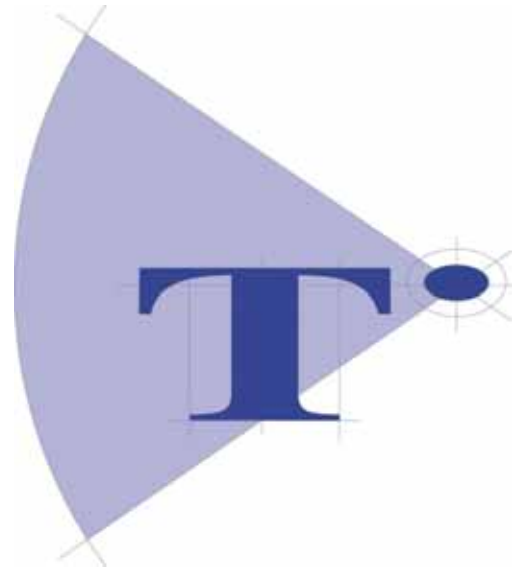




**A REMEDIATION STRATEGY AND GAS
PROTECTION VERIFICATION PLAN FOR
THE PROPOSED CONVERSION OF NEW
FOUNDRY BUILDING, GUTTER HILL,
JOHNSTOWN**

ISSUE 1.0

TE1085RS

25 MAY 2018

FINAL

Prepared for:

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1. INTRODUCTION

1.1. Background

Tier Environmental was commissioned by Watkin Jones & Son Ltd to undertake a Preliminary Risk Assessment (hereafter referred to as 'PRA'), report reference: TE1850PRA, dated 29th March 2018 for an area of land referred to as New Foundry Buildings, Gutter Hill, Johnstown, Wrexham, LL14 1LT (the "Site").

It is understood that the existing building is to be converted from commercial offices (Class B1) to 12 No. residential apartments (Class C3), with external and internal alterations, associated landscaping and other ancillary works.

The PRA identified that there is a potential for ground gas generation and source of potential contamination associated with the on-site Made Ground that was likely imported to raise ground levels on-site. A site investigation and chemical testing will be required to determine whether the current shallow soils are suitable for use or whether a clean cover will be required, based on a residential without home grown produce end use.

The historic railway immediately north of the Site and the historic gas works (now a fire station) to the north of Gutter Hill may also be potential sources of gas and groundwater contamination.

It is considered that no potential pollutant linkages to controlled waters receptors will be created by the proposed conversion of the existing building.

There is a potential for hazardous ground gas generation related to radon bearing strata, on-site Made Ground associated with raised ground levels, the 2 No. disused mine shafts and potential shallow coal seams/workings.

No historic intrusive ground investigations or ground gas monitoring data are available with regard to the original construction of the existing building. Construction details for the existing building are also unavailable with regard to ground gas protection measures.

Sub floor telescopic air vents have been installed at approximate 2m centres around the periphery of the building, indicating a suspended ground floor slab and below slab void. Locally, some of the vents have been partially or completely blocked or damaged.

Basic radon measurements are required (if not already installed in the existing building).

Potential development constraints and associated mitigation measures were presented within the PRA and included:

- In order to break the direct contact, dust inhalation and ingestion pathways associated with possible metals and hydrocarbon impacted soils and inhalation pathways associated with any possible asbestos containing materials (ACMs) in areas of soft landscaping and planting, a clean cover system may be required. A minimum of 600mm 'clean cover' derived from imported topsoil and subsoil laid over a geotextile membrane will be installed if deemed necessary to prevent mixing of potentially contaminated material with the cover layer. It will also guard against ecological disturbance (e.g. moles, plant roots etc); and,



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- Basic radon gas protection measures are required. Ground gas protection measures may also be required, in accordance with BS8485. This will include the retrofit of a volatile resistant membrane in order to break the potential vapour pathway between the potential source within the shallow soils and the future site users receptors.

It is proposed to undertake intrusive investigations (hand excavated trial pits) during the conversion works to determine whether the 600mm of clean cover soils is required. Access to undertake this intrusive investigation is not currently possible due to the occupation of the building.

1.2. Remediation Strategy

Taking into account the planned future use of the Site, the objectives of this report are:

- To summarise the potential risks posed by any potential ground contamination within the site and present the revised conceptual site model with regard to the redevelopment of the site;
- To provide a detailed remediation statement to manage the risks;
- Propose remedial targets which will be used to assess the suitability of any material to remain *in situ*;
- Provide the specification for the proposed cover layer proposed around the soft landscaped areas (including verification sampling);
- Provide detailed specifications for the ground gas mitigation installations required on site; and,
- To provide details of what documentation will be required as part of a final verification report.

This report, which was designed to meet the requirements of all relevant current guidance including CLR 11, presents the factual information available during this appraisal, interpretation of the data obtained and recommendations relevant to the defined objectives.

It has been assumed in the production of this report that the existing building within the Site is to be converted from a commercial use to apartments with areas of soft landscaping and hardstanding (residential without home grown produce). In addition, it is assumed that ground levels will not change significantly from those described in this report. If this is not the case, then amendments to the recommendations made in this report may be required.

Where the report refers to the potential presence of asbestos-containing materials, such observations are for information only and should be verified by a suitably qualified expert.

The comments and opinions presented in this report are based on the findings of the investigation works performed by Tier Environmental. There may be other conditions prevailing on the Site which have not been revealed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for any conditions not revealed by this investigation. Any diagram or opinion on the possible configuration of the findings is conjectural and given for guidance only. Confirmation of intermediate ground conditions should be undertaken if deemed necessary.



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This report does not include for assessment of risks to construction workers as any redevelopment and construction work should be conducted in accordance with HS(G)66. Similarly, nuisance health effects are not considered within this report. The Statutory Nuisance Act considers olfactory impacts from odours and allows comparison of enclosed space air concentrations with odour threshold concentrations.



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2. SITE DETAILS AND DESCRIPTION

Table 2.1 Current Site Overview

Site name	New Foundry Buildings, Wrexham.
Site address	New Foundry Buildings, Gutter Hill, Johnstown, Wrexham, LL14 1LS. A site location plan is included as Drawing No. TE1085GIR1 within Appendix A.
National Grid Reference	329834, 346290.
Location description	The Site is situated on the western edge of Johnstown, approximately 5.5km southwest of Wrexham town centre. The Site consists of 1 No. commercial property car parking and a public path running along the western and southern boundary. The Site is bounded by Gutter Hill to the north and amenity grassland to the east, south and west.
Approximate Site area	0.28ha
Site shape	The Site is irregular in shape and elongate in a northeast-southwest orientation.
General topography and ground levels	The Site is generally flat lying with topography reducing in the south eastern area.
Current land use	The Site currently comprises of 1 No. office building in the central area of the Site with areas of associated car parking and hardstanding in the north and east of the Site.
Existing structures	1 No. commercial property with associated car parking areas.
Site ground surfaces	The majority of the Site is covered in hardstanding with areas of soft landscaping.
Sub-surface structures	Manhole covers have been noted in the western area of the Site, presumably associated with the existing building. Unrecorded services may also be present.
Fly Tipping	No evidence of fly tipping was observed during the site walkover.
Invasive plant species	No invasive plant species have been reported by Tier Environmental geoenvironmental engineers, however; the presence/ absence of any invasive plant species should be confirmed by a suitable qualified specialist.
Existing gas protection measures	Investigations undertaken on 14 th May 2018 confirmed that approximately 70mm of concrete screed underlain by a likely block and beam suspended floor slab was encountered within the building. There did not appear to be an existing gas membrane beneath the screed. Plastic telescopic sub floor air vents were noted at approximate 2m centres around the periphery of the building.



