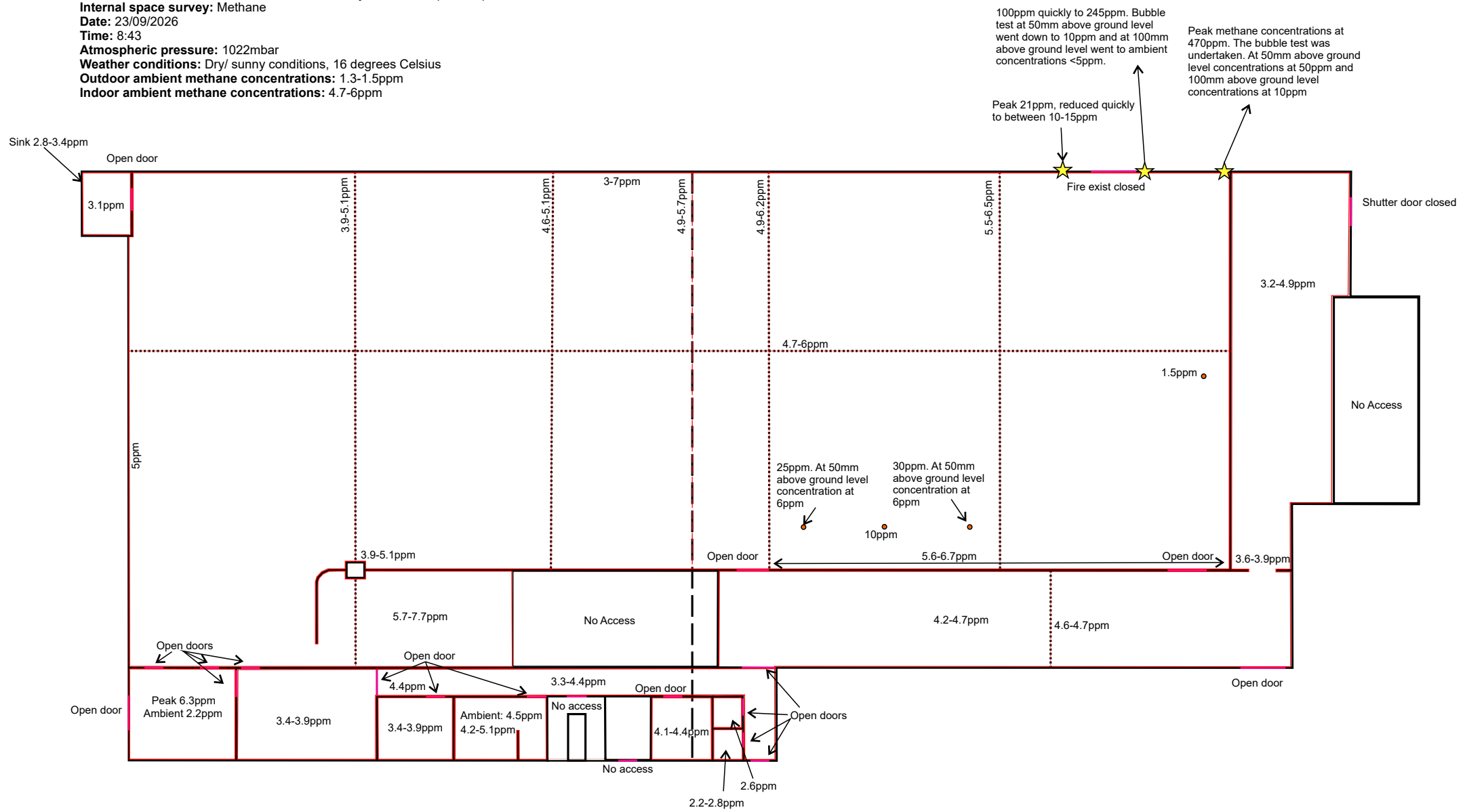


Location: Home Bargains, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Methane
Date: 23/09/2026
Time: 11:30
Atmospheric pressure: 1023mbar
Weather conditions: Dry/ sunny conditions, 16 degrees Celsius
Outdoor ambient methane concentrations: 1.1ppm
Indoor ambient methane concentrations: 1.3-1.4ppm

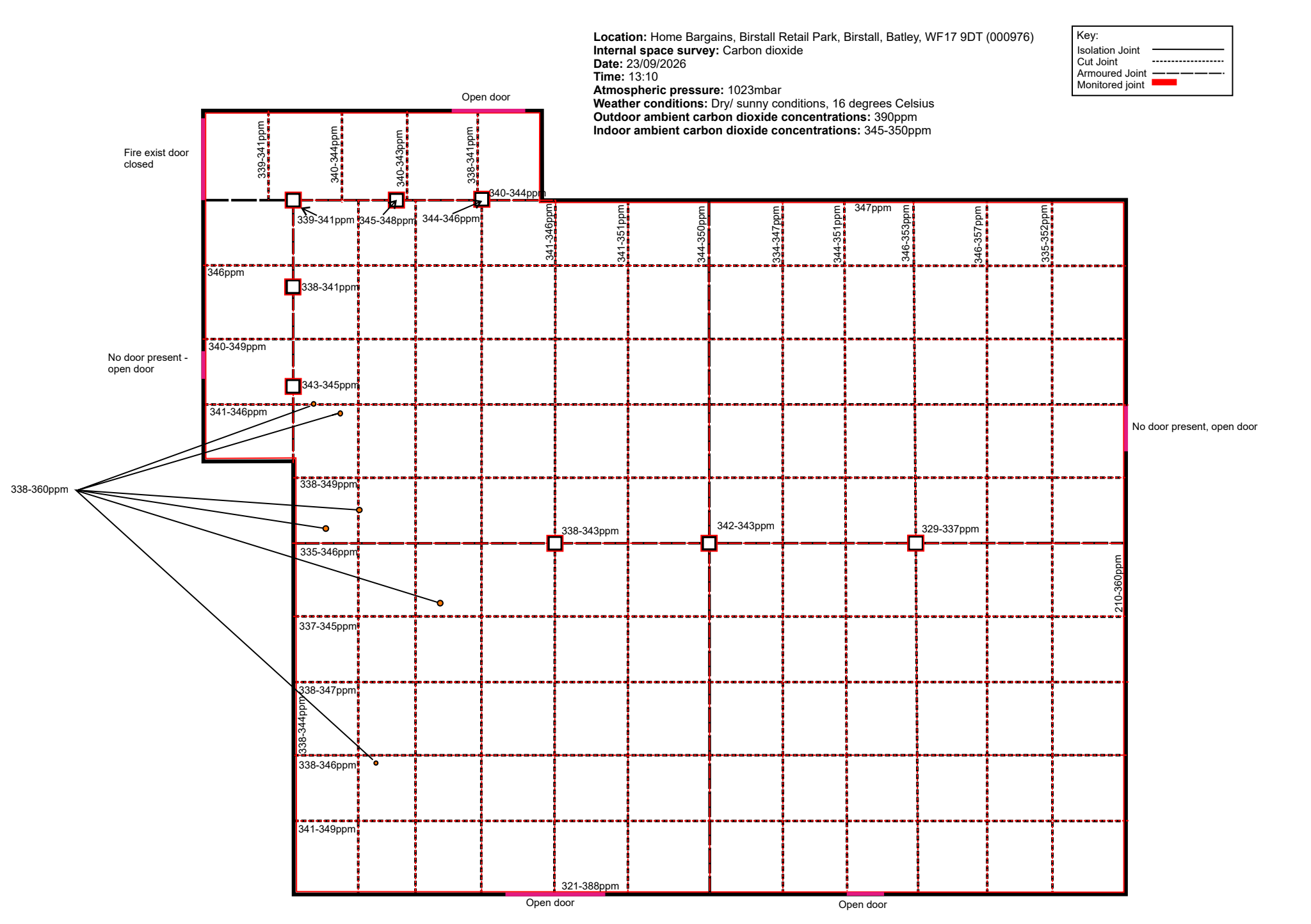
Key:
Isolation Joint
Cut Joint
Armoured Joint
Monitored joint



