GEOENVIRONMENTAL RISK SOLUTIONS

31st May 2012

Booth King Partnership Ltd
Tollgate House
9c Bridge Street
Ramsbottom
BL0 9AB

FAO – Ian Leaper

Dear Ian,

**RE: GRS0112-1458 Proposed Specialist Unit, Former Gardeners Arms, Broad Green Road, Liverpool – Addendum Letter Report.**

This letter report presents and discusses the completed ground gas monitoring results for the above site and should be read in conjunction with GRS0112-1458 Ground Engineering Interpretative Report issued on the 11th May 2012.

The gas monitoring results from the final monitoring visit undertaken on the 29th May 2012 and the five previous monitoring results shows that a very slight percentage (0.1%) methane gas has been detected (WS3). Concentrations of oxygen were shown to be generally in the range of normal with the exception of WS3 during the first and last visit where depleted oxygen levels were recorded. Slightly raised levels of carbon dioxide were also detected throughout the monitoring period. No hydrogen sulphate or carbon monoxide was detected in any of the installations. The maximum flow rate recorded was 5.6 l/h.

It should be noted that after the fourth monitoring visit the monitoring installation in WS1 was found to be damaged to the point that no further readings were possible.

A Preliminary Risk Assessment of the ground gas regime at the site was carried out in the Ground Engineering Interpretative Report (GRS, May 2012). The risk assessment categorised the site as 'Characteristic Situation 2' (Low Risk) for which specialised ground gas protection measures are required. As the monitoring period is now complete, a further risk assessment has been carried out using all of the monitoring data. Below is a table summarising the results from the whole of the monitoring period.

| Exploratory Hole No. | No. of Monitoring Visits | Range of Peak Methane (%) | Range of Peak Carbon Dioxide (%) | Range of Min. Oxygen (%) | Range of Peak Flow (l/hr) | Range of Carbon Monoxide (ppm) | Range of Atmospheric Pressure (mb) |
|---|---|---|---|---|---|---|---|
| **WS3** | 6 | 0-0.1 | 0 – 1.7 | 13.6 – 20.9 | 0.1 | 0 | 987 - 1010 |
| **WS1** | 4 | 0 | 0 – 2.5 | 16.5 – 21.5 | 0 – 5.6 | 0 | 987 – 1009 |
| **WS7** | 6 | 0 | 0.6 -1.3 | 18.2 – 21.1 | 0 – 0.1 | 0 | 987-1010 |

Guidance from CIRIA Report C665 'Assessing Risks Posed By Hazardous Ground Gases to Buildings' uses gas concentration and flow rates to calculate the Gas Screening Value (GSV). The GSV for the worst case scenario is then used to categorise the site as defined in report C665. The GSV for this site has been calculated using the highest value recorded for Methane (0.1%) and Carbon Dioxide (2.5%) and the highest flow reading (5.6/h). The GSV for Methane is 0.0056l/h and carbon dioxide is 0.14l/h. Using these values in the Wilson and Card Classification the site falls into the category of 'Characteristic Situation 2' (Low Risk) for which specialised ground gas protective measures are required.

The recommendations for ground gas protective measures therefore remain the same as stated within the GIR (GRS, May 2012). The typical scope of protective measures relating to 'Characteristic Situation 2' is as follows (as recommended in CIRIA C665):

a) Reinforced concrete in situ floor slab (suspended, non-suspended or raft) with at least 1200gDPM$_2$.
b) Beam and block or pre cast concrete slab minimum 2000gDPM/reinforced gas membrane.
c) All joints and penetrations sealed.
d) Possibly underfloor venting or pressurisation in combination with a) or b) depending on use.

It should be noted that these protective measures relate to generic commercial buildings. Therefore as the proposed development is a specialist care unit it may be more appropriate to use the points system given in BS8485:2007 'Code of Practice for characterisation and remediation from ground gas in affected developments' as it defines public buildings (eg. Managed apartments, schools, hospitals) as a separate category. Although this development may not be considered a public building the end use of the site could be considered similar in use to a public building. This system still uses the Characteristic Situation scenario but for required protection measures a certain number of points have to be achieved through the construction method. Therefore for 'Characteristic Situation 2' a total of 3 points have to be scored. However the recorded concentrations of carbon dioxide and methane are only slightly raised and the Gas Screening Value is only slightly above the boundary between 'Characteristic Situation 2' and 'Characteristic Situation 1'. It may therefore be more appropriate to relax the number of points required to that of a commercial building for which 2 points are required.