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3. PROPOSED DEVELOPMENT

It is understood that the existing building on the Site is to be converted from commercial offices (Class B1) to 12 No. Residential apartments (Class C3), with external and internal alterations, associated landscaping and other ancillary works.

The proposed internal layout of the building is presented in John McCall Architects Ltd Drawing No. L110, which is included within Appendix A to this report.



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4. CONCEPTUAL SITE MODEL SUMMARY

This Remediation Strategy has been prepared with reference to the Preliminary Risk Assessment Report produced by Tier Environmental (Report Reference: TE1085PRA, dated 29th March 2018).

Whilst it is not the intention of this report to repeat the information contained within the PRA in full, the salient points which have informed this Remediation Strategy are covered below along with background context to the Site.

4.1. Justification

Investigation Findings

- The Site currently comprised of an irregular shaped parcel of land just to the south of Gutter Hill. The Site comprised of 1 No. commercial building with associated areas of car parking and soft landscaping.
- The majority of the Site is bounded by a SSSI with the northern portion of the Site bounded by Gutter Hill Road.
- Historical OS maps indicate that the Site has been developed since 1900. The current site layout appears on maps dated from 2002.
- Historical OS maps (1900 to 1912) indicate the ground level has been raised in the northern section of the Site associated with the former railway adjacent to the northern site boundary. A historical inert landfill has been registered by the Environmental Agency in the southern area of the Site. Therefore, Made Ground and ground gas materials may be present on Site. Shallow coal seams and the mine shafts may also be potential sources of hazardous ground gases.
- The Site is indicated to be underlain by Till, Diamicton classified as an unproductive aquifer.
- The superficial deposits are shown to be underlain by the Pennine Lower Coal Measures generally comprising mudstone, siltstone and sandstone. The Pennine Lower Coal Measures are classified as a Secondary (A) Aquifer – Permeable Layers.
- Minor Aquifer/High Leaching Potential (HU) soils are located within the Site.
- There is no recorded groundwater or surface water abstractions within the vicinity of the Site. The Site is not located within a Source Protection Zone.
- The site is located within a radon affected area. Basic radon protective measures are required.
- The river Aberderfyn, a tertiary watercourse located approximately 80m northeast of the Site.

Potential Sources

- Possible localised metal, PAH, phenol, sulphate, asbestos and organic contamination of on-site and off-site Made Ground associated raised ground level on-site and the adjacent historic railway.



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- Possible localised hazardous gas generation from on-site and off-site Made Ground, hydrocarbon impacted soils and radon bearing bedrocks and soils.
- Possible hazardous mine gas emissions from shallow coal seams and/or mine entries on-site and to the west of the Site.

Potential Pathways

- Dermal contact, ingestion and inhalation of contaminants on site.
- Migration of ground gas / explosion.
- Lateral and/or vertical migration of mobile contaminants.

Potential Receptors

- Future and adjacent users of the Site.
- Buildings, hardstanding and services.
- Site investigation and future underground service maintenance workers from hazardous short term exposure.
- Secondary (A) Aquifers beneath the Site.

4.2. Uncertainties

- Ground gas protection measures incorporated into the existing building.
- Presence and depth of any existing clean cover soils within landscaped areas.
- The presence of any features unrecorded by the historical maps.
- Any unrecorded geological features.
- Any unreported pollution events during the Site's history.



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Table 4. 1. Assessment of Pollutant Linkages.

Pollutant linkage		Qualitative risk assessment		
	Source	Pathway(s)	Receptor(s)	
1	Possible localised metal, PAH, phenol, sulphate, asbestos and organic contamination of on-site Made Ground associated raised ground level on-site and the adjacent historic railway.	Dermal contact, ingestion and inhalation of contaminants including contaminated dust migration during construction.	Future site users (residential)	Medium x Likely = Moderate Risk
			Current site users (site visitors, residents and farm workers)	Medium x Likely = Moderate Risk
			Site investigation and future maintenance workers	Medium x Likely = Moderate Risk
2	Possible radon and localised hazardous gas generation from Made Ground on Site and from potentially historic inert landfill.	Lateral and/or vertical migration of mobile contaminants.	Secondary (A) Aquifer located beneath the Site.	Medium x Low Likelihood = Moderate/Low Risk
			Tertiary River/watercourse and adjacent SSSI	Medium x Unlikely = Low Risk
		Inhalation (indoor and outdoor)	Future site users (residential).	Medium x Likely = Moderate Risk
			Site investigation and future maintenance workers.	Medium x Likely = Moderate Risk
3	Possible hazardous mine gas emissions from shallow coal seams and/or mine entries on-site and to the west of the Site.	Migration of ground gas / explosion	Future site users (residential).	Medium x Likely = Moderate Risk
			Future site users (residential).	Medium x Likely = Moderate Risk
			Site investigation and future maintenance workers.	Medium x Likely = Moderate Risk
		Migration of ground gas / explosion	Future site users (residential).	Medium x Likely = Moderate Risk
			Future site users (residential).	Medium x Likely = Moderate Risk

For definition of the terms used in the qualitative risk assessment, please see Appendix C.



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5. REMEDIATION STRATEGY

5.1. Proposed Ground Investigation Works

Intrusive investigations (hand excavated trial pits) will be undertaken following the vacation of the building by the current tenants as access is not currently possible. The trial pits will be inspected by a suitably qualified geo-environmental consultant and photographs taken. Based upon the historical information available for the Site and the potential pollutant linkages identified for the proposed conversion, Tier Environmental will schedule chemical laboratory testing on selected soil samples. The purpose of the testing will be to:

- Determine the concentration and spatial distribution of potential contaminants in the shallow soils to determine their suitability for retention *in situ*; and,
- Undertake an initial waste soils classification.

All testing will be carried out by a UKAS and/or MCERTS accredited laboratory. The analysis will include a suite of testing for metals, speciated PAH, TPHCWG and asbestos screening (and quantification if asbestos identified).

The findings of the ground investigation will be included in the Verification Report that will be issued upon completion of the remediation works.

5.2. Anticipated Remedial Works

Based upon the findings of the site investigation, the following remediation strategy has been devised in order to make the Site safe and suitable for redevelopment, as proposed:

- Potential removal of shallow soils to accommodate the clean cover soils;
- In order to break any direct contact, dust inhalation and ingestion pathways associated with metals, PAHs, TPH and the inhalation pathways associated with any potential asbestos containing materials in areas of soft landscaping and planting, a clean cover system will be installed. A minimum of 600mm 'clean cover' derived from imported topsoil and subsoil laid over a geotextile membrane to prevent mixing of potentially contaminated material with the capping layer. It will also guard against ecological disturbance (e.g. moles, plant roots etc); and,
- Installation of ground gas protection measures in line with the ground gas protection verification plan. This will include a volatile resistant membrane (PAGeotechnical NC400) in order to break the vapour pathway between any potential sources within the shallow soils and bedrock and the future site users receptors.

5.3. Independent Verification and Supervision of the Works

Verification of Impacted Soil Removal

In order to ensure verification of the removal of contaminated soils, if encountered, excavations will be carried out as follows:



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- A visual inspection of the soil will be undertaken. The excavation will be progressed until no visual evidence of gross contamination remains or until excavation is no longer practicable / safe due to the proximity to adjoining structures of services.
- Soil samples will be taken from the base and sides of the excavation, prior to infilling, on a 5m grid. Sample collection will be made by the use of the excavator bucket to 'scrape' the sample locations. The Site Engineer will not enter the excavation at any time. Base samples will be obtained in a 'W' shape pattern to provide confidence in the lateral and vertical verification of the resultant excavations;
- If, in the experience of the competent Site Engineer, it is thought that the sample is likely to be below remedial targets, the sample will be submitted for laboratory analysis;
- Should the results of laboratory analysis be greater than the remedial targets, then further assessment and/or potential remediation of the contamination will be necessary.