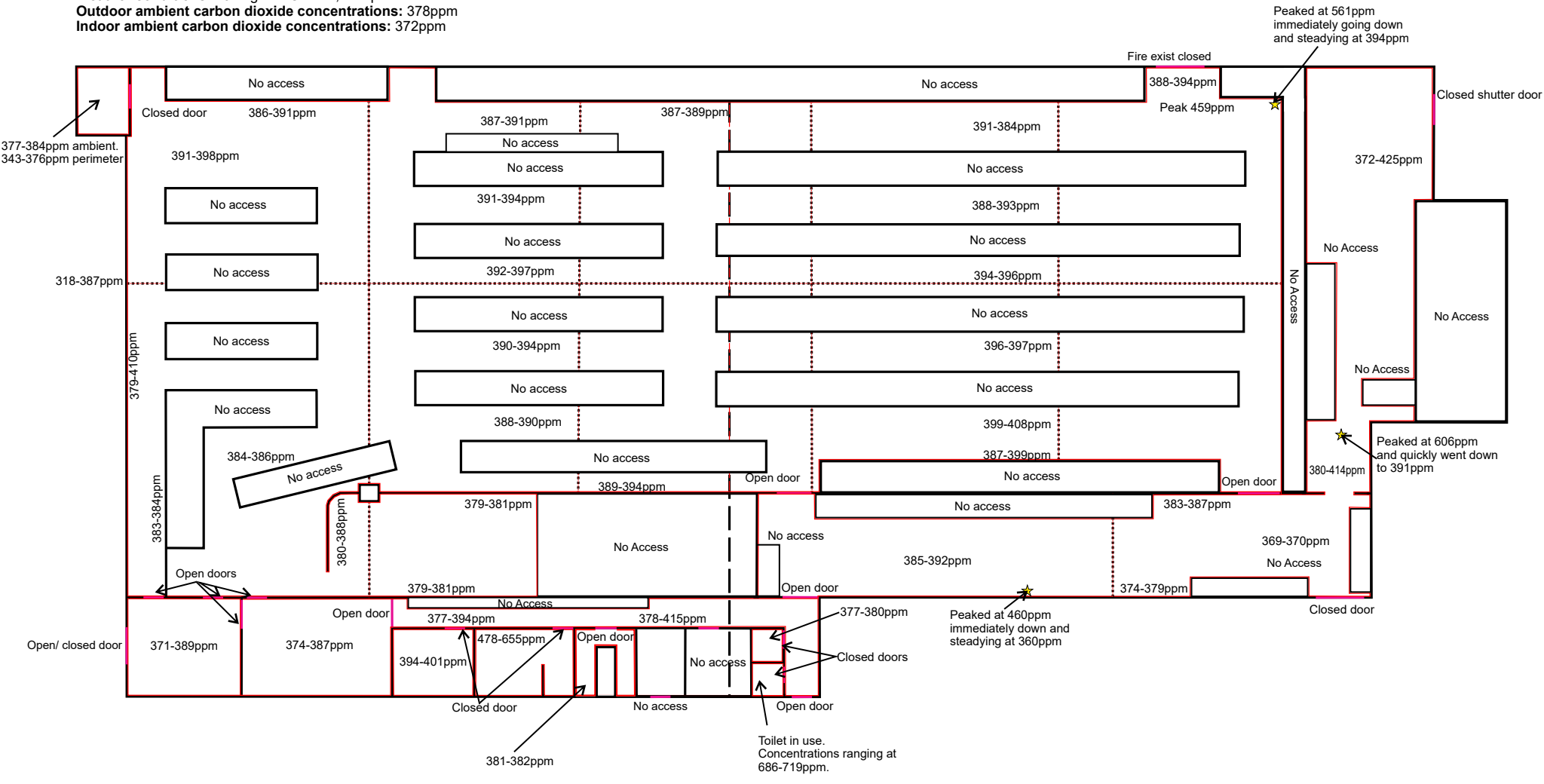
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Internal space survey: Methane
Date: 23/09/2026
Time: 8:43
Atmospheric pressure: 1022mbar
Weather conditions: Dry/ sunny conditions, 16 degrees Celsius
Outdoor ambient methane concentrations: 1.3-1.5ppm
Indoor ambient methane concentrations: 4.7-6ppm



Location: Home Bargains, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Carbon dioxide
Date: 23/09/2026
Time: 13:10
Atmospheric pressure: 1023mbar
Weather conditions: Dry/ sunny conditions, 16 degrees Celsius
Outdoor ambient carbon dioxide concentrations: 390ppm
Indoor ambient carbon dioxide concentrations: 345-350ppm