As the exact design structure is not available at the time of writing of this report GRS cannot score the ground gas protection measures. Reference should therefore be made to the below table 3 extract from BS8485 during the construction design phase.

If you have any further questions or queries, please do not hesitate to contact the undersigned.

Yours Sincerely

Dominic David BSc (Hons)
Associate

Table 3 Solutions scores

| PROTECTION ELEMENT/SYSTEM | | SCORE | COMMENTS |
|---|---|---|---|
| **a) Venting/dilution (see Annex A)** | | | |
| Passive sub floor ventilation (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) [A] | Very good performance | 2.5 | *Ventilation performance in accordance with Annex A.* *If passive ventilation is poor this is generally unacceptable and some form of active system will be required.* |
| | Good performance | 1 | |
| Subfloor ventilation with active abstraction/pressurization (venting layer can be a clear void or formed using gravel, geocomposites, polystyrene void formers, etc.) [A] | | 2.5 | *There have to be robust management systems in place to ensure the continued maintenance of any ventilation system.* *Active ventilation can always be designed to meet good performance.* *Mechanically assisted systems come in two main forms: extraction and positive pressurization.* |
| Ventilated car park (basement or undercroft) | | 4 | *Assumes car park is vented to deal with car exhaust fumes, designed to Building Regulations Document F [5] and IStructE guidance [6].* |
| **b) Barriers** | | | |
| Floor slabs | | | |
| Block and beam floor slab | | 0 | *It is good practice to install ventilation in all foundation systems to effect pressure relief as a minimum.* *Breaches in floor slabs such as joints have to be effectively sealed against gas ingress in order to maintain these performances.* |
| Reinforced concrete ground bearing floor slab | | 0.5 | |
| Reinforced concrete ground bearing foundation raft with limited service penetrations that are cast into slab | | 1.5 | |
| Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints | | 1.5 | |
| Fully tanked basement | | 2 | |
| **c) Membranes** | | | |
| Taped and sealed membrane to reasonable levels of workmanship/in line with current good practice with validation [B], [C] | | 0.5 | *The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation, and the integrity of joints.* |
| Proprietary gas resistant membrane to reasonable levels of workmanship/in line with current good practice under independent inspection (CQA) [B], [C] | | 1 | |
| Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation | | 2 | |
| **d) Monitoring and detection (not applicable to non-managed property, or in isolation)** | | | |
| Intermittent monitoring using hand held equipment | | 0.5 | |
| Permanent monitoring and alarm system [A] | Installed in the underfloor venting/ dilution system | 2 | *Where fitted, permanent monitoring systems ought to be installed in the underfloor venting/dilution system in the first instance but can also be provided within the occupied space as a fail safe.* |
| | Installed in the building | 1 | |
| **e) Pathway intervention** | | | |
| Pathway intervention | | — | *This can consist of site protection measures for off-site or on-site sources (see Annex A).* |

*NOTE In practice the choice of materials might well rely on factors such as construction method and the risk of damage after installation. It is important to ensure that the chosen combination gives an appropriate level of protection*

[A] It is possible to test ventilation systems by installing monitoring probes for post installation validation.

[B] If a 1 200 g DPM material is to function as a gas barrier it should be installed according to BRE 212 [8]/BRE 414 [9], being taped and sealed to all penetrations.

[C] Polymeric Materials >1 200 g can be used to improve confidence in the barrier. Remember that their gas resistance is little more than the standard 1 200 g (proportional to thickness) but their physical properties mean that they are more robust and resistant to site damage.

Ground Gas and Groundwater Monitoring Results

| | | | | | |
|---|---|---|---|---|---|
| Site No: | GRS0112-1458 | Weather Conditions: | Rain | Pressure Trend | Falling |
| Site Name: | Former Gardeners Arms | | | | |
| Date: | 03/04/2012 | | | | |

GEOENVIRONMENTAL RISK SOLUTIONS

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS3 | Ambient | | 0 | 0 | 21 | 79 | 0 | L | 0 | 0 | 0 | 1.5 | 13.6 | 0.31 | 998 | - | 1 | |
| | Installation | 30 Sec | 0 | 1 | 16 | 83 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0.8 | 16.8 | 86.4 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 1.4 | 13.8 | 84.8 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | -0.1 | 0 | -0.1 | -0.1 | -0.1 | 0 | -0.1 | -0.1 | -0.1 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS1 | Ambient | | 0 | 0 | 21.3 | 78.7 | 0 | L | 0 | 0 | 0 | 0 | 21.5 | -0.03 | 998 | 0.96 | 2.91 | |
| | Installation | 30 Sec | 0 | 0 | 21.5 | 78.5 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0 | 21.5 | 78.5 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0 | 21.5 | 78.5 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | 5.6 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS7 | Ambient | | 0 | 0 | 21.6 | 78.4 | 0 | L | 0 | 0 | 0 | 0.7 | 21.1 | -0.06 | 998 | - | 2.95 | |
| | Installation | 30 Sec | 0 | 0.7 | 21.1 | 78.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0.7 | 21.1 | 78.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0.7 | 21.1 | 78.2 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

