

Remediation Statement & Validation Proposal Sheets

To be approved by Durham County Council

Project reference: 22-288

Site: Proposed Residential Development – Former Highwayman Public House, Twizell Lane, West Pelton, DH9 6SG

Carried out by Darren McGrath



Section A – Site Investigation Works

This Remediation Statement should be read in conjunction with the following reports produced for the site:

- o Geo-Environmental Assessment Report, Ref. 11-117, Arc Environmental Ltd., July 2011
- o Hazardous Ground Gas Risk Assessment Addendum Report, 11-117.03L, Arc Environmental Ltd., November 2011

Section B - Summary of Site Investigation & Risk Assessments:

Ground Contamination Risk Assessment

When considering the ground investigation works were carried out in 2011, this would normally result in an updated ground contamination risk assessment being required in accordance with current guidance. However, as no change in the site has occurred from 2011 up until present day with the site remaining unchanged with regards to existing surfacing, usage (vacant land), etc., it is felt that the results of the previous intrusive investigation works are applicable with regards to the required remediation of the site.

From the previous works carried out, made ground has been recorded to depths of between c.0.50m to c.1.75m below current ground levels, generally comprising initial site surfacing of either tarmac or crushed concrete, brick and dolomitic stone overlying disturbed natural strata with anthropogenic debris (ash, brick, concrete, etc.). It should be noted that the deeper zone of made ground around the location of TP10 is likely to be associated with an infilled cellar when considering this location is within the footprint of the former Public House and concrete was recorded at the base of the excavation.

The underlying natural drift deposits were variable, comprising soft, firm and stiff sandy gravelly clays, very loose through to dense gravelly sand and clayey sandy gravel, recorded to depths of between c.1.50m to c.4.45m below current ground levels.

From the results of the contamination screening, 'hot spots' of Benzo(a)pyrene & Dibenz(ah)anthracene were recorded within the made ground at the locations of BH04 & TP01 respectively which represent a potential risk to human health where exposure pathways are available. However, when considering the LQM CIEH Generic Assessment Criteria (Residential –2nd Edition, 2009) values used at the time of the completion of the report, these were updated in August 2015. As a result, the 'hot spot' of Benzo(a)pyrene previously recorded at the location of BH04 is no longer considered a 'hot spot' and no further assessment will be required. In addition, following discussions with the client the location around BH04 will be raised by at least c.0.60m to create a level garden area which will further negate any risk. However, the 'hot spot' of Dibenz(ah)anthracene at the location of TP01 remains a 'hot spot' following these updated values and will therefore require remediation.

Hazardous Ground Gas Risk Assessment

The results of the hazardous ground gas monitoring show the presence of hazardous ground gas does not exceed the GSV assessment value of 0.07 l/hr. (Characteristic Situation 1), indicating that no gas protection measures would be required for the proposed development.

However, since the maximum Carbon Dioxide concentration exceeds the action trigger level of 5%, the CIRIA 665 guidance recommends an increase in the characteristic situation by an order of 1 to take into account the gas concentrations recorded. As such, it is felt that an appropriate determination for this site would be to place the site within Characteristic Situation 2 (CS2) or Amber 1 (NHBC Traffic light system), Therefore, appropriate gas protection measures will need to be implemented within the building design to negate against any risks to future end users, in accordance with BS8485:2015 + A1:2019.

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Section C - Remediation Strategy:

Removal of Impacted soils around TP01

To remove the dermal contact and ingestion *pathways* for the proposed end users from the elevated level of Dibenz(ah)anthracene, it is proposed to remove the impacted made ground material (c.0.50m depth) and place on the southern portion of the site (i.e. area to be raised by c.0.60m to create a level garden). This will remove the source-pathway-receptor pollutant linkage and will no longer be a potential risk to the end users.

Provision of Gas Protection Measures

The site has been characterised as a CS2 / Amber 1 classification for gas protection measures. In accordance with BS8485:2015 + A1:2019 'Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings', the proposed residential property has been assessed as a Type A building (Table 3) and therefore the gas protection measures should meet a minimum gas protection score of **3.5 points** (Table 4).

