Climate change and sustainability

Ground gas risk assessment and mitigation

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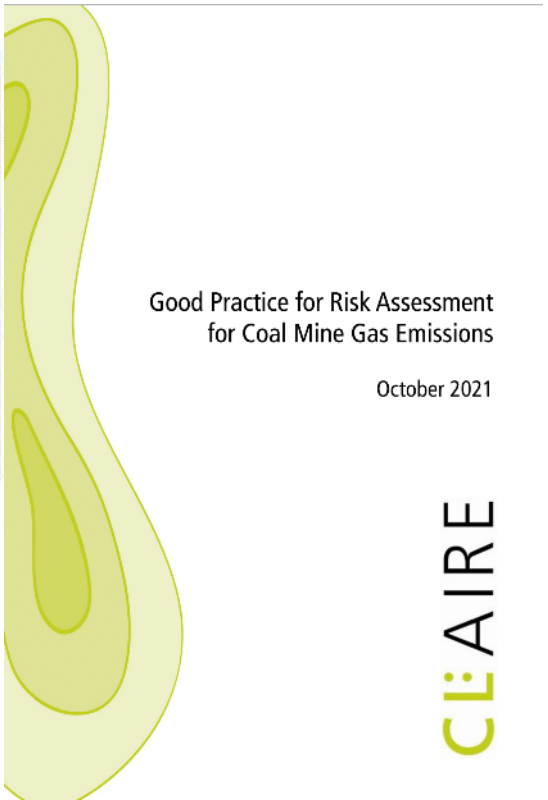
Introduction

- Future effects due to climate change should be considered during ground gas risk assessments.
- At some, but not all, sites climate change may affect future risk from ground gas emissions.
- Advice on assessing climate change in
  - CIRIA Report C795, Retrofitting ground gas protection measures to existing and refurbished buildings
  - CL:AIRE Good Practice for Risk Assessment for Coal Mine Gas Emissions).
- EA study on flood and landfill gas risk
- Over conservatism in risk assessments



A Warning: *The Precautionary Approach*

The precautionary principle is not intended to apply to 'hypothetical effects and imaginary risk'; rather, it should be based on a scientific examination of the issue. Indeed, this has been confirmed on numerous occasions by the Court of Justice of the EU (see e.g. Case T-13/99 Pfizer Animal Health SA v Council of the European Union [2002] ECR II-03305). The precautionary principle will not apply where the desired level of protection is defined, and the risk of harm can be quantified. This situation can be dealt with using 'normal' risk-management tools.

European Commission (2017)

CL:AIRE (2021) Good Practice for Risk Assessment for Coal Mine Gas Emissions

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CIRIA C795 and CLAIRE

- CIRIA
  - Consider the likelihood of conditions changing such that gas emissions could increase in future and overwhelm the gas protection system
  - Based on a realistic consideration of changes
  - The considerations should be documented with a clear statement of why a particular factor is likely to have a significant effect on gas risk.
  - Generic statements (eg climate change or changing the air tightness will increase gas risk) are not acceptable
- CL:AIRE
  - It is extremely important that the influence of climate change on mine gas risk are considered
  - This does not mean that climate change will increase risk on all sites
  - Consider on a site specific basis and do not make generic assumptions

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Majority of sites

- On most sites the source of gas is the limiting factor for ground gas emissions and migration off site or into buildings will not be affected by climate change
- It is extremely unlikely that any changes would increase risk beyond the ability of a gas membrane to provide protection
- On domestic landfill sites changes could increase risk of migration outside the site – but limiting factor may well still be generation rate at source
- Mine gas risk from ungrouted shallow workings may be affected by groundwater level changes