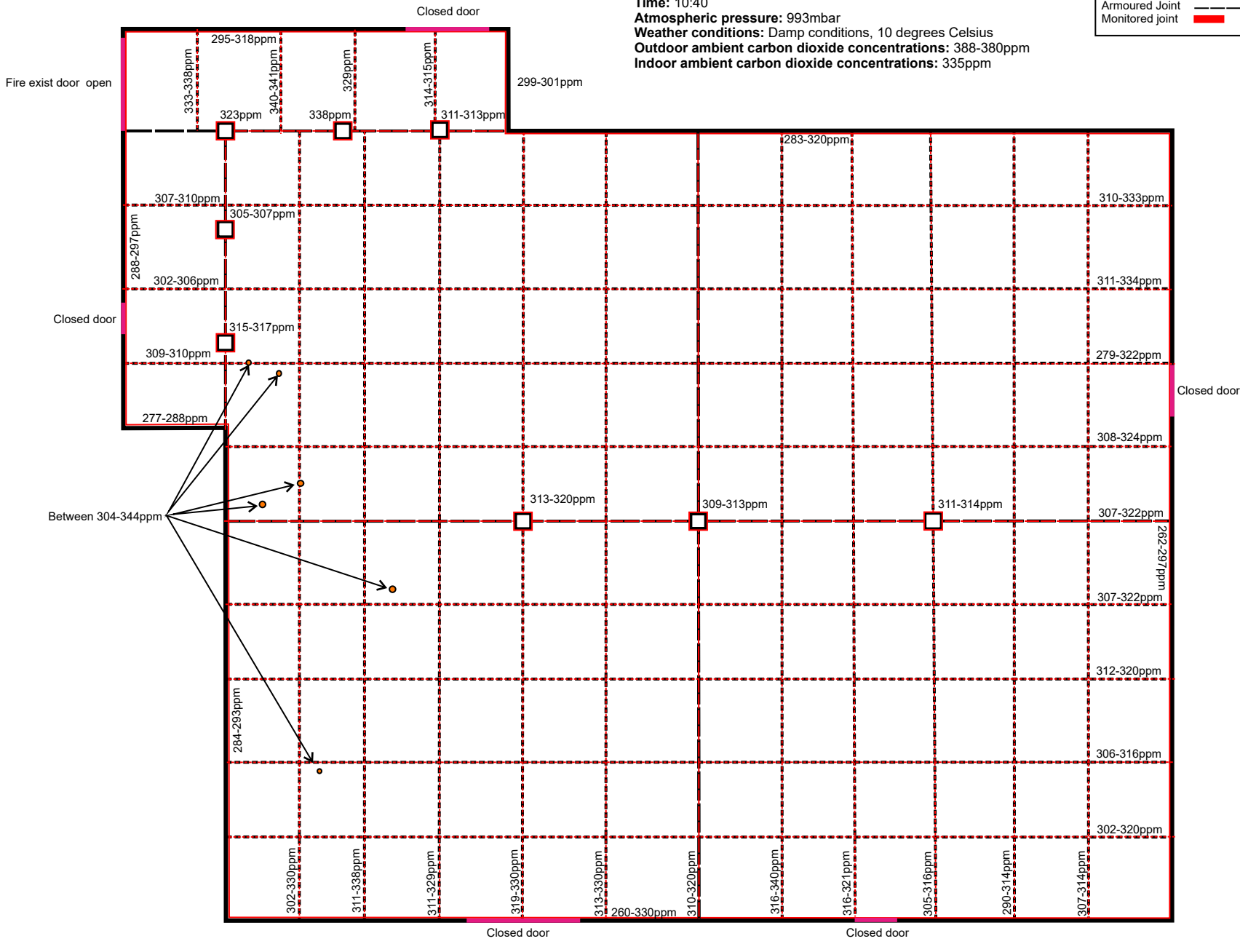


LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Carbon dioxide
Date: 23/10/2026
Time: 9:15
Atmospheric pressure: 993mbar
Weather conditions: 10 degrees Celsius, damp conditions
Outdoor ambient carbon dioxide concentrations: 378ppm
Indoor ambient carbon dioxide concentrations: 372ppm

