Apple Tree House
Birtsmorton, Near Malvern, Worcestershire

Part IIA Investigation and Remediation Report

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Malvern Hills District Council

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1.0 INTRODUCTION

In April 2009, SLR Consulting Ltd (SLR) was appointed by Malvern Hills District Council (MHDC) to undertake the remediation of a kerosene spill at a residential property known as Apple Tree House (the Site) near Birtsmorton in Worcestershire.

SLR understands that the Site was determined as Contaminated Land by Malvern Hills District Council under Part IIA of the Environmental Protection Act 1990 in January 2009 for the reason that an *"oil tank spillage contaminating private water supply within grounds of residential plot".* The contaminating substance was identified as *kerosene fuel oil*.

This report presents the results of the works undertaken at the site by SLR on behalf of MHDC in order to delineate and remediate contaminated land at Apple Tree House. The results of this work presented in this report seeks to demonstrate that the kerosene contamination has been remediated to a degree that ensures that it no longer presents a risk of contamination as defined in Part IIA of the Environmental Protection Act 1990.

In order to understand the site setting and develop the Conceptual Site Model SLR has reviewed a report provided by Malvern Hills District Council:

- Contaminated Land Investigation: Apple Tree House, Birtsmorton, Malvern, Worcestershire. Prepared for Malvern Hills District Council by ESI, dated January 2009.

This report includes a summary of results of previous investigations undertaken by Briggs Environmental Services (Briggs). It is understood that Briggs were appointed by the insurers of the former occupant of Apple Tree House to investigate the spill and undertake initial remedial measures. Relevant published and public sources of information, such as British Geological Survey maps and memoirs, Ordnance Survey mapping, Environment Agency (EA) records and statutory authority records have been consulted where necessary.

Initial investigations by SLR in May 2009, identified lower than expected concentrations of kerosene contamination in soils and groundwater. Following this, a further phase of investigation and groundwater monitoring was undertaken between June and August 2009 in order to verify current contaminant concentrations and refine the remedial strategy. This additional phase of investigation confirmed the May 2009 findings.

SLR's final remedial works, as agreed with MHDC, comprised the decommissioning and sealing of the water supply well on site, the placement of Oxygen Release Compound (ORC) in trenches down-gradient of the fuel release in order to remediate any fugitive residual kerosene dissolved in groundwater, the removal of three dead conifer trees at the Site and, finally the decommissioning of all groundwater monitoring wells.

This report presents the results of additional delineation investigations and remedial verification works undertaken at the site as follows:

- Section 2.0 of this report outlines the Site setting and a summary of the original pollution incident.

- Section 3.0 summarises the results of the previous Site investigations undertaken by Briggs and ESI.

- Section 4.0 presents the preliminary conceptual site model of the potential pollutant linkages at the Site.

- Section 5.0 summarises SLR's preliminary remedial strategy
- Section 6.0 describes the preliminary Site investigations
- Section 7.0 the results of SLR's additional delineation investigations.
- Details of the revised remedial strategy and results of subsequent remediation verification works are presented in Section 8.0.
- Section 9.0 Summary of the works completed at the Site.

2.0 SITE SETTING AND SUMMARY OF 2007 CONTAMINATION EVENT

2.1 Site Description

The Site is approximately 0.3ha in area and consists of a detached residential property, slightly overgrown grounds and a derelict outbuilding. The Site is surrounded to the north, west and east by a land drain (which was dry in the summer of 2009) with fields beyond. Millers Court Road runs along the southern boundary of the site; and to the south side of this single track road in a shallow course runs the Birtsmorton Brook which flows eastwards. Open fields are present to the south beyond the Brook. A plan of the Site and surrounding land uses is presented as Drawing 1. It is understood that the house has not been occupied since shortly after the original spill occurred.

Within the garden of Apple Tree House were three conifer trees around 5 to 6m high located in the garden area to the south-west of the house, all were dead or showing signs of severe distress in early spring of 2009 and it was inferred that these were within the original plume of kerosene impact.

2.2 Summary of the Contamination Incident

SLR understands that the kerosene spillage was first identified in 2007 when the former elderly resident of Apple Tree House noticed that the drinking water had become tainted with hydrocarbons. The details of the original pollution incident are largely anecdotal, as there is no written account of the sequence of events, particularly the works undertaken by Briggs. Nevertheless, the following presents a summary of SLR's understanding of the incident:

- The drinking water supply came from a large diameter well that was located adjacent to the west side of the house.

- The well (4.5m deep, 1.1m diameter) was brick lined and was found to contain a layer of kerosene fuel floating on the water; when water was drawn from the well to the house via an electric pump, the kerosene entered the water supply.

- Kerosene was subsequently found to have leaked from a fuel line that was buried at shallow depth close to the building line and then migrated along a preferential pathway to enter the backfill to the water supply pipe, that in turn connected to the water well used to supply drinking water to the house. The duration of leak is not known, but it is considered likely that the fuel leak may have started several weeks before it was first identified.

- Following this discovery, Briggs Environmental Services Ltd. (Briggs) was commissioned by the insurers of the property to carry out a series of site investigation and remedial response works in 2007. Initially a 1m deep cut-off trench was dug along the southern boundary of the Site in order to stop the off-Site migration of fuel. Free phase fuel was then pumped from the cut-off trench and drinking supply well for off-site disposal. Approximately 1680 litres of free phase product was reportedly recovered by Briggs from the water well (900 litres) and the cut-off trench (780 litres) and it was estimated by ESI in January 2009 that up to 3,300 litres of Kerosene may have leaked into ground beneath the Site.

- Follow-up site investigation works were then carried out by Briggs between July 2007 and February 2008 involving the drilling of 32 soil and groundwater sampling boreholes in 3 phases. Briggs identified elevated concentrations of TPH (total petroleum hydrocarbons) in shallow soils and groundwater to the south and southwest of the leak point.

In 2008 ESI Ltd were retained by Malvern Hills District Council to undertake additional investigations and risk assessment in order to assist the Council to decide whether the Site may be determined as Contaminated Land under Part IIA of the Environment Act 1990. ESI drilled 14 boreholes at the Site to allow further soil sampling and field screening. Seven of the boreholes were installed as semi-permanent 50mm diameter monitoring wells. ESI identified elevated concentrations of hydrocarbons at the Site, broadly in line with those recorded by Briggs.

In January 2009 the Site was determined as Contaminated Land under Part IIA of the Environment Act 1990.

3.0 SUMMARY OF PREVIOUS INVESTIGATIONS

3.1 Briggs Environmental Services Ltd.

Following the initial remedial responses to the leak carried out by Briggs, follow-up site investigation works were carried out by Briggs between July 2007 and February 2008 involving the drilling of 32 soil and groundwater sampling boreholes in 3 phases.

During these works, Briggs identified elevated concentrations of TPH in shallow soils and groundwater to the south and southwest of the leak point, analysing 7 shallow soil samples from 6 locations; TPH (total petroleum hydrocarbons) concentrations ranged from 300 to 8800 mg/kg with 4 samples exceeding 1000mg/kg. SLR has not been provided with any formal reports detailing the results of Briggs' investigations.

3.2 ESI Ltd.

In December 2008 ESI Ltd drilled 14 boreholes (06401 to 06414) at the Site to allow further soil sampling and field screening. Seven of the boreholes were installed as semi-permanent 50mm diameter monitoring wells.

ESI submitted 17 soil samples for laboratory analysis for TPH and identified concentrations of hydrocarbons of between 350 and 2800 mg/kg in 5 of the samples; with the maximum recorded at 0.44m below ground level in location 06407. These results were broadly in line with those recorded by Briggs.

Seven groundwater samples were also retained for analysis, generally recording TPH concentrations of between 110mg/l and 660mg/l. A sample retained from 06408, close to the Briggs cut-off trench recorded a concentration of 7500mg/l, whilst the sample from 06411 was found to be free of impact.

Following a risk assessment ESI identified the following significant pollutant linkages as summarised in Table 1 below (reproduced from Table 7.1 in ESI report).

Table 1
ESI identified Significant Pollutant Linkages

SPL	Pollutant	Pathway(s)	Receptor	Grounds for Determination
1	Heating oil (free phase and residual soil concentrations; localised aqueous phase hydrocarbons represent potential secondary sources)	Migration of petroleum hydrocarbon vapours from the sub surface into the property; subsequent inhalation of vapours within building	Humans (residents of Apple Tree House) and pet animals	Significant risk of significant harm
2		Migration of dissolved phase and potentially free phase heating oil into the Minor Aquifer, principally via existing water well	Minor Aquifer (groundwater within Mercia Mudstone)	Pollution of controlled waters

3.3 Evaluation of Previous Investigations

SLR noted that ESI had identified the main source of hydrocarbon as near surface soils. Using the data provided by ESI, SLR undertook a preliminary assessment of the results in order to evaluate the potential mass of kerosene present in subsurface soils and to consider the extent of the area potentially requiring remediation. Based on the non-scaled plan produced as Figure 4.2 in the ESI report and the Site dimensions estimated during a Site visit, SLR estimated that:

- Shallow impacted soils extended over an area of around 110m^2 (+/- 20%) extending from the location of the former oil tank towards the cut-off trench. Impacted soils were likely to extend beneath around 50% of the garage;
- Around 90m^2 of the impacted soil may be accessible for excavation; the remainder may be present beneath the garage;

- Six soil analyses recorded total hydrocarbons exceeding 1000mg/kg with an average concentration of 4000 mg/kg;

- It was difficult from the information to infer the thickness of the impacted soil layer. However, it was noted that around the former water supply well that soil impacts are recorded at depths ranging from 0.75 to 1.5m; in areas where the made ground/drift deposits are up to 2m thick. To the south west of this area, below the raised bed of shrubs; the soil impacts are indicated to be present at depths of between 0.2 and 1m below ground level. It is likely that impacted soils around the former tank are up to 1.5m thick and thin south-westwards to form a layer as little as 0.25m thick;

- Based on a plume area of 90m^2 and a thickness of between 1.5 and 0.25m; the total volume of impacted soils is most likely to be around 68m^3; and,

- Assuming a density of 1800kg/m^3 for the made ground; 68m^3 of impacted soils is equivalent to 120 tonnes of soil.

- 120 tonnes of soil contaminated with kerosene at an average concentration of 4000mg/kg; would contain 490 kg of kerosene. Assuming a fuel density of 0.85kg/litre (allowing for light end evaporation) this is equivalent to 575 litres of liquid kerosene.

In relation to the mass of kerosene in groundwater, SLR estimated that:

- The average concentration of dissolved hydrocarbon in the impacted monitoring wells was 1.5mg/l.

- If it is assumed that the plume of impacted groundwater occupies a wider area than the soil impact; estimated at 150m^2 and the thickness of the impacted groundwater plume is 1.5m, then assuming a porosity of 30%; the volume of water in the groundwater plume is 67.5m^3. On this basis, at 1.5mg/l, the groundwater contains only 0.1kg of kerosene.

Therefore based on existing investigation data SLR concluded that contaminated soils at the Site contain in excess of 99.97% of the kerosene with only 0.02% dissolved in groundwater. Therefore, in terms of contaminant mass removal and risk reduction, SLR considered that remedial efforts should target treatment of the soil source. A revised conceptual model of potential pollutant linkages in relation to this contaminant source is presented in the following section.

4.0 PRELIMINARY CONCEPTUAL SITE MODEL

This section of report presents SLR's preliminary Conceptual Site Model that was developed from the existing reports at the commencement of the project in April 2009.

In order to outline the conceptual model SLR used the information gathered from previous investigation works and the recorded fuel spill to identify the key Contaminants, Pathways and Receptors present on Site. When considering the potential pollutant linkages at the Site it was assumed that the Site will remain unchanged comprising a single residential house with gardens in a rural area with nearby surface water receptors. A summary table of the distribution of potential contaminants associated with these sources is presented as Table 2 below.

Table 2: Contaminants

Contaminant Phase	Elements and Compounds	Notes
Separate phase – contaminants present in soil and /or porosity as non-aqueous phase liquid (NAPL)	Fuels – petroleum hydrocarbons	Separate Phase Fuel was present in the ground during the remedial works conducted by Briggs.
Sorbed phase – contaminants sorbed onto soil particles	Fuels – petroleum hydrocarbons	Recorded in the boreholes and trial pits excavated by Briggs and ESI.
Vapour phase – contaminants present vapour in the soil	Fuels – petroleum hydrocarbons	Presence unknown – dependent upon the degree of weathering of the separate phase fuel in the ground – potential to be present by volatisation from any fuel trapped beneath the concrete floor slab of the house.
Dissolved phase – contaminants dissolved in groundwater	Fuels – petroleum hydrocarbons	Recorded in the boreholes and the disused groundwater supply well at the Site.

SLR understood that the source of contamination was kerosene, a middle distillate, light fuel oil. Its composition generally comprises hydrocarbons in the C_7–C_{16} range which boils between 150 and 300°C and is composed mainly of cycloalkanes and n-alkanes with lower concentrations of mono-aromatics and branched alkanes and very low concentrations of BTEX and PAHs. Therefore, analysis of soil impacted by kerosene will contain hydrocarbons identified in the laboratory as both of diesel (C_8–C_{20}) and petrol (C_4–C_{12}) range organics.

Following an assessment of the environmental and geological setting of the Site and considering the current and proposed land use, the potential pathways via which contaminants could impact receptors have been assessed. The statutory guidance for Part IIA, DETR Circular 02/2000, defines a Pathway as: *"one or more routes or means by, or through, which a receptor: (a) is being exposed to, or affected by, a contaminant; or (b) could be exposed or affected".*

Tables 3 and 4 list all of the pathways to be considered by a Part IIA assessment. A tick **(✓)**, has been used where SLR consider these receptors to be present. Those that are not considered present **(×)** are excluded from further assessment.

Table 3: Potential Exposure Pathways - Environmental

Pathways		Potential Presence (✗ or ✓)	Notes
Ecological	Ingestion of soil & dust	✗	There are no designated ecological receptors such as nature reserves or sites of special scientific interest within 500m of the Site, hence these pathways have not been considered.
	Ingestion of food	✗	
	Ingestion of water	✗	
	Dermal Exposure	✗	
	Inhalation of dust	✗	
	Inhalation of vapour	✗	
Property: Flora & Fauna	Root Uptake	✗	There is no commercial flora or fauna present at or proposed for the Site, and given the setting this is unlikely to occur in the future hence these pathways have not been considered.
	Leaf Contact	✗	
	Ingestion of soil & dust	✗	
	Ingestion of food	✗	
	Ingestion of water	✗	
	Dermal Exposure	✗	
	Inhalation of dust	✗	
	Inhalation of gas/vapour	✗	
Property: Buildings	Contact with materials	✗	There is no evidence that the structural integrity of future buildings is at risk. With respect to potential accumulation of petroleum vapours, there is uncertainty about the presence of vapour in the ground and this requires further assessment.
	Build-up of vapours	✓	
	Unstable materials	✗	
Controlled Water: Surface Waters	Surface runoff	✓	The Site is loosely surfaced; any run-off could, in times of extreme inundation, enter the surface water stream to the south beyond the road. The Site geology is predominantly clays suggesting that the groundwater pathway is of low permeability.
	Movement of contaminants via drains, mine workings, adits, etc	✗	
	Migration via groundwater	✓	
Controlled Water: Groundwater	Leaching from soil	✓	The Site is loosely surfaced and the site geology suggests that the pathway to deeper groundwater is of low permeability, but leaching from near surface soils and lateral migration of perched groundwater could impact surface water streams. However, the presence of a dug well into the Mercia Mudstone presents the potential, dependent upon the elevation of the groundwater table, for infiltrating rainwater to connect to the deeper groundwater.
	Movement of contaminants via drains, mine workings, adits, etc	✓	

Table 4: Potential Exposure Pathways – Humans

Exposure Pathway	Critical Medium	Potential Presence (✗ or ✓)	Notes
Ingestion of soil	Soil	✓	In the context of ongoing residential use of the Site, and the known release at or near surface of liquid hydrocarbons, the potential for human exposure to hydrocarbon contaminants via the pathways identified in this table are considered to exist.
Ingestion of building dust	Indoor dust	✓	
Ingestion of contaminated vegetables	Vegetables	✓	
Ingestion of soil attached to vegetables	Soil	✓	
Dermal contact with soil	Soil	✓	
Dermal contact with building dust	Indoor dust	✗	
Inhalation of fugitive soil dust	Soil	✓	
Inhalation of fugitive building dust	Indoor dust	✓	
Inhalation of vapours outside	Air	✓	
Inhalation of vapours inside	Air	✓	

Finally, a consideration of the potential receptors at Apple Tree House has been made. The statutory guidance for Part IIA, DETR Circular 02/2000, defines a Receptor as:

"either (a) a living organism, a group of organisms, an ecological system or a piece of property which (i) is in a category listed in Table A as a type of receptor, and (ii) is being, or could be, harmed, by a contaminant; or (b) controlled waters which are being, or could be, polluted by a contaminant".

Table 5 lists all of the receptors to be considered by a Part IIA or Planning Policy Statement: Planning and Pollution Control, Annex 2: Development on Land Affected by Contamination (PPS23) assessment. A tick **(✓)**, has been used where SLR consider these receptors to be present. Those that are not considered present **(✗)** are excluded from further assessment.

Table 5: Potential Receptors

Receptor	Receptor types	Potential Presence (✗ or ✓)	Notes
Humans	Human beings	✓	Ongoing residential use of the Site.
Ecosystems	Any designated ecological system, or living organism forming part of such a system	✗	There are no designated ecosystems suspected within 500m of the Site.

Receptor	Receptor types	Potential Presence (✘ or ✓)	Notes
Property (Flora and Fauna)	Crops, including timber	✘	With the exception of home grown vegetables and domestic animals, none of these receptors are/or likely to be present on the Site.
	Produce grown domestically, or on allotments for consumption	✓	
	Livestock	✘	
	Other owned or domesticated animals	✓	
	Wild animals which are the subject of shooting or fishing rights	✘	
Property (Buildings)	A 'building' means any structure or erection, and any part of a building including any part below ground level, but does not include plant or machinery comprised in a building.	✘	The existing house is located above or potentially within hydrocarbon impacted soils; given the age of the spill, these soils are unlikely to release potentially hazardous petroleum vapour with the potential to cause explosions.
Controlled Waters	Territorial waters	✘	The controlled waters on or in the vicinity of the Site are the minor stream that lies close to the south of the Site on the far side of the lane. The underlying Mercia Mudstone is classified as a non aquifer, but groundwater was abstracted from it for domestic supplies to this property.
	Coastal waters	✘	
	Inland freshwaters	✓	
	Lakes	✘	
	Groundwater	✓	

4.1 Evaluation of Pollutant Linkages

Based on the results of the site investigations undertaken by ESI and Briggs it is clearly apparent that a source (petroleum hydrocarbon impact) was present at the Site, primarily to the south west of the oil tank and building across and beneath the garden areas. On the basis of the above evaluation of the presence of pathways and receptors a revised summary of significant pollutant linkages (SPL) has been completed and is summarized in Table 6 overleaf.

Table 6: Pollutant Linkages

SPL	Pollutant	Pathway(s)	Receptor
1	Heating oil (free phase and residual soil concentrations; localised aqueous phase hydrocarbons represent potential secondary sources)	Migration of dissolved phase and potentially free phase heating oil into the Minor Aquifer, principally via existing water well	Minor Aquifer (groundwater within Mercia Mudstone)
2	Heating oil (free phase and residual soil concentrations; localised aqueous phase hydrocarbons represent potential secondary sources)	Migration of petroleum hydrocarbon vapours from the sub surface into the property; subsequent inhalation of vapours within building	Humans (residents of Apple Tree House) and pet animals
3		Direct contact and ingestion risks from gardening activity and from pathways present if garden vegetables cultivated and consumed on-Site	Humans (residents of Apple Tree House) and pet Animals
4		Lateral migration of dissolved phase and potentially free phase heating oil To surface water receptors, via perched groundwater in superficial soil deposits and surface water run-off	Birstsmorton Brook

Apple Tree House was determined as Contaminated Land under Part IIA of the Environment Act 1990 due to SPL 1 summarised above. However, investigation and remedial works will need to ensure that residual risks via SPL2 to 4 are also addressed.

5.0 PRELIMINARY REMEDIAL STRATEGY

An assessment of the previous investigation data summarised in Section 3.3 concluded that contaminated soils at the Site contain in excess of 99.97% of the residual kerosene impact with only 0.02% dissolved in groundwater.

A detailed remedial options appraisal was not undertaken as it was recognised that the use of novel, or in-situ engineered remediation techniques would be limited by the evident preference for the heavier end kerosene hydrocarbon fraction to adhere to clay and silt soil particles and the low proportion of kerosene that was present in the groundwater phase. Instead, remedial options would be focussed on mass removal of the kerosene soil source with ancillary engineered works to break the remaining pathways.

Therefore, based on SLR’s experience of similar sites, it was assumed that the likely low permeability of the Mercia Mudstone and any overlying river terrace deposits, topsoil and made ground it was considered that options for remediation of the kerosene impacted soils were likely to be limited to excavation and off-site removal.

In order to break the pollutant linkages described in Section 4.0 the following strategy was adopted:

SPL1: Cleaning and backfilling with impermeable grout the brick-lined water supply well in order to block any pathway for residual kerosene impacts to enter deeper groundwater in the underlying Mercia Mudstone.

SPL2: Monitoring soil vapour concentrations beneath the building slab to Apple Tree House via drilling and installation of two soil vapour sampling wells inside the garage in order to collect soil vapour samples to be used for the assessment of the potential risk of vapour ingress. The garage was selected as it was located close to the kerosene leak point and had a concrete floor of similar age and construction to the adjacent house.

SPL3 & 4: Excavation and off-site disposal of near-surface kerosene impacted soils in order to remove or reduce the source of hydrocarbon impact at the Site and thereby reduce the potential for complete pollutant linkages to human health and surface water receptors.

In order to progress the site remedial works, a preliminary phase of site investigation to augment those carried out by Briggs and ESi was planned. This comprised additional delineation investigations and completion of a round of groundwater monitoring, in order to verify the extent of soil and groundwater impacts in advance of the main phase of Site remediation works. In particular these investigations were necessary to verify the extent of soil impacts requiring remediation, to collect samples of soils for waste classification purposes and to verify current groundwater impacts.

6.0 SUMMARY OF SLR SITE INVESTIGATIONS

6.1 Preliminary Investigations

Following on from ESI and Briggs initial remedial works at the Site, SLR carried out an initial phase of site investigation in May 2009, in order to verify the source of impact identified by the preliminary Conceptual Site Model and confirm the scope of the preliminary remedial strategy.

6.1.1 Scope of Works

On 12th May 2009, SLR supervised the advancement of ten boreholes using hand-held windowless sampling equipment, supplied and operated by Sherwood Drilling Services. The following section outlines the findings of these site investigation works.

The field and laboratory methodologies for this investigation are included in Appendix A. Borehole logs and analytical test data for are included in Appendix B and Appendix C respectively. A plan showing the locations of all boreholes is reproduced as Drawing 2.

6.1.2 Borehole Positioning and Monitoring Well Installations

Two boreholes (S1 and S2) were advanced inside the garage building, adjoining the house, and installed as dedicated 19mm soil vapour sampling wells in order to assess the potential for a pathway for hydrocarbon vapours to enter the main building.

The remaining eight boreholes (S3 to S10) were advanced down gradient of the fuel release point to assess residual soil and groundwater impacts. Two boreholes (S5 and S7) were installed as 50mm monitoring wells.

6.1.3 Encountered Conditions

All borehole arisings were logged in accordance with BS5930, with visual and olfactory observations of contamination noted. Soil samples were also screened, at regular intervals, for hydrocarbon vapours.

Ground conditions encountered generally consisted of made ground of sand and clay with gravels of brick, concrete and occasionally coal and ash present to a maximum thickness of 1.1m in all boreholes except S6. Made ground was underlain by slightly sandy clay over weathered Mercia Mudstone. The clay layer overlying the Mercia Mudstone was absent from boreholes S5 and S10. Table 7 overleaf outlines field observations made during the investigation, full borehole logs are enclosed with this letter.

Table 7
Field Observations

BH No.	Thickness of Made Ground (m)	Borehole Completion Depth (mbgl)[1]	Observations/Comments	Maximum Field Screening Result (ppmTOV)[2]
S1	0.4	2.0	0.4 to 1.25m Slight hydrocarbon odour 1.25 to 1.6m Moderate hydrocarbon odour 1.6 to 1.8m Slight hydrocarbon odour	175 @ 1.5m
S2	0.3	2.0	0.4 to 1.05m Slight hydrocarbon odour 1.05 to 1.7m Slight to moderate hydrocarbon odour 1.7 to 2.0m Slight hydrocarbon odour	420 @ 1.7m
S3	1.1	1.8	1.1 to 1.5m Slight hydrocarbon odour	70 @ 1.8m
S4	0.6	2.0	1.2 to 2.0m Slight hydrocarbon odour	60 @ 0.75m & 1.5m
S5	0.55	2.0	0.3 to 0.65m Slight to moderate hydrocarbon odour 0.65 to 2.0m Slight hydrocarbon odour	195 @ 0.4m
S6	0	1.5	0.2 to 1.5m Slight hydrocarbon odour	110 @ 0.5m
S7	0.35	2.0	None	125 @ 0.9m
S8	0.5	1.0	None	45 @ 0.2m
S9	0.1	1.0	None	10 @ 0.6m
S10	0.35	1.0	0.2 to 0.4m Feint hydrocarbon odour	5 @ 0.3, 0.6 & 1.0m

[1] metres below ground level
[2] parts per million Total Organic Vapours – measured using a GMI Gasurveyor calibrated to pentane

Field observations suggested that low levels of soil contamination persist at the Site.

6.1.4 Groundwater Monitoring

A full round of groundwater monitoring and sampling was carried out by SLR on 20th May 2009, using all accessible monitoring wells. Wells were also surveyed in using a 'dumpy' surveyor's level and related back to an Ordnance Datum recorded by ESI. Results of the groundwater monitoring are outlined in Table 8 below:

Table 8
Groundwater Monitoring Data

Well Label	Screened Interval (mbgl)	Ground Elevation (mAOD)[1]	Date	Groundwater Depth (mbgl)	Groundwater Elevation (mAOD)[1]	SPH[2] Thickness (mm)	Well Vapours (ppmTOV)[3]
S1	1.3 to 1.5	-	20/05/09	-	-	-	25
S2	1.3 to 1.5	-	20/05/09	-	-	-	180
S5	1.3 to 2.0	16.65	20/05/09	1.093	8.18	Slight Sheen	15
S7	0.5 to 2.0	16.46	20/05/09	0.541	8.54	Nil	40
06402	0.5 to 2.5	17.32	20/05/09	1.335	8.61	Nil	85
06407	0.75 to 3.0	16.65	20/05/09	0.688	8.57	Nil	70
06408	0.6 to 3.6	16.50	20/05/09	0.733	8.28	Nil	135
06412	1.0 to 4.0	17.42	20/05/09	1.508	8.56	Nil	140
06413	0.5 to 1.0	17.40	20/05/09	0.662	9.40	Nil	45
Water Well	Unknown	17.38	20/05/09	1.35	8.65	Nil	0

[1] metres Around Ordnance Datum.
[2] Separate Phase Hydrocarbons.
[3] parts per million Total Organic Volatiles, measured using a GMI Pellister calibrated against pentane.

The groundwater monitoring data collected by SLR does not indicate a clear hydraulic gradient beneath the Site, although there may be a general trend (fall) in groundwater elevation towards the west. The majority of Site investigation points and the cut off trench installed in 2007 have been targeted to the south of the release point.

6.1.5 Analytical Chemistry Results - Soil

Eight representative soil samples were submitted to Alcontrol Geochem in Cheshire for analysis for DRO (diesel range organics), GRO (gasoline range organics), BTEX (benzene, toluene, ethyl-benzene and xylenes). A further 2 samples from impacted soils found in S1 and S5 were scheduled for analysis for Speciated TPH (total petroleum hydrocarbon) analysis. The results of these analyses are summarised in Table 9 below.

In addition, to aid with plans for potential waste disposal, 2 samples were analysed for Speciated PAHs (polycyclic aromatic hydrocarbons) and a suite of metals. One sample was analysed for the presence of Asbestos fibres. Full laboratory certificates are enclosed in Appendix C.

Table 9
Analytical Chemistry Results - Soil

BH I.D.	Sample Depth (mbgl)	DRO (C_{10}-C_{35})	DRO (C_{10}-C_{40})	PRO (C_{10}-C_{12})	Benzene	Toluene	Ethyl-benzene	Xylenes	MTBE
S1	1.5	46	-	19	<0.01	<0.01	<0.01	<0.01	<0.01
S2	1.5	-	140	15	<0.01	<0.01	<0.01	0.13	<0.01
S3	1.6	-	190	0.78	<0.01	<0.01	<0.01	<0.01	<0.01
S5	0.4	130	-	27	<0.01	<0.01	<0.01	<0.01	<0.01
S5	0.6	-	<35	0.38	<0.01	<0.01	<0.01	<0.01	<0.01
S5	0.8	-	50	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S6	0.5	-	73	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S6	0.8	-	39	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S7	0.9	-	36	0.16	<0.01	<0.01	<0.01	<0.01	<0.01
S10	0.3	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

All concentrations in mg/kg rounded to 2 significant figures

The highest concentration of DRO recorded was 190mg/kg at 1.6m in borehole S3 approximately 5m west of the release point. Concentrations of 140 and 130mg/kg were recorded in boreholes S2 (~5m SE) and S5 (~5m SW), respectively.

6.1.6 Analytical Chemistry Results - Groundwater

Six representative water samples were submitted to Alcontrol Geochem in Cheshire for analysis for speciated TPH analysis. The results of these analyses are summarised in Table 10 overleaf.

Table 10: Analytical Chemistry - Groundwater

Well No.	Date	DRO (C_{10}-C_{35})	PRO (C_{10}-C_{12})	Benzene	Toluene	Ethyl-benzene	Xylenes	MTBE
06402	20/05/09	0.93	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
06407	20/05/09	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
06408	20/05/09	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S5	20/05/09	0.13	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S7	20/05/09	0.09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Water Well	20/05/09	0.42	0.66	<0.01	<0.01	0.02	0.02	<0.01

All concentrations in mg/l rounded to 2 significant figures

Traces to low concentrations of DRO were recorded in all samples analysed. Low concentrations of PRO were identified in the Water Well at the Site along with trace concentrations of ethyl-benzene and Xylenes.

6.1.7 Soil Vapour

Two samples of soil vapour were retained by SLR for the measurement of petroleum vapour concentrations on 20th May. The samples were collected, using Tenax sorbent tubes and low flow sampling pumps, from dedicated soil vapour sampling boreholes S1 and S2. Two blank samples were also retained, one, which was briefly opened to ambient air, to assess exposure during handling of the sampling tubes and one, which was left unopened, to assess exposure during storage and transport of the tubes.

The aim of installing the soil vapour monitoring wells and testing soil vapour samples was to assess whether the potentially significant pollutant linkage (SPL2) due to migration of petroleum vapour from the kerosene migrating into the property and subsequent inhalation of vapour by people living in the house was complete.

If the monitoring indicated that SPL2 was complete then an evaluation of whether vapour extraction was a feasible remedial option would be necessary.

Soil vapour samples were submitted to Gradko Environmental in Hampshire for analysis for a range if hydrocarbon vapours. A tracer compound containing Limonene, which is not found in petroleum products, was applied around the top of the well during the vapour sampling. Samples were also tested for the presence of Limonene to assess the potential and extent of any leakage of air around the well pipe and gas tap fittings. Results of the analysis are summarised in Table 11 below. Full laboratory certificates are enclosed in Appendix D.

Table 11
Analytical Chemistry – Soil Vapour

Chemical	Sample I.D.				
	S1	S2	Handling Blank	Travel Blank	Residential RfCs
Benzene	0.0033	<LOD	<LOD	<LOD	0.005
Toluene	0.031	0.0006	0.0016	<LOD	5.0
Ethylbenzene	0.0020	<LOD	<LOD	<LOD	0.76
Total Xylenes	0.0083	<LOD	<LOD	<LOD	0.19
Aliphatics (C_5-C_7)	1.4	0.0019	<LOD	<LOD	18
Aliphatics (C_8-C_{10})	0.22	<LOD	<LOD	<LOD	1.0
Aliphatics (C_{11}-C_{12})	0.010	<LOD	<LOD	<LOD	-
Aromatics (C_8-C_{10})	0.0086	<LOD	<LOD	<LOD	0.18
Aromatics (C_{11}-C_{12})	<LOD	<LOD	<LOD	<LOD	0.19
Limonene	0.0051	<LOD	<LOD	<LOD	-
Total Recorded Vapour (excluding Limonene)	1.7	0.0025	0.0016	0	-

All concentrations in mg/m^3 rounded to two significant figures, unless otherwise stated
<LOD = below laboratory Limit of Detection

In the table above, the recorded soil vapour concentrations are compared to residential reference concentrations (RfCs). These are taken directly from the air quality guidelines or toxicologically-derived inhalation concentrations used by the Environment Agency to derive TDI_{inh} in terms of intake per kg bodyweight. For the petroleum hydrocarbon fractions, RfCs are generally taken from the reference concentrations recommended by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG, 1997)[1]. All RfCs are adjusted for the background concentration of each compound or petroleum hydrocarbon fraction. Full details on the derivation of the RfCs are included in Appendix E.

In sample S1, that recorded the maximum vapour concentrations, the in-ground vapour concentrations are at least 10 times lower than the health-based indoor air criteria. Indeed, there is some evidence that vapours from the tracer compound (shaving foam) including limonene have been detected in S1 indicating actual risks may be lower.

Very low vapour concentrations were recorded in S2 located just over 5m from the release point and close to the main house.

6.2 Evaluation of Results

From the findings of this phase of investigation, SLR drew the following conclusions:

- The soil analyses showed that, whilst contamination was present, soil contaminant concentrations were relatively low given the scale of the release of kerosene at the Site; the concentrations recorded were in SLR's opinion consistent with field observations recorded during the drilling. The soil phase concentrations were typically around 0.2kg/T (200mg/kg) (S3), close to the source diminishing to less than 0.1kg/T (100mg/kg) at a distance of less than 10m from the source (BH's S5, S6 and S7).

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[1] TPHCWG (1997) Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons, Volume 4. Total Petroleum Hydrocarbon Criteria Working Group Series. Amherst: Amherst Scientific

- If 120 tonnes of soil contaminated with kerosene was present at an average concentration of 200mg/kg; it would contain 24kg of kerosene. Based on previous investigation results, SLR anticipated impacts 10 to 20 times higher than those recorded in this phase of investigation.

- Based on the maximum concentrations of dissolved phase impacts recorded, less than 0.05kg of Kerosene remained dissolved in Site groundwater.

- The vapour monitoring and analyses indicated that the vapour concentrations in the ground did not exceed the RfCs.

Table 12 below provides the initial risk screening by comparing the maximum concentration recorded against SLR's Generic Assessment Criteria (GAC). A summary of the source and derivation of these GAC are included in Appendix F. The GAC, minimum concentration recorded and maximum concentration recorded are all expressed in mg/kg.

Table 12 Screening: Soils at Apple Tree House

Contaminant	No. of samples	GAC	Min. Conc.	Max.Conc	Max. Conc > GAC (Y/N)
Aliphatic C5-C6	2	62	< 0.01	< 0.01	N
Aliphatic >C6-C8	2	150	0.19	0.28	N
Aliphatic >C8-C10	2	38	2.5	2.6	N
Aliphatic >C10-C12	2	50	5	8.2	N
Aliphatic >C12-C16	2	1250	20	98	N
Aliphatic >C16-C21	2	3500	4.3	4.9	N
Aliphatic >C21-C35	2	3500	<0.1	<0.1	N
Aromatic >C8-C10	2	37	3.7	4.0	N
Aromatic >C10-C12	2	83.1	7.4	12	N
Aromatic >C12-C16	2	197	2.1	4.5	N
Aromatic >C16-C21	2	541	<0.1	<0.1	N
Aromatic >C21-C35	2	1770	<0.1	6.1	N
PRO	8	38*	<0.01	27	N
DRO	8	197*	<35	190	N
Benzene	8	0.079	<0.01	<0.010	N
Toluene	8	119	<0.010	<0.010	N
Ethylbenzene	8	65	<0.010	<0.010	N
Xylenes	8	42	<0.010	<0.010	N

* represents lowest GAC for a hydrocarbon fraction with the petrol and diesel range respectively

Table 12 shows that from the 10 soil samples collected and analysed by SLR, none exceed the GAC for hydrocarbons with respect to human health for a residential land use with plant uptake.

6.3 Review of Potential Pollutant Linkages

Overall, in relation to the conceptual model of pollutant linkages the results indicated the following:

SPL1: Cleaning and backfilling with impermeable grout the brick-lined water supply well in order to block any pathway for residual kerosene impacts to enter deeper groundwater in the underlying Mercia Mudstone remained necessary.

SPL2: Monitoring of soil vapour concentrations beneath the building slab to Apple Tree House indicated that any residual kerosene impacts beneath or adjacent to the House were not acting as a significant source of petroleum vapour and there appear to be no complete pollutant linkage via this pathway. As this was a potential significant pollutant linkage a second round of vapour monitoring to confirm the preliminary results was recommended.

SPL3: Concentrations of kerosene in near surface soils were low to a degree that indicated that this pollutant linkage may not be complete. In light of the low and unexpected results of the initial soil analyses, SLR undertook a phase of follow-up investigations in order to verify whether kerosene impacts were localised to discrete shallow soil migration pathways that may not have been intercepted by SLR investigations or whether the kerosene impacts across the Site had undergone a substantial degree of attenuation.

SPL4: Concentrations of dissolved kerosene in groundwater were very low indicating that migration of kerosene via perched groundwater pathways was unlikely to be significant.

The initial phase of site investigation recorded lower levels of kerosene impact in soils and groundwater than were anticipated based on the results of the previous site investigation by ESI and the description of the extent of spill remediation works undertaken in response to the original release. Two possible factors were identified for the reduced concentrations:

- The kerosene impact has been channelled in the shallow superficial deposits such that ESI and Briggs, in 2007 and 2008, encountered more contaminated soils than did SLR in 2009; or, alternatively

- Volatilisation and natural attenuation processes have led to the biodegradation of soil and groundwater impacts over a relatively short timescale.

In order to verify the delineation and assessment of residual kerosene impacts, SLR undertook a second phase of investigation, advancing a series of trial pits and trial trenches excavated perpendicular to the extent of the kerosene plume inferred from ESI and Briggs data. The results are detailed in the following section.

7.0 ADDITIONAL DELINEATION INVESTIGATIONS

7.1 Scope of Works

SLR's additional delineation investigations comprised the following activities:

- Undertaking a repeat round of soil vapour sampling on 26th June as well as ground clearance works in preparation for further site investigation works;
- Additional delineation investigations comprise the excavation of 7 trial pits (TP1 to TP7) and 3 inspection trenches (Trenches 1, 2 & 3) using a 1.5 tonne tracked excavator, supplied and operated by Smith Plant Hire, on 29th and 30th June. Pits and trenches were positioned down gradient of the fuel release point perpendicular to the inferred pathways in order to assess the potential for discreet contaminant flow paths which may have been missed by the borehole investigation;
- Logging trial pit arisings in accordance with BS5930, with additional observations of contamination noted;
- Full round of groundwater monitoring from the installed monitoring well network on 7th August 2009;
- Removal/purging of intercepted perched groundwater from the in-situ trenches via vacuum tanker on 7th August 2009, including the original Briggs cut-off trench; sampling of water from trenches on 10th August 2009;.
- Submitting soil, groundwater and vapour samples to accredited laboratories for analysis for suites of hydrocarbons; and
- Assessment of soil contamination concentrations against generic assessment criteria (GACs) for common hydrocarbon contaminants calculated using the latest version of the CLEA model (v1.04).

7.2 Investigation Results

7.2.1 Encountered Conditions

As previously, the ground conditions encountered generally consisted of made ground of sand and clay with gravels of brick, concrete and occasionally coal and ash present to a maximum thickness of 1.1m. Made ground was underlain by slightly sandy clay over weathered Mercia Mudstone. Table 13 below outlines field observations made during the borehole and trial investigations; a summary of the total concentrations of diesel (DRO) and petrol (PRO) range organic compounds recorded in the soils at the site is included. Trial pit logs are included as Appendix B.

Table 13
Field Observations

Investigation Location	Thickness of Made Ground (m)	Completion Depth (mbgl)[1]	Observations/Comments	Max. Field Screening Result (ppmTOV)[2]	Max. DRO (mg/kg)	Max. PRO (mg/kg)
Trench 1	Multiple sample locations				250	37
Trench 2	Multiple sample locations				290	93

Investigation Location	Thickness of Made Ground (m)	Completion Depth (mbgl)[1]	Observations/Comments	Max. Field Screening Result (ppmTOV)[2]	Max. DRO (mg/kg)	Max. PRO (mg/kg)
Trench 3	Multiple sample locations				96	<0.01
TP1	1.0	1.5	None	35 @ 1.5m	NS	NS
TP2	1.1	1.5	1.1 to 1.45m Light grey discolouration and moderate hydrocarbon odour.	580 @ 1.2m	330	45
TP3	1.0	1.5	1.1 to 1.45m Light grey discolouration and moderate hydrocarbon odour.	535 @ 1.2m	NS	NS
TP4	1.0	1.5	1.0 to 1.2m Slight greyish discolouration and slight hydrocarbon. 1.2 to 1.45m Grey discolouration and slight to moderate odour. 1.45 to 1.5m mottled discolouration and slight odour.	>1000 @ 1.3m	210	87
TP5	0.9	1.4	0.9 to 1.3m Mottled grey discolouration and slight to moderate hydrocarbon odour.	870 @ 1.4m	220	5.2
TP6	0.5	1.1	1.05m …seeps of water with very slight oily sheen.	25 @ 1.1m	97	<0.01
TP7	0.4	1.2	0.4 to 1.2m …slight grey discolouration and slight odour.	720 @ 0.8m	NS	NS

[1] metres below ground level
[2] parts per million Total Organic Vapours – measured using a GMI Gasurveyor calibrated to pentane

Field observations combined with laboratory analyses suggest that low concentrations of soil contamination persist at the site.

7.2.2 Groundwater Monitoring

A full round of groundwater monitoring and sampling was carried out by SLR on the 7th August 2009 in all accessible monitoring wells. The results of the groundwater monitoring are outlined in

Table 14 below, including May 2009 data for comparative purposes.

Table 14
Groundwater Monitoring Data

Well Label	Screened Interval (mbgl)	Ground Elevation (mAOD)[1]	Date	Groundwater Depth (mbgl)	Groundwater Elevation (mAOD)[1]	SPH[2] Thickness (mm)	Well Vapours (ppmTOV)[3]
S1	1.3 to 1.5	-	20/05/09	Dry to 1.5m	-	-	25
			07/08/09	Dry to 1.5m	-	-	0
S2	1.3 to 1.5	-	20/05/09	Dry to 1.5m	-	-	180
			07/08/09	Dry to 1.5m	-	-	0
S5	1.3 to 2.0	16.65	20/05/09	1.093	15.56	Slight Sheen	15
			07/08/09	1.002	15.65	Nil	35
S7	0.5 to 2.0	16.46	20/05/09	0.541	15.92	Nil	40
			07/08/09	0.636	15.82	Nil	15
06402	0.5 to 2.5	17.32	20/05/09	1.335	15.99	Nil	85
			07/08/09	1.251	16.07	Nil	25
06407	0.75 to 3.0	16.65	20/05/09	0.688	15.96	Nil	70
			07/08/09	1.030	15.62	Nil	50
06408	0.6 to 3.6	16.50	20/05/09	0.733	15.77	Nil	135
			07/08/09	0.535	15.97	Nil	0

Well Label	Screened Interval (mbgl)	Ground Elevation (mAOD)[1]	Date	Groundwater Depth (mbgl)	Groundwater Elevation (mAOD)[1]	SPH[2] Thickness (mm)	Well Vapours (ppmTOV)[3]
06412	1.0 to 4.0	17.42	20/05/09	1.508	15.91	Nil	140
			07/08/09	1.561	15.86	Nil	15
06413	0.5 to 1.0	17.40	20/05/09	0.662	16.74	Nil	45
			07/08/09	1.063	16.34	Nil	25
Water Well	Unknown	17.38	20/05/09	1.35	16.03	Nil	0
			07/08/09	1.251	16.13	Nil	NM

[1] metres Around Ordnance Datum.
[2] Separate Phase Hydrocarbons.
[3] parts per million Total Organic Volatiles, measured using a GMI Pellister calibrated against pentane.
NM = Not Measured

The groundwater monitoring data collected by SLR does not indicate a clear hydraulic gradient beneath the Site, although there is a general trend down towards the south. Given the relatively flat topography of the site and surrounding area, the change in gradient may reflect the influence of recharge on open trenches. The majority of boreholes and the interception trenches have been targeted to the south of the release point.

7.2.3 Groundwater Chemistry

Seventeen representative groundwater samples were submitted to Alcontrol Geochem in Cheshire for Speciated TPH analysis. The results of the groundwater monitoring are outlined in Table 15 below and include the May 2009 data for comparative purposes:

Table 15: Analytical Chemistry - Groundwater

Well No.	Date	DRO (C_{10}-C_{35})	PRO (C_{10}-C_{12})	Benzene	Toluene	Ethyl-benzene	Xylenes	MTBE
06402	20/05/09	0.93	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	07/08/09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
06407	20/05/09	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	07/08/09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
06408	20/05/09	0.06	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	07/08/09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
06410	07/08/09	0.33	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
06412	07/08/09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S5	20/05/09	0.13	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	07/08/09	1.3	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
S7	20/05/09	0.09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	07/08/09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Water Well	20/05/09	0.42	0.66	<0.01	<0.01	0.02	0.02	<0.01
Cut Off Trench	12/05/09	0.08	0.08	<0.01	<0.01	<0.01	<0.01	<0.01
	07/08/09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trench 1	07/08/09	0.45	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Trench 2	07/08/09	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

All concentrations in mg/l rounded to 2 significant figures

7.2.4 Soil Vapour

Two samples of soil vapour were collected by SLR as part of a repeat sampling visit on 26th June 2009. Sample collection and analysis procedures were as described in Section 6.1.7. Results of the analysis are summarised in Table 16, below.

Table 16: Analytical Chemistry – Soil Vapour

Chemical	Sample I.D.								Reference Concentr-ations
	S1		S2		Handling Blank		Travel Blank		
	20/05/09	26/6/09	20/05/09	26/6/09	20/05/09	26/6/09	20/05/09	26/6/09	
Benzene	0.0033	0.00093	<LOD	<LOD	<LOD	0.0021	<LOD	<LOD	0.005
Toluene	0.031	0.0061	0.0006	0.00072	0.0016	<LOD	<LOD	<LOD	5.0
Ethylbenzene	0.0020	0.0021	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.76
Total Xylenes	0.0083	0.0091	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.19
Aliphatics (C_5-C_7)	1.4	0.0449	0.0019	<LOD	<LOD	<LOD	<LOD	<LOD	18
Aliphatics (C_8-C_{10})	0.22	0.0908	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	1.0
Aliphatics (C_{11}-C_{12})	0.010	0.0028	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	-
Aromatics (C_8-C_{10})	0.0086	0.0093	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.18
Aromatics (C_{11}-C_{12})	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	0.19
Limonene	0.0051	0.013	<LOD	<LOD	<LOD	<LOD	<LOD	<LOD	-
Total Recorded Vapour (excluding Limonene)	1.7	0.20	0.0025	0.00072	0.0016	0.0021	0	0	-

All concentrations in mg/m^3 rounded to two significant figures, unless otherwise stated
<LOD = Below laboratory Limit of Detection

The laboratory results from both rounds of vapour monitoring have been compared to health-based RfCs for indoor air derived by SLR. In sample S1 that recorded the maximum vapour concentrations, the in-ground vapour concentrations are at least 10 times lower than the health-based indoor air criteria.

7.3 Findings of Additional Assessment

The key findings of the follow-up assessment are as follows:

- Soil vapour sampling results were generally consistent with those recorded in May 2009. Full laboratory certificates are enclosed in Appendix C.
- Ground conditions encountered were generally consistent with those encountered during the May 2009 site investigation,

- Field observations of contamination (slight to moderate hydrocarbon odours, some discolouration in places) were noted in trial pits TP2 to TP7; as shallow as 0.4m (TP7) and as deep as 1.5m (TP2). Field observations indicated that low concentrations of soil contamination persisted at the Site.

- Trenches 1 and 2 were left open to allow groundwater to accumulate, for sampling purposes, and flexibility with regards possible remedial options.

- The highest concentration of DRO recorded was 330mg/kg in TP2 at 1.2m; the laboratory identified the DRO as a combination of kerosene and humic acid. Samples of apparently clean soil analysed for DRO at the Site recorded concentrations of humic acids around 40 mg/kg so it is reasonable to estimate that up to 290 mg/kg of DRO is attributable to the kerosene release.

- The highest concentration of PRO was found in Trench 2 at 93mg/kg; it is reasonable to assume that all PRO recorded here is derived from the kerosene release.

7.4 Evaluation

Following on from the May 2009 works and from the findings outlined in section 7.3, SLR drew the following conclusions:

- Residual kerosene impact in soil vapour beneath the garage building and close to the house, as recorded in S1 and S2, were very low and unlikely to pose any actual risks to health of people living in the house now or in the future.
- Residual kerosene impacts in soil phase are 10 to 20 times lower than was anticipated based on the concentrations found by the ESI investigation. The trial pit and trial trench investigations confirmed that the mass of hydrocarbon remaining in the ground were low and did not reflect variability of the in-ground contaminant concentrations caused by preferential flow pathways. Residual mass of kerosene in the soil phase was estimated at between 25 and 50kgs.
- Residual kerosene impacts in groundwater remained in borehole S5 in August 2009 but were absent from other monitoring wells and trenches; the localised impact corresponded with the low residual soil impacts.
- In order to assess residual risks to human health from direct contact with soils, SLR has compared the residual concentrations to generic assessment criteria (GACs) for common hydrocarbon contaminants calculated using the latest version of the CLEA model (v1.04), a summary of the derived GACs are included as attachment to this report. The maximum concentrations of aliphatic and aromatic hydrocarbons are below the GACs for a residential scenario with direct uptake from vegetables grown at the site and assuming a 1% soil organic matter content, indicating that no risks remain via this pathway as illustrated in Table 17 below.

Table 17: Analytical Chemistry – Soil Hydrocarbons comparison with GAC

	Aliphatics Soil (mg/kg)		Aromatics Soil (mg/kg)	
	Site Max	GAC	Site Max	GAC
(C_6-C_8)	1.2	150	NA	NA
(C_8-C_{10})	13	38	19	37
(C_{10}-C_{12})	22	50	33	83.1
(C_{12}-C_{16})	100	1,250	21	197

On the basis of these investigation results combined with those described in Section 6.0 it was reasonable to draw the following conclusions in relation to potential pollutant linkages:

SPL1: Cleaning and backfilling with impermeable grout the brick-lined water supply well in order to block any pathway for residual kerosene impacts to enter deeper groundwater in the underlying Mercia Mudstone remained necessary as a precautionary measure because residual kerosene impact may remain in or trapped behind the brick lining to the well.

Low concentrations of kerosene in soil, soil vapour and the very low concentrations of residual kerosene locally in perched groundwater indicated that **SPL2, SPL3 and SPL4 were unlikely to be complete.** The recorded residual kerosene concentrations in soil and groundwater measured at the Site are below the levels that merit remedial action.

It is inferred that natural attenuation of recorded impacts between 2008 and 2009 is likely to have led to the lower than expected results recorded in this assessment. Indeed, as kerosene is composed predominantly of alkanes, it is likely that the lighter petrol-range components were removed via evaporation whilst the heavier components were degraded by biological processes in near-surface soils and perched groundwater. Degradation is likely to have been relatively rapid as the molecules constructed with single bonds between carbon atoms are likely to be simpler to degrade than complex aromatic hydrocarbons; it is inferred that half lives for these compounds are likely to be of the order of days.

8.0 REMEDIAL WORKS

Following the results of SLR's 2009 site investigations indicating that residual soil impacts had degraded to concentrations no longer posing an ongoing risk to controlled waters or human health, the following revised remedial measures were agreed with MHDC and the EA:

- The former drinking water supply well was to be dewatered and grouted up using Bentonite-cement grout in order to 'lock up' any residual impacts that may have sorbed to the Well's brick lining and to seal up a potential pathway into deeper groundwater within the Mercia Mudstone.
- Oxygen Releasing Compound (ORC) supplied by Regensis (ORC Advanced®) was to be placed in the base of Trenches 1 and 2 and the Brigg's cut-off trench as an additional, but non-essential, risk management measure. Advanced Formula Oxygen Release Compound (ORC Advanced®) is a proprietary formulation of calcium oxy-hydroxide that produces a controlled release of oxygen for period of up to 12 months when hydrated. The ORC release dissolved oxygen to groundwater to accelerate the rate of naturally occurring aerobic contaminant biodegradation. It is a widely recognised solution for removal of residual dissolved phase petroleum hydrocarbon impacts.
- All remaining open excavations, such as the one dug to expose the water pipe to the rear of the garage on site, to be backfilled.

- Three dead conifer trees at the site, suspected to have been killed by kerosene contaminating their root systems, to be felled, up rooted and appropriately disposed of. Samples of soil around the roots to be taken to confirm contamination had not preferentially accumulated around the roots.

- Groundwater monitoring wells to be decommissioned using bentonite pellets.

The following sections summarise these activities.

8.1 Well Decommissioning

Tor Drilling Limited (Tor) was commissioned by SLR to carry out the grouting up of the brick lined water well at the site on 7th August 2009. Clean water was brought to Site in a vacuum tanker supplied and operated by Cleansing Services Group Limited (CSG). The water was pumped into clean Intermediary Bulk Containers (IBCs), supplied by Tor.

The Vacuum tanker was used to pump groundwater from the water well. Once the well had been fully dewatered, it was backfilled with bentonite-cement grout mixed and applied using a grout pumping rig supplied and operated by Tor. The vacuum tanker was also used to de-water the open trenches to remove any residual groundwater impact and to verify that no mobile kerosene remained trapped in the vicinity.

The well was backfilled to a final depth of 0.95m below ground level. The water recovered from the well was disposed of by CSG to an approved facility; copies of the Waste Transfer Notes are included in Appendix G. After three days the well was monitored and a reduction in level of the grout was noted indicating the grout had migrated into voids between the brick lining and dug well wall, therefore the pathway to the deeper groundwater in the Mercia Mudstone is no longer considered to be complete.

8.2 ORC Placement and Trench Backfilling

Although concentrations of hydrocarbons in soil and groundwater at the Site were found to be below those requiring remedial action, in order to ameliorate any residual risks it was considered prudent, as an additional risk management measure, to place Oxygen Releasing Compound (ORC) in the open trenches, down-gradient of the original release point, in order to promote the degradation of any fugitive residual kerosene impacts prior to backfilling these trenches.

Tor was again commissioned by SLR to carry out the mixing and placement of ORC on 2nd November 2009. Clean water was brought to site, by Tor, in two large IBCs, this was pumped from the storage containers into a large mixing tank where the ORC was added and mixed to the correct quantities. The quantities of ORC and water mix needed to fill the trenches was calculated using a specification set out by the supplier (Rareness) as shown in the calculations below. An 8cm deep layer using a 10% solids slurry mix was sprayed onto to the base of Trench 1 and Trench 2. A lower percentage mix was added to the base of the cut off trench as this area of the site had previously been found to be less impacted.

- Trench 1 (Area of 2.5m^2) 2 x 11kg bags of ORC mixed with 225 Litres of water.
- Trench 2 (Area of 4m^2) 4 x 11kg bags of ORC mixed with 450 Litres of water.
- Cut off Trench (Area of 9m^2) 1.5 x 11kg bags of ORC mixed with 225 Litres of water.

On completion the trenches were cordoned off and left open overnight to allow the ORC to soak and settle into the base of the excavation.

The trenches were then backfilled, on 3rd November 2009, from the on Site stockpiles of previously excavated material, using a 3 tonne excavator and driver supplied by Reconomy Ltd. Prior to the material's re-use as backfill, a composite sample was taken from each of the stockpiles on 16th October and submitted for laboratory analysis for PRO, speciated DRO and MTBE (methyl-tertiary-butyl-ether) & BTEX (benzene, toluene, ethyl-benzene, Xylenes to confirm its suitability for use). The summarised results of these analyses can be found in Table 18, full laboratory certificates are in Appendix C of this report. The soil samples showed no visible or olfactory evidence of contamination and measured <0.1ppm when field screened for volatile organic vapours.

Table 18
Laboratory Analysis – Backfill Material

Sample I.D.	Sample Location	DRO (C_{10}-C_{40})	PRO (C_4-C_{12})	BTEX	MTBE
Cut Off Backfill A	Briggs cut-off trench excavation stockpile	130	<0.01	<0.01	<0.01
T1 Backfill A	Trench 1 excavation stockpile	71	29	<0.01	<0.01
T2 Backfill A	Trench 2 excavation stockpile	150	0.16	<0.01	<0.01

All concentrations in mg/kg rounded to 2 significant figures.

During the backfilling of the trenches, the backfill material was mixed residual ORC slurry in the base of the trenches in order to maximise its effectiveness. The trenches were backfilled and left proud of ground level to allow the soil to settle and compact over time. The surrounding areas were than made tidy, level and safe.

8.3 Tree Felling

The three dead conifers at the site were felled by Nature First Limited accredited tree surgeons supplied by Reconomy Ltd on 4th November 2009. Once felled, the trees were chipped on-site and recycled by the tree surgery contractors at their facility at Down Hatherley, Gloucester. The three conifer tree stumps were then dug out using a 3 Tonne excavator on 5th November 2009 and collected by the Nature First for recycling at their Down Hatherley site. The recycling facility is registered as exempt from Waste Management Licensing by the Environment Agency (EA). Copies of the registration and exemption certificates issued by the Environment Agency for Reconomy and Nature First are included in Appendix G.

Once the stumps had been removed, a soil sample was taken from the base of each of the three holes. Each sample was examined for any signs of contamination and field screened for volatile organic odours. The samples were submitted to Jones Environmental Laboratory and tested for TPHCWG. The results of the field observations are shown in the Table 19 below.

Table 19
Field Observations – Conifer Trees

Sample Location	Depth (m)	Headspace (ppmTOV)	Soil Conditions	Observations	Max. DRO (mg/kg)	Max. PRO (mg/kg)
Conifer 1	0.5	5	Soft brown silty clayey topsoil with abundant roots	No visual or olfactory signs of contamination	370	17
Conifer 2	0.4	10	Soft dark brown silty clayey topsoil with abundant roots	No discolouration, slight hydrocarbon odour	140	17
Conifer 3	0.4	10	Soft dark brown silty clayey topsoil with abundant roots	No visual or olfactory signs of contamination	390	<0.01

A slight hydrocarbon odour was detected in the soil sample taken from underneath Conifer 2. The laboratory interpreted the DRO found in this sample as possible kerosene residues. The higher concentrations of DRO recorded beneath Conifers 1 and 3 were identified as unknown pattern or PAHs and PAHs or Humic Acids respectively by the laboratory. SLR infers that the source of the high DRO concentrations is naturally hydrocarbon-like compounds associated with the resin or sap of the conifer trees.

Half a tub (5.5kg) of ORC was mixed with water and added to the holes which were then backfilled with clean spoil from the stockpiles.

8.4 Groundwater Monitoring and Analyses

A final round of groundwater monitoring and analysis was completed on 16th October 2009. The results are summarised in Table 15 below. Full laboratory analyses are included in Appendix C.

Table 20: Analytical Chemistry - Groundwater

Borehole No	Groundwater Depth	DRO (C_{10}-C_{40})	PRO (C_4-C_{12})	BTEX	MTBE
06402	1.71	0.31	<0.01	<0.01	<0.01
06407	1.02	<0.01	<0.01	<0.01	<0.01
06408	0.79	0.16	<0.01	<0.01	<0.01
06410	1.07	<0.01	<0.01	<0.01	<0.01
06412	1.92	<0.01	<0.01	<0.01	<0.01
S5	1.05	0.75	<0.01	<0.01	<0.01
S7	0.90	0.33	<0.01	<0.01	<0.01

All concentrations in mg/l rounded to 2 significant figures

Marginal increases in DRO concentrations were recorded in boreholes 6402, 6408 and S7, it is inferred that this may be due to the seasonally low groundwater table at the Site. However the diesel range fractions that are contributing the recorded impacts are greater than C_{16} and as these components are relatively immobile in groundwater they are unlikely to represent kerosene impacts.

8.5 Monitoring Well Decommissioning

In order to remove any lasting potential pathways for the downward migration of residual contamination, boreholes S1 to S5, S7, and S9, 06412, 06413 and 06407 were decommissioned as part of the final phase of work. In each case any covers were removed, for disposal, the well pipe was removed using the excavator and the resulting hole was backfilled with hydrated bentonite pellets. Boreholes S1 and S2, located in the garage, were reinstated and made level with concrete and boreholes 06412 and 06413, located on the drive way, were concreted to approximately 5cm below surface then finished with cold lay tarmac flush to grade.

9.0 EVALUATION AND CONCLUSIONS

Apple Tree House was determined as Contaminated Land by Malvern Hills District Council under Part IIA of the Environmental Protection Act 1990 in January 2009 for the reason that an *"oil tank spillage contaminating private water supply within grounds of residential plot".* The contaminating substance was identified as *kerosene fuel oil*.

The former groundwater supply well at the Site has been emptied of groundwater and residual dissolved phase kerosene via vacuum tanker prior to being filled with bentonite cement slurry from the base to around 1m below ground level. Therefore risks via this pollutant linkage (SPL1) to the deeper groundwater in the Mercia Mudstone have been remediated.

Monitoring of soil vapour concentrations beneath the building slab of the garage for Apple Tree House on two occasions indicated that any residual kerosene impacts beneath or adjacent to the House were not acting as a significant source of petroleum vapour and SPL 2 appears incomplete.

Residual kerosene impacts in the soil phase are 10 to 20 times lower than was anticipated based on the concentrations found by previous investigations. The trial pit and trial trench investigations have confirmed that the mass of hydrocarbon remaining in the ground is low and does not reflect variability of the in-ground contaminant concentrations caused by preferential flow pathways. Residual mass of kerosene in the soil phase is estimated at between 25 and 50kgs. It is inferred that because kerosene is composed predominantly of alkanes, it is likely that the lighter petrol-range components were removed via evaporation whilst the heavier components were degraded by biological processes in near-surface soils and perched groundwater. Degradation is likely to have been relatively rapid as the molecules constructed with single bonds between carbon atoms are likely to be simpler to degrade than complex aromatic hydrocarbons. For this reason it is considered that residual kerosene in the soil phase no longer poses a risk via SPL 3 to 4.

If the original volume of kerosene released was of the order of 4000litres, as described in previous reports, this indicates a mass reduction or removal of the kerosene by spill response, volatilisation and natural attenuation of over 98%.

Based on the information presented here, it appears reasonable for this property to be identified as remediated on the register of Contaminated Land as defined by Part IIA of the Environmental Protection Act 1990.

Finally, it is recommended that any future purchaser or occupier of the property should consider undertaking the following works prior to occupation or use of Apple Tree House. It should be noted that the following are not considered to be within the remit of contaminated land remediation under Part IIA of the Environmental Protection Act 1990.

- A new domestic oil storage tank and pipeline were installed in 2007 at the site; the tank contains heating oil and the outlet valve connected to the underground fuel line is closed. Due to the excavation works that have taken place in the vicinity of the house it is recommended that the integrity of the fuel pipeline connecting the tank to the house is properly assessed prior to re-commissioning; and,

- The internal plumbing and any water storage tank in Apple Tree House may contain residual kerosene impacted water. In the event that the internal plumbing is not wholly replaced, this should be investigated and suitable measures taken to ensure that any new water supply remains potable and suitable for use.

LIMITATIONS

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of Malvern Hills District Council; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

LEGEND

—	SITE BOUNDARY (ASSUMED)
AST	FORMER ABOVE GROUND STORAGE TANK (KEROSENE)
G	GARAGE ATTACHED TO HOUSE
W	APPROXIMATE LOCATION OF DOMESTIC WASTER SUPPLY WELL TO APPLE TREE HOUSE
—	EDGE OF RAISED BED
T	CUT OFF TRENCH INSTALLED 2007
▨	AREA INVESTIGATED BY ESI & BRIGGS

Revision	By	Chk'd By	Date	Comments

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Site
APPLE TREE HOUSE

Project
PART IIA REMEDIATION REPORT

Drawing Title
SITE SETTING APRIL 2009

Project File Reference
2664.00001.04.01.0

Drawn By
BF

Scale
1:500@A3

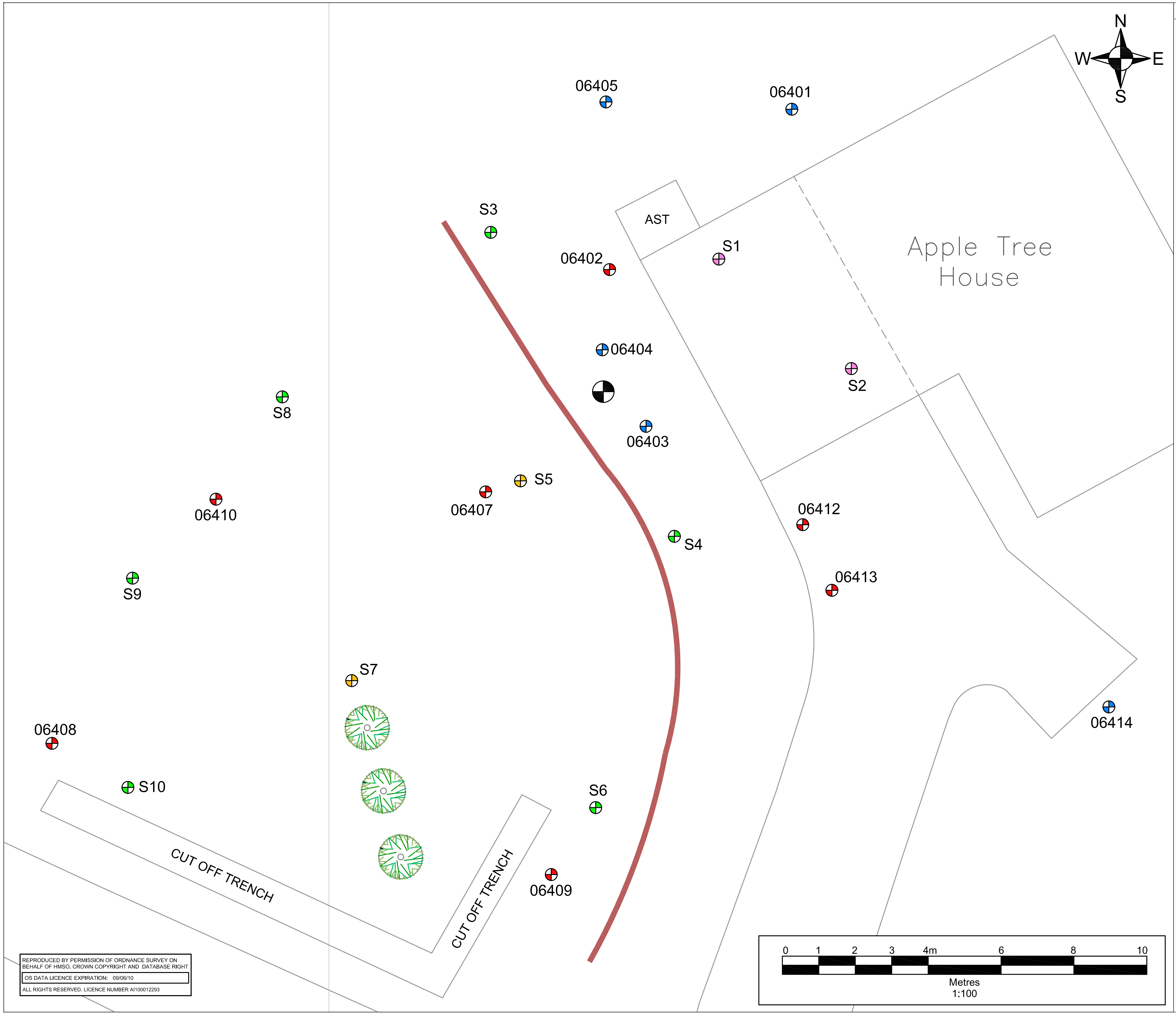
Date
DECEMBER 2009

Chk'd By
LW

Drawing Number
1

Revision
0

FINAL



LEGEND

⊕	ESi SLR BOREHOLE LOCATION 2008 (NOT INSTALLED)
⊕	ESi BOREHOLE LOCATION 2008 (50mm MONITORING WELL)
◐	FORMER DOMESTIC WATER SUPPLY WELL
⊕	SLR BOREHOLE LOCATION 2009 (NOT INSTALLED)
⊕	SLR BOREHOLE LOCATION 2009 (19mm GAS WELL)
⊕	SLR BOREHOLE LOCATION 2009 (38mm MONITORING WELL)
✳	DEAD CONIFER TREE
AST	FORMER ABOVE GROUND STORAGE TANK (KEROSENE)
▬	EDGE OF RAISED BED

Revision	By	Chk'd By	Date	Comments

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Project
PART IIA REMEDIATION REPORT

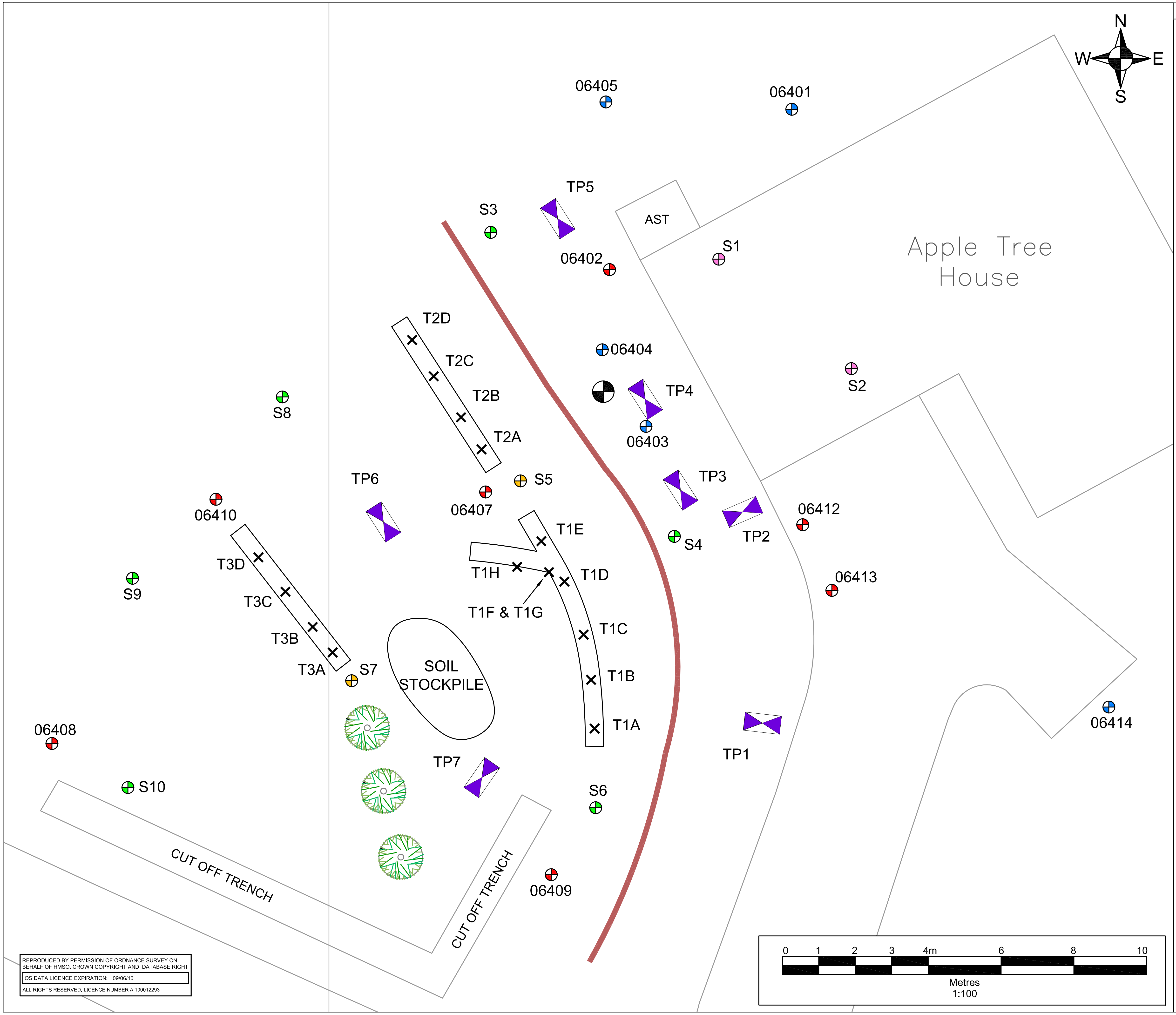
Drawing Title
ESI & SLR BOREHOLE LOCATIONS MAY 2009

Project File Reference 2664.00001.04.02.0	Drawn By BF

Scale 1:100@A3	Date DECEMBER 2009	Chk'd By LW

Drawing Number 2	Revision 0

FINAL



LEGEND

⊕	ESi SLR BOREHOLE LOCATION 2008 (NOT INSTALLED)
⊕	ESi BOREHOLE LOCATION 2008 (50mm MONITORING WELL)
◐	FORMER DOMESTIC WATER SUPPLY WELL
⊕	SLR BOREHOLE LOCATION 2009 (NOT INSTALLED)
⊕	SLR BOREHOLE LOCATION 2009 (19mm GAS WELL)
⊕	SLR BOREHOLE LOCATION 2009 (38mm MONITORING WELL)
✳	DEAD CONIFER TREE
AST	FORMER ABOVE GROUND STORAGE TANK (KEROSENE)
⋈	SLR TRIAL PIT 2009
✕	SLR INSPECTION TRENCH SAMPLING LOCATION
▬	EDGE OF RAISED BED

Revision	By	Chk'd By	Date	Comments

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APPLE TREE HOUSE

Project
PART IIA REMEDIATION REPORT

Drawing Title
TRIAL PIT, TRIAL TRENCH AND BOREHOLE LOCATIONS

Project File Reference 2664.00001.04.03.0	Drawn By BF

Scale 1:100@A3	Date DECEMBER 2009	Chk'd By LW

Drawing Number 3	Revision 0

FINAL

LAND QUALITY AND REGENERATION GROUP

STANDARD OPERATING PROCEDURE
FOR:
DRILLING SUPERVISION

SOP Number: 2.5	Version Number: 1
TDM Signature:	Issue Date: July 2007

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) has been developed by SLR’s Land Quality & Regeneration Group and provides specific guidance on how drilling supervision is to be managed, completed and reported within the Quality Assurance system operated by SLR.

2.0 QUALITY ASSURANCE

SLR operates a Quality Assurance (QA) system and this specific SOP has been developed in accordance with this system.

Responsibility for the correct implementation of this SOP rests with all members of the Group whose work falls within the scope of the document.

Members of staff will receive training appropriate to the SOP. Individual training records are subject to a separate SOP (1.6).

Implementation of this SOP is from the date stated above. The correct version of the document is posted on the company Intranet within the Land Quality & Regeneration Group’s Standard Operating Procedures area.

Where a requirement to revise the document becomes evident due to, for example, revised statutory guidance, new equipment, amended technical procedure, etc, this is to be notified to the Technical Discipline Manager in writing (i.e. memo or email) who will designate an appropriate member of staff to make the necessary amendments.

Revision of this SOP can only be undertaken following the approval of the Technical Discipline Manager and he/she must sign to confirm the revised procedure is in use from the date stated.

3.0 TECHNICAL PROCEDURES

REQUIRED EQUIPMENT:

Work Instruction or similar (Ref. SOP 1.9)
Proposed borehole location plan
Barriers / cones / hazard tape for cordoning works area (if required) (Ref. SOP 2.1)
Safety equipment (PPE/RPE) as appropriate (Ref. SOP 2.1)
Appropriate sampling equipment (Ref. SOP 2.8 and 2.9)
5m steel retractable tape measure
30m or 50m fibre tape measure
Groundwater dip meter and/or interface probe
Camera

3.1 Background

The drilling of boreholes will usually be undertaken to:

- Investigate deeper strata;
- Investigate locations where space is restricted (or on operational sites) to minimise impact on the site;
- Install gas/groundwater monitoring wells.

The boreholes will be drilled with a drilling rig, typically operated by a one or two man crew, together with associated ancillary equipment (e.g. water bowsers, compressors etc). Various methods of drilling are available and those most commonly used include:

- Window (or windowless) sampling / dynamic probing.
- Cable percussion (shell and auger).
- Rotary solid stem auger.
- Rotary hollow stem auger.
- Rotary open-hole.
- Rotary coring.

This Standard Operating Procedure relates to the supervision of drilling works as part of ground investigations.

All siteworks shall be conducted according to the Company Health & Safety Policy and the site-specific Health & Safety Plan (SOP 2.1).

3.2 Procedure for Supervision of Drilling Contractors

1. Arrange an area of the site where equipment can be stored.

2. Arrange an area for cleaning equipment where the run-off will not pose a problem to site activities, or establish run-off containment measures as appropriate.

3. Brief the drilling crew on health and safety requirements, the possible contaminants present, exposure risks and safety precautions to be taken. Issue the drilling crew with the project Health and Safety plan and ensure that it is read and signed for.

4. Check that special measures to be adopted by the drilling crew (e.g. as identified in the Health & Safety plan) are in place.

5. Check the equipment that has been supplied against that which has been ordered and arrange for the delivery of any missing equipment, or the replacement of any incorrect or faulty equipment. Pay particular attention to drilling equipment diameters, sufficiency of well construction materials, and safety equipment. **NB** – check the length of the driller's tape measure and/or dip meter (i.e. the one to be used to measure the hole depth); if it has been shortened due to damage ensure that this is taken account of during measurements. If drilling spoil requires off site disposal, arrangements should be made for safe temporary storage on site and for its eventual disposal.

6. Discuss the work required with the drilling crew with particular regard to sample integrity, procedures to avoid cross contamination and work timescales. It is essential that the working day is established at the procurement stage. It is reasonable to expect that the drilling day will consist of eight hours, particularly if we are paying on a day rate basis. Be aware that when drillers are waiting for instruction and are being paid on a metreage basis, there may be a claim for standing time that might not be recoverable from the client.

7. Check all proposed boring locations with the relevant site personnel and check against site service plans, service trace plans and for visual signs of underground services.

8. Check all proposed locations for adequate height clearance, working area and access with the driller. When using rotary drilling techniques, a larger working area will be required.

9. Survey all locations with a cable avoidance tool or other radio detection equipment to confirm that the proposed locations are free of cables or pipes (SOP 2.4).

10. Relocate if the location is unacceptable and follow steps 7 to 9 for the new location.

11. Photograph the location to be drilled. If drilling in a sensitive location, such as adjacent to private property, close to parked vehicles etc, photograph the surrounding area so that future claims for potential damage can be assessed. Make a note of any existing damage to nearby property, such as unstable/damaged property boundaries, dented vehicles etc and photograph these features.

12. Ensure that all safety barriers are erected, together with any screens required in order to prevent drilling flush or flying material impacting nearby areas.

13. Core or break out the concrete at each location using a concrete corer or concrete breaker and compressor. If sparks or dust could be a hazard, use clean water to damp down the work and wear dust masks if appropriate. Once the concrete is broken out, an inspection pit should be hand dug as required in accordance with SOP 2.4. Ensure this is done by the drilling crew before the concrete breaking / coring equipment is off hired or removed from the site, in case of further obstructions.

14. Ensure boring equipment that might affect sampling is acceptably clean for the work to be undertaken. If it is not, instruct the drilling crew to clean the equipment at the designated location.

15. Set up the rig at the first location. If the site is operational, or uncontained spoil is unacceptable, cover the area around the location in tarpaulin or thick plastic sheeting. Where plastic sheeting is used care should be exercised in the working area as this can become very slippery. As a precautionary measure, plywood boards can be laid on the sheeting. If much water is generated during drilling then sand bags or similar should be used to create a temporary bund. Water may also be controlled by turning to 'solid' waste by mixing with soil arisings, or clean material such as sand. The Project Manager should identify such measures in the specification. This will effectively make clean up at each location easier. However, this may be impractical with rotary drilling techniques and consideration should be given to cleaning up afterwards.

16. Allocate a unique identification code to the location (e.g. BH1 – NB: liaise with the Project Manager on this point as previous investigations may have taken place on the site and duplication of borehole identification numbers can cause confusion during future reporting) and give this to the driller. The driller should be provided with a formal instruction detailing sampling intervals, hole identification, final depth and other specific information. Where all the holes are to be carried out in a similar manner, one instruction is sufficient. Ideally, the instruction should be written.

17. Initiate boring. Log the spoil arising from the hole in accordance with BS5930:1999.

18. If any unusual layers or odours are encountered, work should be temporarily suspended until any additional samples have been taken and the odours have been verified as not posing a fire or health hazard.

19. Take soil samples at the relevant depths. The method of sampling will depend on the drilling technique used and the soil conditions. Sampling should be undertaken in accordance with SOP 2.8.

20. With some drilling techniques, such as cable percussion, it may be necessary to add water to a borehole in order to bore through dry cohesion less strata. Ensure that the amount of water added during boring is kept to a minimum and record the approximate volume used. Ensure that any water added is clean water.

21. The borehole may need to be cased to prevent its collapse, normally when cohesion less strata or groundwater is encountered, or to prevent cross contamination between strata. If possible no lubricating oil should be added to the threads, but if lubrication is required the use of vegetable oil or 'eco friendly' washing up liquid should be considered, as these will not affect subsequent hydrocarbon analysis.

22. If permeability tests are required, follow the SOP 2.12.

23. Use a second casing if boring through contaminated surface horizons and an aquitard, into permeable lower horizons. The job specification and instructions from the Project Manager will identify where there are requirements to carry out aquifer protection, or where there is a risk that an aquitard may be breached.

24. Continue boring until the desired depth is reached. If monitoring installations are required then follow SOP 2.6, otherwise backfill the borehole either with arisings, clean imported material, cement/bentonite grout or as specified by the Project Manager.

25. The installation design should be provided to the drillers as a formal (preferably written) instruction. Diagrammatic instructions showing the required depths for the base of the well pipe, the filter material, the length of slotted section of the well pipe, the location of the bentonite seals and the surface completions should be provided. Refer to SOP 2.6.

26. The Field Engineer should monitor the assembly and insertion of the instrument into the borehole to ensure that instructions are followed. Installations of wells in deep holes can be difficult and any problems should be discussed with the driller prior to installation. The anticipated well design will be dependent upon the requirements of each job and will be instructed by the Project Manager.

27. On completion of the well installation or backfill, the working area should be cleared of all rubbish and spoil and left in a clean and safe condition. Where reinstatement cannot be performed immediately after completion of the borehole then the working area should be made safe appropriate to the circumstances at the location, e.g. barriers, cones or warning tape may need to be erected around the hole until reinstatement can be effected.

28. It is the responsibility of the Field Engineer to approve the reinstatement carried out by the contractor. The reinstated borehole location should be photographed. As indicated in point 11 above, sensitive surrounding property should again be photographed upon completion of the works to demonstrate that no damage has been caused.

29. Prior to demobilisation of the drilling contractors from site, the engineer shall ensure that all reinstatements are satisfactory and that all records have been provided by the contractor.

30. It is a requirement that each drilling crew provides a copy of their daily journal. Part 7 of BS5930:1999 presents a description of information that should be provided. Sheets should be obtained on site at the start of each day. They should be signed as ‘received’.

31. These journals contain both technical and contractual information and comments should be noted. If it is the opinion of the Field Engineer that the comments are inappropriate, they should be annotated as such. The Field Engineer in charge of the siteworks is responsible for confirming the final cost of the works (the measure). This is a record of the work carried out by the drilling contractor and is generally based on the daily journal and any other relevant correspondence. Items shall be measured in accordance with the items in the Bill of Quantities or the rates in the drilling contractors offer as accepted by SLR. Small jobs may not warrant production of an actual measure, but just require checking of invoices.

It should be noted that there has been a trend over recent years for drilling contractors to be paid on a daily rate, rather than on ‘metreage’ rates. In this case, any delays or slow working have a significant impact upon the cost of the works and, in the case of lump sum projects, impact the costs to SLR as additional costs may not be passed on to our clients. Therefore, it is the Field Engineer's responsibility to ensure that the works proceed appropriately. If, in the opinion of the Field Engineer, there are unacceptable delays to the works, e.g. through the drilling contractor not providing the necessary equipment at the start of the works or through the behaviour of the drilling crew, these should be brought to the attention of the Project Manager immediately so that appropriate action may be taken to rectify the situation.

Remember – The drilling contractor has been employed to do a job at agreed rates. Therefore, it is the contractor's responsibility to carry out the work for which they are being paid. It is not SLR staff responsibility to spend time making arrangements on behalf of the contractor, such as ordering materials or equipment which have been overlooked.

3.3 Supervision of Drilling Contractors with Qualified Supervision Provided by the Contractor

Although the principle is similar, there are slight differences in day to day site management when qualified supervision is provided by the contractors. When the contractor provides a level of supervision at the site then all correspondence and instruction should be passed via the contractors 'Site Agent'. Verbal instructions and other discussions shall be backed up with a written instruction and/or comments. The Field Engineer shall exercise discretion so as to avoid unnecessary paperwork; however all issues that have a cost implication shall be confirmed in writing. Breaches of Health & Safety and technical issues shall be raised in writing. Instructions that are given directly to drilling crews should be restricted to sampling where the Field Engineer is in attendance at a rig. The ground rules for direct instruction to the contractors labour or other operatives should be established with the 'Site Agent' at the start of the works. On large contracts, in terms of time and value, it is the Field Engineer's responsibility to review the Measure during the site work and wherever possible to agree the Measure on site. All items that can be agreed should be confirmed in writing. All contentious items that cannot be agreed at site level shall be referred to the Project Manager. It is essential that items of work that may generate claims by the contractor and/or that are being incorrectly measured are identified at an early stage.

3.4 Records

All work records shall be **legibly** recorded in a field notebook or on a standard field worksheet. The data recorded should include:

- **Times** (A detailed breakdown of the day, including – arrival of yourself, drilling crew, visitors etc, breaks, standing time for H&S induction courses, difficult moves etc, drilling operations for each location, completion of work)
- **Information Exchange** (e.g. what information was given to the drilling crew on H&S, information received from the client, drilling crew or visitor, names of drillers and any visitors)
- **Drilling Details** (surface cover and strata descriptions [to BS5930], thicknesses and depths, groundwater strikes, results of field tests, unusual appearances or odours, depth and diameter of borings, ease of drilling, drilling plant used, details of monitoring well installations, quality and cleanliness/tidiness of reinstatement)
- **Problems** (a log of any problems that arose and how they were overcome – also include a record of who said what)

The actual as-drilled location of each borehole shall be recorded on a copy of the site plan.

Upon return to the office, the field notebook and as-drilled borehole location plan should be scanned and a pdf copy saved to the project file on the server. The formal logs should then be written up as soon as possible, preferably by the Field Engineer that carried out the fieldwork in accordance with SOP 3.1.

The digital photographs should also be downloaded to the project file on the server.

References & Guidance Documents

British Standard Institute (BSI), BS 5930:1999 Code of Practice for Site Investigations.

LAND QUALITY AND REGENERATION GROUP

STANDARD OPERATING PROCEDURE
FOR:
GROUNDWATER MONITORING & SAMPLING

SOP Number: 2.9 Version Number: 1
TDM Signature: Issue Date: July 2007

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) has been developed by SLR's Land Quality & Regeneration Group and provides specific guidance on how groundwater monitoring and sampling is to be managed, completed and reported within the Quality Assurance system operated by SLR.

2.0 QUALITY ASSURANCE

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3.0 TECHNICAL PROCEDURES

3.1 Groundwater Monitoring

REQUIRED EQUIPMENT:

Work Instruction or similar (Ref. SOP 1.9)
Investigation plan
Barriers / cones / hazard tape for cordoning works area (if required) (Ref. SOP 2.1)
Safety equipment (PPE/RPE) as appropriate (Ref. SOP 2.1)
Tools for opening well (screwdriver / allen keys / socket and ratchet set);
Dipmeter or interface probe;
Pid or pellister for well vapours;
Clear bailer for product check;
Paper towels and clean water or Decon 90 spray for decontamination

Procedure:

1. Isolate / make safe well or sampling location.
2. Open well cover.
3. Remove well cap / open gas tap and record well headspace vapours.
4. Record depth to product / depth to water / depth to base of well against measuring datum (usually top of casing (toc), cover level and/or ground level). Identify measuring datum on notes. If datum not ground level, record stick up / bgl difference.
5. When dipping product thickness, measure level of first product indication, lower probe through into water beneath by about 1 meter, then wind dipmeter back up carefully to verify depth of base of product / water interface.
6. If product is recorded, verify thickness using clear bailer for visual check.

In general, the wells should be monitored in a specified order, starting with the cleanest wells, and ending with the most contaminated wells. This reduces the likelihood of cross contamination between wells.

A template site monitoring sheet is attached, an electronic copy of this should be completed and saved in the job file on return to the office.

3.1.1 Decontamination

A clean wetted (water or Decon 90) paper towel should be wrapped and held around the dipmeter tape at ground level, and the dipmeter should then be wound back up through the paper towel to clean the dipmeter tape of silts and product.

The dipmeter probe should be sprayed with clean water or Decon 90 and wiped with a clean paper towel between boreholes.

Template Site Monitoring Sheets (Blank versions in xL):

Groundwater Monitoring Sheet 2.9.1

3.2 Groundwater Sampling

SLR's standard approach to groundwater sampling from monitoring wells and boreholes comprises two simple techniques:

- Standard sampling using dedicated disposable bailers;
- Low flow sampling.

The choice of sampling technique will be dependent on the desired sample quality, and project budget. Generally we would expect to carry out standard sampling on initial investigations, low sensitivity sites or simple liability assessments, and would utilise low flow sampling where the site is very sensitive or where DQRA will be carried out.

Standard sampling can typically cover up to 12 shallow wells per day, low flow sampling would typically cover between 4 to 7 wells per day.

If water sampling is required beneath product, either bail off as much product as possible before sampling, or, preferably, case through the product using narrower diameter well casing, and sample beneath product using low flow methods.

In line filters may be used for sampling for dissolved metals and inorganics. Filters should not be used when sampling for organics, PAHs and TPHs due to their high partitioning nature. If suspended solids in samples are an issue, low flow sampling should be used.

3.2.1 Standard Sampling with Bailers

REQUIRED EQUIPMENT:
Barriers / cones / hazard tape for cordoning works area (Ref. SOP 2.1)
Tools for opening well (screwdriver / allen keys / socket and ratchet set);
Clean factory sealed disposable bailer;
Polyethylene String;
Bucket;
Laboratory Glassware & Coolbox & Lab chain of custody.

This methodology assumes the wells have been suitably developed (see SOP 2.6).

Procedure:

1. Purge three well volumes to remove stagnant water from well, using new bailer.
2. Place purged water into bucket (noting purged volume and evidence of sheens & suspended solids).
3. Measure water level following purging, if well runs dry during purging, three purged volumes are probably not required. Leave well to recover sufficiently for sampling.
4. Insert bailer into well and collect water sample from the top of the water column.
5. Retrieve sample and transfer to sampling glassware, using sampling funnel supplied with bailer. For volatiles samples, transfer with minimal flow and disturbance to avoid volatilisation. Note presence of suspended solids. For dissolved metals, sample filtering can be used. Filtering must not be used for organics.

6. Record and label sample location, depth, project name & number & date. Complete appropriate chain of custody.

In some cases the bailer may be left in the well for reuse at the discretion of the project manager, particularly for clean wells. To do this, tie the bailer to the top of the well or cover, coil the excess string, and invert the bailer into the top of the casing above the water table. Fix the bailer in position using the well cap or bung. If the bailer is excessively impacted or stained, do not leave in the well for reuse.

Waste Water Disposal

Purged water should be disposed through the sites drainage system on petrol filling stations or industrial sites where oil interceptors are used. On sites with no managed drainage system, purged water should be returned to the well, or infiltrated back into the ground, but only where no visible contamination is present in the purged water and where no risk of water run off to the drainage system or a water course is possible. The Project Manager for the works should be consulted if there is any doubt on this issue.

If groundwater contains product or excessive impact expected, a plan for appropriate waste disposal procedures should be adopted, such as storing purged water in containers for offsite disposal at waste management facilities.

3.2.2 Low Flow Sampling

Low Flow sampling comprises two techniques depending on the groundwater depth:

- Shallow low flow sampling using peristaltic surface pumps (<8m depth);
- Deep low flow sampling using bladder or Waterra tubing & pumps (>8m depth);

The purpose of low flow sampling is to collect representative aquifer water from a discrete sampling depth within the well, without needing to purge the whole well volume. This method minimises disturbance of well sediment and allows for more accurate sampling of dissolved phase contaminants. Field readings for aquifer parameters such as temp, pH, conductivity and dissolved oxygen are used to determine when stabilised aquifer water is being sampled. Typically pump rates of between 100ml/min and 500ml/min should be used.

As the sampled aquifer water correlates to the depth of the inlet of the sampling tubing, determining the desired sample depth is important. This is usually just above the mid point between the water table and the base of the screened interval being targeted. However for wells with very large screened intervals below the water table (i.e >5m), the inlet should generally not be more than two metres below the water table.

When sampling for hydrocarbons in a source zone, the inlet should be set within 1m of the water table.

REQUIRED EQUIPMENT:
Barriers / cones / hazard tape for cordoning works area;
Tools for opening well (screwdriver / allen keys / socket and ratchet set);
Dipmeter or interface probe;

Shallow Sampling (<8m depth):

Peristaltic pump (12V)
Flexible tubing for pump mechanism (~ 40cm for each borehole to be sampled): 9.5mm silicone tubing from Waterra
Rigid sample tubing (sufficient to reach the above described sampling points plus extra to carry discharge from pump): 6mm low flow tubing from Waterra
Groundwater multi-meter with flow cell and calibration fluids
Sharp knife
Borehole logs or notes on screen depth and borehole depth
Timing Device
Bucket
Laboratory Glassware & Coolbox & Lab chain of custody.

Additional equipment for Deep Sampling (>8m depth):

Either:

Downhole air driven bladder pumps, compressor and air and water pipes; or
Narrow tube inertial foot valves and pipe (Waterra type) with waterra surface pump.

Procedure for Shallow Low flow using Peristaltic Pump:

1. Prior to any works, secure the area around the borehole using cones, barriers, vehicle, etc. so that it is safe to continue.
2. ON PETROL STATIONS OR SIMILAR: Turn on the Pellister. The peristaltic pump (PP) can only be used if the LEL <1% . Continuously monitor for explosive vapours throughout operations in Zone 2. No working in Zone 1/0. **Should the LEL exceed this level, the pump must be turned off immediately**.
3. Open the cover and dip the well as per the SOP for water monitoring
4. Determine the length of tubing required to reach the desired sampling depth. Cut enough stiff tubing to reach from this depth to the pump.
5. Cut a length ~40cm of the flexible tubing. New tubing must be used for each well
6. Unscrew and remove the clear plastic cover and tube grip from the pump mechanism on the front of the Pump.
7. Feed the flexible tubing through the mechanism so that it extends from one inlet, around the curved edge of the mechanism and back through the second inlet, then fix the plastic cover and tube grip back into place
8. Cut enough sampling tubing (stiff) to reach from the sampling depth to the peristaltic pump (PP) and attach one end to the tubing running from the inlet of the PP mechanism (the upper inlet as you will set the pump to rotate left). New tubing must be used for each well
9. Attach the tubing from the outlet of the PP mechanism to the flow cell inlet with meters in place and from the flow cell outlet to discharge point (bucket /containers/surface drain, etc.)
10. Slowly lower the sampling tube into the water column until it reaches the desired depth; disturb the stagnant water above the sampling point as little as possible as this has a direct effect on purging times
11. Check all tubing is connected correctly, record the time and turn the PP on
12. Press the “Rotate left” button and then slowly increase the speed by pressing the “Speed up” button ~5 times

Measurement of Field Parameters:

13. Once water is passing through the flow cell, record the various parameters (pH, conductivity, redox, DO, turbidity) and the water level regularly (typically every 3 minutes)
14. The water level should not drop by more than 0.1m during the operation; draw down of between 0.05 and 0.1m should ensure reasonable purging times without affecting sample quality unduly. Very low permeability formations may result in excessive drawdown.
15. Once three consecutive readings within acceptable variance have been achieved, sampling can take place. The acceptable variances are:

    - pH +- 0.1
    - conductivity +- 3%
    - redox +- 10mv
    - turbidity +- 10%
    - DO +- 10%

16. Prior to sampling, the flow cell and water meter should be disconnected so that sampled water passes through well specific tubing only.
17. Once sampling is complete, remove tubing from the PP and the well and either dispose of it or store it on site for future use, making sure to note in which well it was used. Alternatively, leave the rigid tubing fixed in place in the well.

Waste Water Disposal

Low flow sampling should significantly reduce the volume of purged water to dispose. Typically volumes should be much less than a single bucket volume (10 to 15 litres). Protocols described previously in 3.2.1 apply for disposal.

Procedure for Deep Low Flow Sampling using Downhole pumps or Waterra Valves:

The procedure should follow the same approach as for the peristaltic pump detailed above, but amended to include the relevant equipment used.

Downhole Bladder Pump

This method uses a low flow downhole bladder pump powered by compressed air. The pump is inserted into the well to the required sampling depth and connected up and operated per the specific equipment instructions. Van Walt rent a complete pump and compressor unit on a weekly basis for about £250 per week. Measurement of field parameters and sample collection follows the procedure as per the peristaltic pump method.

Waterra Foot Valve & Pump

This method uses the standard Waterra tubes and valves, combined with the Waterra surface pump, available from the Farnborough office. The smallest low flow tubes and vales should be used to ensure low flow rates and minimising disturbance. The tube valve should not be placed in the base of the well as normal, but placed at the required sampling interval as stated above. The clamps on the surface pump will hold the tubing at the desired depth. Measurement of field parameters and sample collection follows the procedure as per the peristaltic pump method.

Waste Water Disposal

Low flow sampling should significantly reduce the volume of purged water to dispose. Typically volumes should be much less than a single bucket volume (10 to 15 litres).

References & Guidance Documents

USEPA, 1996. Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, EPA/540/S-95/504

BS 10175:2001. Investigation of potentially contaminated sites - Code of practice

ISO/DIS 5667-18, Water quality – Sampling - Part 18: Guidance on the sampling of groundwater of contaminated sites, 2001

EA 2000, Technical Aspects of Site Investigation. Vol I and II. Overview and Text Supplements. R&D Technical Report P5-065/TR

American Society for Testing and Materials (ASTM). "Standard Practice for Low Flow Purging and Sampling for Wells and Devices Used for Ground Water Quality Investigations", ASTM D-6771-02, January 2002

LAND QUALITY AND REGENERATION GROUP

STANDARD OPERATING PROCEDURE
FOR:
SAMPLING POTENTIALLY CONTAMINATED SOIL FOR LABORATORY ANALYSIS

SOP Number: 2.8	Version Number: 1.0
TDM Signature:	Issue Date: July 2007

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) has been developed by SLR's Land Quality & Regeneration Group and provides specific guidance on how sampling potentially contaminated soil for laboratory analysis is to be managed, completed and reported within the Quality Assurance system operated by SLR.

Soil sampling will be undertaken as part of site investigation and remediation projects and related SOPs are:

2.5	Drilling Supervision
2.7	Trial Pitting
2.5	Drilling Supervision
2.15	Waste or Stockpile Sampling

2.0 QUALITY ASSURANCE

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Implementation of this SOP is from the date stated above. The correct version of the document is posted on the company Intranet within the Land Quality & Regeneration Group's Standard Operating Procedures area.

Where a requirement to revise the document becomes evident due to, for example, revised statutory guidance, new equipment, amended technical procedure, etc, then this is to be notified to the Technical Discipline Manager in writing (i.e. memo or email) who will designate an appropriate member of staff to make the necessary amendments.

Revision of this SOP can only be undertaken following the approval of the Technical Discipline Manager and he/she must sign to confirm the revised procedure is in use from the date stated.

3.0 HEALTH AND SAFETY

The H&S requirements are outlined in Generic Risk Assessments (RA) for Site Investigations and SOP 2.1. Where determined necessary by the Project Manager and TDM, Project Specific RA will be incorporated into Site Health & Safety Plans (HASPs).

4.0 EQUIPMENT REQUIREMENTS

- Work Instruction or similar (Ref. SOP 1.9)
- Proposed trial pit or borehole location plan
- PPE - safety boots, overalls, disposable gloves, hard hat, disposable gloves, and where necessary disposable Tyvek overalls (Ref. SOP 2.1).
- Tools – stainless steel trowel and / or shovel
- Sampling Containers – glass jars, plastic tubs (laboratory specified and supplied)
- Shipping Containers – e.g. cool box with ice packs (laboratory supplied)
- Marker pen, labels (where jars/tubs not pre-labelled), Chain of Custody Forms (CoC).
- Address label for receiving laboratory, packaging material and parcel tape.

5.0 TECHNICAL PROCEDURES

Review HASP and where necessary include site specific controls for hazardous substances that are anticipated to be present. Ensure appropriate soil sample containers are obtained in advance from the external testing house (that will provide suitable containers for the proposed analyses).

Don PPE and sample soil from borehole, trial pit, stockpile or remedial excavation using a sampling tool or directly (by scooping) into the respective jar / tub. The tub or jar should be immediately sealed to prevent loss or volatiles or deterioration of the sample. Sampling tools should be cleaned and decontaminated between each sample. Disposable gloves changed where required to avoid cross contamination.

The location and frequency of samples should be as detailed in the project Work Instruction.

Samples should be selected so as to be representative of the soil mass as a whole at the specified sampling depth and location and include all grain sizes (fine to coarse). Containers should be filled so as to avoid head space and voids.

Waste or stockpile sampling should in accordance with the appropriate SOP and undertaken to ensure representative weathered or exposed surface materials are not sampled but material from the bulk mass within the stored material.

Field head space screening samples should not be used for laboratory analysis but a separate duplicate selected at the time of sampling (see SOP 2.12).

Label each sample container to identify the date collected, location, depth, project name and number.

Place the samples in a shipping container (e.g. cool box) with an ice pack(s) and surrounded with packaging material to prevent breakages. Ensure ice pack is located centrally in container to ensure a low temperature is maintained. Complete CoC, top copy is placed in shipping container, bottom copy retained by SLR in Project file. Seal shipping container and secure address label for onward transportation to the external laboratory in accordance with the project Start Up Notes.

LAND QUALITY AND REGENERATION GROUP

STANDARD OPERATING PROCEDURE
FOR:
SOIL VAPOUR SAMPLING

SOP Number: 2.11	Version Number: 1
TDM Signature:	Issue Date: August 2007

1.0 INTRODUCTION

This Standard Operating Procedure (SOP) has been developed by SLR's Land Quality & Regeneration Group and provides specific guidance on how Soil Vapour Sampling is to be managed, completed and reported within the Quality Assurance system operated by SLR.

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3.0 TECHNICAL PROCEDURES

REQUIRED EQUIPMENT:

Barriers / cones / hazard tape for cordoning works area
Tools for opening well (screwdriver / allen keys / socket and ratchet set)
Tools for tightening fittings (adjustable spanners / wrenches)
Selection of swagelock fittings, hoses, and tubing to fit ¼” NPT
Vacuum gauge with swagelock fittings (¼” NPT)
60ml or 100ml syringe with swagelock fittings (¼” NPT)
GA 2000 with flowpod
Wind speed / temperature and atmospheric pressure monitor
SKC sidekick pumps and drycal flowmeter
Sorption tubes (ordered and specified from laboratory in advance)
Paper towels and clean water spray for decontamination

3.1 Vacuum Test

Prior to the start of sampling a series of vacuum tests should be performed on each sampling well to determine the integrity of the gas tap and well.

3.1.1 Sampling Apparatus Test

Check the gas tap to ensure the tap is fully threaded in and that an air tight seal is present. Connect a vacuum gauge in line with the sampling tube, connect a syringe to one end of the tube, the other end is inserted into the well gas tap. With the gas tap in the closed position, pull the syringe plunger back to max position and lock in place, and record the vacuum within the line. Leave the syringe in place for 5 minutes. The vacuum in the line should be maintained and not decrease with time. If the vacuum pressure falls, this indicates that there is a leak within the sampling apparatus and this should be replaced and the test repeated. If the vacuum is maintained, proceed with the sampling process.

3.1.2 Feasibility Test

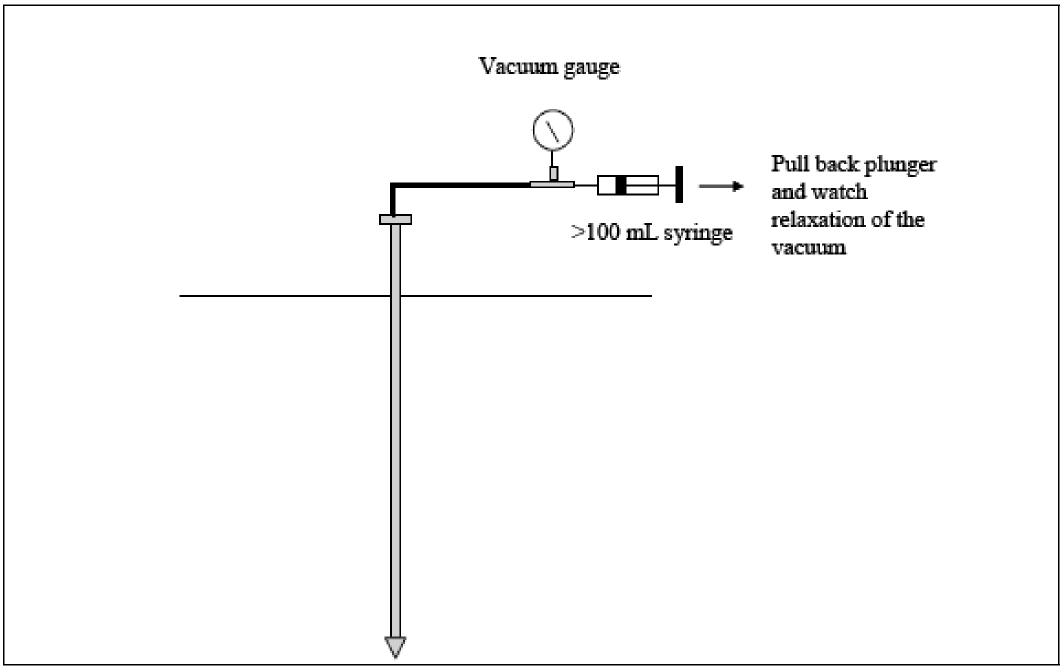
This is a qualitative test is to determine that soil gas sampling is possible at the site.

Connect a vacuum gauge in line with the sampling tube, connect a syringe to one end of tube, the other end is inserted into the well gas tap. Pull the syringe plunger back to max position, and extract sufficient vapour to exceed the internal dead volume within the well, monitor and record the vacuum created, followed by its relaxation. If plunger does not return within a few minutes to an hour, soil gas sampling is not possible due to extremely low air permeability of the soil – this is more likely in cohesive soils such as clay.

If no vacuum can be maintained, this indicates that there is a good flow of vapour from the ground to the well, and sampling will be effective.

An example of this test is illustrated in Drawing 1.

Drawing 1: Example test apparatus to determine if soil vapour sampling is practicable (After API, 2005)



3.2 Ground Gas Monitoring

Prior to soil vapour sampling, each gas well will be monitored using A GA 2000 infra red gas analyser for concentrations of oxygen, carbon dioxide and methane. Soil to air gas flow rates will also be measured using a flow pod.

Additionally, the atmospheric pressure, wind speed and air temperature will also be monitored during each sampling visit to allow for atmospheric variations.

Summary of Gas Monitoring data:

- Oxygen concentration;
- Carbon dioxide concentration;
- Methane concentration;
- Gas flow rate;
- Atmospheric pressure;
- Wind speed;
- Air temperature.

A site sampling sheet is attached.

3.3 Well Purging

According to the API soil vapour sampling procedure, purge volumes are generally between one and five well volumes, with the number of dead volumes purged may be based on a fixed value (e.g., three dead volumes), or other procedures such as conducting a purged volume test to determine the number of dead volumes to remove that corresponds to the highest recovered vapour concentrations.

The standard approach is to base the initial purging on three well volumes, and to vary this during subsequent sampling visits if required.

Once purging is completed the sampling can be performed. The purge volume should also take into account the extracted volumes during the vacuum tests.

The required purging volume is calculated from the equation π r^2 x well length x 3. A summary of example well details, dead volumes and required purge volumes, is summarised in the Table below. This data should be recorded on site using the attached site sampling sheet.

Example well record / purge volumes

Well	**Well Diameter (m)**	**Well Length (m)**	**Well Volume (m3)**	**Well Volume (Litres)**	**Purge Volume (L) – x 3 well vol.**
SG1A	0.019	1.55	0.0004395	0.439	1.32
SG2A	0.019	1.50	0.0004253	0.425	1.276
SG3	0.019	1.60	0.0004536	0.453	1.36
SG4	0.019	1.55	0.0004395	0.439	1.32

3.4 Leak Testing

A leak tracer can be utilised during further sampling visits through the use of an artificial tracer such as butane or isobutane. If the tracer compound is recorded in the sample analysis, then the sampling equipment is indicated to be leaky and the results possibly invalid. The suggested method for this is the use of a canister based shaving foam applied to the inside of the well head or shroud box at the top of the borehole after connection of the gas tubing. Shaving foams commonly contain propellants of butane and isobutane, or perfumes such as limonene and pinene which can be targeted during lab analysis to determine whether surface leakage has occurred.

3.5 Vapour Sampling

Sampling rates should not exceed 1litre per minute, and should not induce vacuums in excess of 136 inches of water (338.6mbar) as recommended by California Department of Toxic Substance Control (DTSC) soil gas guidance. Ideally a vacuum of 25mb should be maintained. The induced vacuum on the in line gauge during the sampling event will be recorded.

SLRs proposed sampling rate is 100ml/min or less based on recommendations in US guidance. Each sample will be collected for a set period of time, based either on the required detection limit for cleaner sites, or the level of expected hydrocarbon vapour, in order to prevent saturation of the Tenax tubes. This is usually a judgement based decision following observations and results obtained from previous sampling events, and should be agreed before attending site. If very high concentrations are expected two tubes connected in series should be used, so if the first tube becomes over saturated, the second tube can be analysed to quantify the additional vapour.

This information should be recorded on the site sampling sheet.

3.5.1 Sampling Procedure

The sampling pipework will be connected to the gas tap on the well, using ¼" swagelock fittings with an inline vacuum gauge to the vacuum sampling pump. All connections will be sealed with external PTFE tape or gas tight Swagelok fittings to ensure gas tight connections.

Following connection and sealing of the sampling tubing on each well head the pumps switched on, and the shaving foam tracer will be applied to the top of the well, and the sampling event will then proceed. Care should be taken to ensure cross contamination does not occur through handling the sampling tubes after handling the foam. To avoid this, gloves should be used and changed between sample locations, and all clothing and hands wiped clean of shaving foam using a dry paper or cloth towel.

Ideally all sample tubes should be connected up to the sampling pipework and sampling commenced before the foam is applied.

3.6 Quality Assurance

Sampling blanks are a required quality control element for VOC sampling and analysis. This provides a guarantee that primary samples are not contaminated during transportation. A sampling blank is a TENAX tube taken from the laboratory to the sampling site and returned to the laboratory, which is opened on site for a brief time to replicate the opening and sealing of the actual sampling tubes on site. This is particularly relevant where background vapour exposures are expected, such as in urban or roadside areas.

A trip blank can also be used, which is the same as the sampling blank but is not opened at all, and is used to verify lab and storage procedures.

The following quality assurance procedures will ensure an accurate sampling result:

1. Use of suitable qualified sampling personnel;
2. Replacement of disposable gloves and cleaning of hands using dry paper towels between sampling locations;
3. Use of calibrated equipment, serviced in accordance with the appropriate schedule;
4. Appropriate storage of sample tubes, inclusive of minimal time period between tube receipt, use and despatch;
5. Use of a sampling blank for each sampling visit; and
6. Formalised labelling and documentation.

On sensitive sites, a trip blank and a sampling blank should be included in the sampling scope. Both of these tubes are analysed, so an allowance for two additional samples should be made.

3.6.1 Transport

The tubes themselves are sealed with ¼ NPT Swagelok fittings. Individually labelled tubes are despatched to the appropriate laboratory for analysis in a standard container, in accordance with standard laboratory instruction for this tube type.

The use of a trip blank will provide assurance that the transport of samples has not resulted in contamination.

3.6.2 Analytical Technique

Analysis for Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX) and banded Total Petroleum Hydrocarbons (TPH) is undertaken using Gas Chromatography/Mass Spectrometry (GCMS).

Results are reported the form of a VOC Diffusion Analysis Report in bands of BTEX, C4-C6 Hydrocarbons, C7-C8 Hydrocarbons, C9-C10 Hydrocarbons, C11-C12 Hydrocarbons and C13-C16 Hydrocarbons, with individual hydrocarbons speciated. Units used are ng on tube, and µg/m3.

3.6.3 Laboratory

SLR currently use the Gradko International Laboratory, where analysis is undertaken in accordance with their Laboratory Quality Management System. This laboratory holds UKAS Accreditation for Analysis Methods for VOC (C2-C28 quantitative and Semi-Quantitative).

Template Site Sampling Sheets (Blank versions in xL):

Soil Vapour Sampling Sheet 1: Ground Gas Sheet

Soil Vapour Sampling Sheet 2: Vapour Sampling Sheet

References & Guidance Documents

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Hartman, B. 2002. “2002. “How to Collect Reliable Soil-Gas Data for Risk-Based Applications, Part 1: Active Soil-Gas Method.” LUST Line Bulletin 42. October.

American Petroleum Institute, 2005. “Collecting and Interpreting Soil Gas Samples from the Vadose Zone” Publication No. 4741. November.

USEPA, 1999. “Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Compendium Method TO-17, Determination of Volatile Organic Compounds in Ambient Air Using Active Sampling Onto Sorbent Tubes”. Second Edition EPA/625/R-96/010b.

HSE, 2000 “Volatile Organic Compounds in Air “(4) MDHS96 HSE Books March 2000.

California Regional Water Quality Control Board – Los Angeles Region (CRWQCB) and the Department of Toxic Substances Control (DTSC). 2003. “Advisory – Active Soil Investigations.*”* January.

USEPA. 2002a. OSWER Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*.* November 29.
http://www.epa.gov/epaoswer/hazwaste/ca/eis/vapor.htm Draft.

BOREHOLE LOG

BOREHOLE No.
S1

Client:
MALVERN HILL DISTRICT COUNCIL

Project No: 404.2664.00001	Date: 12/05/09	Ground Level:	Co-ordinates:

Project:
APPLE TREE HOUSE

Sheet: 1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result	Water
0.30	HS	HS	0ppm	
0.50	HS	HS	110ppm	
0.70	HS	HS	10ppm	
0.70	JAR			
0.90	HS	HS	20ppm	
1.20	HS	HS	75ppm	
1.50	HS	HS	175ppm	
1.50	JAR			
1.75	JAR			
1.80	HS	HS	75ppm	

STRATA

Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
	░	0.10	CONCRETE	▨
	▩	(0.30) 0.40	Red and cream fine to coarse SAND with some fine to coarse subrounded to angular gravel of brick and concrete. (MADE GROUND)	■
	☰	(0.70) 1.10	Soft brown CLAY with rare fine angular gravel of assorted lithologies. Slight hydrocarbon odour.	■
	☰	(0.50) 1.60	Soft to firm blackish brown slightly sandy CLAY with some to much fine to coarse angular gravel of assorted lithologies. Slight hydrocarbon odour. 1.25 ... hydrocarbon odour becomes moderate.	■ ░
	☰	(0.40) 2.00	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE. Slight hydrocarbon odour. 1.80 ... drilling becomes hard going. Odour diminishes	■ ▩
			Borehole complete at 2.00m	

1
2
3

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

Hole drilled using hand-held, open hole windowless sampling techniques.

Hole installed with 19mm gas pipe with 1-2mm filter sand around slotted section.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

BOREHOLE LOG

BOREHOLE No.
S10

Client: **MALVERN HILL DISTRICT COUNCIL**			
Project No: 404.2664.00001	Date: 12/05/09	Ground Level:	Co-ordinates:
Project: **APPLE TREE HOUSE**			Sheet: 1 of 1

SAMPLES & TESTS					STRATA				
Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
						▨	(0.35) 0.35	Brown slightly sandy CLAY with abundant fine to coarse angular gravel of concrete, brick and assorted lithologies. (MADE GROUND) 0.20 - 0.40 ... feint hydrocarbon odour.	
0.30	HS	HS	5ppm						
0.30	JAR								
						☰	(0.65) 1.00	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE.	
0.60	HS	HS	5ppm						
0.60	JAR								
1.00	HS	HS	5ppm					Borehole complete at 1.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hole drilled using hand-held, open hole windowless sampling techniques. Hole backfilled with arisings.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

BOREHOLE LOG

BOREHOLE No.
S2

Client:
MALVERN HILL DISTRICT COUNCIL

Project No: 404.2664.00001	Date: 12/05/09	Ground Level:	Co-ordinates:

Project:
APPLE TREE HOUSE

Sheet: 1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result
0.20	HS	HS	10ppm
0.40	HS	HS	55ppm
0.60	HS	HS	210ppm
0.60	JAR		
1.00	HS	HS	125ppm
1.20-1.70	B		
1.30	HS	HS	150ppm
1.50	HS	HS	245ppm
1.50	JAR		
1.70	HS	HS	420ppm
1.90	HS	HS	240ppm
1.90	JAR		

STRATA

Water	Reduced Level	Legend (Thickness)	Depth	DESCRIPTION
			0.10	CONCRETE
		(0.20)	0.30	Red and cream fine to coarse SAND with some fine to coarse subrounded to angular gravel of brick and concrete. (MADE GROUND)
		(0.75)	1.05	Soft brown CLAY with rare fine angular gravel of assorted lithologies. Slight hydrocarbon odour.
		(0.65)	1.70	Soft to firm blackish brown slightly sandy CLAY with some to much fine to coarse angular gravel of assorted lithologies. Slight to moderate hydrocarbon odour. 1.55 ... becomes moist.
		(0.30)	2.00	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE. Slight hydrocarbon odour. 1.80 ... drilling becomes hard going.

Borehole complete at 2.00m

Instrument/ Backfill

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

Hole drilled using hand-held, open hole windowless sampling techniques.

Hole installed with 19mm gas pipe with 1-2mm filter sand around slotted section.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

BOREHOLE LOG

BOREHOLE No.
S3

Client: **MALVERN HILL DISTRICT COUNCIL**			
Project No: 404.2664.00001	Date: 12/05/09	Ground Level:	Co-ordinates:
Project: **APPLE TREE HOUSE**			Sheet: 1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result
0.40	HS	HS	15ppm
0.60	HS	HS	20ppm
0.90	HS	HS	35ppm
0.90	JAR		
1.20	HS	HS	0ppm
1.40	HS	HS	35ppm
1.40	JAR		
1.60	HS	HS	65ppm
1.60	JAR		
1.80	HS	HS	70ppm

Water

STRATA

Reduced Level	Legend (Thickness)	Depth	DESCRIPTION	Instrument/ Backfill
	▩	0.15	Brown, very sandy CLAY with occasional fine angular gravel of brick and concrete. (MADE GROUND)	
	▩	0.30	Red-brown sandy coarse angular GRAVEL of brick. (MADE GROUND)	
	▩	(0.25) 0.55	Brown medium to coarse SAND with some angular fine to medium angular gravel of brick and concrete. (MADE GROUND)	
	▩	0.70	Black coarse SAND of ash and coal. (MADE GROUND)	
	▩	(0.40) 1.10	Soft brown CLAY with rare fine angular gravel of assorted lithologies and rare brick and concrete. (MADE GROUND)	
	▤	(0.20) 1.30	Soft to firm blackish brown slightly sandy CLAY with some to much fine to coarse angular gravel of assorted lithologies. Slight hydrocarbon odour.	
	▤	(0.50) 1.80	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE. Slight hydrocarbon odour. 1.50 ... odour diminishes.	
			Borehole complete at 1.80m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	Hole drilled using hand-held, open hole windowless sampling techniques. Hole backfilled with arisings.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

Form SLR AGS3 UK BH File 090514 404.2664.00001 X APPLE TREE SHALLOW BH LOGS.GPJ 15-05-09

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

BOREHOLE LOG

BOREHOLE No.
S4

Client:
MALVERN HILL DISTRICT COUNCIL

Project No: 404.2664.00001	Date: 12/05/09	Ground Level:	Co-ordinates:

Project:
APPLE TREE HOUSE

Sheet: 1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result
0.25	HS	HS	0ppm
0.50	HS	HS	25ppm
0.75 0.75	HS JAR	HS	60ppm
1.20 1.20	HS JAR	HS	25ppm
1.50 1.50	HS JAR	HS	60ppm
1.80	HS	HS	50ppm

STRATA

Water	Reduced Level	Legend (Thickness)	Depth	DESCRIPTION	Instrument/ Backfill
		▨ (0.30)	0.30	Brown sandy CLAY with some fine to coarse angular gravel of concrete and brick. (MADE GROUND)	
		▨ (0.30)	0.60	Red-grey slightly clayey, sandy fine to coarse angular GRAVEL of brick, glass and concrete. (MADE GROUND)	
		▤ (0.40)	1.00	Soft brown CLAY with rare fine angular gravel of assorted lithologies.	
		▤ (0.20)	1.20	Soft to firm blackish brown slightly sandy CLAY with some to much fine to coarse angular gravel of assorted lithologies.	
		▤ (0.80)	2.00	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE. Slight hydrocarbon odour.	
				Borehole complete at 2.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

Hole drilled using hand-held, open hole windowless sampling techniques.

Hole backfilled with arisings.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

SLR Consulting Ltd., Brockhill Court, Brockhill Lane, Redditch, Worc, B97 6RB, Tel: 01527 597000, Fax: 01527 584408

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

BOREHOLE LOG

BOREHOLE No.	**S5**
Client:	**MALVERN HILL DISTRICT COUNCIL**
Project No:	404.2664.00001
Date:	12/05/09
Ground Level:	
Co-ordinates:	
Project:	**APPLE TREE HOUSE**
Sheet:	1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result
0.20	HS	HS	25ppm
0.20	JAR		
0.40	HS	HS	195ppm
0.40	JAR		
0.60	HS	HS	75ppm
0.60	JAR		
0.80	HS	HS	70ppm
0.80	JAR		
1.00	HS	HS	55ppm
1.50	HS	HS	30ppm
2.00	HS	HS	25ppm

Water: ▼ 1.00

STRATA

Reduced Level	Legend (Thickness)	Depth	DESCRIPTION
		0.05	Black CLAY with some fine to coarse angular gravel of brick and concrete. (MADE GROUND)
		(0.50) 0.55	Brown slightly sandy CLAY with abundant fine to coarse angular gravel of concrete, brick and assorted lithologies. (MADE GROUND) 0.30 - 0.65 ... slight to moderate hydrocarbon odour.
		(1.45) 2.00	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE. Slight hydrocarbon odour. 1.00 ... becomes wet.
			Borehole complete at 2.00m

Instrument/ Backfill

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

Hole drilled using hand-held, open hole windowless sampling techniques.

Hole installed with 38mm well pipe with 1-2mm filter sand around slotted section.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

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LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

BOREHOLE LOG

BOREHOLE No.
S6

Client: **MALVERN HILL DISTRICT COUNCIL**			
Project No: 404.2664.00001	Date: 12/05/09	Ground Level:	Co-ordinates:
Project: **APPLE TREE HOUSE**			Sheet: 1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result	Water
0.20	HS	HS	25ppm	
0.20	JAR			
0.50	HS	HS	110ppm	
0.50	JAR			
0.80	HS	HS	50ppm	1 ▼
0.80	JAR			
1.20	HS	HS	10ppm	
1.50	HS	HS	25ppm	

STRATA

Reduced Level	Legend (Thickness)	Depth	DESCRIPTION	Instrument/ Backfill
	(0.20)	0.20	Soft to firm blackish brown slightly sandy CLAY with some to much fine to coarse angular gravel of assorted lithologies.	
	(1.30)	1.50	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE. Slight hydrocarbon odour. 0.90 ... becomes wet.	
			Borehole complete at 1.50m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

Hole drilled using hand-held, open hole windowless sampling techniques.

Hole backfilled with arisings.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

BOREHOLE LOG

BOREHOLE No.
S7

Client:
MALVERN HILL DISTRICT COUNCIL

Project No:	Date:	Ground Level:	Co-ordinates:
404.2664.00001	12/05/09		

Project:
APPLE TREE HOUSE

Sheet: 1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result
0.20	HS	HS	45ppm
0.50 0.50	HS JAR	HS	120ppm
0.90 0.90	HS JAR	HS	125ppm
1.20 1.20	HS JAR	HS	90ppm
1.50	HS	HS	35ppm
1.80	HS	HS	15ppm

STRATA

Water	Reduced Level	Depth (Thickness)	Depth	DESCRIPTION
		(0.35)	0.35	Brown slightly sandy CLAY with abundant fine to coarse angular gravel of concrete, brick and assorted lithologies. (MADE GROUND)
		(1.65)	2.00	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE. 1.40 ... pockets of dark grey sand from 1.4m.
				Borehole complete at 2.00m

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

Chiselling			Water Added	
From	To	Hours	From	To

General Remarks

Hole drilled using hand-held, open hole windowless sampling techniques.

Hole installed with 38mm well pipe with 1-2mm filter sand around slotted section.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

BOREHOLE LOG

BOREHOLE No.
S8

Client: **MALVERN HILL DISTRICT COUNCIL**			
Project No: 404.2664.00001	Date: 12/05/09	Ground Level:	Co-ordinates:
Project: **APPLE TREE HOUSE**			Sheet: 1 of 1

SAMPLES & TESTS					STRATA				
Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend (Thick-ness)	Depth	DESCRIPTION	Instrument/ Backfill
0.20 0.20	HS JAR	HS	45ppm			(0.50)	0.50	Brown slightly sandy CLAY with abundant fine to coarse angular gravel of concrete, brick and assorted lithologies. (MADE GROUND)	
0.50 0.50	HS JAR	HS	20ppm						
0.80 0.80	HS JAR	HS	5ppm			(0.50)	1.00	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE.	
								Borehole complete at 1.00m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added	
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To

General Remarks

Hole drilled using hand-held, open hole windowless sampling techniques.

Hole backfilled with arisings.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

Form SLR AGS3 UK BH File 090514 404.2664.00001 X APPLE TREE SHALLOW BH LOGS.GPJ 15-05-09

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

BOREHOLE LOG

BOREHOLE No.	**S9**
Client:	**MALVERN HILL DISTRICT COUNCIL**
Project No:	404.2664.00001
Date:	12/05/09
Ground Level:	
Co-ordinates:	
Project:	**APPLE TREE HOUSE**
Sheet:	1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result	Water
0.30	HS	HS	0ppm	
0.30	JAR			
0.60	HS	HS	10ppm	
0.60	JAR			
1.00	HS	HS	5ppm	

STRATA

Reduced Level	Legend (Thickness)	Depth	DESCRIPTION	Instrument/ Backfill
		0.10	Brown slightly sandy CLAY with abundant fine to coarse angular gravel of concrete, brick and assorted lithologies. (MADE GROUND)	
	(0.90)	1.00	Firm reddish brown, grey mottled, CLAY. Weathered MERCIA MUDSTONE.	
			Borehole complete at 1.00m	

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

Chiselling			Water Added	
From	To	Hours	From	To

General Remarks

Hole drilled using hand-held, open hole windowless sampling techniques.

Hole backfilled with arisings.

All dimensions in metres Scale 1:25	Contractor : Sherwood Drilling Plant: Hand-held Equipment	Method: Windowless Sampler Hole Size:	Logged By: MD	Approved By:

TRIAL PIT LOG

TRIAL PIT No
TP1

Client:
MALVERN HILLS DC

Project:
APPLE TREE HOUSE

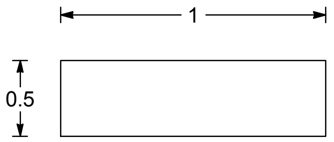
Project No: 404.2664.00001	Date: 29/06/09	Ground Level:	Co-ordinates:	Sheet: 1 of 1

SAMPLES & TESTS					STRATA				
Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument/ Backfill
							(0.30) 0.30	Dark brown sandy TOPSOIL.	
0.50 0.50	HS JAR	HS	0ppm				(0.70) 1.00	Brown slightly silty fine to medium SAND with occasional angular fine gravel to cobbles of brick and concrete. (MADE GROUND)	
1.00 1.00	HS JAR	HS	0ppm				1.10	Dark brown CLAY.	
							(0.40) 1.50	Red slightly sandy CLAY with occasional pockets of fine grey sand. MERCIA MUDSTONE	
1.50 1.50	HS JAR	HS	35ppm					Trial Pit complete at 1.50m	

GENERAL REMARKS:

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space (measured with GMI Pellister)

Trial Pit Dimensions:



Shoring/Support: None
Stability: Good

All dimensions in metres Scale 1:25	Contractor : Smith's Plant Hire Plant: JCB 1.5T Excavator	Method: Trial Pit/trench	Logged By: MD	Approved By:

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

TRIAL PIT LOG

TRIAL PIT No
TP2

Client: **MALVERN HILLS DC**				
Project: **APPLE TREE HOUSE**				
Project No: 404.2664.00001	Date: 29/06/09	Ground Level:	Co-ordinates:	Sheet: 1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result	Water
0.50 0.50	HS JAR	HS	0ppm	
1.00 1.00	HS JAR	HS	0ppm	
1.20 1.20	HS JAR	HS	580ppm	
1.50 1.50	HS JAR	HS	250ppm	

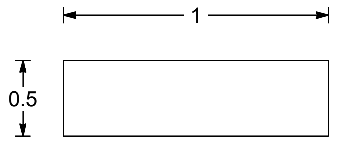
STRATA

Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument/ Backfill
		(0.30) 0.30	Dark brown sandy TOPSOIL.	
	▨	(0.80) 1.10	Brown slightly silty fine to medium SAND with occasional angular fine gravel to cobbles of brick and concrete. (MADE GROUND)	
			Dark brown CLAY.	
		(0.40) 1.50	Red slightly sandy CLAY with occasional pockets of fine grey sand. MERCIA MUDSTONE 1.10 - 1.45 ... light grey discolouration and moderate hydrocarbon odour.	
			Trial Pit complete at 1.50m	

GENERAL REMARKS:

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space (measured with GMI Pellister)

Trial Pit Dimensions:



Shoring/Support: None
Stability: Good

All dimensions in metres Scale 1:25	Contractor : Smith's Plant Hire Plant: JCB 1.5T Excavator	Method: Trial Pit/trench	Logged By: MD	Approved By:

SLR Consulting Ltd., Brockhill Court, Brockhill Lane, Redditch, Worc, B97 6RB, Tel: 01527 597000, Fax: 01527 584408
LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

Form SLR AGS3 UK TP File 090702 404.2664.00001 X APPLE TREE TRIAL PIT LOGS.GPJ 06-07-09

TRIAL PIT LOG

TRIAL PIT No
TP3

Client:
MALVERN HILLS DC

Project:
APPLE TREE HOUSE

Project No: 404.2664.00001	Date: 29/06/09	Ground Level:	Co-ordinates:	Sheet: 1 of 1

SAMPLES & TESTS

Depth	Type No	Test Type	Test Result	Water
0.50	HS	HS	0ppm	
1.00 1.00	HS JAR	HS	0ppm	
1.20 1.20	HS JAR	HS	535ppm	
1.50 1.50	HS JAR	HS	270ppm	

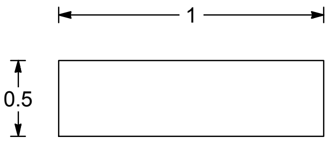
STRATA

Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument/ Backfill
	▨	(1.00) 1.00	Brown-black slightly silty fine to medium SAND with angular medium to coarse gravel of brick and concrete and occasional ash pockets. (MADE GROUND)	▩
	— —	1.10	Dark brown CLAY.	▩
	— —	(0.40) 1.50	Red slightly sandy CLAY with occasional pockets of fine grey sand. MERCIA MUDSTONE 1.10 - 1.45 ... light grey discolouration and moderate hydrocarbon odour.	▩
			Trial Pit complete at 1.50m	

GENERAL REMARKS:

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space (measured with GMI Pellister)

Trial Pit Dimensions:



Shoring/Support: None
Stability: Good

All dimensions in metres Scale 1:25	Contractor : Smith's Plant Hire Plant: JCB 1.5T Excavator	Method: Trial Pit/trench	Logged By: MD	Approved By:

TRIAL PIT LOG

TRIAL PIT No
TP4

Client: **MALVERN HILLS DC**	
Project: **APPLE TREE HOUSE**	

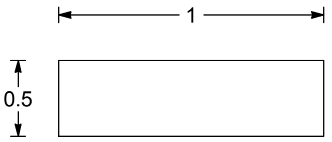
Project No:	Date:	Ground Level:	Co-ordinates:	Sheet:
404.2664.00001	29/06/09			1 of 1

SAMPLES & TESTS					STRATA				
Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument/ Backfill
0.50	HS	HS	0ppm				(1.00) 1.00	Brown-black slightly silty fine to medium SAND with angular medium to coarse gravel of brick and concrete and occasional ash pockets. (MADE GROUND)	
1.00 1.00	HS JAR	HS	735ppm				(0.20) 1.20	Brown CLAY with slight greyish discolouration and slight hydrocarbon odour.	
1.30 1.30	HS JAR	HS	>1000ppm				(0.30) 1.50	Red slightly sandy CLAY with occasional pockets of fine grey sand. MERCIA MUDSTONE. Grey discolouration and slight to moderate odour. 1.45 ... discolouration becomes mottled, odour becomes slight.	
1.50 1.50	HS JAR	HS	815ppm					Trial Pit complete at 1.50m	

GENERAL REMARKS:

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space (measured with GMI Pellister)

Trial Pit Dimensions:



Shoring/Support: None
Stability: Good

All dimensions in metres Scale 1:25	Contractor : Smith's Plant Hire Plant: JCB 1.5T Excavator	Method: Trial Pit/trench	Logged By: MD	Approved By:

LOGGING HAS BEEN CARRIED OUT IN ACCORDANCE WITH

TRIAL PIT LOG

TRIAL PIT No
TP5

Client:
MALVERN HILLS DC

Project:
APPLE TREE HOUSE

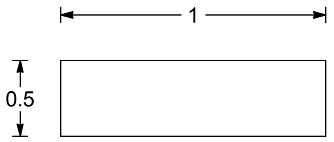
Project No: 404.2664.00001	Date: 29/06/09	Ground Level:	Co-ordinates:	Sheet: 1 of 1

SAMPLES & TESTS				Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Type	Test Result		Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	
						▩	(0.40) 0.40	Brown slightly sandy CLAY with occasional fine to coarse angular gravel of brick. (MADE GROUND)	▨
0.50 0.50	HS JAR	HS	330ppm			▤	(0.50) 0.90	Brown CLAY.	▨
1.00 1.00	HS JAR	HS	640ppm			▤	(0.50) 1.40	Red slightly sandy CLAY with occasional pockets of fine grey sand. MERCIA MUDSTONE. Mottled grey discolouration and slight to moderate hydrocarbon odour. 1.30 ... odour becomes slight.	▨
1.40 1.40	HS JAR	HS	870ppm					Trial Pit complete at 1.40m	

GENERAL REMARKS:

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space (measured with GMI Pellister)

Trial Pit Dimensions:



Shoring/Support: None
Stability: Good

All dimensions in metres Scale 1:25	Contractor : Smith's Plant Hire Plant: JCB 1.5T Excavator	Method: Trial Pit/trench	Logged By: MD	Approved By:

Form SLR AGS3 UK TP File 090702 404.2664.00001 X APPLE TREE TRIAL PIT LOGS.GPJ 06-07-09

TRIAL PIT LOG

TRIAL PIT No
TP6

Client:
MALVERN HILLS DC

Project:
APPLE TREE HOUSE

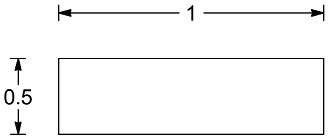
Project No: 404.2664.00001	Date: 29/06/09	Ground Level:	Co-ordinates:	Sheet: 1 of 1

SAMPLES & TESTS					STRATA				
Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	Instrument/ Backfill
0.30		HS	10ppm			▨	(0.50) 0.50	Dark brown silty fine to medium SAND with some ash and occasional fine to medium gravel of angular brick. (MADE GROUND)	
							(0.20) 0.70	Dark grey/brown slightly sandy CLAY.	
0.70		HS	15ppm				(0.40) 1.10	Red slightly sandy CLAY with occasional pockets of fine grey sand. MERCIA MUDSTONE. 1.05 ... seeps of water with very slight oily sheen.	
1.10		HS	25ppm					Trial Pit complete at 1.10m	

GENERAL REMARKS:

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space (measured with GMI Pellister)

Trial Pit Dimensions:



Shoring/Support: None
Stability: Good

All dimensions in metres Scale 1:25	Contractor : Smith's Plant Hire Plant: JCB 1.5T Excavator	Method: Trial Pit/trench	Logged By: MD	Approved By:

TRIAL PIT LOG

TRIAL PIT No
TP7

Client: **MALVERN HILLS DC**	
Project: **APPLE TREE HOUSE**	

Project No:	Date:	Ground Level:	Co-ordinates:	Sheet:
404.2664.00001	29/06/09			1 of 1

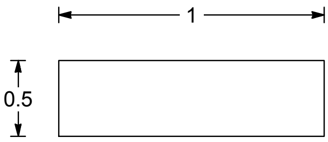
SAMPLES & TESTS					STRATA				
Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend	Depth (Thickness)	DESCRIPTION	Instrument/ Backfill
						▩	(0.40) 0.40	Dark brown silty fine to medium SAND with some ash and occasional fine to medium gravel of angular brick. (MADE GROUND)	
0.80 0.80	HS JAR	HS	720ppm			▤	(0.80) 1.20	Red slightly sandy CLAY with occasional pockets of fine grey sand. MERCIA MUDSTONE. Slight grey discolouration and slight odour.	
1.00	HS	HS	295ppm						
1.20 1.20	HS JAR	HS	75ppm					Trial Pit complete at 1.20m	

Depth scale: 1, 2, 3

GENERAL REMARKS:

KEY:
V = Hand Vane Shear Strength
PP = Pocket Penetrometer Shear Strength
D = Small Disturbed Sample
B = Large Bulk Sample
HS = Head Space (measured with GMI Pellister)

Trial Pit Dimensions:



Shoring/Support: None
Stability: Good

All dimensions in metres Scale 1:25	Contractor : Smith's Plant Hire Plant: JCB 1.5T Excavator	Method: Trial Pit/trench	Logged By: MD	Approved By:

Form SLR AGS3 UK TP File 090702 404.2664.00001 X APPLE TREE TRIAL PIT LOGS.GPJ 06-07-09

BOREHOLE LOG

BOREHOLE No.
Water Well

Client:
MALVERN HILLS DISTRICT COUNCIL

Project No: 404.2664.00001	Date: 07/08/09	Ground Level:	Co-ordinates:

Project:
APPLE TREE HOUSE

Sheet: 1 of 1

SAMPLES & TESTS					STRATA				
Depth	Type No	Test Type	Test Result	Water	Reduced Level	Legend (Thickness)	Depth	DESCRIPTION	Instrument/ Backfill
							(0.95) 0.95	Open Hole (brick lined)	
							(3.55) 4.50	Bentonite cement grout.	■
								Borehole complete at 4.50m	

Boring Progress and Water Observations				Casing		Chiselling			Water Added		General Remarks
Date	Time	Depth	Water Dpt	Depth	Dia. mm	From	To	Hours	From	To	
											1.1m diameter brick lined domestic water well, dewatered of contaminated water by vacuum tanker and backfilled with bentonite cement grout slurry.

All dimensions in metres Scale 1:50	Contractor : Tor Driling Plant:	Method: Hole Size:	Logged By: MD	Approved By:

Form SLR AGS3 UK BH File 090810 404.2664.00001 WATER WELL DECOMMISSIONING LOG.GPJ 10-08-09

ALcontrol Laboratories

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Carbon Range C10-C40

Job Number : 09/06016/02/01
Client : SLR Consulting Ltd
Client Ref : 404-2664-00001
Matrix [Units] : SOLID [mg/kg]

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	EPH	Interpretation
10	S2	1.5	140	kerosene type residues
18	S3	1.6	190	kerosene type residues
30	S5	0.6	<35	no identification possible
32	S5	0.8	50	kerosene type resideues/humic acids
36	S6	0.5	73	kerosene type resideues/humic acids
38	S6	0.8	39	humic acids
42	S7	0.9	36	humic acids

Extractable Petroleum Hydrocarbons (formally Diesel Range Organics) :- Any compound extractable in n-hexane within the carbon range C10-C40, includes Aliphatic (Min Oil), Aromatic (PAHs) and naturally occurring compounds.

ALcontrol Laboratories Analytical Services
Sample Descriptions

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref : 404-2664-00001

Grain sizes

<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

Sample Identity	Depth (m)	Colour	Grain Size	Description	Batch
S1	1.5	Brown	0.1mm - 2mm	Sandy Clay with some Stones	1
S2	1.1-1.7	Brown	0.1mm - 0.063mm	Silty Clay with some Stones	1
S2	1.5	Brown	0.1mm - 0.063mm	Silty Clay with some Stones	1
S3	1.6	Brown	<0.063mm	Clay Loam	1
S5	0.4	Dark Brown	0.1mm - 2mm	Sandy Clay Loam with some Stones	1
S5	0.6	Brown	0.1mm - 0.063mm	Clay Loam with some Vegetation	1
S5	0.8	Brown	0.1mm - 0.063mm	Silty Clay	1
S6	0.5	Brown	0.1mm - 0.063mm	Silty Clay	1
S6	0.8	Brown	0.1mm - 0.063mm	Silty Clay	1
S7	0.9	Brown	0.1mm - 0.063mm	Silty Clay	1
S10	0.3	Brown	0.1mm - 0.063mm	Silty Clay with some Brick	1

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.
Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.
¹ Sample Description supplied by client

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Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001
Matrix: SOLID
Location: APPLE TREE HOUSE
Client Contact: Matt Drage

Sample Identity	S1	S2	S3	S5	S5	S5	S6	S6	S7	**Method Code**	**LoD/Units**
Depth (m)	1.5	1.5	1.6	0.4	0.6	0.8	0.5	0.8	0.9		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09		
Sample Received Date	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09		
Batch	1	1	1	1	1	1	1	1	1		
Sample Number(s)	**3-4**	**10-11**	**18-19**	**28-29**	**30-31**	**32-33**	**36-37**	**38-39**	**42-43**		
Total Sulphate	390	-	330	-	-	-	-	-	-	TM129$^{\#}_{M}$	<100 mg/kg
Arsenic	<3	-	<3	-	-	-	-	-	-	TM129$^{\#}_{M}$	<3.0 mg/kg
Cadmium	<0.2	-	0.3	-	-	-	-	-	-	TM129	<0.2 mg/kg
Chromium	20	-	46	-	-	-	-	-	-	TM129$^{\#}_{M}$	<4.5 mg/kg
Copper	10	-	31	-	-	-	-	-	-	TM129$^{\#}_{M}$	<6 mg/kg
Lead	5	-	5	-	-	-	-	-	-	TM129$^{\#}_{M}$	<2 mg/kg
Mercury	<0.4	-	<0.4	-	-	-	-	-	-	TM129$^{\#}_{M}$	<0.4 mg/kg
Nickel	17	-	47	-	-	-	-	-	-	TM129$^{\#}_{M}$	<0.9 mg/kg
Selenium	<3	-	<3	-	-	-	-	-	-	TM129$^{\#}_{M}$	<3 mg/kg
Zinc	58	-	120	-	-	-	-	-	-	TM129$^{\#}_{M}$	<2.5 mg/kg
pH Value	8.13	-	8.51	-	-	-	-	-	-	TM133$^{\#}_{M}$	<1.00 pH Units
Amosite (Brown) Asbestos	-	-	-	-	-	-	-	-	-	TM048$^{\#}$	NONE
Chrysotile (White) Asbestos	-	-	-	-	-	-	-	-	-	TM048$^{\#}$	NONE
Crocidolite (Blue) Asbestos	-	-	-	-	-	-	-	-	-	TM048$^{\#}$	NONE
Fibrous Tremolite	-	-	-	-	-	-	-	-	-	TM048$^{\#}$	NONE
Fibrous Anthophyllite	-	-	-	-	-	-	-	-	-	TM048$^{\#}$	NONE
Fibrous Actinolite	-	-	-	-	-	-	-	-	-	TM048$^{\#}$	NONE
Non-Asbestos Fibre	-	-	-	-	-	-	-	-	-	TM048$^{\#}$	NONE

All results expressed on a dry weight basis.

Date 26.05.2009

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Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	SOLID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	S1	S2	S3	S5	S5	S5	S6	S6	S7	**Method Code**	**LoD/Units**
Depth (m)	1.5	1.5	1.6	0.4	0.6	0.8	0.5	0.8	0.9		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09		
Sample Received Date	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09		
Batch	1	1	1	1	1	1	1	1	1		
Sample Number(s)	**3-4**	**10-11**	**18-19**	**28-29**	**30-31**	**32-33**	**36-37**	**38-39**	**42-43**		
GRO Surrogate	69	-	-	62	-	-	-	-	-	TM089	%
GRO (C4-C12)	19	-	-	27	-	-	-	-	-	TM089	<0.01 mg/kg
MTBE	<0.01	-	-	<0.01	-	-	-	-	-	TM089$^{\#}$	<0.01 mg/kg
Benzene	<0.01	-	-	<0.01	-	-	-	-	-	TM089$^{\#}_{M}$	<0.01 mg/kg
Toluene	<0.01	-	-	<0.01	-	-	-	-	-	TM089$^{\#}_{M}$	<0.01 mg/kg
Ethyl benzene	<0.01	-	-	<0.01	-	-	-	-	-	TM089$^{\#}_{M}$	<0.01 mg/kg
m & p Xylene	<0.01	-	-	<0.01	-	-	-	-	-	TM089$^{\#}_{M}$	<0.01 mg/kg
o Xylene	<0.01	-	-	<0.01	-	-	-	-	-	TM089$^{\#}_{M}$	<0.01 mg/kg
Aliphatics C5-C6	<0.01	-	-	<0.01	-	-	-	-	-	TM089	<0.01 mg/kg
Aliphatics >C6-C8	0.28	-	-	0.19	-	-	-	-	-	TM089	<0.01 mg/kg
Aliphatics >C8-C10	2.5	-	-	2.6	-	-	-	-	-	TM089	<0.01 mg/kg
Aliphatics >C10-C12	5.0	-	-	8.2	-	-	-	-	-	TM089	<0.01 mg/kg
Aliphatics >C12-C16	20	-	-	98	-	-	-	-	-	TM173$^{\#}$	<0.1 mg/kg
Aliphatics >C16-C21	4.3	-	-	4.9	-	-	-	-	-	TM173$^{\#}$	<0.1 mg/kg
Aliphatics >C21-C35	<0.1	-	-	<0.1	-	-	-	-	-	TM173$^{\#}$	<0.1 mg/kg
Total Aliphatics C5-C35	32	-	-	110	-	-	-	-	-	TM61/89	<0.1 mg/kg
Aromatics C6-C7	<0.01	-	-	<0.01	-	-	-	-	-	TM089	<0.01 mg/kg
Aromatics >C7-C8	<0.01	-	-	<0.01	-	-	-	-	-	TM089	<0.01 mg/kg
Aromatics >EC8-EC10	3.7	-	-	4.0	-	-	-	-	-	TM089	<0.01 mg/kg
Aromatics >EC10-EC12	7.4	-	-	12	-	-	-	-	-	TM089	<0.01 mg/kg
Aromatics >EC12-EC16	4.5	-	-	2.1	-	-	-	-	-	TM173$^{\#}$	<0.1 mg/kg
Aromatics >EC16-EC21	<0.1	-	-	<0.1	-	-	-	-	-	TM173$^{\#}$	<0.1 mg/kg
Aromatics >EC21-EC35	<0.1	-	-	6.1	-	-	-	-	-	TM173$^{\#}$	<0.1 mg/kg
Total Aromatics C6-C35	16	-	-	24	-	-	-	-	-	TM61/89	<0.1 mg/kg
TPH (Aliphatics and Aromatics C5-C35)	47	-	-	140	-	-	-	-	-	TM61/89	<0.1 mg/kg

All results expressed on a dry weight basis.

Date 26.05.2009

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	SOLID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	S1	S2	S3	S5	S5	S5	S6	S6	S7	**Method Code**	**LoD/Units**
Depth (m)	1.5	1.5	1.6	0.4	0.6	0.8	0.5	0.8	0.9		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09		
Sample Received Date	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09		
Batch	1	1	1	1	1	1	1	1	1		
Sample Number(s)	**3-4**	**10-11**	**18-19**	**28-29**	**30-31**	**32-33**	**36-37**	**38-39**	**42-43**		
EPH (DRO) (C10-C40)	-	140	190	-	<35	50	73	39	36	TM061$^{\#}_{M}$	<35 mg/kg
EPH (DRO) (C10-C40) % Surrogate Recovery	-	120	120	-	120	110	110	110	110	TM061$^{\#}_{M}$	%
GRO Surrogate	-	62	65	-	62	51	62	59	53	TM089	%
GRO (C4-C10)	-	5.0	0.22	-	0.11	<0.01	<0.01	<0.01	0.08	TM089	<0.01 mg/kg
GRO (C10-C12)	-	10	0.56	-	0.27	<0.01	<0.01	<0.01	0.08	TM089	<0.01 mg/kg
Benzene	-	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
Toluene	-	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
Ethyl benzene	-	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
m & p Xylene	-	0.13	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
o Xylene	-	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
Sum m&p and o Xylene	-	0.13	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/kg
Sum of BTEX	-	0.13	<0.01	-	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/kg
MTBE	-	<0.01	<0.01	-	0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/kg

All results expressed on a dry weight basis.

Date 26.05.2009

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	SOLID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	S1	S2	S3	S5	S5	S5	S6	S6	S7	**Method Code**	**LoD/Units**
Depth (m)	1.5	1.5	1.6	0.4	0.6	0.8	0.5	0.8	0.9		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09		
Sample Received Date	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09		
Batch	1	1	1	1	1	1	1	1	1		
Sample Number(s)	**3-4**	**10-11**	**18-19**	**28-29**	**30-31**	**32-33**	**36-37**	**38-39**	**42-43**		
PAH by GCMS											
Naphthalene-d8 -Surrogate Recovery	88	-	93	-	-	-	-	-	-	TM218$^{\#}_{M}$	%
Acenaphthene-d10 -Surrogate Recovery	86	-	93	-	-	-	-	-	-	TM218$^{\#}_{M}$	%
Phenanthrene-d10 -Surrogate Recovery	85	-	91	-	-	-	-	-	-	TM218$^{\#}_{M}$	%
Chrysene-d12 -Surrogate Recovery	77	-	81	-	-	-	-	-	-	TM218$^{\#}_{M}$	%
Perylene-d12 -Surrogate Recovery	79	-	81	-	-	-	-	-	-	TM218$^{\#}_{M}$	%
Naphthalene	0.29	-	0.24	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.009 mg/kg
Acenaphthylene	<0.012	-	<0.012	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.012 mg/kg
Acenaphthene	0.011	-	<0.008	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.008 mg/kg
Fluorene	<0.01	-	<0.01	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.01 mg/kg
Phenanthrene	<0.015	-	<0.015	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.015 mg/kg
Anthracene	<0.016	-	<0.016	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.016 mg/kg
Fluoranthene	<0.017	-	<0.017	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.017 mg/kg
Pyrene	<0.015	-	<0.015	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.015 mg/kg
Benz(a)anthracene	<0.014	-	<0.014	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.014 mg/kg
Chrysene	<0.01	-	<0.01	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.01 mg/kg
Benzo(b)fluoranthene	<0.015	-	<0.015	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.015 mg/kg
Benzo(k)fluoranthene	<0.014	-	<0.014	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.014 mg/kg
Benzo(a)pyrene	<0.015	-	<0.015	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.015 mg/kg
Indeno(123cd)pyrene	<0.018	-	<0.018	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.018 mg/kg
Dibenzo(ah)anthracene	<0.023	-	<0.023	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.023 mg/kg
Benzo(ghi)perylene	<0.024	-	<0.024	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.024 mg/kg
PAH 16 Total	0.30	-	0.24	-	-	-	-	-	-	TM218$^{\#}_{M}$	<0.118 mg/kg

All results expressed on a dry weight basis.

Date 26.05.2009

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

\# ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	SOLID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	S10									**Method Code**	**LoD/Units**
Depth (m)	0.3										
Sample Type	SOLID										
Sampled Date	12.05.09										
Sample Received Date	14.05.09										
Batch	1										
Sample Number(s)	**56-57**										
Total Sulphate	-									TM129$^{\#}_{M}$	<100 mg/kg
Arsenic	-									TM129$^{\#}_{M}$	<3.0 mg/kg
Cadmium	-									TM129	<0.2 mg/kg
Chromium	-									TM129$^{\#}_{M}$	<4.5 mg/kg
Copper	-									TM129$^{\#}_{M}$	<6 mg/kg
Lead	-									TM129$^{\#}_{M}$	<2 mg/kg
Mercury	-									TM129$^{\#}_{M}$	<0.4 mg/kg
Nickel	-									TM129$^{\#}_{M}$	<0.9 mg/kg
Selenium	-									TM129$^{\#}_{M}$	<3 mg/kg
Zinc	-									TM129$^{\#}_{M}$	<2.5 mg/kg
pH Value	-									TM133$^{\#}_{M}$	<1.00 pH Units
Amosite (Brown) Asbestos	No Fibres Detected									TM048$^{\#}$	NONE
Chrysotile (White) Asbestos	Fibres Detected									TM048$^{\#}$	NONE
Crocidolite (Blue) Asbestos	No Fibres Detected									TM048$^{\#}$	NONE
Fibrous Tremolite	No Fibres Detected									TM048$^{\#}$	NONE
Fibrous Anthophyllite	No Fibres Detected									TM048$^{\#}$	NONE
Fibrous Actinolite	No Fibres Detected									TM048$^{\#}$	NONE
Non-Asbestos Fibre	No Fibres Detected									TM048$^{\#}$	NONE

All results expressed on a dry weight basis.

Date 26.05.2009

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

\# ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/01
Matrix: SOLID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	S10									**Method Code**	**LoD/Units**
Depth (m)	0.3										
Sample Type	SOLID										
Sampled Date	12.05.09										
Sample Received Date	14.05.09										
Batch	1										
Sample Number(s)	**56-57**										
EPH (DRO) (C10-C40)	-									TM061#M	<35 mg/kg
EPH (DRO) (C10-C40) % Surrogate Recovery	-									TM061#M	%
GRO Surrogate	35									TM089	%
GRO (C4-C10)	<0.01									TM089	<0.01 mg/kg
GRO (C10-C12)	<0.01									TM089	<0.01 mg/kg
Benzene	<0.01									TM089#M	<0.01 mg/kg
Toluene	<0.01									TM089#M	<0.01 mg/kg
Ethyl benzene	<0.01									TM089#M	<0.01 mg/kg
m & p Xylene	<0.01									TM089#M	<0.01 mg/kg
o Xylene	<0.01									TM089#M	<0.01 mg/kg
Sum m&p and o Xylene	<0.01									TM089	<0.01 mg/kg
Sum of BTEX	<0.01									TM089	<0.01 mg/kg
MTBE	<0.01									TM089#	<0.01 mg/kg

All results expressed on a dry weight basis.

Date 26.05.2009

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number:	09/06016/02/01
Client:	SLR Consulting Ltd
Client Ref. No.:	404-2664-00001

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to $1.03x10^{-7}$

NDP	No Determination Possible	*	Subcontracted test
ACM	Asbestos Containing Materia	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
		EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample ¹	Surrogate Corrected
TM008	BS 1377:Part 1977	Particle size distribution of solid samples			WET	
TM048		Identification of Asbestos in Bulk Material	✓		WET	
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓	✓	DRY	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)			WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer			DRY	
TM129	Method 3120B, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 3050B	Determination of Metal Cations by IRIS Emission Spectrometer	✓	✓	DRY	
TM133	BS 1377: Part 3 1990;BS 6068-2.5	Determination of pH in Soil and Water using the GLpH pH Meter	✓	✓	WET	
TM173		Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID	✓		DRY	
TM218		Microwave extraction - EPA method 3546	✓	✓	WET	
TM61/89		see TM061 and TM089 for details			WET	

¹ Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.
WET indicates samples analysed as submitted.

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
1	11.6

ALcontrol Laboratories

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Carbon Range C10-C40

Job Number : **09/06016/02/01**
Client : **SLR Consulting Ltd**
Client Ref : **404-2664-00001**
Matrix [Units] : **SOLID [mg/kg]**

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	EPH	Interpretation
20	S4	0.75	<35	no identification possible
22	S4	1.2	55	kerosene type residues
26	S5	0.2	160	kerosene type residues
40	S7	0.5	41	possible humic acids
46	S8	0.2	200	PAH's/humic acids
48	S8	0.5	44	humic acids
52	S9	0.3	47	humic acids

Extractable Petroleum Hydrocarbons (formally Diesel Range Organics) :- Any compound extractable in n-hexane within the carbon range C10-C40, includes Aliphatic (Min Oil), Aromatic (PAHs) and naturally occurring compounds.

ALcontrol Laboratories Analytical Services
Sample Descriptions

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref : 404-2664-00001

Grain sizes

<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

Sample Identity	Depth (m)	Colour	Grain Size	Description	Batch
S4	0.75	Brown	0.1mm - 0.063mm	Silty Clay	1
S4	1.2	Brown	0.1mm - 2mm	Sandy Clay with some Stones	1
S5	0.2	Brown	0.1mm - 0.063mm	Silty Clay with some Stones	1
S7	0.5	Brown	0.1mm - 0.063mm	Silty Clay	1
S8	0.2	Brown	0.1mm - 0.063mm	Silty Clay with some Stones	1
S8	0.5	Brown	0.1mm - 0.063mm	Silty Clay	1
S9	0.3	Brown	0.1mm - 0.063mm	Silty Clay with some Stones	1

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.
Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.
[1] Sample Description supplied by client

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	SOLID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	S4	S4	S5	S7	S8	S8	S9			**Method Code**	**LoD/Units**
Depth (m)	0.75	1.2	0.2	0.5	0.2	0.5	0.3				
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID				
Sampled Date	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09	12.05.09				
Sample Received Date	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09	14.05.09				
Batch	1	1	1	1	1	1	1				
Sample Number(s)	**20-21**	**22-23**	**26-27**	**40-41**	**46-47**	**48-49**	**52-53**				
EPH (DRO) (C10-C40)	<35	55	160	41	200	44	47			TM061$^{\#}_{M}$	<35 mg/kg
EPH (DRO) (C10-C40) % Surrogate Recovery	100	110	100	100	100	110	100			TM061$^{\#}_{M}$	%
GRO Surrogate	88	100	55	90	53	75	92			TM089	%
GRO (C4-C10)	<0.01	<0.01	0.55	0.10	<0.01	<0.01	<0.01			TM089	<0.01 mg/kg
GRO (C10-C12)	<0.01	<0.01	7.3	0.10	<0.01	<0.01	<0.01			TM089	<0.01 mg/kg
Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			TM089$^{\#}_{M}$	<0.01 mg/kg
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			TM089$^{\#}_{M}$	<0.01 mg/kg
Ethyl benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			TM089$^{\#}_{M}$	<0.01 mg/kg
m & p Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			TM089$^{\#}_{M}$	<0.01 mg/kg
o Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			TM089$^{\#}_{M}$	<0.01 mg/kg
Sum m&p and o Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			TM089	<0.01 mg/kg
Sum of BTEX	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			TM089	<0.01 mg/kg
MTBE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01			TM089$^{\#}$	<0.01 mg/kg

All results expressed on a dry weight basis.

Date 17.06.2009

Validated ☑
Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	LIQUID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	CUT OFF TRENCH									**Method Code**	**LoD/Units**
Depth (m)											
Sample Type	LIQUID										
Sampled Date	12.05.09										
Sample Received Date	14.05.09										
Batch	1										
Sample Number(s)	**60-62**										
GRO Surrogate	110									TM089	%
GRO (C4-C12)	0.08									TM089#	<0.01 mg/l
MTBE	<0.01									TM089#	<0.01 mg/l
Benzene	<0.01									TM089#	<0.01 mg/l
Toluene	<0.01									TM089#	<0.01 mg/l
Ethyl benzene	<0.01									TM089#	<0.01 mg/l
m & p Xylene	<0.01									TM089#	<0.01 mg/l
o Xylene	<0.01									TM089#	<0.01 mg/l
Aliphatics C5-C6	<0.01									TM089	<0.01 mg/l
Aliphatics >C6-C8	<0.01									TM089	<0.01 mg/l
Aliphatics >C8-C10	<0.01									TM089	<0.01 mg/l
Aliphatics >C10-C12	0.03									TM089	<0.01 mg/l
Aliphatics >C12-C16 Aqueous	<0.01									TM174	<0.01 mg/l
Aliphatics >C16-C21 Aqueous	<0.01									TM174	<0.01 mg/l
Aliphatics >C21-C35 Aqueous	<0.01									TM174	<0.01 mg/l
Total Aliphatics C5-C35 Aqueous	0.03									TM61/89	<0.01 mg/l
Aromatics C6-C7	<0.01									TM089#	<0.01 mg/l
Aromatics >C7-C8	<0.01									TM089#	<0.01 mg/l
Aromatics >EC8-EC10	<0.01									TM089	<0.01 mg/l
Aromatics >EC10-EC12	0.05									TM089	<0.01 mg/l
Aromatics >EC12-EC16 Aqueous	<0.01									TM174	<0.01 mg/l
Aromatics >EC16-EC21 Aqueous	<0.01									TM174	<0.01 mg/l
Aromatics >EC21-EC35 Aqueous	<0.01									TM174	<0.01 mg/l
Total Aromatics C6-C35 Aqueous	0.05									TM61/89	<0.01 mg/l
TPH (Aliphatics and Aromatics C5-C35) Aqueous	0.08									TM61/89	<0.01 mg/l

Date 17.06.2009

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number:	09/06016/02/01
Client:	SLR Consulting Ltd
Client Ref. No.:	404-2664-00001

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03x10^{-7}

NDP	No Determination Possible	*	Subcontracted test
ACM	Asbestos Containing Materia	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
		EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓	✓	DRY	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)			WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	
TM174		Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID			NA	
TM61/89		see TM061 and TM089 for details			NA	

[1] Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.
WET indicates samples analysed as submitted.

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
1	11.6

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/01
Matrix: LIQUID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	06402	06407	06408	S5	S7	WATER WELL				**Method Code**	**LoD/Units**
Depth (m)	1.335	0.688	0.733	1.093	0.541	1.35					
Sample Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID					
Sampled Date	20.05.09	20.05.09	20.05.09	20.05.09	20.05.09	20.05.09					
Sample Received Date	22.05.09	22.05.09	22.05.09	22.05.09	22.05.09	22.05.09					
Batch	2	2	2	2	2	2					
Sample Number(s)	**63-65**	**66-68**	**69-71**	**78-80**	**81-83**	**84-86**					
GRO Surrogate	99	130	120	110	110	120				TM089	%
GRO (C4-C12)	<0.01	<0.01	<0.01	<0.01	<0.01	0.66				TM089#	<0.01 mg/l
MTBE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				TM089#	<0.01 mg/l
Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				TM089#	<0.01 mg/l
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				TM089#	<0.01 mg/l
Ethyl benzene	<0.01	<0.01	<0.01	<0.01	<0.01	0.02				TM089#	<0.01 mg/l
m & p Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	0.02				TM089#	<0.01 mg/l
o Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				TM089#	<0.01 mg/l
Aliphatics C5-C6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				TM089	<0.01 mg/l
Aliphatics >C6-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				TM089	<0.01 mg/l
Aliphatics >C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	0.09				TM089	<0.01 mg/l
Aliphatics >C10-C12	<0.01	<0.01	<0.01	<0.01	<0.01	0.16				TM089	<0.01 mg/l
Aliphatics >C12-C16 Aqueous	0.02	<0.01	0.01	<0.01	<0.01	<0.01				TM174	<0.01 mg/l
Aliphatics >C16-C21 Aqueous	0.17	<0.01	0.05	<0.01	<0.01	<0.01				TM174	<0.01 mg/l
Aliphatics >C21-C35 Aqueous	0.74	<0.01	<0.01	0.09	0.09	<0.01				TM174	<0.01 mg/l
Total Aliphatics C5-C35 Aqueous	0.93	<0.01	0.06	0.09	0.09	0.25				TM61/89	<0.01 mg/l
Aromatics C6-C7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				TM089#	<0.01 mg/l
Aromatics >C7-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				TM089#	<0.01 mg/l
Aromatics >EC8-EC10	<0.01	<0.01	<0.01	<0.01	<0.01	0.17				TM089	<0.01 mg/l
Aromatics >EC10-EC12	<0.01	<0.01	<0.01	<0.01	<0.01	0.24				TM089	<0.01 mg/l
Aromatics >EC12-EC16 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	0.02				TM174	<0.01 mg/l
Aromatics >EC16-EC21 Aqueous	<0.01	<0.01	<0.01	0.01	<0.01	<0.01				TM174	<0.01 mg/l
Aromatics >EC21-EC35 Aqueous	<0.01	0.05	<0.01	0.03	<0.01	<0.01				TM174	<0.01 mg/l
Total Aromatics C6-C35 Aqueous	<0.01	0.05	<0.01	0.04	<0.01	0.43				TM61/89	<0.01 mg/l
TPH (Aliphatics and Aromatics C5-C35) Aqueous	0.93	0.05	0.06	0.13	0.09	0.68				TM61/89	<0.01 mg/l

Date 03.06.2009

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03x10^{-7}

NDP	No Determination Possible		*	Subcontracted test
ACM	Asbestos Containing Materia		»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited		M	MCERTS Accredited
			EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample ¹	Surrogate Corrected
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)			NA	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		NA	
TM174		Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID			NA	
TM61/89		see TM061 and TM089 for details			NA	

¹ Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.
WET indicates samples analysed as submitted.

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
2	12.2

ALcontrol Laboratories

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: mkt@alcontrol.co.uk
website: www.alcontrol.co.uk

SLR Consulting Ltd
Brockhill Court
Brockhill Lane
Redditch
B97 6RB ATTN: Matt Drage

CERTIFICATE OF ANALYSIS

Date:	25 July, 2009
Our Reference:	09/06016/02/03
Your Reference:	404-2664-00001
Location:	APPLE TREE HOUSE

Supplement 003 to report number 09/06016/02/01

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials- whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.
Asbestos testing - we are not accredited for screen testing of asbestos fibres. We are only accredited for asbestos containing materials found in bulk samples.

Signed

Diane

Diane Whittlestone	**David O'Hare**	**Kim Harrison**	**Byron Hagan**
Tech. Support Manager	Project Manager	Project Coordinator Team Leader	Project Coordinator Team Leader

Valid if signed by any of the above signatories.

MCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING 1291 GROUP

Compiled By ....
Laura Parr

ALcontrol Laboratories

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Carbon Range C10-C40

Job Number : **09/06016/02/03**
Client : **SLR Consulting Ltd**
Client Ref : **404-2664-00001**
Matrix [Units] : **SOLID [mg/kg]**

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	EPH	Interpretation
87	T1A	0.6	250	kerosene
95	T1E	0.6	180	kerosene
101	T1H	1.1	44	kerosene type residues
103	T2D	0.8	220	kerosene
105	T2A	0.8	290	kerosene
111	T3A	0.8	96	kerosene type residues
115	T3C	0.8	51	kerosene type residues
129	TP2	1.2	330	kerosene type residue/humic acids
147	TP5	1.0	220	kerosene type residue/humic acids
153	TP6	0.7	97	kerosene type residues/humic acids

Extractable Petroleum Hydrocarbons (formally Diesel Range Organics) :- Any compound extractable in n-hexane within the carbon range C10-C40, includes Aliphatic (Min Oil), Aromatic (PAHs) and naturally occurring compounds.

ALcontrol Laboratories Analytical Services
Sample Descriptions

Job Number: 09/06016/02/03
Client: SLR Consulting Ltd
Client Ref : 404-2664-00001

Grain sizes

<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

Sample Identity	Depth (m)	Colour	Grain Size	Description	Batch
T1A	0.6	Brown	0.1mm - 0.063mm	Sandy Clay Loam	3
T1E	0.6	Brown	0.1mm - 0.063mm	Sandy Clay Loam	3
T1F	0.5	Brown	0.1mm - 0.063mm	Clay Loam with some Stones	3
T1G	0.8	Brown	0.1mm - 0.063mm	Sandy Clay Loam	3
T1H	1.1	Rust	0.1mm - 0.063mm	Sandy Clay Loam	3
T2A	0.8	Brown	0.1mm - 0.063mm	Sandy Clay Loam with some Stones	3
T2D	0.8	Brown	0.1mm - 0.063mm	Sandy Clay Loam with some Oil/Petroleum	3
T3A	0.8	Brown	0.1mm - 0.063mm	Sandy Clay Loam	3
T3C	0.8	Brown	0.1mm - 0.063mm	Sandy Clay Loam	3
TP2	1.2	Brown	0.1mm - 0.063mm	Silty Clay Loam with some Stones	3
TP4	1.3	Brown	0.1mm - 0.063mm	Sandy Clay Loam with some Stones	3
TP5	1.0	Brown	0.1mm - 0.063mm	Silty Clay Loam with some Stones	3
TP6	0.7	Brown	0.1mm - 0.063mm	Clay Loam	3

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.
Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.
¹ Sample Description supplied by client

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

\# ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/03	**Matrix:**	SOLID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	T1A	T1E	T1F	T1G	T1H	T2A	T2D	T3A	T3C	**Method Code**	**LoD/Units**
Depth (m)	0.6	0.6	0.5	0.8	1.1	0.8	0.8	0.8	0.8		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	29.06.09	29.06.09	30.06.09	30.06.09	30.06.09	30.06.09	30.06.09	30.06.09	29.06.09		
Sample Received Date	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09		
Batch	3	3	3	3	3	3	3	3	3		
Sample Number(s)	**87-88**	**95-96**	**97-98**	**99-100**	**101-102**	**105-106**	**103-104**	**111-112**	**115-116**		
GRO Surrogate	-	-	71	71	-	-	-	-	-	TM089	%
GRO (C4-C12)	-	-	14000	36000	-	-	-	-	-	TM089	<10 ug/kg
MTBE	-	-	<10	<10	-	-	-	-	-	TM089$^{\#}$	<10 ug/kg
Benzene	-	-	<10	<10	-	-	-	-	-	TM089$^{\#}_{M}$	<10 ug/kg
Toluene	-	-	<10	<10	-	-	-	-	-	TM089$^{\#}_{M}$	<10 ug/kg
Ethyl benzene	-	-	<10	<10	-	-	-	-	-	TM089$^{\#}_{M}$	<10 ug/kg
m & p Xylene	-	-	<10	<10	-	-	-	-	-	TM089$^{\#}_{M}$	<10 ug/kg
o Xylene	-	-	<10	<10	-	-	-	-	-	TM089$^{\#}_{M}$	<10 ug/kg
Aliphatics C5-C6	-	-	<10	<10	-	-	-	-	-	TM089	<10 ug/kg
Aliphatics >C6-C8	-	-	43	350	-	-	-	-	-	TM089	<10 ug/kg
Aliphatics >C8-C10	-	-	1100	3700	-	-	-	-	-	TM089	<10 ug/kg
Aliphatics >C10-C12	-	-	4300	11000	-	-	-	-	-	TM089	<10 ug/kg
Aliphatics >C12-C16	-	-	26000	44000	-	-	-	-	-	TM173$^{\#}$	<100 ug/kg
Aliphatics >C16-C21	-	-	5000	7500	-	-	-	-	-	TM173$^{\#}$	<100 ug/kg
Aliphatics >C21-C35	-	-	800	<100	-	-	-	-	-	TM173$^{\#}$	<100 ug/kg
Total Aliphatics C5-C35	-	-	37000	66000	-	-	-	-	-	TM61/89	<100 ug/kg
Aromatics C6-C7	-	-	<10	<10	-	-	-	-	-	TM089	<10 ug/kg
Aromatics >C7-C8	-	-	<10	<10	-	-	-	-	-	TM089	<10 ug/kg
Aromatics >EC8-EC10	-	-	1700	5500	-	-	-	-	-	TM089	<10 ug/kg
Aromatics >EC10-EC12	-	-	6400	16000	-	-	-	-	-	TM089	<10 ug/kg
Aromatics >EC12-EC16	-	-	6300	8200	-	-	-	-	-	TM173$^{\#}$	<100 ug/kg
Aromatics >EC16-EC21	-	-	2800	1200	-	-	-	-	-	TM173$^{\#}$	<100 ug/kg
Aromatics >EC21-EC35	-	-	9600	500	-	-	-	-	-	TM173$^{\#}$	<100 ug/kg
Total Aromatics C6-C35	-	-	27000	31000	-	-	-	-	-	TM61/89	<100 ug/kg
TPH (Aliphatics and Aromatics C5-C35)	-	-	64000	97000	-	-	-	-	-	TM61/89	<100 ug/kg

All results expressed on a dry weight basis.

Date 25.07.2009

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/03
Matrix: SOLID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	T1A	T1E	T1F	T1G	T1H	T2A	T2D	T3A	T3C	**Method Code**	**LoD/Units**
Depth (m)	0.6	0.6	0.5	0.8	1.1	0.8	0.8	0.8	0.8		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	29.06.09	29.06.09	30.06.09	30.06.09	30.06.09	30.06.09	30.06.09	30.06.09	29.06.09		
Sample Received Date	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09	02.07.09		
Batch	3	3	3	3	3	3	3	3	3		
Sample Number(s)	**87-88**	**95-96**	**97-98**	**99-100**	**101-102**	**105-106**	**103-104**	**111-112**	**115-116**		
EPH (DRO) (C10-C40)	250	180	-	-	44	290	220	96	51	TM061$^{\#}_{M}$	<35 mg/kg
EPH (DRO) (C10-C40) % Surrogate Recovery	100	110	-	-	100	100	100	100	100	TM061$^{\#}_{M}$	%
GRO Surrogate	110	59	-	-	81	86	69	85	88	TM089	%
GRO (C4-C10)	1400	10000	-	-	670	5300	32000	<10	<10	TM089	<10 ug/kg
GRO (C10-C12)	3400	27000	-	-	810	15000	61000	<10	<10	TM089	<10 ug/kg
Benzene	<10	<10	-	-	<10	<10	<10	<10	<10	TM089$^{\#}_{M}$	<10 ug/kg
Toluene	<10	<10	-	-	<10	<10	<10	<10	<10	TM089$^{\#}_{M}$	<10 ug/kg
Ethyl benzene	<10	<10	-	-	<10	<10	<10	<10	<10	TM089$^{\#}_{M}$	<10 ug/kg
m & p Xylene	<10	<10	-	-	<10	<10	<10	<10	<10	TM089$^{\#}_{M}$	<10 ug/kg
o Xylene	<10	<10	-	-	<10	<10	<10	<10	<10	TM089$^{\#}_{M}$	<10 ug/kg
Sum m&p and o Xylene	<10	<10	-	-	<10	<10	<10	<10	<10	TM089	<10 ug/kg
Sum of BTEX	<10	<10	-	-	<10	<10	<10	<10	<10	TM089	<10 ug/kg
MTBE	<10	<10	-	-	<10	<10	<10	<10	<10	TM089$^{\#}$	<10 ug/kg

All results expressed on a dry weight basis.

Date 25.07.2009

Validated ☑
Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

\# ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/03
Matrix: SOLID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	TP2	TP4	TP5	TP6						**Method Code**	**LoD/Units**
Depth (m)	1.2	1.3	1.0	0.7							
Sample Type	SOLID	SOLID	SOLID	SOLID							
Sampled Date	29.06.09	29.06.09	29.06.09	30.06.09							
Sample Received Date	02.07.09	02.07.09	02.07.09	02.07.09							
Batch	3	3	3	3							
Sample Number(s)	**129-130**	**141-142**	**147-148**	**153-154**							
GRO Surrogate	-	76	-	-						TM089	%
GRO (C4-C12)	-	87000	-	-						TM089	<10 ug/kg
MTBE	-	<10	-	-						TM089$^{\#}$	<10 ug/kg
Benzene	-	<10	-	-						TM089$^{\#}_{M}$	<10 ug/kg
Toluene	-	<10	-	-						TM089$^{\#}_{M}$	<10 ug/kg
Ethyl benzene	-	<10	-	-						TM089$^{\#}_{M}$	<10 ug/kg
m & p Xylene	-	<10	-	-						TM089$^{\#}_{M}$	<10 ug/kg
o Xylene	-	<10	-	-						TM089$^{\#}_{M}$	<10 ug/kg
Aliphatics C5-C6	-	<10	-	-						TM089	<10 ug/kg
Aliphatics >C6-C8	-	1200	-	-						TM089	<10 ug/kg
Aliphatics >C8-C10	-	13000	-	-						TM089	<10 ug/kg
Aliphatics >C10-C12	-	22000	-	-						TM089	<10 ug/kg
Aliphatics >C12-C16	-	100000	-	-						TM173$^{\#}$	<100 ug/kg
Aliphatics >C16-C21	-	6100	-	-						TM173$^{\#}$	<100 ug/kg
Aliphatics >C21-C35	-	<100	-	-						TM173$^{\#}$	<100 ug/kg
Total Aliphatics C5-C35	-	150000	-	-						TM61/89	<100 ug/kg
Aromatics C6-C7	-	<10	-	-						TM089	<10 ug/kg
Aromatics >C7-C8	-	<10	-	-						TM089	<10 ug/kg
Aromatics >EC8-EC10	-	19000	-	-						TM089	<10 ug/kg
Aromatics >EC10-EC12	-	33000	-	-						TM089	<10 ug/kg
Aromatics >EC12-EC16	-	21000	-	-						TM173$^{\#}$	<100 ug/kg
Aromatics >EC16-EC21	-	5800	-	-						TM173$^{\#}$	<100 ug/kg
Aromatics >EC21-EC35	-	23000	-	-						TM173$^{\#}$	<100 ug/kg
Total Aromatics C6-C35	-	100000	-	-						TM61/89	<100 ug/kg
TPH (Aliphatics and Aromatics C5-C35)	-	250000	-	-						TM61/89	<100 ug/kg

All results expressed on a dry weight basis.

Date 25.07.2009

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/03
Matrix: SOLID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	TP2	TP4	TP5	TP6						**Method Code**	**LoD/Units**
Depth (m)	1.2	1.3	1.0	0.7							
Sample Type	SOLID	SOLID	SOLID	SOLID							
Sampled Date	29.06.09	29.06.09	29.06.09	30.06.09							
Sample Received Date	02.07.09	02.07.09	02.07.09	02.07.09							
Batch	3	3	3	3							
Sample Number(s)	**129-130**	**141-142**	**147-148**	**153-154**							
EPH (DRO) (C10-C40)	330	-	220	97						TM061$^{\#}_{M}$	<35 mg/kg
EPH (DRO) (C10-C40) % Surrogate Recovery	100	-	98	110						TM061$^{\#}_{M}$	%
GRO Surrogate	69	-	77	83						TM089	%
GRO (C4-C10)	14000	-	1100	<10						TM089	<10 ug/kg
GRO (C10-C12)	31000	-	4100	<10						TM089	<10 ug/kg
Benzene	<10	-	<10	<10						TM089$^{\#}_{M}$	<10 ug/kg
Toluene	<10	-	220	<10						TM089$^{\#}_{M}$	<10 ug/kg
Ethyl benzene	<10	-	<10	<10						TM089$^{\#}_{M}$	<10 ug/kg
m & p Xylene	<10	-	<10	<10						TM089$^{\#}_{M}$	<10 ug/kg
o Xylene	<10	-	<10	<10						TM089$^{\#}_{M}$	<10 ug/kg
Sum m&p and o Xylene	<10	-	<10	<10						TM089	<10 ug/kg
Sum of BTEX	<10	-	220	<10						TM089	<10 ug/kg
MTBE	<10	-	<10	<10						TM089$^{\#}$	<10 ug/kg

All results expressed on a dry weight basis.

Date 25.07.2009

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number:	09/06016/02/03
Client:	SLR Consulting Ltd
Client Ref. No.:	404-2664-00001

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

NDP	No Determination Possible	*	Subcontracted test
ACM	Asbestos Containing Materia	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
		EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample ¹	Surrogate Corrected
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓	✓	DRY	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)			WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	
TM173		Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID	✓		DRY	
TM61/89		see TM061 and TM089 for details			WET	

¹ Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.
WET indicates samples analysed as submitted.

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/03
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
3	23.6

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

ISO 17025 accredited
M MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	LIQUID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	06402	06407	06408	06410	06412	CUT OFF TRENCH	S5	S7	T1 WATER	**Method Code**	**LoD/Units**
Depth (m)	1.253	1.030	0.535	0.742			1.002	0.636			
Sample Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID		
Sampled Date	07.08.09	07.08.09	07.08.09	07.08.09	07.08.09	10.08.09	07.08.09	07.08.09	10.08.09		
Sample Received Date	12.08.09	12.08.09	12.08.09	12.08.09	12.08.09	12.08.09	12.08.09	12.08.09	12.08.09		
Batch	4	4	4	4	4	4	4	4	4		
Sample Number(s)	**161-163**	**164-166**	**167-169**	**170-172**	**173-175**	**176-178**	**179-181**	**182-184**	**185-187**		
GRO Surrogate	41	39	35	39	38	39	40	41	38	TM089	%
GRO (C4-C12)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
MTBE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
Ethyl benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
m & p Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
o Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
Aliphatics C5-C6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aliphatics >C6-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aliphatics >C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aliphatics >C10-C12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aliphatics >C12-C16 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.06	<0.01	0.10	TM174	<0.01 mg/l
Aliphatics >C16-C21 Aqueous	<0.01	<0.01	<0.01	0.08	<0.01	<0.01	0.19	<0.01	<0.01	TM174	<0.01 mg/l
Aliphatics >C21-C35 Aqueous	<0.01	<0.01	<0.01	0.25	<0.01	<0.01	0.86	<0.01	0.30	TM174	<0.01 mg/l
Total Aliphatics C5-C35 Aqueous	<0.01	<0.01	<0.01	0.33	<0.01	<0.01	1.1	<0.01	0.39	TM61/89	<0.01 mg/l
Aromatics C6-C7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
Aromatics >C7-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089#	<0.01 mg/l
Aromatics >EC8-EC10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aromatics >EC10-EC12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aromatics >EC12-EC16 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM174	<0.01 mg/l
Aromatics >EC16-EC21 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM174	<0.01 mg/l
Aromatics >EC21-EC35 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.21	<0.01	0.06	TM174	<0.01 mg/l
Total Aromatics C6-C35 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.21	<0.01	0.06	TM61/89	<0.01 mg/l
TPH (Aliphatics and Aromatics C5-C35) Aqueou	<0.01	<0.01	<0.01	0.33	<0.01	<0.01	1.3	<0.01	0.45	TM61/89	<0.01 mg/l

Date 20.08.2009

Validated ☑
Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^\#$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	LIQUID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	T2 WATER									**Method Code**	**LoD/Units**
Depth (m)											
Sample Type	LIQUID										
Sampled Date	10.08.09										
Sample Received Date	12.08.09										
Batch	4										
Sample Number(s)	**188-190**										
GRO Surrogate	41									TM089	%
GRO (C4-C12)	<0.01									TM089$^\#$	<0.01 mg/l
MTBE	<0.01									TM089$^\#$	<0.01 mg/l
Benzene	<0.01									TM089$^\#$	<0.01 mg/l
Toluene	<0.01									TM089$^\#$	<0.01 mg/l
Ethyl benzene	<0.01									TM089$^\#$	<0.01 mg/l
m & p Xylene	<0.01									TM089$^\#$	<0.01 mg/l
o Xylene	<0.01									TM089$^\#$	<0.01 mg/l
Aliphatics C5-C6	<0.01									TM089	<0.01 mg/l
Aliphatics >C6-C8	<0.01									TM089	<0.01 mg/l
Aliphatics >C8-C10	<0.01									TM089	<0.01 mg/l
Aliphatics >C10-C12	<0.01									TM089	<0.01 mg/l
Aliphatics >C12-C16 Aqueous	<0.01									TM174	<0.01 mg/l
Aliphatics >C16-C21 Aqueous	<0.01									TM174	<0.01 mg/l
Aliphatics >C21-C35 Aqueous	<0.01									TM174	<0.01 mg/l
Total Aliphatics C5-C35 Aqueous	<0.01									TM61/89	<0.01 mg/l
Aromatics C6-C7	<0.01									TM089$^\#$	<0.01 mg/l
Aromatics >C7-C8	<0.01									TM089$^\#$	<0.01 mg/l
Aromatics >EC8-EC10	<0.01									TM089	<0.01 mg/l
Aromatics >EC10-EC12	<0.01									TM089	<0.01 mg/l
Aromatics >EC12-EC16 Aqueous	<0.01									TM174	<0.01 mg/l
Aromatics >EC16-EC21 Aqueous	<0.01									TM174	<0.01 mg/l
Aromatics >EC21-EC35 Aqueous	<0.01									TM174	<0.01 mg/l
Total Aromatics C6-C35 Aqueous	<0.01									TM61/89	<0.01 mg/l
TPH (Aliphatics and Aromatics C5-C35) Aqueous	<0.01									TM61/89	<0.01 mg/l

Date 20.08.2009

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03×10^{-7}

NDP	No Determination Possible	*	Subcontracted test
ACM	Asbestos Containing Materia	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
		EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample ¹	Surrogate Corrected
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)			NA	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		NA	
TM174		Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID			NA	
TM61/89		see TM061 and TM089 for details			NA	

¹ Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.
WET indicates samples analysed as submitted.

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
4	16.4

ALcontrol Laboratories

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Carbon Range C10-C40

Job Number : 09/06016/02/01
Client : SLR Consulting Ltd
Client Ref : 404-2664-00001
Matrix [Units] : SOLID [mg/kg]

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	EPH	Interpretation
194	CUT OFF BACKFILL A		130	PAH's/humic acids
198	T1 BACKFILL A		71	kerosene type residues/humic acids
212	T2 BACKFILL A		150	PAH's/humic acids

Extractable Petroleum Hydrocarbons (formally Diesel Range Organics) :- Any compound extractable in n-hexane within the carbon range C10-C40, includes Aliphatic (Min Oil), Aromatic (PAHs) and naturally occurring compounds.

ALcontrol Laboratories Analytical Services
Sample Descriptions

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref : 404-2664-00001

Grain sizes

<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

Sample Identity	Depth (m)	Colour	Grain Size	Description	Batch
CUT OFF BACKFILL A		Brown	0.1mm - 0.063mm	Silty Clay with some Stones	5
T1 BACKFILL A		Brown	0.1mm - 0.063mm	Silty Clay	5
T1A REPEAT		Brown	0.1mm - 0.063mm	Silty Clay	5
T1E REPEAT		Brown	0.1mm - 0.063mm	Silty Clay	5
T1F REPEAT	0.5	Brown	<0.063mm	Clay Loam	5
T1G REPEAT	0.9	Brown	0.1mm - 0.063mm	Silty Clay	5
T1H REPEAT	1.1	Brown	0.1mm - 0.063mm	Silty Clay	5
T2 BACKFILL A		Brown	0.1mm - 0.063mm	Silty Clay with some Stones	5
T2A REPEAT	0.8	Brown	0.1mm - 0.063mm	Silty Clay	5
T2D REPEAT	0.8	Brown	0.1mm - 0.063mm	Silty Clay	5

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.
Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.
[1] Sample Description supplied by client

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/01
Matrix: SOLID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	CUT OFF BACKFIL L A	T1 BACKFIL L A	T1A REPEAT	T1E REPEAT	T1F REPEAT	T1G REPEAT	T1H REPEAT	T2 BACKFIL L A	T2A REPEAT	**Method Code**	**LoD/Units**
Depth (m)					0.5	0.9	1.1		0.8		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09		
Sample Received Date	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09		
Batch	5	5	5	5	5	5	5	5	5		
Sample Number(s)	**194-195**	**198-199**	**202-203**	**204-205**	**206-207**	**208-209**	**210-211**	**212-213**	**216-217**		
GRO Surrogate	-	-	110	120	130	130	140	-	110	TM089	%
GRO (C4-C12)	-	-	36	67	31	53	<0.01	-	8.1	TM089	<0.01 mg/kg
MTBE	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089$^{\#}$	<0.01 mg/kg
Benzene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
Toluene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
Ethyl benzene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
m & p Xylene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
o Xylene	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089$^{\#}_{M}$	<0.01 mg/kg
Aliphatics C5-C6	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089	<0.01 mg/kg
Aliphatics >C6-C8	-	-	<0.01	1.7	<0.01	0.11	<0.01	-	<0.01	TM089	<0.01 mg/kg
Aliphatics >C8-C10	-	-	3.5	0.63	3.1	6.1	<0.01	-	0.68	TM089	<0.01 mg/kg
Aliphatics >C10-C12	-	-	11	26	9.1	15	<0.01	-	2.6	TM089	<0.01 mg/kg
Aliphatics >C12-C16	-	-	26	88	28	79	80	-	3.2	TM173$^{\#}$	<0.1 mg/kg
Aliphatics >C16-C21	-	-	1.7	4.2	<0.1	3.1	4.2	-	0.5	TM173$^{\#}$	<0.1 mg/kg
Aliphatics >C21-C35	-	-	1.1	2.0	1.3	0.5	1.4	-	<0.1	TM173$^{\#}$	<0.1 mg/kg
Total Aliphatics C5-C35	-	-	43	120	41	100	85	-	6.9	TM61/89	<0.1 mg/kg
Aromatics C6-C7	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089	<0.01 mg/kg
Aromatics >C7-C8	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	-	<0.01	TM089	<0.01 mg/kg
Aromatics >EC8-EC10	-	-	5.2	0.94	4.7	9.2	<0.01	-	1.0	TM089	<0.01 mg/kg
Aromatics >EC10-EC12	-	-	17	38	14	23	<0.01	-	3.9	TM089	<0.01 mg/kg
Aromatics >EC12-EC16	-	-	<0.1	16	6.4	6.9	6.9	-	<0.1	TM173$^{\#}$	<0.1 mg/kg
Aromatics >EC16-EC21	-	-	<0.1	0.8	1.6	0.5	<0.1	-	<0.1	TM173$^{\#}$	<0.1 mg/kg
Aromatics >EC21-EC35	-	-	3.2	<0.1	3.8	3.9	4.9	-	<0.1	TM173$^{\#}$	<0.1 mg/kg
Total Aromatics C6-C35	-	-	25	56	30	43	12	-	4.9	TM61/89	<0.1 mg/kg
TPH (Aliphatics and Aromatics C5-C35)	-	-	68	180	71	150	97	-	12	TM61/89	<0.1 mg/kg

All results expressed on a dry weight basis.

Date 28.10.2009

Validated ☑
Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/01
Matrix: SOLID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	CUT OFF BACKFILL A	T1 BACKFILL A	T1A REPEAT	T1E REPEAT	T1F REPEAT	T1G REPEAT	T1H REPEAT	T2 BACKFILL A	T2A REPEAT	**Method Code**	**LoD/Units**
Depth (m)					0.5	0.9	1.1		0.8		
Sample Type	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID		
Sampled Date	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09		
Sample Received Date	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09		
Batch	5	5	5	5	5	5	5	5	5		
Sample Number(s)	**194-195**	**198-199**	**202-203**	**204-205**	**206-207**	**208-209**	**210-211**	**212-213**	**216-217**		
EPH (DRO) (C10-C40)	130	71	-	-	-	-	-	150	-	TM061$^{\#}_{M}$	<35 mg/kg
EPH (DRO) (C10-C40) % Surrogate Recovery	100	100	-	-	-	-	-	96	-	TM061$^{\#}_{M}$	%
EPH C10-12	<35	<35	-	-	-	-	-	<35	-	TM061$^{\#}$	<35 mg/kg
EPH >C12-16	<35	<35	-	-	-	-	-	<35	-	TM061$^{\#}$	<35 mg/kg
EPH >C16-21	<35	<35	-	-	-	-	-	<35	-	TM061$^{\#}$	<35 mg/kg
EPH >C21-40	100	<35	-	-	-	-	-	83	-	TM061$^{\#}$	<35 mg/kg
GRO Surrogate	79	110	-	-	-	-	-	84	-	TM089	%
GRO (C4-C10)	<0.01	9.2	-	-	-	-	-	0.05	-	TM089	<0.01 mg/kg
GRO (C10-C12)	<0.01	20	-	-	-	-	-	0.11	-	TM089	<0.01 mg/kg
Benzene	<0.01	<0.01	-	-	-	-	-	<0.01	-	TM089$^{\#}_{M}$	<0.01 mg/kg
Toluene	<0.01	<0.01	-	-	-	-	-	<0.01	-	TM089$^{\#}_{M}$	<0.01 mg/kg
Ethyl benzene	<0.01	<0.01	-	-	-	-	-	<0.01	-	TM089$^{\#}_{M}$	<0.01 mg/kg
m & p Xylene	<0.01	<0.01	-	-	-	-	-	<0.01	-	TM089$^{\#}_{M}$	<0.01 mg/kg
o Xylene	<0.01	<0.01	-	-	-	-	-	<0.01	-	TM089$^{\#}_{M}$	<0.01 mg/kg
Sum m&p and o Xylene	<0.01	<0.01	-	-	-	-	-	<0.01	-	TM089	<0.01 mg/kg
Sum of BTEX	<0.01	<0.01	-	-	-	-	-	<0.01	-	TM089	<0.01 mg/kg
MTBE	<0.01	<0.01	-	-	-	-	-	<0.01	-	TM089$^{\#}$	<0.01 mg/kg

All results expressed on a dry weight basis.

Date 28.10.2009

Validated ☑
Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/01
Matrix: SOLID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	T2D REPEAT									**Method Code**	**LoD/Units**
Depth (m)	0.8										
Sample Type	SOLID										
Sampled Date	16.10.09										
Sample Received Date	20.10.09										
Batch	5										
Sample Number(s)	**218-219**										
GRO Surrogate	130									TM089	%
GRO (C4-C12)	100									TM089	<0.01 mg/kg
MTBE	<0.01									TM089$^{\#}$	<0.01 mg/kg
Benzene	<0.01									TM089$^{\#}_{M}$	<0.01 mg/kg
Toluene	<0.01									TM089$^{\#}_{M}$	<0.01 mg/kg
Ethyl benzene	<0.01									TM089$^{\#}_{M}$	<0.01 mg/kg
m & p Xylene	<0.01									TM089$^{\#}_{M}$	<0.01 mg/kg
o Xylene	<0.01									TM089$^{\#}_{M}$	<0.01 mg/kg
Aliphatics C5-C6	<0.01									TM089	<0.01 mg/kg
Aliphatics >C6-C8	2.9									TM089	<0.01 mg/kg
Aliphatics >C8-C10	21									TM089	<0.01 mg/kg
Aliphatics >C10-C12	19									TM089	<0.01 mg/kg
Aliphatics >C12-C16	88									TM173$^{\#}$	<0.1 mg/kg
Aliphatics >C16-C21	5.5									TM173$^{\#}$	<0.1 mg/kg
Aliphatics >C21-C35	1.0									TM173$^{\#}$	<0.1 mg/kg
Total Aliphatics C5-C35	140									TM61/89	<0.1 mg/kg
Aromatics C6-C7	<0.01									TM089	<0.01 mg/kg
Aromatics >C7-C8	<0.01									TM089	<0.01 mg/kg
Aromatics >EC8-EC10	31									TM089	<0.01 mg/kg
Aromatics >EC10-EC12	29									TM089	<0.01 mg/kg
Aromatics >EC12-EC16	23									TM173$^{\#}$	<0.1 mg/kg
Aromatics >EC16-EC21	7.6									TM173$^{\#}$	<0.1 mg/kg
Aromatics >EC21-EC35	25									TM173$^{\#}$	<0.1 mg/kg
Total Aromatics C6-C35	120									TM61/89	<0.1 mg/kg
TPH (Aliphatics and Aromatics C5-C35)	250									TM61/89	<0.1 mg/kg

All results expressed on a dry weight basis.

Date 28.10.2009

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number: 09/06016/02/01
Matrix: LIQUID
Client: SLR Consulting Ltd
Location: APPLE TREE HOUSE
Client Ref. No.: 404-2664-00001
Client Contact: Matt Drage

Sample Identity	06402	06407	06408	06410	06412	S5	S7	**Method Code**	**LoD/Units**
Depth (m)	1.712	1.023	0.792	1.068	1.923	1.048	0.900		
Sample Type	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID	LIQUID		
Sampled Date	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09	16.10.09		
Sample Received Date	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09	20.10.09		
Batch	5	5	5	5	5	5	5		
Sample Number(s)	**220-222**	**223-225**	**226-228**	**229-231**	**232-234**	**235-237**	**238-240**		
GRO Surrogate	83	79	83	85	97	98	96	TM089	%
GRO (C4-C12)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
MTBE	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
Ethyl benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
m & p Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
o Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
Aliphatics C5-C6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aliphatics >C6-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aliphatics >C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aliphatics >C10-C12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aliphatics >C12-C16 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM174	<0.01 mg/l
Aliphatics >C16-C21 Aqueous	0.05	<0.01	0.03	<0.01	<0.01	0.06	0.06	TM174	<0.01 mg/l
Aliphatics >C21-C35 Aqueous	0.26	<0.01	0.13	<0.01	<0.01	0.45	0.26	TM174	<0.01 mg/l
Total Aliphatics C5-C35 Aqueous	0.31	<0.01	0.16	<0.01	<0.01	0.51	0.33	TM61/89	<0.01 mg/l
Aromatics C6-C7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
Aromatics >C7-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089$^{\#}$	<0.01 mg/l
Aromatics >EC8-EC10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aromatics >EC10-EC12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	TM089	<0.01 mg/l
Aromatics >EC12-EC16 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	0.02	<0.01	TM174	<0.01 mg/l
Aromatics >EC16-EC21 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	TM174	<0.01 mg/l
Aromatics >EC21-EC35 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	0.19	<0.01	TM174	<0.01 mg/l
Total Aromatics C6-C35 Aqueous	<0.01	<0.01	<0.01	<0.01	<0.01	0.24	<0.01	TM61/89	<0.01 mg/l
TPH (Aliphatics and Aromatics C5-C35) Aqueou	0.31	<0.01	0.16	<0.01	<0.01	0.75	0.33	TM61/89	<0.01 mg/l

Date 28.10.2009

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03x10^{-7}

NDP	No Determination Possible	*	Subcontracted test
ACM	Asbestos Containing Materia	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
		EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample [1]	Surrogate Corrected
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓		DRY	
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓	✓	DRY	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)			WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	
TM173		Determination of Speciated Extractable Petroleum Hydrocarbons in Soils by GC-FID	✓		DRY	
TM174		Determination of Speciated Extractable Petroleum Hydrocarbons in Waters by GC-FID			NA	
TM61/89		see TM061 and TM089 for details			WET	

[1] Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.
WET indicates samples analysed as submitted.

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
5	5.6

ALcontrol Laboratories

Extractable Petroleum Hydrocarbons (EPH) By GC-FID

Carbon Range C10-C40

Job Number : **09/06016/02/01**
Client : **SLR Consulting Ltd**
Client Ref : **404-2664-00001**
Matrix [Units] : **SOLID [mg/kg]**

All results expressed on a dry weight basis.

Sample No	Sample Identity	Depth	EPH	Interpretation
241	CONIFER 1	0.5	370	pahs/unknown pattern
245	CONIFER 2	0.4	140	possible kerosene type residue
248	CONIFER 3	0.4	390	PAH's/humic acids

Extractable Petroleum Hydrocarbons (formally Diesel Range Organics) :- Any compound extractable in n-hexane within the carbon range C10-C40, includes Aliphatic (Min Oil), Aromatic (PAHs) and naturally occurring compounds.

ALcontrol Laboratories Analytical Services
Sample Descriptions

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref : 404-2664-00001

Grain sizes

<0.063mm	Very Fine
0.1mm - 0.063mm	Fine
0.1mm - 2mm	Medium
2mm - 10mm	Coarse
>10mm	Very Coarse

Sample Identity	Depth (m)	Colour	Grain Size	Description	Batch
CONIFER 1	0.5	Dark Brown	0.1mm - 0.063mm	Clay Loam with some Vegetation	6
CONIFER 2	0.4	Brown	0.1mm - 0.063mm	Clay Loam with some Vegetation	6
CONIFER 3	0.4	Dark Brown	0.1mm - 0.063mm	Clay Loam with some Vegetation	6

* These descriptions are only intended to act as a cross check if sample identities are questioned, and to provide a log of sample matrices with respect to MCERTS validation. They are not intended as full geological descriptions.

We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials-whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample.
Other coarse granular materials such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

[1] Sample Description supplied by client

Validated ☑

Preliminary ☐

ALcontrol Laboratories Analytical Services
Table Of Results

$^{\#}$ ISO 17025 accredited
^{M} MCERTS accredited
* Subcontracted test
» Shown on prev. report

Job Number:	09/06016/02/01	**Matrix:**	SOLID
Client:	SLR Consulting Ltd	**Location:**	APPLE TREE HOUSE
Client Ref. No.:	404-2664-00001	**Client Contact:**	Matt Drage

Sample Identity	CONIFER 1	CONIFER 2	CONIFER 3								**Method Code**	**LoD/Units**
Depth (m)	0.5	0.4	0.4									
Sample Type	SOLID	SOLID	SOLID									
Sampled Date	05.11.09	05.11.09	05.11.09									
Sample Received Date	07.11.09	07.11.09	07.11.09									
Batch	6	6	6									
Sample Number(s)	**241-244**	**245-247**	**248-250**									
EPH (DRO) (C10-C40)	370	140	390								TM061$^{\#}_{M}$	<35 mg/kg
EPH (DRO) (C10-C40) % Surrogate Recovery	96	93	93								TM061$^{\#}_{M}$	%
EPH C10-12	<35	<35	<35								TM061$^{\#}$	<35 mg/kg
EPH >C12-16	55	50	73								TM061$^{\#}$	<35 mg/kg
EPH >C16-21	54	<35	43								TM061$^{\#}$	<35 mg/kg
EPH >C21-40	240	63	260								TM061$^{\#}$	<35 mg/kg
GRO Surrogate	77	96	72								TM089	%
GRO (C4-C10)	3.2	4.6	<0.01								TM089	<0.01 mg/kg
GRO (C10-C12)	14	12	<0.01								TM089	<0.01 mg/kg
Benzene	<0.01	<0.01	<0.01								TM089$^{\#}_{M}$	<0.01 mg/kg
Toluene	<0.01	<0.01	<0.01								TM089$^{\#}_{M}$	<0.01 mg/kg
Ethyl benzene	<0.01	<0.01	<0.01								TM089$^{\#}_{M}$	<0.01 mg/kg
m & p Xylene	<0.01	<0.01	<0.01								TM089$^{\#}_{M}$	<0.01 mg/kg
o Xylene	<0.01	<0.01	<0.01								TM089$^{\#}_{M}$	<0.01 mg/kg
Sum m&p and o Xylene	<0.01	<0.01	<0.01								TM089	<0.01 mg/kg
Sum of BTEX	<0.01	<0.01	<0.01								TM089	<0.01 mg/kg
MTBE	<0.01	<0.01	<0.01								TM089$^{\#}$	<0.01 mg/kg

All results expressed on a dry weight basis.

Date 17.11.2009

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number:	09/06016/02/01
Client:	SLR Consulting Ltd
Client Ref. No.:	404-2664-00001

Report Key :

Results expressed as (e.g.) 1.03E-07 is equivalent to 1.03x10^{-7}

NDP	No Determination Possible	*	Subcontracted test
ACM	Asbestos Containing Materia	»	Result previously reported (Incremental reports only)
#	ISO 17025 accredited	M	MCERTS Accredited
		EC	Equivalent Carbon (Aromatics C8-C35)

Note: Method detection limits are not always achievable due to various circumstances beyond our control.

Summary of Method Codes contained within report :

Method No.	Reference	Description	ISO 17025 Accredited	MCERTS Accredited	Wet/Dry Sample ¹	Surrogate Corrected
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓		DRY	
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)	✓	✓	DRY	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)			WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓		WET	
TM089	Modified: US EPA Methods 8020 & 602	Determination of Gasoline Range Hydrocarbons (GRO) and BTEX (MTBE) compounds by Headspace GC-FID (C4-C12)	✓	✓	WET	

¹ Applies to Solid samples only. **DRY** indicates samples have been dried at 35°C. **NA** = not applicable.
WET indicates samples analysed as submitted.

ALcontrol Laboratories Analytical Services
Table Of Results - Appendix

Job Number: 09/06016/02/01
Client: SLR Consulting Ltd
Client Ref. No.: 404-2664-00001

Summary of Coolbox temperatures

Batch No.	Coolbox Temperature (°C)
6	6.8

APPENDIX

APPENDIX

1. Results are expressed on a dry weight basis (dried at 35°C) for all soil analyses except for the following: NRA Leach tests, flash point, ammonium as NH_4 by the BRE method, VOC TICS, SVOC TICS, TOF-MS SCAN/SEARCH and TOF-MS TICS.
2. Samples will be run in duplicate upon request, but an additional charge may be incurred.
3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for both soil jars, tubs and volatile jars. All waters and vials will be discarded 10 days after the analysis is completed (e-mailed). All material removed during an asbestos containing material screen and analysed for the presence of asbestos will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALcontrol Laboratories reserve the right to charge for samples received and stored but not analysed.
4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.
5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.
6. When requested, the individual sub sample scheduled will be screened in house for the presence of large asbestos containing material fragments/pieces. If no asbestos containing material is found this will be reported as ‘no asbestos containing material detected’. If asbestos containing material is detected it will be removed and analysed by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If asbestos containing material is present no analysis will be undertaken. At no point is the fibre content of the soil sample determined.
7. If no separate volatile sample is supplied by the client, the integrity of the data may be compromised if the laboratory is required to create a sub-sample from the bulk sample – similarly, if a headspace or sediment is present in the volatile sample. This will be flagged up as an invalid VOC on the test schedule or recorded on the log sheet.
8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.
9. NDP – No determination possible due to insufficient/unsuitable sample.
10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals – total metals must be requested separately.
11. A table containing the date of analysis for each parameter is not routinely included with the report, but is available upon request.
12. **Surrogate recoveries** – Most of our organic methods include surrogates, the recovery of which is monitored, but not corrected or reported.
    For EPH, MO, PAH, GRO and VOCs on soils the result is not surrogate corrected, but a percentage recovery is quoted.
13. **Product analyses** – Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.
14. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).
15. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 14).
16. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.
17. Our MCERTS accreditation for PAHs by GCMS applies to all product types apart from Kerosene, where naphthalene only is not accredited.
18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.
19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.
20. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.
21. For all leachate preparations (NRA, DIN, TCLP, BSEN 12457-1, 2, 3) volatile loss may occur, as we do not employ zero headspace extraction.
22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials – whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.
23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C4 – C10 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

Last updated April 2009

LIQUID MATRICES EXTRACTION SUMMARY

ANALYSIS	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
PAH MS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC MS
EPH	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
EPH CWG	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
MINERAL OIL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC FID
PCB 7 CONGENERS	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GC MS
PCB TOTAL	HEXANE	STIRRED EXTRACTION (STIR-BAR)	GS MS
SVOC	DCM	LIQUID/LIQUID SHAKEN SVOC	GC MS
FREE SULPHUR	DCM	SOLID PHASE EXTRACTION	HPLC
PEST OCP/OPP	DCM/EA	SOLID PHASE EXTRACTION	GC MS
TRIAZINE HERBS	DCM/EA	SOLID PHASE EXTRACTION	GC MS
PHENOLS MS	DCM	SOLID PHASE EXTRACTION	GC MS
TPH by INFRA RED (IR)	TCE	LIQUID/LIQUID EXTRACTION	HPLC
MINERAL OIL by IR	TCE	LIQUID/LIQUID EXTRACTION	HPLC
SAPONIFIABLE	TCE	LIQUID/LIQUID EXTRACTION	HPLC
UNSAPONIFIABLE	TCE	LIQUID/LIQUID EXTRACTION	HPLC
GLYCOLS	DCM	LIQUID/LIQUID EXTRACTION	EZ FLASH

SOLID MATRICES EXTRACTION SUMMARY

ANALYSIS	D/C OR WET	EXTRACTION SOLVENT	EXTRACTION METHOD	ANALYSIS
Solvent Extractable Matter	D&C	DCM	SOXTHERM	GRAVIMETRIC
Cyclohexane Ext. Matter	D&C	CYCLOHEXANE	SOXTHERM	GRAVIMETRIC
Thin Layer Chromatography	D&C	DCM	SOXTHERM	IATROSCAN
Elemental Sulphur	D&C	DCM	SOXTHERM	HPLC
Phenols by GCMS	WET	DCM	SOXTHERM	GC-MS
Herbicides	D&C	HEXANE:ACETONE	SOXTHERM	GC-MS
Pesticides	D&C	HEXANE:ACETONE	SOXTHERM	GC-MS
EPH (DRO)	D&C	HEXANE:ACETONE	END OVER END	GC-FID
EPH (Min oil)	D&C	HEXANE:ACETONE	END OVER END	GC-FID
EPH (Cleaned up)	D&C	HEXANE:ACETONE	END OVER END	GC-FID
EPH CWG by GC	D&C	HEXANE:ACETONE	END OVER END	GC-FID
PCB tot / PCB con	D&C	HEXANE:ACETONE	END OVER END	GC-MS
Polyaromatic Hydrocarbons (MS)	D&C	HEXANE:ACETONE	Microwave TM218.	GC-MS
C8-C40 (C6-C40)EZ Flash	WET	HEXANE:ACETONE	SHAKER	GC-EZ
Polyaromatic Hydrocarbons Rapid GC	WET	HEXANE:ACETONE	SHAKER	GC-EZ
Semi Volatile Organic Compounds	WET	DCM:ACETONE	SONICATE	GC-MS

Last updated April 2009

gradko environmental
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tel.: 01962 860331 fax: 01962 841339 e-mail:diffusion@gradko.co.uk

UKAS TESTING
2187

LABORATORY ANALYSIS REPORT

REPORT NUMBER	**GCMS 3765**
CUSTOMER	**SLR Consulting Ltd** **Brockhill Court** **Brockhill Lane** **Redditch B97 6RB**
GRADKO LAB REFERENCE	**GMSD 1479-1482**
DATE SAMPLES RECEIVED	**22.05.09**
DESPATCH REF.NUMBER	**S0R000958**
BOOKING IN REF.	**C 2893**

SEMI-QUANTITATIVE ANALYSIS FOR BANDED HYDROCARBONS AND QUANTITATIVE ANALYSIS FOR BTEX ON TENAX DIFFUSION TUBES BY GC/MS

Tube Number	**GRA 04630**
Sample Volume (L)	**2.25**
Sample ID	**Apple Tree House 51**

BTEX	**ng on tube**	**µgm-3***
Benzene	7.41	3.29
Toluene	68.56	30.47
Ethylbenzene	4.45	1.98
p-Xylene	13.66	6.07
o-Xylene	5.03	2.24

C5-C7 Aliphatic Hydrocarbons	**ng on tube**	**µgm-3***
Hexane, 3-methyl-	896.34	398.37
Hexane, 2-methyl-	626.57	278.48
Heptane	492.86	219.05
Pentane, 2,3-dimethyl-	340.88	151.50
Cyclohexane, methyl-	276.91	123.07
Cyclopentane, 1,2-dimethyl-	122.16	54.29
Pentane, 3,3-dimethyl-	86.59	38.48
Cyclopentane, 1,3-dimethyl-	80.71	35.87
Hexane	46.07	20.47

The Diffusion Tubes have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures calculations and assessments involving the exposure procedures and periods provided by the client are not within the scope of our UKAS accreditation. Those results obtained using exposure data shall be indicated by an asterisk. Any queries concerning the data in this report should be directed to the Laboratory Manager Gradko International Ltd.

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LABORATORY ANALYSIS REPORT

Cyclopentane, methyl-	36.82	16.36
Cyclopentane, ethyl-	30.82	13.70
Pentane, 2-methyl-	25.15	11.18
Pentane, 3-methyl-	25.01	11.12
Pentane, 2,2-dimethyl-	22.99	10.22
Pentane, 2,4-dimethyl-	19.94	8.86
Butane, 2,2,3-trimethyl-	5.92	2.63

C8-C10 Aliphatic Hydrocarbons	**ng on tube**	**µgm-3***
Cyclohexane, 1,3-dimethyl-, cis-	80.70	35.87
Cyclohexane, 1,2-dimethyl-, trans-	50.64	22.50
Hexane, 2,4-dimethyl-	40.59	18.04
Heptane, 3-methyl-	39.65	17.62
Cyclohexane, 1,1,3-trimethyl-	29.45	13.09
Cyclohexane, ethyl-	26.13	11.61
Nonane, 4-methyl-	26.07	11.59
Cyclopentane, 1,2,3-trimethyl-, (1.alpha.,2.alpha.,3.beta.)-	24.77	11.01
Cyclohexane, 1,1-dimethyl-	23.35	10.38
Hexane, 2,5-dimethyl-	22.47	9.99
Pentane, 2,2,4-trimethyl-	19.43	8.64
Cyclohexane, 1,4-dimethyl-, cis-	17.94	7.97
Octane, 4-methyl-	17.66	7.85
Hexane, 2,3-dimethyl-	15.21	6.76
Heptane, 2,6-dimethyl-	14.21	6.32
Nonane, 3-methyl-	12.87	5.72
Heptane, 2,3-dimethyl-	9.68	4.30
Cyclohexane, 1,2-dimethyl-, cis-	8.26	3.67
Cyclohexane, 1-ethyl-2-methyl-, cis-	6.02	2.68
Pentane, 2,3,3-trimethyl-	3.39	1.51
Cyclohexane, 1-ethyl-2-methyl-	3.14	1.39

C11-C12 Aliphatic Hydrocarbons	**ng on tube**	**µgm-3***
Decane, 4-methyl-	23.17	10.30

C8-C10 Aromatic Hydrocarbons	**ng on tube**	**µgm-3***
Benzene, 1,2,4-trimethyl-	19.39	8.62

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LABORATORY ANALYSIS REPORT

	ng on tube	µgm-3*
D-Limonene	11.54	5.13

Tube Number	**GRA 06060**
Sample Volume (L)	**2.31**
Sample ID	**Apple Tree House 52**

BTEX	ng on tube	µgm-3*
Benzene	< LOD	< LOD
Toluene	1.33	0.58
Ethylbenzene	< LOD	< LOD
p-Xylene	< LOD	< LOD
o-Xylene	< LOD	< LOD

C5-C7 Aliphatic Hydrocarbons	ng on tube	µgm-3*
Hexane, 3-methyl-	4.41	1.91
C8-C10 Aliphatic Hydrocarbons	< LOD	< LOD
C11-C12 Aliphatic Hydrocarbons	< LOD	< LOD
C8-C10 Aromatic Hydrocarbons	< LOD	< LOD
C11-C12 Aromatic Hydrocarbons	< LOD	< LOD
D-Limonene	< LOD	< LOD

Tube Number	**GRA 04287**
Sample Volume (L)	
Sample ID	**Apple Tree House Handling Blank**

BTEX	ng on tube
Benzene	< LOD
Toluene	1.57
Ethylbenzene	< LOD
p-Xylene	< LOD
o-Xylene	< LOD

LABORATORY ANALYSIS REPORT

C5-C7 Aliphatic Hydrocarbons	< LOD
C8-C10 Aliphatic Hydrocarbons	< LOD
C11-C12 Aliphatic Hydrocarbons	< LOD
C8-C10 Aromatic Hydrocarbons	< LOD
C11-C12 Aromatic Hydrocarbons	< LOD
D-Limonene	< LOD

Tube Number	**GRA 04039**
Sample Volume (L)	
Sample ID	**Apple Tree House Travel Blank**

BTEX	ng on tube
Benzene	< LOD
Toluene	< LOD
Ethylbenzene	< LOD
p-Xylene	< LOD
o-Xylene	< LOD
C5-C7 Aliphatic Hydrocarbons	< LOD
C8-C10 Aliphatic Hydrocarbons	< LOD
C11-C12 Aliphatic Hydrocarbons	< LOD
C8-C10 Aromatic Hydrocarbons	< LOD
C11-C12 Aromatic Hydrocarbons	< LOD
D-Limonene	< LOD

Comment:Results are not Blank corrected.

LABORATORY ANALYSIS REPORT

Where <LOD = below limit of detection.
Limits of Detection:
Semi-Quantitative Analysis 1.10ng
Benzene 2.57ng
Toluene 1.10ng
Ethylbenzene 1.30ng
p-Xylene 2.70ng
o-Xylene 1.00ng

Overall MOU 19.77%+- for quantitative analysis.
MOU 5.91%+-(Unspecified peak-Toluene)

Analyst Name M. Angelova	**Date of Analysis**	**01.06.09**
Analyst Signature	**Date of Report**	**03.06.09**

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(A division of Gradko International Ltd.)

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UKAS TESTING
2187

LABORATORY ANALYSIS REPORT

REPORT NUMBER **AMENDMENT2 TO LABORATORY REPORT PE5MS 0145**
CUSTOMER **SLR Consulting Ltd**
Brockhill Court
Brockhill Lane
Redditch B97 6RB
GRADKO LAB REFERENCE **PE5D 0416-0419**
DATE SAMPLES RECEIVED **30.06.09**
DESPATCH REF.NUMBER **S0R001396**
BOOKING IN REF. **C 3644**

SEMI-QUANTITATIVE ANALYSIS FOR BANDED HYDROCARBONS AND QUANTITATIVE ANALYSIS FOR BTEX ON TENAX DIFFUSION TUBES BY GC/MS

Tube Number	**GRA 04802**
Sample Volume (L)	**2.29**
Sample ID	**Apple Tree House S1**

BTEX	**ng on tube**	**µgm-3***
Benzene	2.13	0.93
Toluene	13.94	6.09
Ethylbenzene	4.76	2.08
m/p-Xylene	13.20	5.76
o-Xylene	7.56	3.30

C5-C7 Aliphatic Hydrocarbons	**ng on tube**	**µgm-3***
1-Pentene, 2-methyl-	12.47	5.44
Cyclohexane, methyl-	6.43	2.81
Cyclopentane, methyl-	4.02	1.76
Pentane, 3-methyl-	1.74	0.76
Hexane, 3-methyl-	34.12	14.90
Hexane, 2-methyl-	24.21	10.57
Pentane, 2,3-dimethyl-	11.37	4.97
Heptane	8.39	3.66

The Diffusion Tubes have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures calculations and assessments involving the exposure procedures and periods provided by the client are not within the scope of our UKAS accreditation. Those results obtained using exposure data shall be indicated by an asterisk. Any queries concerning the data in this report should be directed to the Laboratory Manager Gradko International Ltd.

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LABORATORY ANALYSIS REPORT

C8-C10 Aliphatic Hydrocarbons	**ng on tube**	**µgm-3***
Heptane, 4-methyl-	26.64	11.64
Cyclohexane, ethyl-	4.18	1.83
Heptane, 3-methyl-	3.91	1.71
Heptane, 2,4-dimethyl-	71.15	31.07
2,4-Dimethyl-1-heptene	62.29	27.20
Heptane, 2,3-dimethyl-	13.83	6.04
Nonane	12.28	5.36
Nonane, 4-methyl-	8.46	3.69
1-Ethyl-3-methylcyclohexane (c,t)	2.75	1.20
1-Ethyl-4-methylcyclohexane	2.40	1.05

C11-C12 Aliphatic Hydrocarbons	**ng on tube**	**µgm-3***
Dodecane	6.41	2.80

C8-C10 Aromatic Hydrocarbons	**ng on tube**	**µgm-3***
Benzene, 1,2,3-trimethyl-	11.29	4.93
Benzene, (1-methylethyl)-	9.97	4.35

C11-C12 Aromatic Hydrocarbons	Not detected	

	ng on tube	**µgm-3***
Limonene	30.49	13.31

Tube Number	**GRA 02464**
Sample Volume (L)	**2.29**
Sample ID	**Apple Tree House S2**

BTEX	**ng on tube**	**µgm-3***
Benzene	<LOD	<LOD
Toluene	1.66	0.72
Ethylbenzene	<LOD	<LOD
m/p-Xylene	<LOD	<LOD
o-Xylene	<LOD	<LOD

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LABORATORY ANALYSIS REPORT

C5-C7 Aliphatic Hydrocarbons	<LOD	<LOD
C8-C10 Aliphatic Hydrocarbons	<LOD	<LOD
C11-C12 Aliphatic Hydrocarbons	<LOD	<LOD
C8-C10 Aromatic Hydrocarbons	<LOD	<LOD
C11-C12 Aromatic Hydrocarbons	<LOD	<LOD
Limonene	<LOD	<LOD

Tube Number	**GRA 02825**
Sample Volume (L)	
Sample ID	**Apple Tree House Handling Blank**

BTEX	**ng on tube**
Benzene	2.08
Toluene	<LOD
Ethylbenzene	<LOD
m/p-Xylene	<LOD
o-Xylene	<LOD
C5-C7 Aliphatic Hydrocarbons	<LOD
C8-C10 Aliphatic Hydrocarbons	<LOD
C11-C12 Aliphatic Hydrocarbons	<LOD
C8-C10 Aromatic Hydrocarbons	<LOD
C11-C12 Aromatic Hydrocarbons	<LOD

Tube Number	**GRA 02369**
Sample Volume (L)	
Sample ID	**Apple Tree House Travel Blank**

LABORATORY ANALYSIS REPORT

BTEX	**ng on tube**
Benzene	<LOD
Toluene	<LOD
Ethylbenzene	<LOD
m/p-Xylene	<LOD
o-Xylene	<LOD
C5-C7 Aliphatic Hydrocarbons	<LOD
C8-C10 Aliphatic Hydrocarbons	<LOD
C11-C12 Aliphatic Hydrocarbons	<LOD
C8-C10 Aromatic Hydrocarbons	<LOD
C11-C12 Aromatic Hydrocarbons	<LOD

Where <LOD = below limit of detection.
Limits of Detection:
Semi-Quantitative Analysis 1.28ng
Benzene 1.17ng
Toluene 1.28ng
Ethylbenzene 1.0ng
p-Xylene 1.15ng
o-Xylene 1.00ng

Overall MOU 14.53%+- for quantitative analysis.
MOU 5.98%+-(Unspecified peak-Toluene)

Analyst Name M. Angelova	**Date of Analysis**	**17.07.09**
Analyst Signature	**Date of Report**	**10.07.09**

The Diffusion Tubes have been tested within the scope of Gradko International Ltd. Laboratory Quality Procedures calculations and assessments involving the exposure procedures and periods provided by the client are not within the scope of our UKAS accreditation. Those results obtained using exposure data shall be indicated by an asterisk. Any queries concerning the data in this report should be directed to the Laboratory Manager Gradko International Ltd.

REPORT OFFICIALLY CHECKED

Gradko International Ltd
This signature confirms the authenticity of this document
Signed..
G. Stutchbury, Laboratory Manager

SLR VERSION 4b. 'GENERIC ASSESSMENT CRITERIA' (mg/kg)

Chemical	GAC Source	SOM	Residential with plant uptake	Residential without plant uptake	Allotments	Commercial/ Industrial
METALS						
Arsenic	SGV (2009)		32	*35*	43	640
Mercury – Inorganic	SGV (2009)		170	*240*	80	3,600
(Elemental)			*(1.0)*		*(26)*	*(26)*
Nickel	SGV (2009)		130	*130*	230	1,800
Selenium	SGV (2009)		350	*600*	120	13,000
Cadmium	SGV (2009)		10	*18*	1.8	230
Lead	SLR		290	340	250	5,700
Chromium (VI)	LQM/CIEH (2009)		4.3		2.1	35
Chromium (III)			3,000		35,000	30,000
Copper	LQM/CIEH (2009)		2,330		524	72,000
Zinc	LQM/CIEH (2009)		3,750		618	670,000
Vanadium	LQM/CIEH (2009)		75		18	3,200
Beryllium	LQM/CIEH (2009)		51		55	420
Boron	LQM/CIEH (2009)		291		45	192,000
ORGANICS						
Phenol	SGV (2009)	1%	180	*310*	66	3,200$^{\#}$
		3%	320	*440*	160	
		6%	420	*520*	280	
BTEX COMPOUNDS						
Benzene	SGV (2009)	1%	0.079	0.27	0.017	28
		3%	0.18	0.56	0.04	57
		6%	0.33	*1.0*	0.07	95
Toluene	SGV (2009)	1%	119	607	22	869
		3%	319	1,510	61	2,300
		6%	610	*2,710*	120	4,400
Ethylbenzenes	SGV (2009)	1%	65	167	16	518
		3%	183	451	46	1,500
		6%	350	*843*	90	2,800

Chemical	**GAC Source**	**SOM**	**Residential with plant uptake**	**Residential without plant uptake**	**Allotments**	**Commercial/ Industrial**
Xylene	SGV (2009)	1%	42	53	29	576
		3%	117	148	83	1,610
		6%	230	*288*	160	2,600
		POLYCYCLIC AROMATIC HYDROCARBONS				
Threshold Toxicity PAHs						
Acenaphthene	LQM/CIEH (2009)	1%	210		34	≥5,000*
		2.5%	480		85	
		6%	1000		200	
Acenaphthylene	LQM/CIEH (2009)	1%	170		28	≥5,000*
		2.5%	400		69	
		6%	850		160	
Anthracene	LQM/CIEH (2009)	1%	2,300		380	≥5,000*
		2.5%	4,900		950	
		6%	9,200		2,200	
Fluoranthene	LQM/CIEH (2009)	1%	260		52	≥5,000*
		2.5%	460		130	
		6%	670		290	
Fluorene	LQM/CIEH (2009)	1%	160		27	≥5,000*
		2.5%	380		67	
		6%	780		160	
Naphthalene	SLR	1%	10	16	4.1	76
		3%	29	45	12	219
		6%	56	87	23	432
Phenanthrene	LQM/CIEH (2009)	1%	92		16	≥5,000*
		2.5%	200		38	
		6%	380		90	
Pyrene	LQM/CIEH (2009)	1%	560		110	≥5,000*
		2.5%	1,000		270	
		6%	1,600		620	
Non-threshold Toxicity PAHs						
Benz(a)anthracene	LQM/CIEH (2009)	1%	3.1		2.5	90
		2.5%	4.7		5.5	95
		6%	5.9		10	97
Benzo(a)Pyrene	SLR	1%	1	1	1.1	14
		3%			1.6	
		6%			1.8	
Benzo(b)fluoranthene	LQM/CIEH (2009)	1%	5.6		3.5	
		2.5%	6.5		7.4	100
		6%	7.0		13	

Chemical	GAC Source	SOM	Residential with plant uptake	Residential without plant uptake	Allotments	Commercial/ Industrial
Benzo(k)fluoranthene	LQM/CIEH (2009)	1%	10		6.8	140
		2.5%			14	
		6%			23	
Benzo(ghi)perylene	LQM/CIEH (2009)	1%	44		70	650
		2.5%	46		120	
		6%	47		160	
Chrysene	LQM/CIEH (2009)	1%	6.0		2.6	140
		2.5%	8.0		5.8	
		6%	9.3		12	
Dibenz(ah)anthracene	LQM/CIEH (2009)	1%	1		0.8	13
		2.5%			1.5	
		6%			2.3	
Indeno(123-cd)pyrene	LQM/CIEH (2009)	1%	3.2		1.8	60
		2.5%	3.9		3.8	
		6%	4.2		7.1	
PETROLEUM HYDROCARBON FRACTIONS						
Aliphatic EC 5-6	MVDC/SLR (2009)	1%	62	62	≥800*	300
		3%	130	131		632
		6%	233	234		≥800*
Aliphatic EC>6-8	MVDC/SLR (2009)	1%	150	150	≥800*	150
		3%	400	400		400
		6%	770	770		770
Aliphatic EC>8-10	MVDC/SLR (2009)	1%	38	39	664	82
		3%	111	112	≥800*	240
		6%	219	220		480
Aliphatic EC>10-12	MVDC/SLR (2009)	1%	50	50	≥800*	50
		3%	150	150		150
		6%	300	300		300
Aliphatic EC>12-16	MVDC/SLR (2009)	1%	1,250	1,250	2,060	≥5,000*
		3%	2,920	2,930	≥3,500*	
		6%	≥3,500*	≥3,500*		
Aliphatic EC>16-35	MVDC/SLR (2009)		≥3,500*	≥3,500*	≥3,500*	≥5,000*
Aliphatic EC>35-44	MVDC/SLR (2009)		≥10,000*	≥10,000*	≥10,000*	≥10,000*

Chemical	GAC Source	SOM	Residential with plant uptake	Residential without plant uptake	Allotments	Commercial/ Industrial
Aromatic EC>8-10	MVDC/SLR (2009)	1%	37	43	42	620
		3%	109	125	125	≥800*
		6%	214	245	248	
Aromatic EC>10-12	MVDC/SLR (2009)	1%	83.1	218	19	370
		3%	234	557	56	≥800*
		6%	431	≥800*	112	
Aromatic EC>12-16	MVDC/SLR (2009)	1%	197	1,560	34	≥5,000*
		3%	513	2,150	101	
		6%	858	2,370	199	
Aromatic EC>16-21	MVDC/SLR (2009)	1%	541	2,650	102	≥5,000*
		3%	1,150		297	
		6%	1,600		574	
Aromatic EC>21-35	MVDC/SLR (2009)	1%	1,770	2,670	745	≥5,000*
		3%	2,270		1,900	
		6%	2,450		3,100	
Aromatic EC>35-44	MVDC/SLR (2009)	1%	1,780	2,670	747	≥10,000*
		3%	2,280		1,900	
		6%	2,450		3,100	
Aliphatic & Aromatic EC>44-70	MVDC/SLR (2009)	1%	2,360	2,670	2,360	≥10,000*
		3%	2,550		≥10,000*	
		6%	2,600			

Notes:

1. Generic assessment criteria in mg/kg dry weight in soil
2. SGV - Soil Guideline Value reports, EA 2009. Refer to relevant “SGV” or “Tox” report for further details
3. Based on sandy loam soil as defined in CLEA report
4. Chromium is assumed to be all Chromium (VI)
5. No GAC is pH influenced
6. SLR – Version 4a ‘SLR in-house criteria’ produced using CLEA model (v1.04)
7. SOM – Soil Organic Matter Content
8. 500 – Health based criteria generated using the CLEA model v1.04 are considerably higher than these values; the values reported are theoretical soil saturation limits, particularly were vapour pathway is critical for volatile contaminants
9. * – Health based criteria generated using the CLEA model v1.04 are considerably higher than these values, the values reported are based on Canadian ‘management limits’ for petroleum hydrocarbons in fine grained soils (CCME, 2008). The management limit for CCME fraction 1 (800 mg/kg) is adopted for petrol range organics (PRO); the management limits for fraction 3 are adopted for DRO, i.e. 3,500 mg/kg for agricultural/residential land use and 5,000 mg/kg for commercial/industrial; and the management limit for fraction 4 (10,000 mg/kg) is adopted for EC>35. CCME management limits are based on free phase formation, exposure of workers in trenches, fire and explosive hazards, effects on buried infrastructure, aesthetic considerations and technological factors.
10. $^{\#}$ - SGV based on phenol concentration potentially corrosive to skin

This table constitutes the fourth release (i.e. Version 4) of ‘generic assessment criteria’ (GAC) to be used by SLR staff for screening purposes in the generic quantitative risk assessment of potentially contaminated land. The values contained in the table are comprised of:

- Revised ‘Soil Guideline Values’ (SGVs) published to date by the Environment Agency during 2009;
- Generic Assessment Criteria published by Land Quality Management and the Chartered Institute of Environmental Health (LQM/CIEH, 2009); and
- SLR-generated values, derived using the CLEA v1.04 model (released by the Environment Agency in January 2009).

‘SLR’ values have been generated following the approaches recommended in the CLEA Report (EA, 2009a) and associated material (CLEA software Handbook; EA, 2009b) and are therefore based on health criteria values selected following the TOX Guidance Report (EA, 2009c). Physico-chemical input parameters for the CLEA v1.04 model were selected from Environment Agency publications (e.g. previous SGV reports and EA, 2009d), where available, and other authoritative data sources[1].

It should be noted that a number of the GAC derived by LQM/CIEH and SLR are populated by input parameter values taken from the Agency’s SGV and TOX reports published between 2002 and 2005. The Environment Agency is currently undertaking a programme to update these reports, which are due to be reissued throughout 2009. This program is likely to result in changes to the values recommended in the TOX and SGV reports with the effect that published SGVs and re-calculated GACs may be different to the values detailed here. The results of an assessment based on these criteria could therefore be re-evaluated in light of any future changes.

Petroleum hydrocarbon contamination should be assessed using GAC for indicator compounds (i.e. BTEX compounds, benzo[a]pyrene and naphthalene) in conjunction with the values detailed above for hydrocarbon transport fractions. An additive ‘Hazard Index’ approach should be employed for the assessment of threshold effect hydrocarbons (i.e. the fractions and TEX). No values are presented for transport fractions ‘aromatic EC 5-7’ and ‘aromatic EC>7-8’ as these are comprised solely of benzene and toluene, respectively, and are assessed by consideration of these indicator compounds. Similarly, it is possible to subtract the concentrations of ethylbenzene and ‘total xylenes’ from the ‘aromatic EC>8-10’ fraction to avoid double-counting.

GAC for petroleum hydrocarbons have been derived using health criteria, soil vapour saturation limits where inhalation exposure is the critical pathway and the application of CCME management limit values based on criteria including visual aesthetics (e.g. staining of soil) , fire and explosive risks, risks to ground workers and technological factors (CCME, 2008).

An additive hazard index approach should also be used for risk assessment of the non-threshold PAHs (i.e. those compounds judged to be genotoxic carcinogens). Threshold effect PAHs with similar health endpoints should also be considered to be additive.

This table of GAC are for use within SLR only and will added to as further SGV/GACs are published by the Environment Agency and LQM/CIEH and values are generated in-

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[1] E.g. CRC Handbook of Chemistry and Physics, IUPAC-NIST Solubility Series and US Environmental Protection Agency.

house for additional contaminants. Future releases will be labelled Version 5, 6….etc. and will supersede all previous versions.

References

Environment Agency (2009a) Updated Technical Background to the CLEA model, Science Report SC050021/SR3. Bristol: Environment Agency.

Environment Agency (2009b) CLEA Software (Version 1.04) Handbook, Science Report SC050021/SR4. Bristol: Environment Agency.

Environment Agency (2009c) Human Health Toxicological Assessment of Contaminants in Soil, Science Report SC050021/SR2. Bristol: Environment Agency.

Environment Agency (2009d) Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values. Science Report SC050021/SR7. Bristol: Environment Agency

CCME (2008) Canada-Wide Standard for Petroleum Hydrocarbons (PHC) in Soil: Scientific Rationale – Supporting Technical Document, PN 1399, ISBN 978-1-896997-77-3. Canadian Council of Ministers of the Environment, January 2008.

LQM/CIEH (2009) The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition). Land Quality Press, Nottingham. ISBN 0-9547474-7-X

Mole Valley District Council and SLR Consulting (2009) Human Health Generic Assessment Criteria for Petroleum Hydrocarbons: Position Paper. Available at http://www.mole-valley.gov.uk/index.cfm?articleid=562

Compound	Residential RfC RBCA/Screening $mg.m^{-3}$	Commercial RfC RBCA $mg.m^{-3}$	Commercial RfC Vapour Screening $mg.m^{-3}$	Ref
Benzene	0.005	0.019	0.030	EA, 2009a
Toluene	5.0	19	30	EA, 2009b
Ethylbenzene	0.76	3.0	4.7	EA, 2009c
Xylenes	0.19	0.79	1.3	EA, 2009d
Aliphatic EC 5-6	18	70	110	TPHCWG, 1997
Aliphatic EC>6-8	27	100	160	MVDC, 2009
Aliphatic EC>8-16	1.0	3.9	6.3	TPHCWG, 1997
Aromatic EC>8-10	0.18	0.80	1.3	EA, 2009d
Aromatic EC>10-12	0.19	0.72	1.1	TPHCWG, 1997
Aromatic EC>12-16	0.20	0.76	1.2	TPHCWG, 1997

For the BTEX compounds residential reference concentrations (RfCs) are taken directly from the air quality guidelines or toxicologically-derived inhalation concentrations used by the Environment Agency to derive TDI_{inh} in terms of intake per kg bodyweight. For the petroleum hydrocarbon fractions, RfCs are generally taken from the reference concentrations recommended by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG, 1997).

All RfCs are adjusted for the background concentration of each compound or petroleum hydrocarbon fraction.

Commercial RfCs are based on calculation from $TDSI_{inh}$[1] with the receptor being a female worker employed for 230 days per year with a weighted average of 8.3 hr per day being spent indoors and an inhalation rate of 14.8 m^3 day^{-1} (EA, 2009e).

Please note that slightly different commercial RfCs are to be used for the RBCA model and screening of soil vapour measurements or indoor air concentrations. The RBCA model includes an ‘exposure multiplier’ to account for the number of days worked per year so this adjustment is not made to the RfC used for RBCA.

References

EA (2009a) Contaminants in Soil: Updated Collation of toxicological Data and Intake Values for Humans. Benzene. Science Report SC050021, Environment Agency, Bristol.

EA (2009b) Contaminants in Soil: Updated Collation of toxicological Data and Intake Values for Humans. Toluene. Science Report SC050021, Environment Agency, Bristol.

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[1] $TDSI_{inh}$ is calculated by subtracting mean daily intake (MDI) from TDI_{inh}. TDI_{inh} is calculated from an inhalation health criteria value (HCV) assuming 70 kg bodyweight and an inhalation rate of 20 m^3 day^{-1}.

EA (2009c) Contaminants in Soil: Updated Collation of toxicological Data and Intake Values for Humans. Ethylbenzene. Science Report SC050021, Environment Agency, Bristol.

EA (2009d) Contaminants in Soil: Updated Collation of toxicological Data and Intake Values for Humans. Xylene. Science Report SC050021, Environment Agency, Bristol.

EA (2009e) Updated Technical Background to the CLEA Model. Science Report SC050021/SR3, Environment Agency, Bristol.

MVDC (2009) Human Health Generic Assessment Criteria – Position Paper. Mole Valley District Council, May 2009

TPHCWG (1997) Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons, Volume 4. Total Petroleum Hydrocarbon Criteria Working Group Series. Amherst: Amherst Scientific Publishers. Available on-line at: http://www.aehs.com/publications/catalog/contents/tph.htm

EA (2009c) Contaminants in Soil: Updated Collation of toxicological Data and Intake Values for Humans. Ethylbenzene. Science Report SC050021, Environment Agency, Bristol.

EA (2009d) Contaminants in Soil: Updated Collation of toxicological Data and Intake Values for Humans. Xylene. Science Report SC050021, Environment Agency, Bristol.

EA (2009e) Updated Technical Background to the CLEA Model. Science Report SC050021/SR3, Environment Agency, Bristol.

MVDC (2009) Human Health Generic Assessment Criteria – Position Paper. Mole Valley District Council, May 2009

TPHCWG (1997) Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons, Volume 4. Total Petroleum Hydrocarbon Criteria Working Group Series. Amherst: Amherst Scientific Publishers. Available on-line at: http://www.aehs.com/publications/catalog/contents/tph.htm

WORK TICKET / DUTY OF CARE
CONTROLLED WASTE TRANSFER NOTE

Ticket No. 35442

erson collecting the waste (Transferee)
SERVICE GROUP

Registered Waste Carrier Reg. No. HAM/406452/CB Issued by the Environment Agency

OVENTRY DEPOT, COLLIERY LANE,
XHALL, COVENTRY, WARKS, CV7 9NW.

Current holder of the waste (Transferor) **- WASTE PRODUCER**

isiness Services
.0133 Company SLR CONSULTING LTD
MMA ELSTON
.R CONSULTING LTD
/O APPLE TREE HOUSE
ILLERS COURT ROAD
R CASTLEMORETON
ORCESTERSHIRE, WR13 6AP.

s not the producer please indicate n which the holder operates in vith the duty of care code of practice

Licence No./Reg. No.
Issued by

PRODUCER DECLARATION

I certify that waste collected is as described, and that the work has been carried out to my satisfaction, pursuant to the price agreed and in accordance with the conditions overleaf.

Signed
Printed Name M. DRAGE (BLOCK CAPITALS)
Date 07/08/09

Description of the waste
Oil Contamination
ntained in:- ROAD TANKER

tion/containment is not correct please change

Quantity Cleared (Approx) 2000
Units GALLONS

Work ticket details Order No. 404.CS.9833

rt of Water/Oil Contamination from Well.
r depot to depot
1 of Water/Oil Contamination EWC 16 10 02
EARED 3X TRENCHES CONTAMINATED WATER FROM WELL

Job No. 10052
Area No. 115

[redacted]

[redacted]

Vehicle Registration KES1 ONP
Driver KARL LEWIS (BLOCK CAPITALS)
Signed
Collection Date 07/08/09 Time 1645

- Disposal details

s of Disposal Point

Issued by
No.
sfer
sfer Ticket No(s).

E2 Person receiving waste at the site (Transferee)
Signed
Full Name
(BLOCK CAPITALS)
Representing

Complete this box if different from driver above

E3 Person delivering waste to the site (Transferor)
Signed
Full Name
(BLOCK CAPITALS)
Representing

To:

WORK TICKET / DUTY OF CARE
CONTROLLED WASTE TRANSFER NOTE

Ticket No. 35435

Section A - Person collecting the waste (Transferee)

CLEANSING SERVICE GROUP

Registered Waste Carrier Reg. No. HAM/406452/CB Issued by the Environment Agency

COVENTRY DEPOT, COLLIERY LANE,
EXHALL, COVENTRY, WARKS, CV7 9NW.

Section B - Current holder of the waste (Transferor) - WASTE PRODUCER

SIC Business Services
Account SL0133 Company SLR CONSULTING LTD
Contact EMMA ELSTON
Site SLR CONSULTING LTD
C/O APPLE TREE HOUSE
MILLERS COURT ROAD
NR CASTLEMORETON
WORCESTERSHIRE, WR13 6AP.

If the holder is not the producer please indicate the capacity in which the holder operates in accordance with the duty of care code of practice

Licence No./Reg. No.
Issued by

PRODUCER DECLARATION

I certify that waste collected is as described, and that the work has been carried out to my satisfaction, pursuant to the price agreed and in accordance with the conditions overleaf.

Signed
Printed Name N. DRAGE (BLOCK CAPITALS)
Date 07/08/09

Section C - Description of the waste

water to site

The waste is contained in:- ROAD TANKER

If the description/containment is not correct please change

Quantity Cleared (Approx) 1500
Units GALLONS

Section D - Work ticket details

Order No. 404-00-[illegible]
Job No. [illegible]0061 ONE OFF
Area No. 115

Service
Supply 5000 litres of water not for drinking

[redacted]

[redacted]

Vehicle Registration KE51 ONP
Driver KARL LEWIS (BLOCK CAPITALS)
Signed
Collection Date 07/08/09 Time 0843

Section E1 - Disposal details

Name & Address of Disposal Point
ON SITE DISPOSAL

Licence or Exemption Cert No.
Issued by
Date(s) of Transfer 07/08/09
Time(s) of Transfer
Ticket No(s).

E2 Person receiving waste at the site (Transferee)

Signed
Full Name (BLOCK CAPITALS)
Representing

Complete this box if different from driver above

E3 Person delivering waste to the site (Transferor)

Signed
Full Name (BLOCK CAPITALS)
Representing

In case of query please contact the office on 02476 644416

Time on Job From: 0805 To: 1045

Detailed Public Register Information

Search criteria: EAGENCY_AGGWASTE - NATURE FIRST LTD

N.B. The level of detail will not be the same for all results. If you require further information for a specific licence or licences, select the licence(s) of interest using the check boxes and click the *Next* button at the bottom of the list, this will take you to an e:mail containing the licences for which you require documents, fill in the required contact details and it will be sent to our offices for processing.

For more information about Exemption types please view the following documents

- Simple Exemptions
- Complex Exemptions

Request documents

00074058 - Nature First Ltd

☐

Site Registration No:	00074058
Party Name:	Nature First Ltd
Party Address:	Wood Lane Nursery, Down Hatherley Lane, Down Hatherley, GLOUCESTER, Gloucestershire, GL2 9QB
Site Address:	Wood Lane Nursery, Down Hatherley Lane, Down Hatherley, GLOUCESTER, Gloucestershire, GL2 9QB
Exemption type:	17, 18, 21, 30

Next

Environment Agency

CERTIFICATE OF REGISTRATION UNDER THE CONTROL OF POLLUTION (AMENDMENT) ACT 1989

Regulation Authority

Name: E A National Customer Contact Centre

Address:
The Quadrant
99 Parkway Avenue
Sheffield
Post Code: S9 4WG

Tel: 08708 506 506 Telex: Fax:

The following information is hereby certified by the above-mentioned authority to be information which at the date of this certificate† is entered in the register which they maintain under regulation 3 of the Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991:-

Name(s) of registered carrier: Nature First Ltd

Registration number: BLS/345151

Business name (if any): Nature First Ltd

Address of registered carrier's principal place of business:
Wood Lane
Down Hatherley
Gloucester
Gloucestershire
GL2 9QB

Tel: 01452 731199 Telex: 07772 021149 Fax: 01452 731131

Date of registration: 03/05/2007

Date of expiry of registration*: 02/05/2010

Date on which last amendment (if any) was made to the carrier's entry in the register: 03/05/2007

Signature of authorised officer of the regulation authority: J Quinn

Joseph Quinn

Date: 03 MAY 2007

[See over]

Environment Agency

CERTIFICATE OF REGISTRATION UNDER THE CONTROL OF POLLUTION (AMENDMENT) ACT 1989

Regulation Authority

Name: E A National Customer Contact Centre

Address: Environment Agency
The Quadrant 2
99 Parkway Avenue, Sheffield
Post Code: S9 4WG

Tel: 08708 506 506 Telex: Fax:

The following information is hereby certified by the above-mentioned authority to be information which at the date of this certificate† is entered in the register which they maintain under regulation 3 of the Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations 1991:-

Name(s) of registered carrier:	Critical Resource Ltd.
Registration number:	CB/LN5011NX (Previously known as BUS/722000)
Business name (if any):	Critical Resource Ltd.
Address of registered carrier's principal place of business:	RADFORD HOUSE STAFFORD PARK 7 TELFORD SHROPSHIRE TF3 3BQ

Tel: 01952 292000 Telex: Fax: 07050 658625

Date of registration: 27/09/2009

Date of expiry of registration*: 26/09/2012

Date of which last amendment (if any) was made to the carrier's entry in the register: 27/09/2009

Signature of authorised officer of the regulation authority:
[See over]

Date: 24/06/2009
060049

NOTES

†You can check whether there has been any change in the information contained in this certificate by contacting the regulation authority named above.

*Registration will expire on this date unless-

(a) it is revoked before expiry:
(b) The carrier requests the removal of his name from the register at an earlier time;
(c) an application for renewal is made within the six months ending on the expiry date and the application is still outstanding, or is the subject of an appeal, on that date;
(d) in the case of a registered partnership, if any of the partners ceases to be registered or if anyone who is not registered becomes a partner.

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