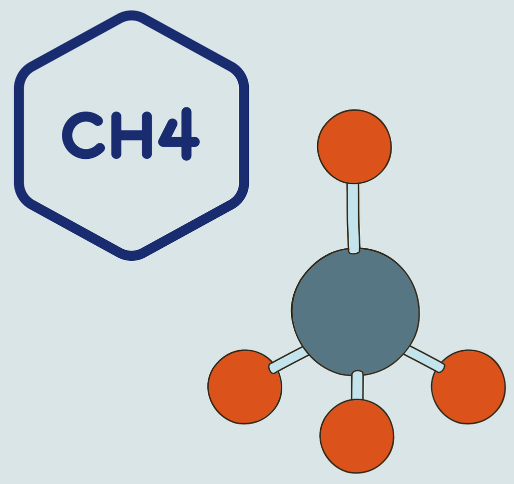

The benefits of measuring dissolved methane for interpreting ground gas results in a groundwater prevelant site

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INTRODUCTION

Where groundwater is present in gas monitoring wells it may contain dissolved methane that can influence the measured gas concentrations in the well headspace. Traditional gas monitoring techniques give unrepresentative readings of the gas regime often presenting elevated gas concentrations that do not represent gas levels of the surrounding soil (figure 1).

In the soil a high concentration of methane will only exist immediately above the groundwater. Within the soil the methane will be oxidised and or diluted. Thus the overall gas concentration in the unsaturated zone will be a lot less than that measured in the well head space.

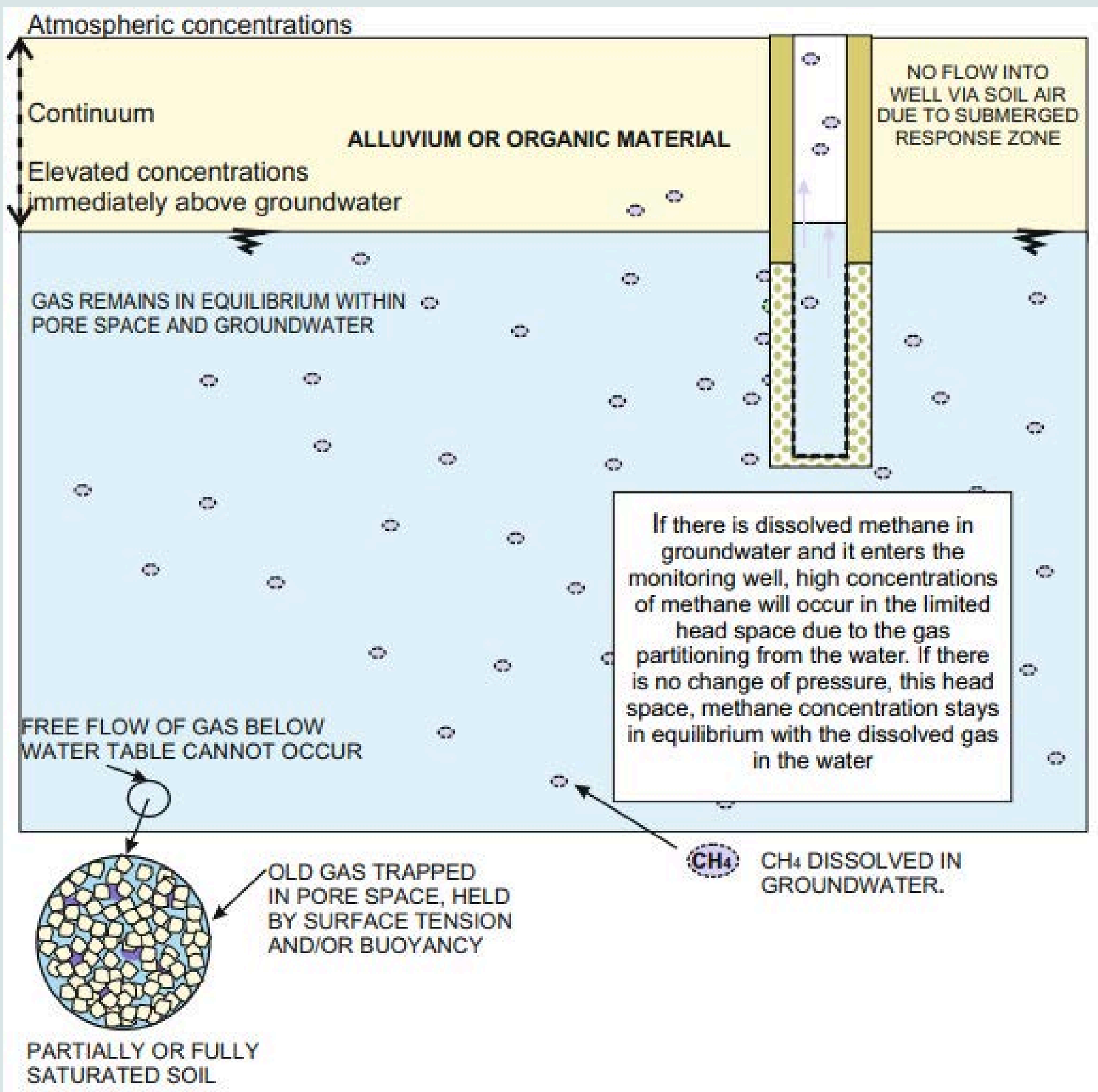

FIGURE 1: The presence and behaviour of dissolved methane within a borehole and its surrounding soil (adapted from Haines, S. at The Environmental Protection Group)

Pressure has a considerable effect on methane concentration in water but elevated concentrations of methane will only pose a risk if the water discharges into a confined space via the action of rapid pumping at significant depth. Therefore, the presence of high dissolved concentrations in groundwater below a building will not normally pose a risk because there is no significant change in pressure, and migration to the surface is driven by diffusion. There are also no instances in which dissolved methane has migrated through the soil into buildings.