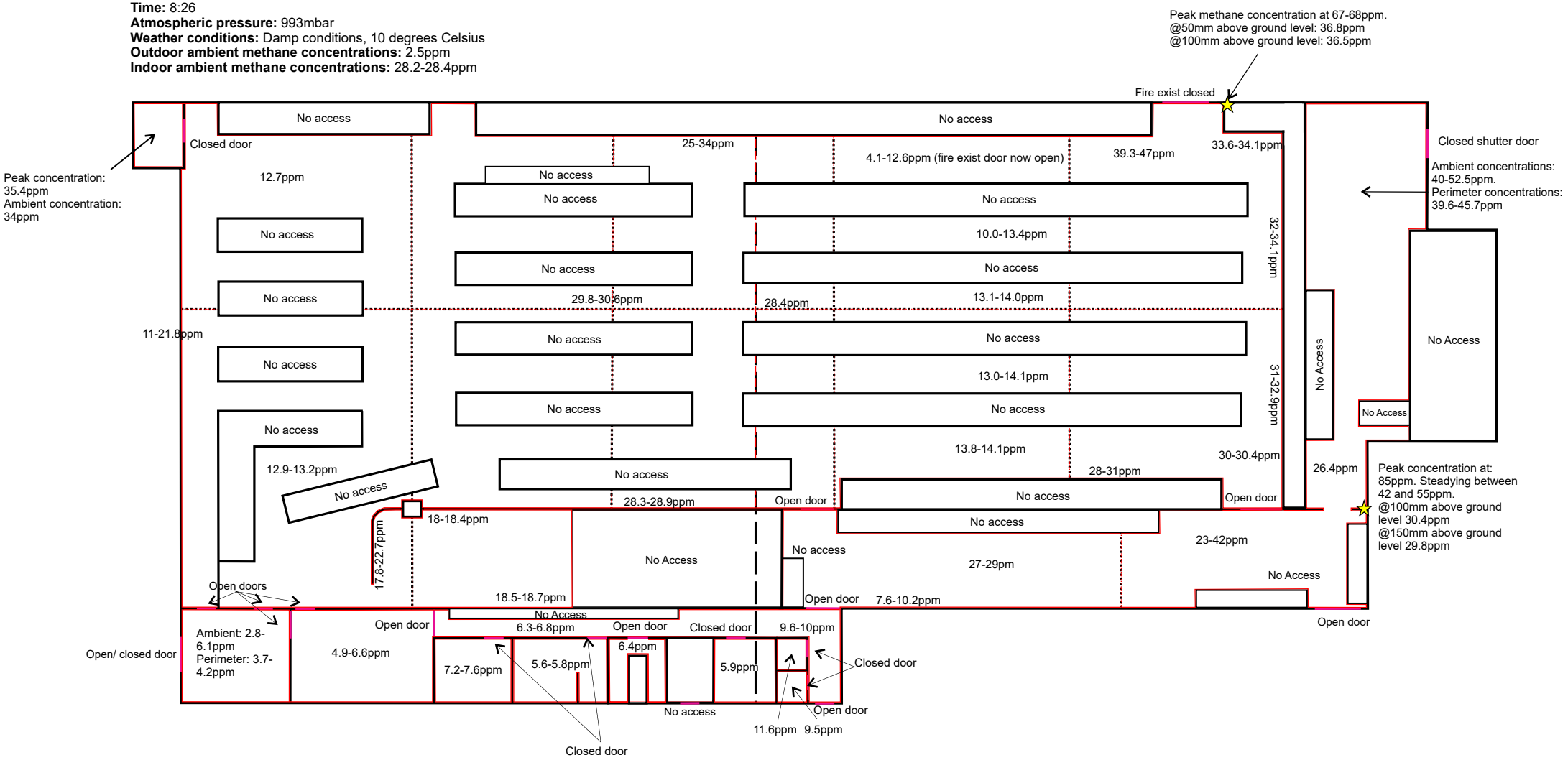


LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Carbon dioxide
Date: 23/10/2026
Time: 10:40
Atmospheric pressure: 993mbar
Weather conditions: Damp conditions, 10 degrees Celsius
Outdoor ambient carbon dioxide concentrations: 388-380ppm
Indoor ambient carbon dioxide concentrations: 335ppm

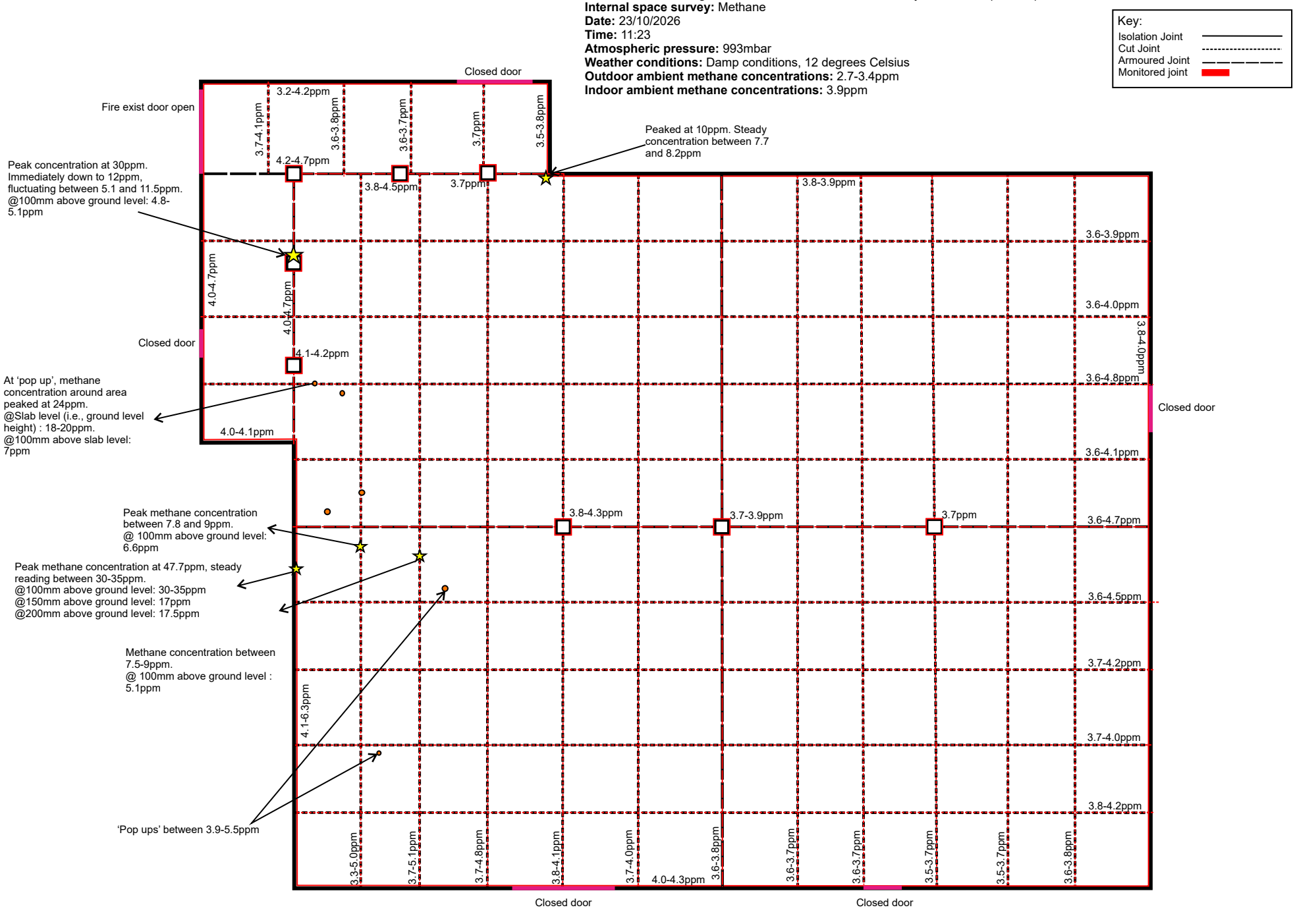
Key:
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Cut Joint
Armoured Joint
Monitored joint



