Contaminated land investigation: detailed inspection of Furnace Close, Cinderford

Prepared for

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0 EXECUTIVE SUMMARY

ESI Ltd. (ESI) was commissioned by the Forest of Dean District Council in November 2010 to undertake a contaminated land assessment of the former colliery site at Furnace Close. The purpose of this work was to assess the potential risks posed by the current land quality to all identified environmental receptors, including risks to human health and relevant controlled waters receptors.

In 1881 (the earliest available historical map), the site occupied an area of barren ground within the Forest Vale Iron Works; a tramway line ran directly to the north of the site. By 1903 the extensive iron works had ceased operation. There appears to have been little change in the site land use from the start of the twentieth century until at least 1976, after which the plot was developed as residential housing.

The site is located approximately 0.5 km west of Cinderford town centre, at an elevation of approximately 140 m above ordnance survey. Locally, the land surface falls westwards towards the valley containing Cinderford Brook, located about 100 m to the west. The site has a trapezoidal form and measures approximately 60 m east to west, and between 50 m and 80 m north to south. The total area of the site is approximately 0.4 ha.

Soil sampling on adjacent sites to the north and east had previously indicated the presence of elevated arsenic, nickel and PAH (benzo(a)pyrene, benzo(a)anthracene and chrysene) concentrations in sub surface soil.

Comprehensive site investigations were coordinated by ESI between November 2010 and January 2011, with the aim of developing a robust conceptual understanding of the site and thus enabling the quantitative assessment of environmental risks posed by observed land quality. Representative soil and groundwater samples were obtained from across the site using a combination of a percussive Terrier drill rig and shallow hand digs.

Three boreholes were drilled within the site boundary, all of which were installed with monitoring wells. 34 shallow hand dug pits were also excavated. A total of 28 soil samples were analysed from across the site from depths of up to 1.1 m bgl. Three groundwater samples were taken from the installed boreholes across the site during one monitoring round carried out in January 2011. In addition, three rounds of bulk gas monitoring were also performed.

The site lithology was shown to comprise topsoil overlying less than 1 m of Made Ground. The underlying natural deposits include several metres of superficial deposits (Head) and the subsequent Coal Measures Formation, which was not intercepted during the site investigation. The Made Ground is typically composed of sandy clay or clayey sand, with fragments of brick, coal, clinker and sandstone. The Head deposits were of varying composition from clayey sand and silt to sandy clay.

The Coal Measures and superficial deposits beneath the site are classified as a Secondary Aquifer (formerly referred to as a Minor Aquifer). The site is not located on a published Source Protection Zone. Furthermore, there are no groundwater abstractions or designated sites of ecological significance within 1.5 km of the site.

Shallow groundwater was observed within the Made Ground and Head deposits. Measured water levels suggest a groundwater flow direction towards the south and south west. It is likely that this groundwater discharges to the Cinderford Brook c. 100 m to the west.

The observed chemical quality of the Made Ground indicates the presence of various soil contaminants which are symptomatic of former colliery sites, including the presence of PAHs, heavier end petroleum hydrocarbon fractions and various heavy metals. Groundwater quality associated with the Made Ground and natural deposits beneath the site also included moderately elevated concentrations of selected metals and metalloids. No organic compounds were however detected in groundwater. Field data indicate the absence of any appreciable bulk gases or soil vapours associated with sub surface soils.

Relevant receptors which may be impacted upon by potentially contaminated ground conditions include humans (predominantly the occupants of the properties located on the site), the Secondary Aquifer (Head and Coal Measures) and the Cinderford Brook. Given the modest resource potential of the local aquifer, the shallow groundwater system is considered to be of relatively low sensitivity.

A human health risk assessment has been undertaken by applying the latest CLEA methodology to identify any contaminants which may pose a significant risk to human health. The screening process identified potential health risks associated with a number of organic compounds (including certain long chain hydrocarbons) and arsenic. Subsequent statistical interpretation of the soil quality results suggested that the observed soil quality data pose no significant risks to human health.

A conservative screening exercise has been undertaken to identify any contaminants which may cause pollution of controlled waters, namely the Secondary Aquifer and the Cinderford Brook. The results of this exercise indicate that the majority of substances (based on groundwater and leach test concentrations) do not pose a pollution risk to controlled waters. However, the observed concentrations of a number of metals and metalloids do exceed the adopted target concentrations and therefore warranted additional discussion. Following further assessment, observed concentrations of these contaminants are considered to pose little risk to groundwater or surface water quality due to their relatively modest source concentrations, the low sensitivity of the local groundwater and the anticipated reduction in contaminant concentrations along the transport pathway to the Cinderford Brook (as a consequence of attenuation and dilution processes).

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1 INTRODUCTION

1.1 Background

In response to its duties under Part IIA of the Environmental Protection Act 1990, Forest of Dean District Council (FDDC), has identified Furnace Close, Cinderford (the "Site") as posing a potentially significant environmental risk on the basis of the Site's historical land use and sensitive environmental setting. Now in residential use, the land was formerly occupied by the Bilson Colliery in the Forest of Dean. As such, Furnace Close was therefore identified by FDDC as a 'site for further investigation'. The Site location is shown in Figure 1.1.

On behalf of FDDC, ESI Ltd. (ESI) undertook a desk study (Phase 1) review of the potential environmental risks associated with the Furnace Close site (ESI, 2010). Previous investigations on land adjacent to the north and east provided valuable information to inform the desk study; elevated concentrations of arsenic, nickel and polyaromatic hydrocarbons (PAH) had been detected. The Phase 1 document concluded that potentially significant pollutant linkages exist in relation to the current land use, which merit further detailed inspection (i.e. intrusive site investigation, environmental sampling/testing and appropriate risk assessment).

ESI Ltd. (ESI) was commissioned by the Council in November 2010 to undertake a contaminated land assessment of the former colliery site at Furnace Close. Details of ESI's site investigation activities, conceptual modelling and environmental risk assessments are presented in this document.

1.2 Objectives

The objective of the work is to undertake appropriate intrusive site investigations to aid consideration of whether or not there is one or more significant pollutant linkages associated with the Site (in other words, whether or not a significant risk to human health, buildings or ecological receptors may exist and/or pollution of controlled waters is occurring or is likely to occur, from observed soil and groundwater quality and soil gas/vapour concentrations across the Site).

As such, sufficient information is required from the site investigation and subsequent risk assessments to enable the Council to make appropriate informed and defensible decisions regarding determination of the Site or parts thereof under Part IIA of the Environmental Protection Act 1990 (see Section 1.4).

1.3 Scope of work

In order to achieve the objectives stated above, the scope of work carried out for this assessment included:

- Review salient documentary information for the Site and surrounding area.
- Undertake intrusive site investigation works across the Site; these works were undertaken during 22 to 24 November 2010.
- Perform various follow-up monitoring and sampling works (as performed between December 2010 and January 2011).
- Develop a conceptual site model of potential contaminant transport pathways and fate processes and identify all potential source-pathway-receptor scenarios (i.e. relevant 'pollutant linkages').
- Quantify potential risks from contaminated land arising from the observed site conditions including an assessment of risks to identified controlled waters and human health receptors.

- Prepare a summary report in line with the approach advocated by the CLR11 guidance (EA, 2004).

1.4 Relevant legislation

Part IIA of the Environmental Protection Act 1990 introduced a regulatory regime for the identification and remediation of contaminated land. Statutory Guidance (DEFRA, 2006) and the Contaminated Land (England) Regulations (2000) contain details of the regime relevant to the detailed inspection works. Note: revised Statutory Guidance is anticipated from October 2011.

Under Part IIA the local authority, when deciding on the determination of contaminated land, is required to undertake two steps; firstly, to satisfy itself that a source of contamination, a pathway and also a relevant receptor, all exist in relation to the site in question. This condition has been met for the Site as a consequence of the previous investigations on adjacent land to the north and east. The second step required of the Council under the Part IIA regime is to establish an active linkage involving any identified source(s), pathway(s) and receptor(s) and to satisfy itself that the pollution linkage is resulting in significant harm being caused, presents a significant possibility of significant harm being caused, is resulting in the pollution of controlled waters, or is likely to result in such pollution. The results and interpretation contained in this report are intended to assist the Council in addressing the second step in the determination process.

1.5 Report structure

The information contained within this report comprises the following:

- Section 2: Site location and history : Details of the current Site setting and historical Site land use
- Section 3: Environmental setting : Summary of physical characteristics of the Site and surrounding area, including geology, hydrogeology, hydrology and drainage
- Section 4: Previous site investigation works : Summary of the previous investigations performed to the north and east of the Site
- Section 5: ESI site investigation : Description of the salient site investigation findings relating to geology, hydrogeology, soil and groundwater quality and soil gas
- Section 6: Conceptual site models : Description of both the updated Conceptual Site Model (the physical site setting) and the Conceptual Exposure Model, including details of contaminant sources, pathways and receptors
- Section 7: Human health risk assessment : Quantitative assessment of the risks posed to human health by observed soil and groundwater quality
- Section 8: Ground gas risk assessment : Quantitative assessment of the risks posed to site users and nearby residents from the observed ground gas regime
- Section 9: Controlled waters risk assessment : Quantitative assessment of the risks posed to controlled waters by observed groundwater quality
- Section 10: Project conclusions and recommendations : Salient project conclusions and recommendations

2 SITE HISTORY

2.1 History of the Site

A search of the internet yielded the following information relating to the Site history:

- Bilson colliery was in place prior to 1826, when a John Protheroe purchased the colliery. (http://www.british-history.ac.uk/report.aspx?compid=23267)
- Economic depression reduced colliery output during the 1890s and Cinderford ironworks was closed in 1890, leading to the abandonment of many mines; however, no mention of Bilson colliery is made in this regard.

  (http://www.way-mark.co.uk/forestofdean/historic/hstcin0e.htm)
- The opening of Lister's factory consolidated the importance of the engineering industry in the area's economy after the Second World War. Part of the industry was carried on in small, scattered works and foundries, some of them long established. Many were in the Cinderford area, to which the business of the Cannop foundry was transferred in 1957. Occupying the former Bilson gasworks in Valley Road, it produced manhole covers and other castings for road and ornamental use and it was operating in 1992 (http://www.british-history.ac.uk/report.aspx?compid=23267)

Historical maps were available from an Envirocheck report as presented by Cotswold Geotech (2008).

- In 1881 (the earliest available historical map), the site lay within the Forest Vale Iron Works in an area of barren ground (described by Cotswold Geotech as "rough pasture"). A tramway line ran along the north of the Site.
- By 1903 the extensive iron works had gone with just a weigh house and one or two other buildings remaining a short distance to the north of the Site. The tramway lines had been removed by this time.
- Little changed until at least 1976 with the Site being developed as residential housing by 2006.

Note: The Site's name (Furnace Close) suggests the possible historical presence of a furnace in the vicinity of this location. However, the historical maps do not display any evidence of this.

Information provided by FDDC indicates that the Site was developed for residential housing in the early 1980s.

3 ENVIRONMENTAL SETTING

3.1 General site setting and current land use

The Site (see Figure 1.1 and Figure 2.1) is located approximately 0.5 km west of Cinderford town centre, at an elevation of approximately 140 m above ordnance survey (aOD). The land falls westwards to the valley containing Cinderford Brook. The Site has a trapezoidal form and measures approximately 60m east-west, and between 50 m and 80 m north-south. The total area is approximately 0.4 ha.

Valley Road is located to the west of the Site with a grassed area between the road and Cinderford Brook, which runs north-south approximately 90 m further to the west.

A grassed mound is present directly to the north of the Site. This feature is approximately 10 m in height (150 mAOD) and may consist of colliery spoil. It is steep-sided along the road to the west and has an uneven surface. The remainder of this area is largely composed of scrub vegetation. According to current mapping, a number of "works" are present to the north west, north and north east. An electrical substation is also located about 50 m to the north west of the Site.

The area to the east has recently been developed for housing. Residential properties are also present to the south east. Hastings Road is located directly to the south east and a green area lies to the south.

Ground cover across the Site is relatively evenly split between hard standing and buildings on the one hand and gardens and/soft landscaping on the other. This includes 15 houses, associated parking, the tarmac of the Close, gardens, hedgerows and grassed areas.

3.2 ESI site inspection (July 2010)

A Site visit was undertaken on 15th July 2010 as reported in ESI (2010). During the visit, blackened fill materials were evident directly beneath the ground surface within the Site boundaries; these were considered likely to be former colliery wastes.

3.3 Documented geology

The Site lies within the Forest of Dean coal basin. The geological map is shown in Figure 3.1. Superficial cover of 'Head' deposits is shown on the geological map (British Geological Survey (BGS), 1974) above Upper Coal Measures (Westphalian D Pennant strata). "Head" deposits can comprise gravel, sand and clay. There are possible sandstone bands present within the Coal Measures.

At least seven coal seams with westerly dips are present a short distance to the east of the Site (Geotechnical Engineering Ltd., 2007a) at 40 m to 90 m depth. It is reported that these were last worked in 1913. A mine shaft has been recorded a short distance to the north west of the Site to a depth of about 110 m. However, it is known that this was filled with unknown material in around 1961.

3.4 Documented hydrogeology

Both the Coal Measures and superficial deposits beneath the Site are classified as a Secondary Aquifer (formerly Minor Aquifer). Although not producing large quantities of water for abstraction, they can be important for local supplies and in supplying base flow to rivers. No local data are available on the quantity or quality of groundwater within these aquifers; and no groundwater is known to be locally abstracted (see Section 3.6).

The Site is not located within a source protection zone (SPZ). The closest SPZ is located about 130 m to the east (total catchment area). Zone 2 (outer catchment area) is located about 850 m to the east.

Given the local geological and topographic controls, shallow groundwater flow is likely to be in a general westerly direction towards Cinderford Brook.

The hydrogeological conditions occurring beneath the Site were better defined as a result of the site investigation works undertaken. Details are presented in Sections 4 and 5.

3.5 Hydrology and drainage

There are no surface water features on the Site. Cinderford Brook is the closest surface water feature. As mentioned above, it runs southerly and is located about 100 m to the west. Cinderford Brook is classified by the Environment Agency as of Grade B (Good) water quality. Significant surface water runoff from the Site may occur as well as drainage via man-made drainage infrastructure which may limit infiltration to ground.

3.6 Water abstractions

An Envirocheck report which was included in reporting undertaken by Cotswold Geotech (2008) shows that there is one current licensed abstraction within 1 km of the Site. This is for industrial purposes and is taken from a surface water source.

The closest licensed groundwater abstraction is about 1.7 km to the south of the Site (Geotechnical Engineering Ltd., 2007a). This is operated by Severn Trent Water as a public water supply source.

3.7 Waste management/landfill sites

Geotechnical Engineering Ltd. (2007a) report the following:

- Five historical landfills within 1 km of the Site, the closest being about 80 m from the Site at Cannop Foundry.
- Two BGS-recorded landfill sites recorded within 1 km of the Site – the closest is Bilson Tip, approximately 200 m to the north west of the Site. It is described as containing inert, industrial and commercial waste, but no dates regarding tipping activities are provided.
- Four local authority-recorded landfill sites recorded within 1 km of the site, one of which is at the Cannop Foundry a short distance to the north west. The Status of this is described as closed.

3.8 Ecology and wildlife

There are no recorded Ramsar sites, National Nature Reserves, Local Nature Reserves, Special Areas for Conservation, Special Protection Areas, Sites of Special Scientific Interest or National Parks within a 1 km radius of the Site (http://www.magic.gov.uk/).

4 PREVIOUS SITE INVESTIGATION WORKS

4.1 Previous investigation works

No previous site investigation records were available for the Site. However, Cotswold Geotech (2008) and Geotechnical Engineering (2007b) carried out intrusive investigations directly to the east and north respectively, which provide valuable information on the likely ground conditions present beneath the Site. These historical site investigation locations are shown in Figure 4.1.

Subsequent comprehensive site investigations were coordinated by ESI between November 2010 and January 2011, with the aim of developing a robust conceptual understanding of the Site and thus enabling the quantitative assessment of environmental risks posed by observed land quality.

The Cotswold Geotech study area lies directly to the east of the Site (see Figure 4.1). Five trial pits were excavated for the ground investigation and five soil samples were taken and analysed for metals, PAH, petroleum hydrocarbons and pH.

The Geotechnical Engineering study area lies immediately to the north of the Site (see Figure 4.1). The following works were undertaken:

- 3 boreholes were drilled to depths of between 3 and 4.5 m below ground level (bgl) and installed for gas/groundwater monitoring
- 10 trial pits were excavated to depths of between 1 and 2.1 m bgl.
- 12 soil samples were taken and analysed for metals, PAH, total phenols, pH, sulphate, cyanide and thiocyanates. Six soil samples and three groundwater samples were also analysed for speciated petroleum hydrocarbons.

4.2 Geological interpretation

Based on the five trial pits directly to the east of the Site, Cotswold Geotech (2008) report a typical geology in that area comprising:

- A 0.2 m thickness of topsoil.
- Made Ground described as “foundry waste” from <1m (in north east), thickening to the west and south to a maximum recorded depth of 2.6 m. The foundry waste was described as “black, brown, red and orange, silt-bound, mostly ashy, granular deposits of stone, slag and/or clinker, often with red brick fragments, sometimes with burnt shale, and occasionally with concrete fragments and coal particles”.
- Superficial deposits comprising firm to stiff reddish brown to orange mottled grey, silty and sandy clays with gravel of sandstone. The base of the superficial deposits/top of bedrock was not proven at any location (the maximum trial pit depth was 2.9 m bgl).

To the north, Geotechnical Engineering Ltd. (2007b) report a typical geology in that area comprising:

- Topsoil with grass.
- “Made Ground” of brown, ashy, sandy, fine to coarse gravel or silty sand with concrete, brick, clinker, slag, sandstone, pottery and glass to a depth of 0.1 to 1.8 m bgl.
- Superficial deposits of fine grey clay, medium to coarse gravel, grey clayey sand and gravel, soft to firm brown/orange brown and grey clay across the Site. Clay was recorded at all locations within the superficial deposits where the Made Ground was penetrated fully. The base of the superficial deposits/top of bedrock was not proven at any location (the maximum borehole depth was 4.5 m bgl).