OBJECTIVE

A site with multiple sources of gas from organic clays, natural alluvium and former sewage sludge ponds situated within a high groundwater table can be used to demonstrate that high gas concentrations from flooded response zones are most likely from dissolved methane. By using dissolved methane probes, realistic concentrations of methane within the wells at different depths, are measured (figure 2). This allows for a better understanding of the risk any gases pose to development compared to measuring methane levels carrying out the traditional spot gas monitoring procedure.

METHODOLOGY

- After locating the relevant measuring well a gas sample is first taken using a GFM gas analyser to give a preliminary understanding of the methane concentration. This helps to understand the appropriate dissolved methane gas probe to use with regards to the limit of detection required (0.3mg/l, 3mg/l and 30mg/l), so that the probe does not get over-saturated.
- Positioning of the probe is determined using dip to water level (DTL) and dip to borehole base (DTB) measurements and establishes three areas within the borehole in decending order.
- The appropriate probe is then connected to the monitoring hardware and computer software. Once the correct baud rate is confirmed, the sensor distributes the data as methane (%), methane (mg/l), water temperature (degrees Celsius) and water pressure (mbar).
- Parameters are recorded every 30 seconds for three minutes once a steady reading is established.

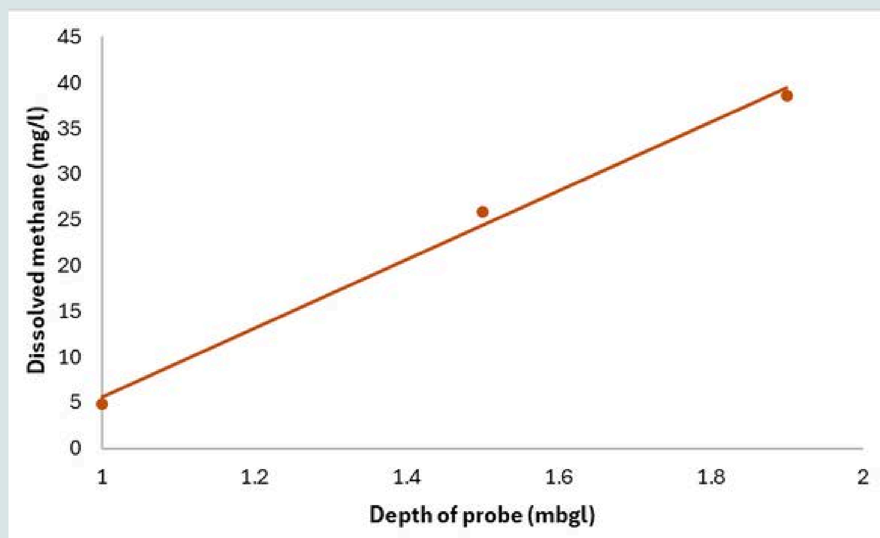

FIGURE 2: Correlation between dissolved methane (mg/l) and depth (mbgl) in example borehole

BENEFITS OF DISSOLVED METHANE PROBES OVER GROUNDWATER SAMPLING METHOD

- Measures methane directly in the well without needing to extract water and is therefore not affected by sample collection and handling at both the site and laboratory. Consequently, degassing and methane losses are eliminated which would normally inflict a negative concentration bias on the sample.
- Groundwater sampling is brought up to the surface from a depth to atmospheric conditions which creates degassing of methane; this is not the case when dissolved methane probing.
- Dissolved methane probing gives an accurate representation of dissolved methane levels at various depths (figure 2) within the groundwater table unlike groundwater sampling which is only collected near the surface.
- Does not lower the water level during monitoring which would degass the methane.
- Can be used at significant depths.
- Can measure high concentrations of dissolved methane within a well, unlike the groundwater sampling method.
- Automated measurements with dissolved methane probing means there is reduction in human error.
- Dissolved methane probing can be used in continuous monitoring, allowing long-term data and seasonal variation.
- More cost-effective than groundwater sampling methods as does not require laboratory analysis.

WHY USE DISSOLVED METHANE PROBES

Significant advancement in groundwater monitoring providing **real-time data** whilst minimising the risk of methane loss or degassing.

Improves understanding of the gas regime as well as refining the conceptual site model.

Appropriate remedial actions and protections measures can be carried out by engineers that are a true reflection of the ground gas risk to development.

Good practice within the workplace.

“THE GREATEST UNCERTAINTIES ARE ASSOCIATED WITH SAMPLE AND ANALYSIS OF HIGHER METHANE CONCENTRATIONS”

References: Bowes. M.J., Rivett. M.O., and Bell. R.A. ‘ Field-scale evaluation of collection methods for dissolved methane samples in groundwaters’ Environmental Change, Adaptation and Resilience Programme, British Geological Survey. 2022. Reference: 0R/22/035; Rivett. M.O., Bell. R.A., and Ward. R.S. ‘Methods for sampling and analysing methane in groundwater: a review of current research and practice’ Environmental Agency, December 2021. Reference: SC190007; ; Wilson. S., Haines, S., ‘Ground Gas information Sheet No.2 - Dissolved methane monitoring for ground gas risk assessment’ The Environmental Protection Group. August 2018