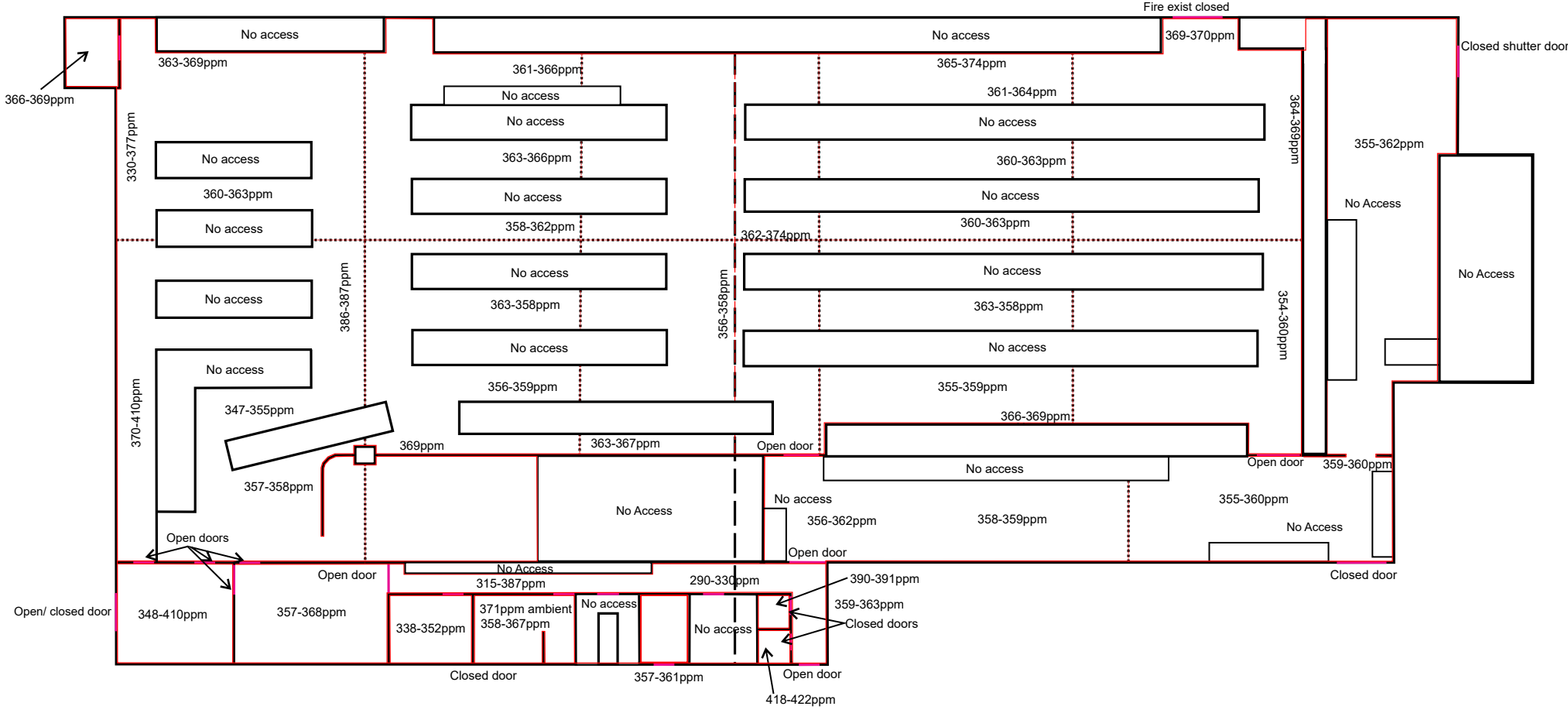
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Internal space survey: Methane
Date: 23/10/2026
Time: 8:26
Atmospheric pressure: 993mbar
Weather conditions: Damp conditions, 10 degrees Celsius
Outdoor ambient methane concentrations: 2.5ppm
Indoor ambient methane concentrations: 28.2-28.4ppm



Location: Home Bargains, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Methane
Date: 23/10/2026
Time: 11:23
Atmospheric pressure: 993mbar
Weather conditions: Damp conditions, 12 degrees Celsius
Outdoor ambient methane concentrations: 2.7-3.4ppm
Indoor ambient methane concentrations: 3.9ppm

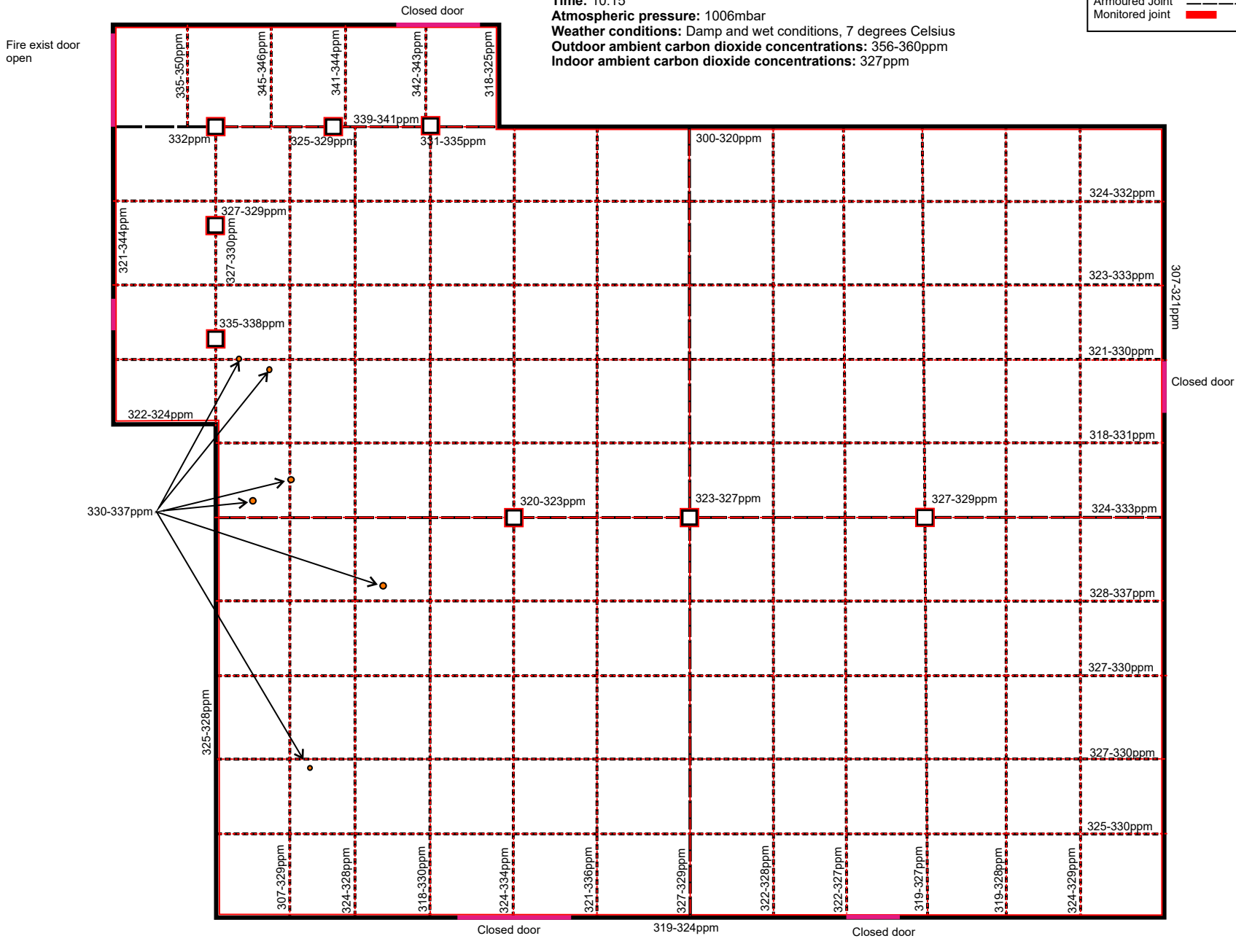


LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Carbon dioxide
Date: 26/10/2026
Time: 9:20
Atmospheric pressure: 1006 mbar
Weather conditions: 7 degrees Celsius, damp and wet conditions
Outdoor ambient carbon dioxide concentrations: 383ppm
Indoor ambient carbon dioxide concentrations: 358ppm

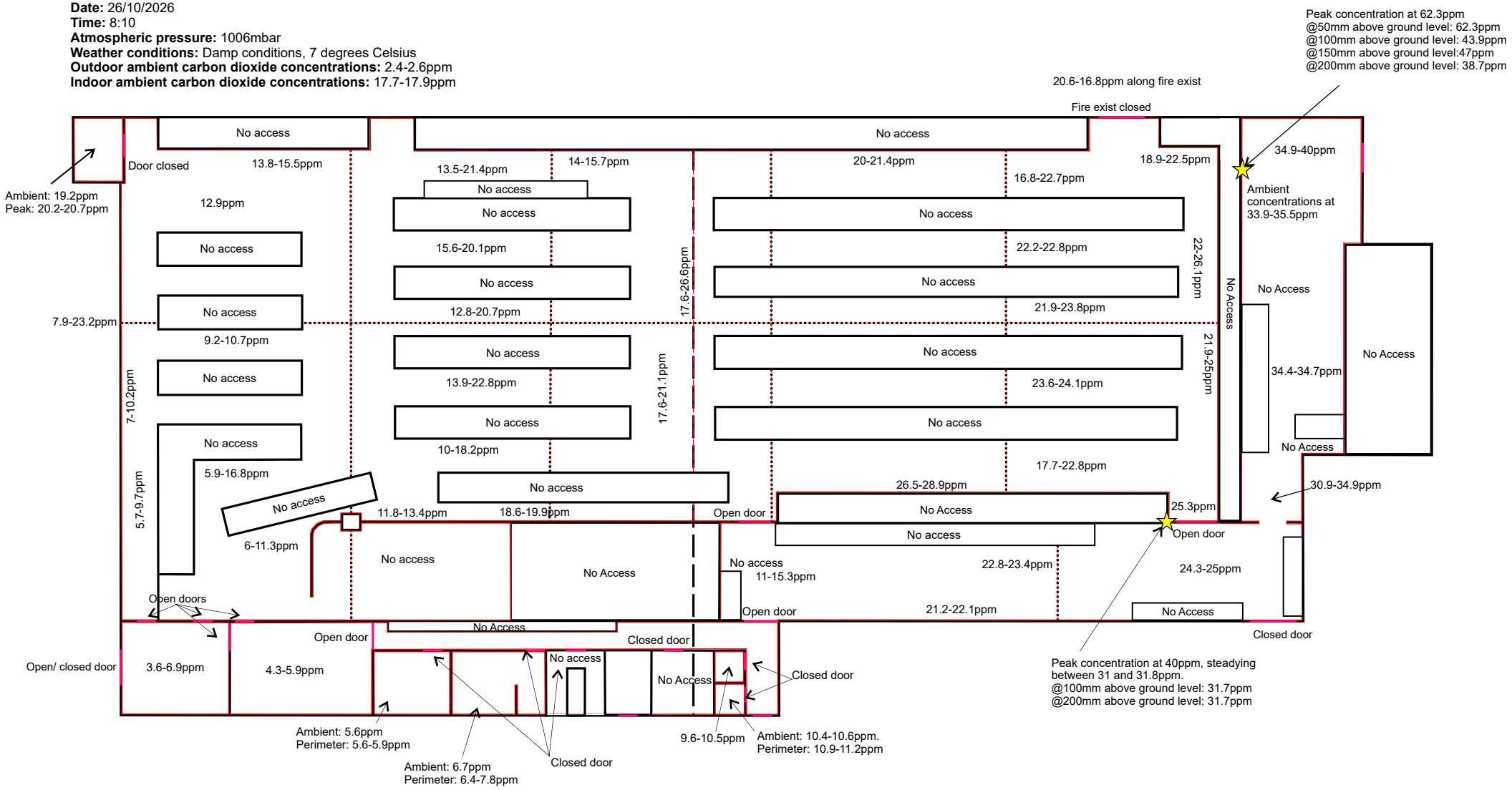


LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Carbon dioxide
Date: 26/10/2026
Time: 10:15
Atmospheric pressure: 1006mbar
Weather conditions: Damp and wet conditions, 7 degrees Celsius
Outdoor ambient carbon dioxide concentrations: 356-360ppm
Indoor ambient carbon dioxide concentrations: 327ppm

Key:
Isolation Joint
Cut Joint
Armoured Joint
Monitored joint

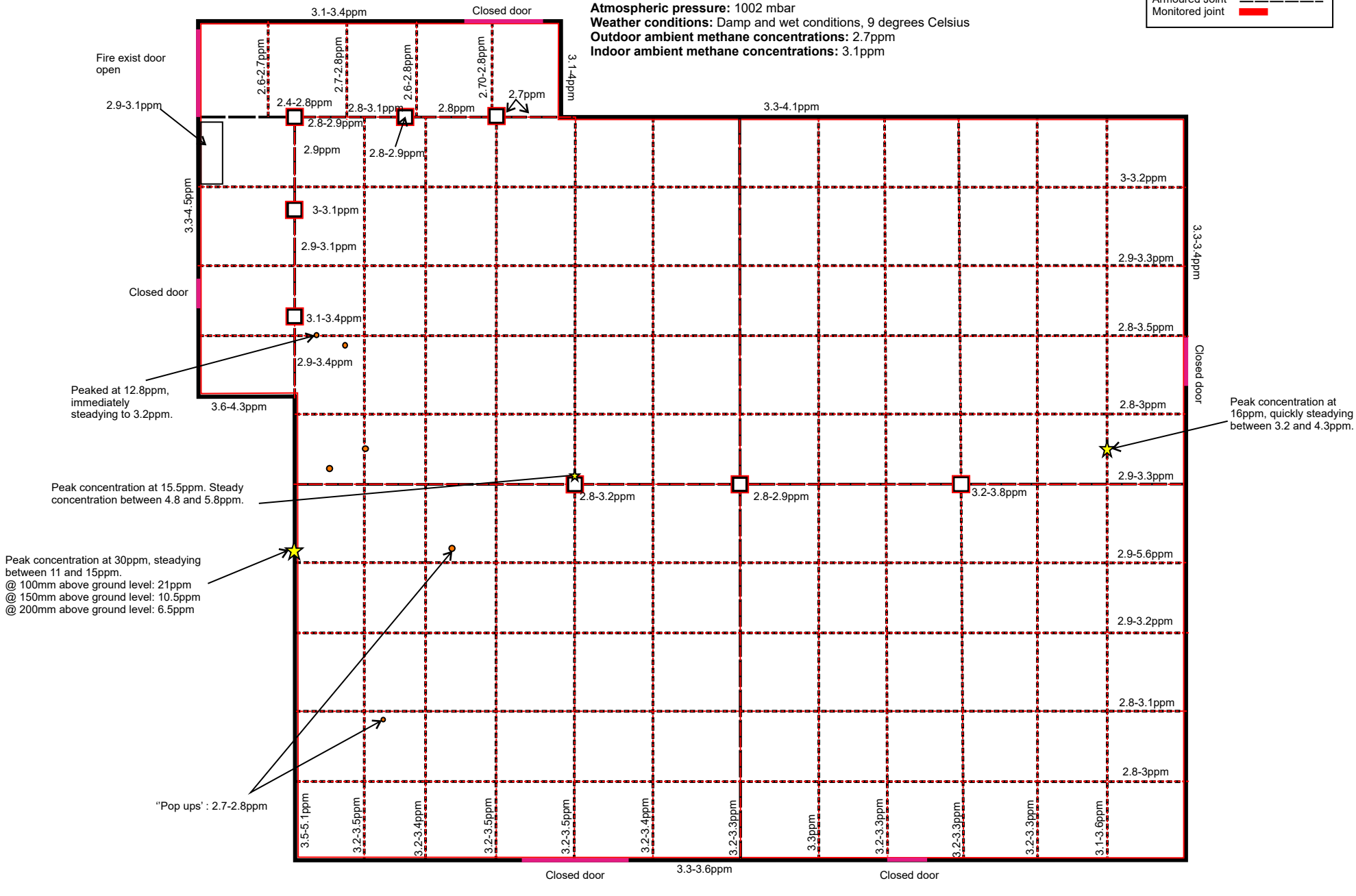


LIDL, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Methane
Date: 26/10/2026
Time: 8:10
Atmospheric pressure: 1006mbar
Weather conditions: Damp conditions, 7 degrees Celsius
Outdoor ambient carbon dioxide concentrations: 2.4-2.6ppm
Indoor ambient carbon dioxide concentrations: 17.7-17.9ppm



Location: Home Bargains, Birstall Retail Park, Birstall, Batley, WF17 9DT (000976)
Internal space survey: Methane
Date: 26/10/2026
Time: 11:23
Atmospheric pressure: 1002 mbar
Weather conditions: Damp and wet conditions, 9 degrees Celsius
Outdoor ambient methane concentrations: 2.7ppm
Indoor ambient methane concentrations: 3.1ppm

Key:
Isolation Joint
Cut Joint
Armoured Joint
Monitored joint





Appendix C

Gound gas DQRA model results

SITE AND MODEL DETAILS

Lidl Birstall

Risk assessment model for ground bearing slab

CHEMICAL PHYSICAL PROPERTIES

		Methane	Carbon dioxide	Comment
Assumed subsurface temperature	^{0}C	16	16	Assumed temperature.
Diffusivity In Air	cm^2/sec	1.50E-01	1.39E-01	Chemical specific EIC/SoBRA
Diffusivity in Water	cm^2/sec	1.50E-05	1.39E-05	Chemical specific EIC/SoBRA
Molecular Weight	g/mol	16	44	Chemical specific EIC/SoBRA
Henry's Law Constant (ref temp at 25^{0}C)	unitless	29	1.1	Chemical specific EIC/SoBRA
Unit Weight	kg/m^3	0.67	1.84	Chemical specific
Odour Threshold at STP	ppm	N/A	N/A	Chemical specific
	mg/m^3			Chemical specific
Inhalation Reference Concentration RfC	µg/m^3	N/A	N/A	EIC/SoBRA
Lower Explosive Limits (LEL) or allowable concentration at STP	%v/v	5.00	0.10	Chemical specific
	mg/m^3	N/A	N/A	Chemical specific
	Ref.	Ground gas Handbook	Ground gas Handbook	If no value stated

BUILDING PROPERTIES

Building Type		Commercial		Site-specific
Building Rooms of Interest		Groundfloor		Groundfloor main area of concern for VI
No. of Levels		1	1	Site-specific
Type (eg. slab on grade)		Cast insitu ground bearing slab		Site-specific
Slab Material		Reinforced concrete		Site-specific
Floor Slab Thickness	m	0.15	0.15	Based on 75mm thick reinforced screed and 75mm insulation boards. Ignores block and beam thickness
Building Length	m	52	52	Small room over free movement joint
Building Width	m	44	44	Small room over free movement joint
Building Height (floor to ceiling Only)	m	8	8	As per CLEA Briefing Note 3 for residential properties for post 1970s office
Total Building Volume	m^3	18304	18304	
Floor Area (A_B)	m^2	2288	2288	
Adopted Migration Area over Floor (A_B)	m^2	2288	2288	
Building Ventilation	hr^{-1}	5.00	5.00	As per CLEA Briefing Note 3
	m^3/hr	91520	91520	
	m^3/sec	25.42222	25.42222	
Sub slab sub-base				
Length	m	52	52	Assumes void is the same area as groundfloor
Width	m	44	44	
Depth of sub-base	m	0.65	0.65	Load trasnfer platform min 650mm
Total Volume of sub-base	m^3	1487.20	1487.20	
Porosity of sub-base		0.20	0.20	
Migration Area into sub-base (A_{sb})	m^2	2288	2288	
Assumed Air Exchange Rate in sub-base	m^3/day	65.7	65.7	Based on BS5925:1991 using U_r, C_d and ΔC_p
	m^3/sec	7.60E-04	7.60E-04	
	hr^{-1}	0.01	0.01	
	day^{-1}	0.04	0.04	