Three of the trial pits were carried out in the soil mound in the south of the directly to the north of the Site. The mound comprised clayey, fine to coarse gravel and cobbles of mudstone, sandstone and siltstone with some gravel-sized fragments of coal, burnt waste and shale. A black, sandy, ashy gravel of clinker, brick, coal and sandstone was also recorded at one of these locations to 1.2 m bgl.

4.3 Hydrogeological information

The five trial pits to the east of the Site, excavated to a maximum depth of 2.9 m bgl, each encountered minor groundwater seepages, but the Cotswold Geotech (2008) report described the Made Ground material as typically dry.

To the north of the Site, no groundwater was encountered at any trial pit or borehole location during the works but groundwater subsequently entered the three piezometers installed in the boreholes. At two locations the groundwater levels suggested the presence of a small quantity of water sitting at the base of the Made Ground material on the superficial deposits (1.0 to 1.7 m bgl) while at the third location the water level was within the superficial deposits (at about 3.4 m bgl).

The slow ingress of water suggests that the hydraulic conductivity of the superficial deposits is likely to be low. This is consistent with the logged geology with clay observed to dominate the superficial deposits composition.

4.4 Soil quality

The table below gives the maximum concentration of selected contaminants from both the Cotswold Geotech (2008) and Geotechnical Engineering Ltd. (2007b) areas. The maximum concentrations are compared to the relevant human health screening values for human health risks based on residential land-use. The screening values are sourced either from Soil Guideline Values (SGVs) published by the Environment Agency (2009a and 2009b) or Generic Assessment Criteria (GACs) published by LQM (2009). Results are highlighted where the maximum concentration exceeds the screening value with exceedances for arsenic, nickel and PAHs (benzo(a)pyrene, benzo(a)anthracene and chrysene) observed.

Table 4.1 Maximum soil concentrations

Parameter	Screening value	Source	Cotswold Geotech (2008)	Geotechnical Engineering (2007b)
			Max conc. (mg/kg)	Max conc. (mg/kg)
Arsenic	32	SGV	**63**	**100**
Nickel	130	SGV	89	**166**
Zinc	3750	LQM GAC	700	1520
Copper	2330	LQM GAC	160	153
Benzo(a)pyrene	1	LQM GAC	**5**	**47.9**
Naphthalene	8.7	LQM GAC	2.5	2.2
Benzo(a)anthracene	5.9	LQM GAC	**6.6**	**52.3**
chrysene	9.3	LQM GAC	8.3	**41.9**
TPH	-	-	64	175
TPH Aromatic >EC21-EC35	1230	LQM GAC	-	29

Note: LQM GACs based on sandy loam soil and 6% SOM

4.5 Groundwater quality

Geotechnical Engineering Ltd. (2007b) tested three groundwater samples to the north of the Site and reported that all the tested determinands were recorded at values less than their respective drinking water standards (DWS) and environmental quality standards (EQS). (The determinands tested are listed in Section 4.1).

It is noted however that the aromatic total petroleum hydrocarbon (TPH) fraction (C21-35) was detected at one location at 23 µg/l, above the drinking water standard for petroleum hydrocarbons of 10 µg/l.

4.6 Ground gas

Geotechnical Engineering Ltd. (2007b) carried out gas monitoring on four occasions at BH01, BH02 and BH03 between September 2007 and October 2007 The maximum recorded concentrations of methane and carbon dioxide were 0.1% and 7.4 % respectively.

5 ESI SITE INVESTIGATION

5.1 Objectives

The outline aims of the site investigation works were as follows:

- To establish the typical soil profile across the Site, including the composition and thicknesses of the Made Ground deposits and depth to the underlying Head.
- To characterise shallow groundwater conditions (if present) including water level depths and likely groundwater flow directions. The presence of any free product on the water surface was also to be assessed.
- To assess soil and groundwater quality across the Site, with particular reference to contaminants of concern associated with historical land uses.
- To assess any gas generation potential of Made Ground/contaminated soils/groundwater, particularly adjacent to residential properties.

5.2 Sampling strategy

The site investigation was designed to provide as complete a picture as possible of the most vulnerable locations, within the limitations of the number of samples available. Working within the access constraints associated with built structures and roads, intrusive site investigation locations were distributed across the Site. The sampling was focused on rear gardens, where activities most likely to result in health hazards are expected to be concentrated. It was also important to be sensitive to land ownership boundaries, and to provide information for each separate land ownership area.

Sampling included two sets of samples, taken during the same field investigation. The first set was analysed immediately by the chosen laboratory. The second set was stored by the laboratory for additional analysis, to confirm or expand upon the results of the first set where this was deemed necessary.

Site investigation locations are shown in Figure 5.1.

5.3 Works undertaken

Three gas and groundwater monitoring boreholes were drilled to a depth of approximately 5 m bgl using a “Terrier” rig. The purpose of these holes was to define the thickness and composition of the Made Ground materials, assess the thickness and properties of the overburden material, allow groundwater levels and quality to be assessed, to enable selective soil sampling and to permit robust soil gas monitoring. Summary details of the boreholes are given in Table 5.1.

27 shallow soil samples (predominantly from within 0.5 m of the ground surface) were taken to enable assessment of risks due to soil ingestion, dermal contact, vegetable uptake and dust inhalation from sources at or close to the ground surface (see Table 5.2). 16 of these were taken from rear gardens; the remainder from front gardens and open spaces between the houses.

A further seven shallow soil samples were taken but were not initially analysed. Analysis was subject to the results of the soil tests on the main batch of samples. Based on the results, only 1 of the 6 samples was subsequently analysed (S12A).

The following potential colliery material contaminants were identified for analysis:

- aromatic hydrocarbons e.g. benzene, toluene, ethylbenzene, xylenes (BTEX)
- PAH
- sulphates
- petroleum hydrocarbons

- metals including arsenic, cadmium, chromium, cobalt, copper, iron, lead, nickel, manganese, magnesium, mercury, molybdenum, vanadium and zinc.

Based on the Site's position in the Forest Vale Iron Works, the following potential contaminants were also considered:

- cyanides and thiocyanates
- ammoniacal nitrogen
- phenols (total)

Hence, all shallow soil samples were tested for speciated PAH, sulphates, metals, cyanides and thiocyanates, ammoniacal nitrogen and phenols. Furthermore, an indication of the concentrations of volatile organic compounds were derived using a hand-held PID meter. Where elevated PID readings were encountered relevant samples were also analysed for total petroleum hydrocarbon (TPH) fractions and BTEX compounds.

Seven soil samples were specified for leachability testing including a range of inorganic parameters (sulphates, metals, cyanides and thiocyanates and ammoniacal nitrogen). The test method used was compliant with BS EN 12457 (BSI, 2002), as specified in the Environment Agency's Remedial Targets Methodology. The Environment Agency recommends that partitioning equations are used to assess the leachability of hydrophobic compounds, since leaching tests do not perform well for these compounds. This approach was adopted for organic compounds and 10 soil samples were therefore also analysed for fraction of organic carbon, to enable use of site-specific information in the partitioning calculations.

All laboratory analyses were performed at a UKAS accredited laboratory, using MCERTS certified tests where available.

All soils were carefully logged according to current best practice.

The three boreholes were installed with 50 mm stand pipes; the response zones were specified based on the geological sequence observed at each location. All installations incorporated a good seal around the stand pipe at ground surface (to prevent water ingress and gas escape); gas taps and flush covers were also fitted at each location. (The conceptual site model did not indicate that ground gas was likely to be present at concentrations that would constitute an emergency situation, or that would warrant indoor air monitoring.

Groundwater levels were recorded on three occasions, in November 2010, December 2010 and January 2011, at each borehole. Gas monitoring was conducted on the same occasions, in line with current best practice (CIRIA, 2007). Monitoring of ground gases (including methane, carbon dioxide, oxygen and hydrogen sulphide) was undertaken using a hand-held soil gas analyser (LMSxi Type G3.18). Records were also made of atmospheric pressure, borehole gas flow rates and temperature. Furthermore, an indication of the concentration of volatile organic compounds was derived using a hand-held PID meter.

A single groundwater sampling round was undertaken in January 2011, with each location analysed as described above (3 samples).

Table 5.1 Summary of percussive borehole locations

BH ref	Drill date	Depth (m)	Installation details	Location
BH1	23/11/10	2.2	Borehole dry during drilling. 50 mm piezometer installed with 1 mm slots and gas tap	Open ground to north of No.4, Furnace Close
BH2	23/11/10	4.0	Borehole dry during drilling. 50 mm piezometer installed with 1 mm slots and gas tap	Open ground at Close entrance, south of No.15, Furnace Close
BH3	23/11/10	0.7	Refused at 0.7 m on slab. Water at 0.7 m bgl	Open ground north of No.13, Furnace Close
BH3B	23/11/10	5.0	Borehole dry during drilling. 50 mm piezometer installed with 1 mm slots and gas tap	Open ground north of No.13, Furnace Close

Table 5.2 Summary of shallow samples

Sample reference	Location	Lab sample Number	Depth (m)	Date sampled
BH3	Open space between No's 12 and 13	161631	0.65	23/11/2010
BH3B	Open space between No's 12 and 13	161632	1.10	23/11/2010
S1	Rear garden, No.1	161734	0.30	22/11/2010
S2	Rear garden, No.2	161735	0.25	22/11/2010
S3	Rear garden, No.3	161736	0.32	22/11/2010
S4	Rear garden, No.4	161746	0.30	22/11/2010
S4A	Rear garden, No.4	161747	0.28	22/11/2010
S5	Rear garden, No.5	161737	0.27	22/11/2010
S5A	Rear garden, No.5	Not analysed	0.28	22/11/2010
S6	Rear garden, No.6	161738	0.25	22/11/2010
S7	Rear garden, No.7	161744	0.32	22/11/2010
S8	Rear garden, No.8	161741	0.29	22/11/2010
S9	Rear garden, No.9	161739	0.26	22/11/2010
S10	Rear garden, No.10	161742	0.21	22/11/2010
S10A	Rear garden, No.10	Not analysed	0.22	22/11/2010
S11	Rear garden, No.11	161740	0.20	22/11/2010
S12	Rear garden, No.12	161743	0.20	22/11/2010
S12A	Rear garden, No.12	163333	0.35	22/11/2010
S13	Rear garden, No.13	161882	0.27	24/11/2010
S14	Rear garden, No.14	161745	0.19	22/11/2010
S15	Rear garden, No.15	161748	0.22	22/11/2010
S16	Front garden, No.1	Not analysed	0.3	24/11/2010
S17	Front garden, No.4	Not analysed	0.15	24/11/2010
S18	Front garden, No.5/open space	161634	0.25	23/11/2010
S20	Open space between No's 12 and 13	161878	0.55	24/11/2010
S21	Front garden, No.2	Not analysed	0.25	24/11/2010

Sample reference	Location	Lab sample Number	Depth (m)	Date sampled
S22	Front garden, No.3	161633	0.15	23/11/2010
S24	Open space in centre of Close	161884	0.35	24/11/2010
S26	Open space at Close entrance	161635	0.29	23/11/2010
S27	Open space at Close entrance	161883	0.22	24/11/2010
S28	Open space between No's 12 and 13	161881	0.12	24/11/2010
S29	Open space between No's 12 and 13	161880	0.10	24/11/2010
S30	Open space between No's 12 and 13	161879	0.05	24/11/2010

5.3.1 Field observations

Salient observations made during the site investigation works included:

- Topsoil across most of the site consisted largely of mid- to dark brown, relatively loose sandy clay.
- In the north east corner of the Site the topsoil was red-brown and sandy
- Made Ground beneath the topsoil was dark brown, somewhat sandier, with varying amounts of gravel. Gravel included pieces of sandstone, brick, coal and slag, usually less than 1 cm in size but occasionally up to 5 cm.
- Fragments of coal, clinker and brick were commonly found in the north and west of the Site, but largely absent from the south and east.
- Underlying the Made Ground was clay or silty material.
- No odours were identified during sampling or drilling, and PID readings detected no volatile gases.

5.4 Site-specific geology

Made Ground was encountered beneath the topsoil, with a thickness of 50 to 75 cm. The Made Ground was generally found to comprise a clayey sand to sandy clay matrix containing gravel of various typical colliery spoil fill (coal, brick, clinker) as well as sandstone. It appears that the bank along the eastern edge of the Site is Made Ground, indicating a greater thickness in the adjacent site to the east. This was confirmed by Cotswold Geotech (2008).

This Made Ground overlies a variable sequence, different in each of the three boreholes, and including predominant clay, with some sand and silt, particularly in BH2.

Detailed geological logs for each of the borehole locations are presented in Appendix A. Table 5.3 summarises the local geological sequence.

Table 5.3 Local stratigraphy

Formation	Thickness	Lithology
Made Ground	0.5 to c. 0.75 m	A loose material comprising a sandy clay matrix with frequent gravel and occasional cobbles of brick, clinker, coal and sandstone
Head	up to at least 4 m	Rather variable sandy clay and sandy silt, sometimes with gravel

5.5 Site specific hydrogeology

All boreholes were dry during drilling, with the exception of BH3, which refused at an obstruction at 0.85 m bgl. Water was observed above this obstruction. However, groundwater levels were subsequently monitored at all borehole locations. The collated water level information is presented in Appendix B.

The water levels indicate that groundwater was encountered at depths between 0.4 and 2.7 m bgl. Borehole locations were not levelled in to provide elevations, but the ground surface slopes from north east to south west, suggesting that the elevation of measured groundwater may decrease (indicating groundwater flow) towards the south-south-west. This is consistent with topography and the position of local surface drainage.

5.6 Soil quality data

All soil chemistry data relating to samples taken from across the Site during the site investigation works are presented in Appendix C. In addition, summary tables of all soil and water quality test results are presented in Appendix D.

Summary soil quality data from the recent ESI site investigation are presented in Table 5.4. In the calculation of the summary statistics, any results reported as being below the LOD (limit of detection) are conservatively assumed to be equal to the relevant LOD concentration.

Table 5.4 Summary of soil quality

Analytical Parameter	Units	Limit of detection	No samples	No <LOD	Min value	Max value	Mean value
General Inorganics							
Total Cyanide	mg/kg	1	27	26	<1.00	3.60	1.10
Free Cyanide	mg/kg	1	27	27	<1.00	<1.00	<1.00
Thiocyanate as SCN	mg/kg	5	27	27	<5.00	<5.00	<5.00
Water Sol Sulphate as SO_3 (2:1)	g/l	0.005	20	0	0.01	0.11	0.04
Total Sulphate as SO_4	mg/kg	100	7	0	380	1200	772.9
Ammoniacal Nitrogen as N	mg/kg	5	27	27	<5.00	<5.00	5.00
Fraction Organic Carbon (FOC)	N/A	0.00001	10	0	0.00	0.04	0.02
Total Phenols							
Total Phenols (monohydric)	mg/kg	2	27	27	<2.00	<2.00	<2.00
Speciated PAH							
Naphthalene	mg/kg	0.05	28	20	<0.05	7.10	0.72
Acenaphthylene	mg/kg	0.2	28	23	<0.20	1.40	0.28
Acenaphthene	mg/kg	0.1	28	25	<0.10	0.33	0.11
Fluorene	mg/kg	0.2	28	23	<0.20	1.40	0.29
Phenanthrene	mg/kg	0.2	28	20	<0.20	13.00	0.89
Anthracene	mg/kg	0.1	28	20	<0.10	8.80	0.49
Fluoranthene	mg/kg	0.2	28	12	<0.20	32.00	2.02
Pyrene	mg/kg	0.2	28	12	<0.20	25.00	1.65
Benzo(a)anthracene	mg/kg	0.2	28	14	<0.20	18.00	1.08
Chrysene	mg/kg	0.05	28	12	<0.05	12.00	0.80
Benzo(b)fluoranthene	mg/kg	0.1	28	12	<0.10	19.00	1.11
Benzo(k)fluoranthene	mg/kg	0.2	28	16	<0.20	6.80	0.53
Benzo(a)pyrene	mg/kg	0.1	27	15	<0.10	1.70	0.34
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	28	22	<0.20	8.40	0.53
Dibenz(a,h)anthracene	mg/kg	0.2	28	27	<0.20	1.20	0.24

Analytical Parameter	Units	Limit of detection	No samples	No <LOD	Min value	Max value	Mean value
Benzo(ghi)perylene	mg/kg	0.05	28	19	<0.05	8.50	0.46
Total PAH							
Speciated Total EPA-16 PAHs	mg/kg	1.6	28	12	1.60	170.00	11.27
Heavy Metals / Metalloids							
Arsenic	mg/kg	1	27	0	2.90	39.00	13.61
Barium	mg/kg	1	7	0	69.0	410.0	186.14
Beryllium	mg/kg	0.06	7	0	0.90	3.40	1.90
Boron (water soluble)	mg/kg	0.2	7	2	<0.20	3.20	1.00
Cadmium	mg/kg	0.2	27	20	<0.20	3.30	0.43
Chromium (hexavalent)	mg/kg	1.2	7	7	<1.20	1.20	1.20
Chromium	mg/kg	1	27	0	10.0	290.0	34.2
Cobalt	mg/kg	0.15	27	0	5.90	39.00	13.60
Copper	mg/kg	1	27	0	4.30	120.00	40.31
Iron	mg/kg	40	27	0	22000	250000	67074
Lead	mg/kg	2	27	0	8.00	140.00	35.14
Manganese	mg/kg	1	27	0	85.00	7600.0	810.19
Mercury	mg/kg	0.3	27	27	<0.30	<0.30	<0.30
Molybdenum	mg/kg	0.25	27	0	0.30	13.00	2.26
Nickel	mg/kg	2	27	0	8.90	110.00	34.51
Vanadium	mg/kg	1	27	0	13.00	680	68.74
Zinc	mg/kg	2	27	0	21.00	240.00	71.81
Magnesium	mg/kg	20	27	0	1500.0	21000.0	6288.8
Monoaromatics							
Benzene	µg/kg	1	7	7	<1.00	<1.00	<1.00
Toluene	µg/kg	1	7	7	<1.00	<1.00	<1.00
Ethylbenzene	µg/kg	1	7	7	<1.00	<1.00	<1.00
p & m-xylene	µg/kg	1	7	7	<1.00	<1.00	<1.00
o-xylene	µg/kg	1	7	7	<1.00	<1.00	<1.00
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	7	7	<1.00	<1.00	<1.00
Petroleum Hydrocarbons							
TPH7 - Aliphatic >C5 - C6	mg/kg	0.1	7	7	<0.10	<0.10	<1.00
TPH7 - Aliphatic >C6 - C8	mg/kg	0.1	7	7	<0.10	<0.10	<1.00
TPH7 - Aliphatic >C8 - C10	mg/kg	0.1	7	7	<0.10	<0.10	<1.00
TPH7 - Aliphatic >C10 - C12	mg/kg	1	7	5	<1.00	2.20	1.26
TPH7 - Aliphatic >C12 - C16	mg/kg	2	7	5	<2.00	8.40	3.44
TPH7 - Aliphatic >C16 - C21	mg/kg	8	7	6	<8.00	9.70	8.24
TPH7 - Aliphatic >C21 - C35	mg/kg	8	7	5	<8.00	44.00	15.57
TPH7 - Aliphatic (C5 - C35)	mg/kg	10	7	5	<10.00	57.00	21.71
TPH7 - Aromatic >C5 - C7	mg/kg	0.1	7	7	<0.10	<0.10	<1.00
TPH7 - Aromatic >C7 - C8	mg/kg	0.1	7	7	<0.10	<0.10	<1.00
TPH7 - Aromatic >C8 - C10	mg/kg	0.1	7	7	<0.10	<0.10	<1.00
TPH7 - Aromatic >C10 - C12	mg/kg	1	7	4	<1.00	17.00	5.80
TPH7 - Aromatic >C12 - C16	mg/kg	2	7	4	<2.00	24.00	7.40
TPH7 - Aromatic >C16 - C21	mg/kg	10	7	2	<10.00	59.00	26.86
TPH7 - Aromatic >C21 - C35	mg/kg	10	7	2	<10.00	250.00	97.00
TPH7 - Aromatic (C5 - C35)	mg/kg	10	7	2	<10.00	280.00	134.14

5.7 Groundwater quality data

Three groundwater samples were taken from the boreholes installed on the Site. All sampled boreholes were screened across the Made Ground and underlying natural deposits to maximise potential for the piezometers to be suitable for both groundwater and gas monitoring purposes.

Inorganic groundwater quality data from the recent ESI site investigation are presented in Table 5.5. None of the organic compounds analysed were detected above the relevant LODs in any groundwater sample and these are omitted from the table for brevity. The full groundwater quality results are presented in Appendix C and D.

Table 5.5 Inorganic groundwater quality results

Analytical Parameter	Units	Limit of detection	BH1	BH2	BH3A
General Inorganics					
Total Cyanide	µg/l	10	< 10	< 10	< 10
Free Cyanide	ug/l	10	< 10	< 10	< 10
Thiocyanate as SCN	µg/l	30	< 30	< 30	< 30
Sulphate as SO_4	µg/l	100	160000	87000	100000
Ammoniacal Nitrogen as N	µg/l	15	< 15	35	340
Magnesium (dissolved)	mg/l	0.3	60	32	27
Heavy Metals / Metalloids (dissolved)					
Arsenic	µg/l	10	< 10	< 10	< 10
Cadmium	µg/l	0.5	< 0.5	< 0.5	< 0.5
Chromium	µg/l	1	< 1.0	< 1.0	< 1.0
Cobalt	µg/l	1	3.4	< 1.0	< 1.0
Copper	µg/l	1	19	13	12
Iron	mg/l	0.2	< 0.2	< 0.2	< 0.2
Lead	µg/l	5	< 5.0	< 5.0	< 5.0
Manganese	µg/l	1	1500	13	70
Mercury	µg/l	1.5	< 1.5	< 1.5	< 1.5
Molybdenum	µg/l	3	11	6.2	19
Nickel	µg/l	1	16	4.2	5.7
Vanadium	µg/l	5	< 5.0	< 5.0	< 5.0
Zinc	µg/l	1	9.3	6.6	11

5.8 Leach test results

In addition to the groundwater analyses, seven soil samples underwent leach testing to determine the quality of leachate derived from them. These leachate samples were analysed for a range of inorganic determinands. The results are summarised in Table 5.6.

Table 5.6 Summarised soil leach test results

Analytical Parameter (Water Analysis)	Units	Nr samples	Nr non-detects	Min value	Max value	Mean
General Inorganics						
Total Cyanide	µg/l	7	7	<10	<10	<10
Free Cyanide	ug/l	7	7	<25	<25	<25
Thiocyanate as SCN	µg/l	7	7	<30	<30	<30
Sulphate as SO_4	µg/l	7	0	3400	38000	16786
Ammoniacal Nitrogen as N	µg/l	7	0	57	74	64.1
Magnesium (dissolved)	mg/l	7	0	0.8	8.3	5.21
Heavy Metals / Metalloids						
Arsenic (dissolved)	µg/l	7	4	<10	45	14
Cadmium (dissolved)	µg/l	7	7	<0.5	<0.5	<0.5
Chromium (dissolved)	µg/l	7	3	<1	13	3.76
Cobalt (dissolved)	µg/l	7	5	<1	2.5	0.9
Copper (dissolved)	µg/l	7	0	8.1	33	15.3
Iron (dissolved)	mg/l	7	0	0.2	12	2.99
Lead (dissolved)	µg/l	7	3	<5	13	6.8
Manganese (dissolved)	µg/l	7	0	2.7	80	29.5
Mercury (dissolved)	µg/l	7	7	<1.5	<1.5	<1.5
Molybdenum (dissolved)	µg/l	7	2	<3	63	23.0
Nickel (dissolved)	µg/l	7	0	2.3	7.4	4.14
Vanadium (dissolved)	µg/l	7	3	<5	31	10.5
Zinc (dissolved)	µg/l	7	1	<1	44	12.4

5.9 Soil gas results

Ground gas monitoring was undertaken during the site investigation programme. Bulk ground gas concentrations (including carbon dioxide and methane) along with borehole flow rates were monitored at the three boreholes on three separate occasions. The main results are shown in Table 5.7, and the complete results are presented in Appendix B.

Table 5.7 Ground gas monitoring results

Borehole reference	Date	Time	Atmospheric Pressure (mb) during monitoring	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Flow (l/hr)	VOC (ppm)
BH1	24/11/2010	12:30	997	0.0	1.2	17.6	-0.1	0
BH2	24/11/2010	12:45	997	0.0	0.3	20.4	-0.1	0
BH3	24/11/2010	12:15	997	0.0	0.4	18.9	-0.1	0
BH1	08/12/2010	17:00	1004	0.0	2.7	16.0	-0.1	-
BH2	08/12/2010	17:30	1007	0.0	0.4	20.4	-0.1	-
BH3	08/12/2010	17:15	1006	0.0	1.2	14.1	-1.9	-
BH1	13/01/2011	09:00	993	0.0	0.0	20.4	0.1	-

BH2	13/01/2011	10:45	994	0.0	0.4	19.5	0.0	-
BH3	13/01/2011	09:50	994	0.0	0.0	20.4	0.0	-

The results indicate the general absence of any appreciable bulk gas including methane, carbon dioxide and hydrogen sulphide (which was not detected).

No appreciable gas flows were measured at any of the monitoring locations.

Volatile organic compounds (VOC) (as measured by a hand-held PID device) were also absent from all monitoring borehole locations when monitored on 24/11/10.

6 CONCEPTUAL MODEL

Coal beneath the Site and the wider area was worked from Bilson Colliery, which had closed down by 1903. A tramway line ran along the north of the Site in 1881 but had been removed by 1903.The Site was subsequently an area of barren ground within the Forest Vale Iron Works, with no other significant land use up to at least 1976, and probably until its development for residential housing during the early 1980's.

6.1 Conceptual ground model

The Site has an approximate area of 0.4 ha comprising a cul-de-sac and 15 residential properties. Most of the properties have front and rear gardens. The topography slopes from north east to south west, with a drop of approximately 4 m across the Site (from 149 to 145 mAOD). The land then slopes west to Cinderford Brook at approximately 142 mAOD. (Note that these levels are taken from the Ordnance Survey 1:50,000 map and are approximate: no Site topographical survey has been undertaken.)

Figure 6.1 shows the conceptual model for the Site. Upper Coal Measures strata lie beneath the Site. Above the bedrock, "Head" deposits are present, including sand, silt and clay. ESI's site investigation showed the superficial geological/soil sequence to comprise:

- Typically 0.2 m of topsoil
- Made Ground between 0.5 and 0.75 m in thickness, consisting of sandy clay or clayey sand, with fragments of brick, coal, clinker and sandstone.
- Up to at least 4 m of superficial deposits (Head) beneath the Made Ground, of varying composition from clayey sand and silt to sandy clay.

The Coal Measures and superficial deposits beneath the Site are classified as a Secondary Aquifer (formerly Minor Aquifer). The Site is not located on a SPZ. Boreholes drilled on Site were dry during installation, but all subsequently collected groundwater, with levels between 0.4 and 2.7 m bgl in the Made Ground/superficial deposits. The slow ingress of water indicates that the hydraulic conductivity of the superficial deposits is relatively low. This is consistent with the logged geology with clay and silt observed to dominate the makeup of the superficial deposits. Groundwater flow is believed to be south to south west across the Site with the likely discharge point being Cinderford Brook in the shallow valley to the west.

There are no surface water features on the Site. Cinderford Brook is the closest surface water feature and is located approximately 90 m to the west.

There are no groundwater abstractions or designated sites within 1.5 km of the Site.

6.2 Conceptual exposure model

A conceptual exposure model has been developed for the Site which describes the likely contaminant sources present across the Site, potential receptors and the possible pathways linking sources and receptors. In order for harm or pollution to be caused to identified receptors there must be three essential elements present:

A contaminant: a substance that is in, on, or under the land and has the potential to cause harm or to cause pollution of controlled waters;

A receptor: in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property or a water body;

A pathway: a route or means by which a receptor can be exposed to or affected by a contaminant.

An environmental hazard is identified where all three of these elements are present, and there is consequently the potential for a contaminant to affect a particular receptor through a particular pathway. The risk assessments presented in subsequent sections aim to assess,

in quantitative terms, the likelihood of significant harm or pollution occurring to identified receptors.

6.2.1 Sources

Potential off site sources of contamination include a number of historical and current works to the north west, north and north east (including a gasworks which was located about 75 m to the north east), an electrical substation to the north west and historical activities on the former wider Forest Vale Iron works and Bilson colliery. There is therefore a wide range of potential contaminants of concern.

Based on our current understanding of the Site's history (Section 2) and the recent site investigation results, relevant contaminant sources include:

- *Solid and adsorbed contaminants present within the Made Ground*

  The observed chemical quality of the soils (Section 5.6) indicates the presence of various contaminants including PAH, heavy metals and petroleum hydrocarbons.

- *Aqueous phase contaminants within the Made Ground/Head*

  Groundwater quality associated with the Made Ground and natural deposits beneath the Site includes somewhat elevated ammoniacal nitrogen in BH3 and modest concentrations of certain heavy metals (Section 5.7).

Note: Section 5.9 shows that bulk soil gases are not present in significant concentrations and can therefore be discounted as a potential contaminant source.

6.2.2 Pathways

Potential pollutant pathways have been identified as follows:

- Soil and dust ingestion, dermal contact, dust inhalation and vegetable uptake from sources at or close to the ground surface;
- Vapour inhalation of any volatile contaminants associated with the Made Ground
- Leaching of soil contaminants and transport of dissolved phase contaminants to groundwater and/or surface water. Shallow lateral migration in Made Ground is possible as well as vertical migration to the Coal Measures aquifer.

Initial observations concerning potential contaminant pathways include:

- In the context of human receptors, direct contact exposure pathways will be limited to areas of soft landscaping. The majority of the gardens (as observed during the recent site visit) are largely comprised of grassed areas and flower beds, offering the potential for direct exposure mechanisms. Several communal grassed areas also offer the potential for direct contact exposures.
- Human Health risks associated with the inhalation of soil vapours are unlikely to be significant since the site investigation did not identify any appreciable sources of volatile or semi-volatile organic substances.
- Contaminant pathways to the underlying secondary aquifer are largely dependent on the properties and thickness of the Head materials overlying the Coal Measures. Because the Head is generally fine-grained, flow rates are expected to be relatively low.
- The same considerations apply to horizontal flow within the Made Ground and Head towards Cinderford Brook.

6.2.3 Receptors

Under the Part IIA regime, the Local Authority is required to consider potential risks to a number of receptor categories, including risks to human health, controlled waters, ecological

systems/living organisms, property in the form of crops, livestock etc., and property in the form of buildings.

Based on the current Site understanding, potential receptors are identified as:

- Occupants of the Site properties.
- Occupants of properties directly neighbouring the Site.
- The Coal Measures secondary aquifer.
- Cinderford Brook and any associated ecological receptors.

6.3 Pollutant linkages

Combining the Site-specific observations on potential sources, pathways and receptors enables production of a summary of potential pollutant linkages, which is presented in Table 6.1. Potential pollutant linkages are brought forward to the human health and controlled waters risk assessments presented in Sections 7 and 9 respectively.

Table 6.1 Potential pollutant linkages

Ref	Sources	Contaminants	Pathways	Receptors	Comments
	Contaminants present within the Made Ground				
PL1	Shallow soils/Made Ground	Heavy metals, TPH and PAH	Ingestion of soils and soil dust; inhalation of soil dust and dermal contact with contaminated soils	Occupants of on-Site properties	*Potential pollutant linkage (see risk assessment in Section 7)*
PL2		No volatiles detected in gas sampling	Volatilisation of organic substances and subsequent inhalation	Occupants of on-Site properties	***Pollutant linkage discounted***
PL3		Heavy metals, TPH and PAH	Dissolution of soil phase contaminants into pore water or shallow groundwater and subsequent migration via shallow groundwater system	Secondary aquifer and Cinderford Brook (and associated ecologies)	*Potential pollutant linkage (see risk assessment in Section 9)*
	Aqueous phase contaminants within/below the Made Ground				
PL4	Groundwater in Made Ground/ Head deposits	Heavy metals	Ingestion of contaminated groundwater	Occupants of on-Site properties	*Potential pollutant linkage (see risk assessment in Section 7)*
PL5		Volatile organics were not detected in groundwater	Volatilisation of organic compounds and subsequent inhalation	Occupants of on-Site properties	***Pollutant linkage discounted***
PL6		Ammoniacal nitrogen, metals	Migration via shallow groundwater system	Secondary Aquifer and Cinderford Brook (and associated ecologies)	*Potential pollutant linkage (see risk assessment in Section 9)*
	Soil vapour/bulk gas concentrations within the Made Ground				
PL7	Soil gas/vapours	None identified at concentrations of concern	Lateral migration through soils, collection in buildings or buried structures and subsequent inhalation	Occupants of on-Site properties	***Pollutant linkage discounted***

7 HUMAN HEALTH RISK ASSESSMENT

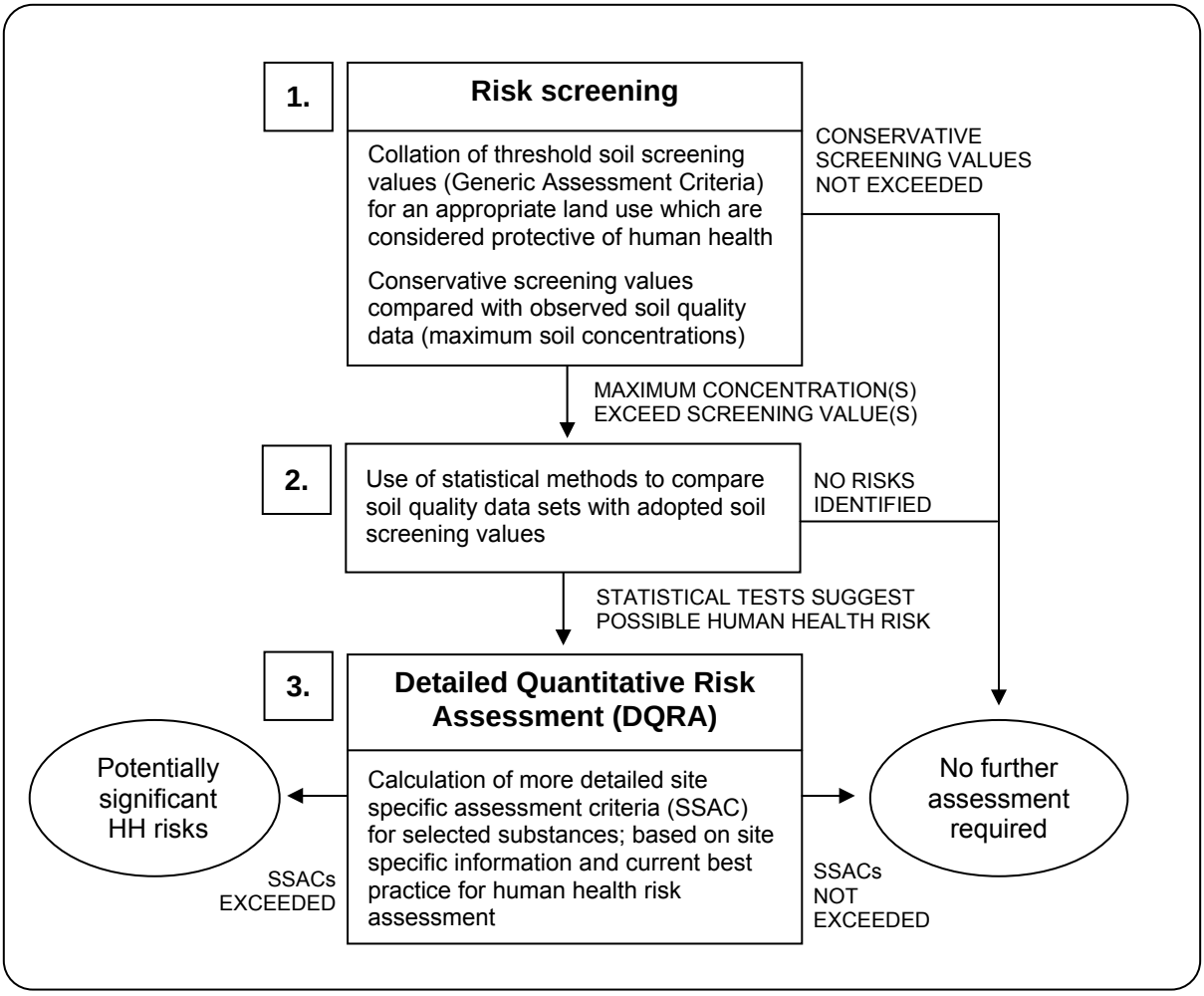
7.1 Introduction

Part IIA of the Environmental Protection Act 1990 introduced a regulatory regime for the identification and remediation of contaminated land. Statutory Guidance (DETR, 2006) and the Contaminated Land (England) Regulations (2000) contain details of the regime relevant to the works described in this report.