Section D - Implementation of Remediation Strategy

Removal of Impacted soils around TP01

The following actions will need to be completed to comply with the proposed Remediation Strategy:

- To remove the impacted made ground materials from around TP01, they will need to be excavated by a dedicated mechanical excavator (i.e. Backhoe Excavator or 360° Tracked Excavator) down to the natural deposits. The soils will be placed below the south portion of the site (i.e. area to be raised by c.0.60m).
- Samples from the completed excavation(s) will be taken to allow validation laboratory testing to be undertaken. The results should be compared to appropriate and current Level 1 Risk Assessment Values for a *Residential* end-use, and at least 7 working days should be allowed between samples being taken and confirmation being provided by Arc Environmental Ltd. that the remediation works have been satisfactorily completed, prior to excavations being backfilled (if necessary).
- During all the remedial works, care should be taken to avoid any potential cross-contamination. Consequently, plant should be cleaned following contact with impacted materials (i.e. buckets).
- Validation works will comprise site attendance, photographic records and validation sampling to confirm that all impacted soils which potentially poses a significant risk have been removed and replaced below c.0.60m of clean imported soils, with these works and the results compiled within a Validation Report following the completion of these works.
- The excavation will be backfilled with site won materials which have been tested as part of the Ground Investigation Works and deemed suitable for reuse.

Implementation of Gas Protection Measures

To achieve the required gas protection score, a combination of protection elements taken from Tables 5, 6 & 7 (contained within BS8485) should be implemented.

Table 5 –Structural Barrier –Depending upon the foundation type, floor used and the quality of the design & construction, a number of points can be achieved, for example provision of an insitu cast reinforced concrete slab (ground bearing or suspended) will achieve between 0.5 & 1.5 points and a raft can achieve **1.5 points**. It should be noted that a suspended block and beam floor will be achieve 0 points and therefore alternative measures from Tables 6 & 7 will need to be adopted.

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Section D - Implementation of Remediation Strategy (Cont'd)

Implementation of Gas Protection Measures (Cont'd)

Table 6 –Ventilation Protection Measures –Where sub-floor ventilation is provided this should comprised either a min. 150mm clear void, void former blanket or gas drains, with ventilation from the sub-floor ventilation through the internal wall to the external wall using telescopic swan neck vents with air bricks providing 1500mm²/m run void ventilation spaced at maximum 2.0m centres will achieve **1.5 points**. In addition, cross ventilation will need to be incorporated into sleeper walls / party walls.

Table 7 –Gas Resistant Membrane - The final element of the gas protection measures is the provision of a suitable gas resistant barrier membrane, which should comply with the criteria listed in Table 7. There is also the requirement for the verification of the gas barrier membrane installation, undertaken in accordance with CIRIA C735. The implementation of gas resistant barriers will achieve **2.0 points**. Notes on the installation of gas barrier membranes is given below;

- The performance of the gas barrier membrane is dependent on the quality and design of the installation, and therefore guidance suggests that suitably qualified and experienced contractors (holding an NVQ Level 2 qualification in gas protection installation) should carry out the construction / installation of the gas barrier membrane.
- The gas barrier membrane will need to be installed in accordance with the manufacturer's details.
- The membrane should be installed in a logical sequence across the footprint of the building, to achieve a minimum number of joints. A minimum overlap of 150mm is recommended where membranes sections are joined together. A combination of thermal welding and butyl double-sided jointing tape can be used for joining gas barrier membranes together. The top lapped edges, where the membrane has been jointed using double-sided jointing tape, should be further protected by the application of gas resistant self-adhesive membrane, to prevent dirt and moisture ingress.
- Where steel stanchions and service entries / ducts penetrate the floor construction these should be suitable sealed, using a pre-formed top-hat or wrapped in gas resistant self-adhesive membrane. Where ducts are used to feed in services, the top of the duct and service should be appropriately sealed, using either closed celled foam inside the duct and / or appropriate gas resistant products (i.e. gastite tape or GR SAM) wrapped around the duct and service.
- Following validation of the gas barrier membrane, it is the responsibility of the main contractor / groundworks contractor to protect the gas barrier membrane from damage by follow-on trades or during the construction of subsequent final floor layers, in order to maintain the integrity of the gas barrier membrane.

It has been confirmed by the client a suspended floor slab with a 150mm clear void and telescopic swan neck vents will be used within the proposed development.

Design drawings will be provided showing the proposed installation / construction of the protection measures to be adopted and it is understood that a Visqueen Gas Barrier Membrane and associated Visqueen Products will be used. The design drawings will be reviewed to ensure they meet the BS8485 guidance and this Remediation Strategy.