## Ground Gas and Groundwater Monitoring Results

| | | | | | |
|---|---|---|---|---|---|
| Site No: | GRS0112-1458 | Weather Conditions: | Sunny | Pressure Trend | Steady |
| Site Name: | Former Gardeners Arms | | | | |
| Date: | 12/04/2012 | | | | |

GEOENVIRONMENTAL RISK SOLUTIONS

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS3 | Ambient | | 0 | 0 | 20.9 | 79.1 | 0 | L | 0 | 0 | 0.1 | 0 | 20.8 | 0 | 998 | 0.7 | 1 | |
| | Installation | 30 Sec | 0.1 | 0 | 20.8 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0 | 20.8 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0 | 20.8 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS1 | Ambient | | 0 | 0 | 21 | 79 | 0 | L | 0 | 0 | 0 | 0.1 | 20.7 | -0.04 | 998 | 1.08 | 2.9 | |
| | Installation | 30 Sec | 0 | 0.1 | 20.7 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0 | 20.8 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0 | 20.8 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS7 | Ambient | | 0 | 0 | 20.9 | 79.1 | 0 | L | 0 | 0 | 0 | 0.6 | 19.9 | -0.04 | 998 | 2.88 | 2.95 | |
| | Installation | 30 Sec | 0 | 0.6 | 19.9 | 79.5 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0.6 | 19.9 | 79.6 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0.6 | 19.9 | 79.5 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

## Ground Gas and Groundwater Monitoring Results

| Site No: | GRS0112-1458 | Weather Conditions: | Cloudy | Pressure Trend | Rising | GEOENVIRONMENTAL RISK SOLUTIONS |
|---|---|---|---|---|---|---|
| Site Name: | Former Gardeners Arms | | | | | |
| Date: | 20/04/2012 | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS3 | Ambient | | 0 | 0 | 20.8 | 79.2 | 0 | L | 0 | 0 | 0 | 0.1 | 20.1 | -0.07 | 987 | 0.6 | 1 | |
| | Installation | 30 Sec | 0 | 0.1 | 20.1 | 79.8 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0.1 | 20.2 | 79.7 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0.1 | 20.2 | 79.7 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS1 | Ambient | | 0 | 0 | 20.9 | 79.1 | 0 | L | 0 | 0 | 0 | 0.3 | 20.5 | -0.08 | 987 | 1.1 | 2.9 | |
| | Installation | 30 Sec | 0 | 0.3 | 20.5 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0.3 | 20.6 | 79.1 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0.1 | 20.7 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | -4.8 | 3.5 | 4.8 | 4.8 | 4.8 | 4.7 | 4.8 | 4.8 | 4.8 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS7 | Ambient | | 0 | 0 | 21.1 | 78.9 | 0 | L | 0 | 0 | 0 | 0.8 | 21.1 | 0 | 987 | 2.9 | 2.95 | |
| | Installation | 30 Sec | 0 | 0.8 | 20 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0.8 | 20 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0.8 | 20 | 79.2 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

## Ground Gas and Groundwater Monitoring Results

| | | | | | |
|---|---|---|---|---|---|
| Site No: | GRS0112-1458 | Weather Conditions: | Sunny | Pressure Trend | Rising |
| Site Name: | Former Gardeners Arms | | | | |
| Date: | 30/04/2012 | | | | |

GEOENVIRONMENTAL RISK SOLUTIONS

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS3 | Ambient | | 0 | 0 | 20.7 | 79.3 | 0 | L | 0 | 0 | 0 | 0.2 | 19.6 | -0.31 | 1009 | 0.5 | 1 | |
| | Installation | 30 Sec | 0 | 0.2 | 19.6 | 80.1 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0.1 | 20.2 | 79.7 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0.1 | 20.2 | 79.7 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS1 | Ambient | | 0 | 0 | 20.8 | 79.2 | 0 | L | 0 | 0 | 0 | 2.5 | 16.5 | -0.28 | 1009 | | | Installation damaged, bung could not be removed |
| | Installation | 30 Sec | 0 | 2.5 | 16.5 | 81 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 2.4 | 16.7 | 81 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 2.3 | 16.8 | 80.9 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | -4.1 | -1.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS7 | Ambient | | 0 | 0 | 20.8 | 79.2 | 0 | L | 0 | 0 | 0 | 0.7 | 18.7 | -0.34 | 1009 | 2.68 | 2.95 | |
| | Installation | 30 Sec | 0 | 0.7 | 18.7 | 80.6 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0.7 | 18.7 | 80.6 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0.7 | 18.7 | 80.6 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