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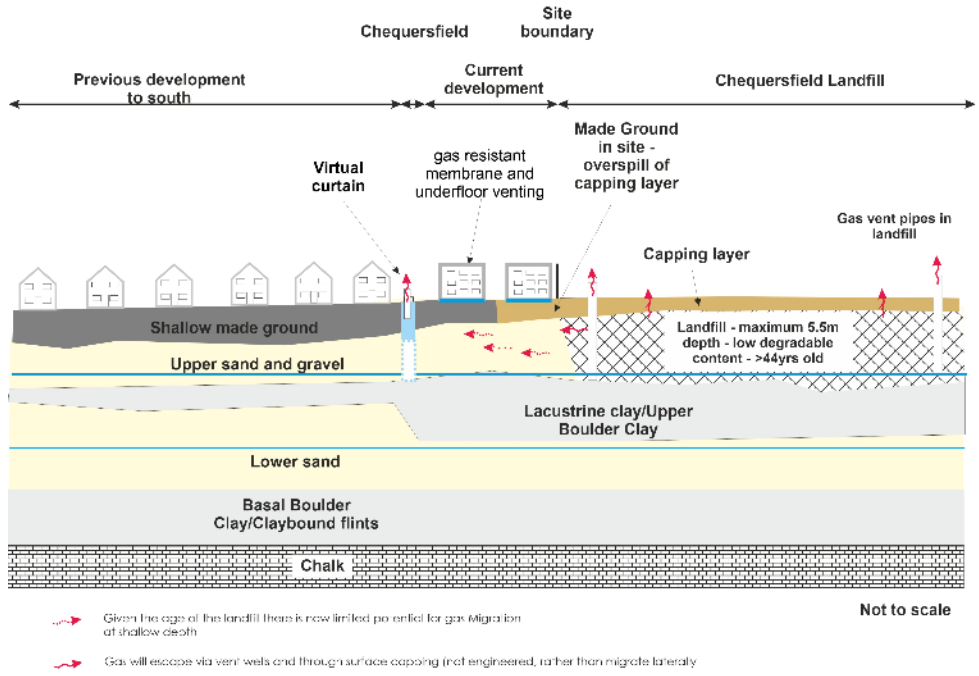
Climate change impacts UK

- Increased frequency of warm spells
- Increase in dry spells
- Increased frequency of heavy rainfall events and rainfall intensity and therefore flooding
- Inconclusive if pressure drops will increase in frequency or magnitude due to climate change

What effect are these changes likely to have on your site?

- If your gas source is Alluvium probably no effect on ground gas risk at all
- If your gas source is Made Ground that is predominantly soil probably no effect at all
- But check and consider every site – just in case
- If your source is landfill or mine gas or the gas is radon or VOCs consider potential effects very carefully



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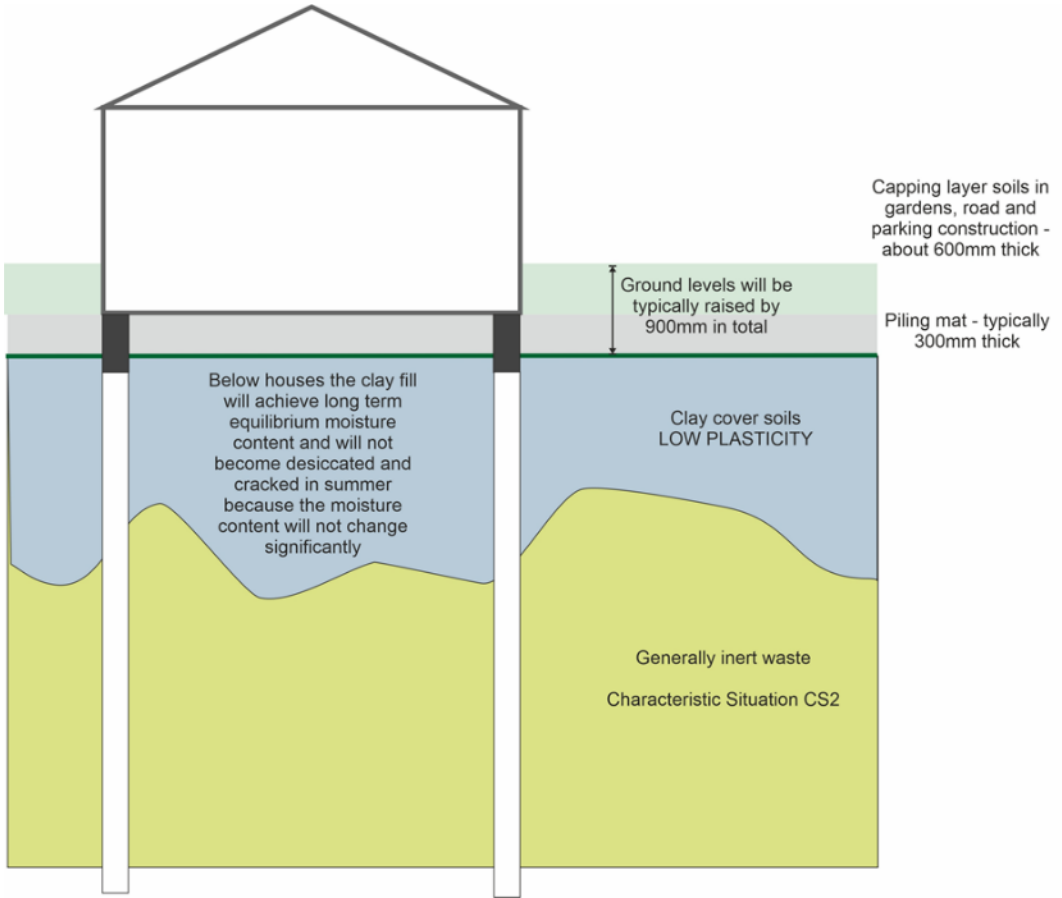
Other risk factors – pathways in the ground

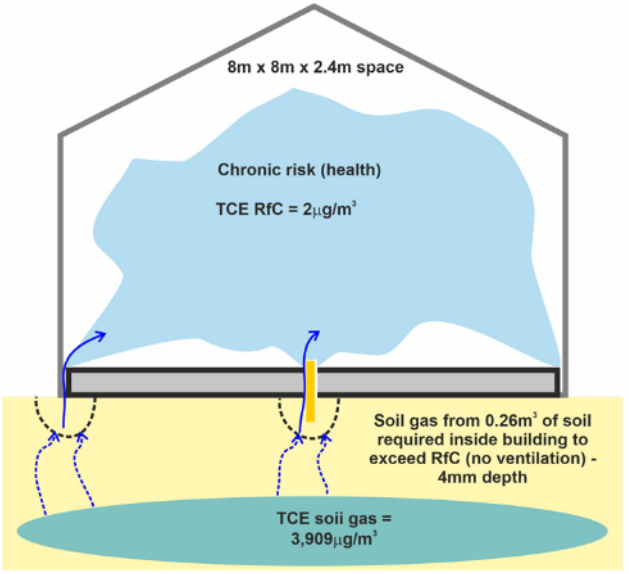
- Main effects will be on groundwater levels and infiltration of water
- Groundwater changes – open or close migration pathways – but can the source generate at a rate that sustains migration?
- Increased infiltration can possibly increase gas generation – but only with highly degradable material, not likely to be significant with most Made Ground
- Desiccation cracking of clay capping soils
- Water-logged surface soils
- Groundwater level rises during heavy rain
- Saturation of waste

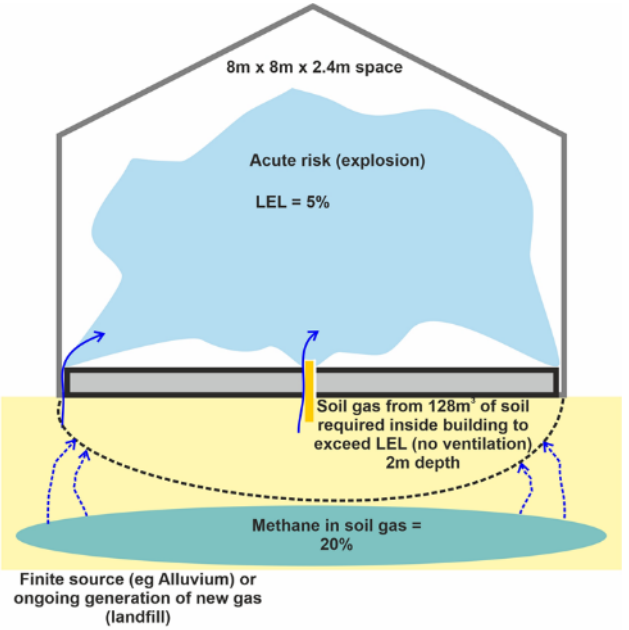
On this site it was suggested that desiccation of clay in future could increase gas risk



Other risk factors – building effects

- More energy efficient construction methods, what is the impact?
  - greater inherent resistance to gas ingress?
  - less dilution and attenuation
  - effect of ventilation systems
- The zone of influence of suction below a slab is limited
- Unlike VOCs or Radon it is difficult for negative pressure inside a building to suck large volumes of methane or carbon dioxide into the building from soil – needs open pathway and large reservoir of gas





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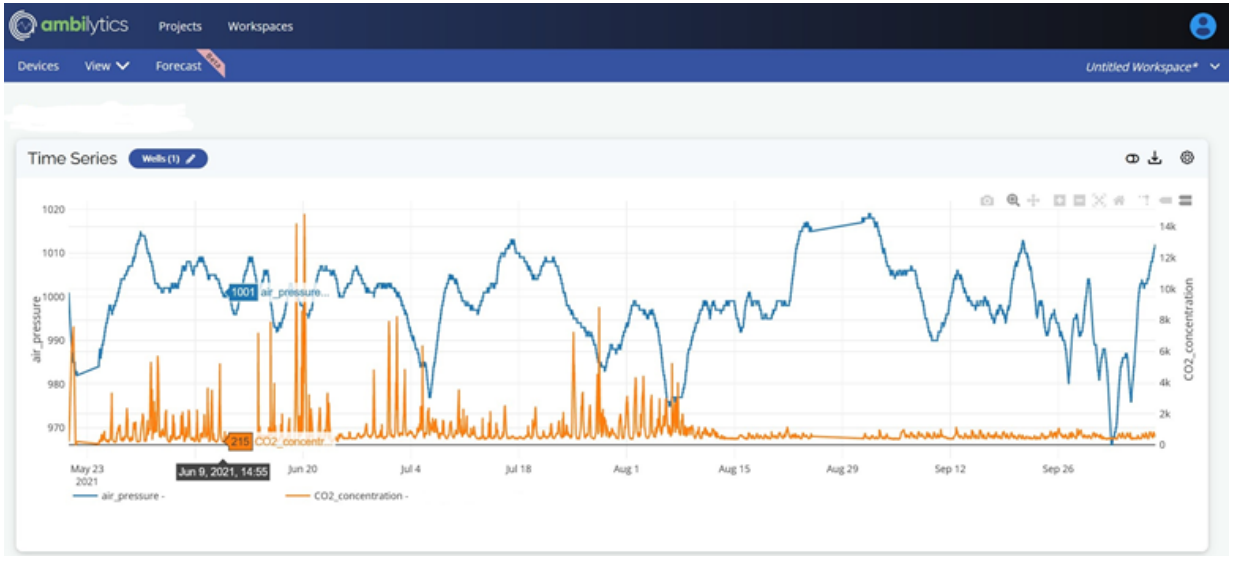
Building effects

- With mine gas risk where there is an open pathway building effects can influence gas risk
- But it is not likely to change the scope of gas protection required
- Changes in carbon dioxide concentration inside building in response to barometric pressure changes
- Also responses caused by occupants
- Raft foundations and gas membrane
- Gas entry via open water duct
- Sealing the service entry stopped the gas ingress
- Climate change will not increase the gas risk such that extra measures are needed



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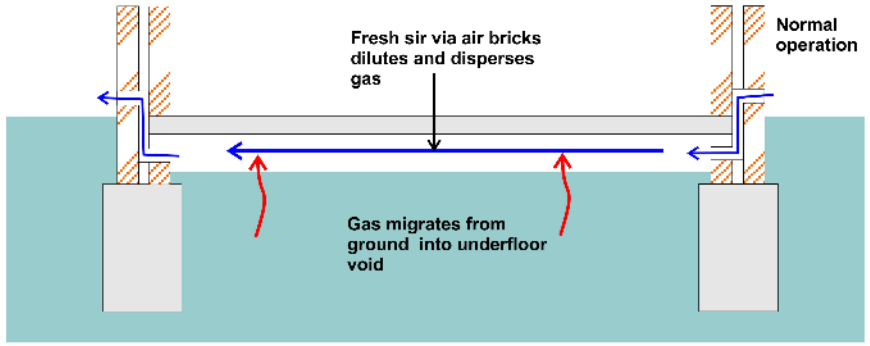
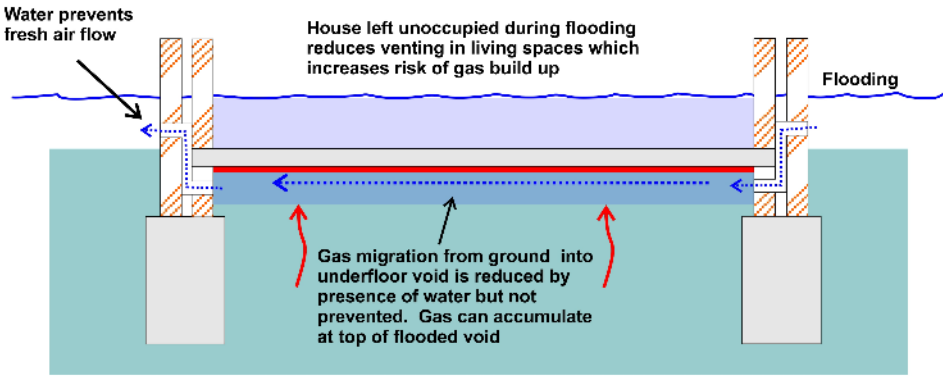
Flooding and landfill gas migration