Importation of Soils to Create Level Garden

Any materials brought on to site, including topsoil and subsoil (stone), for use in areas of soft landscaping should be suitably screened and tested for human health assessment prior to delivery, with these results sent to ARC a minimum of 1 week before delivery to site. To confirm the suitability of these materials, validation testing will be required following emplacement and / or importation onto site.

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Section D - Implementation of Remediation Strategy (Cont'd)

Unforeseen Contamination

It should be noted that if during the site strip / remediation works any visual and / or olfactory evidence of unidentified or unforeseen potentially contaminated materials are identified then the site should notify Arc Environmental as soon as it is possible to allow for further sampling and screening to be undertaken. Details of the appropriate course of action undertaken to deal with these materials will be provided to the Local Authority, prior to carrying out any additional remediation works, if required.

Section E: Validation of Remediation Strategy:

Validation of Removal of Made Ground Around TP01

Validation works will comprise site attendance and sampling, to confirm that all the impacted made ground material around the location of TP01 which potentially pose a risk has been replaced within the south portion of the site within the area to be raised to create a level garden area, and to verify that residual materials do not represent a potential risk to Human Health.

The results of the validation screening should be compared to appropriate and current Level 1 Risk Assessment Values for a *Residential* end use, and the results compiled within the final Validation Report following the completion of the remediation works.

Validation of Gas Protection Measures

For this site, the implementation of CS2 / Amber 1 gas protection measures must be witnessed, photographed and validated by an experienced and suitably qualified Engineer to ensure that all works are being completed in strict accordance with this Remediation Strategy, the proposed design details, BS8485 & CIRIA C735.

Each site visit should validate the construction and emplacement of each element of the gas protection measures within the proposed building plots, as well as confirming that all installation requirements have been met. Typical inspection should follow the criteria set out in CIRIA C735, and the procedure for inspection / validation of the gas protection measures is outlined below;

- The verification of each residential property will be recorded visually using the proforma outlined in Appendix A5 of CIRIA C735 to verify that the works have been carried out in full accordance to the submitted design drawing and product specifications.
- The visual inspection will be accompanied by a full photographic record. The inspected / photographic record will include (as a minimum) the verification of the following construction details:-
 - Passive sub-floor dispersal ventilation: Inspection of sub-floor ventilation, presence of cross ventilation in sleeper / party walls and installation of telescopic swan-neck vents.
 - External wall vents: to assess the number and size of telescopic swan-neck vents and airbricks around the perimeter of the building, including spacing of side ventilation, and to assess the vents are free from debris and extend beneath the gas protection membrane into the passive sub-floor dispersal ventilation below the floor slab.
 - Construction of structural barrier: confirmation of the construction of any insitu cast reinforced concrete slabs / rafts.
 - The underside of the gas barrier membrane: to assess that no uneven / rough surfaces are present.
 - Gas barrier membrane type: full product / manufacturers specification, gauge, colour, batch/roll number.

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Section E: Validation of Remediation Strategy (Cont'd):

Validation of Gas Protection Measures (Cont'd)

- Gas barrier membrane condition: to assess that there are no punctures, tears, rips or other defects to the membrane.
- Joining tape: to assess product type, brand, thickness, material, width and colour.
- Lapping design: to assess whether joints are lapped and sealed in accordance with the manufacturer's specifications (including double taping and correct overlapping)
- Service entries: to assess whether service entries have been appropriately sealed i.e. assessing top hat arrangements with the use of Jubilee clips, use of GR SAM and sealing of ducts used for service feeds.

The completed inspection record sheets will be submitted to the LA within the final Validation Report along with the product specification / datasheets.

Validation of Imported soils

Validation screening will be undertaken on all materials brought onto site for the areas of soft landscaping to ensure they are suitable for use. The number of samples screened will be dependent upon the final volumes brought to site and the origin of the imported materials. We would propose to adopt the Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) 'Verification Requirements for Cover Systems', Ver 4.1 June 2021, (See Table 1 below) sampling frequency as follows:

Table 1 - Verification Requirements for Cover Systems', Ver 4.1 June 2021 - Sampling Frequency

Type	Number of Samples	Testing Schedule	Assessment Criteria
Virgin quarried material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr, Cr (VI), Cu, Hg, Ni, Pb, Se & Zn)	This needs to be agreed with the Local Authority. The Assessment criteria needs to be UK based, e.g. LQM, S4UIs, Defra C4SLs or other similarly derived GACs.
Crushed hardcore, stone, brick (excluding asphalt)	Minimum 1 per 500m ³ .	Standard metals/metalloids (as above) PAH (16 USEPA specification) Asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	
Greenfield soils / manufactured soils	Minimum 3. Dependant on source and receptor, between 1 per 50m ³ and 1 per 250m ³ (whichever is greater).	Standard metals/metalloids (as above) PAH (16 USEPA specification) Asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).	
Brownfield soils / screened soils	Minimum 6 Dependant on source and receptor, between 1 per 50m ³ and 1 per 100m ³ (whichever is greater).	Standard metals/metalloids (as above) PAH (16 USEPA specification) TPH (CWG banded) Asbestos, Ph and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).	

