



**Phase 2 Contamination Site Investigation
&
Risk Assessment Report**

For

Land Adjoining 23 Jagger Lane

**Emley Moor
Huddersfield
West Yorkshire
HD8 9SY**

On behalf of

R & B Schofield Building Contractors

Report Ref. AC00100

Planning Application No: 2012/62/90390/E

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1 Executive Summary

- 1.1 This section summarises the findings of the report and any recommendations for further work and/or changes to observed site management practices as appropriate. In order to gain a full understanding of the assessment undertaken and conclusions reached this section should be read in conjunction with the remainder of the report.
- 1.2 The site is considered to present a **Low to Medium** overall level of environmental risk in relation to the proposed redevelopment of the site for 2 detached dwellings. A number of issues and recommendations have been identified which are summarised below.
- 1.3 This report has been prepared to comply with Condition 6 of the planning consent reference 2012/62/90390/E dated 27 June 2012 and follows the issue of a '*Phase 1 Contamination Audit*' for the site prepared by A.L.H Environmental Services in February 2012. A remediation strategy has also been formulated to comply with Condition 7.
- 1.4 The site has previously been occupied at various times as a brickworks, depot and builders yard, all of which are considered potentially contaminative uses. An unbunded above ground waste oil tank, the location of at least one other former fuel tank, 2 no. old and rusted 205 litre full or partially full metal drums, a water filled brick lined vehicle inspection pit, stockpiles of topsoil and a stockpile of asbestos sheeting at ground level were also identified as potential point sources of contamination.
- 1.5 The intrusive investigation relating to this report was undertaken on 20 November 2014 and involved the mechanical excavation of 6 trial pits to depths of between 0.9 and 1.6m, the preliminary screening on site of 21 soil samples for volatile vapours and the chemical analysis of 16 soil and 1 groundwater sample. Five soil samples also subsequently underwent testing for leachability.
- 1.6 The Made Ground (fill material) was encountered at all trial pit locations and generally comprised a surface crust of dark grey soils with various combinations of old tarmac, gravelly ash, road scalplings, sandstone hardcore and bricks to depths of between 0.27 and 0.40m. The locations where the Made Ground extended beyond this depth included the following. Made Ground also extended below this depth at some locations.
- 1.7 The underlying natural (or reworked natural) soils comprise a firm to stiff grey and yellow/orange Clay from depths of 0.35-1.00m. Groundwater was encountered at 3 locations at depths ranging from 0.7 to 1.0m and indicated the likely direction of groundwater flow to be to the south and south east.
- 1.8 Hydrocarbon odours were apparent from a depth of 0.20m within TP6 adjoining the former location of a fuel tank. Occasional small globules of a faint coloured sheen were observed to the groundwater surface within TP2.
- 1.9 The chemical assessment has identified soil contamination from arsenic, lead, polyaromatic hydrocarbons (PAHs) and isolated petroleum hydrocarbons (TPHs) at concentrations considered unacceptable to remain on site.

- 1.10 With the exception of the TPHs associated with TP6, the contaminants generally appear to be associated with the old tarmac, gravelly ash, road scalplings, sandstone hardcore and brick fill within the top 0.27-0.40m which appears to extend across a large part of the site. This material would be unsuitable to be retained on site within the proposed garden areas regardless of the levels of contamination. Hotspot locations have also been identified at 3 locations elevated in lead (TP1), arsenic, lead and PAHs (TP3) and TPHs (TP6).
- 1.11 A rough estimate for the volume of contaminated soils requiring remedial action at the site based on the available information is between 223 and 333m³. Excavation and removal for offsite disposal to an appropriately licensed waste management facility is anticipated to be the most practical method of dealing with the contaminants, but other potential options have also been identified.
- 1.12 Elevations in sulphate have been identified in 2 of the soil samples and whilst these are not considered significant from a human health risk point of view, they suggest that the use of sulphate resistant cement may be required for building work.
- 1.13 In respect of the soil mounds (M1, M2 and M3), the chemical assessment has shown that these soil stockpiles would be suitable for reuse on site during the proposed redevelopment.
- 1.14 In respect of the risk to controlled waters, the assessment has identified a low to moderate risk to groundwater from elevated lead in soil from TP1 which will be mitigated by remedial treatment.
- 1.15 Based on the results of this assessment, the following can be concluded:
- There is a risk of the serviceability of the site for its proposed residential use to be impacted unless some remedial treatment is undertaken;
 - With the exception of a low to moderate risk to neighbouring occupants during demolition, there is a low risk of an impact on the wider environment (controlled waters and surrounding uses) and therefore the risk of environmental liability to surrounding third parties is low;
 - There is a low risk of the site being designated as contaminated land under Part 2A of the Environmental Protection Act 1990.
- 1.16 A Remediation Strategy setting out the mitigation measures to deal with the environmental risks has been prepared in accordance with Condition 7 of the planning permission. This has been incorporated into a Remediation Statement which is appended to this report and will need to be agreed with the Contaminated Land Officer of Kirklees Council prior to commencement.
- 1.17 Upon the satisfactory completion of the remedial measures a Validation Report will need to be submitted to the Council in accordance with Condition 9 of the planning permission to verify that the remedial measures have been completed in accordance with the agreed strategy.
- 1.18 It should be noted that the Coal Authority advise developers to seek appropriate technical advice prior to any site works at this location due to possible shallow mine workings and the close proximity of an abandoned mine entry.

2 Introduction

- 2.1 AC Environment Solutions Limited was instructed to proceed with a Phase 2 Contamination Site Investigation for a site referred to as Land Adjoining 23 Jagger Lane, Emley Moor, Huddersfield, West Yorkshire, HD8 9SY by R & B Schofield Building Contractors on 30th October 2014.
- 2.2 Planning approval was granted for the demolition of the two existing buildings and the erection of two detached residential dwellings on 27th June 2012 and a copy of the planning permission (2012/62/90390/E) with a plan showing the proposed site layout are presented as Appendix A. Conditions 6, 7, 8 and 9 of the planning permission relate to requirements for the investigation, remediation and remediation validation of any contamination identified at the site.
- 2.3 A *'Phase 1 Contamination Audit'* was previously prepared for the site on behalf of R & B Schofield by A.L.H Environmental Services in February 2012.
- 2.4 This report has been prepared to comply with Condition 6 of the planning consent by presenting the results from a Phase 2 (intrusive) investigation with updated Conceptual Site Model and risk assessment. The report also includes a review of the previous Phase 1 report and updated Phase 1 (desk top) research. In accordance with Condition 7 of the planning consent a Remediation Strategy has also been completed.
- 2.5 A site inspection has been undertaken by the AC Environment Solutions representative in which the Royal Institution of Chartered Surveyors (RICS) Property Observation Checklist has been completed. This checklist forms part of the RICS guidance note *'Contamination, the environment and sustainability – implications for chartered surveyors and their clients'* third edition published 2010.
- 2.6 The investigation and analysis has been undertaken in accordance with DoE (now DEFRA) Contaminated Land Report (CLR4 1995) *'Sampling strategies for contaminated land'*, BS ISO10381-1:2002 *'Soil quality sampling'*, BS10175:2011 *'Investigation of potentially contaminated sites – Code of practice'*, BS5930:1999 *'Code of practice for site investigation'* and updated reports relating to the Contaminated Land Exposure Assessment (CLEA) model first published by DEFRA and the Environment Agency in March 2002.
- 2.7 Reference has also been made to Contaminated Land Report (CLR) 11 *'Model Procedures for the Management of Land Contamination'* published by the Environment Agency dated September 2004 and a generic quantitative risk assessment in respect of contamination has been undertaken.
- 2.8 The Environment Agency 'GPLC' series of guidance notes on land contamination dated March 2010 have also been consulted.
- 2.9 The comments and opinions expressed in this report are based on the ground conditions encountered at the specific locations during the fieldwork and on the results of measurements made in the field and in the laboratory. However, conditions may prevail which were not revealed by the investigation and which, therefore, could not be taken into account. In particular it should be noted that groundwater levels may vary due to seasonal or other effects such as boring, drilling and excavation processes.

- 2.10 The conclusions reached in this report are necessarily restricted to those which can be determined from available information and may be subject to amendment in the light of additional information becoming available or to changes in relevant legislation.
- 2.11 The writer knows of no conflicts of interest in the production of this report.

3 Site Location, Topography and Description

- 3.1 The site adjoins Jagger Lane opposite its junction with Westfield Lane, approximately 1.2 kilometres to the west of Emley village and 0.7 kilometres to the east of Emley Moor mast and to the south of the A637 Barnsley Road, as shown on Drawing No. 1.
- 3.2 The site is situated at an approximate height of 233 metres Above Ordnance Datum and the National Grid Reference for the centre of the site is 423002, 413155.
- 3.3 The property extends to an approximate area of 0.28 hectares and has a very gentle gradient from the north-west to the south-east.
- 3.4 The site is believed to have been occupied as a builders storage yard since 1997 and includes an old open fronted brick barn originating from the early history of the site and a larger asbestos cement sheet clad shed and associated yard areas. The nature of the land as it currently exists is described in detail in Section 5 of this report.

4 Review of Previous Documentation

- 4.1 During the preparation of this report a review has been made of a '*Phase 1 Contamination Audit*' for the site prepared by A.L.H Environmental Services on behalf of the client in February 2012.
- 4.2 The report was prepared with a view to the proposed residential redevelopment and includes a site description, details of a site walkover and inspection with photographic record and an outline of the site history by reference to the historical Ordnance Survey maps.
- 4.3 The report also includes an assessment of the environmental setting of the site by reference to the underlying geology, hydrogeology, hydrology, the potential for mining and mineral extraction, sensitive land uses, the potential for landfilling and landfill gas, subsidence and flood risk.
- 4.4 Environmental searches were also conducted which included information on registered waste treatment and disposal sites, regulated industries, radioactive sources, emissions to air and pollution incidents.
- 4.5 The report also included a qualitative risk assessment with conclusions and recommendations.
- 4.6 At the time the Phase 1 report was prepared, the site was being used by the owners as a builder's yard and storage area for materials such as vehicle tyres, red building bricks, concrete blocks, building sand, building stone and a wormery.
- 4.7 The site inspection referred to two existing buildings, one of which was clad in corrugated asbestos cement sheeting. However, no detailed description or photographs of the interior of the shed were included as the building was locked at the time of the inspection.
- 4.8 The other existing building was open fronted, of red brick construction and used for storing hay bales, steel and wooden poles, timber and rusting metal. The materials found within the building were placed at ground level. However, the internal floor space could not be inspected as it was covered with a thick dirt layer. At the time of the report it was presumed a concrete floor would be evident under the mud covering.
- 4.9 External areas comprised what appeared to be a compacted dirt access road, areas of concrete hardstanding and areas of overgrown thick vegetation.
- 4.10 A waste oil tank was identified adjoining the rear (western) elevation of the corrugated asbestos cement clad building. The tank was of metal construction and unbunded. At the time of the inspection, there was no evidence of spillage or staining of the ground surface around the oil tank.
- 4.11 The report also refers to the presence of a number of small mounds of topsoil, empty refuse bins, disused windows, a small stack of asbestos cement sheeting and an occasional nominally empty oil drum.
- 4.12 The historical review shows that the site was open ground from the earliest map extract of 1854 until a brick works was constructed at some point between the 1850s and 1890s. The brickworks consisted of two unnamed buildings, located within the eastern region and what appeared to have been two ponds which were located within the north western and south western parts.

- 4.13 The brickworks was disused by 1894, by the early 1900s one of the brick works structures had been demolished and by 1961 the aforementioned ponds were no longer shown (possibly infilled). By 1988 a further building had been developed when the site was identified as a depot, since when the application site has continued to be the location of the two existing buildings which have also been used for material storage and a builder's yard.
- 4.14 The report identified the former brickworks, depot and builders yard uses within the site as potential sources of historical contamination. Point sources of potential contamination were also identified at the time of the site inspection which included an unbunded above ground waste oil tank, stockpiles of topsoil and a stockpile of asbestos sheeting at ground level.
- 4.15 Possible linkages between these potential sources and possible pathways and sensitive receptors were also identified with consequential potential risks to site end-users and surface waters which needed to be quantified.
- 4.16 The report identified the site to be underlain by the Pennine Lower Coal Measures incorporating cyclical bands of mudstone, siltstone and sandstone. Geological faulting was also identified within the local area.
- 4.17 It was determined that the site is underlain by a Minor Aquifer and that the nearest watercourse was a small issue located approximately 228 metres to the north west.
- 4.18 No known historical or currently registered landfills were identified within a 250 metre radius of the site and the risk of landfill gas migration was assessed as being low.
- 4.19 The report identified the site to be located in a Radon Affected Area, although according to BR211, no radon protection measures are considered necessary.
- 4.20 The site was assessed to have an overall Medium to High risk in respect of the proposed redevelopment, which was broken down as follows:
- Risk to future users of the site - Medium to High
 - Risk to construction workers - Medium
 - Risk to surface watercourses - Low
 - Risk to groundwater if car parking provided with hardstanding - Low
- 4.21 The report recommended an intrusive contamination investigation be undertaken to determine the nature of soil materials beneath the site and within the stockpiles of material, and identify the presence, nature and extent of any contamination.
- 4.22 The report recommended that the investigation included analysis for metals, polyaromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs), benzene, toluene, ethylbenzene and xylenes (BTEX) and asbestos.
- 4.23 An asbestos survey of the existing premises was also recommended prior to redevelopment commencing.

5 Reconnaissance

- 5.1 During the inspection for the '*Phase 1 Contamination Audit*' undertaken by A.L.H Environmental Services in January 2012, access could not be gained to one of the buildings. At the time of the recent investigation a number of changes were also noted to have taken place within the site since completion of the Phase 1 report.
- 5.2 A further inspection of the subject site was therefore undertaken at the time of the investigation by representatives from AC Environment Solutions Limited. The inspection was undertaken on 20 November 2014 in the presence of the site representative, Mr Andrew Schofield.
- 5.3 The RICS property observation checklist for commercial and industrial land use was completed during the course of the visit to record obvious potential for contamination and representative photographs were taken which are presented as Appendix B. The weather at the time of the inspection was overcast, dry and cool.
- 5.4 The site was observed to comprise a roughly rectangular shaped area of land incorporating an old open fronted brick barn and a larger shed with associated yard areas.
- 5.5 Access to the site was gained from the single vehicular entrance from Jagger Lane within the north eastern corner of the site which was secured by a lockable barrier.
- 5.6 Site boundaries were delineated dry stone walls extending to heights of between 0.5 and 1m.
- 5.7 The observed uses within the property and in the site vicinity are noted as follows :-

Observed use of the **subject property**:

- | | | |
|---|------------------------------|--|
| Industry/manufacturing? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Waste disposal or waste processing? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Surface or underground mineral working? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Vehicle maintenance or refuelling? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |

Evidence seen of such uses having taken place **within the vicinity** of the subject property:

- | | | |
|---|------------------------------|--|
| Industry/manufacturing? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Waste disposal or waste processing? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Surface or underground mineral working? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Vehicle maintenance or refuelling? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |

Evidence of **potential flooding issues** on or within the vicinity of the subject property:

- | | | |
|---|------------------------------|--|
| Is the property near a river, stream or ditch? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Is the property in a hollow or at the bottom of a hill where flood water could collect? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |
| Knowledge of any flood events affecting the property or immediate area? | <input type="checkbox"/> Yes | <input checked="" type="checkbox"/> No |

- 5.8 The site representative revealed that the property had been in his family's ownership from 1997, since when it had been used for farm related uses and for the storage of building materials associated with his business. The representative also revealed that prior to 1997 the property had been occupied by H Lodge & Sons as a depot for their landscape contracting business.
- 5.9 Asbestos containing materials (ACMs) were noted in the form of asbestos cement cladding and roofing to the large shed. A stockpile of similar material was also noted outside this building adjoining the northern elevation. Due to the age of the buildings the possibility of other asbestos containing materials within the fabric of the structures cannot be discounted. It is understood that no refurbishment / demolition survey for ACMs has yet been completed.

Buildings

- 5.10 The large shed was of reinforced concrete portal frame construction with blockwork and asbestos cement sheet clad elevations and a pitched roof of asbestos cement sheeting incorporating several translucent panels. Information in the Phase 1 report indicates that this was built before 1988.
- 5.11 The site representative revealed that the building had previously been used for the storage of building materials and equipment such as scaffolding associated with his construction business. At the time of the inspection, the interior comprised a well constructed concrete floor across which there was much dirt and debris, but no evidence of hydrocarbon or other staining.
- 5.12 A vehicle inspection pit covered with timber planks was observed in the centre of the shed. The timber planks were removed revealing the pit to be brick lined and the brickwork appeared to be in good condition. The pit was probed with a timber rod and determined to have a hard solid base at a depth of 1.33m. The pit was also filled with water to a depth of 0.83m and whilst some dust and dirt was observed to the water surface, no visual or olfactory evidence of hydrocarbon contamination was noted.
- 5.13 A small number of plastic trays, together with several small containers of oil and paint were noted at the front of the unit near a gully drain.
- 5.14 Towards the back of the shed a stockpile of solidified compost was noted which the site representative revealed to be derived from horse manure and was associated with the wormery he had established outside the building to the rear.
- 5.15 A small breeze block partitioned office unit was noted in the north eastern corner of the shed which was observed to be empty.
- 5.16 The old open fronted barn was of brick construction with timber trusses supporting a pitched slate roof and a compacted dirt floor with a light covering of straw. Information in the Phase 1 report indicates that this building dates back to at least 1893 and the time of the former brick works.
- 5.17 The site representative revealed that the building had until recently been used for the storage of hay bales. At the time of the inspection the building was largely empty but was in a poor state of repair.

- 5.18 Within the south eastern corner of the building, the top of a brick arch structure was visible near ground level which was partially backfilled with soil and some slate tiles. Some of the soil was manually excavated to determine the extent of this structure which was found to comprise a single 1.4m wide span extending back 2.1 metres as far as the eastern elevation of the building, although the height of the arch could not be determined.
- 5.19 The soil backfill appeared to be of reasonable quality with no obvious visual or olfactory evidence of potential contamination.

External Areas

- 5.20 External areas included a yard area to the front of the buildings, areas of shrubbery or trees along the northern and parts of the western boundaries and areas of largely cleared vegetation at other locations.
- 5.21 The yard area included a small area of concrete hardstanding and larger area of compacted un-surfaced ground. The remains of two old telegraph poles and several building sacks of sand were stored in this area and a small stockpile of compost covered by tarpaulin.
- 5.22 The brick supports to a former fuel tank were noted adjoining the north eastern corner of the brick barn, the floor area beneath which comprised soft ground. A small area of oil staining was noted to one of the brick supports. The photographs presented in the 2012 Phase 1 report show what is believed to be a green coloured rectangular metal tank at this location.
- 5.23 The blockwork supports to another possible former tank were also noted adjoining the same location, the floor area beneath which comprised concrete hardstanding which appeared to be in good condition.
- 5.24 An unbanded rectangular shaped metal tank was observed close to ground level adjoining the north western corner of the larger shed which is described as a waste oil tank in the 2012 Phase 1 report. This was believed to be nominally empty, unbanded and had an unsecured tap fitting.
- 5.25 One old 205 litre metal drum was noted adjoining the western elevation of the brick barn which was in poor condition with part of the lid rusted through from which rainwater overspill could take place.
- 5.26 A similar drum, also in a poor condition, was noted adjoining the western site boundary within the north western part of the site.
- 5.27 Approximately 3 weeks prior to the inspection, the site representative mechanically excavated 3 test pits to an approximate depth of 1.5 metres across the western side of the site to try and identify the depth of Made Ground. Two of the pits had been left open, one of which was located within the south western part of the site in which a dark grey ashy fill had been encountered with occasional old glass bottle and pottery fragments. It is possible that this is backfill to one of the former ponds which appear to be shown on the earliest historical map at this location. Clear standing water was observed in the base of the excavation.
- 5.28 Clear standing water was also observed in the base of the second pit located near the mid-point of the western site boundary which had been excavated through a thin ash fill and road scalplings into an apparent weathered mudstone or mudstone fill.

- 5.29 The site representative identified the location of a wormery adjoining the southern site boundary to the rear of the larger shed. This comprised a tarpaulin covered mound of compost within a low block wall enclosure.
- 5.30 Three small mounds of partially vegetated soil material were noted within the northern half of the site which the site representative identified as surplus soils having originated off site from residential gardens during past building projects. Since it may be possible to reuse the soils within the proposed site redevelopment these mounds have been identified as M1, M2 and M3 for testing purposes. A small mound of building sand was also noted in this area.
- 5.31 A larger mound of building stone was also observed near one of the soil mounds adjoining the eastern site boundary which the site representative revealed had been built up over a period of approximately 10 years.

Summary

- 5.32 In summary, the inspection revealed that much of the building materials observed at the time of the '*Phase1 Contamination Audit*' in 2012 had been removed and vegetation cleared. The following potential sources of contamination have been identified:
- One unbanded nominally empty waste oil tank adjoining the large shed;
 - The former location of at least one other tank adjoining the north eastern corner of the brick barn;
 - 2 no. old and rusted 205 litre full or partially full metal drums;
 - A water filled brick lined vehicle inspection pit within the larger shed which appeared well constructed with no obvious visual or olfactory evidence of hydrocarbon contamination;
 - Corrugated asbestos cement roofing and cladding to the large shed and a stockpile of similar material adjoining the northern elevation externally.
- 5.33 No obvious signs of surface instability were apparent, although the top of the eastern gable end of the brick barn was observed to be leaning outward.
- 5.34 It is understood that no refurbishment / demolition survey for ACMs has yet been completed which will be required before demolition of the premises commences in accordance with the Control of Asbestos Regulations 2012.
- 5.35 In terms of surrounding uses, it was noted that the site is located in a semi-rural location with the nearest properties being of residential use with a low perceived risk of potential contamination.

6 Environmental Setting

Geology

- 6.1 A review of information available on the British Geological Survey (BGS) website together with information within the 2012 '*Phase 1 contamination audit*', together with the recent site inspection, suggests that the geology beneath the property is as set out in the following Table.

Table 1 – Anticipated Site Geology

Artificial Ground	
Made Ground	Associated with the historical uses of the site and comprising old ash fill with localised glass and pottery fragments and compacted road scalplings to a shallow depth.
Superficial Geology	
None Recorded	
Solid Geology (Bedrock)	
Pennine Lower Coal Measures Formation	To an anticipated depth of a few hundred metres and comprising interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.

- 6.2 The site is shown to be located close to an area of infilled ground (Artificial Deposit) to the west.
- 6.3 No mass movement deposits have been identified in the locality.
- 6.4 Geological faults have been identified in close proximity to both the eastern and western site boundaries trending in a north west to south east orientation.

Coal Mining

- 6.5 The '*Review of Mining Instability in Great Britain*' summary map dated July 1990 and prepared by Arup Geotechnics for the Department of the Environment (DoE), now Department for Environment Food and Rural Affairs (DEFRA), indicates that the site is located in an area which may have been undermined, but the map indicates the existence and extent of any mining to be 'inconclusive'.
- 6.6 Reference to the Coal Resources Map of Britain prepared by the BGS and the Coal Authority and dated 1999, indicates that the site is located within the East Pennine Coalfield and therefore may have been undermined for coal in the past.
- 6.7 According to the Environment Agency website, there are no closed and abandoned mining waste facilities causing serious harm to the environment or to human health either on or within a 1 kilometre radius of the property.
- 6.8 A Non-Residential Coal Authority Mining Report for the site dated 30th October 2014 has been supplied by the client, a copy of which is presented as Appendix C.

- 6.9 The report reveals, based on records in possession of the Coal Authority, that the property is located within the likely zone of physical influence at the surface from workings in 3 seams of coal at 40 to 150 metres depth, with the last date of working being 1982. The report also reveals that ground movement from these workings should by now have ceased.
- 6.10 Furthermore, the report also reveals that the property is located in an area where coal is believed to exist at or close to the surface that may have been worked at some time in the past. The report states that the potential presence of coal workings at or close to the surface should be considered prior to any site works or future development activity.
- 6.11 The report also reveals that the property is not located within the zone of likely physical influence at the surface from present underground coal workings and no future workings are currently planned. However, reserves of coal are indicated to exist in the locality which could be worked at some time in the future subject to feasibility, licences and planning consents.
- 6.12 The Authority has no record of any notice of the risk of the land being affected by subsidence being given under S.46 of the Coal Mining Subsidence Act 1991.
- 6.13 The Coal Mining Report identifies one mine entry within a 20 metre radius of the boundary of the property, the location of which is shown to be beneath Jagger Lane, approximately 7 metres to the north of the site (approximately 25 metres to the north of the nearest proposed dwelling). There is no record of any treatment that may have been undertaken to the mine entry. The report also states that records may be incomplete, as a consequence of which there may exist in the local area mine entries of which the Coal Authority has no knowledge.
- 6.14 The report reveals that the Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining.
- 6.15 The report also reveals that the property is not located within the area of any former opencast coal workings and the property is not located within the vicinity of any historical, present or proposed opencast coal workings.
- 6.16 There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.
- 6.17 The property has not been subject to remedial works by or on behalf of the Authority, following the reporting of an alleged coal mining related hazard under its Emergency Surface Hazard Call Out procedures.
- 6.18 It is important to note that the Coal Authority comment that in view of the mining circumstances the Authority considers that a prudent developer should seek appropriate technical advice before any works are undertaken on site. This means that where development proposals are being considered, technical advice relating both to the investigation of coal and former coal mines and their treatment should be obtained before beginning work on site. All proposals should apply good engineering practice developed for mining areas and no development should be undertaken that intersects, disturbs or interferes with any coal or mines of coal without permission of the Coal Authority.

- 6.19 Developers should be aware that the investigation of coal seams / former mines of coal may have the potential to generate and/or displace underground gases and these risks both under and adjacent to the development should be fully considered in developing any proposals. The need for effective measures to prevent gases entering into public properties either during investigation or after development also needs to be assessed and properly addressed. This is necessary due to the public safety implications of any development in these circumstances.

Hydrology

- 6.20 According to the 2012 *'Phase 1 Contamination Audit'*, the nearest natural water feature to the site is considered to be a ditch drain located approximately 228m to the north west. This flows in a north easterly direction and is believed to join Mouse House Dike further to the north.
- 6.21 A small watercourse is also located approximately 600m to the south which is a tributary of Baildon Dike located further to the south.
- 6.22 No historic water quality data is currently available on the Environment Agency website for any of the above watercourses under the Environment Agency's chemical General Quality Assessment (GQA) Scheme classification.
- 6.23 According to the Environment Agency's River Basin Management Plan which is a programme of measures to meet the European Union's Water Framework Directive for the management of Europe's rivers, there are no ecological or chemical classifications for Mouse House Dike, but the current ecological classification for Baildon Dike is 'Moderate'.
- 6.24 Information on the Environment Agency website does not identify any pollution incidents to controlled waters within a 1 kilometre radius of the site.
- 6.25 The Environment Agency map of water abstraction licences shows no licensed surface water abstractions within a 1 kilometre radius of the site.
- 6.26 The Environment Agency website shows no 'Surface Water Safeguard Zone' within a 1 kilometre radius which are sometimes designated to protect the location of drinking water abstractions.
- 6.27 A search for environmental permits for water discharges on the Environment Agency online public register has revealed no recorded permits for water discharges within a 1 kilometre radius of the site.
- 6.28 Based on the above information it is considered that the site is not located in a sensitive area in terms of surface water resources.

Flooding

- 6.29 In respect of flooding, the Environment Agency Flood Map has been consulted which identifies the extent of the natural floodplain if there were no flood defences as well as the location of any flood defences constructed in the last 5 years.

- 6.30 The Environment Agency define a floodplain as 'the area that would naturally be affected by flooding if a river rises above its banks, or high tides and stormy seas cause flooding in coastal areas'. On rivers this will normally be the area affected by a river during a flood that has at least a 1 in 100 year return period. In coastal areas the floodplain will be the area affected by the sea during a flood that has at least a 1 in 200 year return period. In addition the Environment Agency has defined areas that are likely to be affected by a major flood only in extreme conditions with up to a 1 in 1000 year return period.
- 6.31 The Environment Agency Flood Map for the area shows the application site is located within Flood Zone 1. Flood Zone 1 is where the annual probability of flooding caused by rivers and seas is 0.1% or less (1 in 1000 chance).
- 6.32 The Environment Agency Flood Risk Map showing the risk of flooding from reservoirs has also been consulted. This identifies the largest area that might be flooded if a reservoir were to fail and release the water it holds and indicates that the property is not located within the maximum extent of flooding from any reservoir.
- 6.33 The Environment Agency Flood Risk Map showing the risk of flooding from surface waters has also been consulted which identifies those areas at risk of flooding when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground. This shows that the site is located within an area of 'Very Low' risk of flooding from surface water where the chance of flooding each year is less than 1 in 1000 (0.1%).
- 6.34 The site is not located within an Environment Agency designated 'Flood Warning Area' where flood warnings may be issued requiring immediate action.
- 6.35 The property is also not located within an Environment Agency designated Flood Alert Area in which alerts are issued when flooding is possible.

Hydrogeology

- 6.36 The Environment Agency Aquifer Designation Map (replacing the former Groundwater Vulnerability Maps from 1 April 2010) identifies the bedrock strata underlying the site to be classified as Secondary A Aquifer (formerly Minor Aquifer). Secondary A aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases form an important source of base flow to rivers.
- 6.37 The former Groundwater Vulnerability map also identifies the site to be underlain by soils of low leaching potential. These are soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants. Lateral flow from these soils may contribute to groundwater recharge elsewhere in the catchment.
- 6.38 Environment Agency information reveals that the site is not located within any of the nearly 2000 Groundwater Source Protection Zones which have been identified in England and Wales as major groundwater sources (wells, boreholes or springs) used for public drinking water supply.
- 6.39 The Environment Agency map of water abstraction licences shows no licensed groundwater abstractions within a 1 kilometre radius of the site.
- 6.40 The Environment Agency website shows no 'Groundwater Safeguard Zone' within a 1 kilometre radius which are sometimes designated to protect the location of drinking water abstractions.

- 6.41 According to the Environment Agency's River Basin Management Plan which is a programme of measures to meet the European Union's Water Framework Directive for the management of Europe's rivers, the current chemical quality of groundwater in the area is classified as 'Poor' and since there is no upward chemical trend, this is predicted to continue until at least 2015.
- 6.42 Based on the above information, it is considered that the site is not located in an area which is highly sensitive in terms of groundwater resources.

Landfill Sites

- 6.43 According to the 2012 '*Phase 1 Contamination Audit*' no historic or currently authorised landfills have been identified within a 250 metre radius. The nearest recorded landfill was identified to be an historic landfill located 449 metres to the north.
- 6.44 A review of the Environment Agency website identifies one historic landfill within a 1 kilometre radius of the site which is believed to be the one identified in the Phase 1 report, the details of which are summarised in the following Table.

Table 2 – Historic Landfills

Operator, Site Name, Address (& License No.)	Accepted Waste Types (and Control Measures)	First Waste Received	Last Waste Received	Location
Operator – West Yorkshire Metropolitan County Council Fletcher Park, Windmill Hill Lane, Huddersfield, West Yorkshire Lic. Ref: 0	Inert, industrial, commercial, household and liquids / sludge (Gas control measures provided)	-	31/12/1983	385m NW

- 6.45 A review of contour mapping for the locality suggests that the anticipated direction of groundwater flow from the Fletcher Park Landfill is to the north east and not towards the site.
- 6.46 No currently authorised landfill sites are identified on the Environment Agency website to be within a 1 kilometre radius of the subject property.

7 Preliminary Conceptual Site Model

- 7.1 The conceptual site model (CSM) is based on the concept that for there to be a risk of contamination there must be a link between a source of contamination, a pathway by which it can migrate and a receptor or target. This is used as a preliminary screening exercise to identify the source-pathway-receptor linkages which form the basis for the risk assessment.
- 7.2 The potential sources, pathways and receptors forming the basis for the CSM in respect of the proposed residential redevelopment of the site are listed as follows:

Sources (potential sources from historical and existing uses of the site and surrounding area)

On-site

- Brick works (ash, metals, grease and brick oil);
- Depot (landscaping contractors);
- Builders yard and storage;
- Asbestos containing materials and fibres;
- Above ground unbunded waste oil tank (remaining);
- Above ground unbunded fuel tank (removed);
- 2 old 205 litre metal drums of unknown contents;
- Made Ground associated with historical uses including pond backfill;
- Soil stockpiles;
- Vehicle inspection pit;
- Containers of oil and paint.

Off-site

- Agricultural land;
- Farms;
- Colliery and associated tip;
- Historical landfill (385m NW).

Pathways (based on the proposed use of the property)

- Contaminant transport to shallow groundwater within the Secondary A Aquifer;
- Wind (airborne particles);
- Volatilisation of contaminants to indoor or outdoor air;
- Ingress of soil vapours and gases;
- Ingestion and inhalation from direct human contact with soil, water and vapours;
- Defective drainage;
- Service pipes.

Receptors (targets)

- Shallow groundwater in the Secondary A Aquifer;
- On site drinking water supply pipes (if aggressive chemical environment);
- Site construction workers and future occupants;
- Residential properties (and their occupants) adjoining the site to the west and 50 metres to the east;
- Building structures (if aggressive chemical environment).

- 7.3 From the above it is considered that there are potentially viable significant pollution linkages associated with the proposed redevelopment which could foreseeably impact on controlled waters, human health and building structures.

- 7.4 In accordance with the DoE Industry Profiles for 'Ceramics, cement and asphalt manufacturing works' and 'Road vehicle fuelling, service and repair – transport and haulage centres', which appear to have some relevance to the site, the principal potential contaminants include metals, sulphates, petroleum hydrocarbons, polyaromatic hydrocarbons, phenols, benzene, chlorinated solvents, battery acid and asbestos.

8 Contamination Site Investigation

Introduction

- 8.1 The purpose of the investigation was to provide an assessment of soil and possible groundwater conditions beneath the site to determine the existence and nature of any potential contamination associated with the historical use of the site which could potentially present the following:-
- An impact on the future use of the site for its proposed residential use as two dwellings with soft landscaped garden areas;
 - Any associated impact on the wider environment (controlled waters and surrounding uses) which could give rise to a risk of environmental liability;
 - The site being designated as contaminated land under Part 2A of the Environmental Protection Act 1990.

Investigation Strategy

- 8.2 The proposals for the investigation involved the excavation of trial pits set out with the aim of providing the following:-
- Targeting the location of the former ponds (TP1, TP2 in the proposed scope);
 - Targeting the location of an existing above ground waste oil tank (TP3);
 - Targeting the location of a former above ground fuel tank (TP4);
 - Assessing the proposed garden areas (TP1,TP2 and TP5);
 - Targeting the former location of a caravan / trailer (TP5);
 - Targeting of the small soil stockpiles.
- 8.3 The proposals for the investigation were incorporated into a specification with which the Contaminated Land Officer at Kirklees Council was consulted. This was agreed, subject to the possible requirement for additional testing beyond the proposed scope if circumstances suggested that further testing would be appropriate. A copy of the specification is presented as Appendix D, but it should be noted that the numbering of the proposed trial pits differs from those completed on the day of the investigation.
- 8.4 The proposals for the investigation did not include monitoring for landfill gases (carbon dioxide and methane) since the Phase 1 research had not identified any significant potential sources within the surrounding area and the nature and shallow depth of the Made Ground overlying a reasonable thickness of Clay observed across much of the site, did not suggest the underlying strata represented a significant potential source.

Fieldwork

- 8.5 The investigation was undertaken on 20 November 2014 and broadly followed the proposed scope and involved the following:
- The excavation of 6 trial pits (TP1-TP6 shown on Drawing No. 2) by JCB 3CX using a 0.55 metre wide bucket to depths of between 0.90 and 1.60 metres (average of 1.26 metres) below ground level. Trial pit depths were limited by rapid groundwater inflows or the presence of small stone lined culverts or unstable sides or the confirmation of natural or reworked natural strata being encountered making deeper excavation unnecessary;
 - The collection of 25 soil samples, 21 of which were subjected to preliminary on site screening for volatile vapours using a MiniRAE 3000 photoionisation detector (PID);
 - Site supervision and recording by a qualified Chartered Environmental Surveyor.

- 8.6 Each exploration hole was logged by a qualified Chartered Environmental Surveyor based on soils arising.
- 8.7 A selection of photographs from the investigation is presented in Appendix E. The exploration hole locations are shown on Drawing No. 2 (on which the existing buildings are shaded) and the trial pit records with descriptions of the strata encountered and PID readings are presented in Appendix F.

Sampling

- 8.8 Soil samples were selected based upon visual screening for obvious contamination (significant staining and / or pungent odours), the suspicion of contamination in the soils or a change in the soil profile.
- 8.9 In the absence of any visual or olfactory evidence, in general at each location one soil sample was taken from the near surface Made Ground with further samples from the deeper Made Ground and / or from natural soils below the Made Ground if encountered.
- 8.10 With regard to the selection of samples for organic compound analysis (petroleum hydrocarbons and volatile organic compounds), this was determined by the screening of soil samples for volatile vapours using the MiniRAE PID.
- 8.11 Representative soil samples were collected using a stainless steel trowel and samples were placed directly into laboratory supplied pre-cleaned jars/containers.
- 8.12 Where soil samples were taken to be analysed for organic compounds, the soil samples were placed in amber glass jars and stored in an insulated cool box to reduce the loss of volatile constituents in line with current best practice, prior to despatch to the chemical laboratory.
- 8.13 A total of 25 soil samples were collected (including 1 composite sample from each of the 3 soil stockpiles M1, M2 and M3 shown on Drawing No. 2), 21 of which underwent preliminary on site screening for volatile vapours using the PID. Sixteen soil samples were selected for chemical analysis by a UKAS and MCERTS accredited chemical laboratory
- 8.14 One groundwater sample was also obtained from TP2 for chemical analysis since occasional small globules of a faint coloured sheen were observed to the surface of the water at this location.

Soil Conditions and Observations

- 8.15 The succession of strata encountered, as interpreted from the exploration hole records, is described in the following Table.

Table 3 - Summary of Ground Conditions

Stratum	Depth to Top (mbGL)	Thickness (m)
Made Ground (fill material) - variable but generally comprising a firm dark grey brown organic silty topsoil with rootlets above a dark gravelly ashy silt with old tarmac gravel and boulders, road scalplings, fine coal fragments, red brick (whole bricks and fragments), fragments of bottle glass and pottery, metal, grey mudstone and red shale.	Surface	0.3m – >1.6
Natural (or reworked natural) - Soft and firm to stiff grey and yellow/orange mottled Clay.	0.3m - >1.6m	>0.45->0.95 (Not proven)

- 8.16 A summary of the observations made during the course of the investigation is presented in the Table below.

Table 4 – Observations During Trial Pitting

Location	Hole Depth (m)	Depth to Base of Made Ground (m)	Visual or Olfactory Signs of Potential Contamination	PID Readings (ppm)	Depth to Groundwater Encountered (mbGL)
TP1	1.30	0.35	None observed	0	Not encountered
TP2	1.45	1.00	Occasional small globules of coloured sheen to water surface	0-0.2	1.0m
TP3	1.05	0.65	None observed	0-1	0.75m
TP4	0.90	>0.90	None observed	0	0.70m
TP5	1.25	0.40	None observed	0-2.7	1.15m (culvert)
TP6	1.60	0.55	Hydrocarbon odours from 0.20m.	0.1-88.1	1.60m (culvert)

Made Ground

- 8.17 Made Ground (fill material) was encountered at all 6 trial pits. The Made Ground was proven to depths of between 0.35 and 1.0m at 5 locations and observed to an unproven depth at TP4 (which historical maps show to be the possible location of a former pond) where mudstone backfill was encountered.
- 8.18 In general terms, at the majority of locations the Made Ground was found to comprise a surface crust of dark grey soils with various combinations of old tarmac, gravelly ash, road scalplings, sandstone hardcore and bricks to depths of between 0.27 and 0.40m
- 8.19 The Made Ground extended beyond this top layer of fill at TP2 where historical maps show to be the possible location of a former pond and where the maximum depth of Made Ground was proven to 1.0m. The deeper fill at this location comprised a firm dark gravelly ash with occasional pieces of metal and glass bottle fragments.
- 8.20 The Made Ground at TP3 excavated next to an existing above ground waste oil tank extended to a depth of 0.65m where there was evidence of a 0.20m wide red ash/clinker gravel section cutting across the pit representing the backfill to what the site representative identified as a land drain.
- 8.21 TP4 was excavated within the north western part of the site where historical maps show to be the possible location of a second former pond where a grey (orange stained in places) weathered mudstone was encountered beneath the top 0.27m of fill. Since Clay was encountered beneath the obvious fill at all trial pit locations except TP4, the weathered mudstone is believed to be reworked natural material, the depth of which could not be proven due to unstable sides and groundwater ingress.
- 8.22 Across the northern part of the site is an area of thin grass cover which was the location of TP5 where a firm dark grey gravelly soil with sandstone hardcore and occasional fine red shale (or red brick) was encountered to a depth of 0.40m above reworked natural Clay. The Clay was considered to be reworked since a small stone lined culvert was encountered at a depth of 1.15m.

- 8.23 TP6 was located adjoining the brick supports to what is believed to have been a former above ground fuel tank adjoining the north eastern corner of the old brick barn. The Made Ground at this location comprised a dark grey slightly gravelly sandy silt to 0.55m. Hydrocarbon odours were apparent from 0.20m to the full depth of the trial pit to 1.60m.

Natural Soils

- 8.24 Natural (or reworked natural) soils in the form of a firm to stiff grey and yellow/orange Clay were encountered at all trial pit locations except TP4 (see above) from depths of 0.35-1.00m. The Clay at TP2 was accompanied with a stagnant odour and partial dark grey discolouration which is consistent with its former location as part of a pond.
- 8.25 At TP3, TP5 and TP6, the reworked Clay was identified from the existence of a land drain or small stone culverts.

Groundwater

- 8.26 Groundwater was encountered in all of the trial pits with the exception of TP1. The groundwater recorded at TP5 and TP6 however, is believed to have arisen from the disturbance of small old stone lined culverts encountered at these locations at depths of 1.15 and 1.60m respectively.
- 8.27 Groundwater was encountered at the other locations (TP2, TP3 and TP4) at depths ranging from 0.7m (TP4) within the north western part of the site to 1.0m (TP2) within the south western part of the site. It would therefore appear that groundwater flow direction follows the topography of the locality and is in a south and south easterly direction. TP4 was the highest located trial pit within the western end of the site and from this point the site gradually slopes in a south easterly direction, towards TP3 (0.75m) and beyond.

Volatile Vapour Survey

- 8.28 Twenty-one soil samples underwent preliminary screening for volatile vapours using a MiniRAE 3000 photoionisation detector (PID) to assist in the selection of soil samples to undergo analysis for organic compounds (volatile organic compounds and / or petroleum hydrocarbons).
- 8.29 The PID readings were made by the soil headspace method in which the intake pipe to the PID is inserted through a predrilled hole in the lid of the soil tub which was covered with tape.
- 8.30 The calibration certificate for the MiniRAE 3000 is presented as Appendix G and the PID readings are provided in the trial pit records presented in Appendix F (and summarised in Table 4 above). These show that elevations in volatile vapours were determined from 4 of the trial pits (TP2, 3, 5 and 6) with readings ranging from 0.1 to 88.1. The highest readings were recorded at TP6 (adjoining the brick supports to a former fuel tank) where vapour readings ranged from 0.1ppm within the top 0.1m to 88.1ppm at 0.75-0.80m and 84.3ppm at 1.55-1.60m.
- 8.31 Only slight elevations in volatile vapours were recorded from the other 3 trial pits (0.2ppm at TP2, 1ppm at TP3 and 0.5-2.7ppm at TP5). Readings were also taken from the 3 soil stockpile samples M1, M2 and M3, all of which recorded zero.
- 8.32 On this basis soil samples to undergo analysis for organic compounds were selected in accordance with Table 5 (below).

Table 5 – Samples Selected for Organic Compound Analysis

Trial Pit	Depth (m)	Analysis			
		TPH CWG	TPH 3 Band	TPH Total	VOCs
TP2	0.7	•			•
TP3	0.60-0.70	•			•
TP5	0.90-1.05	•			•
TP6	0.25-0.35			•	
	0.75-0.80	•			•
	1.55-1.60		•		

Chemical Laboratory Analysis

- 8.33 For this investigation 16 soil and 1 groundwater sample were scheduled for analysis by the chemical laboratory of Chemtest. This laboratory is UKAS (United Kingdom Accreditation Service) accredited (UKAS testing Nos. 2183) and has MCERTS accreditation for soil testing.

The samples were selected for analysis in accordance with the following schedule:-

Table 6 - Chemical Analysis Suite

Analytical Parameters	Soils	Ground water
pH (acidity/alkalinity)	13	1
Metals (arsenic, boron, cadmium, chromium, copper, lead, mercury, nickel, selenium, zinc)	13	1
Cyanide (free)	13	
Cyanide (total)	13	1
Thiocyanate	13	1
Sulphate (total)	13	1
Sulphate (2:1 water soluble) as SO ₄	13	
Sulphide	13	1
Total phenols	13	1
Total and speciated polyaromatic hydrocarbons (PAHs)	13	1
Total petroleum hydrocarbons (TPHs) CWG (Criteria Working Group) aliphatic / aromatic	4	1
TPHs (3 split and total)	1	
TPHs (total)	1	
Volatile organic compounds (VOCs)	4	
Soil organic matter (SOM)	16	
Asbestos identification and type	8	

Soil Screening Assessment

- 8.34 A generic quantitative risk assessment (GQRA) in respect of human health has been undertaken in which the chemical testing results for the soils has been assessed against generic assessment criteria (GAC) values currently applicable in the UK which include following:

1. The Contaminated Land Exposure Assessment (CLEA) model issued by the Department for Environment, Food and Rural Affairs (DEFRA) in March 2002. This specifies Soil Guideline Values (SGVs) for a selected number of substances, above which the concentrations could pose an unacceptable risk to the health of site users which warrant further investigation or remediation.

At the time of writing this report the CLEA methodology is going through a period of revision and Contaminated Land Reports (CLR) 7-10 and the CLEA SGVs have been withdrawn with a view to the EA periodically releasing new reports and

SGVs from 2009. At the present time new SGVs for 10 parameters have been issued which have been utilised in this report together with the withdrawn SGVs for some of the remaining parameters.

2. Generic Assessment Criteria for Human Health Risk Assessment produced from research undertaken by Land Quality Management Limited (LQM) in collaboration with the Chartered Institute of Environmental Health (CIEH), 2nd edition dated July 2009.
 3. Soil Generic Assessment Criteria for Human Health Risk Assessment published by Contaminated Land: Applications in Real Environments (CL:AIRE), dated January 2010.
- 8.35 References 2 and 3 of the above specify Generic Assessment Criteria (GAC) values for a selected number of substances not covered by CLEA, above which the concentrations could pose an unacceptable risk to the health of site users which warrant further investigation or remediation.
- 8.36 In all of the above the soil concentrations can be compared against values for 3 categories of land use (residential, allotment and commercial). For the purposes of this assessment the results have been assessed against the values for residential use.
- 8.37 Where no SGVs or GAC values are provided for a particular determinand, for the purposes of a screening assessment, secondary generic assessment criteria have been used in the form of either the Dutch or old ICRL values. However these have been used with caution and as a preliminary indicator only.
- 8.38 For the assessment of petroleum hydrocarbons and polyaromatic hydrocarbons, GAC values relevant to a soil organic matter (SOM) content of 6% were used based on the average SOM value for the site of 15.92%.
- 8.39 The results of the chemical analysis on the soil samples are presented in Appendix H and the results of the generic assessment are presented in the following Tables, in which those chemical parameters exceeding the screening criteria (if any) are highlighted.

Table 7 - Summary of Metal Analysis Results for Soils

Parameters	Range of Levels Found on Site (mg/kg)	CLEA SGV (mg/kg)	Proportion of Samples Exceeding CLEA SGV	LQM CIEH GAC (mg/kg)	Proportion of Samples Exceeding LQM CIEH GAC
Arsenic	11-240	32	6 from 13 (49 at TP2) (77-240 at TP3) (39-46 at TP4) (36 at M1)		
Boron ¹	0.51-1.3			291	0
Cadmium	0.13-2.0	10	0		
Chromium (total)	20-100			627	0
Chromium VI	<0.50			4.5	0
Copper ¹	25-340			2330	0
Lead	43-590	450	1 from 13 (590 at TP3)		
Mercury	<0.10-0.65	170	0		
Nickel ¹	18-88	130	0		
Selenium	<0.20-0.72	350	0		
Zinc ¹	60-550			3750	0

1. Phototoxic parameters which may be detrimental to the growth and maintenance of plants

Table 8 - Summary of Inorganic Compound Analysis Results for Soils

Parameters	Range of Levels Found on Site (mg/kg)	CLEA SGV (mg/kg)	Proportion of Samples Exceeding CLEA SGV	LQM CIEH GAC (mg/kg)	Proportion of Samples Exceeding LQM CIEH GAC
Total sulphate	340-2800			2000 ¹	2 from 13 (2200 at TP3) (2800 at TP4)
Sulphate (2:1 water soluble) as SO ₄	0.016-0.15g/l			0.25g/l ²	0
Sulphide	1.3-130			200 ³	0
Thiocyanate	<5.0			20 ³	0
Cyanide (total)	<0.50			20 ³	0
Cyanide (free)	<0.50			20 ³	0

1. ICRL Threshold for buildings and hard cover (no CLEA SGV or LQM CIEH GAC values available)

2. Water Supply (Water Quality) Regulations 1989 and 2000 maximum

3. Dutch Intervention value (no CLEA SGV or LQM CIEH GAC values available)

Table 9 - Summary of Petroleum Hydrocarbon Analysis Results on Soils

Parameters	Range of Levels Found on Site (mg/kg)	CLEA SGV (mg/kg)	Proportion of Samples Exceeding CLEA SGV	LQM CIEH GAC (mg/kg) (@6% SOM ¹)	Proportion of Samples Exceeding LQM CIEH GAC
TPHs – 3 split					
TPH >C6-C10 (petrol)	<1.0				
TPH >C10-C21 (diesel)	330				
TPH >C21-C40 (min. oil)	30				
Total TPHs	360-7600			5000 ²	TP6 7600 at 0.25-0.35
TPH CWG aliphatic / aromatic split (detailed)					
TPH aliphatic >C5-C6	<0.10			55	0
TPH aliphatic >C6-C8	<0.10			160	0
TPH aliphatic >C8-C10	<0.10			46	0
TPH aliphatic >C10-C12	<1-1.7			230	0
TPH aliphatic >C12-C16	<1-33			1700	0
TPH aliphatic >C16-C21	<1-53			64000 (>C16-C35)	0
TPH aliphatic >C21-C35	<1-21			64000 (>C16-C35)	0
TPH aliphatic >C35-C44	<1			64000	0
TPH aromatic >C5-C7 (benzene)	<0.10			130	0
TPH aromatic >C7-C8 (toluene)	<0.10			270	0
TPH aromatic >C8-C10	<0.10			65	0
TPH aromatic >C10-C12	<1.0			160	0
TPH aromatic >C12-C16	<1.0-7.1			310	0
TPH aromatic >C16-C21	<1.0-31			480	0
TPH aromatic >C21-C35	<1.0-42			1100	0
TPH aromatic >C35-C44	<5.0-79			1100	0
Total TPHs (Aliphatic + aromatic)	<10-160			5000 ²	0

1. GAC values relevant to a soil organic matter content of 6% selected based on the average value for the site of 15.92%

2. Dutch Intervention value (no CLEA SGV or LQM CIEH GAC values available)

Table 10 - Summary of Other Organic Compound Analysis Results on Soils

Parameters	Range of Levels Found on Site (mg/kg)	CLEA SGV (mg/kg)	Proportion of Samples Exceeding CLEA SGV	LQM CIEH GAC (mg/kg) (@6% SOM ¹)	Proportion of Samples Exceeding LQM CIEH GAC
Volatile organic compounds (including but not limited to the following)					
Benzene	0.2	0.33	0		
Toluene	0.2	610	0		
Ethylbenzene	0.2	350	0		
o-Xylene	0.2	250	0		
m & p xylene	0.2	240+230	0		
Semi-volatile organic compounds					
Total phenols	<0.30-0.43	420	0		
Polyaromatic Hydrocarbons (PAH)s					
Acenaphthene	<0.10-2.3			1000	0
Acenaphthylene	<0.10-1.5			850	0
Anthracene	<0.10-5.4			9200	0
Benzo(a)anthracene	<0.10-21			5.9	4 from 13 (17 at TP2) (6.8 at TP3) (21 at TP4) (8.4 at TP5)
Benzo(a)pyrene	<0.10-19			1.0	9 from 13 (2.6-17 at TP2) (3.0-7.1 at TP3) (6-19 from TP4) (7.5 at TP5) (1.4 at M1) (3.6 at M3)
Benzo(b)fluoranthene	<0.10-24			7.0	5 from 13 (21 at TP2) (8.8 at TP3) (7.5-24 at TP4) (9.2 at TP5)
Benzo(g,h,i)perylene	<0.10-10			47	0
Benzo(k)fluoranthene	<0.10-11			10	1 from 13 (11 at TP4)
Chrysene	<0.10-24			9.3	3 from 13 (18 from TP2) (24 at TP4) (9.7 at TP5)
Dibenz(ah)anthracene	<0.10-2.2			0.90	5 from 13 (2.1 at TP2) (1.4 at TP4) (1.5 at TP4) (2.2 at TP5) (1.2 at M3)
Fluoranthene	<0.10-46			670	0
Fluorene	<0.10-2.4			780	0
Ideno(1,2,3-cd)pyrene	<0.10-12			4.2	3 from 13 (12 at TP2) (10 at TP4) (5.3 at TP5)
Naphthalene	<0.10-0.88			8.7	0
Phenanthrene	<0.10-25			380	0
Pyrene	<0.10-43			1600	0
PAHs (total)	<2.0-250			40 ²	7 from 13

1. GAC values relevant to a soil organic matter content of 6% selected based on the average value for the site of 15.92%

2. Dutch Intervention value (no CLEA SGV, LQM CIEH GAC or EIC AGS CL:AIRE GAC values available)

8.40 The above tables show that the principle contaminants are arsenic and lead (Table 7), isolated petroleum hydrocarbons (TPHs) (Table 9) and polyaromatic hydrocarbons (PAHs) (Table 10).

- 8.41 The high elevations in TPHs are associated with the former location of a fuel tank at TP6 where the highest total TPH concentration of 7600mg/kg was recorded at a depth of 0.25-0.35m. The TPH 3 split analysis on a deeper sample from the same location (1.55-1.60m) determined a total TPH concentration of 360mg/kg where the split showed the principal component (92%) to be diesel.
- 8.42 Table 8 also identifies 2 elevations in sulphate which are not considered significant from a human health risk point of view, but suggests that the use of sulphate resistant cement may be advised for building work.
- 8.43 The analysis for volatile organic compounds (VOCs), some of which (benzene, toluene, ethylbenzene and xylenes) are listed in Table 10, determined all VOCs to be below detection limits.
- 8.44 In addition to the above tabulated assessment, 13 of the soil samples were analysed for pH (acidity and alkalinity) which determined samples to range from pH6.6 to 8.3, with an average equating to 7.66 across the site and within the range which is considered acceptable.
- 8.45 Six soil samples from near surface locations and 2 from the soil mounds were also screened for asbestos, but no asbestos fibres were identified in any of the samples.
- 8.46 In March 2014 the Department for the Environment and Rural affairs (DEFRA) issued Category 4 Screening Levels (C4SLs) for a small number of substances and for a range of differing land uses to determine if a site is suitable for a proposed use and if such a site may be deemed to be contaminated in accordance with Part 2A of the Environmental Protection Act 1990.
- 8.47 The elevations in arsenic, lead and benzo(a)pyrene (a key PAH compound) determined at the subject site, have been assessed against the C4SLs and those concentrations found to be above the C4SLs for these substances are presented in Table 11 (below). This confirms that the site would not be suitable for the proposed use in respect of these substances at the concentrations determined.

Table 11 – Assessment Against DEFRA C4SLs

Parameters	C4SL (for residential use with home grown produce)	Proportion of Samples Exceeding CLEA SGV	Location and Depth (m)	Concentration (mg/kg)
Arsenic	37	5 from 13	TP2 (0.15-0.25)	49
			TP3 (0.05-0.15)	240
			TP3 (0.60-0.70)	77
			TP4 (0.15-0.27)	46
			TP4 (0.79)	39
Lead	200	4 from 13	TP1 (0.25-0.35)	270
			TP2 (0.15-25)	260
			TP3 (0.05-0.15)	590
			TP3 (0.60-0.70)	390
Benzo(a)pyrene	5	5 from 13	TP2 (0.15-0.25)	17
			TP3 (0.05-0.15)	7.1
			TP4 (0.15-0.27)	19
			TP4 (0.79)	6
			TP5 (0.30)	7.5

- 8.48 The elevated concentrations in TPHs, PAHs, arsenic and lead identified in the above assessment and which are considered significant enough to warrant remediation, are identified on Drawing No. 2.
- 8.49 Following the initial testing, selected soil samples in which highest concentrations in arsenic, lead and benzo(a)pyrene had been determined, were further tested for soil leachability in accordance with BS EN 12457 Part 2 to assess the potential for these substances to become mobilised into the groundwater. The results from this have been included in the controlled waters screening assessment.

Controlled Waters Screening Assessment

- 8.50 To assess the risk to controlled waters (surface and groundwater) a GQRA has been undertaken in which the chemical testing results on the groundwater sample from TP2 and the leachability testing results on selected soil samples elevated in arsenic, lead and benzo(a)pyrene have been assessed against health or environmental 'screening' criteria, termed Generic Assessment Criteria (GAC) selected from the following published guidance:-
- Water Supply (Water Quality) Regulations 2010;
 - Water Supply (Water Quality) Regulations 1989 (TPHs only);
 - Environmental Quality Standards (EQS) for inland surface waters;
 - Drinking Water Directive;
 - Surface Water Directive;
 - Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996;
 - Environment Agency Environmental Quality Standards contained in Appendix A to H1 Annex D-basic surface water discharges, v2.2 dated December 2011;
 - WHO Guidelines for Drinking Water Quality, third edition dated 2004.
- 8.51 The results of the soil leachability testing are presented as Appendix I and the results of the chemical analysis on the groundwater sample from TP2 are presented in Appendix J.
- 8.52 The results of the screening assessment are presented in Table 12 below, with the exceedances above the relevant GACs (if any) highlighted.

Table 12 – Controlled Waters Screening Assessment

Parameter	Generic Screening Value (µg/l)	Water	Soil Leachability				
		TP2 (µg/l)	TP1 (µg/l)	TP2 (µg/l)	TP3 (µg/l)	TP4 (µg/l)	TP5 (µg/l)
pH (acidity / alkalinity)	-	7.8					
Metals							
Arsenic	10 ^{1.3}	<1.0		3.1	3.6	2.2	
Boron	1mg/l ^{1.3}	0.55					
Cadmium	<0.45-1.5 ⁵	0.083					
Chromium	4.7 ⁵	<1.0					
Chromium (hexavalent)	3.4 ⁵	<20					
Copper	1-28 ⁵	3.7					
Lead	10 ³	<1.0	24	1.2	4.8		
Mercury	0.07 ⁶	<0.5					
Nickel	20 ^{1.3}	7.4					
Selenium	10 ^{1.3}	1.1					
Zinc	1-125 ⁵	55					
Inorganic Compounds							
Sulphate	250mg/l ^{1.5}	150					
Sulphide	0.25 ²	<50					
Thiocyanate		<500					
Cyanide (total)	1/5 ⁵	<50					
Total Petroleum Hydrocarbons – CWG (detailed)							
Total aliphatic	10 ¹	<5					

Parameter	Generic Screening Value (µg/l)	Water	Soil Leachability				
		TP2 (µg/l)	TP1 (µg/l)	TP2 (µg/l)	TP3 (µg/l)	TP4 (µg/l)	TP5 (µg/l)
Total aromatic	10 ¹	<5					
Total TPHs	10 ¹	<10					
Semi-Volatile Organic Compounds							
Total phenols	7.7 ^b	<30					
Polyaromatic Hydrocarbons							
Acenaphthene	-	<0.1					
Acenaphthylene	-	<0.1					
Anthracene	0.1 ²	<0.1					
Benzo (a) anthracene	-	<0.1					
Benzo (a) pyrene	0.01 ¹	<0.1		<0.1	<0.1	<0.1	<0.1
Benzo (b) fluoranthene	Sum 0.03 ²	<0.1					
Benzo (k) fluoranthene							
Chrysene	-	<0.1					
Dibenz (a,h) anthracene	-	<0.1					
Fluoranthene	0.1 ²	<0.1					
Flourene	-	<0.1					
Ideno (1,2,3-cd) pyrene	Sum 0.002 ²	<0.1					
Benzo (g,h,i) perylene							
Naphthalene	2.4 ²	<0.1					
Phenanthrene	-	<0.1					
Pyrene	-	<0.1					
PAHs (16 total)	0.1 ¹	<2					
Notes							
1. Water Supply (Water Quality) Regulations 2010 (UK drinking water standards) and 1989 Regulations for TPHs only							
2. Environmental Quality Standard (EQS) for inland surface waters							
3. Drinking Water Directive							
4. Surface Water Directive							
5. Surface waters (Abstraction for Drinking Water) (Classification) Regulations 1996							
6. Environment Agency Environmental Quality Standards contained in Appendix A to H1 Annex D-basic surface water discharges							

- 8.53 The results of the screening assessment on the water sample from TP2 identified all concentrations in substances to be either below their relevant GACs or below detection limits.
- 8.54 The leachability testing results have identified a slight potential for leaching of lead from the surface soils at TP1 into the groundwater, but the potential leachability of lead from TP2 and TP3 is low enough to be considered acceptable. The potential leachability of arsenic from soils at TP2, 3 and 4 is also considered low enough to be acceptable. The leachability testing results also failed to identify a potential for the leaching of benzo(a)pyrene from TP2, 3, 4 and 5 into the groundwater.

9 Revised Conceptual Site Model and Risk Assessment

- 9.1 The revised conceptual site model (CSM) with risk assessment for the proposed demolition of the two existing buildings and the erection of two detached residential dwellings is presented in tabulated format in Appendix K.
- 9.2 This identifies a number of potentially viable pollution linkages, from which a number of unacceptable risks have been identified, which are summarised below.

Table 13 – Summary of Main Risks

Nature of Risk	Level of Risk
Risk to construction workers and future occupants from elevated concentrations in soils of petroleum hydrocarbons from a former fuel tank within soils at TP6 and arsenic, lead and PAHs (including benzo(a)pyrene) at other locations.	Low-Moderate
Risk to future occupants from the degradation of the drinking water supply pipe from petroleum hydrocarbons.	Low-Moderate
Risk to groundwater from petroleum hydrocarbons in soils at the location of a former fuel tank (TP6) and from lead in surface soils at TP1.	Low-Moderate
Risk to building structures from elevated concentrations of sulphate in soils at TP3 and TP4.	Low-Moderate
Risk to construction workers from the proposed demolition of the large shed building containing corrugated asbestos cement (chrysotile) sheet roofing and cladding and from other potential asbestos containing materials that may be located elsewhere within the building fabric.	Moderate
Risk to neighbouring residents from potential windblown dust during dismantling of the asbestos cement sheet roofing and cladding to the large shed.	Low-Moderate

- 9.3 A strategy to reduce the levels of risk to acceptable levels is set out in the Remediation Statement presented as Appendix L.

10 Conclusions and Recommendations

- 10.1 The Phase 2 investigation which is the subject of this report follows on from the '*Phase 1 Contamination Audit*' for the site prepared by A.L.H Environmental Services on behalf of the client in February 2012. The Phase 1 report identified the historical uses of the site as a brickworks, depot and builders yard, as potential sources of historical contamination. An unbunded above ground waste oil tank, stockpiles of topsoil and a stockpile of asbestos sheeting at ground level were also identified as potential point sources of contamination.
- 10.2 A further inspection of the site at the time of the Phase 2 investigation identified the following:
- Confirmation of the unbunded waste oil tank remaining (with residual contents);
 - The former location of at least one other tank adjoining the north eastern corner of the existing brick barn;
 - 2 no. old and rusted 205 litre full or partially full metal drums;
 - A water filled brick lined vehicle inspection pit within the larger shed.
- 10.3 The Phase 2 (intrusive) investigation was undertaken on 20 November and involved the mechanical excavation of 6 trial pits to depths of between 0.9 and 1.6m, the preliminary screening on site of 21 soil samples for volatile vapours and the chemical analysis of 16 soil and 1 groundwater sample.
- 10.4 Trial pit depths were restricted by rapid groundwater inflows or the presence of small stone lined culverts or unstable sides or the confirmation of natural or reworked natural strata being encountered making deeper excavation unnecessary.
- 10.5 The Made Ground was encountered at all trial pit locations and generally comprised a surface crust of dark grey soils with various combinations of old tarmac, gravelly ash, road scalplings, sandstone hardcore and bricks to depths of between 0.27 and 0.40m. The locations where the Made Ground extended beyond this depth included the following:
- TP2 - where the deeper fill extends to 1.0m and comprises a firm dark gravelly ash with occasional metal and glass bottle fragments (old bottle ash fill within part of a former pond);
 - TP3 - where there was a 0.20m wide section cutting across the pit to a depth of 0.65m backfilled with red ash/clinker gravel representing the backfill to a trench excavated for a land drain;
 - TP4 - where the depth of the deeper fill comprises weathered mudstone to a minimum depth of 0.9m within part of another former pond;
 - TP6 - adjoining the location of a former fuel tank where the fill comprises a slightly gravelly sandy silt to 0.55m.
- 10.6 Natural (or reworked natural) soils comprise a firm to stiff grey and yellow/orange Clay from depths of 0.35-1.00m and at TP3, TP5 and TP6, the reworking of the Clays was identified to be associated with the existence of a land drain (0.8m at TP3) or stone culverts (1.15m at TP5 and 1.60m at TP6).
- 10.7 Natural groundwater was encountered at 3 locations at depths ranging from 0.7 to 1.0m and indicated the likely direction of groundwater flow to be to the south and south east. Occasional small globules of a faint coloured sheen were observed to the groundwater surface at TP2.
- 10.8 The chemical assessment identified soil contamination from arsenic, lead, polyaromatic hydrocarbons (PAHs) and isolated petroleum hydrocarbons (TPHs).

- 10.9 With the exception of the TPHs associated with TP6, the contaminants generally appear to be associated with the old tarmac, gravelly ash, road scalplings, sandstone hardcore and brick fill within the top 0.27-0.40m which appears to extend across a large part of the site. This material would be unsuitable to be retained on site within the proposed garden areas regardless of the levels of contamination.
- 10.10 In terms of the lateral extent of the contaminated surface fill, it is difficult to estimate this accurately based on the limited number of trial pits, but rough calculations based on the available information suggest this may be between 550 and 850m². On this basis removal to an average depth of 0.35m could equate to a possible volume of between 190 and 300m³. Validation testing will be required following removal to prove that any remaining concentrations are acceptable.
- 10.11 Hotspot locations have also been identified at the following locations where some over-digging will be required around the trial pit.
- TP1 - 16m² to 0.40m to remove soils elevated in lead;
 - TP3 - 16m² to 0.75m to remove soils elevated in arsenic, lead and PAHs;
 - TP6 - 25m² to 0.6m to remove soils significantly elevated in TPHs.
- 10.12 It is estimated to remove the hotspots around TP1, TP3 and TP6, approximately 33m³ of soil would need to be removed followed by validation testing of the excavation bases and sidewalls.
- 10.13 It is considered that the deeper bottle ash fill encountered from 0.37m at TP2 is suitable for the proposed use as part of a residential garden in terms of contamination levels and can remain although it is assumed that this will be covered with a suitable thickness (approximately 0.35m) of topsoil material which will need to be chemically validated to be clean.
- 10.14 It should be possible for the arsenic and benzo(a)pyrene concentrations identified at 0.79m at TP4 to remain since they are only slightly above their Category 4 Screening Levels for residential use and isolated at this depth unlikely to present a risk to end users following removal of the top 0.27m and replacement with topsoil chemically validated to be clean. Arsenic and benzo(a)pyrene are also none leachable at this location and therefore do not present a risk to groundwater.
- 10.15 Soil leachability testing on samples elevated in arsenic, lead and PAHs indicates that as an alternative to excavation and removal from site, and subject to the approval of Kirklees Council, it may be possible to deal with at least some of the contaminated surface fill (excluding hotspot excavations at TP1 and TP6) by burying it beneath the proposed driveway / entrance and footings of the proposed buildings and reusing any suitable clay soils excavated from this location for landscaping elsewhere on site.
- 10.16 It may also be possible to excavate a void beneath the proposed building footprints, reusing any suitable materials from such excavations elsewhere on site and using the void for the backfill compaction of the contaminated surface fill and capping with concrete. Taking this a step further, the ground floor levels within the proposed buildings could be raised slightly to accommodate a larger volume of fill, although it is recognised that the planning officer (in addition to the Contaminated Land Officer) would also need to be consulted to avoid being in contravention of the planning consent.
- 10.17 Elevations in sulphate have been identified in 2 of the soil samples and whilst these are not considered significant from a human health risk point of view, they suggest that the use of sulphate resistant cement may be required for building work.

- 10.18 In respect of the soil mounds (M1, M2 and M3), the chemical assessment has shown that these soil stockpiles would be suitable for reuse on site during the proposed redevelopment.
- 10.19 In respect of the risk to controlled waters, the assessment has identified a low to moderate risk to groundwater from elevated lead in soil from TP1 which will be mitigated following the excavation and removal from site outlined in paragraph 10.11.
- 10.20 In respect of the main objectives of the report set out in paragraph 8.1, the results of this assessment indicate the following:
- There is a risk of the serviceability of the site for its proposed residential use to be impacted unless some remedial treatment is undertaken;
 - With the exception of a low to moderate risk to neighbouring occupants during demolition, there is a low risk of an impact on the wider environment (controlled waters and surrounding uses) and therefore the risk of environmental liability to surrounding third parties is low;
 - There is a low risk of the site being designated as contaminated land under Part 2A of the Environmental Protection Act 1990.
- 10.21 A Remediation Strategy setting out the mitigation measures to deal with the environmental risks has been prepared in accordance with Condition 7 of the planning permission. This has been incorporated into a Remediation Statement presented as Appendix L which will need to be agreed with the Contaminated Land Officer of Kirklees Council prior to commencement.
- 10.22 Upon the satisfactory completion of the remedial measures a Validation Report will need to be submitted to the Council in accordance with Condition 9 of the planning permission to verify that the measures have been completed in accordance with the agreed strategy. It will therefore be necessary to maintain detailed records relating to the completion of the agreed remedial measures, recording dates, organisations involved, photographs, drawings, chemical testing results and waste transfer / consignment notes etc, for inclusion in the Validation Report.
- 10.23 In addition to the above, it has been highlighted within the Coal Authority Mining Report that a prudent developer should seek appropriate technical advice before any works are undertaken. This is due to possible shallow mine workings and the close proximity of an abandoned mine entry.

11 Risk Overview

11.1 It is considered that the overall level of environmental risk is **Low to Medium** given the information in this assessment. This risk classification forms part of RICS guidance and is designed to consider environmental risk in the context of the proposed redevelopment of the site for 2 detached dwellings in accordance with planning consent 2012/62/90390/E. This may be set in the following hierarchy of risk:

High : Significant risk of contamination without remediation. Precludes all but the least sensitive of development, e.g. car parking. Significant potential for environmental pollution. Remediation measures expensive. Site investigation required.

Medium : Risk of contamination but allowing non-sensitive development, e.g. commercial, for reasonable costs of remediation, although more sensitive development, e.g. housing, may require substantial remedial measures. Potential for environmental pollution. Site investigation may be required.

Low : Little risk of contamination where all development options are likely to be possible with little or no remediation measures. Little potential for environmental pollution. Confirmatory site investigation may be required.

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Date: 19th January 2015

12 Report Limitations

- 12.1 This report has been produced by AC Environment Solutions Limited for the site referred to as Land Adjoining 23 Jagger Lane, Emley Moor, Huddersfield, West Yorkshire, HD8 9SY on behalf of R & B Schofield Building Contractors solely for the use of the client and their professional advisors with whom the assignment has been agreed.
- 12.2 AC Environment Solutions Limited accepts no responsibility or liability for the consequences of the document being used for any project or purpose other than that for which it was commissioned, or by any third party with whom an agreement has not been executed. Written approval must be sought from AC Environment Solutions Limited should any third party wish to use or rely upon its contents and a charge may be levied against such approval.
- 12.3 The opinions expressed in the report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information which has been reviewed should not be considered exhaustive and has been accepted as providing true and representative data pertaining to site conditions in good faith.
- 12.4 Should additional information become available which may affect the opinions expressed in this report, AC Environment Solutions Limited retains the right to review such information, and, if warranted, to modify the opinions accordingly.

Drawings

Appendix A

Planning Consent 2012/62/90390/E

Appendix B
Site Inspection Photographs

Appendix C
Coal Authority Mining Report

Appendix D
Site Investigation Specification

Appendix E
Site Investigation Photographs

Appendix F
Trial Pit Records

Appendix G
PID Calibration Certificate

Appendix H

Chemical Analysis Results on Soil Samples

Appendix I

Leachability Testing Results on Selected Soil Samples

Appendix J

Chemical Analysis Results on Groundwater Sample

Appendix K

Revised Conceptual Site Model and Risk Assessment for the Proposed Use

Appendix L
Remediation Statement