DETERMINATION OF SOURCE TERM - GAS SOURCE

Concentration at Source (Cs)	g/m^3	540.0000	372.0000	Assume 80% methane and 20% carbon dioxide in landfill waste material - assume extends below whole of Home Bargains
	mg/m^3	5.40E+05	3.72E+05	
	ug/m^3	5.40E+08	3.72E+08	
	ppm	8.00E+05	2.00E+05	
	%v/v	80.0	20.0	
Comparison of Cs against LEL		**>LEL**	**>LEL**	

SOIL DIFFUSION

HORIZON A (Unsaturated Zone)				
Effective Diffusion Coefficient (D^{eff}) Unsaturated Zone	m^2/day	1.52E-02	1.40E-02	
Soil Air-filled Porosity	cm^2/cm^2	0.1	0.1	Load transfer platform compacted to 10% air voids
Soil Total Porosity	cm^2/cm^2	0.2	0.2	
Soil Water Filled Porosity	cm^2/cm^2	0.1	0.1	Total porosity 20%
Horizon A Zone Thickness	m	0.65	0.65	
HORIZON B (Unsaturated Zone)				
Effective Diffusion Coefficient (D^{eff}) Unsaturated Zone	m^2/day	3.20E-03	2.99E-03	Reworked natural clay
Soil Air-filled Porosity	cm^2/cm^2	0.12	0.12	
Soil Total Porosity	cm^2/cm^2	0.59	0.59	
Soil Water Filled Porosity	cm^2/cm^2	0.47	0.47	
Horizon B Zone Thickness	m	2	2	
CAPILLARY ZONE (WET)				
Effective Diffusion Coefficient (D^{eff}_{CZ}) Capillary Zone	m^2/day	5.22E-04	5.16E-04	Horizon not applicable for this ground model
Soil Air-filled Porosity	cm^2/cm^2	0.068	0.068	
Soil Total Porosity	cm^2/cm^2	0.568	0.568	
Soil Water Filled Porosity	cm^2/cm^2	0.5	0.5	
Capillary Zone Thickness	m	0	0	Horizon not applicable for this ground model
Pathway Length (L_T)	m	2.65	2.65	
Overall Effective Diffusion Coefficient (D^{eff}_T)	m^2/day	3.96E-03	3.70E-03	
	m^2/s	4.59E-08	4.28E-08	

GAS MIGRATION AND ESTIMATED INDOOR AIR CONCENTRATIONS (NO MEMBRANE)

SUB-BASE AIR SPACE CALCULATIONS

Diffusion of Gas Into Sub-base	mg/s	2.14E+01	1.38E+01	As per Wilson S. 2008
	µg/s	2.14E+04	1.38E+04	
EquilibriumSub-base Air Void Space Air Concentration (diffusion dominated)	mg/m^3	2.81E+04	1.81E+04	As per Wilson S. 2008
	ug/m^3	2.81E+07	1.81E+07	
	ppm	4.30E+04	1.01E+04	
	%v/v	4.300E+00	1.006E+00	
Comparison of Cvoid against LEL/RfC		**<LEL**	**>Allowable**	
Margin of Safety		1.163	0.099	
Attenuation Factor (alpha)	-	5.21E-02	4.87E-02	
Equivalent Dilution Factor in Sub-base		2.E+01	2.E+01	

INDOOR AIR CALCULATIONS

Pressure Differential (delta P)	Pa	5	5	CLEA Briefing Note 3
Effective Slab Gas Permeability (Kv)	m^2	5.00E-13	5.00E-13	From SSD tests on floor slabs on other sites
	cm^2	5.00E-09	5.00E-09	
Crack ratio	m^2/m^2	1.0000	1.0000	Assume whole of slab using effective permeability that takes into account armoured joints, etc.
Total Area of Crack (A_{crack})	m^2	2288.00000	2288.00000	
	Pa.sec or kg/m-sec or $N.s/m^2$	1.81E-05	1.81E-05	
Temperature Below Slab	Kelvin	289	289	
Unit Weight of Air	N/m^3	12.23	12.23	
Pressure gradient across migration zone (i)		2.73	2.73	
Viscosity of Air (u)	g/cm-sec	1.81E-04	1.81E-04	
	kg/m-sec	1.81E-05	1.81E-05	Calculated viscosity at specific temperature
Total Emission Rate of Challenge Chemical via Advection Dominated Flow through Crack	mg/s	5.93E+01	3.81E+01	As per Wilson S. 2008
Equilibrium Indoor Air Concentration (ground bearing slab, advection)	mg/m^3	2.33E+00	1.50E+00	As per Wilson S. 2008
	%	**3.56E-04**	**8.34E-05**	
Attenuation Factor (alpha)	-	4.32E-06	4.03E-06	

ESTIMATED INDOOR AIR CONCENTRATIONS WITH GAS MEMBRANE

Gas membrane gas transmission rate	ml/m^2/day/atm	4.00E+01	4.00E+01	BS8485 limiting value
Vapour transmission rate (ISO test result at saturated headspace concentration)	mg/m^2/day	N/A	N/A	JUTA Titanflex specific test data (tested to break through)
Vapour diffusion coefficient	m^2/s	N/A	N/A	Calculated from Titanflex test data
Membrane thickness	m	N/A	N/A	
Flow of vapour through membrane	mg/s	N/A	N/A	
Flow of gas through membrane	ml/h	8.09E-03	1.89E-03	
	m^3/h	8.09E-09	1.89E-09	
Equilibrium Indoor Air Concentration Gas (diffusion dominated)	%v/v	8.84E-12	2.07E-12	As per Wilson S. 2008
	µg/m^3	N/A	N/A	
Attenuation Factor (alpha)	-	1.10E-13	1.03E-13	

SUMMARY

Equilibrium gas concentration in sub-base	% v/v	4.3003	1.0059	
Equilibrium vapour concentration in sub-base	µg/m^3	N/A	N/A	
Equilibrium concentration in building (no membrane)	% v/v	0.00036	0.00008	
Equilibrium vapour concentration in building (no membrane)	µg/m^3	N/A	N/A	
Equilibrium concentration in building (with membrane)	% v/v	8.84E-12	2.07E-12	
Equilibrium vapour concentration in building (with membrane)	µg/m^3	N/A	N/A	
Limiting value in sub-base for NHBC Green classification	% v/v	0.25	100	
Allowable gas concentration inside building	% v/v	0.01	0.1	Minimal risk value for methane (100ppm) and carbon dioxide (1000ppm)
Allowable vapour concentration inside building	µg/m^3	N/A	N/A	Reference concentration

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