- Over 10,000 homes located in areas where historical landfill sites and fluvial flood risk areas overlap
- Effects on gas flux from flooding likely to be temporary
- Groundwater and surface water flooding will have different effects
- Flood waters can change the gas migration pathways
- Flooding of vent layers and flood protection blocking vent layers
- Flooding of gas extraction systems
- Literature review found no published evidence of flooding causing proven increase in gas ingress at buildings outside the landfill

Flooding of underfloor ventilated void (no air brick covers)

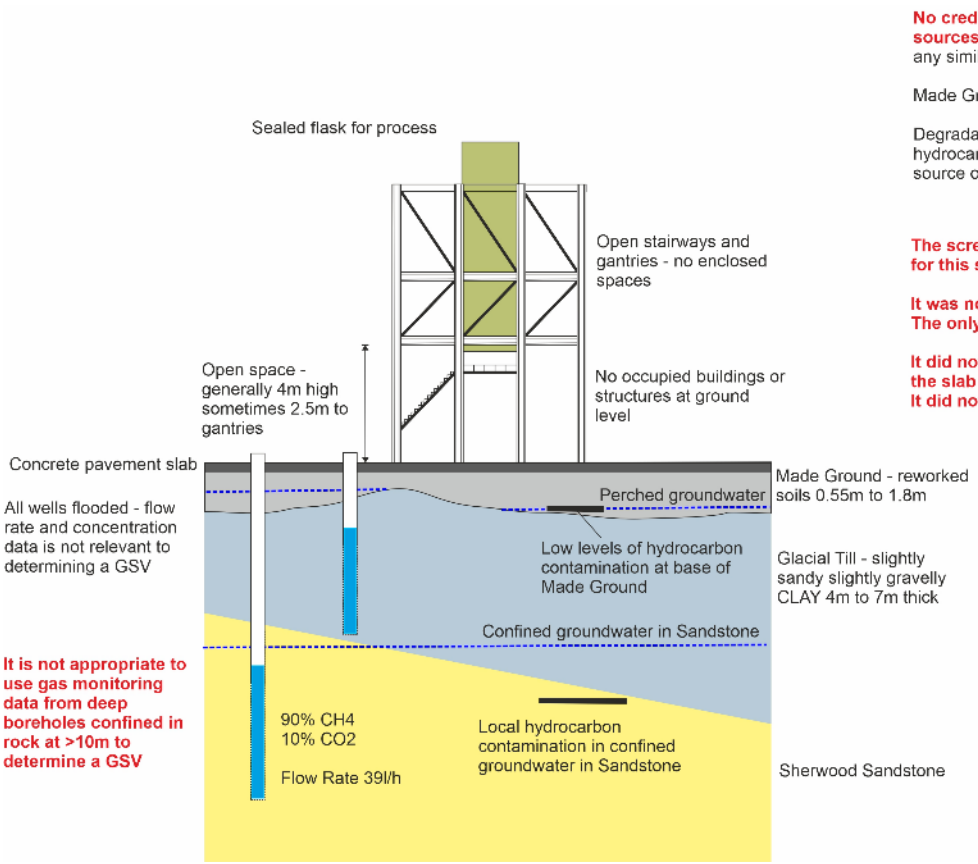




Dissolved methane could migrate in flood waters if the water has seeped through a landfill. However emissions from the surface of the water will be small (a large change in pressure head on the water is required to cause significant de-gassing of the water

Extreme over conservatism

We need to stop examples such as these



No credible high risk gas sources - no landfills, or any similar source.

Made Ground is inert

Degradation of hydrocarbons is only source of ground gas

This cannot be designed using BS8485 - **it is certainly not a Type D building**

The screening approach and points system was not appropriate for this site:

It was not CS5
The only exposure scenario is outodoor air

It did not need a vent mat and positive pressure system below the slab
It did not need a VOC membrane below the slab

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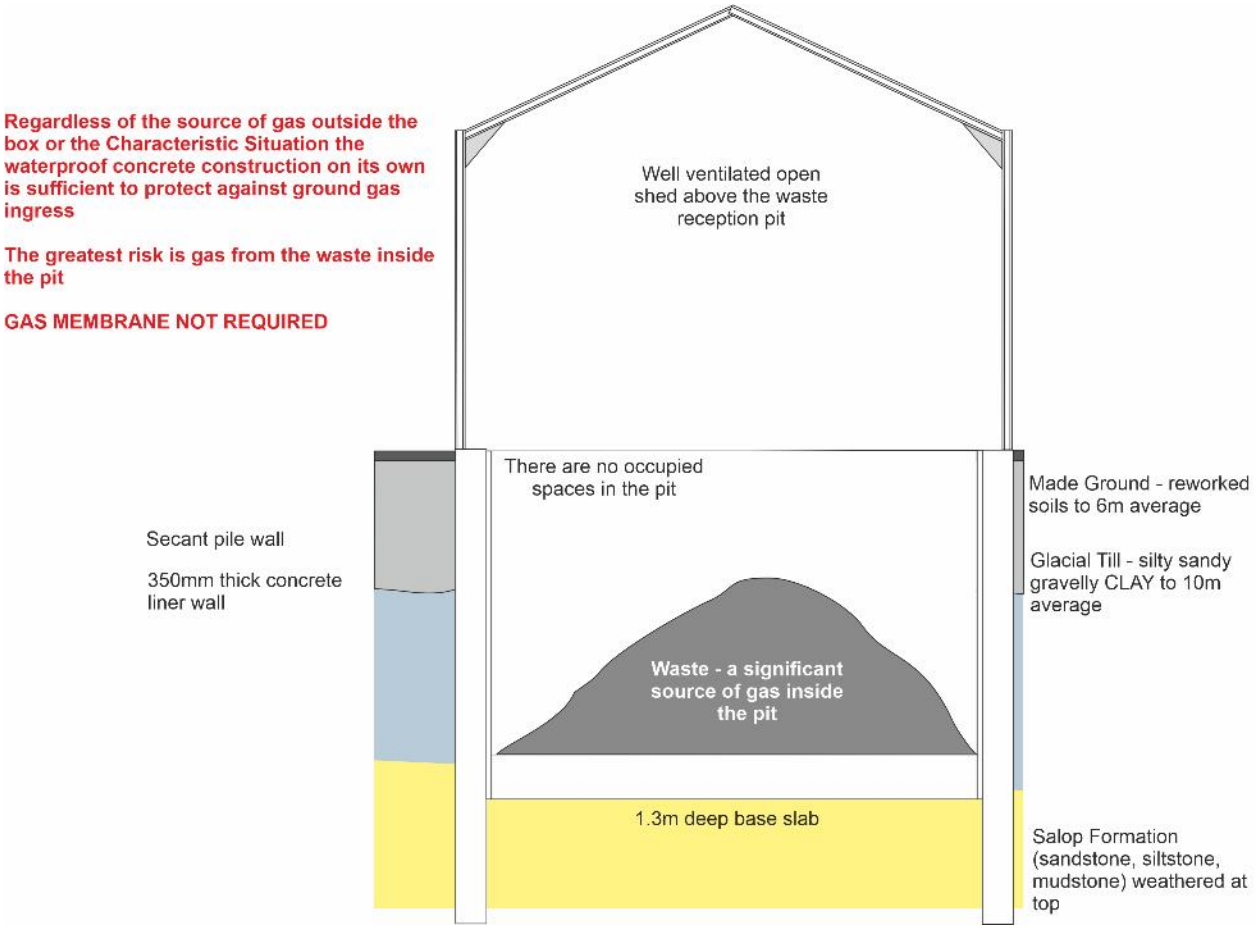

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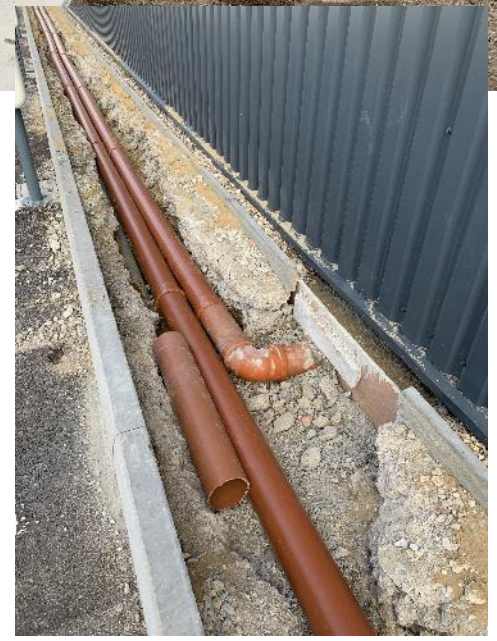
The carbon cost of over conservatism

- Examples of the cost of over conservatism:
- Site 1
  - 9,000m^2 of new concrete slab and membrane removed
  - Excavation of 150mm of sub-base
  - Place new vent blanket and pipework
  - New high level vent stacks and 3m high inlets
  - Replace sub-base and gas membrane
- Site 2
  - Install unnecessary positive pressure system
  - Cost of hundreds of metres of pipework and trenches
  - Ongoing energy costs
  - Back up batteries
  - Replacement fans (they wear out)



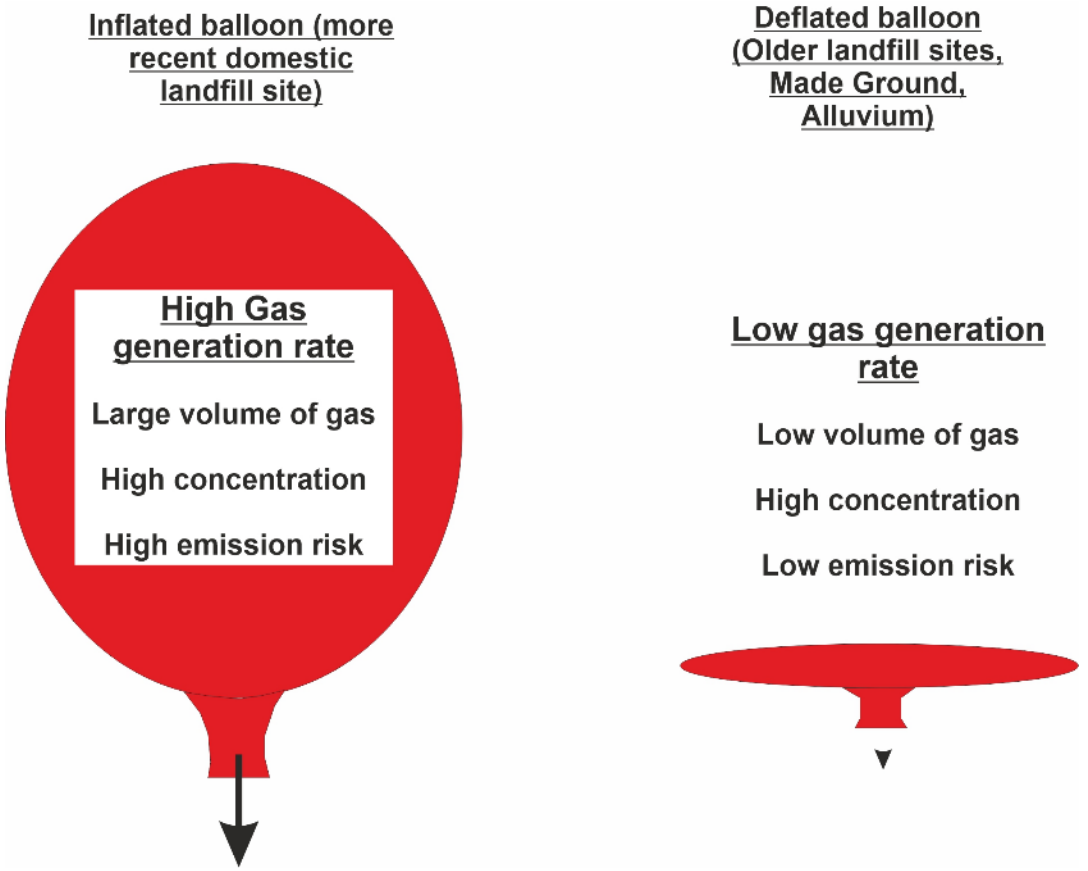
The carbon cost of over conservatism

- Unnecessary gas monitoring visits
- Unnecessary verification visits
- Unnecessary venting of drainage systems

- Over conservatism in ground gas risk assessment has a cost for everyone

Why is over conservatism prevalent?

- Still cannot move away from the concept that high concentration = high risk
- Gas concentration on its own is not a good indicator of risk



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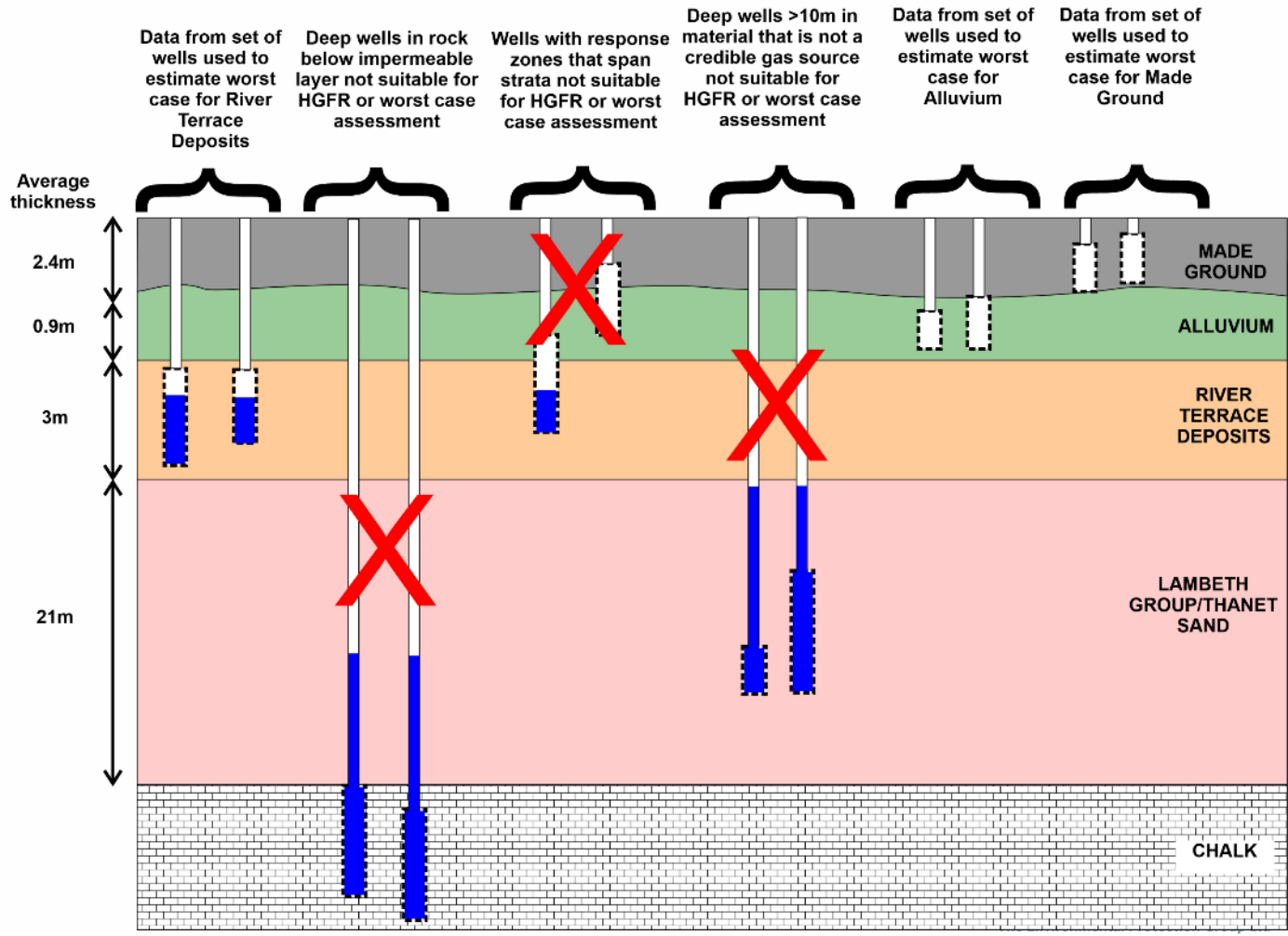
When is gas protection required?

- Probably about 80% of gas protection that is installed for methane and carbon dioxide is not required
- A new product is becoming more prevalent – the ACM
- Research has shown that carbon dioxide up to 21% and methane up to 30% is common in wells where there are natural soils and soil based Made Ground
- Up to 90% methane in Alluvium – there has never been an incident
- Neither poses a risk of emissions into buildings if Hazardous Gas Flow Rates are below limit for Characteristic Situation CS1
- Use ternary plots to show whether an increase to From Characteristic Situation CS1 to CS2 is necessary
- Every investigation that is intended to assess ground gas risk should collect TOC data from all Made Ground at a site (take a lot of samples – 0.5m depth intervals) – this helps with interpretation

Poor worst case assessment

BS8485: 2015 + A1: 2019
Clause 6.3.7.4

Plausible worst case assessment should only use data from wells with response zones in same stratum, discounting peak flows and unrepresentative negative flows



We need more emphasis on competence

- Required competencies change through the stages
- Demonstrate competency for ground gas risk assessment
  - “Chartership with a relevant professional organisation (such as the Institute of Civil Engineers, Geological Society, Institution of Environmental Sciences, or Chartered Institution of Water and Environmental Management) is important in demonstrating competence”
  - SoBRA Accreditation
  - SQP under the NQMS

- Good risk assessment means only installing gas protection where it is needed
- But we need to ensure where it is installed it is done to a good standard by competent installers and inspected by competent verifiers
  - CL:AIRE Gas Protection Verification Scheme
  - NVQ Level 2 qualified installers

- Get your SoBRA accreditation, SilC, CL:AIRE SGPV and SQP applications in asap!

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Thank you

- I will be pleased to discuss the presentation

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