Prior to delivery the Main Contractor will be responsible for providing screening results of any imported materials to site, to verify that they meet the criteria given in Table 2. These results should be passed onto Arc Environmental a minimum of 1 week prior to delivery and should not be more than 2 months old.

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Section E: Validation of Remediation Strategy (Cont'd):

Validation of Imported soils (Cont'd)

Table 2: Assessment Criteria for Imported Soils

Analyte	Critical Conc. (Cc) mg/kg			Analyte	Critical Conc. (Cc) mg/kg		
	1% SOM	2.5% SOM	6% SOM		1% SOM	2.5% SOM	6% SOM
Metals/Metalloids				Speciated PAH's (Cont'd)	1% SOM	2.5% SOM	6% SOM
Arsenic	37 ⁽¹⁾			Benzo(a)anthracene	7.2 ⁽¹⁾	11 ⁽¹⁾	13 ⁽¹⁾
Cadmium	11 ⁽¹⁾			Benzo(a)pyrene	2.2 ⁽¹⁾	2.7 ⁽¹⁾	3.0 ⁽¹⁾
	pH 5.0-6.0	pH 6.0-7.0	pH >7.0	Benzo(b)fluoranthene	2.6 ⁽¹⁾	3.3 ⁽¹⁾	3.7 ⁽¹⁾
	3.0 ⁽⁵⁾	3.0 ⁽⁵⁾	3.0 ⁽⁵⁾	Benzo(ghi)perylene	320 ⁽¹⁾	340 ⁽¹⁾	350 ⁽¹⁾
Chromium III	910 ⁽¹⁾			Benzo(k)fluoranthene	77 ⁽¹⁾	93 ⁽¹⁾	100 ⁽¹⁾
	pH 5.0-6.0	pH 6.0-7.0	pH >7.0	Chrysene	15 ⁽¹⁾	22 ⁽¹⁾	27 ⁽¹⁾
	400-600 ⁽⁵⁾	400-600 ⁽⁵⁾	400-600 ⁽⁵⁾	Dibenz(ah)anthracene	0.24 ⁽¹⁾	0.28 ⁽¹⁾	0.3 ⁽¹⁾
Chromium VI	6 ⁽¹⁾			Fluoranthene	280 ⁽¹⁾	560 ⁽¹⁾	890 ⁽¹⁾
Copper	2,400 ⁽¹⁾			Fluorene	170 ⁽¹⁾	400 ⁽¹⁾	860 ⁽¹⁾
	pH <6.0	pH 6.0-7.0	pH >7.0	Indeno(123cd)pyrene	27 ⁽¹⁾	36 ⁽¹⁾	41 ⁽¹⁾
	<100 ⁽⁴⁾	<135 ⁽⁴⁾	<200 ⁽⁴⁾	Naphthalene	2.3 ⁽¹⁾	5.6 ⁽¹⁾	13 ⁽¹⁾
Lead	200 ⁽²⁾			Phenanthrene	95 ⁽¹⁾	220 ⁽¹⁾	440 ⁽¹⁾
Mercury	40 ⁽¹⁾			Pyrene	620 ⁽¹⁾	1,200 ⁽¹⁾	2,000 ⁽¹⁾
	pH 5.0-6.0	pH 6.0-7.0	pH >7.0	Speciated TPH	1% SOM	2.5% SOM	6% SOM
	1.0-1.5 ⁽⁵⁾	1.0-1.5 ⁽⁵⁾	1.0-1.5 ⁽⁵⁾	Aliphatic EC5-EC6	42 ⁽¹⁾	78 ⁽¹⁾	160 ⁽¹⁾
Nickel	180 ⁽¹⁾			Aliphatic EC6-EC8	100 ⁽¹⁾	230 ⁽¹⁾	530 ⁽¹⁾
	pH <6.0	pH 6.0-7.0	pH >7.0	Aliphatic EC8-EC10	27 ⁽¹⁾	65 ⁽¹⁾	150 ⁽¹⁾
	<60 ⁽⁴⁾	<75 ⁽⁴⁾	<110 ⁽⁴⁾	Aliphatic EC10-EC12	130 ⁽¹⁾	330 ⁽¹⁾	760 ⁽¹⁾
Selenium	250 ⁽¹⁾			Aliphatic EC12-EC16	1,100 ⁽¹⁾	2,400 ⁽¹⁾	4,300 ⁽¹⁾
	pH 5.0-6.0	pH 6.0-7.0	pH >7.0	Aliphatic EC16-EC35	65,000 ⁽¹⁾	92,000 ⁽¹⁾	110,000 ⁽¹⁾
	3.0-5.0 ⁽⁵⁾	3.0-5.0 ⁽⁵⁾	3.0-5.0 ⁽⁵⁾	Aliphatic EC35-EC44	65,000 ⁽¹⁾	92,000 ⁽¹⁾	110,000 ⁽¹⁾
Zinc	3,700 ⁽¹⁾			Aromatic EC5-EC7	70 ⁽¹⁾	140 ⁽¹⁾	300 ⁽¹⁾
	pH <6.0	pH 6.0-7.0	pH >7.0	Aromatic EC7-EC8	130 ⁽¹⁾	290 ⁽¹⁾	660 ⁽¹⁾
	<200 ⁽⁴⁾	<200 ⁽⁴⁾	<300 ⁽⁴⁾	Aromatic EC8-EC10	34 ⁽¹⁾	83 ⁽¹⁾	190 ⁽¹⁾
Cyanide	34 ⁽³⁾			Aromatic EC10-EC12	74 ⁽¹⁾	180 ⁽¹⁾	380 ⁽¹⁾
Asbestos	None Present			Aromatic EC12-EC16	140 ⁽¹⁾	330 ⁽¹⁾	660 ⁽¹⁾
Speciated PAH's	1% SOM	2.5% SOM	6% SOM	Aromatic EC16-EC21	260 ⁽¹⁾	540 ⁽¹⁾	930 ⁽¹⁾
Acenaphthene	210 ⁽¹⁾	510 ⁽¹⁾	1,100 ⁽¹⁾	Aromatic EC21-EC35	1,100 ⁽¹⁾	1,500 ⁽¹⁾	1,700 ⁽¹⁾
Acenaphthylene	170 ⁽¹⁾	420 ⁽¹⁾	920 ⁽¹⁾	Aromatic EC35-EC44	1,100 ⁽¹⁾	1,500 ⁽¹⁾	1,700 ⁽¹⁾
Anthracene	2,400 ⁽¹⁾	5,400 ⁽¹⁾	11,000 ⁽¹⁾				

⁽¹⁾ = LQM S4UL's (2014 & 2015) – Residential with home-grown produce, ⁽²⁾ = CL:AIRE C4SL's – Residential with home-grown produce, ⁽³⁾ = ATRISK^{SOIL} SSV, ⁽⁴⁾ = Potentially Phytotoxic Elements –BS3882:2015 & BS8601:2013, ⁽⁵⁾ = Sewage sludge in agriculture: code of practise for England, Wales and Northern Ireland (May 2018) –Potentially toxic elements limits in soils for arable farming and grassland. Note the TPH total should not exceed 1000mg / kg to avoid bringing potentially Hazardous Material on to site.

Section F - Action Items & Persons Responsible:

- Completion of 'Watching Brief' –Main Contractor
- Removal of made ground and emplacement beneath southern portion of site –Main Contractor
- Provide photographic evidence of removal of made ground and emplacement beneath southern portion of site – Arc Environmental Ltd
- Validation screening of exposed soils following removal of impacted materials –Arc Environmental Ltd
- Construction & installation of gas protection measures –Main Contractor
- Validation of installation of gas protection measures –Arc Environmental Ltd

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Section F- Action Items & Persons Responsible (Cont'd):

- Provision of pre-delivery imported soil screening results – Main Contractor
- Confirmation of suitability of imported soils – Arc Environmental Ltd
- Validation sampling & screening of imported soils and site-won natural materials once insitu – Arc Environmental Ltd
- Completion of final Validation Report incorporating all of the above – Arc Environmental Ltd

This document has been completed by Darren M^cGrath, for and on behalf of Mr Paul M^cVittie.

Signed 
For and behalf of Arc Environmental Ltd.
Darren M^cGrath
Director

Date: 01st June 2022