Ground Gas and Groundwater Monitoring Results

| | | | | | |
|---|---|---|---|---|---|
| Site No: | GRS0112-1458 | Weather Conditions: | Rain | Pressure Trend | Falling |
| Site Name: | Former Gardeners Arms | | | | |
| Date: | 09/05/2012 | | | | |

GEOENVIRONMENTAL RISK SOLUTIONS

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS3 | Ambient | | 0 | 0 | 21 | 79 | 0 | L | 0 | 0 | 0 | 0 | 20.9 | -0.15 | 1002 | 0.7 | 1 | |
| | Installation | 30 Sec | 0 | 0 | 20.9 | 79.1 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 0 | 20.9 | 79.1 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 0 | 20.9 | 79.1 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS1 | Ambient | | Installation damaged, no readings could be taken. | | | | | | | | | | | | | | | |
| | Installation | 30 Sec | | | | | | | | | | | | | | | | |
| | | 1 Min | | | | | | | | | | | | | | | | |
| | | 5 Min | | | | | | | | | | | | | | | | |
| Time | | 10 sec | | | | | | | | | | | | | | | | |
| Flow (l/h) | | | | | | | | | | | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS7 | Ambient | | 0 | 0 | 20.9 | 79.1 | 0 | L | 0 | 0 | 0 | 1 | 19.3 | 0.32 | 1002 | 2.8 | 2.95 | |
| | Installation | 30 Sec | 0 | 1 | 19.3 | 79.7 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 1 | 19.3 | 79.7 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 1 | 19.3 | 79.7 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

## Ground Gas and Groundwater Monitoring Results

| | | | | | |
|---|---|---|---|---|---|
| Site No: | GRS0112-1458 | Weather Conditions: | Sunny | Pressure Trend | |
| Site Name: | Former Gardeners Arms | | | | |
| Date: | 29/05/2012 | | | | |

GEOENVIRONMENTAL RISK SOLUTIONS

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS3 | Ambient | | 0 | 0 | 20.5 | 79.5 | 0 | L | 0 | 0 | 0 | 1.9 | 13.6 | -0.33 | 1010 | 0.8 | 1 | |
| | Installation | 30 Sec | 0 | 1.7 | 14.4 | 83.9 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 1.7 | 14.2 | 84.1 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 1.9 | 13.6 | 54.5 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS1 | Ambient | | Installation damaged, no readings could be taken. | | | | | | | | | | | | | | | |
| | Installation | 30 Sec | | | | | | | | | | | | | | | | |
| | | 1 Min | | | | | | | | | | | | | | | | |
| | | 5 Min | | | | | | | | | | | | | | | | |
| Time | | 10 sec | | | | | | | | | | | | | | | | |
| Flow (l/h) | | | | | | | | | | | | | | | | | | |

| | | | $CH_4$ (%) | $CO_2$ (%) | $O_2$ (%) | BAL (%) | LEL (%) | $H_2$ (Low/Med /High) | $H_2S$ ppm | CO ppm | Peak $CH_4$ (%) | Peak $CO_2$ (%) | Min $O_2$ (%) | Relative Pressure (mB) | Atmospheric Pressure (mB) | Depth to Groundwater (mbgl) | Depth to Base (mbgl) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WS7 | Ambient | | 0 | 0 | 20.5 | 79.5 | 0 | L | 0 | 0 | 0 | 1.3 | 18.2 | -0.5 | 1010 | - | 2.95 | |
| | Installation | 30 Sec | 0 | 1.3 | 18.2 | 80.5 | 0 | L | 0 | 0 | | | | | | | | |
| | | 1 Min | 0 | 1.3 | 18.2 | 80.5 | 0 | L | 0 | 0 | | | | | | | | |
| | | 5 Min | 0 | 1.3 | 18.2 | 80.5 | 0 | L | 0 | 0 | | | | | | | | |
| Time | | 10 sec | 30 sec | 1 min | 2 min | 3 min | 4 min | 5 min | 10 min | 15 min | | | | | | | | |
| Flow (l/h) | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | |