

Geo-Environmental Assessment

Moston Site 5 – Hanson Road

Redrow Homes (Lancashire) Limited
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Executive Summary

WSP Environmental Ltd. (WSPE) was instructed by Redrow Homes Lancashire Ltd. ('the Client') to undertake a Geo-Environmental Assessment of the site known as Hanson Road, Moston (Site 5). The report provides Phase 1 information and a site investigation which has been used to formulate a Site Conceptual Model and a strategy to reuse uncontaminated/suitable soils (Earthworks Strategy) and to provide measures to protect the environment from contaminated soils (Remediation Strategy). Please refer to Appendix I and J for WSPE's Methodology and Limitations.

Phase 1 Information	The site is currently unoccupied, consisting of rough grassed areas in between existing historical roadways. Historical maps indicate that the site's former uses include farm land and terraced housing, which was built prior to 1908. The southern most corner of the site was occupied by a valley associated with Moston Brook. This later became a cutting associated with Lightbowne Sidings. The area was infilled prior to 1960. Published information indicates the site to be underlain by Glacial Till overlying the Collyhurst Sandstone. The Collyhurst Sandstone is a major aquifer. There are no surface water courses within the immediate vicinity of the site. The site does not lie within a flood zone as currently defined by the Environment Agency.
Site Investigation Information	An intrusive ground investigation was undertaken by WSP Environmental Ltd (WSPE) in December 2009. The investigation was designed to provide general coverage of the site and comprised twelve windowless sample boreholes and installation of combined gas and groundwater monitoring wells in all window sample holes. Sixteen machine excavated trial pits and one hand pit were undertaken. Soil sampling was undertaken in all exploratory holes and representative samples subject to chemical and geotechnical testing. Gas and groundwater level monitoring was undertaken on nine occasions.
Environmental Assessment	Benzo(a)pyrene, benzo(a)anthracene, chrysene and ideno(1,2,3-cd)pyrene have been detected in Made Ground at concentrations above the GAC for gardens. Cadmium was recorded to exceed the residential GAC in one location. None of these determinands exceed the GAC for use under hardstanding such as roads, driveways and buildings. Asbestos has been detected in one sample of Made Ground. All other determinands tested are within GAC's for a residential with gardens end use. No risks to controlled waters are considered to be posed by the site. Ground gas monitoring indicates the main body of the site is classified as Green (NHBC, 2000) and Characteristic Situation 1 (CIRIA C665, 2007). Both schemes indicate no special precautions relating to gas are required within buildings across the site. Elevated methane and carbon dioxide were observed in WS1 located in the north of the site. The GSV for this borehole indicates this area is consistent with the main body of the site and is also classified as Green and Characteristic Situation 1. However, it is proposed that the classification is raised by one class for properties immediately around WS01 (estimated to represent 6 plots). These plots should be classified as Amber 1 or CS2 which both require a membrane (2000 g DPM) and ventilated sub-floor void.

Geotechnical Assessment	Residential properties up to three storeys will be suitable for construction on conventional strip footings bearing on the Glacial Till with a minimum foundation depth of 900mm. A safe bearing capacity of 100kN/m^2 is considered suitable for the preliminary design of spread foundations bearing on firm Glacial Till. Softening of the Glacial till has been observed to approximately 2m in WS03. An allowance should be made for deepening a proportion of the foundations and the incorporation of nominal reinforcement into all foundations. Specific attention is drawn to the southern corner of the site where deep Made Ground has been identified. A piled solution should be allowed for at this stage. Additional investigation (2no. boreholes to 15m) will be required to facilitate pile and vibro replacement design. Due to the thickness of Made Ground, floor slabs will require suspending. Groundwater was not encountered during the ground investigation, and significant volumes of shallow groundwater are considered unlikely. Future pavement construction will likely encounter recently disturbed cohesive Made Ground at formation level and a CBR value of less than 2% should be assumed at this stage.
Earthworks Strategy	Made Ground has been proved across the site depths between 0.40m and 2.80m and the Made Ground is identified in two layers ie topsoil and clay. Contamination testing indicates that contaminants of concern to the future users of the site are only of relevance to garden areas. Therefore, it is proposed to undertake a soil strip of 1.00m depth across garden areas to segregate soils suitable for reuse in gardens and either redeposit remaining soils below a 600mm inert layer at depths between 600mm and 1000mm or dispose of the soils off site.
Remediation Strategy	A Remediation Strategy is proposed that includes the following : ■ Excavation and segregation of suitable materials for use within gardens and soft landscaping. ■ Where soils are to be reused on site they should be tested for contaminants of concern at a frequency of 1 per 200m^3. ■ Where contaminated soils are present beneath proposed garden areas and public open space, placement of a clean cover system. The thickness of the cover layer should be a minimum thickness of 600mm. ■ Cover Soils (site won or imported) should have chemical concentrations within thresholds presented in Table 1 at the end of this report. Validation testing should be undertaken on the basis of one test for topsoil and subsoil per 4 plots. ■ Asbestos has been detected in one sample of soil. It is concluded from site observations that this occurrence is likely to be an isolated hot spot and the asbestos in soil in this area should be delineated and the affected soil segregated for disposal off site. ■ Management of dust levels and control of dust throughout site works; ■ Provision of gas protection measures to properties adjacent to WS01; and, ■ Adoption of appropriate Health and Safety measures for excavation, construction and maintenance workers who are involved in any below ground work.

Please Note: This summary forms part of WSP Environmental Ltd. Geo-Environmental Assessment (ref.: 12121870/002/9122(3)). Under no circumstances is it to be used as an independent document.

WSP Environmental Ltd

1 Instruction and Confidentiality Statement

Instruction	On the instruction of Redrow Homes (Lancashire) Limited, a Geo - Environmental Assessment has been carried out by WSP Environmental Limited at Egbert Street, Moston, Greater Manchester. The site is one of a six site portfolio that Redrow Homes (Lancashire) Limited is looking to acquire from Manchester City Council. The main aim of the assessment is to identify potential geotechnical or environmental issues that may represent a constraint to the redevelopment of the site for a future residential end use.
Confidentiality Statement	This report is addressed to and may be relied upon by the following party:- Redrow Homes (Lancashire) Ltd. Redrow House, 14 Eaton Avenue, Matrix Office Park Buckshaw Village Lancashire PR7 7NA This assessment has been prepared for the sole use and reliance of the above named parties. This report shall not be relied upon or transferred to any other parties without the express written authorisation of WSP Environmental Limited. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

2 General Information

Site name	Site 5 – Hanson Road	**Location**	Hanson Road, Moston, Greater Manchester, UK (Figure 1)
NGR	387480, 401210	**Approximate Site Area**	2.7 hectares
Site Description	The site is currently unoccupied, consisting of rough grassed areas in between existing historical roadways. Site photographs are presented in Appendix A.		
Site Topography	The local topography generally falls to the south east. Areas of the site are raised above the level of the surrounding footpaths.		
Surrounding Area	The surrounding area comprises residential housing, with railway sidings approximately 200m to the south east and east.		
Proposed Development	It is understood that the site is to be developed for a residential end use incorporating one hundred and thirty five units. The proposed development plan is included as Figure 2.		

3 Desk Study Information

Sources of information	The following sources of information have been used within this assessment: ■ British Geological Survey (BGS) Sheet 85 (Manchester) 1:50,000 Solid and Drift Edition, dated 1975. ■ www.environment-agency.gov.uk. ■ Landmark Envirocheck Report (Order Number: 29110587_1_1., 15-Oct-2009) (Appendix B) ■ Historical Ordnance Survey Plans (Appendix C)
Geology	The BGS Geological map identifies the site to be underlain by Glacial Till overlying the Collyhurst Sandstone. Given the historical development at the site, it is considered likely that the natural strata will be mantled by a thickness of Made Ground.
Hydrogeology	The Collyhurst Sandstone is classified as a Major Aquifer. The site is not located within a Source Protection Zone (SPZ) for groundwater abstraction. No current Environment Agency licensed groundwater abstractions have been identified in the vicinity of the site.
Hydrology	The nearest surface water feature is Moston Brook, located approximately 230m to the northeast. Historically the brook was shown to flow close to the sites southern boundary, however, the former course has been infilled and it is assumed that the brook is now culverted. The site does not lie within a flood zone as currently defined by the Environment Agency.
Site History	Historical maps (Appendix C) identify the site's former uses to include farm land and terraced housing, which was built prior to 1908. The southern most corner of the site was occupied by a valley associated with Moston Brook. This later became a cutting associated with Lightbowne Sidings. The area was infilled prior to 1960. Anecdotal evidence suggests that the former houses did not have cellars.
Surrounding Area History	Dean Brook Farm and associated spring were located 50m south east of the site in the 19th century. The Lightbowne railway sidings (Yorkshire Lancashire Railway) were shown to be located 200m to the south east of the site on the 1893 OS sheet. The railway sidings were shown to have expanded to within 100m of the southern site boundary by 1908, and to within 20m of the southern site boundary by 1951. Residential Housing developed to the north and east of the site throughout the 20th century. The sidings had been retracted to 200m from the site boundary, the railway cutting infilled and houses built to the south and south east of the site by 1992.
Waste	A landfill (closed in 1981/1982) is located 30m east of the site. Deposited waste included inert, industrial and construction and demolition waste. A further historical landfill (closed 1977) is located 130m south of the site and received commercial and household waste. A further four historical landfills are recorded within a 500m radius of the site.
Geological Hazards	The site is not located within an area affected by coal mining or brine extraction activities.
Radon	The Envirocheck report for the site states that no radon protective measures are necessary in the construction of new dwellings or extensions.

4 Preliminary Risk Assessment

Based on the proposed residential end use with private gardens, a preliminary risk assessment has been undertaken. A conceptual model for the site is presented in Appendix D.

Human Health	**Potential Sources** Based on the available Desk Study information, the following potential sources of contamination have been identified within the site: ■ Potentially impacted Made Ground deposits associated with the construction and subsequent demolition of the former housing stock that occupied the site. This may include heavy metals, PAHs and asbestos associated with ash and demolition waste. **Potential Pathways** The proposed development plans comprise residential houses with private gardens and the following exposure pathways are considered to be relevant: ■ Ingestion of soils and dust ■ Dermal contact with soils and dust ■ Direct inhalation of dust ■ Direct inhalation of asbestos fibres ■ Ingestion of contaminated vegetables or soil adhering to vegetables ■ Indoor inhalation of vapours **Potential Receptors** Based on the available data it is considered that potential receptors include: ■ remediation and construction workers ■ Future residents and site users ■ Future maintenance worker **Potential Pollutant Linkages** Based on the available information it is considered that the following pollutant linkages may be valid and will require investigation and assessment via a Generic Quantitative Risk Assessment (GQRA). ■ Ingestion / inhalation / direct contact with contaminated soil within the Made Ground. ■ Inhalation of asbestos fibres during ground works within the Made Ground. ■ Leaching of contamination from soils to potable water supply pipes.
Controlled Water	No significant sources of potential on site current or historical contamination have been identified that are likely to pose a risk to controlled waters. In addition, whilst potential receptors are present within the vicinity of the site (the Collyhurst Sandstone and the culverted Moss Brook), the Glacial Till should serve to limit lateral and vertical migration of any impacted shallow groundwater. On this basis, it is considered unlikely that there are any significant risks to controlled waters from potential site sources.

Ground Gas	The Desk Study has identified that there is likely to be a thin layer of Made Ground overlying the natural strata and this could contain putrescible materials that may be a potential source of hazardous ground gas. In addition, infilling has taken place close to the sites southern boundary and a number of former landfills are recorded within the vicinity of the site which could also represent potential sources. Based on the foregoing it is considered that the following pollutant linkages require further consideration: ■ Migration of hazardous ground gases into future properties through construction joints and service entry points (end users). ■ Accumulation of ground gas in excavations (site and future maintenance workers).
Built Environment	Chemical testing of the proposed foundation soils will be required to determine the concrete classification. Assessment of soil and/ or groundwater contamination will be required to determine whether measures will be required to protect below ground services.

5 Ground Investigation

Scope of Investigation	An intrusive ground investigation was undertaken by WSP Environmental on 4 December 2009. Given the historical development of the site and the lack of any identified potentially significant sources of contamination, the investigation was designed to provide general coverage of the site (within the constraints posed by its current use) and comprised the following: ■ Twelve window sample boreholes (WS01 to WS12). Eleven boreholes were advanced to 3m bgl and one borehole (WS08) to 5m. ■ Sixteen machine excavated trial pits (TP01-TP16) advanced to between 1.0m and 2.5mbgl. ■ Determination of the undrained shear strength of cohesive soils through use of hand shear vane. ■ A hand dug trial pit (HP1) through the existing road construction on Attleboro Road. ■ Installation of combined gas and groundwater monitoring wells in all twelve window sample holes. ■ Soil sampling from each exploratory hole to ensure representative samples were obtained to allow laboratory chemical testing. ■ Chemical testing of selected soil samples, including inorganics (metals), organics (hydrocarbons) and physical (asbestos) analytes. ■ Geotechnical testing of representative samples of the Glacial Till including moisture content, Atterberg limit states, pH and water soluble sulphate determination. A sample of Made Ground underwent particle size determination, ■ Gas and groundwater level monitoring on nine occasions. The ground investigation was undertaken in general accordance with techniques outlined in BS5930:1999, BS10175:2001 and BS1377:1990. An exploratory hole location plan is included as Figure 3 and exploratory hole logs are presented in Appendix E. Chemical and geotechnical laboratory results are presented in Appendices F and G.
General Ground Conditions Encountered during Investigation	**Made Ground** Topsoil up to 300mm thick was recorded in the majority of the exploratory holes. The Topsoil was underlain in the majority of locations by Made Ground; the exception being TP03 where no Made Ground was encountered. Made Ground across the site typically varied in thickness between 0.4 and 1.6m and comprised sandy gravelly clays and sandy gravels. The gravel content consisted of sandstone, brick, ash, glass and ceramic, with fragments of timer noted locally. In the southern most part of the site, in the vicinity of the corner of Hanson Road and Hugo Street, Made Ground in excess of 5m of Made Ground (WS08) was recorded. As discussed in Section 3, this area formerly comprised the northern valley side of Moston Brook and latterly part of a railway siding. The approximate extent of this area of deepened Made Ground is illustrated on Figure 3. **Glacial Till** Where the base of the Made Ground was proven it was underlain by grey red brown mottled grey slightly sandy slightly gravelly clay (Glacial Till). The gravel comprised subangular fine to coarse sandstone, mudstone and siltstone. The Glacial Till was

	determined to be of low to intermediate plasticity clay (Class CL to CI). At shallow depth the Glacial Till was described as generally firm or stiff. In the eastern portion of the site, WS03 encountered softened Glacial Till to a depth of approximately 2m. A plot of undrained shear strength against depth (using values obtained from the hand shear vane) is presented as Figure 4. **Existing Road Construction** A hand pit was advanced within Attleboro Road. The existing road construction was found to comprise 0.07m of asphalt overlying a layer of cobbles to 0.20m. The cobbles were underlain by 0.20m of ash subbase and firm Glacial Till.
Obstructions / Structures	A drainage pipe was encountered at 0.64mbgl in TP02. A reinforced concrete post was encountered at 0.8-1.0mbgl in TP10.
Groundwater Conditions Encountered	Groundwater seepages were recorded in TP06 at 1.3m bgl and TP12 at 0.95m bgl within the Glacial Till and Made Ground respectively. Subsequent monitoring (Appendix H) has identified variable groundwater depths with groundwater close to ground level on occasions. It is considered likely that the groundwater recorded may represent inflow from the overlying granular Made Ground.
Contamination Observations	No significant visual or olfactory evidence of hydrocarbon contamination was encountered on the site surface or within any of the exploratory hole locations.

6 Environmental Assessment (GQRA)

Based on the proposed residential end use with private gardens, appropriate Soil Guideline Values (SGVs) and CLEA compliant Risk Based Generic Assessment Criteria (GACs) have been selected as those suitable for a residential end use. Assessment Methodologies and Standards are presented in Appendix I.

Soil Contamination	Nine samples taken from within the Made Ground were tested for a range of inorganic and organic determinants. The samples were tested for a range of metals, speciated PAH (poly aromatic hydrocarbons), BTEX, TPH (CWG), pH, Soil Organic Matter and water soluble sulphate. Given that the sampling was not targeted and was aimed at gaining representative samples, the test results were subjected to CLEA V7 statistical analysis. The laboratory test results and the statistical results sheet are included as Appendix F. Generally, all determinants occurred in concentrations below the relevant SGVs and GACs for residential end use. However, Cadmium was recorded to exceed the GAC in one location (40mg/kg in TP12 0.35-1.6m) and the statistical analysis suggests site wide exceedences of two PAH fractions (benzo(a)anthracene and benzo-a-pyrene). Two hotspots of chrusene and ideno(1,2,3-cd)pyrene were identified at WS3 (0.0-0.5m bgl) and WS6 (0.2 – 0.4m bgl). Asbestos (amosite and chrysotile insulating board) was identified in one of the five Made Ground samples analysed (TP12 0.35-1.6m). Quantitative analysis identified the concentration to be less than 0.1%v/v.
Controlled Waters	Based on the low levels of potential contaminants in soils and the underlying cohesive natural soils, it is considered that there is no significant risk to controlled waters from any potential site derived source of contaminants, due to the lack of any significant source or pathway in the vicinity of the site.
Ground Gas	Gas monitoring was undertaken on nine occasions between 18 December 2009 and 16 March 2010. The field data sheets are included as Appendix H. Typically, carbon dioxide has been detected at concentrations up to 1.7% and methane below detection across the site. However, elevated methane and carbon dioxide has been detected in WS01. The maximum concentrations are 8.2% and 6.5% respectively and the maximum recorded flow rate is 0.1 l/hr. Frequent fragments of organic matter and wood were recorded within the Made Ground (0.3-0.85mbgl) in WS01 and this may be responsible for the locally elevated methane concentrations.

7 Environmental Risk Assessment

Based on the chemical testing data and the proposal for redevelopment for residential use across the site, the following potentially significant pollutant linkages have been identified. A pictorial Conceptual Site Model is presented in Appendix D.

Human Health	**Sources** Based on the findings from the intrusive site investigation, the following potential contaminant sources have been identified: ■ PAH compounds including benzo(a)pyrene, benzo(a)anthracene, chrysene and ideno(1,2,3-cd)pyrene within shallow Made Ground soils. ■ Cadmium within the shallow Made Ground soils. ■ Amosite and chrysotile asbestos (most probably insulation fibre) within shallow Made Ground soils. **Pathway** Should the site be redeveloped for residential use without prior remedial measures, elevated cadmium, PAH compounds and free asbestos within the shallow Made Ground soils pose a potential risk to human health via the following exposure pathways: ■ Ingestion of soils and dust ■ Dermal contact with soils and dust ■ Direct inhalation of dust ■ Direct inhalation of asbestos fibres ■ Ingestion of contaminated vegetables or soil adhering to vegetables **Receptors** Given the proposed redevelopment plans, it is considered that potential receptors include: ■ remediation and construction workers ■ Third Parties / adjacent land owners ■ Future residents and site users ■ Future maintenance workers **Pollutant Linkages** Based on the environmental conditions at the site (as detailed in the preceding sections) and the proposed redevelopment proposals comprising traditional residential properties, the following pollutant linkages are considered significant with respect to human health: ■ Direct contact, inhalation of dusts and ingestion of contaminants by residential end users, maintenance and development workers and third parties; ■ Ingestion of contaminated Vegetables/Soil adhering to vegetables by residential

	end users; ■ Impact of ACM's upon residential end users, maintenance and development workers and third parties. **Mitigation Strategies** In order to break the identified pollutant linkages, the following mitigation measures are considered appropriate: ■ Placement of a clean cover system within areas of private gardens and public open space where Made Ground is present at the surface following any site engineering works. The thickness of the cover layer should be a minimum thickness of 600 mm. ■ Where natural soils (i.e. Glacial Till) are exposed at the surface, no capping layer is considered necessary, subject to appropriate chemical validation of the surface soils. Where only a thin layer of Made Ground remains following any site engineering works, it may be more cost effective and sustainable to remove the Made Ground and avoid the requirement for a cover layer. ■ Where soils are to be reused on site they should be tested for contaminants of concern at a frequency of 1 per 200m^3. ■ Cover Soils (site won or imported) should have chemical concentrations within thresholds presented in Table 1 at the end of this report. Validation testing should be undertaken on the basis of one test for topsoil and subsoil in every 4 plots. ■ Asbestos has been detected in one sample of soil. It is concluded from site observations that this occurrence is likely to be an isolated hot spot and the asbestos in soil in this area should be delineated and the affected soil segregated for disposal off site. ■ Management of dust levels and controls to prevent off site migration and impact to third parties ■ Adoption of appropriate Health and Safety measures for future remediation, construction and maintenance workers who are involved in any below ground work and could come into contact with potentially contaminated soils. Generic safe working practices are outlined below. ■ Use of appropriately qualified personnel for the task; ■ Use of appropriate PPE/RPE; ■ Provision of on-site washing facilities; ■ Maintenance of a high standard of basic hygiene; and, ■ Implementation of a non smoking and eating policy within the working area, with designated clean areas set aside for these activities. During remedial operations, should visual or olfactory evidence of deleterious materials be found then these materials should be investigated and characterised so that an assessment can be made to determine appropriate treatment. On completion of site works, all pertinent observations and records of site remediation, soil testing and disposal of soils off site shall be compiled in a Completion Report and criteria), should be included within a Remediation Strategy and submitted to the Regulatory Authority for approval.

Controlled Water	The site is underlain by a major aquifer (Collyhurst Sandstone) beneath low permeability Glacial Till. The Glacial Till is considered to provide a significant barrier to downward or lateral migration of any site derived determinants. No licensed abstractions have been identified within the vicinity of the site. On this basis it is considered that there is no significant risk to controlled waters from potential site sources.
Ground Gas	Gas concentrations and flow rates have been assessed in accordance with CIRIA C665. The maximum Gas Screening Values (GSV) has been calculated using the maximum gas concentrations across the site but excluding results from WS01. The maximum CO2 concentration (1.8%) and the maximum flow rate (2.5 l/hr) provides a GSV of 0.045l/hr. Therefore, ground gas monitoring indicates the main body of the site is classified as Green (NHBC, 2000) and Characteristic Situation 1 (CIRIA C665, 2007). Both schemes indicate no special precautions relating to gas are required within buildings across the site. Elevated methane and carbon dioxide were observed in WS01 located in the north of the site. The nearest boreholes, WS02 and WS04, do not indicate methane and have low carbon dioxide concentrations. Therefore, any elevated gas concentrations are localised to the area of WS01. The GSV calculated for maximum methane 8.2% and flow 0.1 l/hr is 0.0082 l/hr at WS01 and is consistent with the main body of the site ie classified as Green and Characteristic Situation 1. However, the dataset is limited to nine monitoring visits so it is proposed that the classification is raised by one class for properties immediately around WS01 (estimated to represent 6 plots). These plots should be classified as Amber 1 or CS2 which both require a membrane (2000 g DPM) and ventilated sub-floor void.
Built Environment	The concentrations of contaminants identified are unlikely to pose a significant risk to below ground services. However, future site maintenance workers could be exposed to asbestos within Made Ground and it is therefore considered appropriate that services be placed within a geotextile lined oversized service trench backfilled with clean inert material.

8 Geotechnical and Engineering Assessment

The following section details a preliminary geotechnical and engineering assessment for the site. Redrow has provided a proposed site development plan, (Figure 2), which comprises a total of one hundred and thirty five residential units with private gardens and areas of hard standing.

The assessment below should be treated as preliminary and will be subject to review once detailed proposals are available.

Site Levels	The site is generally flat with existing site levels that are marginally elevated (300mm) in relation to Redrow proposed finished levels. In order to achieve the correct finished levels it is likely that excess material will have to be removed from site. Further quantitative assessment of levels and material offsite disposal/transport costs will be required prior.
Foundations	It is anticipated that the majority of the proposed units may be supported on conventional strip/shallow trench fill footings bearing on the Glacial Till. A minimum foundation depth of 900mm is recommended, measured below existing or proposed ground level, whichever gives the deeper foundation. A safe bearing capacity of 100 kN/m^2 is considered suitable for the preliminary design of spread foundations. This is based on assumed shear strength of 60 kN/m^2 at foundation level, derived from a plot of undrained shear strength versus depth (Figure 4). The net allowable bearing pressure used for structural design will need to be determined once structural loads are known and additional ground investigation has been undertaken. However, as a guide, it is anticipated that the settlement of a 1m wide strip foundation at the above safe bearing capacity will be less than 25mm. Softening of the Glacial till has been observed to approximately 2m in WS03. An allowance should be made for deepening a proportion of the foundations and the incorporation of nominal reinforcement into all foundations. Specific attention is drawn to the southern corner of the site (see Figure 3) where deep Made Ground has been identified. A piled solution should be allowed for at this stage. However, providing that the Made Ground does not extend beyond 6m, a vibro replacement stone column solution may provide a cost effective alternative. Pre cast piles would be most cost effective piling solution; however, given noise and vibration issues, the use of small diameter CFA piles may be preferable. Additional investigation (2no. boreholes to 15m) will be required to facilitate pile and vibro replacement design.
Floor Slabs	Given the typical thickness of Made Ground (<600mm), floor slabs will require suspending. Floor slab design will be dependent on the final gas regime adopted for the site, though for preliminary design, basic gas protection measures including a ventilated void should be assumed.
Excavations& Dewatering	Significant volumes of shallow groundwater are considered unlikely. However, based on site observations, localised inflows of groundwater should be anticipated, for example at the interface between the Made Ground and the Glacial Till and within any granular pockets within the Glacial Till itself. It is considered that any such inflows may be adequately controlled by pumping from screened sumps. The stability of the Made Ground must not be relied upon in unsupported excavations.

	Safe working conditions should be ensured at all times. Further Reference may be made to CIRIA Report No. 97,"Trenching Practice" 1992.
Obstructions	Localised obstruction shave been encountered on the site. It would be prudent to make some allowance for local obstruction removal during the groundwork operations.
Road pavements	Shared and private driveways are proposed for vehicular access. Future pavement construction will likely encounter recently disturbed Made Ground and locally Glacial Till at formation level. A CBR value of less than 2% should be assumed for the Made Ground at this stage. A CBR value of 4% may be anticipated for the Glacial Till Prior to constructing pavements, the prepared subgrade should be proof rolled with a heavy roller. Any soft spots encountered should be removed and replaced with well-compacted granular fill. Any obstructions must be "grubbed out" to a minimum depth of 500mm below the underside of subgrade level.
Concrete	In accordance with BRE Special Digest 1, "Concrete in Aggressive Ground", 2005 the Design Sulphate Classification for concrete in contact with the Made Ground is DS-2 and the Aggressive Chemical Environment for Concrete (ACEC) classification is AC-2.

9 Earthworks Strategy

Strategy	Based on the Site Investigation data, Made Ground across the site has benzo(a)pyrene and benzo(a)anthracene at concentrations in excess of the GACs for residential end use (0.83mg/kg in 9 out of 9 samples and 3.1mg/kg in 4 out of 9 respectively). The GAC for materials to be left under buildings and hardstanding is 14mg/kg or 89mg/kg respectively. Localised chrysene and ideno(1,2,3-cd)pyrene are also present above residential GACs (6mg/kg and 3.2mg/kg respectively. These compounds also do not exceed GAC for materials to be left under buildings and hardstandings (140mg/kg chrysene and 60mg/kg ideno(1,2,3-cd)pyrene. Therefore, Made Ground is suitable across the site to be left in place beneath hardstanding without posing a risk to end users. Further inspection of the soil descriptions for Made Ground indicates that the site has two primary classifications of Made Ground materials and they are : ■ Topsoil including sandy subsoil (maximum thickness 0.50m); and, ■ Clay (maximum thickness 2.20m). Benzo(a)pyrene and benzo(a)anthracene are above the contaminant threshold in all types of Made Ground. The Earthworks Strategy is focussed on areas of gardens and hard paving. Areas of hard paving will have materials stripped to 0.30m depth to clear potential hard spots and obstructions from historic features. Made Ground recovered from elsewhere on the site that is deemed suitable for use under hardstanding may be deposited under these areas. Areas of gardens will have materials stripped to 1.00m depth to clear potential hard spots and obstructions from historic features. The Made Ground types will be excavated and segregated to allow stockpiling of materials deemed suitable for use either under buildings/hardstanding or gardens. ■ Materials deemed suitable for use in gardens will be subject to contamination testing (minimum 1 sample per 200m^3) to demonstrate their suitability. ■ The remaining materials will be materials that are directly suitable for structural fill below hard standing or buildings; ■ The remaining materials may also be deposited in gardens but will be placed below clean, inert site derived materials of a depth of 600mm. ■ Where materials are deposited beneath a defined 600mm inert layer a geotextile will be placed as a marker layer. ■ Excess materials or materials specific to excavations to remove hotspots of contamination will be disposed of off site. The earthworks strategy will be undertaken to maximise reuse of materials and minimise the disposal of soils off site. The aim of the earthworks is to remove materials from site that are unsuitable for use in any of the specific areas of development.

10 Conclusions and Recommendations

Environmental Considerations	Based on the available data, the following measures are considered necessary to facilitate the proposed redevelopment: ■ Excavation and segregation of suitable materials for use within gardens and soft landscaping. ■ Where soils are to be reused on site they should be tested for contaminants of concern at a frequency of 1 per 200m^3. ■ Where contaminated soils are present beneath proposed garden areas and public open space, placement of a clean cover system. The thickness of the cover layer should be a minimum thickness of 600mm. ■ Cover Soils (site won or imported) should have chemical concentrations within thresholds presented in Table 1 at the end of this report. Validation testing should be undertaken on the basis of one test for topsoil and subsoil in every 4 plots. ■ Asbestos has been detected in one sample of soil. It is concluded from site observations that this occurrence is likely to be an isolated hot spot and the asbestos in soil in this area should be delineated and the affected soil segregated for disposal off site. ■ Management of dust levels and control of dust throughout site works. ■ Adoption of appropriate Health and Safety measures for excavation, construction and maintenance workers who are involved in any below ground work. ■ Provision of gas protection measures to properties adjacent to WS01. ■ Placement of services in oversize, clean backfilled trenches.
Geotechnical Considerations	Based on the assumption that the development will include two storey residential properties, it is anticipated that conventional strip/trench fill footings bearing on the Glacial Till will be appropriate for the majority of the units. A safe bearing capacity of 100 kN/m^2 is considered suitable for preliminary design. Alternative foundations will likely be required in the area of deep Made Ground on the southern part of the site. Floor slabs will require suspending. A CBR value of less than 2% should be assumed for the Made Ground for preliminary pavement design. Where encountered, a CBR value of 4% is anticipated for the Glacial Till. The Design Sulphate Classification for is DS-2 and the Aggressive Chemical Environment for Concrete (ACEC) classification is AC-2.

TABLE 1

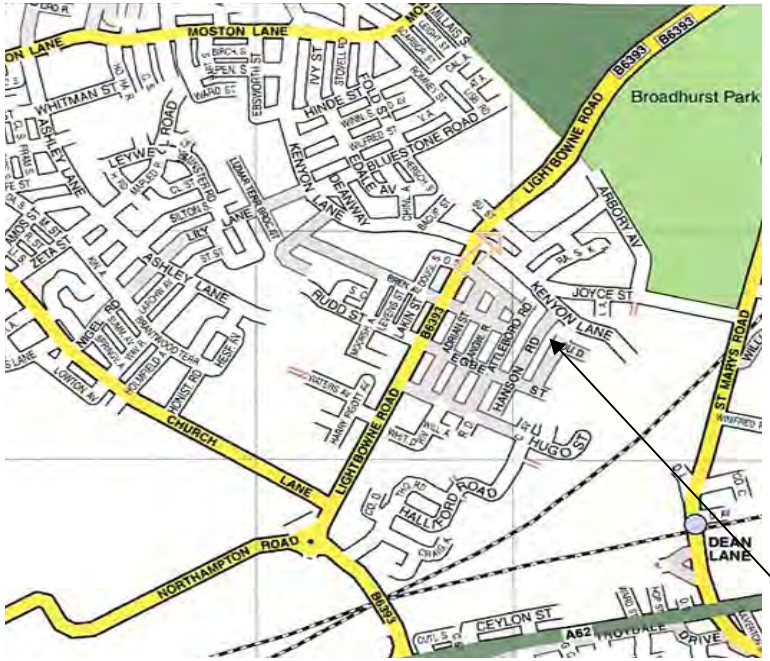
CONTAMINATION THRESHOLD CONCENTRATIONS FOR SITE WON AND IMPORTED SOILS

Determinand	**Site Specific Value mg/kg**		**Source of SSV**
	Gardens	Hard Standing	
Arsenic	32	640	SGV
Cadmium	10	230	SGV
Chromium (total)	3,000	30,000	CLEA V3.2
Copper	2,300	72,000	CLEA V3.2
Mercury (total)	170	3,600	SGV
Nickel	130	1,800	SGV
Lead	410	6,013	CLEA V3.2
Selenium	350	13,000	SGV
Zinc	3,700	660,000	CLEA V3.2
Total Polyaromatic Hydrocarbons	100	100	Landfill Directive
Benzo(a)pyrene	0.96	97	CLEA V3.2
Benzo(a)anthracene	5.0	14	CLEA V3.2
Napthalene	4.4	432	CLEA V3.2
Total Petroleum Hydrocarbons	500	500	Landfill Directive
Phenol	420	3,200	SGV

Garden soils are assumed to have a soil organic matter of 3%

FIGURE 1

SITE LOCATION PLAN





Site Location

ENVIRONMENTAL
Moston Site 5 – Egbert Street
Ref : 12121870/001
Title : Figure 1 – Site Location
Scale : NTS

FIGURE 2

PROPOSED DEVELOPMENT PLAN



No.	Name	Sq Ft	Total
2.	Tetbury 1 Det	900	1800
20.	Tetbury 1 Semi	900	18000
14.	Durham	831	11634
34.	Broadway	816	27744
30	Hexham	695	20850
34.	Evesham	680	23120
1.	Existing	1000	1000
135.			104148

Acres	Total Sq Ft	Sq Ft to Acre
6.54	104148	15924

Revisions

A	AJS Amendments	12.08.09
B	SG Amendments	25.08.09

REDROW HOMES
Redrow Homes (Lancashire) Limited
Redrow House, 14 Eaton Avenue, Buckshaw Village, Chorley, Lancs. PR7 7NA.
Tel: 01772 643700 Fax: 01772 643701 Web: www.redrow.co.uk

Baldwin Design Consultancy Limited
Town Farm,
17 Orford Close,
Golborne,
Warrington,
Cheshire.
WA3 3WP
Tel: 01942 719513
Mob: 07773343602
e-mail: graham.baldwin@bdc.gb.com

Drawing: SKETCH SITE LAYOUT	No. Red-MOS-05
	Rev. b
Development: Site 5, Hanson Road, Moston	Scale. 1:500
	Date. 16.08.09
	Drawn. GB

FIGURE 3

EXPLORATORY HOLE LOCATION PLAN

DO NOT SCALE

KEY:

- WS1 — WINDOW SAMPLER BOREHOLE
- TP2 — MACHINE EXCAVATED TRIAL PIT
- HP1 — HAND DUG TRIAL PIT
- (0.7) — APPROXIMATE DEPTH OF MADE GROUND

WS1 (1.4)
TP5 (0.5)
TP1 (1.0)
WS4 (0.5)
WS2
TP2
TP8 (0.6)
TP6 (0.7)
WS3 (1.4)
WS5 (0.6)
TP3 (0.4)
TP7 (0.6)
TP4 (0.7)
WS6 (0.5)
TP16 (0.6)
WS12 (0.8)
TP15 (0.6)
TP13 (0.8)
WS10 (0.8)
(0.5) WS11
(0.8) TP14
TP12 (1.6)
HP1
WS7 (0.5)
TP11 (0.8)
WS9 (1.2)
TP9 (1.4)
TP10 (2.5+)
WS8 (5.0+)
AREA OF POOR GROUND

Day Centre

\\SER03MAN1UK\ENV\AGRESSO PROJECTS 2001\1851 - 1900\1861 - 1870\12121870 - MOSTON SITES\CAD\SITE 5\FIGURE 3.DWG

REV	DATE	BY	DESCRIPTION	CHK	APD
A	21/01/10	ARJ	FIRST ISSUE	MN	MN

DRAWING STATUS: FOR INFORMATION ONLY

WSP
The Victoria, 150-182 The Quays, Salford M50 3SP
Tel: +44 (0)161 886 2400 Fax: +44 (0)161 886 2401
http://www.wspgroup.com

CLIENT: REDROW HOMES (LANCASHIRE) LTD

ARCHITECT: N/A

PROJECT: SITE 5 HANSON ROAD

TITLE: EXPLORATORY HOLE LOCATION PLAN

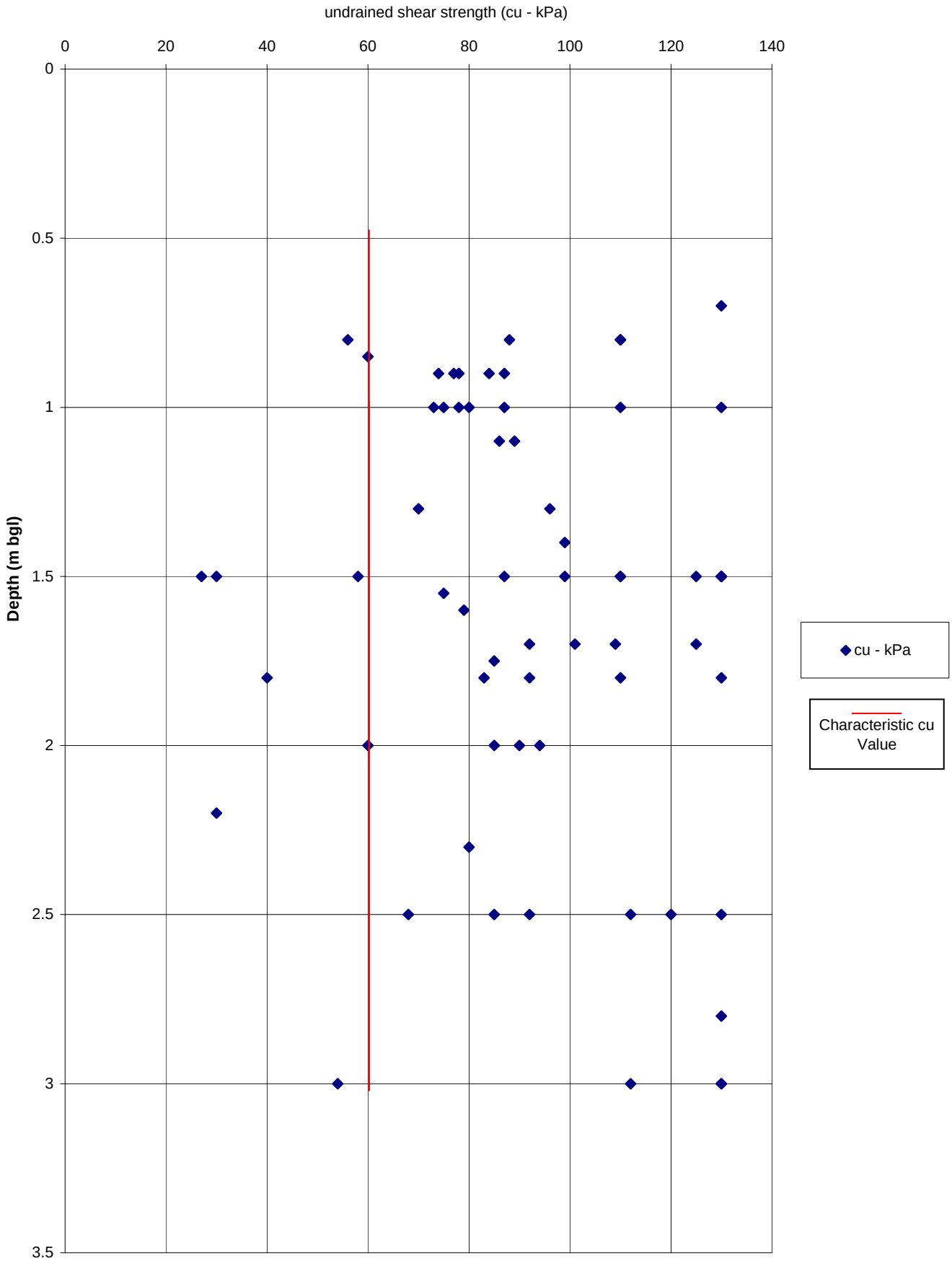
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1:1250	MN	MN
CAD FILE:	DESIGN-DRAWN:	DATE:
FIGURE 3	ARJ	January 2010
PROJECT No:	DRAWING No:	REV:
12121870/001	FIGURE 3	A

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FIGURE 4

PLOT OF UNDRAINED SHEAR STRENGTH Vs DEPTH FOR GLACIAL TILL

Figure 4 - Plot of Undrained Shear Strength vs Depth for Glacial Till



APPENDIX A

SITE PHOTOGRAPHS



Photograph 1: General view looking south towards Hugo Street across area of deep Made Ground.



Photograph 2: General view west across Langworthy Road towards Day Centre



Photograph 3: General view north towards Egbert Street.



Photograph 4: General view north along Hanson Road.

APPENDIX B

LANDMARK ENVIROCHECK REPORT

APPENDIX C

EXTRACTS OF ORDNANCE SURVEY MAPS



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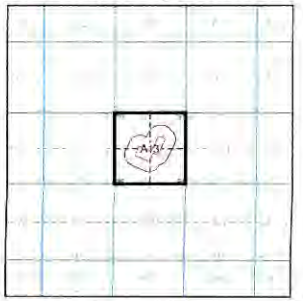
Large-Scale National Grid Data
Published 1992
Source map scale - 1:1,250

'Large Scale National Grid Data' superseded SIM cards (Ordnance Survey's 'Survey of Information on Microfilm') in 1992, and continued to be produced until 1999. These maps were the fore-runners of digital mapping and so provide detailed information on houses and roads, but tend to show less topographic features such as vegetation. These maps were produced at both 1:2,500 and 1:1,250 scales.

Map Name(s) and Date(s)



Historical Map - Segment A13



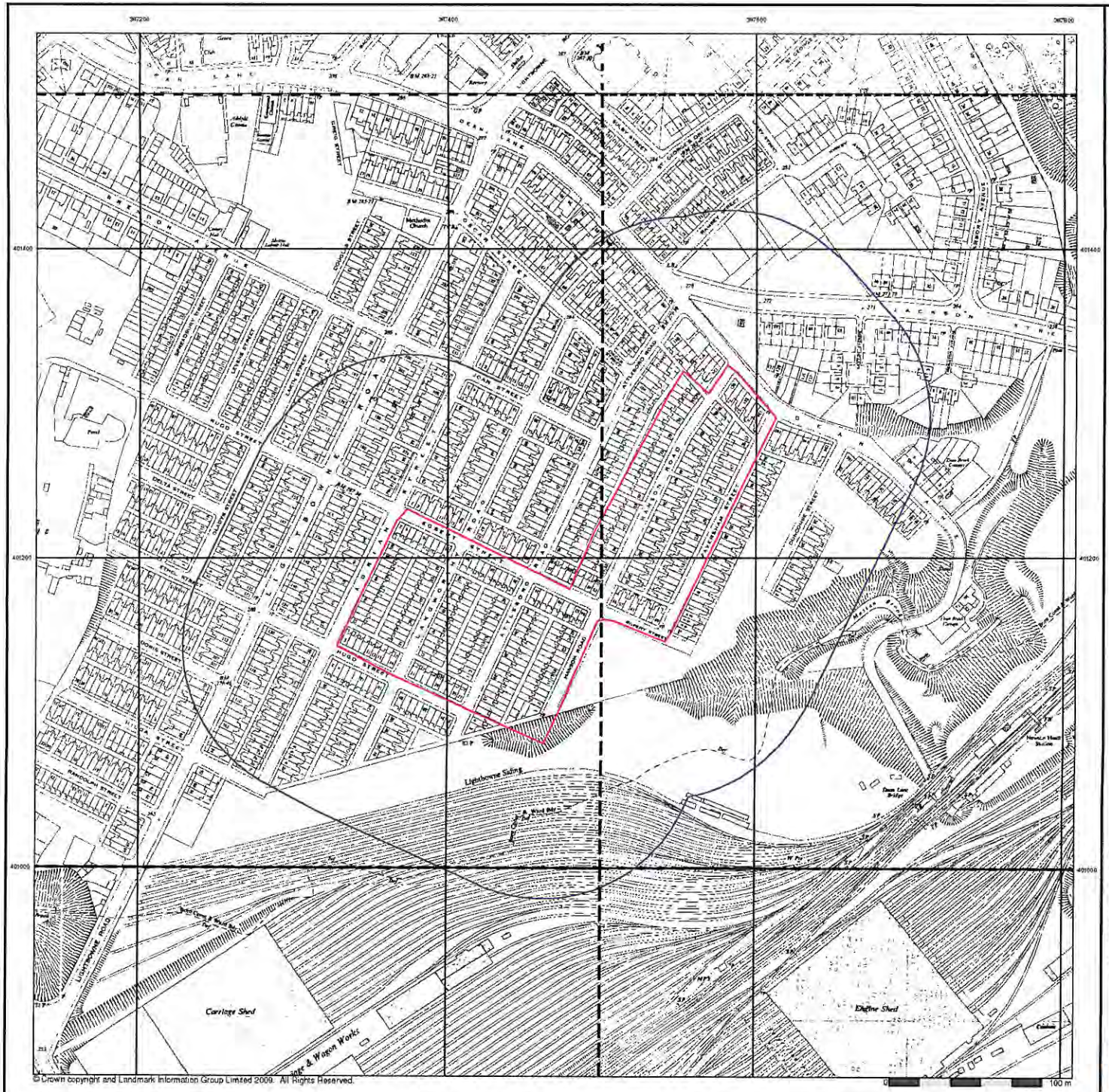
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Customer Ref:	12121870/001
National Grid Reference:	387480, 401210
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	100

Site Details

Site 5, Moston, Manchester

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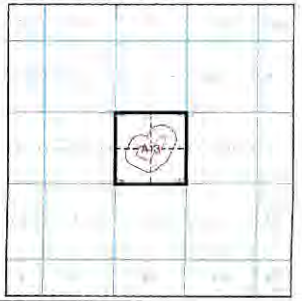
Ordnance Survey Plan
Published 1951
Source map scale - 1:1,250

The historical maps shown were reproduced from maps predominantly held at the scale adopted for England, Wales and Scotland in the 1840's. In 1854 the 1:2,500 scale was adopted for mapping urban areas and by 1895 it covered the whole of what were considered to be the cultivated parts of Great Britain. The published date given below is often some years later than the surveyed date. Before 1938, all OS maps were based on the Cassini Projection, with independent surveys of a single county or group of counties, giving rise to significant inaccuracies in outlying areas.

Map Name(s) and Date(s)



Historical Map - Segment A13



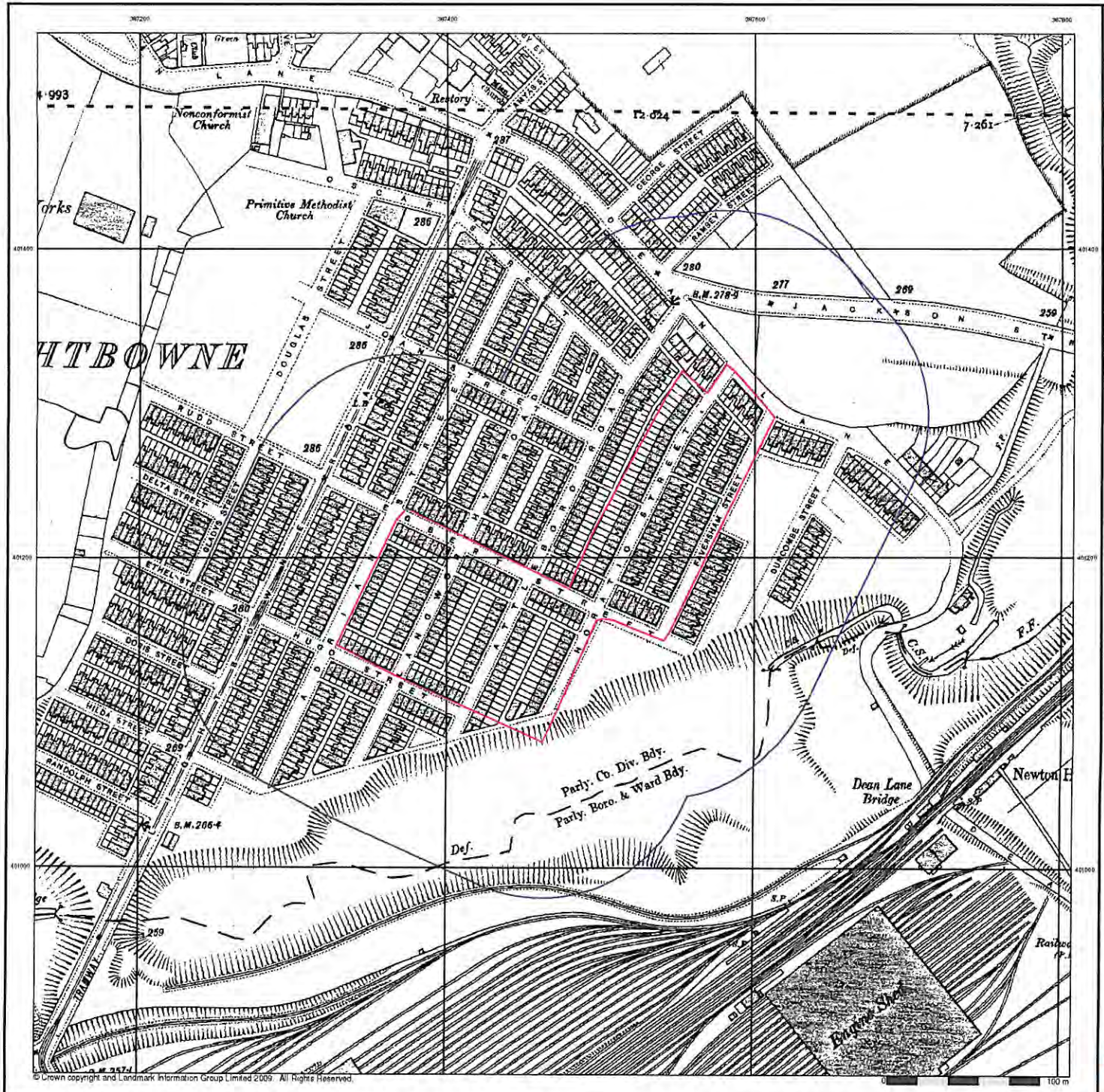
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Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	100

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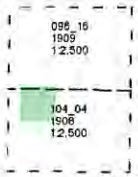
Lancashire And Furness

Published 1908 - 1909

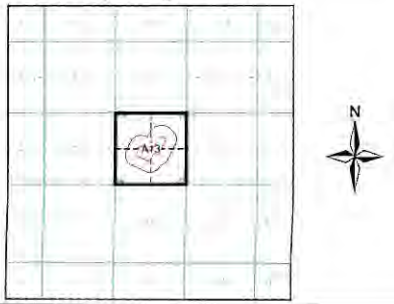
Source map scale - 1:2,500

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Map Name(s) and Date(s)



Historical Map - Segment A13



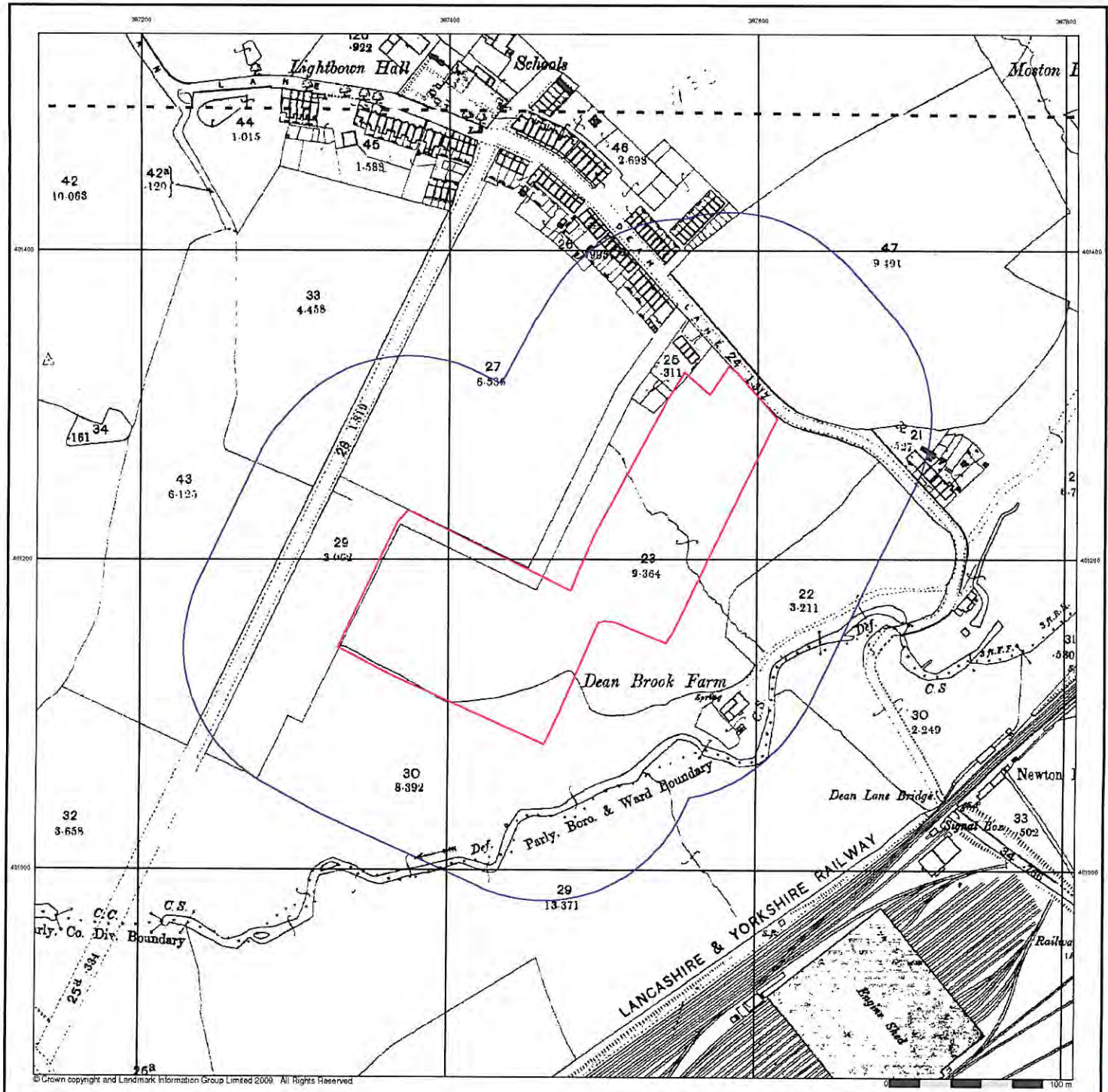
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Site Area (Ha):	2.65
Search Buffer (m):	100

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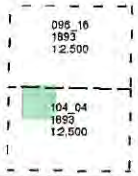
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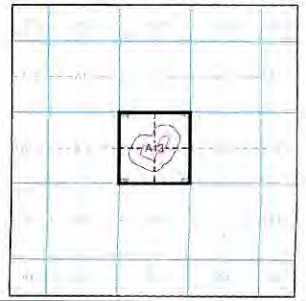
Lancashire And Furness
Published 1893
Source map scale - 1:2,500

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Map Name(s) and Date(s)



Historical Map - Segment A13



Order Details

Order Number:	29110587_1_1
Customer Ref:	12121870/001
National Grid Reference:	387480, 401210
Slice:	A
Site Area (Ha):	2.65
Search Buffer (m):	100

Site Details

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APPENDIX D

CONCEPTUAL SITE MODEL

Site: Moston Site 5 – Hanson Road

Ref: 12121870/002

Title: Conceptual Site Model

Scale: NTS

Pollution Linkages

Risks to Human Health

Pollution Linkage 1: (Direct contact, inhalation of dusts and ingestion of contaminants by residential users, construction and development workers).

Pollution Linkage 2: (Third party inhalation of contaminated dusts from construction activities).

Risks to Controlled Waters

None

Hazardous Gas

Pollution Linkage 1: Direct contact within excavations / confined spaces.

Pollution Linkage 2: Ingress into buildings.

Pollution Linkage 3: Migration via foundations/volatile vapour risk.

Risks to Built Environment

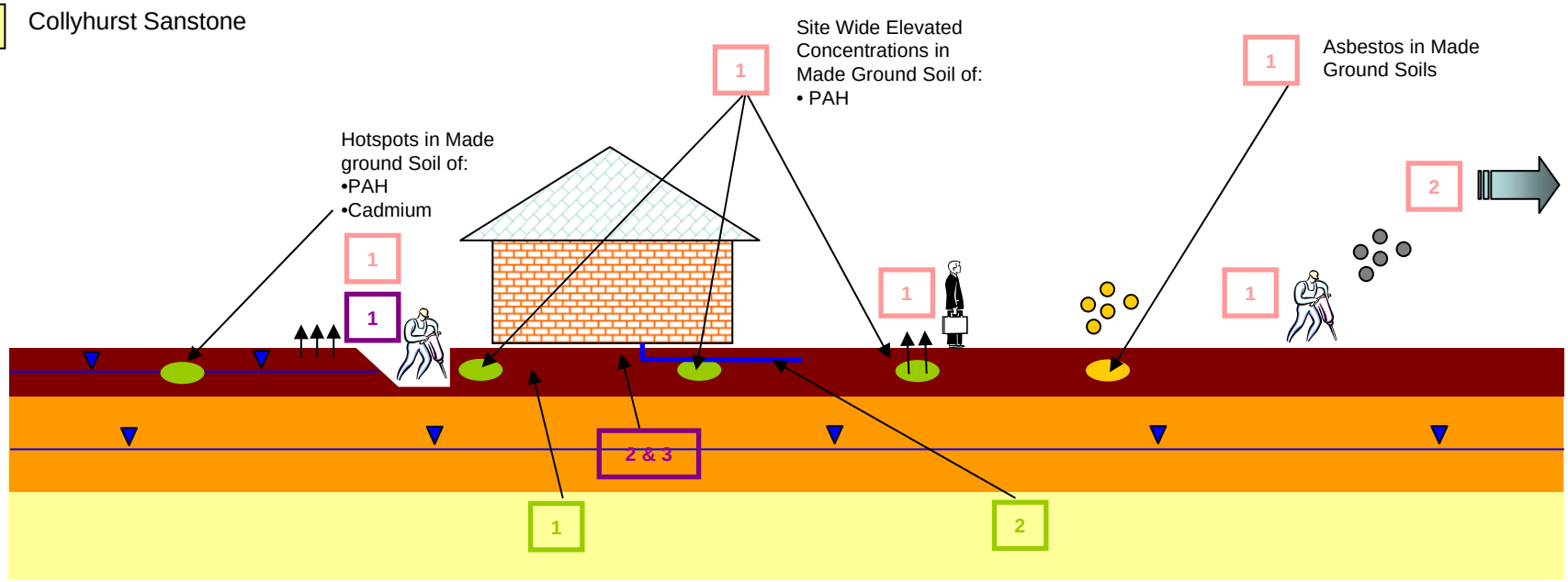
Pollutant Linkage 1: Chemical attack on buried concrete.

Pollutant Linkage 2: Protection of water supply pipe lines from contamination.

Granular/Cohesive Made Ground

Glacial Till

Collyhurst Sanstone



APPENDIX E

EXPLORATORY HOLE LOGS

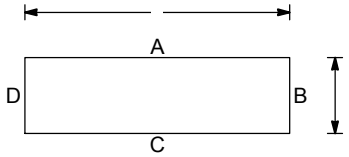
WSP Environmental
The Victoria, 150-182 The Quays
Manchester, M50 3SP
Telephone:
Fax:

TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**HP1**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	30-11-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.07			MADE GROUND: ASPHALT.					
	0.07-0.20			MADE GROUND: COBBLES.					
	0.20-0.40			Black and dark brown SAND and GRAVEL of brick, ash, coke.		0.20-0.40	BHP1		
	0.40-0.50			Firm, grey CLAY					
				Hand pit completed at 0.50m bgl				0.50	46

Shoring/Support:
Stability:



GENERAL REMARKS

Hand excavated trial pit.

All dimensions in metres Scale 1:30.3	Contractor	Method/ Plant Used	Logged By AM

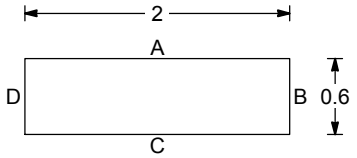
WSP Environmental
The Victoria, 150-182 The Quays
Manchester, M50 3SP
Telephone:
Fax:

TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP01**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.35 (0.35)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises brick and sandstone.					
	0.35-1.00 (0.65)			MADE GROUND: Soft brown, sandy, gravelly, CLAY with cobbles of brick. Gravel comprises brick, sandstone and glass. 0.35 - 1.00 Rootlets present.					
	1.00-1.80 (0.80)			Stiff brown, yellow, grey mottled slightly sandy, CLAY with occasional subangular to subrounded sandstone and mudstone gravel.(GLACIAL TILL).				1.10	86
				Trial pit completed at 1.80m bgl.				1.80	130

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.80m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

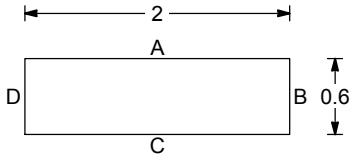
WSP Environmental
The Victoria, 150-182 The Quays
Manchester, M50 3SP
Telephone:
Fax:

TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP02**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.40 (0.40)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises brick and sandstone.					
	0.40-0.56			MADE GROUND: Soft brown, dark brown and black, gravelly sandy CLAY with cobbles of brick. Gravel comprises angular to subangular, brick, ash, sandstone and glass.		0.40-0.56 0.40-0.56	DTP2 ESTP2		
	0.56-0.85 (0.29)			MADE GROUND: Firm brown and red brown, grey mottled slightly sandy, firm CLAY with occasional subangular to subrounded sandstone and mudstone gravel.(REWORKED GLACIAL TILL). 0.64 m bgl. Drainage pipe encountered.					
	0.85-1.80 (0.95)			Firm becoming stiff brown and red brown, grey mottled slightly sandy, CLAY with occasional sandstone and mudstone gravel.(GLACIAL TILL).		0.90-1.10	DTP2	1.00	73
				Trial pit completed at 1.80m bgl.				1.80	83

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.80m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

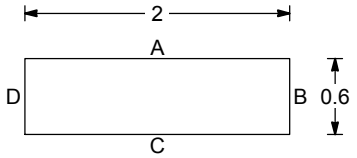
WSP Environmental
The Victoria, 150-182 The Quays
Manchester, M50 3SP
Telephone:
Fax:

TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP03**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.40 (0.40)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular brick and sandstone.					
	0.40-1.50 (1.10)			Stiff red brown, grey mottled slightly sandy, CLAY with occasional subangular to subrounded sandstone and mudstone gravel. (GLACIAL TILL).				0.80	87
				Trial pit completed at 1.50m bgl				1.50	99

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.50m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

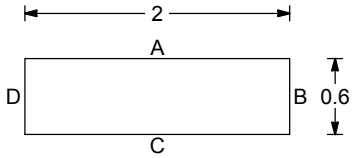
WSP Environmental
The Victoria, 150-182 The Quays
Manchester, M50 3SP
Telephone:
Fax:

TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP04**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.30 (0.30)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises brick and sandstone.					
	0.30-0.70 (0.40)			MADE GROUND: Firm light brown, grey mottled, slightly sandy, slightly gravelly, CLAY with occasional brick cobbles. Gravel comprises subangular to subrounded iron rich sandstone and mudstone. (REWORKED GLACIAL TILL).		0.30-0.50 0.30-0.50	DTP4 ESTP4		
	0.70-1.50 (0.80)			Firm red brown, grey mottled, slightly sandy, slightly gravelly, CLAY. Gravel comprises subangular to subrounded iron rich sandstone and mudstone. (GLACIAL TILL).		1.00-1.20	DTP4	0.90	74
				Trial pit completed at 1.50m bgl.				1.50	87

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.50m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

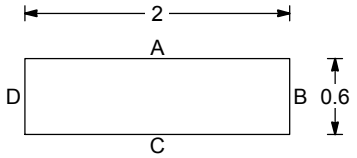
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP05**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.30 (0.30)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular brick and sandstone.					
	0.30-0.50			MADE GROUND: Soft, brown, sandy, gravelly CLAY with cobbles of brick. Gravel comprises brick, sandstone, ash and glass.		0.30-0.50	BTP5		
	0.50-1.00 (0.50)			Very stiff red brown, grey mottled slightly sandy, CLAY with occasional sandstone and mudstone gravel.(GLACIAL TILL).					
				Trial pit completed at 1.00m bgl				1.00	130

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

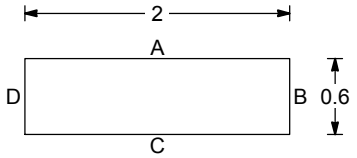
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP06**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.30 (0.30)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular, brick and sandstone.					
	0.30-0.50			MADE GROUND: Soft dark brown and black, slightly sandy, gravelly CLAY with cobbles of brick. Gravel comprises angular to subangular, brick, sandstone, ash, clay pipe and glass.		0.30-0.50 0.30-0.50	DTP6 ESTP6		
	0.50-0.70			MADE GROUND: Firm, light brown, red brown, grey mottled, slightly sandy CLAY with occasional subangular to subrounded sandstone and mudstone gravel (REWORKED GLACIAL TILL).					
	0.70-1.40 (0.70)			Stiff brown, grey mottled, slightly sandy CLAY with occasional subangular to subrounded sandstone and mudstone gravel (GLACIAL TILL). 0.90 m bgl.Pockets of sand encountered .		0.80-1.00	DTP6		
▼1				Trial pit completed at 1.40m bgl.				1.40	99

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.40m bgl. Groundwater seepage encountered at 1.30m. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

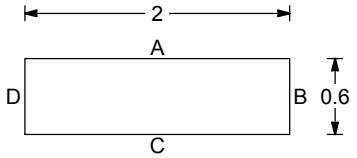
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP07**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.25 (0.25)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises brick and sandstone.					
	0.25-0.60 (0.35)			MADE GROUND: Soft dark brown, slightly gravelly, sandy, CLAY with occasional cobbles of brick. Gravel comprises brick, sandstone, ash, and glass.		0.25-0.60	BTP7		
	0.60-1.55 (0.95)			Firm light brown, grey mottled, slightly sandy CLAY (GLACIAL TILL).				0.80	56
				Trial pit completed at 1.55m bgl				1.55	75

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.55m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

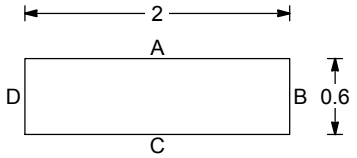
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP08**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.20			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular brick and sandstone.					
	0.20-0.60 (0.40)			MADE GROUND: Soft dark brown, sandy, gravelly CLAY with cobbles of brick. Gravel comprises angular to subangular, brick, sandstone, ash, and glass.		0.20-0.40 0.20-0.40	DTP8 ESTP8		
	0.60-1.70 (1.10)			Stiff, dark brown and brown, grey mottled, slightly sandy CLAY with occasional subangular to subrounded mudstone and sandstone gravel (GLACIAL TILLI).		0.80-1.00	DTP8	1.00	87
				Trial pit completed at 1.70m bgl				1.70	101

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.70m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

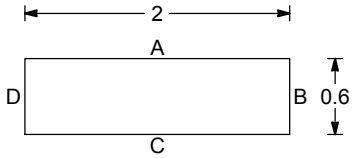
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP09**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.20			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises brick and sandstone.					
	0.20-0.80 (0.60)			MADE GROUND: Soft, dark brown and brown, sandy, gravelly CLAY with cobbles of brick. Gravel comprises angular to subangular brick, sandstone and ash.					
	0.80-1.40 (0.60)			MADE GROUND: Firm light brown, black sandy gravelly CLAY. Gravel comprises angular to subangular brick ash wood and glass. 0.80 - 1.40 m bgl. Some black organic matter encountered.				0.80	45
	1.40-2.20 (0.80)			Soft brown and black, grey mottled, slightly sandy CLAY with occasional subangular to subrounded mudstone and sandstone gravel (possible Made Ground).				1.50	27
				Trial pit completed at 2.20m bgl				2.20	30

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 2.20m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

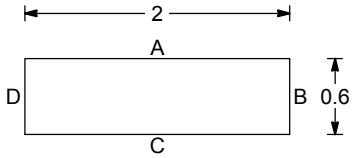
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP10**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.20			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises brick and sandstone.					
	0.20-2.50			MADE GROUND: Dark brown and brown, slightly clayey, gravelly SAND with concrete and brick cobbles. Gravel comprises brick, sandstone, ash, glass and slate.		0.30-2.50 0.30-2.50	DTP10 ESTP10		
				0.80 - 1.00 m bgl. Reinforced concrete post encountered.					
	(2.30)								
				Trial pit completed at 2.50m bgl					

Shoring/Support:
Stability: Unstable



GENERAL REMARKS

Trial pit complete at 2.50m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

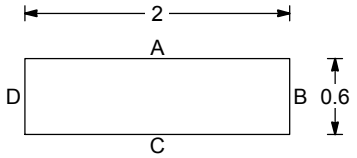
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP11**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.40 (0.40)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular brick and sandstone.					
	0.40-0.80 (0.40)			MADE GROUND: Soft dark brown and brown, slightly sandy, gravelly CLAY with brick cobbles and occasional cement blocks. Gravel comprises angular to subangular brick, sandstone, and clay pipe.		0.40-0.90	BTP11		
	0.80-1.75 (0.95)			Stiff brown, grey mottled, slightly sandy CLAY with occasional and mudstone and sandstone gravel (Glacial Till).				1.00	75
				Trial pit completed at 1.75m bgl.				1.75	85

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.75m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

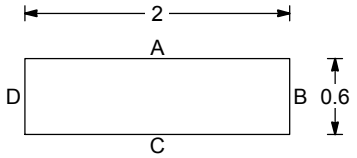
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP12**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.35 (0.35)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular brick and sandstone.					
▼1	0.35-1.60 (1.25)			MADE GROUND: Soft brown and black, sandy, gravelly CLAY with brick cobbles. Gravel comprises angular to subangular brick, sandstone, and ash.		0.35-0.55 0.35-0.55	DTP12 ESTP12		
	1.60-2.00 (0.40)			Stiff red brown, grey mottled, slightly sandy CLAY with occasional subangular to subrounded mudstone and sandstone gravel (GLACIAL TILL).		1.70-1.90	DTP12	1.60	79
				Trial pit completed at 2.00m bgl.				2.00	85

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 2.00m bgl. Groundwater seepage encountered 0.95m. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

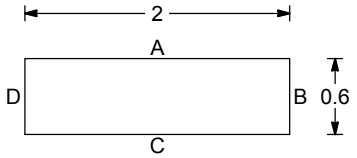
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP13**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.40 (0.40)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular, brick and sandstone.					
	0.40-0.80 (0.40)			MADE GROUND: Soft light brown, grey, slightly sandy, slightly gravelly CLAY. Gravel comprises angular to subangular brick, sandstone, mudstone and clay pipe.		0.40-0.60	BTP13		
	0.80-1.80 (1.00)			Stiff red brown and brown, grey mottled, slightly sandy CLAY with occasional and mudstone and sandstone gravel (GLACIAL TILL).				0.90	77
				Trial pit completed at 1.80m bgl				1.80	92

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.80m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

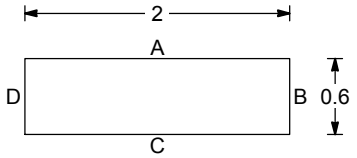
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP14**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.30 (0.30)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular brick and sandstone.					
	0.30-0.80 (0.50)			MADE GROUND: Soft brown, slightly sandy, gravelly CLAY with brick cobbles. Gravel comprises angular to subangular brick, sandstone, clay pipe, glass slate and ash. 0.65 - 0.80 Concrete slab encountered at 0.65m bgl		0.30-0.50 0.30-0.50	DTP14 ESTP14		
	0.80-1.80 (1.00)			Stiff, brown, grey mottled, slightly sandy CLAY with occasional subangular to subrounded mudstone and sandstone gravel (GLACIAL TILL). 0.80 - 1.60 m bgl. Pockets of fine sand encountered.		1.00-1.20	DTP14	1.00	80
				Trial pit completed at 1.80m bgl				1.80	130

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.80m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

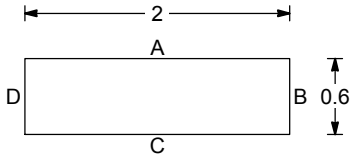
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP15**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.30 (0.30)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular brick and sandstone.					
	0.30-0.60 (0.30)			MADE GROUND: Soft brown, slightly sandy, slightly gravelly CLAY with occasional brick cobbles. Gravel comprises angular to subangular brick, sandstone, clay pipe and glass .		0.30-0.60	BTP15		
	0.60-1.70 (1.10)			Firm red brown and brown, grey mottled, slightly sandy CLAY with occasional subangular to subrounded mudstone and sandstone gravel (GLACIAL TILL).				0.90	85
				Trial pit completed at 1.70m bgl				1.70	92

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.70m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

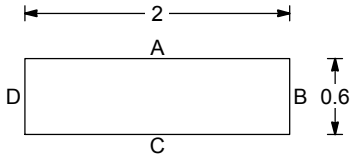
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TRIAL PIT LOG

Project				TRIAL PIT No
Site 5 - Hanson Road, Moston, Greater Manchester				**TP16**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

Water	Depth (thickness)	No	Red'cd Level	STRATA DESCRIPTION	Legend	SAMPLES Depth	SAMPLES Type	HSV Depth	HSV Result kN/m2
	0.00-0.30 (0.30)			MADE GROUND: Grass over dark brown slightly sandy, slightly gravelly clayey TOPSOIL. Gravel comprises angular to subangular brick and sandstone.					
	0.30-0.60 (0.30)			MADE GROUND: Soft dark brown and black, sandy, gravelly CLAY with occasional brick cobbles. Gravel comprises angular to subangular brick, sandstone and ash.		0.30-0.60 0.30-0.60	DTP16 ESTP16		
	0.60-1.70 (1.10)			Stiff light brown and brown, grey mottled, slightly sandy slightly gravelly CLAY. Gravel comprises subangular to subrounded sandstone and mudstone (Glacial Till).		1.00-1.20	DTP16	0.90	87
				Trial pit completed at 1.70m bgl				1.70	109

Shoring/Support:
Stability: Stable



GENERAL REMARKS

Trial pit complete at 1.70m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Trial pit backfilled upon completion.

All dimensions in metres Scale 1:30.3	Contractor Target Civil Engineering Ltd	Method/ Plant Used JCB 3CX	Logged By AM

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WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS01**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend		
							(0.30) 0.30	MADE GROUND: Soft brown slightly sandy slightly gravelly clay TOPSOIL. Gravel is subangular fine of sandstone and coal. With some fine roots.			
0.40-0.80	ES						(0.55) 0.85	MADE GROUND: Firm dark grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of brick. With frequent fragments of organic matter and wood.			
			0.80	60			(0.55) 1.40	MADE GROUND: Firm to stiff red-brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to surbounded of sandstone and brick. With occasional cobbles of brick.			
1.50-1.60	D		1.50	110				Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to medium of sandstone and siltstone. (GLACIAL TILL).			
			1.80	125			(1.60)				
2.50-2.60	D						3.00				
								Borehole terminated at 3.0m.			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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The Victoria, 150-182 The Quays
Manchester, M50 3SP
Telephone:
Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS02**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA					
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend	Geology	Instrument/ Backfill
0.15-0.40	ES						0.15	MADE GROUND: Soft brown sandy slightly gravelly clay TOPSOIL. Gravel is subangular fine of brick.			
							0.40	MADE GROUND: Grey-brown clayey very sandy angular to subangular fine to coarse GRAVEL of sandstone. With pockets of soft to firm-grey brown sandy gravelly clay. With fragmentsof plastic sheet.			
							0.60				
							0.70	MADE GROUND: Light grey sandy angular to subangular fine to coarse GRAVEL concrete.			
							(0.30)				
							1.00	Firm to stiff red-brown occasionally mottled grey sandy CLAY. (GLACIAL TILL).			
			1.10	89				Orange-brown clayey fine SAND with occasional pockets of firm red-brown sandy clay. (GLACIAL TILL).			
			1.50	125				Stiff brown slightly sandy slightly gravelly CLAY. Gravel is fine subangular to subrounded of sandstone and siltstone. (GLACIAL TILL).			
							(2.00)				
			2.20	80							
			2.50	85							
							3.00				
								Borehole terminated at 3.0m.			

Boring Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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Manchester, M50 3SP
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Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS03**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend		
0.00-0.50	ES						0.15	MADE GROUND: Soft grey-brown sandy slightly gravelly clay TOPSOIL. Gravel is subangular fine of sandstone. With some fine roots.			
							(0.35) 0.50	MADE GROUND: Grey-brown slightly clayey gravelly SAND. Gravel is subangular fine of brick and sandstone.			
							0.70	MADE GROUND: Firm grey-brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone, brick and siltstone. With occasional fragments of glass and wood.			
			0.90	45			(0.40) 1.10				
							(0.30) 1.40	MADE GROUND: Firm orange-brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone. From 1.0m: Occasionally mottled red-brown with angular fine gravel of brick.			
			1.50	30							
			1.80	40				MADE GROUND: Firm dark grey to black slightly gravelly CLAY. Gravel is angular fine of coal and occasional clinker.			
							(1.60)	Firm grey-brown occasionally mottled orange-brown slightly sandy slightly gravelly CLAY. Gravel is subrounded fine to coarse of sandstone and siltstone. (GLACIAL TILL). From 2.0m: Brown.			
			2.50	92				From 2.5m: Stiff.			
			2.90	>130			3.00				
								Borehole Terminated at 3.0m.			

Boring Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS04**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend		
0.00-0.50 0.00-0.50 0.00-0.50 0.00-0.50	ES D ES D						(0.50) 0.50	MADE GROUND: Brown, gravelly SAND. Gravel comprises angular brick.			
			0.80	130				Very stiff brown mottled grey CLAY with rare subangular medium sandstone gravel (Glacial Till).			
1.00-1.10	D		1.00	130							
								Pockets of fine sand.			
							(2.50)				
			2.00	130							
							(1.50)				
							3.00				
			3.00	130				Borehole Terminated at 3.0m.			

Boring Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By MN

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Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS05**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA					
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend	Geology	Instrument/ Backfill
							0.15	MADE GROUND: Soft dark grey-brown sandy slightly gravelly clay TOPSOIL. Gravel is angular to subrounded fine of sandstone, siltstone and brick.			
0.30-0.50	ES						(0.35)				
							0.50	MADE GROUND: Dark grey-brown clayey gravelly SAND. Gravel is subangular to rounded fine of sandstone and brick. From 0.4m: Dark grey with frequent fragments of organic matter.			
							0.60				
			0.80	110				MADE GROUND: Soft dark grey-brown sandy slightly gravelly CLAY. Gravel is angular to surbounded fine of sandstone, siltstone and brick.			
			1.20	>130				Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular to rounded of sandstone and siltstone. (GLACIAL TILL).			
			1.70	60			(2.40)				
							3.00				
								Borehole Terminated at 3.0m.			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

WSP Environmental
The Victoria, 150-182 The Quays
Manchester, M50 3SP
Telephone:
Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS06**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA					
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend	Geology	Instrument/ Backfill
							0.15	MADE GROUND: Soft dark-brown very sandy slightly gravelly clay TOPSOIL. Gravel is subangular fine of sandstone.			
0.20-0.40	ES						(0.35)	MADE GROUND: Firm grey-brown slightly sandy gravelly CLAY. Gravel is angular to subangular fine of brick, sandstone and occasional clinker. With occasional fragments of glass.			
							0.50				
0.75-0.85	D		0.90	78				Stiff brown occasionally mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular fine to medium of siltstone, sandstone and mudstone (GLACIAL TILL).			
1.40-1.50	D		1.50	>130			(2.50)				
							3.00				
								Borehole Terminated at 3.0m.			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				WS07
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend		
0.20-0.40	ES						0.20	MADE GROUND: Grass over soft dark brown slightly sandy slightly gravelly clay TOPSOIL. Gravel is subrounded fine to medium of sandstone and siltstone.			
							0.40				
							0.50	MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of brick, siltstone, sandstone occasional fine coal and clinker.			
			0.80	78				MADE GROUND: Light yellow brown slightly clayey sandy subangualr to angular fine to coarse GRAVEL of sandstone.			
								Stiff grey-brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone and coal. (GLACIAL TILL). From 0.8m: Orange-brown mottled grey. At 1.3m: Red-brown sandy lens.			
			1.50	58							
							(2.50)	At 1.7m: Firm brown sandy lens.			
			1.90	90							
			2.50	>130							
							3.00				
								Borehole terminated at 3.0m			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS08**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	04-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend		
							(0.40) 0.40	MADE GROUND: Soft brown slightly sandy slightly gravelly clay TOPSOIL. Gravel is angular fineto medium of brick. With occasional fragments of glass and some fine roots.			
0.60-0.90	ES						(1.00) 1.40	MADE GROUND: Soft grey-brown and dark grey mottled slightly sandy gravelly CLAY. Gravel is subangular fine to coarse of brick, sandstone and coal. With occasional cobbles of brick and sandstone and occasional fragments of glass, metal and wood.			
1.00-1.20	ES										
1.40-1.60	ES						1.60	MADE GROUND: Black sandy GRAVEL of angular to subangular fine to medium brick, sandstone and slag. With occasional fragments of glass.			
							(1.00) 2.60	MADE GROUND: Soft dark grey slightly sandy gravelly CLAY. Gravel is subangular fine to coarse of sandstone, slag and coal.			
							2.80	MADE GROUND: Black sandy angular to subangular fine GRAVEL of slag and brick.			
							3.00	MADE GROUND: Soft light grey sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone and coal. At 2.9m: Cobble of slag.			
							(2.00) 5.00	MADE GROUND: Dark grey clayey angular to subangular fine to coarse GRAVEL of brick, slag and coal. With occasional pockets of soft orange-brown sandy clay.			
								Borehole Terminated at 5.0m.			

Boring Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 5.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS09**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend		
							(0.30) 0.30	MADE GROUND: Soft dark grey-brown sandy slightly gravelly clay TOPSOIL. Gravel is subangular to subrounded fine of sandstone and siltstone.			
0.30-0.50	ES						0.50	MADE GROUND: Firm grey-brown slightly sandy gravelly CLAY. Gravel is angular to rounded fine to coarse of brick and sandstone. With occasional fragments of glass and wood.			
							(0.70) 1.20	MADE GROUND: Red-brown slightly clayey slightly sandy angular GRAVEL and COBBLES of brick.			
1.30-1.40	D		1.30	70				Firm and stiff grey-brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of sandstone, siltstone and coal. (GLACIAL TILL). From 1.5m: Orange-brown occasionally mottled grey.			
			1.90	94			(1.80)	From 2.0m: Red-brown.			
			2.50	68							
2.80-2.90	D		2.90	112			3.00				
								Borehole terminated at 3.0m.			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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The Victoria, 150-182 The Quays
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WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS10**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA					
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend	Geology	Instrument/ Backfill
							0.20	MADE GROUND: Soft dark grey-brown sandy slightly gravelly clay TOPSOIL. Gravel is subangular fine of brick and sandstone. With some fine roots.			
0.40-0.70	ES						(0.60)	MADE GROUND: Firm to stiff brown occasionally mottled light and dark grey slightly sandy slightly gravelly CLAY. Gravel is angular to subangular fine to coarse of brick, sandstone and rare fine gravel of slag. With occasional fine roots.			
							0.80	Stiff red-brown occasionally mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine of sandstone, mudstone and coal. (GLACIAL TILL). From 1.0m: Brown.			
			1.40	>130							
							(2.20)				
			2.50	112							
							3.00	Borehole terimated at 3.0m.			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS11**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA				Geology	Instrument/ Backfill
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend		
							0.20	MADE GROUND: Soft dark grey-brown sandy slightly gravelly clay TOPSOIL. Gravel is subangular fine to medium of sandstone and brick. With some fine roots.			
0.20-0.40	ES						(0.30)				
							0.50	MADE GROUND: Firm grey-brown and orange-brown mottled slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone and brick. At 0.4-0.5m: With some fragments of wood.			
0.60-0.70	D		0.70	110			(1.00)	Siff brown occasionally mottled grey slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine of sandstone and siltstone. (GLACIAL TILL). From 1.0m: Grey-brown with occasional sandy lenses.			
			1.40	110			1.50				
1.50-1.60	D						(0.80)	Orange-brown clayey slightly gravelly SAND. Gravel is subangular fine of sandstone and siltstone. (GLACIAL TILL).			
							2.30				
2.40-2.50	D		2.40	120			(0.70)	Firm and stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine of siltstone and sandstone. (GLACIAL TILL).			
			2.85	54			3.00				
								Borehole terminated at 3.0m.			

Boring Progress and Water Observations					
Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt
Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

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The Victoria, 150-182 The Quays
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Fax:

WINDOW SAMPLE LOG

Project				BOREHOLE No
Site 5 - Hanson Road, Moston, Greater Manchester				**WS12**
Job No	Date	Ground Level (m)	Co-Ordinates ()	
12121870/001	07-12-09			
Supervising Engineer		Client		Sheet
Catherine Wesley		Redrow Homes Lancashire Limited		1 of 1

SAMPLES & TESTS					Water	STRATA					
Depth	Type No	Test Result	HSV Depth	Result kN/m2		Reduced Level	Depth (Thick-ness)	DESCRIPTION	Legend	Geology	Instrument/ Backfill
							0.20	MADE GROUND: Soft dark grey-brown sandy slightly gravelly clay TOPSOIL. Gravel is subangular fine of sandstone. With some fine roots.			
							0.40	MADE GROUND: Firm grey-brown sandy slightly gravelly CLAY. Gravel is subangular fine of brick and sandstone.			
							(0.40)				
							0.80	MADE GROUND: Firm orange-brown and grey-brown slightly sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of sandstone and brick.			
			1.20	96				Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone and siltstone. (GLACIAL TILL).			
			1.70	>130			(1.40)				
							2.20				
							2.40	Brown clayey fine SAND. (GLACIAL TILL).			
			2.70	>130			(0.60)	Stiff brown slightly sandy slightly gravelly CLAY. Gravel is subangular fine to coarse of sandstone and siltstone. (GLACIAL TILL).			
							3.00	Borehole Terminated at 3.0m.			

Boring Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia. mm	Water Dpt

Date	Time	Strike	Minutes	Standing	Casing

GENERAL REMARKS

Borehole completed at 3.00m bgl. No groundwater encountered. No significant visual or olfactory evidence of contamination present. Monitoring point installed on completion.

All dimensions in metres Scale 1:37.5	Contractor / Driller GSS	Method/Plant Used Archway Engineering Dart	Logged By CMW

APPENDIX F

CHEMICAL LABORATORY ANALYSIS RESULTS

Certificate of Bulk Sample Asbestos Identification

WSP
The Laboratory
Lakeview Drive
Sherwood
Nottingham NG15 0ED

t: +44 (0)1623 886 800

Project No. 12121870/006
Job No. 09-10364
Location Moston Site 5 Hanson Road
Customer Redrow
Contact M Neden
Date sampled Not provided
Date of receipt 09/12/2009
Date of analysis 31/12/2009 - 08/01/2010

Stereo light microscope 01132
Polarised light microscope 226954

Lab Reference	Sample Location	Sample Description	Asbestos Identification	Comments
121161	WS3 0-0.5	Soil	No Asbestos Detected	None
121162	WS5 0-0.5	Soil	No Asbestos Detected	None
121163	WS6 0.2-0.4	Soil	No Asbestos Detected	None
121164	WS8 0.6-0.9	Soil	No Asbestos Detected	None
121165	TP12 0.35-1.6	Soil	Amosite & Chrysotile	Insulating Board
121166	TP16 0.3-0.6	Soil	No Asbestos Detected	None
121167	WS7 0.2-0.4	Soil	No Asbestos Detected	None

Authorised by Mark Beastall
Signature

Position Geotechnical Manager
Date of issue 8 January 2010

Analyst Adam Taylor
Signature

Checked by Mohammad Haque

UKAS TESTING
2538N

WSP Environmental
Risk Management Services
Division

Registered Office:
WSP House
70 Chancery Lane
London
WC2A 1AF

Registered Number
1152332 England

The above samples were submitted by WSP Environmental.

Analysis is in accordance with in-house technical procedures - AID, based upon HSE guidance note HSG 248 "Asbestos: The Analysts' Guide For Sampling, Analysis and Clearance Procedures". Sampling by WSP RMS is in accordance with in - house technical procedures - SSA. Where the sample was not taken by WSP RMS, the information above is that which is supplied by the client. WSP are not responsible for sampling errors where the sample is taken by others. Opinions, comments and interperation expressed herein are outside the scope of UKAS accreditation. Information supplied by e-mail may be subject to error during transfer.

WSP Group plc
Offices throughout the UK and worldwide

Certificate of Bulk Sample Asbestos Quantification

WSP
The Laboratory
Lakeview Drive
Sherwood
Nottingham NG15 0ED

t: +44 (0)1623 886 800

Project No. 12121870/006
Job No. 09-10364
Location Moston Site 5 Hanson Road
Customer Redrow
Contact M Neden
Date sampled Not provided
Date of receipt 09/12/2009
Date of analysis 31/12/2009 - 08/01/2010

Stereo light microscope Scope 1
Polarised light microscope 226954

Lab Ref	Sample Location	Description	Asbestos Identification	Containing material	Quantification(%)
121165	TP120.35-1.6	Soil	Amosite & Chrysotile	Insulating Board	< 0.10

Authorised by Mark Beastall
Signature

Position Geotechnical Manager
Date of issue 8 January 2010

Analyst Adam Taylor
Signature

Checked by Mohammad Haque

UKAS TESTING
2538N

WSP Environmental
Risk Management Services
Division

Registered Office:
WSP House
70 Chancery Lane
London
WC2A 1AF

Registered Number
1152332 England

The above samples were submitted by WSP Environmental.

Analysis is in accordance with in-house Asbestos Technical Procedures - BULK ID, based upon HSE guidance note HSG 248 "Asbestos: The Analysts' Guide For Sampling, Analysis and Clearance Procedures", and quantification of Asbestos in Soil (QAS). Sampling by WSP RMS is in accordance with Asbestos Technical Procedures - Bulk Sampling. Where the sample was not taken by WSP RMS, the information above is that which is supplied by the client. WSP is not responsible for sampling errors where the sample is taken by others. If taken by a third party, WSP cannot be held responsible for any incorrect information submitted. Opinions and interperations expressed herein, such as the material type, amount of asbestos fibre, and type of non-asbestos fibre, are outside the scope of UKAS accreditation. The amount of asbestos (w/w) within the sample is determined by in house Asbestos Technical procedure QAS. Samples with an asbestos content of above 0.1% are classified as special waste.
Limits of detection & accuracy depends on initial sample mass. The minimum mass that can be practically weighed is 0.05g & the optimum mass of 500g gives a limit of detection of (0.05/500)x100 = 0.01%. From this the minimum analyzable mass is 50g. To give confidence in the results, a minimum mass of 100g is used (giving a limit of detection of 0.05%). The uncertainty of measurement figures have been split into two categories & are confirmed as: low asbestos content (<0.15% ± 0.09%), high asbestos content (>1.5% ± 0.10%).
Information supplied by e-mail may be subject to error during transfer.

WSP Group plc
Offices throughout the UK and worldwide

Solid Samples

Job No. 09-10364
Site: Moston Site 5 Hanson Road
Report Date: 31/12/2009

			Lab No.	121161	121162	121163	121164	121165	121166	121167
			Sample Date	/ /	/ /	/ /	/ /	/ /	/ /	/ /
			Sample Id	WS3	WS5	WS6	WS8	TP12	TP16	WS7
			Other ID							
			Depth (m)	0-0.5	0-0.5	0.2-0.4	0.6-0.9	0.35-1.6	0.3-0.6	0.2-0.4
Determination	**LOD**	**Units**	**Method**							
Solid Description			101	Loam	Loam	Loam	Loam	Loam	Clay	Clay
Moisture	0.1	%	101	13	11	12	15	20	18	17
pH		pH units	206 *	11	10	8.5	8.3	8.2	8.1	10
Soil Organic Matter	0.2	%	204 *	1.9	---	2.2	---	3.4	2.2	2.0
Selenium, total, as Se	0.3	mg/kg	412 *	< 0.3	< 0.3	< 0.3	0.4	0.8	0.3	< 0.3
Mercury, total, as Hg	0.2	mg/kg	405 *	< 0.2	< 0.2	< 0.2	0.3	3.8	0.3	< 0.2
Arsenic, total, as As	2.5	mg/kg	406 *	3.5	3.4	5.2	11	11	8.9	6.6
Cadmium, total, as Cd	0.25	mg/kg	406 *	< 0.25	< 0.25	< 0.25	0.51	40	0.46	< 0.25
Chromium, total, as Cr	1	mg/kg	406 *	19	17	18	26	38	24	34
Copper, total, as Cu	2.5	mg/kg	406 *	26	24	33	300	74	42	29
Nickel, total, as Ni	2.5	mg/kg	406 M*	16	13	18	25	24	20	19
Lead, total, as Pb	2.5	mg/kg	406 M*	88	56	65	270	170	87	160
Zinc, total, as Zn	5	mg/kg	406 M*	99	90	79	300	170	96	130
Sulphate, water soluble (2:1), as SO4	30	mg/kg	418	1200	550	660	170	370	240	2700
Naphthalene	0.1	mg/kg	408	0.9	0.4	0.8	0.7	2.2	0.6	0.2
Acenaphthylene	0.1	mg/kg	408	0.2	0.1	0.1	0.2	0.2	0.2	< 0.1
Acenaphthene	0.1	mg/kg	408	2.2	0.7	1.7	0.7	4.6	0.9	0.2
Fluorene	0.1	mg/kg	408	1.5	0.6	1.8	0.6	3.3	0.6	0.1
Phenanthrene	0.1	mg/kg	408	13	5.8	16	6.2	21	6.4	1.7
Anthracene	0.1	mg/kg	408	3.1	1.6	4.4	1.0	3.6	1.2	0.4
Fluoranthene	0.1	mg/kg	408	19	9.0	19	7.6	21	9.6	2.7
Pyrene	0.1	mg/kg	408	16	8.0	15	6.3	17	8.1	2.2
Benzo(a)anthracene	0.1	mg/kg	408	8.3	4.4	8.6	3.2	8.0	4.1	1.2
Chrysene	0.1	mg/kg	408	8.9	4.7	9.5	3.6	8.5	4.4	1.2
Benzo(k)fluoranthene	0.1	mg/kg	408	3.5	1.9	3.2	1.4	3.4	1.8	0.6
Benzo(b)fluoranthene	0.1	mg/kg	408	6.5	3.7	6.2	2.8	6.4	3.5	1.0

Accreditation: * ISO17025, M MCerts

Solid Samples

Job No. 09-10364
Site: Moston Site 5 Hanson Road
Report Date: 31/12/2009

			Lab No.	121161	121162	121163	121164	121165	121166	121167
			Sample Date	/ /	/ /	/ /	/ /	/ /	/ /	/ /
			Sample Id	WS3	WS5	WS6	WS8	TP12	TP16	WS7
			Other ID							
			Depth (m)	0-0.5	0-0.5	0.2-0.4	0.6-0.9	0.35-1.6	0.3-0.6	0.2-0.4
Determination	**LOD**	**Units**	**Method**							
Benzo(a)pyrene	0.1	mg/kg	408	8.5	4.9	7.1	3.1	7.8	4.3	1.3
Indeno(1,2,3-c,d)pyrene	0.1	mg/kg	408	4.6	2.9	4.1	2.0	4.6	2.5	0.8
Dibenzo(a,h)anthracene	0.1	mg/kg	408	< 0.1	0.6	1.0	0.4	1.0	0.6	0.2
Benzo(g,h,i)perylene	0.1	mg/kg	408	4.7	2.8	3.8	2.0	4.4	2.5	0.8
PAH Total (EPA 16)	1	mg/kg	408	100	52	100	42	120	51	14
Benzene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
m+p-Xylene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
o-Xylene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
TAME	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PRO (>C5-C6)	10	mg/kg	401	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
PRO (>C6-C8)	10	mg/kg	401	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
PRO (>C8-C10)	10	mg/kg	401	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
PRO (>C5-C10)	30	mg/kg	401	< 30	< 30	< 30	< 30	< 30	< 30	< 30
PRO (>C6-C10)	20	mg/kg	401	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Aliphatic (>C5-C6)	0.2	mg/kg	401	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Aliphatic (>C6-C8)	0.2	mg/kg	401	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Aliphatic (>C8-C10)	0.2	mg/kg	401	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Aliphatic (>C10-C12)	2	mg/kg	419	4.5	3.7	3.8	3.4	2.8	2.6	2.5
Aliphatic (>C12-C16)	2	mg/kg	419	49	32	13	8.8	20	7.4	7.8
Aliphatic (>C16-C21)	5	mg/kg	419	35	23	10	6.4	17	< 5.0	< 5.0
Aliphatic (>C21-C35)	5	mg/kg	419	340	220	76	53	170	41	39
Aliphatic (>C35-C40)	2	mg/kg	419	84	86	18	20	46	11	13
Aliphatic (>C40-C44)	2	mg/kg	419	44	31	6.3	8.2	16	4.3	4.9

Solid Samples

Job No. 09-10364
Site: Moston Site 5 Hanson Road
Report Date: 31/12/2009

			Lab No.	121161	121162	121163	121164	121165	121166	121167
			Sample Date	/ /	/ /	/ /	/ /	/ /	/ /	/ /
			Sample Id	WS3	WS5	WS6	WS8	TP12	TP16	WS7
			Other ID							
			Depth (m)	0-0.5	0-0.5	0.2-0.4	0.6-0.9	0.35-1.6	0.3-0.6	0.2-0.4
Determination	**LOD**	**Units**	**Method**							
Total Aliphatics (>C6-C44)	20	mg/kg	419	560	400	130	99	270	72	72
Aromatic (>C6-C7)	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic (>C7-C8)	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic (>C8-C10)	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic (>C10-C12)	2	mg/kg	419	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	3.5	2.8
Aromatic (>C12-C16)	2	mg/kg	419	98	42	12	32	34	45	21
Aromatic (>C16-C21)	5	mg/kg	419	85	38	10	27	30	38	18
Aromatic (>C21-C35)	5	mg/kg	419	390	230	78	84	180	110	78
Aromatic (>C35-C40)	2	mg/kg	419	180	100	17	26	42	21	17
Aromatic (>C40-C44)	2	mg/kg	419	74	43	12	21	28	12	11
Total Aromatics (>C6-C44)	20	mg/kg	419	830	460	130	190	310	230	150
Total TPH (>C6-C44)	40	mg/kg	419	1400	860	260	290	580	300	220

WSP Environmental Manchester
The Victoria
150-182 The Quays
Salford
Manchester
UK
M50 3SP

Certificate of Analysis

Job Number 09-10364

Report Date	31 December 2009
Project Number	12121870 006
Customer	Redrow
Site Address	Moston Site 5 Hanson Road
Date of Sampling	Unspecified
Date of Analysis	9 December 2009 - 31 December 2009

Dear M Neden

Please find attached your results for the above project.
This report includes the samples we received at WSP Environmental Laboratories on 09/12/2009.

Your feedback is critical to the evolution and improvement of our business, so please feel free to email us your comments to: ideas_lab@wspgroup.com.

Results authorised by



Mike Cohen
Operations Manager

Chemical Analysis is undertaken in accordance with in-house technical procedures and is subject to quality control procedures. Any opinions or interpretations indicated are outside the scope of our UKAS accreditation.

Solid Samples

Job No. 09-10364
Site: Moston Site 5 Hanson Road
Report Date: 31/12/2009

			Lab No.	121161	121162	121163	121164	121165	121166	121167
			Sample Date	/ /	/ /	/ /	/ /	/ /	/ /	/ /
			Sample Id	WS3	WS5	WS6	WS8	TP12	TP16	WS7
			Other ID							
			Depth (m)	0-0.5	0-0.5	0.2-0.4	0.6-0.9	0.35-1.6	0.3-0.6	0.2-0.4
Determination	**LOD**	**Units**	**Method**							
Solid Description			101	Loam	Loam	Loam	Loam	Loam	Clay	Clay
Moisture	0.1	%	101	13	11	12	15	20	18	17
pH		pH units	206 *	11	10	8.5	8.3	8.2	8.1	10
Soil Organic Matter	0.2	%	204 *	1.9	---	2.2	---	3.4	2.2	2.0
Selenium, total, as Se	0.3	mg/kg	412 *	< 0.3	< 0.3	< 0.3	0.4	0.8	0.3	< 0.3
Mercury, total, as Hg	0.2	mg/kg	405 *	< 0.2	< 0.2	< 0.2	0.3	3.8	0.3	< 0.2
Arsenic, total, as As	2.5	mg/kg	406 *	3.5	3.4	5.2	11	11	8.9	6.6
Cadmium, total, as Cd	0.25	mg/kg	406 *	< 0.25	< 0.25	< 0.25	0.51	40	0.46	< 0.25
Chromium, total, as Cr	1	mg/kg	406 *	19	17	18	26	38	24	34
Copper, total, as Cu	2.5	mg/kg	406 *	26	24	33	300	74	42	29
Nickel, total, as Ni	2.5	mg/kg	406 M*	16	13	18	25	24	20	19
Lead, total, as Pb	2.5	mg/kg	406 M*	88	56	65	270	170	87	160
Zinc, total, as Zn	5	mg/kg	406 M*	99	90	79	300	170	96	130
Sulphate, water soluble (2:1), as SO4	30	mg/kg	418	1200	550	660	170	370	240	2700
Naphthalene	0.1	mg/kg	408	0.9	0.4	0.8	0.7	2.2	0.6	0.2
Acenaphthylene	0.1	mg/kg	408	0.2	0.1	0.1	0.2	0.2	0.2	< 0.1
Acenaphthene	0.1	mg/kg	408	2.2	0.7	1.7	0.7	4.6	0.9	0.2
Fluorene	0.1	mg/kg	408	1.5	0.6	1.8	0.6	3.3	0.6	0.1
Phenanthrene	0.1	mg/kg	408	13	5.8	16	6.2	21	6.4	1.7
Anthracene	0.1	mg/kg	408	3.1	1.6	4.4	1.0	3.6	1.2	0.4
Fluoranthene	0.1	mg/kg	408	19	9.0	19	7.6	21	9.6	2.7
Pyrene	0.1	mg/kg	408	16	8.0	15	6.3	17	8.1	2.2
Benzo(a)anthracene	0.1	mg/kg	408	8.3	4.4	8.6	3.2	8.0	4.1	1.2
Chrysene	0.1	mg/kg	408	8.9	4.7	9.5	3.6	8.5	4.4	1.2
Benzo(k)fluoranthene	0.1	mg/kg	408	3.5	1.9	3.2	1.4	3.4	1.8	0.6
Benzo(b)fluoranthene	0.1	mg/kg	408	6.5	3.7	6.2	2.8	6.4	3.5	1.0

Accreditation: * ISO17025, M MCerts

Solid Samples

Job No. 09-10364
Site: Moston Site 5 Hanson Road
Report Date: 31/12/2009

			Lab No.	121161	121162	121163	121164	121165	121166	121167
			Sample Date	/ /	/ /	/ /	/ /	/ /	/ /	/ /
			Sample Id	WS3	WS5	WS6	WS8	TP12	TP16	WS7
			Other ID							
			Depth (m)	0-0.5	0-0.5	0.2-0.4	0.6-0.9	0.35-1.6	0.3-0.6	0.2-0.4
Determination	**LOD**	**Units**	**Method**							
Benzo(a)pyrene	0.1	mg/kg	408	8.5	4.9	7.1	3.1	7.8	4.3	1.3
Indeno(1,2,3-c,d)pyrene	0.1	mg/kg	408	4.6	2.9	4.1	2.0	4.6	2.5	0.8
Dibenzo(a,h)anthracene	0.1	mg/kg	408	< 0.1	0.6	1.0	0.4	1.0	0.6	0.2
Benzo(g,h,i)perylene	0.1	mg/kg	408	4.7	2.8	3.8	2.0	4.4	2.5	0.8
PAH Total (EPA 16)	1	mg/kg	408	100	52	100	42	120	51	14
Benzene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
m+p-Xylene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
o-Xylene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
TAME	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PRO (>C5-C6)	10	mg/kg	401	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
PRO (>C6-C8)	10	mg/kg	401	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
PRO (>C8-C10)	10	mg/kg	401	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
PRO (>C5-C10)	30	mg/kg	401	< 30	< 30	< 30	< 30	< 30	< 30	< 30
PRO (>C6-C10)	20	mg/kg	401	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Aliphatic (>C5-C6)	0.2	mg/kg	401	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Aliphatic (>C6-C8)	0.2	mg/kg	401	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Aliphatic (>C8-C10)	0.2	mg/kg	401	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
Aliphatic (>C10-C12)	2	mg/kg	419	4.5	3.7	3.8	3.4	2.8	2.6	2.5
Aliphatic (>C12-C16)	2	mg/kg	419	49	32	13	8.8	20	7.4	7.8
Aliphatic (>C16-C21)	5	mg/kg	419	35	23	10	6.4	17	< 5.0	< 5.0
Aliphatic (>C21-C35)	5	mg/kg	419	340	220	76	53	170	41	39
Aliphatic (>C35-C40)	2	mg/kg	419	84	86	18	20	46	11	13
Aliphatic (>C40-C44)	2	mg/kg	419	44	31	6.3	8.2	16	4.3	4.9

Solid Samples

Job No. 09-10364
Site: Moston Site 5 Hanson Road
Report Date: 31/12/2009

			Lab No.	121161	121162	121163	121164	121165	121166	121167
			Sample Date	/ /	/ /	/ /	/ /	/ /	/ /	/ /
			Sample Id	WS3	WS5	WS6	WS8	TP12	TP16	WS7
			Other ID							
			Depth (m)	0-0.5	0-0.5	0.2-0.4	0.6-0.9	0.35-1.6	0.3-0.6	0.2-0.4
Determination	**LOD**	**Units**	**Method**							
Total Aliphatics (>C6-C44)	20	mg/kg	419	560	400	130	99	270	72	72
Aromatic (>C6-C7)	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic (>C7-C8)	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic (>C8-C10)	0.01	mg/kg	401	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic (>C10-C12)	2	mg/kg	419	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	3.5	2.8
Aromatic (>C12-C16)	2	mg/kg	419	98	42	12	32	34	45	21
Aromatic (>C16-C21)	5	mg/kg	419	85	38	10	27	30	38	18
Aromatic (>C21-C35)	5	mg/kg	419	390	230	78	84	180	110	78
Aromatic (>C35-C40)	2	mg/kg	419	180	100	17	26	42	21	17
Aromatic (>C40-C44)	2	mg/kg	419	74	43	12	21	28	12	11
Total Aromatics (>C6-C44)	20	mg/kg	419	830	460	130	190	310	230	150
Total TPH (>C6-C44)	40	mg/kg	419	1400	860	260	290	580	300	220

Comparison of statistical results against Screening Values for
PLEASE SELECT SCREENING SCENARIO
The Indoor Vapour Inhalation Pathway is considered to be present

Job Number	12121870/002
Site Name	Moston Site 5
Averaging Area	

pH	8.5
SOM %	3

	Contaminant	Generic Assessment Criteria (mg/kg)	US95 (mg/kg)	No. Samples Included in Statistical Tests	Screening Test Result	Do Any Samples Exceed Screening Value?	Is maximum value an outlier?	Source of Screening Value	Minimum in Data Set (mg/kg)	Maximum in Data Set (mg/kg)	No Samples Exceeding GAC
	Arsenic	32	13.73	9	Pass	No	No	SGV	3.4	27	0
	Cadmium	10	0.56	8	Pass	No	Yes	SGV	0.25	0.94	0
	Chromium	3000	33.34	9	Pass	No	No	SGV	17	45	0
	Copper	2300	132.57	9	Pass	No	Yes	GAC	24	300	0
	Nickel	130	24.97	9	Pass	No	No	SGV	13	35	0
	Lead	410	176.98	9	Pass	No	No	SGV	56	270	0
	Zinc	3700	221.22	9	Pass	No	No	GAC	79	350	0
	Mercury	170	1.40	9	Pass	No	Yes	SGV	0.2	3.8	0
	Selenium	350	0.53	9	Pass	No	No	SGV	0.3	0.8	0
Polyaromatic Hydrocarbons	Naphthalene	1.5	1.10	9	Pass	Yes	No	GAC	0.2	2.2	1
	Acenaphthylene	170	0.19	9	Pass	No	No	GAC	0.1	0.2	0
	Acenaphthene	205	2.22	9	Pass	No	No	GAC	0.2	4.6	0
	Fluorene	160	1.68	9	Pass	No	No	GAC	0.1	3.3	0
	Phenanthrene	92	12.85	9	Pass	No	No	GAC	1.7	21	0
	Anthracene	2250	2.85	9	Pass	No	No	GAC	0.4	4.4	0
	Fluoranthene	260	15.59	9	Pass	No	No	GAC	2.7	21	0
	Pyrene	560	12.79	9	Pass	No	No	GAC	2.2	17	0
	Benzo(a)anthracene	3.1	4.23	6	Fail	Yes	No	GAC	1.2	4.4	4
	Chrysene	6	5.89	7	Pass	Yes	No	GAC	1.2	8.5	1
	Benzo(b)fluoranthene	5.6	5.19	9	Pass	Yes	No	GAC	1	6.5	3
	Benzo(k)fluoranthene	8.5	2.72	9	Pass	No	No	GAC	0.6	3.5	0
	Benzo(a)pyrene	0.83	6.38	9	Fail	Yes	No	GAC	1.3	8.5	9
	Indeno(1,2,3-cd)pyrene	3.2	3.04	7	Pass	Yes	No	GAC	0.8	4.1	1
	Di-benz(a,h,)anthracene	0.76	0.73	9	Pass	Yes	No	GAC	0.1	1	2
	Benzo(g,h,i)perylene	44	3.57	9	Pass	No	No	GAC	0.8	4.7	0

Outlier Values Removed from Data Set

Substance	Sample Ref	Depth	Value
Benzo(a)anthracene	WS6	0.2-0.4	8.6
Benzo(a)anthracene	WS3	0.0-0.5	8.3
Benzo(a)anthracene	TP12	0.35-1.6	8
Cadmium	TP13	0.35-1.6	40
chrysene	WS3	0.0-0.5	8.9
chrysene	WS6	0.2-0.4	9.5
ideno(1,2,3-cd)pyrene	WS3	0.0-0.5	4.6
ideno(1,2,3-cd)pyrene	WS6	0.2-0.4	4.6

Notes:

TEQ = GAC Calculated using the TEQ methodology
SGV = Published Soil Guideline Value
GAC = WSP Generic Assessment Criteria
LQM/CIEH - CIEH Generated GAC
***Acute risk calculated using SNIFFER

Note 1: Insufficient number of samples to complete the Maximum Value Test (Minimum of 4 required)

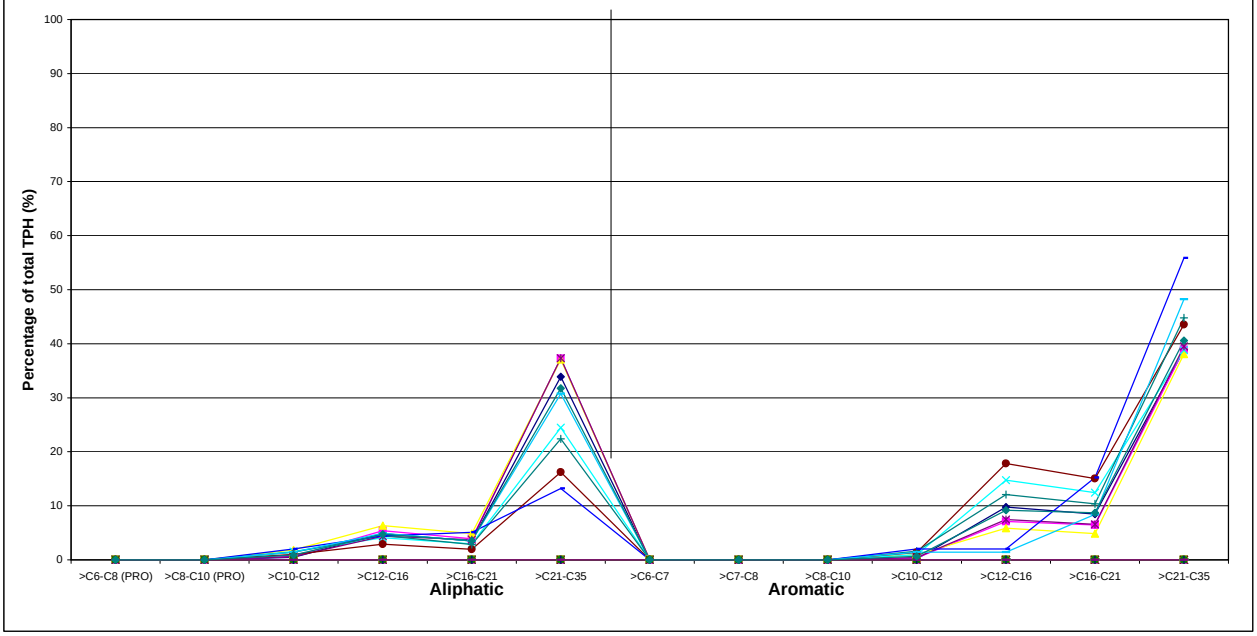
Comparison of TPHCWG statistical results against Screening Values for
PLEASE SELECT SCREENING SCENARIO
The Indoor Vapour Inhalation Pathway is considered to be present

Job Number	12121870/002
Site Name	Moston Site 5
Averaging Area	

pH	8.5
SOM %	3

	Contaminant	Screening Value (mg/kg)	US95 (mg/kg)	No. Samples Included in Statistical Tests	Screening Test Result	Do Any Samples Exceed Screening Value?	Is maximum value an outlier?	Source of Screening Value	Minimum in Data Set (mg/kg)	Maximum in Data Set (mg/kg)	No Samples Exceeding GAC	TPH Fraction (%) of Total
Aliphatics	>C6-C8 (PRO)	73	0.20	9	Pass	No	Yes	GAC	0.2	0.2	0	0
	>C8-C10 (PRO)	19	0.20	9	Pass	No	Yes	GAC	0.2	0.2	0	0
	>C10-C12	93	3.57	9	Pass	No	No	GAC	2	4.5	0	1
	>C12-C16	740	25.84	9	Pass	No	No	GAC	4.4	49	0	5
	>C16-C21	22500	18.97	9	Pass	No	No	GAC	5	35	0	4
	>C21-C35	22500	178.78	9	Pass	No	No	GAC	13	340	0	32
												41
Aromatics	>C6-C7 (Benzene)	65	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	0
	>C7-C8 (Toluene)	120	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	0
	>C8-C10 (Ethylbenzene & Xylene)	27	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	0
	>C10-C12	69	2.59	9	Pass	No	Yes	GAC	2	3.5	0	1
	>C12-C16	140	50.27	9	Pass	No	No	GAC	2	98	0	9
	>C16-C21	250	44.63	9	Pass	No	No	GAC	10	85	0	9
	>C21-C35	890	209.53	9	Pass	No	No	GAC	55	390	0	41
												59
	MTBE	49	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	
BTEX	Benzene	0.08	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	
	Toluene	119	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	
	Ethylbenzene	65	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	
	m,p-Xylenes	86	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	
	o-Xylene	45	0.01	9	Pass	No	Yes	GAC	0.01	0.01	0	

Graph 1: TPH CWG Fractions For Individual Samples



Note 1: Insufficient number of samples to complete the Maximum Value Test (Minimum of 4 required)
TEQ = GAC Calculated using the TEQ methodology
SGV = Published Soil Guideline Value
GAC = WSP Generic Assessment Criteria
LQM/CIEH - CIEH Generated GAC

APPENDIX G

GEOTECHNICAL LABORATORY ANALYSIS RESULTS

Summary of Geotechnical Laboratory results

Job 09-10424

RP09a 12/11/08

Sample Data					Classification BS 1377 Part 2											Compaction BS1377 Part 4			Rock ISRM		Strength & Compression testing BS 1377 Parts 5 & 7								
TP / BH No.	Other Id	Sampnum	Depth from (m)	Depth to (m)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity index	Plasticity category	Material passing 425um	Linear Shrinkage	Saturated Moisture content	Bulk Density	Dry Density	PSD / Sedimentation	Particle Density	CBR	MCV	Compaction	Point load Axial IS50	Point load Diametral IS50	Triaxial Type	Diameter	Cell Pressure	Corrected Deviator Stress	Undrained Shear Strength	Strain @ Failure	Mode of Failure	Hand Shear Vane *	One Dimensional Consolidation
					%	%	%	%		%	%	%	Mg/m^3	Mg/m^3		Mg/m^3				MPA	MPA		mm	kPa	kPa	CUkPa	%		kPa	
WS6		121716	0.75	0.85	20	44	21	23	CI	100																				
WS6		121717	1.4	1.5	18																									
WS4		121718	1	1	14	34	17	17	CL	98																				
WS9		121719	1.3	1.4	26	44	22	22	CI	95																				
WS11		121720	0.6	0.7	17																									
WS11		121721	1.5	1.6	17		NP	NP	NP	100																				
TP10		121723	1	2.5											X															

Summary of Geotechnical Laboratory results

Job 09-10424

RP09b 12/11/08

Sample Data					Chemical								Other Analyses
					BRE SD1				BS 1377 Part 3				
TP / BH No.	Other Id	Sampnum	Depth from (m)	Depth to (m)	Water Soluble Sulphate *	Acid Soluble Sulphate	Total Sulphur	Water Soluble Chloride	Organic Matter	Loss on Ignition **	pH *	matter >2mm	
					g/l	%	%	g/l	%	%	units	%	
WS6		121716	0.75	0.85	0.12						7.2	< 1.00	
WS6		121717	1.4	1.5									
WS4		121718	1	1	0.07						8.3	< 1.00	
WS9		121719	1.3	1.4	0.11						8.3	< 1.00	
WS11		121720	0.6	0.7									
WS11		121721	1.5	1.6	0.02						8.6	< 1.00	
TP10		121723	1	2.5									

Job 09-10424

Summary of Geotechnical Laboratory results

BH/TP No.	Sampnum	Depth	Laboratory Visual Description Eurocode 7 - BS EN 14688-1 & BS5930 (1999) Table 13	Remarks
WS6	121716	0.75-0.85	Soft brown CLAY with occasional gravel	
WS6	121717	1.4-1.5	Firm brown CLAY with rare gravel	
WS4	121718	1-1	Firm brown CLAY with occasional gravel	
WS9	121719	1.3-1.4	Soft brown CLAY	
WS11	121720	0.6-0.7	Firm brown CLAY with occasional gravel	
WS11	121721	1.5-1.6	Brown medium coarse SAND	
TP10	121723	1-2.5	Soft brown / black SILTY SAND with occasional gravel & red brick	

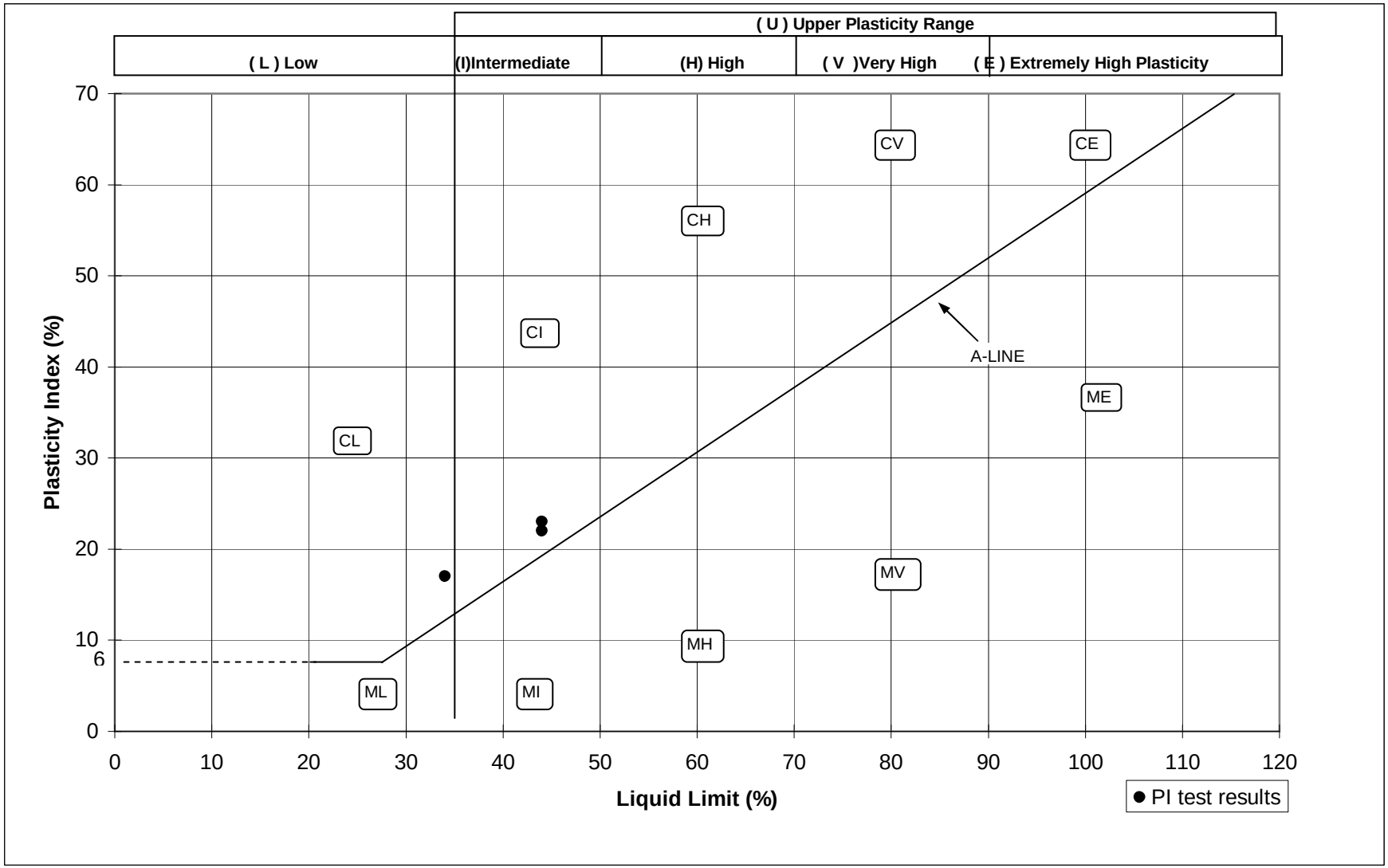
RP09b 09/02/05
ISSUE 1 REV0
Job 09-10424

PLASTICITY CHART from BS5930 : 2000

WSP Environmental Ltd
The Laboratory
Lakeview Drive
Sherwood
Nottingham NG15 0ED

Environmental Laboratories

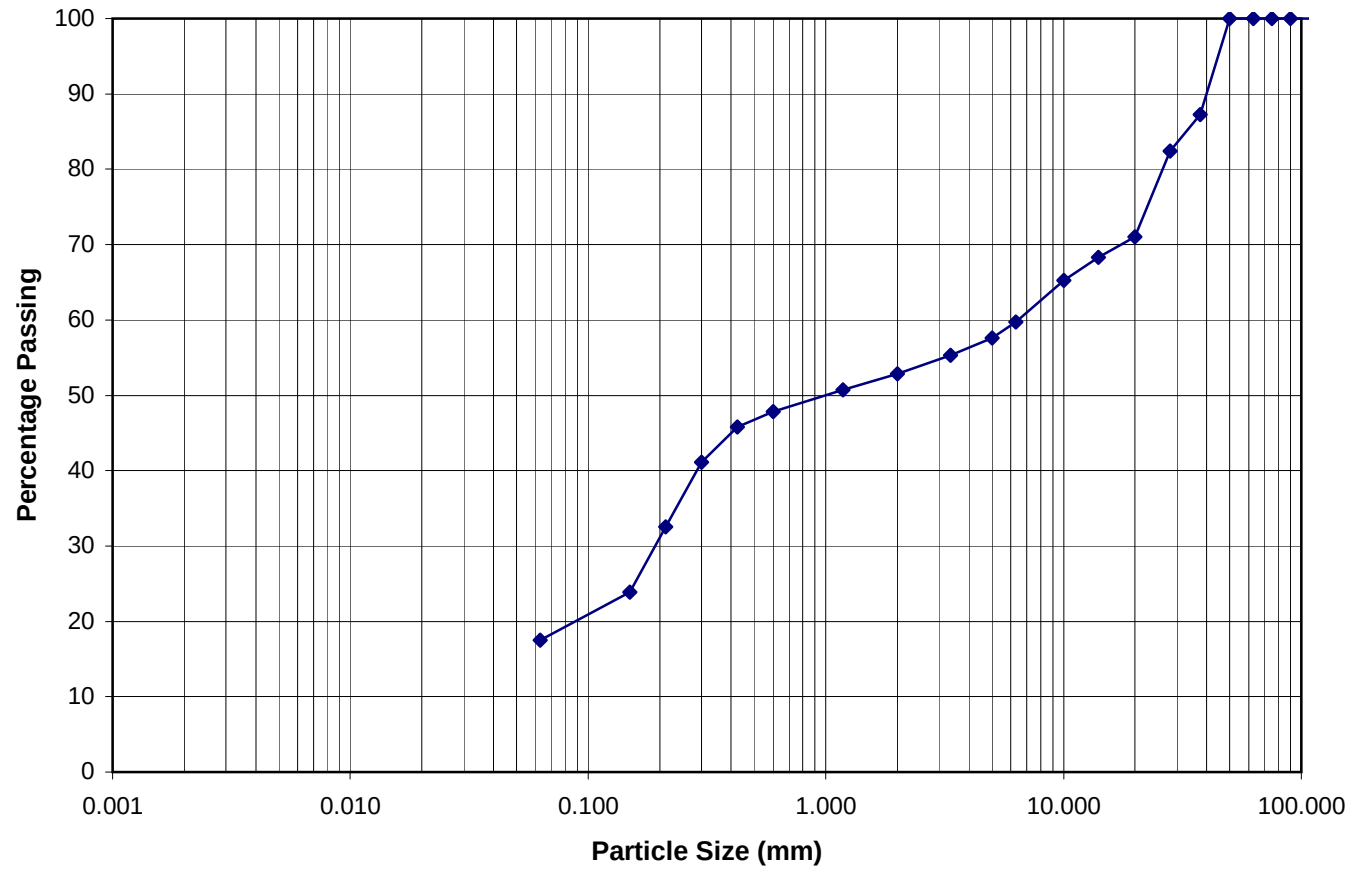
UKAS TESTING 0206



PARTICLE SIZE DISTRIBUTION TEST : BS1377 : PART 2 CL9.2 1990

WSP Environmental Laboratories

PROJECT	Moson Site 1 Hough Hall Road	**SAMPLE**	TP10	**JOB NO**	09-10424
PROJECT NUMBER	12121870 012	**DEPTH(m)**	1-2.5	**SAMPNUM**	121723



CLAY	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	FINE	MEDIUM	COARSE	*
	SILT			SAND			GRAVEL			

SIEVE SIZE	% PASSING
125.00	100.00
90.00	100.00
75.00	100.00
63.00	100.00
50.00	100.00
37.50	87.27
28.00	82.43
20.00	71.06
14.00	68.32
10.00	65.22
6.300	59.70
5.000	57.63
3.350	55.31
2.000	52.88
1.180	50.68
0.600	47.85
0.425	45.81
0.300	41.12
0.212	32.58
0.150	23.85
0.063	17.54

PARTICLE DIAMETER (mm)	% PASSING
2.00	52.88
0.063	17.54

SOIL FRACTION	TOTAL %
GRAVEL	47.12
SAND	35.34
SILT OR CLAY	17.54

Tested by / date	VF 23/12/2009

NOTES:

* PARTICLES SIZED ABOVE 60mm classify as COBBLES

Uc= (Unable to interpret)

WSP Environmental Ltd
The Laboratory
Lakeview Drive
Sherwood
Nottingham NG15 0ED

ISSUE 2 REV 2 DI/MB 06/11/08

UKAS TESTING 0206

APPENDIX H

GAS AND GROUNDWATER MONITORING RESULTS

Groundwater and Ground Gas Monitoring Summary

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001

Start Date	18/12/2009
End Date	03/03/2010
No. Visits	8

	Borehole	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Flow (l/hr)		Standing Water Level (m)		Gas Screening Value Methane (l/hr)	Gas Screening Value Carbon Dioxide (l/hr)
		MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX		
1	WS1	0.0	8.2	0.3	6.5	4.3	20.9	0.0	0.1	0.73	2.86	0.0082	0.0065
2	WS2	0.0	0.1	0.0	0.3	13.9	21.8	0.0	0.2	0.29	0.84	0.0002	0.0006
3	WS3	0.0	0.0	0.0	0.3	18.5	22.0	0.0	0.1	0.15	0.52		0.0003
4	WS4	0.0	0.0	0.0	1.7	14.2	21.1	-0.1	1.0	0.00	0.00		0.017
5	WS5	0.0	0.0	0.0	0.5	16.8	20.9	-0.2	1.6	0.00	0.65		0.008
6	WS6	0.0	0.0	1.7	1.7	17.3	17.3	-0.3	0.0	0.00	1.51		
7	WS7	0.0	0.0	0.1	1.8	18.3	22.1	-0.1	0.2	0.64	1.24		0.0036
8	WS8	0.0	0.0	0.0	1.4	18.1	22.0	0.0	0.2	3.54	3.59		0.0028
9	WS9	0.0	0.0	0.1	0.7	19.8	21.2	-0.7	0.2	0.00	0.61		0.0014
10	WS10	0.0	0.0	0.0	1.5	16.8	21.5	-0.1	0.6	1.82	2.85		0.009
11	WS11	0.0	0.0	0.0	0.9	16.3	21.2	0.0	1.0	0.85	1.04		0.009
12	WS12	0.0	0.0	0.3	1.6	4.8	21.4	0.0	2.5	2.25	2.43		0.04
13													
14													
15													
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Groundwater and Ground Gas Monitoring Form

VISIT 1

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	18/12/2009
Start Time	09.20.00
End Time	12.20.00

Operator	Ian Walker
Pressure at Start mB	1012
Pressure at End mB	1013
Weather Conditions	Sunny, Clear, Occasional Cloud,
Temperature oC	-1.5

Equipment	Serial No.	Calibrated
Gas Analyser	GA05262	Yes
Dipmeter	Dip 30 3689	Yes
Interface Probe	N/A	
PID	N/A	

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.0	1012	8.2	5.9	6.5	4	4.3	6.9				0.87	2.65		No
2	WS2	0.50	3.00	0.0	0.0	1012	0	0	0.3	0.2	18.1	19.2				0.45	2.85		No
3	WS3	0.50	3.00	0.0	0.0	1012	0	0	0.3	0.2	18.5	19.5				0.48	2.89		No
4	WS4	0.50	3.00	0.1	0.0	1012	0	0	0.3	0.3	20.9	21.1				DRY	3.05		No
5	WS5	0.50	3.00	-0.2	-0.1	1012	0	0	0.5	0.3	16.8	19.8				0.39	2.92		No
6	WS6	0.50	3.00	-0.3	-0.2	1012	0	0	1.7	1.7	17.3	17.3				1.51	2.92		No
7	WS7	0.50	3.00	0.2	0.0	1014	0	0	1.8	1.1	18.3	19.3				1.24	3.00		No
8	WS8	0.50	5.00	0.2	0.2	1014	0	0	0.3	0.2	20.6	20.6				3.57	4.35		No
9	WS9	0.50	3.00	0.0															No
10	WS10	0.50	3.00	0.1	0.0	1013	0	0	1.5	1.5	16.8	16.8				DRY	2.74		No
11	WS11	0.50	3.00	0.0	0.0	1013	0	0	0.9	0.8	16.3	16.3				1	2.05		No
12	WS12	0.50	3.00	0.0	0.0	1013	0	0	1.6	1.6	4.8	4.9				2.37	2.82		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: Unable to locate WS9,

Groundwater and Ground Gas Monitoring Form

VISIT 2

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	20/01/2010
Start Time	14.00.00
End Time	.++

Operator	John Watson
Pressure at Start mB	1001
Pressure at End mB	
Weather Conditions	
Temperature oC	

Equipment	Serial No.	Calibrated
Gas Analyser		
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.0	1001	0	0	0.7	0.5	20.7	20.6				0.8	2.65		No
2	WS2	0.50	3.00			1001	0	0	0	0	21.8	21.7				0.46	2.85		No
3	WS3	0.50	3.00			1001	0	0	0	0	21.9	22.0				0.45	2.88		No
4	WS4	0.50	3.00			1001	0	0	0.5	0.6	19.5	18.8				DRY	3.03		No
5	WS5	0.50	3.00													0.00	2.91		No
6	WS6	0.50	3.00													0.1	2.93		No
7	WS7	0.50	3.00						0.1	0.1	22.1	22.1				0.78	3.01		No
8	WS8	0.50	5.00	0.0	0.0	1001	0	0	0.2	0.2	22.0	21.9				3.54	4.34		No
9	WS9	0.50	3.00																No
10	WS10	0.50	3.00	0.6		1001	0	0	0.3	0.4	21.5	21.4				2.45	2.73		No
11	WS11	0.50	3.00			1001	0	0	0.2	0.2	21.2	21.0				0.99	1.88		No
12	WS12	0.50	3.00	0.0	0.0	1001	0	0	0.3	0.4	21.4	20.8				2.3	2.35		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: WS2, WS4, WS5, WS7 & WS11 Nozzel Blocked.

Groundwater and Ground Gas Monitoring Form

VISIT 3

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	26/01/2010
Start Time	11.30 am
End Time	12.30 pm

Operator	Beth Hume
Pressure at Start mB	1028
Pressure at End mB	1033
Weather Conditions	Cloudy
Temperature oC	7

Equipment	Serial No.	Calibrated
Gas Analyser		
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.0	1030	0	0	1.5	0.4	19.4	20.9		0	0	2.86	2.65		No
2	WS2	0.50	3.00	0.0	0.0	1030	0	0	0.1	0.1	20.5	21.1		0	2	0.84	2.84		No
3	WS3	0.50	3.00	0.0	0.0	1030	0	0	0	0	21.2	21.3		0	1	0.49	2.88		No
4	WS4	0.50	3.00	0.0	-0.1	1030	0	0	0	0	20.7	20.7		0	0	DRY	3.02		No
5	WS5	0.50	3.00	1.6	0.0											0.04	2.91		No
6	WS6	0.50	3.00	0.0	0.0											Full	2.91		No
7	WS7	0.50	3.00	0.0	0.0	1030	0	0	0.4	0.1	20.1	20.2		0	0	0.8	2.99		No
8	WS8	0.50	5.00	0.0	0.0	1030	0	0	0.2	0.2	21.2	21.2		0	0	3.56	4.33		No
9	WS9	0.50	3.00	-0.7	0.0	1030	0	0	0.7	0.1	20.5	21.2		0	4	0.38	2.78		No
10	WS10	0.50	3.00	-0.1	-0.1	1030	0	0	0.7	0.7	19.4	19.4		0	0	2.85	2.69		No
11	WS11	0.50	3.00	0.0	0.0	1030	0	0	0.5	0.2	19.6	20.7		0	0	0.98	1.94		No
12	WS12	0.50	3.00	0.0	0.0	1030	0	0	0.3	0.3	19.4	19.3		0	0	2.34	2.81		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: WS6 & WS5 Flooded no gas records.

Groundwater and Ground Gas Monitoring Form

VISIT 4

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	05/02/2010
Start Time	09.10 am
End Time	11.30 am

Operator	Tom Gill
Pressure at Start mB	990
Pressure at End mB	990
Weather Conditions	Overcast, mild
Temperature oC	8

Equipment	Serial No.	Calibrated
Gas Analyser		
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.0	990	0	0	0.7	0.3	19.1	19.7		0	0	0.73	2.64		No
2	WS2	0.50	3.00	0.2	0.1	990	0	0	0.2	0	13.9	19.6		0	0	0.29	2.84		No
3	WS3	0.50	3.00	0.0	0.0	990	0	0	0	0	20.1	20.5		0	0	0.4	2.88		No
4	WS4	0.50	3.00	1.0	0.1	990	0	0	0.8	1	15.7	14.2		0	0	DRY	3.03		No
5	WS5	0.50	3.00													0	2.90		No
6	WS6	0.50	3.00	0.0	0.0											0	2.92		No
7	WS7	0.50	3.00	0.0	0.0	990	0	0	0.4	0.2	20.5	20.5		0	0	0.73	3.01		No
8	WS8	0.50	5.00	0.0	0.0	990	0	0	0	0	20.6	20.7		0	0	3.56	4.32		No
9	WS9	0.50	3.00	0.1	0.0											0	2.77		No
10	WS10	0.50	3.00	0.1	0.0	990	0	0	0.9	1	19.1	18.8		0	0	2.23	2.69		No
11	WS11	0.50	3.00	1.0	0.0	990	0	0	0	0	20.4	20.6		0	0	0.88	1.90		No
12	WS12	0.50	3.00	0.0	0.0	990	0	0	0.7	0.7	18.3	18.2		0	0	2.35	2.81		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: WS5 Flooded, WS6 & WS9 flooded (nozzle above water so flow readings could be taken)

Groundwater and Ground Gas Monitoring Form

VISIT 5

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	09/02/2010
Start Time	10.10 am
End Time	12.20 pm

Operator	Tom Gill
Pressure at Start mB	1002
Pressure at End mB	1002
Weather Conditions	Overcast, sunny spells
Temperature oC	7

Equipment	Serial No.	Calibrated
Gas Analyser		
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.0	1002	0	0	0.6	0.3	20.1	20.6		0	0	0.83	2.65		No
2	WS2	0.50	3.00	0.0	0.0	1002	0	0	0.2	0.1	20.5	20.8		0	0	[illegible]	2.84		No
3	WS3	0.50	3.00	0.1	0.0	1002	0	0	0	0	21.1	21.1		0	0	[illegible]	2.87		No
4	WS4	0.50	3.00	0.0	0.0	1002	0	0	0	0	20.3	20.4		0	0	DRY	3.03		No
5	WS5	0.50	3.00	0.0	0.0	1002										[illegible]	2.92		No
6	WS6	0.50	3.00			1002										GL	2.91		No
7	WS7	0.50	3.00	0.0	0.0	1002	0	0	0.2	0.1	21.2	21.1		0	0	0.87	3.00		No
8	WS8	0.50	5.00	0.0	0.0	1002	0	0	0	0	21.1	21.1		0	0	3.58	4.34		No
9	WS9	0.50	3.00	0.0	0.0	1002	0	0	0.1	0.1	20.9	20.8		0	0	[illegible]	2.78		No
10	WS10	0.50	3.00	0.1	0.0	1002	0	0	0	0	21.0	20.9		0	0	2.18	2.71		No
11	WS11	0.50	3.00	0.1	0.1	1002	0	0	0.3	0.2	20.4	20.5		0	0	1	1.90		No
12	WS12	0.50	3.00	0.2	0.0	1002	0	0	0.7	0.8	19.4	18.8		0	0	2.39	2.81		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: WS5 nozzle above water, sucked up water. WS6 flooded to groud level

Groundwater and Ground Gas Monitoring Form

VISIT 6

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	15/02/2010
Start Time	10.20 am
End Time	12.20 pm

Operator	Tom Gill
Pressure at Start mB	990
Pressure at End mB	990
Weather Conditions	Showery intervals, cold
Temperature oC	6

Equipment	Serial No.	Calibrated
Gas Analyser		
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.1	990	0	0	1.5	0.8	18.4	19.2		0	0	0.84	2.64		No
2	WS2	0.50	3.00	0.0	0.0	990	0	0	0	0	19.5	19.9		0	0	0.84	2.83		No
3	WS3	0.50	3.00	0.0	0.0	990	0	0	0	0	20.3	20.4		0	0	0.3d	2.85		No
4	WS4	0.50	3.00	0.1	0.1	990	0	0	1.7	1.5	16.8	17.3		0	0	DRY	3.03		No
5	WS5	0.50	3.00	0.0	0.0	990	0	0	0	0.1	20.9	20.9		0	0	0.65	2.90		No
6	WS6	0.50	3.00	0.0	0.0											0.2?	2.90		No
7	WS7	0.50	3.00	0.0	-0.1	990	0	0	0.6	0.3	20.1	20.4		0	0	1.07	2.99		No
8	WS8	0.50	5.00	0.0	0.0	990	0	0	1.3	1.4	18.4	18.1		0	0	3.57	4.31		No
9	WS9	0.50	3.00	0.2	0.0	990	0	0	0.5	0.2	19.8	20.1		0	0	0.61	2.77		No
10	WS10	0.50	3.00	0.0	0.0	990	0	0	0.6	0.7	19.5	19.5		0	0	2.12	2.71		No
11	WS11	0.50	3.00	0.0	0.1	990	0	0	0.2	0.1	20.2	20.3		0	0	1.04	1.90		No
12	WS12	0.50	3.00	0.0	0.0	990	0	0	0.9	0.8	19.2	19.1		0	0	2.37	2.81		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: WS6 high water level, pump sucked water so only flow reading was taken.

Groundwater and Ground Gas Monitoring Form

VISIT 7

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	26/02/2010
Start Time	12.30 pm
End Time	14.30 pm

Operator	Tom Gill
Pressure at Start mB	979
Pressure at End mB	979
Weather Conditions	Rainy & cold
Temperature oC	6

Equipment	Serial No.	Calibrated
Gas Analyser		
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.0	979	0.9	0.7	2.1	1.4	7.9	12.0		0	0	0.77	2.66		No
2	WS2	0.50	3.00	0.0	0.0	979	0.1	0	0.1	0	17.3	19.7		0	3	0.56	2.84		No
3	WS3	0.50	3.00	0.0	0.0	979	0	0	0	0	21.2	21.2		0	2	0.15	2.88		No
4	WS4	0.50	3.00	0.0	0.0	979	0	0	0.4	0.4	15.0	15.1		0	1	DRY	3.04		No
5	WS5	0.50	3.00													GL	2.92		No
6	WS6	0.50	3.00													GL	2.92		No
7	WS7	0.50	3.00	0.1	0.0	979	0	0	0.4	0.1	21.0	21.3		0	0	0.64	3.01		No
8	WS8	0.50	5.00	0.0	0.0	979	0	0	0.1	0.2	21.1	21.0		0	0	3.59	4.34		No
9	WS9	0.50	3.00													GL	2.75		No
10	WS10	0.50	3.00	0.0	0.0	979	0	0	0.5	0.7	20.6	20.3		0	0	1.9	2.69		No
11	WS11	0.50	3.00	0.1	0.1	979	0	0	0.1	0	21.1	21.2		0	2	0.85	1.88		No
12	WS12	0.50	3.00	2.5	2.5	979	0	0	1	1.1	18.7	18.0		0	0	2.25	2.82		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: WS 5,6&9 flooded to ground level

Groundwater and Ground Gas Monitoring Form

VISIT 8

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	03/03/2010
Start Time	9.20 am
End Time	11.00 am

Operator	Tom Gill
Pressure at Start mB	1015
Pressure at End mB	1015
Weather Conditions	Overcast & cool
Temperature oC	6

Equipment	Serial No.	Calibrated
Gas Analyser		
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.0	1015	0	0	2.7	1.7	14.4	16.9		0	0	0.87	2.68		No
2	WS2	0.50	3.00	0.0	0.0	1015	0	0	0	0	19.5	19.6		0	0	0.7	2.86		No
3	WS3	0.50	3.00	0.0	0.0	1015	0	0	0.1	0.1	19.6	19.6		0	0	0.93	2.88		No
4	WS4	0.50	3.00	0.0	0.0	1015	0	0	0.7	0.5	18.3	18.4		0	0	DRY	3.03		No
5	WS5	0.50	3.00	0.0	0.0	1015	0	0	0.3	0.1	19.4	19.5		0	0	0.43	2.91		No
6	WS6	0.50	3.00	0.0	0.0	1015										0.1	2.91		No
7	WS7	0.50	3.00	0.1	0.1	1015	0	0	0.4	0.2	19.8	19.9		0	0	0.86	3.00		No
8	WS8	0.50	5.00	0.0	0.0	1015	0	0	0.1	0	20.0	20.1		0	0	3.58	4.32		No
9	WS9	0.50	3.00	0.0	0.0	1015	0	0	0.2	0.1	19.9	20.0		0	0	0.45	2.79		No
10	WS10	0.50	3.00	0.0	0.0	1015	0	0	0.5	0.4	19.6	19.9		0	0	1.82	2.69		No
11	WS11	0.50	3.00	0.0	0.0	1015	0	0	0.2	0.1	20.0	20.1		0	0	1	1.86		No
12	WS12	0.50	3.00	0.0	0.0	1015	0	0	1.3	1.3	18.3	17.6		0	0	2.43	2.82		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS: WS6 sucked water, nozzle above water.

Groundwater and Ground Gas Monitoring Form

VISIT 9

Site Name	Moston Site 5
Client	Redrow Homes
Job No.	12121870/001
Date	11/03/2010
Start Time	15.20 pm
End Time	16.50 pm

Operator	Tom Gill
Pressure at Start mB	1013
Pressure at End mB	1013
Weather Conditions	Sunny & cold
Temperature oC	5

Equipment	Serial No.	Calibrated
Gas Analyser		
Dipmeter		
Interface Probe		
PID		

	Borehole	Response Zone (m)		Gas Flow (l/hr)		Borehole Pressure	Methane (% v/v)		Carbon Dioxide (% v/v)		Oxygen (% v/v)		Other Gasses (ppmV)			Depth to Water	Depth to Base	Thickness of product	Sampled?
		Top	Bottom	Initial	Steady	(mB)	Initial	Steady	Initial	Steady	Initial	Steady	PID	H2S	CO	(m)	(m)	(mm)	(Y/N)
1	WS1	0.50	3.00	0.0	0.0	1013	0.2	0.1	2.3	1.3	17.6	19.6		0	5	0.93	2.67		No
2	WS2	0.50	3.00	0.0	0.0	1013	0	0	0	0	21.1	21.1		0	0	1.11	2.85		No
3	WS3	0.50	3.00	0.4	0.0	1013	0	0	0	0	21.4	21.5		0	4	0.67	2.87		No
4	WS4	0.50	3.00	0.0	0.0	1013	0	0	0.9	0.8	18.9	19.6		0	2	DRY	3.05		No
5	WS5	0.50	3.00	0.0	0.0	1013	0	0	0.2	0.2	21.2	21.2		0	3	0.86	2.91		No
6	WS6	0.50	3.00	0.0	0.0	1013	0	0	0	0	21.5	21.5		0	5	0.93	2.91		No
7	WS7	0.50	3.00	0.0	0.0	1013	0	0	0.1	0.1	21.3	21.4		0	2	1.2	3.00		No
8	WS8	0.50	5.00	0.0	0.1	1013	0	0	0	0	21.5	21.4		0	5	3.57	4.34		No
9	WS9	0.50	3.00	0.0	0.0	1013	0	0	0	0	21.3	21.4		0	3	0.83	2.79		No
10	WS10	0.50	3.00	0.0	0.0	1013	0	0	0.3	0.4	21.1	21.0		0	0	1.77	2.70		No
11	WS11	0.50	3.00	0.0	0.0	1013	0	0	0	0	21.5	21.5		0	0	1.13	1.89		No
12	WS12	0.50	3.00	0.0	0.0	1013	0	0	0.3	0.3	21.1	21.1		0	6	2.52	2.83		No
13																			
14																			
15																			
16																			

COMMENTS & GROUND CONDITIONS:

APPENDIX I

ASSESSMENT METHODOLOGIES & STANDARDS

INTRODUCTION TO GROUND GAS ASSESSMENT APPROACH

Over the past 10 - 15 years a wealth of information has been published regarding ground gas assessment. Much of this has centred around risk from gas generating landfills when, in terms of development activities in the UK, only a small proportion of development sites are situated close to gassing landfill sites.

There has been, and to a point still is, a tendency to focus on absolute numbers when undertaking ground gas assessments rather than good conceptualisation of a site. The WSP Environmental approach is based on appropriate site characterisation based on the principals set out in the EA Document 'Model Procedures for the Management of Land Contamination, CLR 11' (2004).

These documents set out the principals for risk assessment methodology in the UK and centre on the determination of **Source-Pathway-Receptor** relationships following the formulation of a **Conceptual Model**. They discuss tiered approaches to risk assessment as follows:

- Preliminary Risk Assessment;
- Generic Quantitative Risk assessment (GQRA) (e.g. the composition of contaminant concentrations against Soil Guideline Values or Gas Screening Values); and
- Detailed Quantitative Risk Assessment (DQRA) (e.g. the comparison of contaminant concentrations against site specific assessment criteria).

Current Guidance Documents and Standards

The following documents comprise the current recognised guidance with respect to the assessment of hazardous ground gases:

- British Standard BS 8485-2007 (2007), Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments;
- NHBC/RSK Group PLC (2007) Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are Present, Report Edition No. 4; and
- Wilson, Oliver, Mallet, Hutchings and Card (2007): Assessing Risks Posed by Hazardous Gases to Buildings, CIRIA Report C665.

In general, the British Standard draws from and quotes both the NHBC and CIRIA documents and the assessment approaches therein.

The following document provides guidance on the selection and installation of ground gas protection measures:

- British Research Establishment (2001) Report 414: Protective Measures for Housing on Gas-Contaminated Land.

CIRIA C665 and NHBC/RSK Guidance

CIRIA C665 was published in 2007 and provides guidance on the assessment of hazardous gases. Pulling from and developing previous guidance such as that published by CIRIA, Partners in Technology and Wilson and Card; CIRIA C665 discusses all aspects of hazardous gas generation, monitoring, sampling, assessment and remediation.

However, the document does not provide guidance on issues surrounding gas derived from licensed landfill sites or detailed guidance on organic vapours.

The NHBC/RSK guidance has been incorporated into CIRIA C665 and the NHBC approach is recommended for low-rise housing as defined in the NHBC (and CIRIA) guidance.

The guidance is written considering a general legal framework comprising:

- Environmental Protection Act 1990: under which gas could be considered as a 'source' in a 'Pollutant Linkage' that could lead to a determination by a regulator that 'significant harm' is being caused or that there is a 'significant possibility of such significant harm' being caused as set out in Part IIA of the EPA 1990;
- PPS23: The planning system, via PPS23, requires developers to undertake gas assessment sufficient to demonstrate that their proposals are sufficient to mitigate any potential hazards associated with contamination, including ground gas;
- Building Regulations (2004): provide a requirement to protect the health and safety and welfare of people in and around buildings and included the assessment of ground gases.

In addition, these documents have been prepared with reference to, and are generally consistent with the Model Procedures for the Management of Contaminated Land (Defra and the Environment Agency 2004).

A summary of the main elements of CIRIA C665 and NHBC guidance documents is presented below.

Preliminary Risk Assessment

Development of a Conceptual Model

Great emphasis is put on developing a conceptual model that focuses on ground gases, particularly during the desk study phase of an investigation. The use of schematic drawings is encouraged to present a clear and simple demonstration that the ground gas regime is understood or to highlight gaps in the understanding.

Generic Quantitative Risk Assessment

Site Investigation and Monitoring Methodology

The documents discuss site investigation techniques and methodology. The main recommendations presented concern designing gas wells to ensure response zones are placed in the correct strata and the spacing of gas wells across a site to ensure adequate coverage is achieved. In summary:

- The production of a conceptual model during the desk study phase can assist the placement of wells on a site but the site investigation layout should be reassessed during the site works and additional wells installed as necessary if a change in the expected ground conditions is observed;
- Gas well spacing is considered to be important as monitoring wells have a specific zone of influence and more wells will be required on higher risk sites to ensure complete coverage is achieved and, Table 4.2 in CIRIA C665 summarises the recommended spacing of wells; and
- Guidance on monitoring techniques, frequency and duration of monitoring and data presentation is included in the documents. Tables 5.5a and 5.5b in CIRIA C665 detail typical or idealised frequency and periods of monitoring; and the NHBC guidance recommends a minimum monitoring period and frequency of six monitoring visits in three months for low rise residential development, which is in line with that set out in CIRIA C665.

Interpretation and Assessment of Risks

The interpretation of gas monitoring results is considered with emphasis on assuring that the type, quality and quantity of data obtained is sufficient to undertaken a sufficiently robust risk assessment. The assessment methodology is split into two, one for low rise housing (with a clear ventilated floor) from the NHBC guidance, and one for all other situations detailed in CIRIA C665.

The methodology for situations except low rise housing (with a clear ventilated floor) is based on the system proposed by Wilson and Card which in turn was a development of that published in CIRIA 149. The classification system is summarised in Table 8.5 in CIRIA C665.

The guidance document does stress that the Gas Screening Values (GSV) are guidelines only and not absolute thresholds.

The low rise housing methodology is based on the NHBC guidance document. The GSV is calculated in the same way but this value is then compared to Table 14.1 in the NHBC guidance (or Table 8.7 in CIRIA C665).

The tables detail 'Typical Maximum Concentrations' for initial screening purposes and risk based Gas Screening Values for consideration where the Typical Maximum Concentrations are exceeded. Additional details are provided in CIRIA C665 and the NHBC guidance regarding the assumptions that need to be made and limitations that apply when using this assessment.

WSP Environmental Gas Interpretation Approach

Assessment of ground gases has moved away from solely comparing monitoring results to guideline levels towards a more site specific conceptual and holistic approach, involving both qualitative and quantitative assessments as deemed necessary. Indeed this method of assessment is already widely used to assess the significance of chemical testing results. Therefore, in line with these general trends WSP Environmental (UK) Limited has adopted the following approach to gas assessment in line with the available guidance:

1. From the desk study information, derive an understanding of the likely potential sources of hazardous gases and their proximity to the site in question (e.g. mine, landfill and geologic (e.g. peat) gases) and develop a preliminary conceptual model.(Preliminary Risk Assessment).

2. From the information derived from the desk study, design a suitable intrusive investigation to obtain sufficient information to derive a detailed conceptual ground model for the site and assess the most likely sources of the gas and their generation potential.

3. The investigation and subsequent gas monitoring will be undertaken in general accordance with the guidance set out in the CIRIA C665 and NHBC documents. Where possible, guidance on the spacing of wells as set out in Table 4.2 of CIRIA C665 will be adopted, although it is noted that such spacing will not be possible on all assessment sites.

4. During the monitoring phase, determine the likely effects of atmospheric pressure and groundwater levels on the gas monitoring results recorded.

5. Using the assessment procedures set out in CIRIA C665 and the NHBC guidance, determine, where appropriate, the extent of any mitigation measures which may be required to protect the proposed development from ground gas ingress (Generic Quantitative Risk Assessment). The key elements in making this decision are:

i) nature and generation potential of the source.

ii) gas concentrations and gas flows recorded (with reference to factors such as atmospheric pressure).

iii) due consideration of the Gas Screening Values as detailed in the CIRIA and NHBC guidance.

It should be borne in mind that in certain circumstances it will be necessary to quantitatively assess the risk posed by ground gases to a development. However, such assessment methodologies should be determined on a site specific basis and are beyond the scope of this document.

This approach considers that ground gas assessment is the assessment of acute risks to human health and buildings posed primarily by methane and carbon dioxide. The assessment of volatile vapours (chronic risk from hazardous vapours to human health) forms part of general human health risk assessment.

Limitations in the guidance currently available means that, in some circumstances, a preliminary gas assessment will be undertaken on sites where the boundary between 'Very Low', 'Low' and 'Moderate' gas generation potential is unclear (no definition is provided in the guidance documents available) and a low to moderate sensitivity development is proposed. Adoption of a minimal scope comprising four visits over four weeks will be undertaken and advice on the duration of monitoring required sought from the appropriate regulator.

INTRODUCTION TO ENVIRONMENTAL RISK ASSESSMENT

ANALYSIS PROTOCOLS

Two criteria are used for the selection of potential contaminants to test for during a ground investigation, as follows:

- Contaminants must be likely to be present on many sites affected by current or former industrial use in the United Kingdom in sufficient concentrations to cause harm. The purpose of this criterion is to exclude substances that are rarely found or are unlikely to be present in harmful concentrations; and
- Contaminants must pose a potential risk to human beings and to sensitive environmental receptors, i.e. the water environment, the ecosystem or the integrity of construction or building materials.

Only substances meeting both of the above criteria are selected for chemical analysis. Therefore, the selected substances are:

- Likely to occur on many industrial sites in sufficient concentrations to cause harm or pollution; and,
- Known or suspected to pose significant risk to humans (death, serious injury, cancer or other disease, genetic mutation, birth defects or the impairment of reproductive functions); or,
- Known or suspected to pose a significant risk in the water environment, or likely to cause other adverse impacts in the water environment, as a result of their presence on land; or,
- Known or suspected to pose a significant risk to ecosystems as a result of their presence on land; or,
- Known or suspected to have a significant effect on buildings or building materials; or,
- Known or suspected to be persistent and mobile in soils or have tendency to bio-accumulate through exposure of sensitive organisms.

The following documents are the primary sources for identifying those contaminants likely to be present:

- CLR 8 'Priority Contaminants for the Assessment of Land' (Environment Agency 2002a). This document identifies priority contaminants, selected on the basis that they are likely to be present on many current or former sites affected by industrial or waste management activity in the UK in sufficient concentrations to cause harm; and
- The Department of the Environment's Industry Profiles (DoE 1995-95) which describe specific industrial processes and the chemicals that are commonly found on industrial land.

RISK ASSESSMENT APPROACH

The approach to risk assessment with respect to risks to human health from contaminated land in the UK is set out in the publication *Model Procedures for the Management of Land Contamination (CLR11)* (Environment Agency 2004a). This sets out a tiered approach:

- Preliminary Risk Assessment (e.g. establishing potential pollutant linkages);
- Generic Quantitative Risk Assessment (GQRA) (e.g. the comparison of contaminant concentrations against Soil Guideline Values (SGV) or other Generic Assessment Criteria (GAC)); and
- Detailed Quantitative Risk Assessment (DQRA) (e.g. the comparison of contaminant concentrations against site specific assessment criteria).

Use of Statistical Tests in Data Interpretation

A statistical basis for the assessment of the analytical results obtained is detailed within CL:AIRE / CIEH (2008). The premise is to review an entire data set in an appropriate way in comparison to GAC, with the approach differentiated for datasets where random or targeted sampling has been undertaken and where a site is being considered in a planning or Part 2A context.

GENERIC QUANTITATIVE RISK ASSESSMENT – HUMAN HEALTH

In order to undertake a GQRA, contaminant concentrations need to be compared to appropriate GAC. Current UK industry practice is to use, as first preference, UK SGVs published by the Environment Agency and derived using the Contaminated Land Exposure Assessment model (CLEA).

The CLEA model provides an approach for the assessment of chronic risks to human health from concentrations of a substance within soil; where appropriate.

The current version of the model (V1.06) was published in September 2009 and, following its publication, a number of SGVs have also been produced. However, the SGVs published to date are only for a limited number of contaminants. Where published SGV do not exist, other GAC values have been utilised in accordance with the following hierarchy:

- GAC prepared in accordance with the CLEA V1.06 model by authoritative bodies (e.g. Chartered Institute of Environmental Health (CIEH), Environment Industries Commission (EIC)); or in their absence,
- WSP in-house GAC prepared in accordance with the CLEA V1.06 model and associated documents;

The approach utilised by WSP in the preparation of GAC is detailed in the following sections.

WSP Approach

The approach adopted by WSP has been to generate GAC for chronic risks to human health using CLEA V1.06. In generating GAC, input parameters consistent with the recent Environment Agency publications have been adopted:

- Environment Agency (2009a), Human Health Toxicological Assessment of Contaminants in Soil, Report SC050021/SR2, January 2009;
- Environment Agency (2009b), CLEA Software (Version 1.04) Handbook (and Software), Report SC050021/SR4, January 2009; and
- Environment Agency (2009c), Updated Technical Background to the CLEA Model, Report SC050021/SR3, January 2009;

Substance Specific Information – Health Criteria Values

Toxicological data for respective contaminants has been chosen for use based on the guidance in Environment Agency (2009a). Where UK guidance is available (i.e. existing published TOX reports (Environment Agency 2002l-t) the HCV have been adopted. Where no TOX report is available the following approaches has been used (given in order of preference);

- Published toxicity reviews to derive HCV within Nathanial et. al, 2009 and EIC/CL:AIRE 2009;
- Other appropriate UK sources;
- Authoritative European sources;
- International Organisations (e.g. World Health Organisation); or
- Appropriate, authoritative US sources (e.g. USEPA).

Substance Specific Information – Physical Chemical Characteristics

Fate and transport characteristics for the contaminants for which GAC have been derived were chosen using the following hierarchy of data sources;

- Environment Agency (2008a), Compilation of Data for Priority Organic Pollutants, Report SC050021/SR7, November 2008;
- Defra/Environment Agency sources (e.g. Environment Agency, Review of the Fate and Transport of Selected Contaminants in the Soil Environment, Draft Technical Report P5- 079/TR1 (Environment Agency 2003a));

- Other UK Government documents;
- European data sources; (e.g. RIVM Report 711701 023 Technical evaluation of the Intervention Values for Soil/sediment and Groundwater, (RIVM 2001);
- International data sources; (e.g. World Health Organisation); or
- Other national sources (e.g. USEPA).

Where appropriate, source values have been adjusted to reflect a UK soil temperature of 10ºC (e.g. K_{aw}).

Model Settings

In the generation of GAC, default settings have been used for the following exposure scenarios:

- Residential with Plant Uptake;
- Residential without Plant Uptake;
- Allotments; and
- Commercial/Industrial.

The default soil type is set as Sandy Loam with the default pH of 7; Soil Organic Matter of 1%, 3% and 6% have been considered.

Soil Saturation

GAC have not been limited to theoretical soil saturation in their calculation although the theoretical soil saturation limit is provided and can be considered by risk assessors in the assessment. Petroleum hydrocarbon fractions are, where appropriate, addressed based on Hazard Index and so have not been limited to soil saturation.

Cyanides

The primary risk to human receptors from free cyanide in soils is an acute risk (i.e. a single dose could have a lethal affect as opposed to adverse affects from cumulative intake (chronic affect)).

There is no current UK guidance available for calculating acute risks from free cyanide, therefore the (officially withdrawn) SNIFFER 2000 methodology has been used to derive an acute GAC of 60 mg/kg for all exposure scenarios. The value is given for Free or Easily Liberatable Cyanide but should be used to assess Total Cyanide in the absence of cyanide speciation. In cases where the Total Cyanide exceeds the GAC then analysis for Free or Easily Liberatable Cyanide should be completed.

Application of GAC for Human Health

In the application of GAC (and SGV) to a site the user recognises the limitations of CLEA model. Specifically these relate to the absence of certain pollutant considerations such as risks to services, of fire and explosion, aesthetics, institutional perception, groundwater, surface waters, ecotoxicological risk and risks to buildings (amongst others).

The GAC specifically do not meet the requirements of legal definition of 'significant possibility of significant harm' but provide a benchmark below which concentrations of contaminants are not considered to warrant further consideration in the context of the land use scenario.

Groundwater to Indoor Air (Human Health)

The CLEA model does not explicitly consider the potential for chronic impact to Human Health from indoor inhalation of concentrations of volatile vapours from dissolved phase contamination. The potential exists for this to be an important exposure route for a limited number of highly volatile contaminants. GAC have been calculated for volatile contaminants for volatilisation from groundwater using an in-house implementation of the Johnson and Ettinger model (WSPE In-house Groundwater Model V1.1). The WSPE model is based upon the Johnson and Ettinger model described in the CLEA guidance has been adapted to account for a dissolved phase source through consideration of (a) partitioning from groundwater to soil vapour, and, (b) transport through the capillary zone.

The spreadsheet implementation also includes checks to ensure that values generated do not exceed the pure phase solubility of a substance within water.

The target concentration in air is set based upon the Inhalation TDI or ID determined for the substance either from published Environment Agency or other sources.

TDI or ID values are usually presented in units of µg/kg bw^{-1} day-1 in which case the values are converted into µg/m^3 based on an adult inhaling 20m^3 per day and weighing 70kg (Table 3.3 SR2 (Environment Agency 2009a)). Where appropriate the TDI is adjusted to take account of the MDI.

Soil Specific Parameters

Soil specific inputs have been chosen for a 'Sandy Loam' as defined in the CLEA report. This is considered the most conservative approach, specifically within the context of the UK where a sandy loam is more common.

Soil Parameters

Parameter	Definition (Units)	Value	Source
θ_a	air filled soil porosity (cm^3cm^{-3})	0.2	Environment Agency (2009c), Table 4.4 (Sandy Loam)
θ_w	water filled soil porosity(cm^3cm^{-3})	0.33	Environment Agency (2009c), Table 4.4 (Sandy Loam)
θ_T	total air and water filled soil porosity(cm^3cm^{-3})	0.53	Environment Agency (2009c), Table 4.4 (Sandy Loam)
θ_r	Residual soil water content cm^3/cm^3	0.12	Environment Agency (2009c), Table 4.4 (Sandy Loam)
θ_s	Saturated soil water content cm^3/cm^3	0.387	USEPA (2004), *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings*, Table 4 (Sandy Loam)
α_1	Point of inflection in the water retention curve where d θ_{w_C} / d h is maximal, cm^{-1}	0.0689	Environment Agency (2009c), Table 4.4 (Sandy Loam)
N	van Genuchten curve shape parameter, dimensionless	1.4708	Calculated from Equation 4.1 Environment Agency (2009c), Table 4.4 (Sandy Loam)
M	van Genuchten curve shape parameter, dimensionless	0.3201	Environment Agency (2009c), Table 4.4 (Sandy Loam)
R	Mean inter-particle pore radius **(cm)**	0.006	USEPA (2004), *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings*, Table 4 (Sandy Loam)

Building Specific

Building specific parameters have been considered for all of the generic building types as defined in the CLEA (2009a) report:

Building Parameters

Units Small Terraced	Justification (based on Environment Agency 2009c)	Office (pre 1970)	Justification (based on Environment Agency 2009c)
A_B cm^2 280000	Table 4.21 (No basement)	4240000	Table 4.21 (No basement)
L_T	Assumes source is 1 m below the building	115	Assumes source is 1m below the building

Units Small Terraced	Justification (based on Environment Agency 2009c)	Office (pre 1970)	Justification (based on Environment Agency 2009c)
cm 115			
Q_S $cm^3\ s^{-1}$ 25	Section 10.3, p131	150	Section 10.3, p131
L_{crack} cm 15	Table 4.21	15	Table 4.21
A_{crack} cm^2 423.3	Table 4.21	1647.3	Table 4.21
H m 4.8	Table 4.21	9.6	Table 4.21
A_{foot} m^2 28	Table 4.21	424	Table 4.21
Ex hr^{-1} 0.5	Table 4.21	1	Table 4.21

Contaminant Specific Values

The required contaminant specific inputs for each contaminant can be obtained from published Environment Agency sources as detailed in Table 3 or obtained from a literature review as described in SR7 (Environment Agency 2008).

Contaminant Specific Parameter Sources

Parameter	Units	Source/Justification
D_{air}	$m^2 s^{-1}$	Environment Agency (2008), Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values, Ref. SC050021/SR7
D_{water}	$m^2 s^{-1}$	Environment Agency (2008), Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values, Ref. SC050021/SR7
K_{aw}	unitless	Environment Agency (2008), Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values, Ref. SC050021/SR7
S	µg/l	Environment Agency (2008), Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values, Ref. SC050021/SR7

In the absence of UK guidelines, the exposure scenario adopted has considered a groundwater source 1.0m below the base of the building as a conservative approach representing an example of a very shallow aquifer and corresponding with the depth of a soil source as adopted in the generic scenario in the CLEA model.

For many contaminants, no risk is calculated at concentrations below the pure phase solubility of the contaminant. Caution should be applied when Non-Aqueous Phase Liquids (NAPL) are likely to be present, either where these have been detected during monitoring or where the concentration of a component in a mixture exceeds 10% of its calculated effective solubility. In such cases a separate assessment of the generation of volatile vapours from NAPL via modelling or a soil vapour survey may be required.

It is important to note that the values are only applicable to Human Health and cannot be used to determine the potential risks to Controlled Waters.

GENERIC QUANTITATIVE RISK ASSESSMENT - CONTROLLED WATERS

Control of Residual Contamination

Part 2A of the Environmental Protection Act 1990 introduced the regime for the identification and remediation of contaminated land. Land may be classified as contaminated land under the regime by virtue of actual or likely pollution of Controlled Waters caused by substances in, on or under the land. The Environment Agency is a statutory consultee in relation to controlled waters issues. In situations where there is no existing pollutant linkage, Section 161 of the Water Resources Act 1991 (as amended 2003) and the Anti-Pollution Works Regulations 1999 can be used to address contamination which could represent a potential risk.

Control of Contamination from Ongoing Activities

The existing Groundwater Directive (80/68/EEC) aims to protect groundwater from pollution by controlling discharges and disposals of certain dangerous substances to groundwater. In the UK, the directive is implemented through the Groundwater Regulations 1998. Groundwater pollution is prevented under these Regulations by preventing or limiting the inputs of listed substances into groundwater. Substances controlled under the Regulations fall into two lists:

List 1	List 2
organohalogen compounds and substances which may form such compounds in the aquatic environment; organophosphorus compounds; organotin compounds; substances which possess carcinogenic, mutagenic or teratogenic properties in or via the aquatic environment (including substances which have those properties which would otherwise be in list 2); mercury and its compounds; cadmium and its compounds; mineral oils and hydrocarbons; and cyanides.	the following metals and metalloids and their compounds; Zinc, Copper, Nickel, Chromium, Lead, Selenium, Arsenic, Antimony, Molybdenum, Titanium, Tin, Barium, Beryllium, Boron, Uranium, Vanadium, Cobalt, Thallium, Tellurium, Silver; biocides and their derivatives not appearing in List 1; substances which have a deleterious effect on the taste or odour of groundwater and compounds liable to cause the formation of such substances in such water and to render it unfit for human consumption; toxic or persistent organic compounds of silicon and substances which may cause the formation of such compounds in water, excluding those which are biologically harmless or are rapidly converted in water into harmless substances; inorganic compounds of phosphorus and elemental phosphorus; fluorides; and ammonia and nitrites.

- List 1 substances are the most toxic and must be prevented from entering groundwater. Substances in this list may be disposed of to the ground, under a permit, but must not reach groundwater; and
- List 2 substances are less dangerous, and can be discharged to groundwater under a permit, but must not cause pollution.

Listed dangerous substances have assessment criteria in the form of an Environmental Quality Standards (EQS). The dangerous substance is not believed to be detrimental to aquatic life at a concentration below its EQS limit.

The existing Groundwater Directive is to be repealed by the Water Framework Directive in 2013. New or amended regulations are expected before then to enact both the Water Framework Directive and its Daughter Directive on the protection of groundwater. This new Groundwater Directive (2006/118/EC) is commonly referred to as the Groundwater Daughter Directive.

In the meantime, the existing principle of preventing or limiting the inputs of List 1 or List 2 substances respectively into groundwater under the original Groundwater Regulations 1998 remains, but will be expanded to encompass any substance liable to cause pollution. In addition, the Water Framework Directive provides a risk-based framework for regulation.

Water Framework Directive

The Water Framework Directive (WFD) 2000/60/EC came into force on in December 2000 and its transition into UK legislation began in 2003. The directive aims to reduce pollution, prevent deterioration and improve the health of aquatic ecosystems through achieving good status for all water bodies. Good status is considered to be a function of concentrations of pollutants which:

- Do not exceed the quality standards under relevant European Community legislation;
- Would not result in a failure of associated surface water bodies to achieve environmental objectives;
- Would not result in a significant diminution of the ecological or chemical quality of associated surface water bodies;
- Would not result in any significant damage to groundwater dependent terrestrial ecosystems; and
- Do not exhibit the effects of saline or other intrusions.
- In addition, the Water Framework Directive sets further objectives, these include:
- A requirement for measures to be implemented to prevent or limit input of pollutants to groundwater;

- A requirement for measures to be implemented to reverse and significant and sustained upward trends; and
- Groundwater bodies to be protected such that their quality does not deteriorate to the point where additional treatment is required for drinking water supplies.

River Basin Management Plans required as part of the WFD have been published in draft and are to be finalised by December 2009. A consultation document on the classification of water bodies has been issued by Defra (http://www.defra.gov.uk/corporate/consult/wfd-classification-direction/index.htm) which sets out Groundwater and Surface Water Threshold Values, for river basins in England and Wales.

Assessment Approach

At the GQRA level, assessment typically comprises the following:

- Consideration of soil concentrations of organic substances in the context of soil saturation to determine the potential for migration under gravity;
- Comparison of soil leachate concentrations against appropriate GAC; and
- Comparison of groundwater concentrations against appropriate GAC.

This approach is equivalent to Tier 1 / Level 1 Assessment as undertaken using ConSim (2003) / Environment Agency Remedial Targets Methodology V3.1 (2006).

The ideal remediation standard from the regulatory perspective is natural background quality, namely, there should be no significant deterioration in the water quality at the receptor (that is, it should not be detectable against natural background variations). This data may be obtained from up hydraulic gradient locations or regional datasets. The Environment Agency has published information on the baseline condition of several aquifers, it is recognised, however, that such data is rarely available and remediation to such a standard is often not technically achievable or cost effective. For this reason target concentrations utilised as GAC may be based on water quality standards that are appropriate for the intended use or to ensure that objectives for a groundwater or associated water body are met. In England and Wales, the standards selected (as appropriate) include the following:

- The Water Supply (Water Quality) Regulations: 2001 (WSR);
- Environmental Quality Standards, Dangerous Substances Directive (EQS) prepared for List 1 and 2 substances under the existing Groundwater Directive (80/68/EEC);
- The Surface Waters (Abstraction for Drinking Water) (Classification) Regulations 1996 (SWR);
- The Private Water Supplies Regulations 1991;
- European Drinking Water Standards, (Council Directive 98/83/EC);
- World Health Organisation, Guidelines for Drinking Water Quality, Second Addendum to the Third Edition, Volume 1 2008; and
- United States Environmental Protection Agency (USEPA) Region Three, Six and Nine Human Health Medium Specific Risk Based Screening Levels for soils and tap water with dermal exposure routes, which have been derived using human health exposure models consistent with the ASTM Risk Based Corrective Action, approach (ASTM, E1739-95, 1995).

Priority is given to UK standards, however, where data is not available for a specific substance, additional standards such as those published by the WHO or USEPA are used.

ECOLOGICAL RISK ASSESSMENT

Where a statutory ecological receptor is identified on, or in proximity to the site, an assessment in accordance with current Environment Agency Ecological Risk Assessment (ERA) Framework will be undertaken. The frameworks is currently in development (http://www.environment-agency.gov.uk/research/planning/40375.aspx)

Exceedences

Where a GAC is exceeded further work and/or remediation is normally required. For moderate exceedences further work may include progression to a Detailed Quantitative Risk Assessment (DQRA) which is likely to require further data collection. The outcome of the DQRA may be that the risk is not significant or, if the risk is identified as being significant, the generation of site-specific remedial targets.

Where significant exceedences of GAC are identified remedial measures may be require immediately.

The simplest remediation method that is generally accepted for contamination that has been identified to pose a potential risk to humans, but not to other receptors, is to provide a barrier between occupiers / users of a site and the identified contamination. This barrier normally comprises a 'clean' covering horizon of soil. This remediation method is only suitable for contaminants that are of low volatility.

REFERENCES

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APPENDIX J

NOTES ON LIMITATIONS

WSP Environmental Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from WSP Environmental Limited; a charge may be levied against such approval.

WSP Environmental Limited accepts no responsibility or liability for:

a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and

b) this document to any third party with whom an agreement has not been executed.

The work undertaken to provide the basis of this report comprised a study of available documented information from a variety of sources (including the Client) and discussions with relevant authorities and other interested parties. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only to the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, WSP Environmental Limited reserves the right to review such information and, if warranted, to modify the opinions accordingly.

Where no site inspection is undertaken (for example a Desk Study Assessment or due to restricted site access), WSPE cannot comment on the potential for environmental concerns associated with the current use or structure including the presence of asbestos.

It should be noted that any risks identified in this report are perceived risks based on the information reviewed; actual risks can only be assessed following a physical investigation of the site.

WSPE are unaware of any proposed redevelopment plans and any reference made to actions that might be required in the event of redevelopment are made for information only.