5.4. Clean Cover System

Installation

In order to remove the remaining pollutant linkages, it is considered that the soft landscaped areas of the Site should be covered with a 600mm deep clean cover system (150mm Topsoil layer underlain by 450mm subsoil) and a hi visibility Terram geotextile membrane. It is considered that as the proposed development is for residential accommodation purposes without private rear gardens, that a 600mm clean cover system with a geotextile membrane will provide sufficient thickness for the exposure scenarios typical for residential accommodation use and the geotextile will provide a hi-visibility physical barrier in the unlikely event that any excavations are undertaken to this depth. It should be noted that the clean cover system should only be implemented in those areas for which shallow soils still lie at ground surface, i.e. soft landscaped areas as all other areas will be covered in hardstanding and/or buildings which will be sufficient to break the direct contact and dust inhalation pathways in these areas.

The source of the aggregates, imported subsoil and Topsoil material will be inspected and tested prior to being brought to site on site to ensure its chemical suitability and absence of any deleterious materials such as glass, metal, roots, invasive weed species and the like.

Verification

It will be necessary to ensure that the development of the site does not cause an increased risk to receptors. All materials imported to the site will be tested prior to being brought to site to determine its chemical suitability for use on the site in the soft landscaping areas. The imported material will be tested for the standard Tier Environmental soil suite listed in Appendix D of this report as part of a verification testing exercise. The purpose of the testing is to verify the quality of any materials imported to the site and to determine the contaminant concentrations of materials. Imported materials will need to be tested at a minimum rate of 1 sample per 50m³ for topsoil and 1 per 150m³ for subsoil/other backfill materials with a minimum of 3 No. samples of each.

In addition to the chemical testing, the depth of clean cover will also be verified. Verification will take the form of a suitably qualified environmental engineer undertaking hand dug pits in each soft landscape plot, with the number of holes determined based on a 1 per 25m² or per soft landscaped 'plot' area.



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Irrespective of the finished total area of soft landscaped areas, a minimum of 3 No. pits overall will be undertaken within soft landscaped areas to ensure that a combined thickness of 600mm subsoil and Topsoil has been achieved and to prove the installation of the Terram geotextile. These hand dug pits will be photographed and photographs will be submitted as part of the verification report.

5.5. Contingency for any Unknowns

Whilst relatively uniform ground conditions have been encountered at the Site during previous investigations, a small risk exists of the presence of localised unidentified contamination of Made Ground soils.

Should any suspicious material be encountered during the redevelopment works, works shall be ceased within this part of the site and the area should then be investigated further by a suitably qualified geo-environmental engineer and sampled as necessary. The Contaminated Land Officer / Environmental Health Officer (or equivalent) at the local authority should also be notified immediately. Samples will be forwarded to a UKAS/MCERTS accredited laboratory for a suite of analytical testing deemed appropriate based upon an appraisal of the material identified.

Once the results of the analysis are known and have been interpreted, the required remedial action (if any) will be determined and approved with the relevant regulatory authorities.

5.6. Environmental Monitoring and Mitigation

Introduction

In order to mitigate the environmental impacts of the works on nearby residents and sensitive areas, a programme of measures will be implemented during the remediation works.

Dust Mitigation

Appropriate measures shall be implemented at all times during the remediation works, to minimise dust emissions. Soils will be dampened down, as necessary, and activity will be minimised in extremely windy conditions to prevent dust nuisance. An adequate supply of water shall be maintained on site at all times to allow for dust suppression activities to be carried out at short notice.

When dusty material is being loaded onto trucks, extra care will be taken to ensure that the drop height is minimised. Trucks will be suitably covered when leaving the site with contaminated material to prevent dust migration.

The amount of disturbed surfaces left exposed for significant time periods will be minimised. Stockpiles of fine or loose materials should be tamped down or covered if necessary to reduce the production of dust. Traffic both entering and working on the site shall obey a maximum speed limit of 10 mph.

If asbestos is reported at the Site, works should be conducted in accordance with the Control of Asbestos Regulations (CAR) 2012.



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Noise

The requirements of BS 5228:1997 "Noise and Vibration Control on Construction Sites" shall be adhered to at all times. All machinery shall be fitted with effective silencers and shall be serviced at regular intervals. No plant shall be operated with engine covers raised.

Run-off into Drains

All potential drainage on site and any discharge points will be identified, including land drains, foul sewers, surface water drains and any combined drains. These will be marked, as appropriate, for easy identification.

Works will be minimised during periods of heavy rainfall to reduce the likelihood of contaminated run-off. Temporary containment and cover measures or tamping down of stockpiles to reduce run-off shall be used where necessary.

5.7. Waste Soils - Basic Characterisation and WAC

Impacted material exported from the site to landfill shall be hauled by a registered waste carrier in accordance with Duty of Care Regulations, 1991 and the Hazardous Waste Regulations, 2005.

It is anticipated that some of the waste materials will be hazardous on the basis of previous site investigation works and on-site observations.

There will be requirement for the waste producer to provide appropriate Waste Acceptance Criteria (WAC) testing of the soils for disposal to ensure that the soils are appropriately classified and that the landfill is licensed to receive such soils.

5.8. Verification Report

The SE should ensure that the requirements of the strategy are complied with. On satisfactory completion of all remedial works, a verification report should be produced. This report will comprise all relevant site records and act as certification that the remedial preparation works have been carried out in accordance with this remediation strategy.

The Verification Report shall include the following:

- A description of the works undertaken;
- Records of the works;
- Progress photographs;
- Photographs of the ground gas protection measures and details of the installed membrane;
- Waste Transfer Notes;
- Chemical verification test results; and,



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- A statement that the works have been undertaken in accordance with the agreed strategy.

It is acknowledged that any minor exceedances of the remediation criteria from materials left in the ground may require further assessment and/or discussion with Wrexham Borough Council. Due consideration will be given to the viable pathways and the locations of any such minor residual exceedances and qualitative assessment of the potential risks may also be provided in the Verification Report, where appropriate.



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6. GROUND GAS REGIME AND GAS PROTECTION MEASURES

6.1. Tier Ground Gas Risk Assessment

The Tier Environmental PRA determined that basic radon and hazardous ground gas protection measures are likely to be required at the site. These will include a volatile resistant membrane (PAG HC400) in order to break the vapour pathway between the radon and potential volatile sources within the shallow soils/bedrock and the future site user receptors.

During engineering and construction activities, the ground gas risks are to be considered during the preparation of relevant site H&S plans, method statements and related documents, and appropriate working methods adopted:

- Potential elevated methane, carbon dioxide and/or volatile concentrations in ground gas could present an asphyxiation risk in excavations and other confined spaces. The Health & Safety Executive has published information defining safe occupational exposure levels for ground gases and the latest guidance must be consulted to determine whether the ground gas regime necessitates specific precautions during site works.

Basic radon protection measures are currently required for the proposed redevelopment on this site.

6.2. Remedial Objectives

The remediation objectives are to break the potentially active linkage between bulk ground gas from beneath the Site and the buildings or future Site users associated with the proposed development.

6.3. Proposed Foundation and Floor Slab Design

The proposed development is considered by Tier Environmental to fall within a Type B category as defined by BS8485: 2015. Guidance document BS8485:2015 describes a Type B building as the apartment block will be managed by a housing association:

"private or commercial property with central building management control of any alterations to the building or its uses but limited or no central building management control of the maintenance of the building, including the gas protection measures. Multiple occupancy. Small to medium size rooms with passive ventilation of rooms and other internal spaces throughout ground floor and basement areas. May be conventional building or civil engineering construction. Examples include managed apartments, multiple occupancy offices, some retail premises and parts of some public buildings (such as schools, hospitals, leisure centres) and parts of hotels."

As a result, gas protection measures with a minimum gas protection score of 3.5 would be required for a Characteristic Situation 2 – Low Risk scenario. As such it is recommended that the proposed development includes the emplacement of a retrofit gas resistant membrane above the existing ground floor/beneath the proposed insulation meeting all of the following criteria (2.0 points) which must be:

- Sufficiently impervious to the gases with a methane gas transmission rate $<40.0 \text{ ml/day/m}^2/\text{atm}$ (average) for sheets and joints (tested in accordance with BS ISO 15105-1 manometric method);
- Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;



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- Sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab);
- Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools etc);
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and
- Verified in accordance with CIRIA C735.

Tier Environmental has recommended that the site likely sits within Characteristic Situation 2. Based on the characterisation of the Site and the proposed conversion, it is concluded that the following gas protection measures would be appropriate:

- Good performance sub floor void (indicated by the exiting telescopic air vents around the periphery of the building) - 1.5 points
- A retrofit ground gas membrane - 2 points

This combination gives a gas protection guidance value of 3.5 which meets the required value of 3.5.

In order to achieve the 2 points score, the gas barrier will conform to the following criteria:

- Sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method);
- Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
- Sufficiently strong to withstand in-service stresses (e.g. settlement if placed below a floor slab);
- Sufficiently strong to withstand the installation process and following trades until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools, etc);
- Capable, after installation, of providing a complete barrier to the entry of the relevant gas.

In order to fully qualify for the 2 points, the membrane will be verified by Tier Environmental in accordance with CIRIA C735. The specification sheet for the membrane and the detailed design of the membrane are presented in the appendices. The gas membrane will be installed by a professional geomembrane installer with operatives who have or are working towards the NVQ Level 2 Qualifications in Gas Membrane Installation. The membrane is placed continually over the floor slab and it is strongly adhered to the brickwork of the peripheral walls (see appended example) and any penetrations using self-adhesive tape which it is considered to be a suitable method of preventing ground gas ingress into the building.

Where the ground floor level is to be raised around the base of the existing concrete staircase, the gas membrane will be strongly adhered to the staircase prior to the placement of the insulation and new floor screed.



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7. GROUND GAS VERIFICATION PLAN

7.1. General

An informed and risk-based approach has been taken as part of the verification plan, which has been produced to determine the following:

1. Decide which stakeholders are deemed suitable to undertake the necessary verification procedures;
2. How many site inspections should be undertaken; and,
3. The need for, and scope of, any integrity testing.

This risk-based system has taken into account the various factors that have influenced the scope of verification activities (including the possibility of integrity testing), which have included:

- Site-specific gas regime;
- Number of buildings to be inspected and the period over which this will take place;
- Complexity of the design and installation; and,
- Qualifications and experience of the workforce.

Figure 7.1 has been modified from CIRIA C735, with the red dots showing the relative placement of the site.

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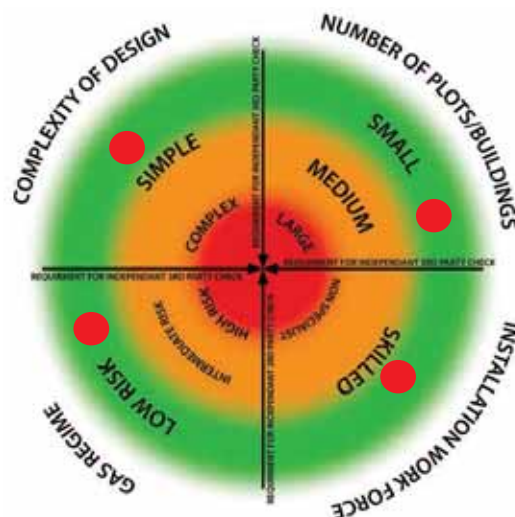


Figure 7.1 Analysis of the variables which have influenced the scope of the verification plan for this site.

7.2. Independence and Competence

In respect to the level of competence required in general ground remediation, the Environment Agency recommends that conflicts of interest in verification should be avoided. A contractor or gas membrane supplier certifying their own work or product is considered to be a conflict of interest and is therefore not good practice. If verification is carried out by the same company (or related company) that carried out the installation then the process, the results and report should be audited by an independent consultant.

The contractor that will be installing the gas protection measures is not known at this stage.

The verification will be undertaken by Tier Environmental Ltd.

7.3. The Inspection Regime

The gas membrane installation should be subject to a visual verification inspection to establish the adequacy of the ground preparation and, subsequently, possible damage to the installed gas membrane. The inspection visits should fall generally in line with the following:

1. The verifier should determine whether an area to be covered in a ground gas membrane is ready for inspection by initiating contact with contractor;
2. The verifier would then inspect all areas of interest with the site manager or groundworks supervisor;
3. The inspection will cover:
 - a. The ground prepared for the gas membrane which should be clean and free from stones, etc;
 - b. The installation of the membrane to an acceptable standard; and,



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- c. The membrane itself.
4. The verifier should also inspect the gas membrane itself over the whole floor area, paying particular attention to laps, edges and the sealing of service entries and penetrations such as vent pipes and pile caps;
 5. The visual inspection should be recorded on the Gas Protection Verification Pro Forma, as presented in Appendix E of this report;
 6. Any discrepancies with the installation method recommended by the gas membrane supplier should be highlighted. These may include small or large holes and rips, tears and punctures, absence of tape (double sided or single sided tape) on the lapped areas, loose or unstuck tape, inadequate corner details, and unbounded seams such as loose edges and 'fish mouths' in the gas membrane;
 7. Tapes used to join gas membranes should be inspected to make sure they are compatible with the gas membrane being joined and are as specified by the gas membrane supplier or specifier; non-proprietary gas resistant tape should never be used to seal a gas membrane. Where welded joints are used, the verifier should ensure they are correctly tested;
 8. Repairs should be instructed and observed on the same day as the site visit or inspected at a later date. This will be documented on the Gas Protection Verification Pro Forma for that visit. The frequency and intensity of inspections should increase to reflect any lower level of competence of the workers installing the gas protection system;
 9. As this membrane is located below the reinforced slabs, inspections should take place installation of the pressure relief pathway and before installation of the membrane and also before concreting. The concrete should then be poured as soon as possible after the gas membrane has been signed off, in order to ensure that follow-on trades do not damage a gas membrane that has been signed off; and,
 10. All follow-on trades should be made aware of the presence and purpose of the gas membrane and pressure relief pathway, and who they should contact if they believe their actions have had the potential to compromise it.

The final verification report will include photographs as supporting evidence. A pro forma should be completed for each inspection visit. All pro formas should be retained for inclusion within the final verification report in order to demonstrate the involvement of the verifier throughout the process and provide evidence of the appropriate installation of the gas protection measures. An example pro forma which highlights all aspects to inspect is provided in Appendix E of this report.

7.4. Inspection Timing and Frequency

There is currently no absolute guidance relating to the number and frequency of visits; however, for the purposes of this verification plan, reference has been made to table A1 within Annex 1 of CIRIA C735. Whilst at this stage it is not possible to give specific dates for inspection visits, the following rules should be adhered to when attending site to make the required visual inspection (relative to the site specific risks shown in Figure 7.1).

- Verifier to conduct a thorough verification (visual) inspection of the membrane and installation prior to between 50 and 75 per cent of concrete pours with inspections undertaken just prior to a concrete pour event. Inspection will be



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predominantly visual but may include the mechanical point stress test (this involves running a blunt instrument (e.g. a screwdriver) along the edge of the seam to identify any unbounded seams).

- The installer to supply sign off sheets (verification evidence) including photographs to the verifier for all other pours.

7.5. Integrity Testing

Consideration has been made to the use of integrity testing as part of the verification of the gas protection measures. In determining the requirement for integrity testing, reference has also been made to the diagram in Figure 7.1 and Table A1 of Annex 1 of CIRIA C735, the Site is Low Risk and the membrane is being inspected by a qualified geoenvironmental engineer. As such integrity testing is not currently recommended in this verification plan. It should be noted; however, that this is dependent upon the results of the initial verification visits. If, following these initial visits, it is deemed by the verifier that the installation is of a questionable standard, the use of integrity testing may be added to this verification plan. The results of any integrity testing must therefore be included in any final verification report.



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8. REGULATORY APPROVALS

The conclusions and recommendations presented above are considered reasonable based on the findings of the GIR. However, these cannot be guaranteed to gain regulatory approval and, therefore, the report should be passed to the appropriate regulatory authorities and/or other organisations for their comment and approval prior to undertaking any works on site.

It is recommended that conditions placed on any planning permission are discharged prior to commencement of site works.



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APPENDIX A - FIGURES AND DRAWING



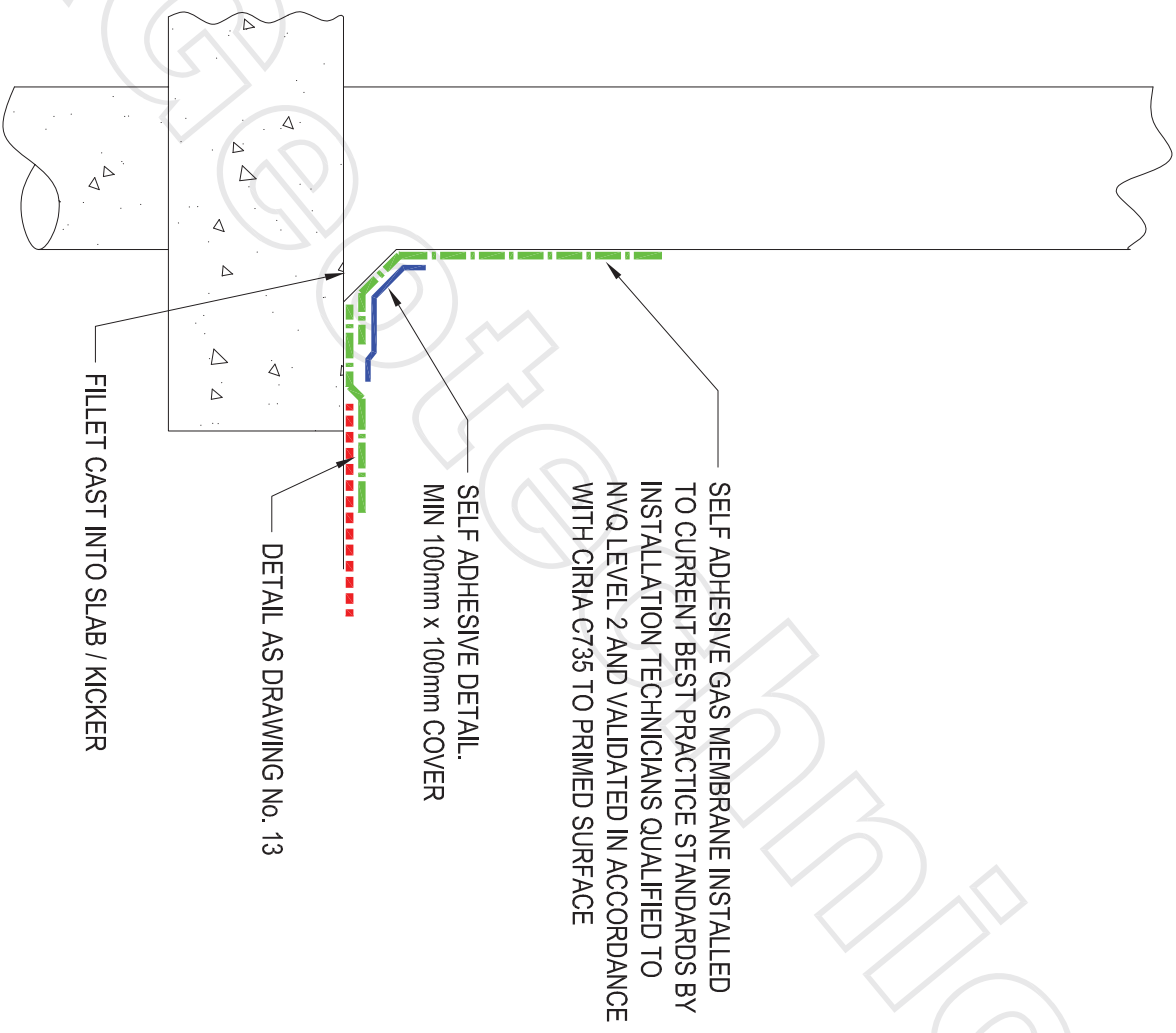
Site Location Plan

Contract Number	TE1085
Contract	New foundry Buildings, Wrexham
Client	Watkin Jones & Son



Reproduced from the Ordnance Survey 1:25,000 scale map with the permission of The Controller of Her Majesty's Stationary Office, © Crown Copyright. All rights reserved.

Scale	NTS	
Drawn by: NG	Approved: SL	
Drawing Number: TE1085PRA1		





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Comments

Site Address

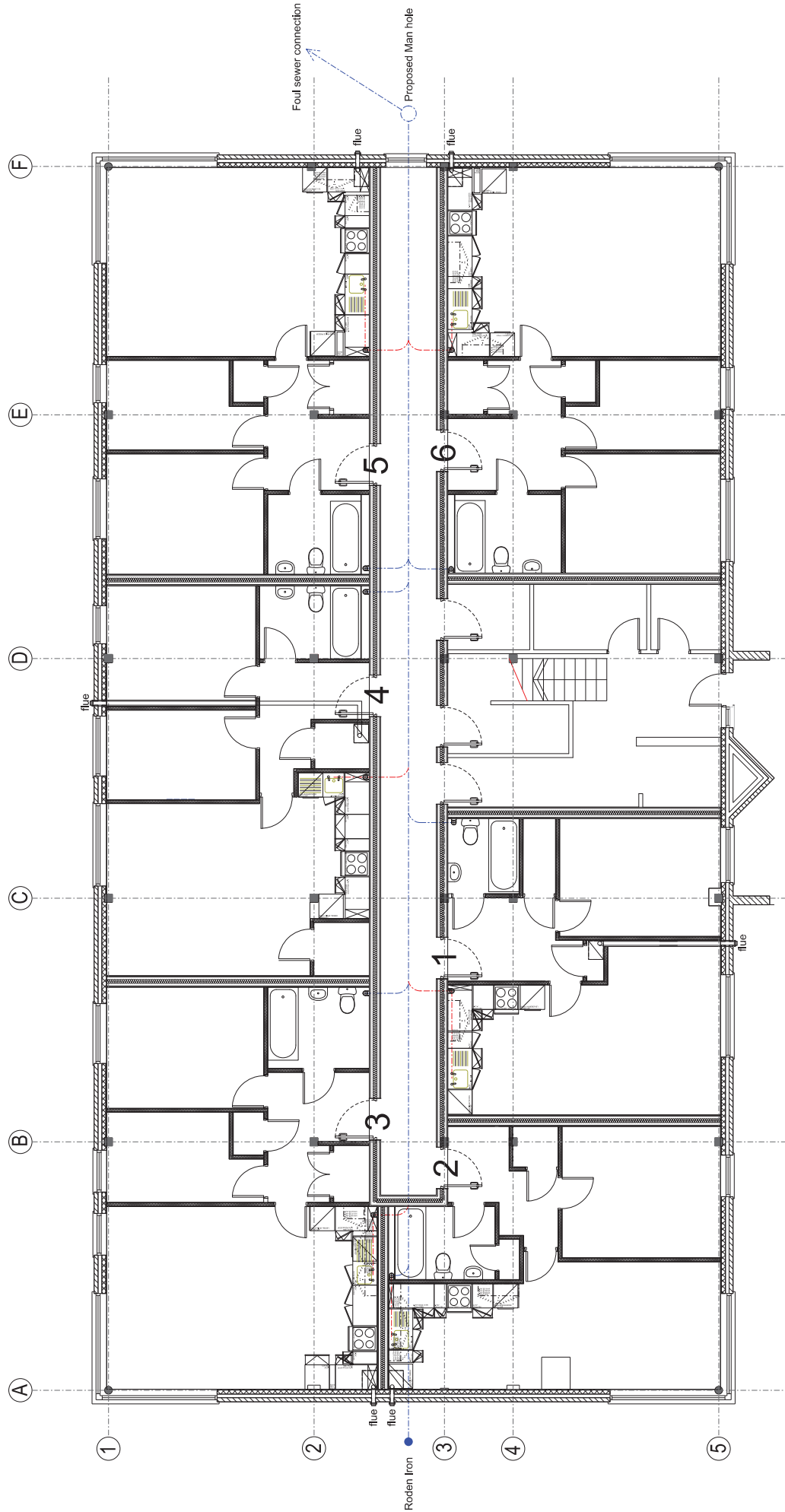
THIS DRAWING IS NOT TO SCALE.
USE DETAILED DIMENSIONS ONLY

Title:
**CONCRETE WALLS /
VERTICAL DETAIL**

Drawing No.:
PAG DETAIL No. 12

Date:
4th November 2016

Drawings are to be checked on site. Do not scale from drawings. Report discrepancies to the Architect.



See Foul and Surface Water Design Philosophy and Specification prepared by Thomasons. The contractor should undertake a pre and post construction CCTV condition survey of the existing drainage network within the roads for each phase. Copies of completed surveys are required prior to handover.

Copies of technical approvals should be provided to the client for information once received. All drainage approvals (for example; Section 106 connections, Section 104 adoptions or similar) must be provided to the Employer prior to completion / handover.

Any drainage requiring adoption must be formally adopted and onto maintenance prior to completion / handover.

The drainage scheme is to be constructed to meet the requirements of the Local Authority. The Contractor will be required to enter into an agreement with the Local Authority in the name of the Employer and pay all costs in connection therewith (excluding Employer's legal costs).

Surface water and foul drainage shall be constructed to the Building Control Officer's requirements.

Underground drainage is to be in accordance with the Engineer's design, which is to be submitted to the Examining authority for approval. Drainage runs are to be inspected and tested by the Building Control Officer prior to backfilling.

Existing drains are to be checked to determine whether the system is combined or separate foul and surface water. The Engineer is to confirm that there is adequate capacity to accommodate all new drainage that is required.

Drainage pipes are to be as detailed in Thomasons Design Philosophy and Specification to suit ground conditions. Fittings shall be standard fittings as the manufacturer's current catalogue.

The Contractor shall include for all works including establishing existing Invert levels and for any sewer / culvert diversions that may be required.

Land drainage shall be provided as necessary to adequately drain the site at all times.

Paved areas shall be provided with adequate surface water drainage to the satisfaction of the Building Control Officer.

Aco Drains
Where the footpath or driveway slope towards the building then the contractor should provide an Aco Drainage channel, connected into the surface water system. This should be avoided where possible.

See Foul and Surface Water Design Philosophy and Specification prepared by Thomasons. The contractor should undertake a pre and post construction CCTV condition survey of the existing drainage network within the roads for each phase. Copies of completed surveys are required prior to handover.

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Surface water and foul drainage shall be constructed to the Building Control Officer's requirements.

APPENDIX B - GLOSSARY OF TERMS

ACEC	Aggressive Chemical Environment for Concrete (classification)
aOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
Designated location	Site (and the ecosystem on that site) protected under national or international legislation. A potential ecological receptor to be considered as part of the assessment of land contamination. Example designated locations include SSSIs (q.v.), SACs (q.v.), national nature reserves, Ramsar sites and bird special protection areas.
DQA	Data Quality Assessment
DQO	Data Quality Objective
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
K _{ow}	Octanol-water partition coefficient
LEL	Lower Explosive Limit
LL	Liquid Limit
LoD	Limit of Detection (analytical)
LoQ	Limit of Quantification (analytical)
Mean Value Test	Statistical test (described in the CIEH Guidance) to estimate the mean value of a normally distributed population of data at a given level of confidence. Normally for contaminated land assessment, the 95th percentile (referred to as the 95%UCL or US95) is applied as a reasonable but conservative estimate of the mean concentration for comparison with the relevant assessment criteria.
Maximum Value Test	Statistical test (described in the CIEH Guidance) to identify whether an elevated concentration within a normally distributed data set forms part of the underlying population from which it has been sampled or whether it is an outlier (such as a localised area of contamination) that merits further consideration.
MC	Moisture Content
NGR	National Grid Reference
NIHHS	Notification of Installations Handling Hazardous Substances (regulations)
OS	Ordnance Survey
PI	Plasticity Index
PID	Photoionisation Detector
PL	Plastic Limit
ppm	Parts per million
ppmv	Parts per million by volume
QA	Quality Assurance
QC	Quality Control
SAC	Special Area of Conservation
SOM	Soil Organic Matter
SPT	Standard Penetration Test
SPZ	Source Protection Zone
SSAC	Site-Specific Assessment Criterion
SSSI	Site of Special Scientific Interest
SVOC	Semi-Volatile Organic Compound

TEF	Toxicity Equivalent Factor
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
US95	95 th percentile estimate of the true mean value of a data population (also known as 95%UCL).
VOC	Volatile Organic Compound

APPENDIX C - DEFINITIONS OF TERMS USED IN QUALITATIVE AND QUANTITATIVE RISK ASSESSMENTS

For the qualitative and quantitative assessment of risks posed by potential pollutant linkages have been undertaken using the risk matrix adapted from CIRIA C552 and outlined in the table below.

	Category	Definition
Potential severity	Severe	Acute (short term) risk to human health, Major pollution of sensitive controlled waters, ecosystems or habitat. Catastrophic damage to buildings or property or crops.
	Medium	Chronic (Medium / long term) risk to human health Pollution of sensitive controlled waters, ecosystems or species, Significant damage to crops, buildings or structures
	Mild	Easily preventable permanent health effects on humans. Pollution of non-sensitive controlled waters. Minor damage to buildings or structures.
	Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soil. Easily repairable damage to buildings or structures.
Probability of risk	High Likelihood	Pollutant linkage may be present and the risk is almost certain to occur, or there is evidence of harm already occurring.
	Likely	Pollutant linkage may be present and it is probable that the risk will occur over the long term.
	Low Likelihood	Pollutant linkages may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
	Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

		Potential Severity			
		Severe	Medium	Mild	Minor
Probability of risk	High Likelihood	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

APPENDIX D - CHEMICAL TEST SAMPLING

Samples were selected by a representative of Tier Environmental during the site investigation works in accordance with the sampling approach described elsewhere in this report.

Samples for chemical analysis

All samples for chemical analysis were placed into clean new containers as summarised in Table 1. Unless explicitly stated elsewhere in this report, no preservatives were used to eliminate the risk that preservatives cause contaminant dissolution or analytical interference. Containers for VOC analysis were fully filled to exclude headspace.

Soil samples were dispensed as soon as possible after collection using reusable stainless steel spatulas, trowels or similar implements.

Ground water samples were collected from boreholes using single-use Teflon bailers or dedicated Waterra tubing with foot valves, except as otherwise noted within this report. Caution was taken to avoid excessive agitation during collection

New disposable gloves were used by the engineer for the collection of each sample.

Reusable equipment was washed down with distilled or deionised water between samples, except where tarry or similarly sticky materials were present. In such cases specific cleaning procedures were adopted as specifically described elsewhere in this report.

All sub-samples taken for chemical analysis were placed into refrigerators or cool boxes containing frozen ice packs immediately after aliquoting. All samples were transferred in cool boxes containing frozen ice packs to the relevant UKAS/MCERTS accredited laboratory as soon as possible. Recommended maximum holding times before analysis are summarised in Table 1.

Table 1. Sample containers and holding times.

Analysis	Container/special requirements	Max. holding time at 4°C before analysis
Soil and sediment samples		
VOCs	30-60 g brown or green glass jar with VOC-resistant cap and inert cap liner. <i>Must be fully filled.</i>	14 days
TPHCWG	30-60 g brown or green glass jar with VOC-resistant cap and inert cap liner PLUS 250-500 g brown or green glass jar with unwaxed cap liner. ¹ <i>The former must be fully filled.</i>	14 days
All other organics	250-500 g brown or green glass jar with unwaxed cap liner.	7 days
Inorganics	Air-tight 0.5-2.0 kg plastic container (250-500 g brown or green glass jar may also be used).	14 days ²
Water samples		
VOCs	40-50 ml glass vial with VOC resistant screw cap and inert liner. <i>Must be fully filled.</i>	14 days
TPHCWG	40-50 ml glass vial with VOC resistant screw cap and inert liner PLUS 500-1000 ml brown or green glass bottle with screw cap and unwaxed liner. ¹ <i>The former must be fully filled, the latter should be filled if possible.</i>	14 days
All other organics	500-1000 ml brown or green glass bottle with screw cap. <i>Fill if possible.</i>	7 days
Inorganics	500-1000 ml translucent or opaque screw cap plastic or brown or green glass bottles. <i>Fill if possible.</i>	14 days ³

¹ The smaller vessel is used for analysis of the volatile components within the TPH mixture and the larger one is for the non-volatile components.

² 14 days is set as a reasonable limit for all routine analyses of soil for those inorganic components vulnerable to chemical and/or biological breakdown. Samples for sulphate analysis are vulnerable to biological sulphate-reduction but can be held for up to 28 days. For total metals, a holding period of up to 6 months is acceptable.

³ 14 days applies for all routine analyses of most inorganic components that may be vulnerable to chemical and/or biological reactions. In the specific cases of sulphide, nitrite, nitrate and phosphate analyses, storage time must not exceed 48 hours. For total metals, a holding time of up to 6 months is acceptable.

Tier Environmental standard analytical suites

The analyses included with Tier Environmental's standard analytical suites for soil, soil leachate and water samples are presented in Table 2. Other individual analyses were specified as described within this report.

Table 2. Tier Environmental Standard Analytical Suites.

Parameter	Sample type					
	Soil		Leachate ¹		Water	
		LoD ² (mg/kg or as stated)		LoD (µg/l or as stated)		LoD (µg/l or as stated)
Metals and metalloids						
Arsenic	✓	1	✓	10	✓	10
Cadmium	✓	1	✓	5	✓	5
Chromium	✓	1	✓	5	✓	5
Mercury	✓	1	✓	1	✓	1
Lead	✓	1	✓	4	✓	4
Selenium	✓	2	✓	10	✓	10
Copper	✓	1	✓	1	✓	1
Nickel	✓	1	✓	50	✓	50
Zinc	✓	1	✓	8	✓	8
Other inorganics						
Ammonia (as NH ₄ -N)					✓	15
Total sulphate	✓	100			✓	50 mg/l
Water-soluble sulphate	✓	0.1 g/l				
Hardness (as CaCO ₃)					✓	1 mg/l
Organics						
Monohydric phenol	✓	1	✓	0.5	✓	0.5
Speciated PAHs (USEPA 16)	✓	0.1	✓	0.01	✓	0.01
Total Organic Carbon	✓	0.1 wt%				
Others						
Electrical conductivity					✓	NA
pH	✓	NA	✓	NA	✓	NA

NA - Not applicable

1 Leachate preparation according to NRA (1994), 10:1 liquid to solid ratio.

2 The table presents the desired limit of detection for the analysis. Higher LoDs may be reported on analytical data sheets due to interference between analytes within specific samples or if the laboratory needed to dilute samples to achieve results within the calibrated range for that instrument.

Analytical QA procedures

Introduction

Quality Assurance (QA) is a system of review and audit that assesses the effectiveness of that product and assures the producer and user that defined standards of quality have been met. If we consider site investigation and chemical analysis, QA is the management system that ensures these measures are in place and working as intended.

QA within the laboratory form part of relevant certification programmes (such as UKAS and MCERTS) and, indeed, will be undertaken in some form by any reputable analyst, whether for a certified technique or not. Laboratory QA/QC is beyond the control of Tier Environmental and will not be considered further in this document, although the relevant laboratory documentation can be obtained upon request. QA must also form part of the design and execution of a site investigation.

Two parameters often used to assess measurement quality objectives are bias and precision. Bias is a systematic deviation in the data. For example, a positive bias (concentrations higher than in reality) would be introduced if sampling bottles were a source of the analyte and this fact was unknown. Precision is the variation in the measurements around a central 'expected' value. This could be due both to real variability in the environmental medium being measured and random errors in the analytical process. Both precision and bias can be assessed by the use of appropriate blanks and replicates within the site investigation programme.

The objectives of the QA activities undertaken in this present site investigation were to recognise and quantify systematic bias within the analytical dataset and to obtain an indication of precision. In environmental samples, much of the observed variability is likely to result from heterogeneity in the sampled medium, particularly for soil and sediment samples.

Such QA practice within the sampling programme is required by current guidance (e.g., Environment Agency report P5-065/TR (2000); Environment Agency LFTGN02 (2002); BS 10175:2001).

Alternative QA procedures to the generic approach presented in this appendix may be specified for a project, provided case-specific justification is given.

QA checking procedure (data validation)

The responsible Engineer and Project Reviewer are required to undertake data validation and provide comment on data quality within the main body of the report(s) issued, when noteworthy matters arise. This QA checking should involve:

- Confirming that data reported by the laboratory have achieved the standards specified by the certification scheme (MCERTS or UKAS). This will be indicated on the analytical certificates issued by the laboratory.
- Checking that the limit of detection (LoD) and limit of quantification (LoQ) achieved by the laboratory for an individual analyte is appropriate for the purposes of the report. LoD and LoQ will vary dependent upon analyte concentrations, sample matrix properties and interference from co-contaminants.
- A check that the reported range of concentrations are reasonable for the analyte. For example, the dissolved concentration of an analyte in a water sample should not exceed saturation. If it does, then this merits further consideration (e.g., was colloidal organic matter or other solid-phase material present or could there have been unobserved free-phase organic liquid?) and explicit comment. At its simplest, there may be a unit error.

- Where analysis involves reporting of Tentatively Identified Compounds (TICs; normally by mass spectrometry), the reviewers should check that these might reasonably be expected at the site under consideration. The uncertainties in identification by MS mean that it is not uncommon that TICs are incorrectly assigned. In cases of doubt, the analytical laboratory can re-check the raw data and confirm.
- A review of the analytical precision by comparing data obtained for duplicate samples. There is no absolute threshold - variability is entirely dependent upon the sample matrix and manner in which the contaminant has entered the sample. Variability that cannot reasonably be assigned to such factors (for example a very high apparent variability in data for sediment-free water samples) should be reviewed with the laboratory. Variability that is attributable to the sample matrix can nevertheless provide important pointers to improve understanding of contaminant transport pathways and the risks posed by pollutant linkages (e.g., soil heterogeneity, the association of contamination with particular soil fractions, the presence of residual NAPL within soil pores or the role of suspended sediments in contaminant transport).
- Confirmation that no errors have been introduced by data transcription, unit conversion or corrections between preliminary and certificates issued by the laboratory. The reviewer should audit a proportion (typically 5-10%) of all data from the original (final) certificates of analysis through to the equivalent values in the report for those specific samples.

It is important to consult the analytical laboratory if apparent QA issues arise. Many apparent concerns can be adequately resolved on the basis of revisiting the raw analytical data or by obtaining a better understanding of the inherent limitations of the analysis for a particular matrix or sample type.

APPENDIX E - GAS MEMBRANE DATASHEET

PAG HC 400

7 layer Gas barrier , fPE and EVOH, Green/Silver

TEST	UNIT		TEST METHOD
Thickness at 2kPa	mic	400 $\pm$ 5 %	
Mass per unit	g/m ²	376	EN 1849-2
Tensile Strength at break MD	N/mm	27 $\pm$ 5 %	EN ISO 527/1/3/5
Tensile Strength at break CMD	N/mm	27 $\pm$ 5 %	EN ISO 527/1/3/5
Elongation at beak MD	%	750 $\pm$ 5 %	EN ISO 527/1/3/5
Elongation at beak CMD	%	850 $\pm$ 5 %	EN ISO 527/1/3/5
Tear resistance MD	N	40 $\pm$ 5 %	EN ISO 34-1
Tear resistance CMD	N	40 $\pm$ 5 %	EN ISO 34-1
Puncture resistance	N	140 $\pm$ 5 %	ASTM D4833
O ₂ Permeability	ml/m ² x day at 1 bar	5 $\pm$ 10 %	ASTM D 1434
Methane Permeation	cm ³ (STP)m ² day ¹ atm ¹ *	< 12	ISO 15105-1
Fuel Vapour transmission Rate			
Unleaded Petrol	/mol/(m ² .s.Pa)	3.45 x10E-13 avg	EN ISO 15105-2
Diesel	/mol/(m ² .s.Pa)	3.45 x10E-13 avg	EN ISO 15105-2
Width	M	2	
Length	M	25	
Classification	Moisture Barrier Type A – EN 13967		
			

*a measurement in cm³(STP)m²day¹atm¹ is directly equivalent to one in ml/day/m²/atm

Jan 2017







APPENDIX F - GAS MEMBRANE VERIFICATION PRO FORMA



VISUAL INSPECTION OF GAS PROTECTION MEASURES

VISIT: 1 of 4

Site name:	[Keywords]	Gas characteristic situation:	[Category]
Job number:	[Company]	Type of development and building:	[Company Address]
Date:		Building description:	[Manager]
Visit by:		Foundation type:	[Status]
Weather:		Gas protection type:	[Subject]

No.	Item	Comments
1 Gas membrane		
1.1	Condition of sub-grade and/or underside of gas membrane	
1.2	Gas membrane type	
1.3	Gas membrane condition	
1.4	Joining tape product	
1.5	Lapping design	
1.6	Laps, welds and joint seals	
1.7	Service entries seals	
2 Passive venting		
2.1	Sub-floor void	
2.2	External wall airbricks	
2.3	Internal sleeper walls	
2.4	External vent trenches/ducts	
3 Active venting		
3.1	System details	
Additional notes:		

Photographs

No.	Description

The gas protection measures inspected are:	
--	--

Name:

Signature:

Date:



VISUAL INSPECTION OF GAS PROTECTION MEASURES

VISIT: 2 of 4

Site name:	[Keywords]	Gas characteristic situation:	[Category]
Job number:	[Company]	Type of development and building:	[Company Address]
Date:		Building description:	[Manager]
Visit by:		Foundation type:	[Status]
Weather:		Gas protection type:	[Subject]

No.	Item	Comments
1	Gas membrane	
1.1	Condition of sub-grade and/or underside of gas membrane	
1.2	Gas membrane type	
1.3	Gas membrane condition	
1.4	Joining tape product	
1.5	Lapping design	
1.6	Laps, welds and joint seals	
1.7	Service entries seals	
2	Passive venting	
2.1	Sub-floor void	
2.2	External wall airbricks	
2.3	Internal sleeper walls	
2.4	External vent trenches/ducts	
3	Active venting	
3.1	System details	
Additional notes:		

Photographs

No.	Description

The gas protection measures inspected are:	
--	--

Name:

Signature:

Date:



VISUAL INSPECTION OF GAS PROTECTION MEASURES

VISIT: 3 of 4

Site name:	[Keywords]	Gas characteristic situation:	[Category]
Job number:	[Company]	Type of development and building:	[Company Address]
Date:		Building description:	[Manager]
Visit by:		Foundation type:	[Status]
Weather:		Gas protection type:	[Subject]

No.	Item	Comments
1	Gas membrane	
1.1	Condition of sub-grade and/or underside of gas membrane	
1.2	Gas membrane type	
1.3	Gas membrane condition	
1.4	Joining tape product	
1.5	Lapping design	
1.6	Laps, welds and joint seals	
1.7	Service entries seals	
2	Passive venting	
2.1	Sub-floor void	
2.2	External wall airbricks	
2.3	Internal sleeper walls	
2.4	External vent trenches/ducts	
3	Active venting	
3.1	System details	
Additional notes:		

Photographs

No.	Description

The gas protection measures inspected are:	
--	--

Name:

Signature:

Date:



VISUAL INSPECTION OF GAS PROTECTION MEASURES

VISIT: 4 of 4

Site name:	[Keywords]	Gas characteristic situation:	[Category]
Job number:	[Company]	Type of development and building:	[Company Address]
Date:		Building description:	[Manager]
Visit by:		Foundation type:	[Status]
Weather:		Gas protection type:	[Subject]

No.	Item	Comments
1	Gas membrane	
1.1	Condition of sub-grade and/or underside of gas membrane	
1.2	Gas membrane type	
1.3	Gas membrane condition	
1.4	Joining tape product	
1.5	Lapping design	
1.6	Laps, welds and joint seals	
1.7	Service entries seals	
2	Passive venting	
2.1	Sub-floor void	
2.2	External wall airbricks	
2.3	Internal sleeper walls	
2.4	External vent trenches/ducts	
3	Active venting	
3.1	System details	
Additional notes:		

Photographs

No.	Description

The gas protection measures inspected are:	
--	--

Name:

Signature:

Date:

