



**ENVIRONMENTAL
MANAGEMENT SOLUTIONS**

Phase One Desk Study Report

Satnam Planning Services Limited

Proposed Residential Development
Land at Peel Hall Farm
Warrington
Cheshire

EMS5414a

Environmental
Management Solutions
24th August 2015

Satnam Planning Services Ltd

Proposed Residential Development, Land at Peel Hall Farm, Warrington

Phase 1 Desk Study Report

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1. Introduction

Satnam Planning Services Ltd, (the Client) of 17 Imperial Square, Cheltenham, Gloucestershire, GL50 1QZ, has commissioned Environmental Management Solutions Limited (EMS) to undertake a Phase 1 Desk Study investigation for a proposed primarily-residential development at land at Peel Hall Farm, Warrington.

The site is approximately centred at National Grid Reference 361455 391746. The site currently predominantly comprises disused farmland located between the northern edge of Warrington and the M62 motorway. The site measures approximately 1,900 m in maximum length (east to west), and 600 m in maximum width (north to south). A site location and boundary plan provided by the Client is included as Appendix A of this report.

The desk study includes review of environmental database information and historical maps provided by Groundsure. A site walkover survey has been undertaken. Relevant pollutant source, pathway and receptor linkages have been considered and a tabular conceptual model has been produced to allow an assessment of the level of risk to each receptor. Recommendations have been given for intrusive investigation of the site.

2. Objectives of the investigation

2.1 Objectives of the investigation

The objectives of this desk study were:

- to provide information on past and current uses of the site and surrounding area and the nature of any related hazards and physical constraints;
- to identify current and likely future receptors, potential sources of contamination and likely pathways, and any features of immediate concern, including those that could be introduced in future;
- to provide information on the geology, geochemistry, soil, hydrogeology and hydrology of the site;
- to identify potentially different sub-areas (zones) of a site, based on differing ground conditions; potential contamination; and past, present and future uses;
- to produce an initial conceptual model for the site as a whole and/or for zones within the site;
- to provide information for a preliminary risk assessment;
- to provide data to assist in the design of potential subsequent exploratory and main investigations and to give an early indication of possible remedial requirements;

- to provide information relevant to worker health and safety and to the protection of the environment during field investigations;
- to identify any need to involve regulatory bodies prior to intrusive investigation;
- to provide preliminary geotechnical information regarding the site and guide any intrusive geotechnical investigation;
- to provide a phase 1 desk study report to be submitted in support of an outline planning application.

2.2 Scope of work

The scope of work was developed in accordance with the Environment Agency and Department for Environment Food and Rural Affairs (DEFRA) document 'Model Procedures for the Management of Land Contamination' Contaminated Land Report (CLR) 11, dated 2004 and the British Standards Institution publication 'BS 10175:2011+A1:2013 – Investigation of Potentially Contaminated Sites – Code of Practice.

2.3 Management limitations

- The report has been prepared under the express instructions and solely for the use of the Client and the Clients agents.
- The findings of this report represent the professional opinion of experienced contaminated land consultants. EMS does not provide legal advice and the advice of lawyers may also be required.
- All work carried out in preparing this report has utilised and is based upon EMS's current professional knowledge and understanding of current relevant UK standards and codes, technology and legislation. Changes in this legislation and guidance may occur at any time in the future and cause any conclusions to become inappropriate or incorrect. EMS does not accept responsibility for advising the Client or other interested parties of the facts or implications of any such changes.
- The report is limited to the site boundaries identified by the Client and confirmed within this report.
- The extent of the investigation was designed in-line with the Client's budget, which is considered suitable, and not limiting, for the proposed development.
- This report represents the conditions and findings on the date of desk study. Over time, site conditions may alter.

3. Land use and setting

3.1 Future land use

The development of the majority of the site for residential purposes is proposed. Many of the proposed houses will have gardens in which residents may grow vegetables for their own consumption. It is understood that, in addition to residential properties, the development will also include a small amount of commercial/industrial space and a local retail centre. A fifty metre wide strip adjacent to the M62 motorway (which runs along the northern site boundary) will not include residential properties due to noise and air quality factors.

A proposed master plan for the development was under construction at the time of writing of this report but was not ready for distribution or inclusion in this report.

3.2 Recorded current land use

The Groundsure Enviro-Insight report (included as Appendix B) indicates one potentially contaminative industrial use at the site itself. This is an electrical sub-station located at the north-eastern corner of the recreation ground in the far east of the site (just outside the site boundary). A further eight features are identified within 100 m of the site. Four of these are electricity sub-stations, all over 25 m from the site. Three gantries are recorded on the M62, to the north of the site. Brickfields Garage (vehicle repair, testing, and servicing) is recorded 43 m west of the site at 7 Newhaven Road (in a predominantly residential area).

The closest recorded petrol or fuel site is Winwick Service Station located 321 m to the south-west. This record is recorded as obsolete.

3.3 Previous investigation works

No previous investigation reports relating to the site have been obtained. However, a number of borehole logs relating to the site are described below, in Section 3.4. These records relate to investigations undertaken between 1973 and 1993, with the majority of the records dating back to the 1970s.

3.4 Geological information

Geological mapping included in the Groundsure Geo-Insights report (Appendix C) indicates the site to be underlain by four different superficial deposits. The far western end of the site is underlain by the Shirdley Hill Sand Formation (sand). The central part of the site is underlain by Glaciofluvial Deposits (sand and gravel), and the eastern part of the site is underlain by Glaciofluvial Sheet Deposits (sand and gravel). A small south-eastern corner of the site, close to Radley Lane, is underlain by Till (normally gravelly clay).

The superficial deposits are underlain by 'solid' strata of the Chester Pebble Beds Formation (pebbly sandstone), in the north-western half of the site, and the Wilmslow Sandstone Formation (sandstone), in the south-eastern half of the site. Both these geological units are part the Sherwood Sandstone Supergroup of Triassic age.

The site is not listed as being in a brine compensation area. This concludes with the anticipated geology, as the evaporates of the Mercia Mudstone Group which are targeted by brine extraction, and for gypsum and salt mining, are geologically above the Sherwood Sandstone Group, and are therefore not present, at any depth, beneath the site.

The British Geological Survey (BGS) holds borehole and trial pit logs from some previous ground investigations (donated by consultants and similar) in a database. Many of these records are publicly available. Thirty-one such logs are listed within the site boundary. Of these twenty-six contain useful information and have been downloaded. The logs are included as Appendix D. The purpose of many of the boreholes is unclear. The majority of the boreholes are scattered around the eastern section of the site. A cluster of boreholes is located adjacent to Spa Brook, in the centre of the site.

The boreholes show much of the site to be underlain by firm and stiff clay, with variable sand and gravel content, and bands of sand. Weathered sandstone is present at depths generally between two metres and six metres. A significant depth of Made Ground was identified only in one location, in the east of the site. The borehole log (BGS scan reference 17333984) records 2.4 m of Made Ground comprising firm brown sandy clay with red sand, sandstone fragments, and occasional rock fragments.

A little over half of the boreholes remained dry through drilling. The remaining boreholes recorded groundwater strikes at depths ranging between 0.50 m and 3.70 m.

Based on the anticipated ground conditions the British Geological Survey (via their natural ground stability dataset) describes the following levels of ground stability hazard at the site:

Hazard Type	Hazard Rating
Shrinking/swelling clays	Negligible / very low
Landslides	Very low
Ground dissolution of soluble rocks	Negligible
Compressible deposits	Negligible
Collapsible deposits	Very low
Running Sand	Very low / low

The hazard rating of low for running sand was recorded in the westernmost part of the site, correlating with the Shirdley Hill Sand Formation.

The site is not within an area, as described by the BRE report BR211, where radon protective measures are required within new dwellings or extensions. However, prior to construction, it is recommended that the relevant building control agency is contacted to check their particular requirements which may stipulate use of radon protective measures on a strongly precautionary basis.

3.5 Coal mining

The site is identified as being within a coal mining area. As a result a Coal Authority Mining Report has been obtained for the site. The report indicates that the site is within the zone of influence from workings in four seams of coal at depths between 750 m and 1,130 m, last worked in 1992. The report states that movement from these workings should have stopped by now. There are no known mine entries within, or within 20 m of, the boundary of the site.

There are records of four properties at (or in close proximity to the site) making a damage notice or a claim for alleged subsidence damage. All four claims were discharged by repairs, as summarised in the following table:

Address of subsidence claim	Date of claim	Distance from site	Cost of repairs
Peel Hall Farmhouse, Radley Lane, Houghton Green, WA2 0TA	September 1996	Enclave surrounded by site	£7,174
Sycamore Cottage, Radley Lane, Houghton Green, WA2 0SY	March 1999	Enclave partially surrounded by site	£2,895
The Millhouse, Ballater Drive, Cinnamon Brow, WA2 0LX	March 1995	Within site	Not stated
16 Radley Lane, Houghton Green, WA2 0SY	February 1999	Immediately adjacent to site	£1,462

The Coal Authority Mining Report is included as Appendix E of this report.

3.6 Landfills and in-filled land

As recorded by the Groundsure Enviro-insight report, the Environment Agency list no current authorised landfills within 500 m of the site. The Environment Agency list a single historical landfill within 500 m of the site. This is the Winwick Quay landfill, located 311 m south-west of the site. Neither the Groundsure report or the Environment Agency's website contain much information on this landfill, but they do map it as being very small in area and being located beneath residential properties.

No other waste treatment, transfer, or disposal sites are recorded within 500 m.

3.7 Hydrogeology and hydrology

The 'solid/bedrock' deposits of Sherwood Sandstone Supergroup (Bunter Pebble Beds and Wilmslow Sandstone Formation) which underlie the site, are listed as Principal Aquifers. The overlying superficial deposits (Shirdley Hill Sand Formation, Glaciofluvial Sheet Deposits, and Glaciofluvial Deposits) are considered to be Secondary-A-Aquifers. The Till, marked only in a small south-eastern corner of the site, is considered to be Unproductive Strata.

The closest identified groundwater abstraction is an abstraction from a well/borehole at a location 497 m north of the site. The abstraction is registered to United Utilities Water PLC and is for public drinking water supply. This is listed as active.

The whole site is within a Zone 3 (total catchment) source protection zone. This appears to relate to the groundwater abstraction 497 m north of the site.

The closest identified surface water bodies are a number of drains and ponds located within the site itself. The only named surface water body at the site is the Spa Brook which runs from north to south through then centre of the site, to sink beneath the adjacent housing estate, probably in an artificial culvert.

3.8 Ecologically sensitive sites

No sites of particular ecological sensitivity, such as nature reserves, or sites of special scientific interest, have been recorded in close proximity to the site.

3.9 Flood information

The EA flood mapping service does not indicate the site to be in an area at particular risk of flooding.

4. Site history

4.1 History of the site

The history of the site has been surmised from historical map editions which are included within this report as Appendix F.

The earliest map edition obtained is dated 1849. The site is located in, and surrounded by, open fields. A watercourse, the present day Spa Brook, runs from north to south across the site. A number of small ponds are situated within the site boundaries. Peel Hall, and an associated well, is situated in an enclave (not part of the site, but surrounded by the site) in the north of the site. A long L-shaped building (probably a farm building) is located to the south of Peel Hall, and extends into the site proper. A track runs through the site, east from Peel Hall, to Birch Tree Farm and the small village of Houghton Green, to the east of the site. A small lane runs through the far south-eastern corner of the site.

The surrounding land comprises further fields with occasional tracks. The surrounding area comprises further agricultural fields, with occasional woods, farmsteads and small villages. A corn mill is identified approximately 150 m to the south-east of the site. A feature named Arbury Pits is located approximately 50 m to the north of the site. A tan yard, later labelled as a tannery, is marked in the village of Orford, some 700 m to the south.

The 1891 map edition shows the present day Radley Lane to run from north to south across the eastern end of the site, running from Houghton Green to Radley Farm which is situated immediately to the south of the site. An area of woodland is marked to the south-west of the assumed farm buildings at Peel Hall.

The 1905/1906 map edition marks a well at Peel Cottage. This appears to be just outside the site boundary in the eastern part of the site.

The 1926 map edition shows further small watercourses (drains) running through the central part of the site. These follow earlier field boundaries. A further building has been constructed

to the south of Peel Hall. The Orford Tannery (some 700 m to the south) has become a large complex by this stage, spreading to approximately 100 m by 100 m and including filter beds. Judging by the direction of flow of local watercourses, the tannery appears to be downstream of the site, and therefore is considered unlikely to impact the site. A small quarry is present 250 m to the north-west of the site. This is labelled as disused.

The 1938/1939 map edition shows a large new housing estate to have been built 500 m to the south-west of the site, and a smaller new housing estate to have been built immediately to the west of the western end of the site. This estate appears to be served by a sewage disposal plant located in the south-west of the site. The plant is marked as a large circular enclosure containing two smaller rectangular buildings. A hospital has been constructed 100 m to the north of the western end of the site.

The 1947/1949 map edition shows much further development to have occurred in the area 300 m to over one kilometre to the south-east of the site. Part of this area is labelled as a training camp, and by the fast rate of development and the neat layout it is considered likely that this area is a military barracks or similar. Internet research indicates that this facility was the Risley Royal Ordnance Factory, constructed during the Second World War to manufacture finished munitions.

The 1967 map edition no longer labels the sewage disposal plant in the west of the site, although the near circular enclosure is still present. The area to the south of the plant is now marked as allotment gardens. A small elongated building, possibly domestic garages, is marked in the far west of the site. Six small squares, labelled as masts are present in the south of the site. One of these appears to be linked to a new building. The building is linked to Peel Hall, in the north of the site, by a track. A further building has been constructed alongside the other two assumed farm buildings to the south of Peel Hall. A new pond is marked to the west of Spa Brook.

A very large housing estate now extends all the way to the southern boundary of the site (in the central part of the site). The Spa Brook appears to be culverted beneath this housing estate.

The 1975 map edition shows the M62 motorway to have been constructed immediately to the north of the site. The eastern and western sections are within cuttings. Further houses have been built up to the southern site boundary in the western part of the site. The masts, and associated building and track, in the south of the site, are no longer marked.

The 2002 map edition shows a reservoir close the M6 motorway, 600 m to the north-east of the site. The assumed farm buildings to the south of Peel Hall have been demolished and woodland is growing in their place. A recreation ground is marked in the far east of the site, and a public house, the present day Mill House, has been constructed in the south-east of the recreation ground area.

The 2010 map edition shows the present day NHS building to have been constructed in an enclave in the far west of the site.

The 2014 map edition shows the hospital to the north of the site, on the far side of the M62 motorway, to have been demolished and replaced with new buildings.

5. Site reconnaissance

5.1 Walkover survey

Site area

A site walkover survey was undertaken on 13th August 2013 by an experienced Geo-Environmental Engineer. Prior to the walkover survey a note was made of all features of interest identified by the other parts of the desk study investigation. These were visited whilst the site was toured in a clockwise loop originating in the western corner which also allowed inspection of the remaining parts of the site. It should be noted that some areas of the site were significantly overgrown and that only limited inspection could be undertaken in these locations. Photographs taken during the site walkover survey are included as Appendix G.

The majority of the site area is occupied by disused agricultural fields. Many of the fields had been mown recently, but it appeared that they had not been planted or ploughed for some time. The land surface was very rough, as if it had been ploughed before allowing it to become overgrown. Some parts of the fields were overgrown with bushes and young trees which had not been cleared. A number of overgrown mature hedges were present around watercourses. Dense reeds were also present around watercourses, preventing detailed inspection of these features.

Ground levels drop from approximately 17 m AOD in the north-western corner to around 11 m AOD in the central part of the site, before rising again to approximately 17 m AOD in the north-eastern part of the site. A number of drains and the Spa Brook are present in the central part of the site. These appear to be artificial watercourse created to help drain the farmland. The layout and topography of the site is shown on the topographic survey drawing provided by 3D Reid which is included as Appendix H of this report.

In the north-western area of the site, a raised manhole cover raised on concrete rings was identified, indicating the presence of underground services. The location of this manhole is shown on the topographic survey drawing.

A ground-working identified by the Groundsure report, located close to Newhaven Road, in the south of the site, was identified on site as an overgrown and reed filled depression. The Spa Brook, further to the east, was similarly overgrown. In one location where it could be accessed at the corner of fields where it is bridged, it was identified to contain shallow flowing water.

In the north of the central part of the site a path leads from a footbridge across the motorway around and across the fields and around Peel Hall (an enclave within the site). The land to the south-west of Peel Hall is wooded, with a ditch and a footpath leading southwards along the eastern edge of the woods. A short distance along this path a pile of corrugated asbestos cement debris was noted at the side of the path, with some of the material spilling onto the path. The pile of material measured approximately 7 m by 5 m. It appears that the asbestos cement material is being regularly trampled, broken and dispersed by members of the public using the footpath. A sample of this material was taken and the material was confirmed as chrysotile cement by Scopes Asbestos Analysis Services Limited (UKAS accredited laboratory number 2707). The laboratory test certificate is included as Appendix I. Some of the surrounding woodland appeared to be utilised by members of the public and fragments of the asbestos cement were noted to be spread across a wide area. The topographic survey drawing records the presence of concrete slabs in the area to the north-west of the mound of asbestos cement; this is the location of the former assumed farm buildings shown on the historical maps.

A track surfaced with crushed macadam leads through former disused agricultural fields past Peel Hall, to Radley Lane. The field to the north of this track is the location identified on borehole logs (discussed in Section 3.4) to contain 2.70 m of Made Ground. No suggestion of the presence of Made Ground, such as anthropogenic material or unusual ground contours, was identified by EMS in this location during the site walkover survey.

The easternmost section of the site is separated from the remainder of the site by Radley Lane, a small road leading to Radley Farm, to the south of the site. The land to the east of Radley Road is occupied by a Recreation Ground. The closely mown central part of the site is surrounded by trees and shrubs. A football pitch is located in the eastern part of the ground and a gravel parking area is situated in the southern part of the ground. The Mill House public house and associated car park are located in the south-eastern corner.

Working back across the southern part of the site: A pond inside the site boundary, to the north of Radley Plantation was heavily overgrown and could not be closely inspected. The southern central part of the site is more heavily overgrown than the remainder of the site and has been only partially mown. A further overgrown reed covered depression is present in this area. The southern part of the Spa Brook is surrounded by reeds and may form a larger wetland area in winter, wetter, conditions.

The south-western tip of the site is heavily overgrown with brambles, bracken, and some raspberry plants – possibly relating to the former use of this part of the site as allotments. A large T-shaped crumbling concrete structure, approximately 1.20 m in height and five metres across was identified in the location of the former water treatment plant. A further smaller concrete structure was situated nearby.

Surrounding land

The land surrounding the site is again described from the western end of the site, in a clockwise direction around the site. The site was accessed from Birch Avenue. The long thin building identified on historical map editions as a possible row of domestic garages is no longer present. A widened pavement area suggests their former presence. Birch Avenue contains two storey houses with gardens. Similar properties along Elm Road line the western site boundary up to the northern site boundary.

A gated macadam surfaced track runs immediately to the north of the site boundary, linking Elm Road with a small un-manned wastewater pumping station. The M62 motorway is situated to the north of the track and immediately to the north of the remainder of the site. The motorway travels through cuttings in the east and west of the site and is raised on an embankment against the central part of the site. A footbridge crosses the motorway close to the central part of the site.

Peel Hall, an enclave in the central part of the site appears to be a combined residential property and boarding kennels.

The eastern part of the site is bounded by further houses on Mill Lane, Radley Lane, and Ballater Drive. A larger road runs alongside the eastern edge of the recreation ground. A small brick electrical substation is located immediately outside the north-eastern corner of the site. Peel Cottage, a further enclave inside the site comprises a run-down house and yard area. The boundary between the site and the southern part of Radley Lane includes a drain, an overgrown hedgerow, and many trees. A large number of trees are present around the southern site boundary in this area.

The main building of Radley Farm, to the south of the site, appears derelict. A new two storey brick house has been built a little to the east. Further to the east, Radley Plantation, an area

of mature trees, is present. A pond is present at the northern tip of this area, adjacent to the site boundary.

To the south of the central part of the site a hall which is marked on ordnance survey plans is no longer present. The building has been demolished but the concrete floor slab remains. From this point further low rise houses surround the site as far as Birch Avenue. At Birch Avenue, a partial enclave in the site is occupied by a modern NHS facility. This houses the Fairhaven/the Alders Young People's Unit which treats mental health problems. A tall and robust looking fence around the facility suggests that it is a secure unit.

5.2 Tanks and associated structures

No fuel tanks or evidence of former fuel tanks has been identified at or close to the site by the site walkover survey. Historical maps (described in Section 4.1) indicate the former presence of a sewage disposal plant which would have included large tanks.

5.3 Services

No information on underground services has been obtained as part of this desk study. Manholes and a sewage pumping station have been identified in the north of the western part of the site indicating that some underground services do cross the site.

5.4 Information provided by local residents and the Client

Limited anecdotal information was provided by members of the public resident in nearby properties who engaged with the Geo-Environmental Engineer during the site walkover survey.

The rough nature of the surface of the site is reportedly deliberate. The site was 'furrowed' in order to prevent car criminals from driving across it as a means of escape from the police. The resident indicated that the land had last been farmed approximately two years ago and has only been mown recently.

The resident also stated that, as a child, his wife used to play in caves within the site. It is suspected by EMS that the caves may be small features dug into earth banks by children, or maybe even animals. The sand based soils anticipated to be present at the site would be easy to excavate in this manner. EMS has been unable to find any other reference to caves at or close to the site.

The Client reports that they have owned the site since the 1980s, and during that time no farming has been undertaken at the site. Prior to that the site was owned by Warrington New Town, and prior to that it was working farmland.

6. Conceptual model

6.1 Potential Sources

The majority of the site is disused agricultural fields. For the majority of these areas no significant potential sources of contamination have been identified. However, across the site, and the immediate surrounds of the site, a number of localised potential sources of contamination have been identified. These potential sources of contamination are described in the following tables:

Potential Source Area On-Site	Potential Contaminants
Numerous small ponds, former ponds, and ditches.	Carbon dioxide and methane if sufficient organic sediments are present.
Former domestic garages in western end of site.	Asbestos, if used in construction of these buildings. Fuel and lubricant hydrocarbons. Heavy metals.
Former assumed farm buildings to the south of Peel Hall Farm (a heap of asbestos cement has been identified in this area).	Asbestos, heavy metals, PAH, fuel and lubricant hydrocarbons.
Area of former masts and associated building in south of site.	Asbestos, heavy metals, PAH, fuel and lubricant hydrocarbons, PCBs from possible transformers.
Former sewage disposal plant in west of site. Reference has been made to the 1995 DoE Industry Profile for Sewage Works and Sewage Farms.	Heavy metals, cyanides, chlorides, fluorides, ammonium, nitrates, phosphates, pesticides, fuel oils, PCBs, pathogens, various treatment chemicals as listed in the DoE profile, asbestos. Methane and carbon dioxide if sludge is buried.
Former allotment gardens in west of site.	PAH and heavy metals (from ash used as fertiliser).

Potential Source Area Off-Site	Potential Contaminants
Small electrical sub-station close to eastern corner of site.	PCBs.
The Winwick Quay historical landfill	Methane and carbon dioxide

The location of each of these potential source areas is shown on the annotated site plan (Appendix J).

6.2 Potential receptors

Human Health:

The construction of residential properties is proposed across the majority of the site. The properties will have gardens in which residents may grow food for their own consumption. This is considered likely to be the most sensitive land use. Employment areas and a local retail centre will be less sensitive to soil contamination.

Construction workers may be exposed to contamination during redevelopment.

Residents of neighbouring properties may be affected by dust or surface water from the site.

Controlled Waters:

The 'solid/bedrock' deposits of Sherwood Sandstone Supergroup (Bunter Pebble Beds and Wilmslow Sandstone Formation) which underlie the site, are listed as Principal Aquifers. The overlying superficial deposits (Shirdley Hill Sand Formation, Glaciofluvial Sheet Deposits, and Glaciofluvial Deposits) are considered to be Secondary-A-Aquifers. The Till, marked only in a small south-eastern corner of the site, is considered to be Unproductive Strata.

The closest identified groundwater abstraction is an abstraction from a well/borehole at a location 497 m north of the site. The abstraction is registered to United Utilities Water PLC and is for public drinking water supply. This is listed as active.

The whole site is within a Zone 3 (total catchment) source protection zone. This appears to relate to the groundwater abstraction 497 m north of the site.

The closest identified surface water bodies are a number of drains and ponds located within the site itself. The only named surface water body at the site is the Spa Brook which runs from north to south through the centre of the site, to sink beneath the adjacent housing estate, probably in an artificial culvert.

Sensitive Sites:

No sites of particular ecological sensitivity, such as nature reserves, or sites of special scientific interest, have been recorded in close proximity to the site.

Buildings:

Buried structures associated with proposed buildings are considered to be a receptor to attack from potential chemical agents, in particular sulphates and acids, within the soils and groundwater. Buildings may be considered receptors for bulk ground gases, including methane explosion.

6.3 Potential pathways

The following pathways should be considered as methods of contamination transfer to receptors:

1) Intake of contamination by ingestion, inhalation, or direct contact with soils: Construction workers and residents of the site may be at risk from these pathways.

2) Intake of contamination by inhalation of vapours: A pathway of migration of bulk ground gases and volatile organic contaminants through permeable natural or manmade materials or preferential pathways onto the site from on site and off site sources is considered to be potentially active.

3) Plant uptake: Plants may uptake the contamination from the soil and concentrate it within their systems leading to a direct toxic effect on the plant. Due to the presence of gardens this pathway will be active on the site following redevelopment. In addition uptake of contaminants by plants which are subsequently consumed by residents is considered to be a potentially active pathway.

4) Leaching of contamination – vertically: A pathway of vertical leaching to the underlying superficial Secondary-A-Aquifers and the bedrock Principal Aquifer is considered to be potentially active.

5) Movement of contamination – horizontally: Migration of possible perched groundwater potentially impacted by contaminants at shallow depths from on-site sources through shallow permeable deposits, or via preferential pathways, is considered to be potentially active. Pathways to future site residents via inhalation of indoor and outdoor air originating from a potentially impacted shallow perched groundwater source are also considered to be potentially active. Drains/ditches at the site could increase the speed of horizontal contamination migration.

6) Future construction works: Foundation excavation works, construction vehicles and workmen all form pathways for disturbance and transfer of contamination. For example: intermixing of contaminated surface strata during foundation construction or boring activities. Air borne dispersion of dust requires particular consideration during construction works during dry spells.

7) Buildings: Certain chemical agents, predominantly sulphates, acids and hydrocarbons present within made ground and contaminated waters under the site, may be destructive to buried concrete. The chemical attack of buried services and pipe work associated with new buildings is also considered to be an active pathway. Buildings are also possible receptors for build-up of ground gases – which may cause suffocation or explosion

6.4 Possible pollutant linkages and preliminary risk assessment

The preliminary risk assessment is designed to assess the risks from all pollutant linkages identified by the Phase I investigation. An explanatory risk matrix has been developed within the document 'Guidelines for Environmental Risk Assessment and Management' (DETR and EA 2000). This matrix is shown below:

Consequence	<i>Severe</i>	<i>Moderate</i>	<i>Mild</i>	<i>Negligible</i>
Probability				
<i>High</i>	High	High	Medium/Low	Near Zero
<i>Medium</i>	High	Medium	Low	Near Zero
<i>Low</i>	High/Medium	Medium/Low	Low	Near Zero
<i>Negligible</i>	High/Medium/Low	Medium/Low	Low	Near Zero

A tabular conceptual model is detailed below. In some cases the risk level is considered medium. This is due to the limited information which can be provided by a desk study alone, thus worst case scenarios are assumed until evidence is provided to show otherwise.

Contaminant	Pathway	Receptor	Risk
Heavy metals and inorganics within upper strata; principally Made Ground	Direct contact, dust inhalation and ingestion of soil	Future residents	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Heavy metals and inorganics within upper strata; principally Made Ground	Direct contact, inhalation and ingestion of soil	Construction workers	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Heavy metals and inorganics within upper strata; principally Made Ground	Direct contact	Structures and services.	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Heavy metals and inorganics within upper strata; principally Made Ground	Uptake into plants, indirect transfer to humans by consumption of plants	Future residents	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Heavy metals and inorganics within upper strata; principally Made Ground	Horizontal and vertical migration	Superficial Secondary-A-Aquifers and bedrock Principal Aquifer	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Heavy metals and inorganics within upper strata, principally Made Ground	Horizontal and vertical migration	Nearest surface water bodies – ponds, drains, and the Spa Brook within the site.	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Direct contact, dust inhalation and ingestion	Future residents	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Direct contact, inhalation and ingestion	Construction workers	Low for the majority of the site. Medium for potential source areas identified in section 6.1.

Contaminant	Pathway	Receptor	Risk
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Direct contact	Structures and services.	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Volatile inhalation	Future residents	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Uptake into plants, indirect transfer to humans by consumption of plants	Future residents	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Horizontal and vertical migration	Superficial Secondary-A-Aquifers and bedrock Principal Aquifer	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Polycyclic aromatic hydrocarbons, phenol, aromatic and aliphatic hydrocarbons within upper strata; both Made Ground and impacted natural soils	Horizontal and vertical migration	Nearest surface water bodies – ponds, drains, and the Spa Brook within the site.	Low for the majority of the site. Medium for potential source areas identified in section 6.1.
Sulphates from made ground beneath site	Direct contact	Concrete structures and water pipes	Medium.
Aggressive pH from made ground beneath site	Direct contact	Concrete structures and water pipes	Medium – Concrete structures and pipes may be at risk from aggressive ground conditions and may cause premature foundation failure

Contaminant	Pathway	Receptor	Risk
Asbestos if present within made ground beneath site	Inhalation of fibres	Future site users	Low for the majority of the site. Medium for potential source areas identified in section 6.1. High for the area to the south of Peel Hall which has been shown to be impacted by asbestos.
Asbestos if present within made ground beneath site	Inhalation of fibres	Construction workers	Low for the majority of the site. Medium for potential source areas identified in section 6.1. High for the area to the south of Peel Hall which has been shown to be impacted by asbestos.

6.5 Preliminary Ground Gas Risk Assessment

Source	Pollutant	Receptors	Pathway	Hazard Severity	Likelihood	Risk
Deep Made Ground beneath the site (general areas)	Carbon dioxide. Possibly methane if extensive organic material present	Human health and structures	Migration, volatilisation into indoor and outdoor air space and accumulation. Ground gas release from Made Ground tends to lack driving force.	Effect on human health (severe) Effect on structures (severe)	Low. Deep Made Ground is unlikely to be present across the majority of the site.	LOW Deep Made Ground is not anticipated across the majority of the site.
Deep Made Ground and natural organic sediments associated with ponds and drains.	Carbon dioxide and methane.	Human health and structures	Migration, volatilisation into indoor and outdoor air space and accumulation.	Effect on human health (severe) Effect on structures (severe)	Medium. Whilst these features are of a small size they may contain highly organic material and could impact any buildings placed upon them.	LOW for the majority of the site. MEDIUM for structures in very close proximity to these features.
Winwick Quay historical landfill, located 311 m south-west of the site	Carbon dioxide and methane.	Human health and structures	Migration, volatilisation into indoor and outdoor air space and accumulation.	Effect on human health (severe) Effect on structures (severe)	Low. The landfill is a significant distance from the site and appears to be a very small size.	LOW

Source	Pollutant	Receptors	Pathway	Hazard Severity	Likelihood	Risk
Natural soils and rocks	Radon	Human Health	Migration, volatilisation into indoor and outdoor air space and accumulation.	Effect on human health (severe)	Low. The site is not within an area where radon protective measures are required in accordance with BR211, however building control agencies may have their own specific requirements.	LOW

7. Conclusions/recommendations

7.1 Conclusions

The desk study has shown the majority of the site to historically have been used only for agricultural purposes. The site as a whole is considered to have a low risk of contamination.

Several areas within the site have been identified as having an increased risk of contamination. These potential source areas are identified in the table of section 6.1 of this report and on the annotated site plan (Appendix I). They include an area of former farm buildings, where chrysotile asbestos cement has been identified on the surface of the ground, an area of former masts, an area of former allotments, and a former sewage disposal plant.

Borehole logs held by the BGS suggest that standard strip/trench/pad foundations will be appropriate across the majority of the site. Whilst coal mining subsidence has occurred around the site in the late 1990s (immediately after cessation of deep coal mining beneath the site) it is considered unlikely to affect the site in the future. The coal seams exploited were at a great depth (between 750 m and 1,130 m) and the report from the Coal Mining Authority indicates that movements relating to these workings should have stopped by now.

7.2 Recommendations – Contamination

Prior to construction works it is recommended that all potential contamination source areas (as identified in Section 6.1 and on the annotated site plan) are subjected to intrusive investigation. The most effective way to do this is likely to be the use of machine excavated trial pits, which will allow cost effective bulk inspection and appropriate sampling of the soils. It would also be worthwhile to make further enquiries into the history of the former sewage disposal plant in the west of the site and the area of masts in the south of the site.

Across the remainder of the site the level of soil contamination risk is considered low. However, geotechnical investigations will be required in these areas, so it is recommended that a limited soil contamination investigation is incorporated into the geotechnical survey for these areas.

It is recommended that this desk study report is passed to the local authority's Contaminated Land Officer for comment as soon as possible. The Contaminated Land Officer may provide further information useful to future intrusive investigations.

7.3 Recommendations – Geotechnical

Borehole logs held by the BGS suggest that standard strip/trench/pad foundations will be appropriate across the majority of the site. It is recommended that geotechnical investigation is undertaken using a grid of machine excavated trial pits. Cable percussion boreholes may also be required if any large structures are proposed.

If construction of buildings on, or close to, any former ground-workings or water features (such as ponds or ditches) is proposed it is also recommended that targeted investigation of these locations is undertaken.

Based on the information contained within the Coal Mining Report, no further investigation with regard to coal mining is considered necessary.

7.4 Recommendations – Asbestos on the surface of the site

The chrysotile asbestos cement identified to the south of Peel Hall is considered to pose a potential risk not just to end-users of the site and ground-workers, but also to present day site users. The asbestos is scattered across a wide area and is clearly being regularly trampled and broken up by the public. It is recommended that a hand-pick removal of the material on the ground surface is undertaken at the earliest possible opportunity.

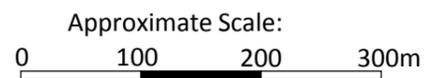
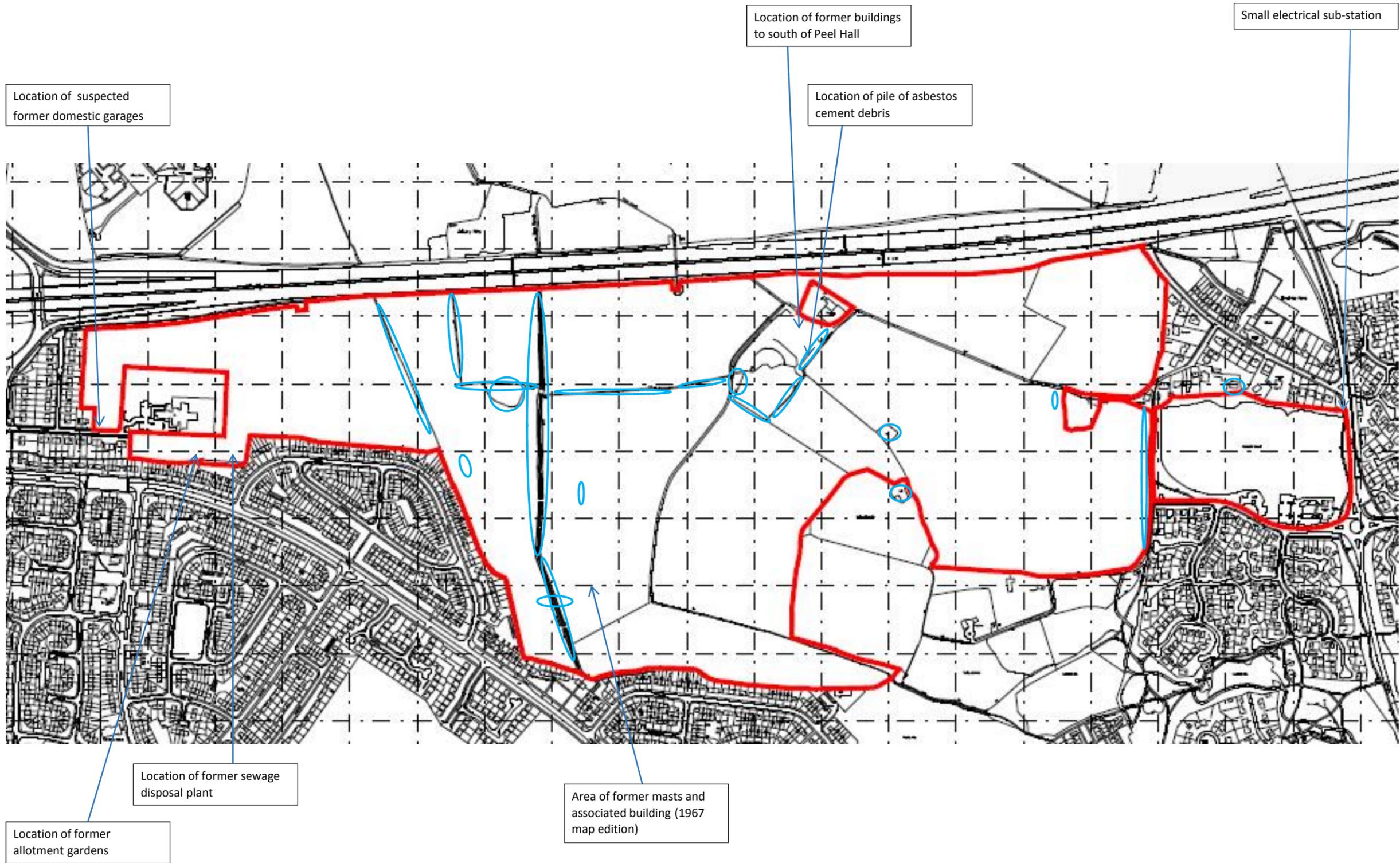
At present the landowner is at risk of prosecution in relation to the Control of Asbestos Regulations 2012, and has a liability to members of the public who may be harmed by asbestos fibres released by these materials.

The removal should be undertaken by trained operatives, with a written risk assessment and method statement, in accordance with the Control of Asbestos Regulations 2012.

Appendices

- a) Site Location and Boundary Plan**
- b) Environmental Database Report**
- c) Geological Data Report**
- d) Borehole Logs from BGS Database**
- e) Coal Authority Mining Report**
- f) Historical Ordnance Survey Plans**
- g) Photographic Record**
- h) Topographic Survey Drawing**
- i) Asbestos Laboratory Report**
- j) Annotated Site Plan**

Appendix J – Annotated Site Plan



= current or former water feature or area of ground working

	Project Number:	EMS5414
	Site:	Land at Peel Hall Farm, Warrington
	Drawing Title:	Annotated Site Plan

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