Potential pollutant linkages have been assessed in Section 6.3 to identify those which may pose potential risks to identified receptors. Having established the key linkages a quantitative assessment of the potential risks posed to the identified human health receptors by current contaminant concentrations across the site must now be performed

7.2 Methodology

The process adopted for assessing risks to human health is summarised in the following flow diagram:



Thus, the assessment of risks posed to human health receptors by the exposure to potentially contaminated soil is conducted through a tiered process, whereby an initial screening exercise is employed to identify any potentially hazardous contaminants. Where any such contaminants are identified, these are then subject to a detailed quantitative risk assessment (DQRA) utilising as much site specific information as possible in order to generate representative site specific assessment criteria (i.e., threshold soil and groundwater concentrations, above which there is considered to be a potentially significant risk to human health for the prevailing conceptual model).

7.2.1 Risk screening

i) Risks posed by observed soil quality *(pollutant linkage: PL1)*

The initial screening exercise was conducted by comparing observed soil quality data with a set of generic human health screening values (commonly referred to as Generic Assessment Criteria (GAC)). GACs have been compiled from various published sources, based on the following hierarchy:

- Updated Soil Guideline Values (SGVs) issued by the Environment Agency (EA, 2009d to 2009m).

  Note: in the absence of a revised lead SGV, the former guideline value for lead (DEFRA and Environment Agency, 2002) has been adopted for the screening exercise. It is recognised that all former SGVs have been derived using an out-dated CLEA methodology. However, given the inherent conservatism used in the derivation of these values the use of the former lead SGV is considered appropriate for the purposes of a screening exercise.

- GACs derived by a consortium of industry professionals and published by LQM (LQM, 2009). The methodology adopted in deriving the GAC values was consistent with that used for producing the revised SGVs.

- GACs derived by a consortium of industry professionals under the guidance of the Environmental Industries Commission (EIC) and published by CL:AIRE (CL:AIRE, 2010). GACs for c. 48 potential contaminants have been derived using the same methodologies, data sources and modelling tools as used by the Environment Agency.

The available soil quality data were assessed against GACs representative of a standard residential land use (assuming the consumption of home-grown produce), with a sandy loam soil type and a soil organic matter (SOM) content of 2.5% (note: the average observed SOM is 3.3%). A listing of all GACs adopted for the screening exercise is presented in Table 7.1.

Table 7.1 Screening values adopted for the human health risk assessment

Parameter	Units	Screening value/GAC	Comment
Metals			
Arsenic	mg/kg	32	SGV: based on dermal and oral exposures only (as per published SGV report; EA, 2009e)
Boron	mg/kg	291	LQM derived value
Barium	mg/kg	1300	EIC derived value (based on no consumption of home grown produce)
Beryllium	mg/kg	51	LQM derived value; based on inhalation exposure only
Cadmium	mg/kg	10	SGV
Chromium VI	mg/kg	4.3	LQM derived value: based on inhalation exposure only
Chromium III	mg/kg	3000	LQM derived value [1]
Total chromium	mg/kg	280	USEPA derived value for total chromium: based on 1:6 ratio Cr VI : Cr III[1]
Copper	mg/kg	2330	LQM derived value
Lead	mg/kg	450	Based on previous SGV report (DEFRA & EA, 2002)
Mercury	mg/kg	0.42	SGV (recalculated for 2.5% SOM): conservatively based on elemental mercury parameterisation (EA, 2009f); for the purposes of modelling the vapour inhalation pathway treated as organic
Molybdenum	mg/kg	670	EIC derived value (based on no consumption of home grown produce)
Nickel	mg/kg	130	Based on inhalation exposure only (as per published SGV report; EA, 2009g)
Selenium	mg/kg	350	SGV
Vanadium	mg/kg	75	LQM derived value
Zinc	mg/kg	3750	LQM derived value
Miscellaneous			
Phenols	mg/kg	290	SGV (recalculated for 2.5% SOM)
Cyanide	mg/kg	1600	USEPA derived value[2] for cyanide ion CN^-
PAH			
Acenaphthene	mg/kg	480	LQM derived value (2.5% SOM)
Acenaphthylene	mg/kg	400	LQM derived value (2.5% SOM)
Anthracene	mg/kg	4900	LQM derived value (2.5% SOM)
Benzo[a]anthracene	mg/kg	4.7	LQM derived value (2.5% SOM)
Benzo[a]pyrene	mg/kg	0.94	LQM derived value (2.5% SOM)
Benzo[b]fluoranthene	mg/kg	6.5	LQM derived value (2.5% SOM)
Benzo[g,h,i]perylene	mg/kg	46	LQM derived value (2.5% SOM)
Benzo[k]fluoranthene	mg/kg	9.6	LQM derived value (2.5% SOM)
Chrysene	mg/kg	8	LQM derived value (2.5% SOM)
Dibenzo[a,h]anthracene	mg/kg	0.86	LQM derived value (2.5% SOM)
Fluoranthene	mg/kg	460	LQM derived value (2.5% SOM)
Fluorene	mg/kg	380	LQM derived value (2.5% SOM)

[1] Adopted chromium GAC (for comparison with total chromium soils data) based on chromium III since all hexavalent chromium results were below the laboratory LOD

[2] It is acknowledged that the adopted GAC has been taken from a non-UK source (http://www.epa.gov/region09/superfund/prg/) and its applicability may therefore be questioned. However, the adopted GAC is considered adequate for screening purposes.

Parameter	Units	Screening value/GAC	Comment
Indeno[1,2,3-cd]pyrene	mg/kg	3.9	LQM derived value (2.5% SOM)
Naphthalene	mg/kg	3.7	LQM derived value (2.5% SOM)
Phenanthrene	mg/kg	200	LQM derived value (2.5% SOM)
Pyrene	mg/kg	1000	LQM derived value (2.5% SOM)
BTEX and speciated TPH			
Benzene	mg/kg	0.16	SGV (recalculated for 2.5% SOM)
Toluene	mg/kg	154	SGV (recalculated for 2.5% SOM)
Ethylbenzene	mg/kg	270	SGV (recalculated for 2.5% SOM)
m & p Xylene	mg/kg	98	SGV for p xylene (recalculated for 2.5% SOM)
o Xylene	mg/kg	106	SGV (recalculated for 2.5% SOM)
Aliphatics C5-C6	mg/kg	55	LQM derived value
Aliphatics >C6-C8	mg/kg	160	LQM derived value
Aliphatics >C8-C10	mg/kg	46	LQM derived value
Aliphatics >C10-C12	mg/kg	118	LQM derived value. GAC set at vapour saturation limit.
Aliphatics >C12-C16	mg/kg	59	LQM derived value. GAC set at soil saturation limit.
Aliphatics >C16-C21	mg/kg	21	LQM derived value (based on GAC for C16-C35 fraction). GAC set at soil saturation limit.
Aliphatics >C21-C35	mg/kg	21	LQM derived value (based on GAC for C16-C35 fraction), GAC set at soil saturation limit.
Aromatics C6-C7	mg/kg	130	LQM derived value (based on GAC for C5-C7 fraction)
Aromatics >C7-C8	mg/kg	270	LQM derived value
Aromatics >EC8-EC10	mg/kg	65	LQM derived value
Aromatics >EC10-EC12	mg/kg	160	LQM derived value
Aromatics >EC12-EC16	mg/kg	310	LQM derived value
Aromatics >EC16-EC21	mg/kg	480	LQM derived value
Aromatics >EC21-EC35	mg/kg	1100	LQM derived value
Aromatics >EC35-EC44	mg/kg	1100	LQM derived value

For the purpose of the risk screening, the maximum observed analyte concentrations were initially compared with the adopted screening values (GAC). For those determinands where the maximum concentration was less than the respective screening concentration, no human health risks were inferred and no further assessment was considered necessary.

Those analytes for which the maximum observed concentration (based on the statistics presented in Table 5.4) exceeds the conservative screening value are presented in Table 7.2.

Table 7.2 Exceedance of screening values

Analytical Parameter	Units	Nr samples	Nr >GAC	Max value	Mean value	GAC
Speciated PAH						
Naphthalene	mg/kg	28	1	7.10	0.72	3.70
Benzo(a)anthracene	mg/kg	28	1	18.00	1.08	4.70
Chrysene	mg/kg	28	1	12.00	0.80	8.00
Benzo(b)fluoranthene	mg/kg	28	1	19.00	1.11	6.50
Benzo(a)pyrene	mg/kg	27	3	1.70	0.34	0.94

Analytical Parameter	Units	Nr samples	Nr >GAC	Max value	Mean value	GAC
Indeno(1,2,3-cd)pyrene	mg/kg	28	1	8.40	0.53	3.90
Dibenz(a,h)anthracene	mg/kg	28	1	1.20	0.24	0.86
Heavy Metals / Metalloids						
Arsenic	mg/kg	27	1	39.00	13.61	32.00
Vanadium	mg/kg	27	4	680	68.7	75
Petroleum Hydrocarbons						
TPH7 - Aliphatic >C21 - C35	mg/kg	7	2	44.00	15.57	21.00

As shown in the table, only 10 analytes were found to exceed the GAC in any soil sample, and only 16 analytical results from a total of 224 exceeded the respective GAC.

Clearly, the maximum observed soil concentration is an exaggerated reflection of the observed soil quality (i.e. reflecting very much a worst case situation). CIEH and CL:AIRE (2008) recommends the comparison of an estimate of the mean soil quality concentration with the adopted screening value as an appropriate approach to site assessment. A statistical tool (the Statistics Calculator) has been developed by ESI (on behalf of CIEH and CL:AIRE) in order to undertake the tests described in the guidance document.

The approach recognises that the observed soil quality data set can only represent a very small fraction of the entire soil mass which is present across the Site. The statistical tests allow an estimated mean soil concentration of a given substance to be calculated with an associated confidence level that the true mean soil concentration is above the critical concentration (i.e. GAC value).

As the purpose of this investigation is to establish whether the Site falls within the scope of Part IIA, the statistical tests are structured to conclude whether we can confidently say that the level of contamination at the Site is high relative to an appropriate measure of risk. The question to determine is whether there is sufficient probability that the true mean soil concentration falls above the critical concentration. A 95% probability is generally considered as robust in the context of contaminated land investigation. However, under Part IIA a decision can also be made on the 'balance of probabilities' which is at the lesser but still defensible confidence level of 51% or more.

The detailed approach taken by the Statistics Calculator is set out in CIEH and CL:AIRE (2008). Non-detects in this case have been conservatively assigned a value equal to the detection limit and outliers have not been removed from the data set.

Statistics have been calculated for the nine analytes listed in Table 7.2, and an electronic version of the Calculator is included as Appendix E. The tool indicates that the measured concentrations are not normally distributed and the Chebychev Theorem is therefore appropriate for estimating the true mean concentrations. The results are reproduced in Table 7.3, which shows the level of evidence *against* the "Null Hypothesis", i.e. the evidence *against* the Site concentration for any determinand being lower than the critical concentration. It also shows in the last column the outcome of the statistical test.

Table 7.3 Statistical test results

Determinand	Nr samples	Nr non-detects	Units	Screening value	95th LCL	Estimated mean	Level of evidence against Null Hypothesis[1]	Test outcome
Naphthalene	28	20	mg/kg	3.7	<0	0.72	0% - 0%	μ ≤ Cc
Benzo(a)anthracene	28	14	mg/kg	4.7	<0	1.08	0% - 0%	μ ≤ Cc
Chrysene	28	12	mg/kg	8.0	<0	0.80	0% - 0%	μ ≤ Cc
Benzo(b)fluoranthene	28	12	mg/kg	6.5	<0	1.11	0% - 0%	μ ≤ Cc
Benzo(a)pyrene	27	15	mg/kg	0.94	0.0046	0.34	0% - 0%	μ ≤ Cc
Indeno(1,2,3-cd)pyrene	28	22	mg/kg	3.9	<0	0.53	0% - 0%	μ ≤ Cc
Dibenz(a,h)anthracene	28	27	mg/kg	0.86	0.08	0.24	0% - 0%	μ ≤ Cc
Arsenic	27	0	mg/kg	32	6.72	13.6	0% - 0%	μ ≤ Cc
Vanadium	27	0	mg/kg	75	<0	68.7	0% - 40%	μ ≤ Cc
TPH Aliphatic >C21 - C35	7	5	μg/kg	21	<0	15.6	0% - 17%	μ ≤ Cc

[1] The upper and lower bounds of evidence are calculated when the Chebychev Theorem is used. The actual level of evidence is a value within this range.

The information presented in Table 7.3 shows that there is insufficient evidence to reject the Null Hypothesis for the Part IIA scenario at either the 95% confidence limit or on the balance of probabilities (i.e. > 51%). This is true for all of the assessed contaminants. The initial conclusion in relation to these substances is therefore that the true mean concentrations are less than, or equal to, the respective critical concentrations. As such, the observed contaminant concentrations for these analytes are unlikely to pose any significant risks to human health based on the observed soil quality dataset.

ii) Risks posed by observed soil vapour concentrations *(pollutant linkage: PL2)*

Given that no volatile organic compound substances were detected on Site during the investigation, and that soil samples confirmed the absence of volatiles (with the exception of occasional low concentrations of naphthalene), we do not consider that any human health risks are posed by observed soil vapours.

iii) Risks posed by groundwater quality *(pollutant linkages: PL4 and PL5)*

Based on available groundwater quality data no risks to human health have been identified from exposure to shallow groundwater. This conclusion is justified by the following observations:

- Current and future on-site potable water supplies are understood to be provided from mains supply; no direct consumption of untreated water derived from beneath the Site is anticipated.
- Volatile organic compounds were not detected in any shallow groundwater samples. As such, the generation of contaminant vapours from the dissolved phase and subsequent human inhalation is therefore unlikely to represent a relevant pollutant linkage.

8 GROUND GAS RISK ASSESSMENT

As noted in Section 4.6, no appreciable ground gas concentrations or borehole flow rates were recorded during the site investigation. As a consequence, there is no requirement for a quantitative ground gas risk assessment. Since, with the absence of a bulk gas source, the risk to surrounding properties and their occupants can be assumed to be very low.

9 CONTROLLED WATERS RISK ASSESSMENT

9.1 Methodology

The controlled waters risk assessment has been undertaken by comparing observed water quality data with selected target concentrations (deemed to be protective of freshwater quality). This approach is consistent with the Environment Agency's Remedial Targets Methodology (EA, 2006).

Target concentrations for controlled waters, in the absence of any specific local issues, may be taken as the UK drinking water standards (UK DWS) – particularly relevant to groundwater quality – or Environmental Quality Standards (EQS), which are appropriate to surface waters and their associated flora and fauna.

An initial screening assessment (Level 1 assessment) therefore compares measured concentrations against these target values. Measured concentrations have been presented in Sections 5.7 and 5.8 (ie. For both groundwater and soil leachability test results). For those compounds that were detected, a screening comparison is presented in Table 9.1.

Table 9.1 Screening of leach test and groundwater results

Analytical Parameter (Water Analysis)	Units	EQS	DWS	Nr samples	Nr non-detects	Min value	Max value	Mean
General Inorganics								
Sulphate as SO_4	mg/l	400	250	10	0	3.4	160	46.5
Ammoniacal Nitrogen as N	µg/l		390	10	1	<15	340	83.2
Ammonia as N (see note 3)	µg/l	15				<0.003	0.63	0.16
Heavy Metals / Metalloids (dissolved)								
Arsenic	µg/l	50	10	10	7	<10	**45**	**11.3**
Chromium	µg/l	5-250	50	10	6	<1	**13**	2.78
Cobalt	µg/l			10	7	0.5	3.4	1.07
Copper	µg/l	1-28	2000	10	0	**8.1**	**33**	**15.1**
Iron	mg/l	1	0.2	10	3	<0.2	**12**	**2.12**
Lead	µg/l	7.2	25	10	6	<5	**13**	**5.51**
Manganese	µg/l		50	10	0	2.7	**1500**	**179**
Molybdenum	µg/l			10	2	<35	63	19.7
Nickel	µg/l	20	20	10	0	2.3	16	5.49
Vanadium	µg/l	20-60		10	6	<5	**31**	8.08
Zinc	µg/l	8-500	5000	10	1	<1	**44**	11.4
Magnesium (dissolved)	mg/l		50	10	0	0.8	**60**	15.6

Since no organic compounds were detected in the groundwater samples analysed (Section 5.7) and because concentrations of organic compounds in soils were also low (Section 5.6), no further discussion of organic contaminants is considered necessary (ie. Organic compounds do not appear to present any risks to the identified controlled waters receptors).

[3] Ammonia concentrations are calculated, based on partitioning calculations for NH_4^+, from the ammoniacal nitrogen values, assuming an ambient temperature of 10°C and pH of 7.

9.2 Risks posed by dissolved phase contaminants *(pollutant linkages: PL3 and PL6)*

For the purpose of identifying contaminants which have the potential to cause pollution of controlled waters Table 9.1 compares mean and maximum observed groundwater and leach test concentrations with adopted target concentrations. Any exceedances of the adopted target concentrations are highlighted in bold.

The results indicate that a number of substances do exceed one or both of the adopted target concentrations and may therefore present a risk to identified controlled waters receptors. Further discussion of the likely pollution risks posed by these substances is presented below.

Arsenic: maximum and mean observed concentrations (45 and 11.3 µg/l) exceed the DWS (10 µg/l), although they fall below the EQS. The mean concentration would require a dilution factor of 1.1 by groundwater flow to reduce the concentration to the DWS. It is considered that this modest dilution will take place within a short distance of the leached water reaching the water table, and given the absence of current usage of the groundwater body it is not believed to represent significant pollution of controlled waters. No arsenic concentrations above the LOD were detected in the groundwater samples.

Chromium: all measured chromium concentrations were below the DWS and the upper bound of the EQS. The maximum concentrations were however above the lower bound of the EQS. Closer review of the data (Appendix D) indicates that two of the leach test results were above 5 µg/l (measuring 8 and 13 µg/l). Given that the concern here is with the potential for impact on Cinderford Brook, we consider that it is reasonable to assess the mean concentration, which lies below 5 µg/l. If we were to consider the maximum value, we consider that other factors would be sufficient to obviate any impact on the watercourse. These factors include the available dilution between the Site and the receptor, the absorption capacity of soils along the pathway, the likelihood of some hardness in the Brook water that would raise the relevant EQS value within the range 5 to 250 µg/l and the dilution afforded in the receptor itself. No chromium concentrations above the LOD were detected in the groundwater samples.

Copper: all measured copper concentrations were below the DWS, but they were all above the lower bound of the EQS. The two largest values observed were 33 and 19 µg/l, in the leach tests and groundwater respectively. The mean concentration observed would require reduction (by attenuation and dilution) by a factor of 15.1 in order to reach the lower bound of the EQS (1 µg/l).

Iron: five of the seven leachate tests for iron gave results above the DWS and four of these were above the EQS. None of the groundwater analyses detected iron. The mean concentration would require reduction by a factor of 2.1 to reach the EQS and by 10.6 to reach the DWS. We consider that available dilution would reduce concentrations to below the EQS in Cinderford Brook. Given that the groundwater analyses did not detect iron, it appears that the leached iron is bound within the soil and presumably unavailable for rapid release, or that available groundwater dilution is significant. In either case there does not appear to be a risk to groundwater.

Lead: Three leachate concentrations exceed the EQS, although no lead was detected in groundwater. A factor of 1.4 would be required to reduce the mean concentration to the lower EQS bound. We therefore consider that no significant impact from lead is likely.

Manganese: Four values exceeded the DWS for manganese, two of which were groundwater samples. However, one of these was a clear outlier in the data set: the maximum value was 1500 µg/l and the next largest value was 80 µg/l. If the outlier is discounted from the data set the mean falls to 32.2, which is below the DWS. We therefore consider that, after dilution is taken into account, manganese is unlikely to cause significant pollution of controlled waters.

Vanadium: The two highest vanadium concentrations (31 µg/l and 21 µg/l) are above the lower bound of the EQS. Both of these values are from leach tests. The mean concentration is well below the EQS range and no vanadium was detected in the groundwater samples. For these reasons we do not consider that vanadium will cause significant impact on controlled waters.

Zinc: Five sample results, including two groundwater analyses, exceeded the lower bound of the EQS for zinc. The mean value would require a reduction factor of 1.4 to bring it to the lower bound of the EQS. Given the availability of dilution in both groundwater and the Brook, we consider that zinc will not cause significant pollution.

Magnesium: The highest magnesium result (60 mg/l), which derives from a groundwater sample, is above the DWS. Given that the three highest magnesium results are all from groundwater, and typically an order of magnitude greater than the values measured in leach tests, it is likely that the origin is off-Site (i.e. that the background groundwater quality contains significant magnesium concentrations). However, the mean concentration is well within the DWS, and we do not consider that magnesium provides cause for concern in relation to pollution of controlled waters by the identified sources.

Dilution in Cinderford Brook is expected to be significant. Estimates from other sources indicate typical flows of the order of 1 Ml/d, and minimum flows of the order of 0.1 Ml/d, in the vicinity of the Site. Site-specific data to calculate groundwater flows towards the Brook are not available. However it is clear that the Brook flows will be very much larger than any groundwater inflow from the Site.

Summary

In summary, groundwater shows no indication of any organic compounds and the low levels observed in Site soils support a conclusion that there is little risk to controlled waters from this source. A number of inorganic determinands, particularly metals, have been observed in either groundwater or leach tests or both, at concentrations exceeding relevant quality standards. However, given the availability of significant dilution as well as the conservative nature of lower bound EQS values quoted, none of these are considered likely to cause significant impact to either surface water or groundwater.

10 CONCLUSIONS AND RECOMMENDATIONS

10.1 Conclusions

The following conclusions are drawn from the site investigation works and subsequent risk assessments described in this report:

Conceptual site model

- The Site lithology comprises topsoil overlying less than 1 m of Made Ground. The underlying natural deposits include several metres of superficial deposits (Head) and Coal Measures, which were not intercepted in the site investigation.
- Shallow groundwater occurs within the Made Ground and Head. Observed water levels suggest a groundwater flow direction towards the south and south west. It is likely that this groundwater discharges to the Cinderford Brook.
- The observed chemical quality of the Made Ground indicates the presence of various soil contaminants which are symptomatic of former colliery sites, including limited concentrations of PAHs, heavier end petroleum hydrocarbon fractions and various heavy metals. Groundwater quality associated with the Made Ground and natural deposits beneath the Site includes moderately elevated concentrations of selected metals and metalloids. No organic compounds were however detected in groundwater.
- Field data indicate the absence of any appreciable bulk gases or vapours associated with sub surface soils.
- Relevant receptors which may be impacted upon by potentially contaminated ground conditions include humans (predominantly the occupants of the properties located on the Site), the Secondary Aquifer (Head and Coal Measures) and Cinderford Brook. Given the modest resource potential of the local aquifer, the shallow groundwater system is considered to be of relatively low sensitivity.

Human health risk assessment

- A conservative screening exercise has been undertaken by applying the latest CLEA methodology to identify any contaminants which may pose a significant risk to human health. The screening process identified potential health risks associated with a number of organic compounds, arsenic and long chain hydrocarbons.
- Subsequent statistical interpretation of the soil quality results suggested that no significant risk to human health is presented by the Site soils.

Controlled waters risk assessment

- A conservative screening exercise has been undertaken to identify any contaminants which may cause pollution of controlled waters, namely the Secondary Aquifer and Cinderford Brook. The results of this exercise indicate that the majority of substances (based on groundwater and leach test concentrations) do not pose a pollution risk to controlled waters. However, the observed concentrations of a number of metals and metalloids do exceed the adopted target concentrations and therefore warranted additional discussion. Following further assessment, observed concentrations of these contaminants are considered to pose little risk to groundwater or surface water quality due to their relatively modest concentrations and the available processes – particularly adsorption and dilution – for reduction in concentrations along the relevant transport pathway.

10.2 Recommendations

In the context of the conclusions outlined above, we do not consider that the Site warrants determination under the Part IIA regime. Soil and groundwater quality are not believed to present significant risks either to human health or to controlled waters.

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FIGURES

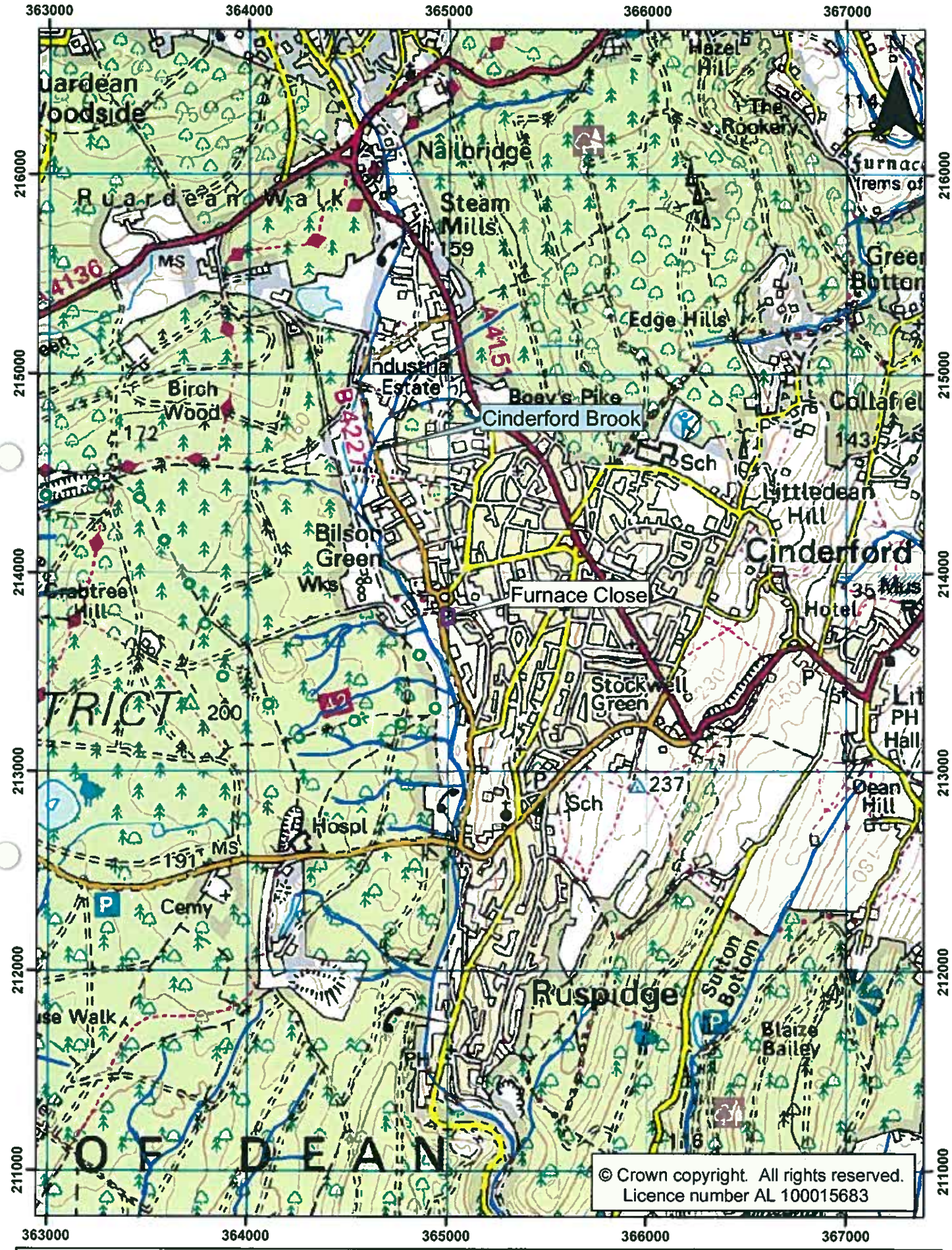

Figure 1.1
Site location

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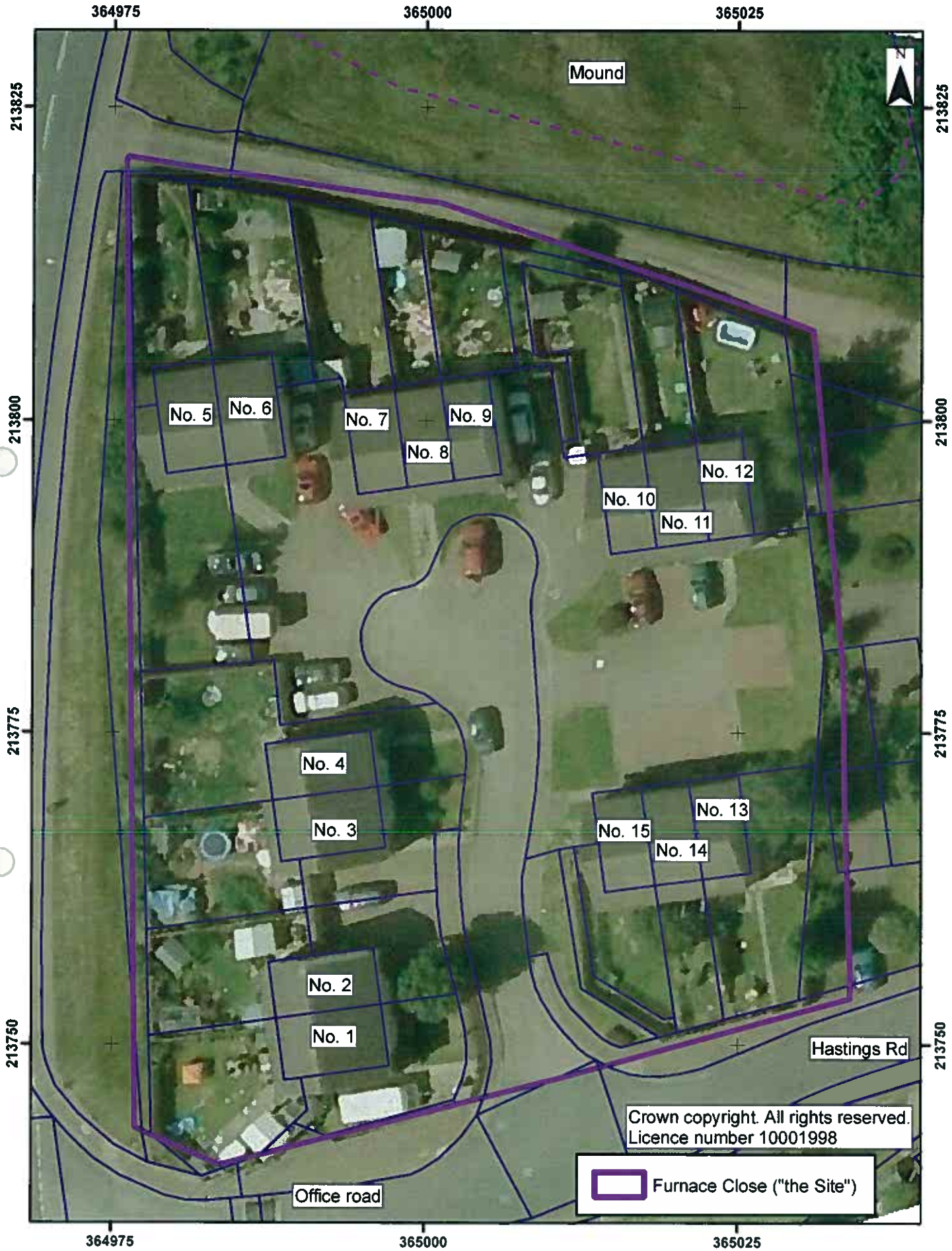

Figure 2.1
Site layout

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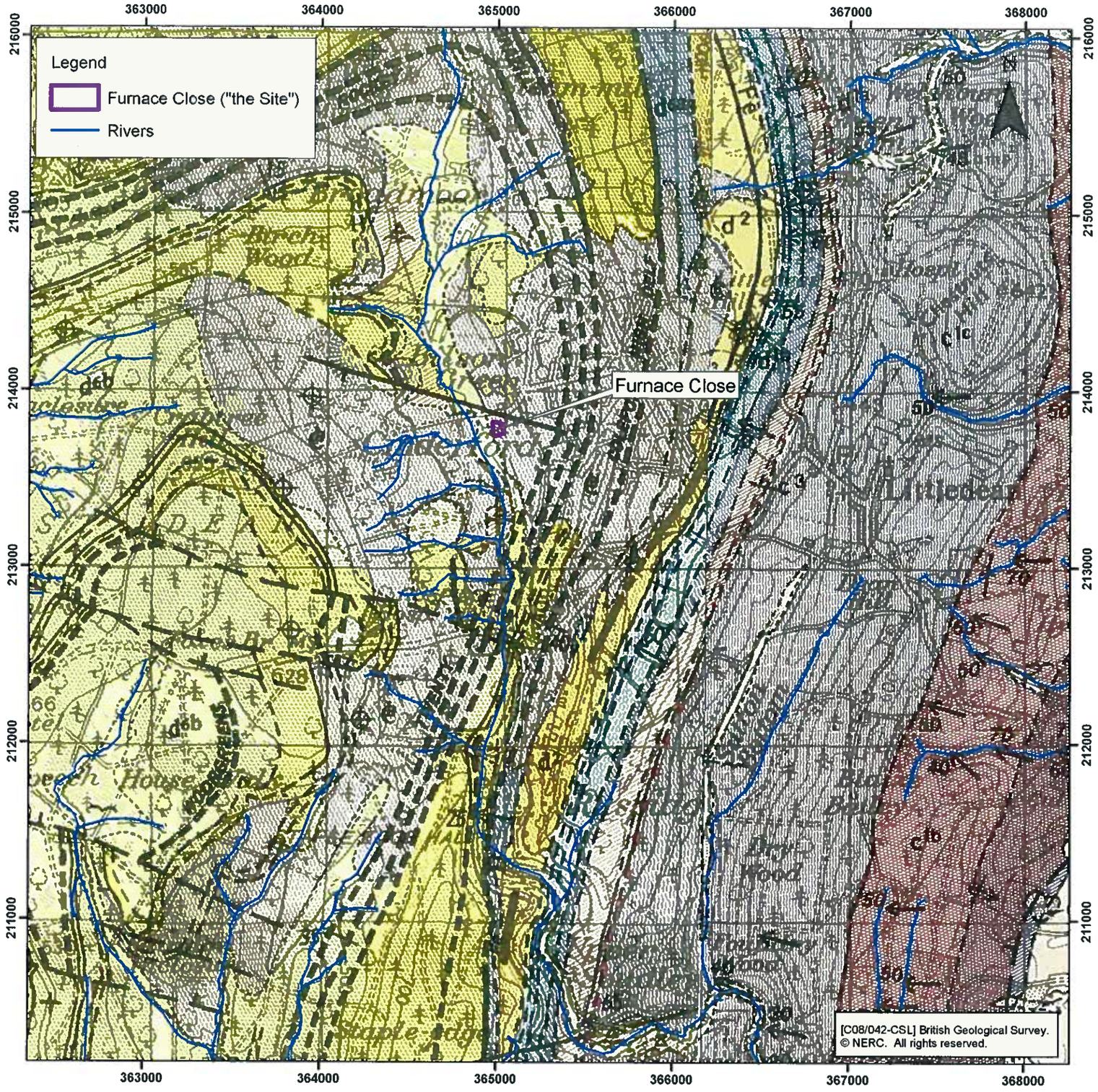

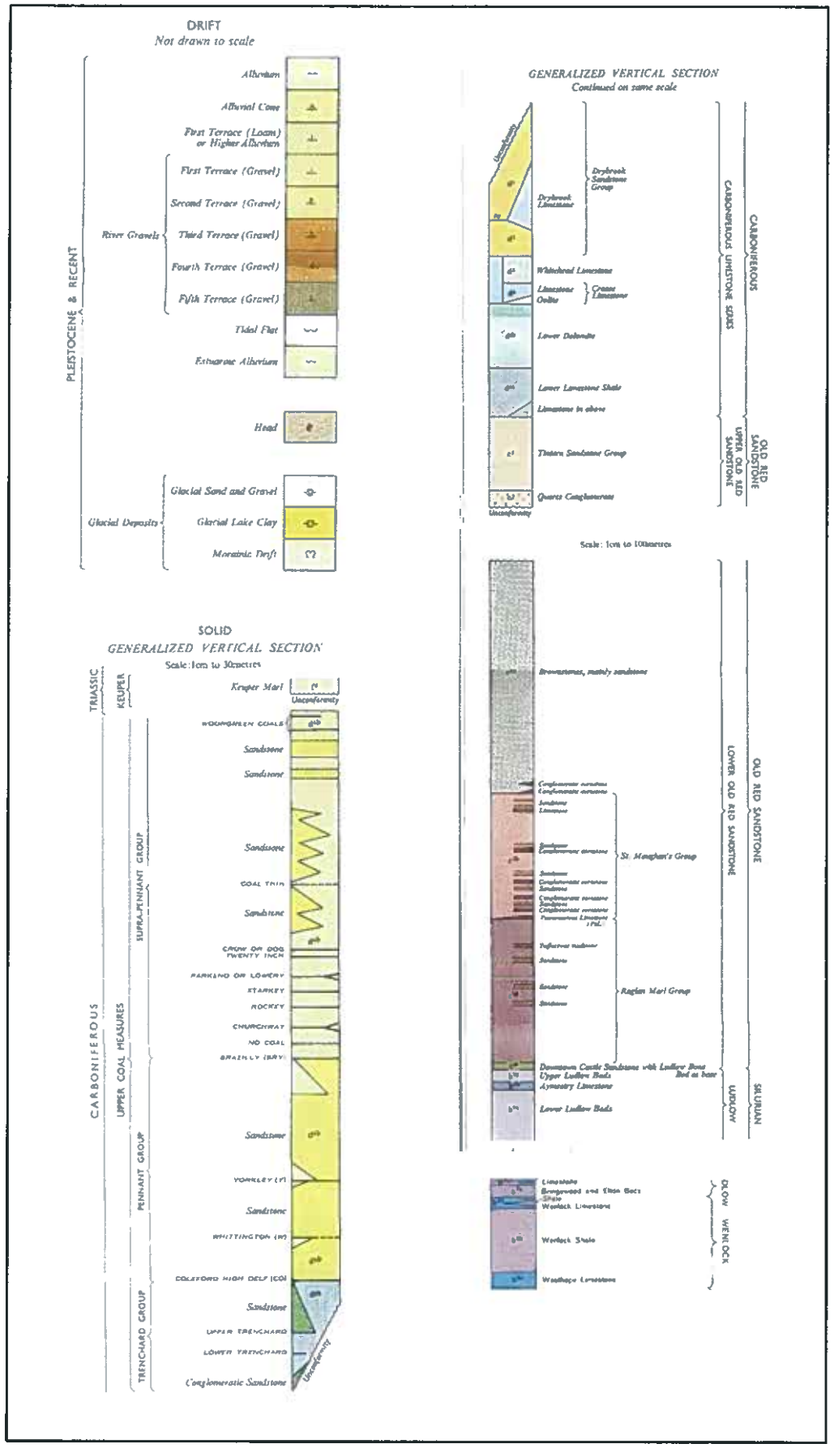

Figure 3.1
Geological map

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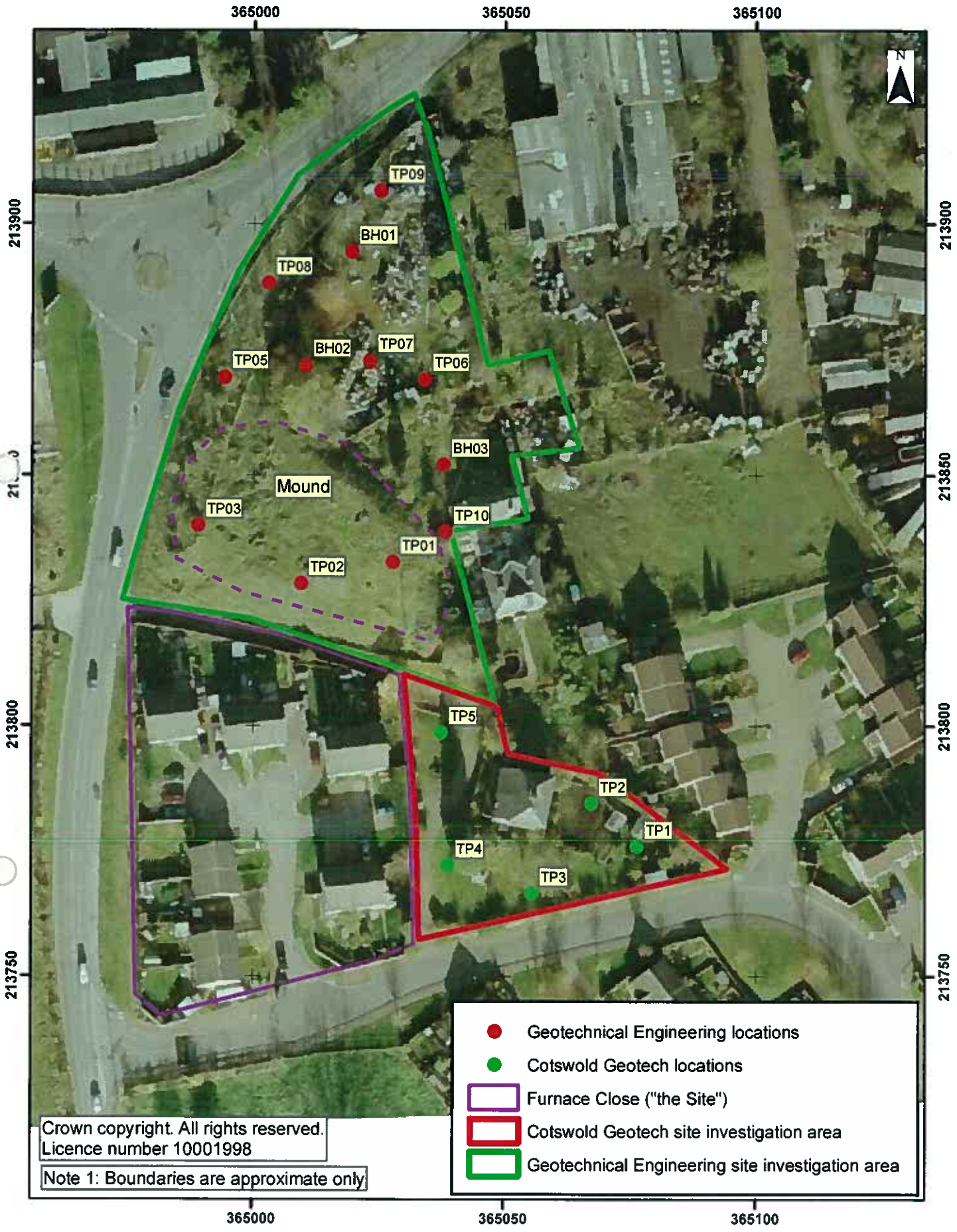

Figure 4.1
Historical site investigation locations

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Figure 5.1
Site investigation locations

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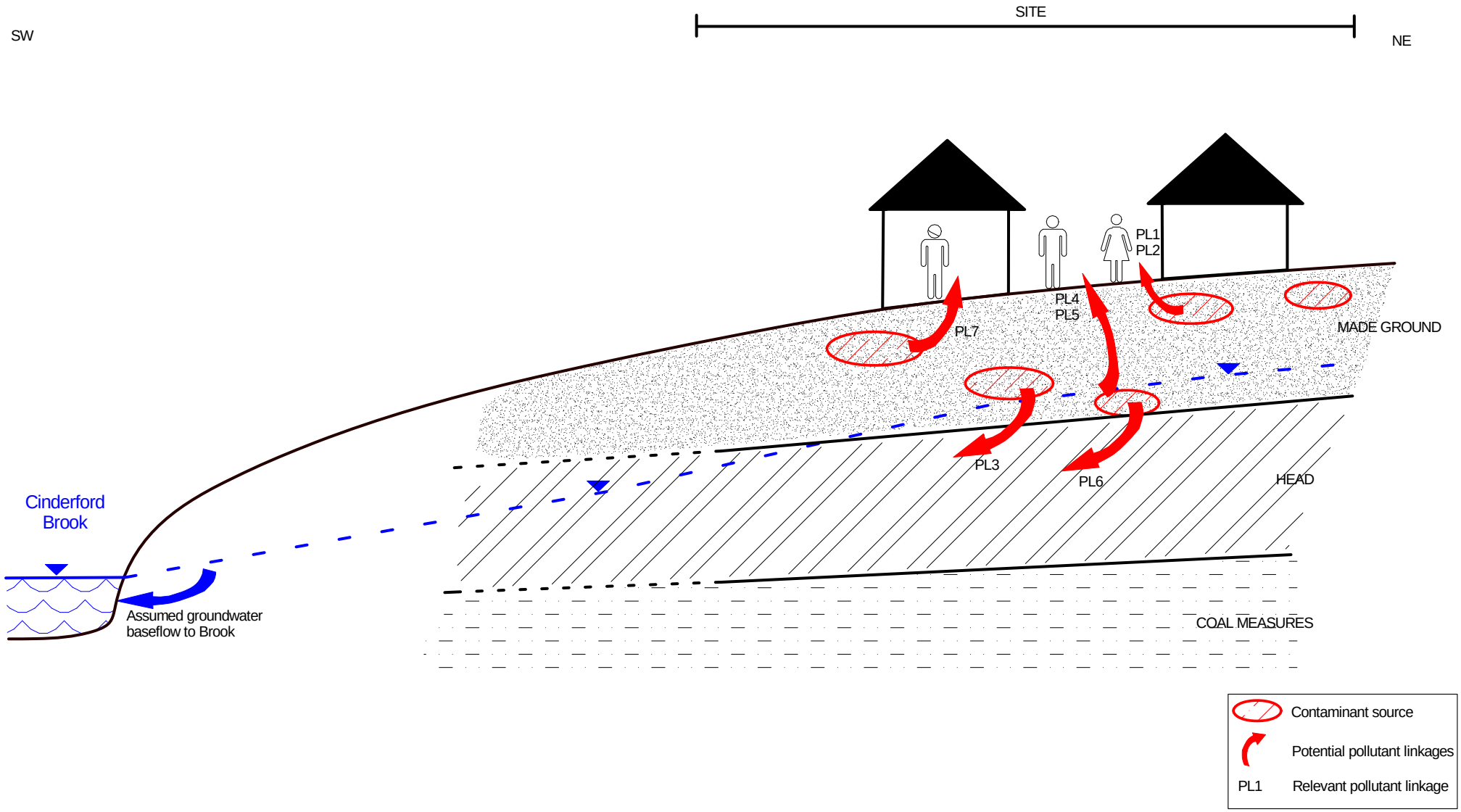

Figure 6.1
Schematic conceptual site model

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APPENDICES

APPENDIX A
Borehole logs

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BOREHOLE LOG

Project				BOREHOLE No
Furnace Close				BH1
Job No	Date	Ground Level (m)	Co-Ordinates ()	
60396	23-11-10 23-11-10			
Contractor				Sheet
CC Ground Investigations Ltd.				1 of 1

SAMPLES & TESTS			Water	STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS		
						(0.25) 0.25	Loose dark brown sandy CLAY (Topsoil)			
						(0.50) 0.75	Loose light brown clayey gravelly SAND. Gravel of brick, slag and coal fragments			
						(0.25) 1.00	Soft dark brown/grey SILT with some brick and clinker			
						1.20	Soft light grey mottled borwn/red sandy CLAY			
						(1.00) 2.20	Firm to stiff red/brown mottled grey CLAY with some grey sand in places			

GENERAL REMARKS

Borehole dry during drilling. 50 mm piezometer installed with 1 mm slots and gas tap.

All dimensions in metres Scale 1: 31	Client Forest of Dean District Council	Method/ Plant Used Terrier rig	Logged By AWT

ESI Ltd
New Zealand House, 160 Abbey Foregate
SY2 6FD
Telephone: 01743 276100
Fax: 01743 248600

BOREHOLE LOG

Project				BOREHOLE No
Furnace Close				BH2
Job No	Date	Ground Level (m)	Co-Ordinates ()	
60396	23-11-10 23-11-10			
Contractor				Sheet
CC Ground Investigations Ltd.				1 of 1

SAMPLES & TESTS			Water	STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS		
						(0.30) 0.30	Loose dark brown sandy CLAY (Topsoil)			
						(0.50) 0.80	Loose dark brown clayey SAND with some gravel of brick, coal/slag and reworked red/brown clay			
						(3.00) 3.80	Red brown clayey SAND and SILT. Clayey in patches. Rare subangular to subrounded gravel of quartz and sandstone. Some light grey sandy clay present as well as dark brown organic matter of wood.			
						4.00	Vert stiff red/brown CLAY with subangular to subrounded gravel to 3 mm in diameter incuding quartz and coal fragments			

GENERAL REMARKS

Borehole dry during drilling. 50 mm piezometer installed with 1 mm slots and gas tap.

All dimensions in metres Scale 1: 31	Client Forest of Dean District Council	Method/ Plant Used Terrier rig	Logged By AWT

ESI Ltd
New Zealand House, 160 Abbey Foregate
SY2 6FD
Telephone: 01743 276100
Fax: 01743 248600

BOREHOLE LOG

Project				BOREHOLE No
Furnace Close				BH3
Job No	Date	Ground Level (m)	Co-Ordinates ()	
60396	23-11-10 23-11-10			
Contractor				Sheet
CC Ground Investigations Ltd.				1 of 1

SAMPLES & TESTS			Water	STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS		
						(0.25) 0.25	Soft to firm dark brown clayey SAND (Topsoil)			
						(0.60) 0.85	Very soft dark brown/grey sandy CLAY with angular gravel of brick, slag, sandstone and mudstone to 5 cm in diameter.			

GENERAL REMARKS

Refused at 0.7 m on slab. Water at 0.7 m bgl.

All dimensions in metres Scale 1: 31	Client Forest of Dean District Council	Method/ Plant Used Hand dip	Logged By AWT

ESI Ltd
New Zealand House, 160 Abbey Foregate
SY2 6FD
Telephone: 01743 276100
Fax: 01743 248600

BOREHOLE LOG

Project				BOREHOLE No
Furnace Close				BH3B
Job No	Date	Ground Level (m)	Co-Ordinates ()	
60396	23-11-10 23-11-10			
Contractor				Sheet
CC Ground Investigations Ltd.				1 of 1

SAMPLES & TESTS			Water	STRATA					Geology	Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thick-ness)	DESCRIPTION	COMMENTS		
						(0.25) 0.25	Soft to firm dark brown clayey SAND (Topsoil)			
						(0.75) 1.00	Loose red/brown clayey SAND with some gravel of sandstone and mudstone			
						1.20	Soft medium brown/grey sandy CLAY with light grey mottling. Rare angular gravel to 2 cm			
						(0.60) 1.80	Loose medium brown/grey gravelly clayey SAND. Gravel is subangular to angular of sandstone and mudstone. No coal/slag observed.			
						1.90	Stiff red/brown CLAY			
						(2.10) 4.00	Stiff medium brown/red gravelly CLAY. Gravel is angular to subangular of sandstone, mudstone, coal fragments. Some light grey clayey sand mottling.			
						(0.80) 4.80	Stiff red/brown/orange/grey CLAY with rare gravel to 1 cm in diameter of angular to subangular sadstone and mudstone and some coal.			
						5.00	Soft to firm red/brown CLAY			

GENERAL REMARKS

Borehole dry during drilling. 50 mm piezometer installed with 1 mm slots and gas tap.

All dimensions in metres Scale 1: 31	Client Forest of Dean District Council	Method/ Plant Used Terrier rig	Logged By AWT

WINDOWLESS SAMPLE LOG 60396.GPJ ESI_STANDARD.GDT 2/3/11

APPENDIX B

Field measurements: bulk gas and shallow groundwater levels

Appendix B.1: Groundwater level monitoring records

Borehole	Total installed depth (m)	Total dippd depth (m)	24/11/2010	10/12/2010	13/01/2011	Comment
BH1	2.2	2.18	1.85	1.2	0.36	Water clear
BH2	4	4	2.49	2.65	2.29	Water clear
BH3B	5	4.45	1	0.76	0.85	Sediment at base of hole

Appendix B.2: Soil gas monitoring records

Borehole reference	Date	Time	Atmospheric Pressure (mb) during monitoring	Methane (%)	Carbon Dioxide (%)	Oxygen (%)	Nitrogen (%)	Hydrogen Sulphide (ppm)	Carbon Monoxide (ppm)	Flow (l/hr)	PID (ppm)	Weather conditions
BH1	24/11/2010	12:30	997	0.0	1.2	17.6	81.1	0.0	93.0	-0.1	0	Dry and cold
BH2	24/11/2010	12:45	997	0.0	0.3	20.4	79.2	0	0	-0.1	0	Dry and cold
BH3B	24/11/2010	12:15	997	0.0	0.4	18.9	80.6	0	0	-0.1	0	Dry and cold
BH1	08/12/2010	17:00	1004	0.0	2.7	16.0	81.2	0.0	0.0	-0.1	-	Dry and cold
BH2	08/12/2010	17:30	1007	0.0	0.4	20.4	79.1	0	0	-0.1	-	Dry and cold
BH3B	08/12/2010	17:15	1006	0.0	1.2	14.1	84.6	0	0	-1.9	-	Dry and cold
BH1	13/01/2011	09:00	993	0.0	0	20.4	79.5	0.0	0.0	0.1	-	cloudy and breezy
BH2	13/01/2011	10:45	994	0.0	0.4	19.5	80	0.0	33.0	0	-	cloudy and breezy
BH3B	13/01/2011	09:50	994	0.0	0	20.4	80	0.0	0.0	0	-	cloudy and breezy

APPENDIX C

Laboratory test results

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t: 01923 67 00 20
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Analytical Report Number : 10-25288

Project / Site name:	60369	**Samples received on:**	25/11/2010
Your job number:		**Samples instructed on:**	25/11/2010
Your order number:		**Analysis completed by:**	08/12/2010
Report Issue Number:	1	**Report issued on:**	08/12/2010
Samples Analysed:	5 soil samples		

Signed:

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Sian John
Senior Scientist - Organics
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting

Analytical Report Number: 10-25288

Project / Site name: 60369

Lab Sample Number				161631	161632	161633	161634	161635
Sample Reference				BH3	BH3B	S22	S18	S26
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.65	1.10	0.15	0.25	0.29
Date Sampled				23/11/2010	23/11/2010	23/11/2010	23/11/2010	23/11/2010
Time Taken				1200	1230	1500	1515	1630
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	24	12	24	14	19
Total mass of sample received	kg	0.001	NONE	0.75	0.78	0.67	0.71	0.69
General Inorganics								
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	3.6
Free Cyanide	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Water Soluble Sulphate as SO_3 (2:1)	g/l	0.005	NONE	0.050	0.046	0.031	0.082	0.063
Ammoniacal Nitrogen as N	mg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Fraction Organic Carbon (FOC)	N/A	0.00001	NONE	0.032	N/A	N/A	N/A	N/A
Total Phenols								
Total Phenols (monohydric)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	1.4
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	1.4
Phenanthrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	13
Anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	8.8
Fluoranthene	mg/kg	0.2	MCERTS	6.0	< 0.20	< 0.20	< 0.20	32
Pyrene	mg/kg	0.2	MCERTS	4.9	< 0.20	< 0.20	< 0.20	25
Benzo(a)anthracene	mg/kg	0.2	MCERTS	1.6	< 0.20	< 0.20	< 0.20	18
Chrysene	mg/kg	0.05	MCERTS	1.5	< 0.05	< 0.05	< 0.05	12
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	1.9	< 0.10	< 0.10	< 0.10	19
Benzo(k)fluoranthene	mg/kg	0.2	MCERTS	0.97	< 0.20	< 0.20	< 0.20	6.8
Benzo(a)pyrene	mg/kg	0.1	MCERTS	1.7	< 0.10	< 0.10	< 0.10	14
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	MCERTS	0.77	< 0.20	< 0.20	< 0.20	8.4
Dibenz(a,h)anthracene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	1.2
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	0.93	< 0.05	< 0.05	< 0.05	8.5
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	20	< 1.6	< 1.6	< 1.6	170
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	18	6.4	9.7	11	39
Barium (aqua regia extractable)	mg/kg	1	MCERTS	100	N/A	N/A	N/A	N/A
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	1.6	N/A	N/A	N/A	N/A
Boron (water soluble)	mg/kg	0.2	MCERTS	0.9	N/A	N/A	N/A	N/A
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.2	< 0.2	0.9
Chromium (hexavalent)	mg/kg	1.2	MCERTS	< 1.2	N/A	N/A	N/A	N/A
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	44	21	15	60	51
Cobalt (aqua regia extractable)	mg/kg	0.15	MCERTS	13	17	7.9	14	25
Copper (aqua regia extractable)	mg/kg	1	MCERTS	28	14	44	29	120
Iron (aqua regia extractable)	mg/kg	40	MCERTS	84000	47000	43000	130000	150000
Lead (aqua regia extractable)	mg/kg	2	MCERTS	24	8.0	35	24	110
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	870	280	230	2300	1100
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Molybdenum (aqua regia extractable)	mg/kg	0.25	MCERTS	3.0	0.3	0.8	1.2	7.0
Nickel (aqua regia extractable)	mg/kg	2	MCERTS	33	21	17	30	63
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	98	29	23	140	120
Zinc (aqua regia extractable)	mg/kg	2	MCERTS	56	35	54	52	240
Magnesium (aqua regia extractable)	mg/kg	20	ISO 17025	6000	4100	4700	5000	9500

Analytical Report Number: 10-25288

Project / Site name: 60369

Lab Sample Number				161631	161632	161633	161634	161635
Sample Reference				BH3	BH3B	S22	S18	S26
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.65	1.10	0.15	0.25	0.29
Date Sampled				23/11/2010	23/11/2010	23/11/2010	23/11/2010	23/11/2010
Time Taken				1200	1230	1500	1515	1630
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics								
Benzene	µg/kg	1	MCERTS	< 1.0	N/A	N/A	N/A	N/A
Toluene	µg/kg	1	MCERTS	< 1.0	N/A	N/A	N/A	N/A
Ethylbenzene	µg/kg	1	MCERTS	< 1.0	N/A	N/A	N/A	N/A
p & m-xylene	µg/kg	1	MCERTS	< 1.0	N/A	N/A	N/A	N/A
o-xylene	µg/kg	1	MCERTS	< 1.0	N/A	N/A	N/A	N/A
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	< 1.0	N/A	N/A	N/A	N/A
Petroleum Hydrocarbons								
TPH7 - Aliphatic >C5 - C6	mg/kg	0.1	NONE	< 0.1	N/A	N/A	N/A	N/A
TPH7 - Aliphatic >C6 - C8	mg/kg	0.1	NONE	< 0.1	N/A	N/A	N/A	N/A
TPH7 - Aliphatic >C8 - C10	mg/kg	0.1	NONE	< 0.1	N/A	N/A	N/A	N/A
TPH7 - Aliphatic >C10 - C12	mg/kg	1	NONE	< 1.0	N/A	N/A	N/A	N/A
TPH7 - Aliphatic >C12 - C16	mg/kg	2	NONE	< 2.0	N/A	N/A	N/A	N/A
TPH7 - Aliphatic >C16 - C21	mg/kg	8	NONE	< 8.0	N/A	N/A	N/A	N/A
TPH7 - Aliphatic >C21 - C35	mg/kg	8	NONE	< 8.0	N/A	N/A	N/A	N/A
TPH7 - Aliphatic (C5 - C35)	mg/kg	10	NONE	< 10	N/A	N/A	N/A	N/A
TPH7 - Aromatic >C5 - C7	mg/kg	0.1	NONE	< 0.1	N/A	N/A	N/A	N/A
TPH7 - Aromatic >C7 - C8	mg/kg	0.1	NONE	< 0.1	N/A	N/A	N/A	N/A
TPH7 - Aromatic >C8 - C10	mg/kg	0.1	NONE	< 0.1	N/A	N/A	N/A	N/A
TPH7 - Aromatic >C10 - C12	mg/kg	1	NONE	3.6	N/A	N/A	N/A	N/A
TPH7 - Aromatic >C12 - C16	mg/kg	2	NONE	2.8	N/A	N/A	N/A	N/A
TPH7 - Aromatic >C16 - C21	mg/kg	10	NONE	14	N/A	N/A	N/A	N/A
TPH7 - Aromatic >C21 - C35	mg/kg	10	NONE	79	N/A	N/A	N/A	N/A
TPH7 - Aromatic (C5 - C35)	mg/kg	10	NONE	99	N/A	N/A	N/A	N/A

Analytical Report Number : 10-25288

Project / Site name: 60369

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content

of a sample is calculated as the % weight of the stones not passing a 2 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
161631	BH3	None Supplied	0.65	Brown topsoil and clay with vegetation.
161632	BH3B	None Supplied	1.10	Light brown clay.
161633	S22	None Supplied	0.15	Brown topsoil and clay with vegetation.
161634	S18	None Supplied	0.25	Brown topsoil and clay with vegetation.
161635	S26	None Supplied	0.29	Brown topsoil and clay with vegetation.

Analytical Report Number : 10-25288

Project / Site name: 60369

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of ammoniacal nitrogen in soil by extraction with potassium chloride followed by addition of buffer solution followed by ion selective electrode.	In-house method	L035-PL	W	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073S-PL	W	MCERTS
Cations in soil by ICP-OES	Determination of cations in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L038-PL	D	MCERTS
Fraction of Organic Carbon in soil	Determination of fraction of organic carbon in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L023-PL	D	NONE
Free cyanide (Low level) in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L068-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L019-UK	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Stones not passing through a 2 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results are not corrected for the stone content of the sample.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by extraction with water followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L038-PL	D	NONE
Thiocyanate in soil	Determination of thiocyanate in soil by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by spectrophotometer.	In-house method	L049-PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	MCERTS
TPH7 (Soil)	Determination of dichloromethane/hexane extractable hydrocarbons in soil by GC-MS.	In-house method	L064-PL	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 10-25305

Project / Site name:	60396	**Samples received on:**	25/11/2010
Your job number:		**Samples instructed on:**	25/11/2010
Your order number:		**Analysis completed by:**	08/12/2010
Report Issue Number:	1	**Report issued on:**	08/12/2010
Samples Analysed:	15 soil samples		

Signed:

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Sian John
Senior Scientist - Organics
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting

Analytical Report Number: 10-25305

Project / Site name: 60396

Lab Sample Number				161734	161735	161736	161737	161738
Sample Reference				S1	S2	S3	S5	S6
Sample Number				1	2	3	5	6
Depth (m)				0.30	0.25	0.32	0.27	0.25
Date Sampled				22/11/2010	22/11/2010	22/11/2010	22/11/2010	22/11/2010
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	14	24	28	18	16
Total mass of sample received	kg	0.001	NONE	0.76	0.71	0.66	0.74	0.71
General Inorganics								
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Water Soluble Sulphate as SO_3 (2:1)	g/l	0.005	NONE	0.017	0.039	0.039	0.043	0.028
Ammoniacal Nitrogen as N	mg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Fraction Organic Carbon (FOC)	N/A	0.00001	NONE	N/A	0.028	N/A	0.035	N/A
Total Phenols								
Total Phenols (monohydric)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Phenanthrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	mg/kg	0.2	MCERTS	0.52	1.2	1.1	< 0.20	< 0.20
Pyrene	mg/kg	0.2	MCERTS	0.51	1.2	1.0	< 0.20	< 0.20
Benzo(a)anthracene	mg/kg	0.2	MCERTS	0.38	0.57	0.61	< 0.20	< 0.20
Chrysene	mg/kg	0.05	MCERTS	0.43	0.61	0.70	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	0.50	0.75	0.91	< 0.10	< 0.10
Benzo(k)fluoranthene	mg/kg	0.2	MCERTS	0.33	0.41	0.37	< 0.20	< 0.20
Benzo(a)pyrene	mg/kg	0.1	MCERTS	< 0.10	0.56	0.71	< 0.10	< 0.10
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	MCERTS	< 0.20	0.25	0.32	< 0.20	< 0.20
Dibenz(a,h)anthracene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.41	0.57	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	2.8	6.0	6.4	< 1.6	< 1.6
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	8.4	16	15	14	7.4
Barium (aqua regia extractable)	mg/kg	1	MCERTS	N/A	130	N/A	69	N/A
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	N/A	1.6	N/A	1.3	N/A
Boron (water soluble)	mg/kg	0.2	MCERTS	N/A	1.8	N/A	0.3	N/A
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	1.1	3.3	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	N/A	< 1.2	N/A	< 1.2	N/A
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	23	40	35	15	15
Cobalt (aqua regia extractable)	mg/kg	0.15	MCERTS	9.1	12	13	11	12
Copper (aqua regia extractable)	mg/kg	1	MCERTS	26	58	50	24	29
Iron (aqua regia extractable)	mg/kg	40	MCERTS	60000	59000	51000	39000	49000
Lead (aqua regia extractable)	mg/kg	2	MCERTS	19	86	75	20	19
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	440	610	730	350	610
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Molybdenum (aqua regia extractable)	mg/kg	0.25	MCERTS	1.2	1.4	0.8	1.8	0.9
Nickel (aqua regia extractable)	mg/kg	2	MCERTS	21	33	33	32	30
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	52	71	44	27	22
Zinc (aqua regia extractable)	mg/kg	2	MCERTS	47	130	170	44	69
Magnesium (aqua regia extractable)	mg/kg	20	ISO 17025	8600	7400	5100	3500	4200

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Project / Site name: 60396

Lab Sample Number				161734	161735	161736	161737	161738
Sample Reference				S1	S2	S3	S5	S6
Sample Number				1	2	3	5	6
Depth (m)				0.30	0.25	0.32	0.27	0.25
Date Sampled				22/11/2010	22/11/2010	22/11/2010	22/11/2010	22/11/2010
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics								
Benzene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	< 1.0	N/A
Toluene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	< 1.0	N/A
Ethylbenzene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	< 1.0	N/A
p & m-xylene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	< 1.0	N/A
o-xylene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	< 1.0	N/A
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	N/A	< 1.0	N/A	< 1.0	N/A
Petroleum Hydrocarbons								
TPH7 - Aliphatic >C5 - C6	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	< 0.1	N/A
TPH7 - Aliphatic >C6 - C8	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	< 0.1	N/A
TPH7 - Aliphatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	< 0.1	N/A
TPH7 - Aliphatic >C10 - C12	mg/kg	1	MCERTS	N/A	< 1.0	N/A	< 1.0	N/A
TPH7 - Aliphatic >C12 - C16	mg/kg	2	MCERTS	N/A	< 2.0	N/A	< 2.0	N/A
TPH7 - Aliphatic >C16 - C21	mg/kg	8	MCERTS	N/A	< 8.0	N/A	< 8.0	N/A
TPH7 - Aliphatic >C21 - C35	mg/kg	8	MCERTS	N/A	< 8.0	N/A	< 8.0	N/A
TPH7 - Aliphatic (C5 - C35)	mg/kg	10	MCERTS	N/A	< 10	N/A	< 10	N/A
TPH7 - Aromatic >C5 - C7	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	< 0.1	N/A
TPH7 - Aromatic >C7 - C8	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	< 0.1	N/A
TPH7 - Aromatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	< 0.1	N/A
TPH7 - Aromatic >C10 - C12	mg/kg	1	MCERTS	N/A	< 1.0	N/A	< 1.0	N/A
TPH7 - Aromatic >C12 - C16	mg/kg	2	MCERTS	N/A	< 2.0	N/A	< 2.0	N/A
TPH7 - Aromatic >C16 - C21	mg/kg	10	MCERTS	N/A	12	N/A	< 10	N/A
TPH7 - Aromatic >C21 - C35	mg/kg	10	MCERTS	N/A	100	N/A	< 10	N/A
TPH7 - Aromatic (C5 - C35)	mg/kg	10	MCERTS	N/A	120	N/A	< 10	N/A

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Lab Sample Number				161739	161740	161741	161742	161743
Sample Reference				S9	S11	S8	S10	S12
Sample Number				9	11	8	10	12
Depth (m)				0.26	0.20	0.29	0.21	0.20
Date Sampled				22/11/2010	22/11/2010	22/11/2010	22/11/2010	22/11/2010
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	23	13	15	18	12
Total mass of sample received	kg	0.001	NONE	0.62	0.69	0.75	0.71	0.70
General Inorganics								
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Water Soluble Sulphate as SO_3 (2:1)	g/l	0.005	NONE	0.068	0.018	0.0093	0.018	0.021
Ammoniacal Nitrogen as N	mg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Fraction Organic Carbon (FOC)	N/A	0.00001	NONE	N/A	N/A	N/A	0.014	0.0074
Total Phenols								
Total Phenols (monohydric)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Phenanthrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Pyrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzo(a)anthracene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chrysene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(k)fluoranthene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzo(a)pyrene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Dibenz(a,h)anthracene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	< 1.6	< 1.6	< 1.6	< 1.6	< 1.6
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	26	9.8	3.8	9.3	8.0
Barium (aqua regia extractable)	mg/kg	1	MCERTS	N/A	N/A	N/A	74	N/A
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	N/A	N/A	N/A	0.9	N/A
Boron (water soluble)	mg/kg	0.2	MCERTS	N/A	N/A	N/A	< 0.2	N/A
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.2	0.3	< 0.2	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	N/A	N/A	N/A	< 1.2	N/A
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	18	24	11	15	19
Cobalt (aqua regia extractable)	mg/kg	0.15	MCERTS	14	11	8.0	9.8	9.0
Copper (aqua regia extractable)	mg/kg	1	MCERTS	66	25	24	17	13
Iron (aqua regia extractable)	mg/kg	40	MCERTS	52000	41000	24000	37000	47000
Lead (aqua regia extractable)	mg/kg	2	MCERTS	30	16	17	24	9.9
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	540	390	320	340	210
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Molybdenum (aqua regia extractable)	mg/kg	0.25	MCERTS	2.0	0.9	0.5	1.1	0.9
Nickel (aqua regia extractable)	mg/kg	2	MCERTS	60	37	24	23	21
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	29	32	15	25	28
Zinc (aqua regia extractable)	mg/kg	2	MCERTS	110	66	52	56	32
Magnesium (aqua regia extractable)	mg/kg	20	ISO 17025	5800	4800	3100	5800	3300

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Lab Sample Number				161739	161740	161741	161742	161743
Sample Reference				S9	S11	S8	S10	S12
Sample Number				9	11	8	10	12
Depth (m)				0.26	0.20	0.29	0.21	0.20
Date Sampled				22/11/2010	22/11/2010	22/11/2010	22/11/2010	22/11/2010
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics								
Benzene	µg/kg	1	MCERTS	N/A	N/A	N/A	< 1.0	N/A
Toluene	µg/kg	1	MCERTS	N/A	N/A	N/A	< 1.0	N/A
Ethylbenzene	µg/kg	1	MCERTS	N/A	N/A	N/A	< 1.0	N/A
p & m-xylene	µg/kg	1	MCERTS	N/A	N/A	N/A	< 1.0	N/A
o-xylene	µg/kg	1	MCERTS	N/A	N/A	N/A	< 1.0	N/A
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	N/A	N/A	N/A	< 1.0	N/A

Petroleum Hydrocarbons

TPH7 - Aliphatic >C5 - C6	mg/kg	0.1	MCERTS	N/A	N/A	N/A	< 0.1	N/A
TPH7 - Aliphatic >C6 - C8	mg/kg	0.1	MCERTS	N/A	N/A	N/A	< 0.1	N/A
TPH7 - Aliphatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	N/A	N/A	< 0.1	N/A
TPH7 - Aliphatic >C10 - C12	mg/kg	1	MCERTS	N/A	N/A	N/A	< 1.0	N/A
TPH7 - Aliphatic >C12 - C16	mg/kg	2	MCERTS	N/A	N/A	N/A	< 2.0	N/A
TPH7 - Aliphatic >C16 - C21	mg/kg	8	MCERTS	N/A	N/A	N/A	< 8.0	N/A
TPH7 - Aliphatic >C21 - C35	mg/kg	8	MCERTS	N/A	N/A	N/A	< 8.0	N/A
TPH7 - Aliphatic (C5 - C35)	mg/kg	10	MCERTS	N/A	N/A	N/A	< 10	N/A

TPH7 - Aromatic >C5 - C7	mg/kg	0.1	MCERTS	N/A	N/A	N/A	< 0.1	N/A
TPH7 - Aromatic >C7 - C8	mg/kg	0.1	MCERTS	N/A	N/A	N/A	< 0.1	N/A
TPH7 - Aromatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	N/A	N/A	< 0.1	N/A
TPH7 - Aromatic >C10 - C12	mg/kg	1	MCERTS	N/A	N/A	N/A	< 1.0	N/A
TPH7 - Aromatic >C12 - C16	mg/kg	2	MCERTS	N/A	N/A	N/A	< 2.0	N/A
TPH7 - Aromatic >C16 - C21	mg/kg	10	MCERTS	N/A	N/A	N/A	< 10	N/A
TPH7 - Aromatic >C21 - C35	mg/kg	10	MCERTS	N/A	N/A	N/A	< 10	N/A
TPH7 - Aromatic (C5 - C35)	mg/kg	10	MCERTS	N/A	N/A	N/A	< 10	N/A

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Lab Sample Number				161744	161745	161746	161747	161748
Sample Reference				S7	S14	S4	S4A	S15
Sample Number				7	14	4	4A	15
Depth (m)				0.32	0.19	0.30	0.28	0.22
Date Sampled				22/11/2010	22/11/2010	22/11/2010	22/11/2010	22/11/2010
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	12	13	22	16	18
Total mass of sample received	kg	0.001	NONE	0.75	0.74	0.73	0.71	0.73
General Inorganics								
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Water Soluble Sulphate as SO_3 (2:1)	g/l	0.005	NONE	0.013	0.033	0.11	0.025	0.11
Ammoniacal Nitrogen as N	mg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Fraction Organic Carbon (FOC)	N/A	0.00001	NONE	0.013	N/A	0.033	N/A	0.013
Total Phenols								
Total Phenols (monohydric)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Acenaphthylene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Phenanthrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Anthracene	mg/kg	0.1	MCERTS	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	mg/kg	0.2	MCERTS	< 0.20	2.0	2.0	0.42	0.57
Pyrene	mg/kg	0.2	MCERTS	< 0.20	2.0	1.8	0.35	0.57
Benzo(a)anthracene	mg/kg	0.2	MCERTS	< 0.20	1.2	1.2	0.21	0.57
Chrysene	mg/kg	0.05	MCERTS	< 0.05	1.4	0.97	0.36	0.40
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	< 0.10	1.2	1.2	0.38	0.52
Benzo(k)fluoranthene	mg/kg	0.2	MCERTS	< 0.20	0.60	0.71	< 0.20	0.22
Benzo(a)pyrene	mg/kg	0.1	MCERTS	< 0.10	1.1	1.0	< 0.10	< 0.10
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	0.51	< 0.20	< 0.20
Dibenz(a,h)anthracene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	< 0.05	0.65	< 0.05	< 0.05
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	< 1.6	9.6	10	1.8	3.0
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	2.9	16	18	10	14
Barium (aqua regia extractable)	mg/kg	1	MCERTS	N/A	N/A	170	N/A	N/A
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	N/A	N/A	1.8	N/A	N/A
Boron (water soluble)	mg/kg	0.2	MCERTS	N/A	N/A	3.2	N/A	N/A
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	1.2	0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	N/A	N/A	< 1.2	N/A	N/A
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	10	22	43	29	15
Cobalt (aqua regia extractable)	mg/kg	0.15	MCERTS	9.1	17	12	13	19
Copper (aqua regia extractable)	mg/kg	1	MCERTS	26	37	83	32	35
Iron (aqua regia extractable)	mg/kg	40	MCERTS	24000	67000	60000	76000	55000
Lead (aqua regia extractable)	mg/kg	2	MCERTS	14	21	140	45	18
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	220	730	530	460	390
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Molybdenum (aqua regia extractable)	mg/kg	0.25	MCERTS	0.5	4.0	1.3	0.8	4.1
Nickel (aqua regia extractable)	mg/kg	2	MCERTS	24	42	35	23	42
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	13	30	63	42	33
Zinc (aqua regia extractable)	mg/kg	2	MCERTS	40	69	160	71	40
Magnesium (aqua regia extractable)	mg/kg	20	ISO 17025	3500	8400	8000	3600	10000

Analytical Report Number: 10-25305

Project / Site name: 60396

Lab Sample Number				161744	161745	161746	161747	161748
Sample Reference				S7	S14	S4	S4A	S15
Sample Number				7	14	4	4A	15
Depth (m)				0.32	0.19	0.30	0.28	0.22
Date Sampled				22/11/2010	22/11/2010	22/11/2010	22/11/2010	22/11/2010
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics								
Benzene	µg/kg	1	MCERTS	N/A	N/A	< 1.0	N/A	N/A
Toluene	µg/kg	1	MCERTS	N/A	N/A	< 1.0	N/A	N/A
Ethylbenzene	µg/kg	1	MCERTS	N/A	N/A	< 1.0	N/A	N/A
p & m-xylene	µg/kg	1	MCERTS	N/A	N/A	< 1.0	N/A	N/A
o-xylene	µg/kg	1	MCERTS	N/A	N/A	< 1.0	N/A	N/A
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	N/A	N/A	< 1.0	N/A	N/A

Petroleum Hydrocarbons

TPH7 - Aliphatic >C5 - C6	mg/kg	0.1	MCERTS	N/A	N/A	< 0.1	N/A	N/A
TPH7 - Aliphatic >C6 - C8	mg/kg	0.1	MCERTS	N/A	N/A	< 0.1	N/A	N/A
TPH7 - Aliphatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	N/A	< 0.1	N/A	N/A
TPH7 - Aliphatic >C10 - C12	mg/kg	1	MCERTS	N/A	N/A	< 1.0	N/A	N/A
TPH7 - Aliphatic >C12 - C16	mg/kg	2	MCERTS	N/A	N/A	< 2.0	N/A	N/A
TPH7 - Aliphatic >C16 - C21	mg/kg	8	MCERTS	N/A	N/A	< 8.0	N/A	N/A
TPH7 - Aliphatic >C21 - C35	mg/kg	8	MCERTS	N/A	N/A	< 8.0	N/A	N/A
TPH7 - Aliphatic (C5 - C35)	mg/kg	10	MCERTS	N/A	N/A	< 10	N/A	N/A

TPH7 - Aromatic >C5 - C7	mg/kg	0.1	MCERTS	N/A	N/A	< 0.1	N/A	N/A
TPH7 - Aromatic >C7 - C8	mg/kg	0.1	MCERTS	N/A	N/A	< 0.1	N/A	N/A
TPH7 - Aromatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	N/A	< 0.1	N/A	N/A
TPH7 - Aromatic >C10 - C12	mg/kg	1	MCERTS	N/A	N/A	< 1.0	N/A	N/A
TPH7 - Aromatic >C12 - C16	mg/kg	2	MCERTS	N/A	N/A	< 2.0	N/A	N/A
TPH7 - Aromatic >C16 - C21	mg/kg	10	MCERTS	N/A	N/A	26	N/A	N/A
TPH7 - Aromatic >C21 - C35	mg/kg	10	MCERTS	N/A	N/A	250	N/A	N/A
TPH7 - Aromatic (C5 - C35)	mg/kg	10	MCERTS	N/A	N/A	280	N/A	N/A

Analytical Report Number : 10-25305

Project / Site name: 60396

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 2 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
161734	S1	1	0.30	Brown clay.
161735	S2	2	0.25	Brown clay.
161736	S3	3	0.32	Brown clay.
161737	S5	5	0.27	Brown topsoil and clay.
161738	S6	6	0.25	Brown topsoil and clay.
161739	S9	9	0.26	Brown topsoil and sand.
161740	S11	11	0.20	Brown topsoil and sand with brick.
161741	S8	8	0.29	Grey topsoil and clay with vegetation.
161742	S10	10	0.21	Brown topsoil and clay.
161743	S12	12	0.20	Light brown clay and sand with vegetation.
161744	S7	7	0.32	Grey topsoil and clay with vegetation.
161745	S14	14	0.19	Brown topsoil and clay with vegetation.
161746	S4	4	0.30	Brown clay.
161747	S4A	4A	0.28	Brown clay.
161748	S15	15	0.22	Brown clay with vegetation.

Analytical Report Number : 10-25305

Project / Site name: 60396

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of ammoniacal nitrogen in soil by extraction with potassium chloride followed by addition of buffer solution followed by ion selective electrode.	In-house method	L035-PL	W	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073S-PL	W	MCERTS
Cations in soil by ICP-OES	Determination of cations in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L038-PL	D	MCERTS
Fraction of Organic Carbon in soil	Determination of fraction of organic carbon in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L023-PL	D	NONE
Free cyanide (Low level) in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L068-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L019-UK	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Stones not passing through a 2 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results are not corrected for the stone content of the sample.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK	D	NONE
Sulphate, water soluble, in soil	Determination of water soluble sulphate by extraction with water followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L038-PL	D	NONE
Thiocyanate in soil	Determination of thiocyanate in soil by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by spectrophotometer.	In-house method	L049-PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	MCERTS
TPHCWG (Soil)	Determination of pentane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L076-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 10-25323

Project / Site name:		**Samples received on:**	26/11/2010
Your job number:	60396	**Samples instructed on:**	26/11/2010
Your order number:		**Analysis completed by:**	09/12/2010
Report Issue Number:	1	**Report issued on:**	09/12/2010
Samples Analysed:	7 soil samples		

Signed:

Sian John
Senior Scientist - Organics
For & on behalf of i2 Analytical Ltd.

Signed:

Anna Romanska
Group Quality Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting

Analytical Report Number: 10-25323

Lab Sample Number				161878	161879	161880	161881	161882
Sample Reference				S20	S30	S29	S28	S13
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.55	0.05	0.10	0.12	0.27
Date Sampled				24/11/2010	24/11/2010	24/11/2010	24/11/2010	24/11/2010
Time Taken				0900	0915	0930	0945	1000
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	N/A	NONE	20	24	13	25	14
Total mass of sample received	kg	0.001	NONE	0.73	0.53	0.57	0.59	0.58
General Inorganics								
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Free Cyanide	mg/kg	1	NONE	< 1	< 1	< 1	< 1	< 1
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Sulphate as SO_4	mg/kg	100	ISO 17025	1100	660	650	740	1200
Ammoniacal Nitrogen as N	mg/kg	5	MCERTS	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Fraction Organic Carbon (FOC)	N/A	0.00001	NONE	N/A	0.0017	N/A	N/A	0.013
Total Phenols								
Total Phenols (monohydric)	mg/kg	2	MCERTS	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	0.68	2.3	1.2	1.4	7.1
Acenaphthylene	mg/kg	0.2	MCERTS	< 0.20	0.29	< 0.20	< 0.20	0.89
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	0.12	< 0.10	< 0.10	0.33
Fluorene	mg/kg	0.2	MCERTS	< 0.20	0.35	< 0.20	< 0.20	0.95
Phenanthrene	mg/kg	0.2	MCERTS	< 0.20	1.2	0.62	0.36	2.7
Anthracene	mg/kg	0.1	MCERTS	< 0.10	0.37	0.23	0.13	1.0
Fluoranthene	mg/kg	0.2	MCERTS	< 0.20	1.8	0.84	0.49	2.6
Pyrene	mg/kg	0.2	MCERTS	< 0.20	1.5	0.66	0.37	1.9
Benzo(a)anthracene	mg/kg	0.2	MCERTS	< 0.20	0.87	0.33	< 0.20	0.88
Chrysene	mg/kg	0.05	MCERTS	< 0.05	0.91	0.37	0.18	0.87
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	< 0.10	0.84	0.43	0.26	1.0
Benzo(k)fluoranthene	mg/kg	0.2	MCERTS	< 0.20	0.30	< 0.20	< 0.20	0.39
Benzo(a)pyrene	mg/kg	0.1	MCERTS	< 0.10	0.48	0.28	0.19	0.78
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	0.32
Dibenz(a,h)anthracene	mg/kg	0.2	MCERTS	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.15	0.12	< 0.05	0.36
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	< 1.6	12	5.2	3.4	22
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	5.3	18	31	9.3	20
Barium (aqua regia extractable)	mg/kg	1	MCERTS	N/A	350	N/A	N/A	410
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	N/A	2.7	N/A	N/A	3.4
Boron (water soluble)	mg/kg	0.2	MCERTS	N/A	< 0.2	N/A	N/A	0.4
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	< 0.2	< 0.2	0.4	< 0.2	< 0.2
Chromium (hexavalent)	mg/kg	1.2	MCERTS	N/A	< 1.2	N/A	N/A	< 1.2
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	14	27	290	12	21
Cobalt (aqua regia extractable)	mg/kg	0.15	MCERTS	6.7	24	15	5.9	39
Copper (aqua regia extractable)	mg/kg	1	MCERTS	4.3	62	100	17	87
Iron (aqua regia extractable)	mg/kg	40	MCERTS	22000	140000	250000	25000	110000
Lead (aqua regia extractable)	mg/kg	2	MCERTS	9.8	28	49	32	21
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	85	780	7600	170	800
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Molybdenum (aqua regia extractable)	mg/kg	0.25	MCERTS	0.6	7.1	1.8	1.5	13
Nickel (aqua regia extractable)	mg/kg	2	MCERTS	8.9	69	36	17	110
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	26	75	680	21	58
Zinc (aqua regia extractable)	mg/kg	2	MCERTS	21	69	79	37	37
Magnesium (aqua regia extractable)	mg/kg	20	ISO 17025	1500	6700	1800	5400	15000

Analytical Report Number: 10-25323

Lab Sample Number				161878	161879	161880	161881	161882
Sample Reference				S20	S30	S29	S28	S13
Sample Number				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Depth (m)				0.55	0.05	0.10	0.12	0.27
Date Sampled				24/11/2010	24/11/2010	24/11/2010	24/11/2010	24/11/2010
Time Taken				0900	0915	0930	0945	1000
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics								
Benzene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	N/A	< 1.0
Toluene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	N/A	< 1.0
Ethylbenzene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	N/A	< 1.0
p & m-xylene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	N/A	< 1.0
o-xylene	µg/kg	1	MCERTS	N/A	< 1.0	N/A	N/A	< 1.0
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	N/A	< 1.0	N/A	N/A	< 1.0
Petroleum Hydrocarbons								
TPH7 - Aliphatic >C5 - C6	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	N/A	< 0.1
TPH7 - Aliphatic >C6 - C8	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	N/A	< 0.1
TPH7 - Aliphatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	N/A	< 0.1
TPH7 - Aliphatic >C10 - C12	mg/kg	1	MCERTS	N/A	1.6	N/A	N/A	2.2
TPH7 - Aliphatic >C12 - C16	mg/kg	2	MCERTS	N/A	5.7	N/A	N/A	8.4
TPH7 - Aliphatic >C16 - C21	mg/kg	8	MCERTS	N/A	< 8.0	N/A	N/A	9.7
TPH7 - Aliphatic >C21 - C35	mg/kg	8	MCERTS	N/A	44	N/A	N/A	25
TPH7 - Aliphatic (C5 - C35)	mg/kg	10	MCERTS	N/A	57	N/A	N/A	45
TPH7 - Aromatic >C5 - C7	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	N/A	< 0.1
TPH7 - Aromatic >C7 - C8	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	N/A	< 0.1
TPH7 - Aromatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	< 0.1	N/A	N/A	< 0.1
TPH7 - Aromatic >C10 - C12	mg/kg	1	MCERTS	N/A	16	N/A	N/A	17
TPH7 - Aromatic >C12 - C16	mg/kg	2	MCERTS	N/A	17	N/A	N/A	24
TPH7 - Aromatic >C16 - C21	mg/kg	10	MCERTS	N/A	57	N/A	N/A	59
TPH7 - Aromatic >C21 - C35	mg/kg	10	MCERTS	N/A	110	N/A	N/A	120
TPH7 - Aromatic (C5 - C35)	mg/kg	10	MCERTS	N/A	200	N/A	N/A	220

Analytical Report Number: 10-25323

Lab Sample Number				161883	161884			
Sample Reference				S27	S24			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.22	0.35			
Date Sampled				24/11/2010	24/11/2010			
Time Taken				1100	1130			
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1	< 0.1			
Moisture Content	%	N/A	NONE	24	12			
Total mass of sample received	kg	0.001	NONE	0.76	2.0			
General Inorganics								
Total Cyanide	mg/kg	1	MCERTS	< 1.0	< 1.0			
Free Cyanide	mg/kg	1	NONE	< 1	< 1			
Thiocyanate as SCN	mg/kg	5	NONE	< 5.0	< 5.0			
Total Sulphate as SO_4	mg/kg	100	ISO 17025	680	380			
Ammoniacal Nitrogen as N	mg/kg	5	MCERTS	< 5.0	< 5.0			
Fraction Organic Carbon (FOC)	N/A	0.00001	NONE	N/A	N/A			
Total Phenols								
Total Phenols (monohydric)	mg/kg	2	MCERTS	< 2.0	< 2.0			
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	1.6	3.1			
Acenaphthylene	mg/kg	0.2	MCERTS	< 0.20	0.34			
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10	0.13			
Fluorene	mg/kg	0.2	MCERTS	< 0.20	0.36			
Phenanthrene	mg/kg	0.2	MCERTS	0.33	0.98			
Anthracene	mg/kg	0.1	MCERTS	0.11	0.44			
Fluoranthene	mg/kg	0.2	MCERTS	0.35	1.1			
Pyrene	mg/kg	0.2	MCERTS	0.28	0.90			
Benzo(a)anthracene	mg/kg	0.2	MCERTS	< 0.20	0.47			
Chrysene	mg/kg	0.05	MCERTS	0.14	0.49			
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	0.18	0.50			
Benzo(k)fluoranthene	mg/kg	0.2	MCERTS	< 0.20	0.25			
Benzo(a)pyrene	mg/kg	0.1	MCERTS	0.12	0.44			
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	MCERTS	< 0.20	< 0.20			
Dibenz(a,h)anthracene	mg/kg	0.2	MCERTS	< 0.20	< 0.20			
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05	0.19			
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	3.2	9.8			
Heavy Metals / Metalloids								
Arsenic (aqua regia extractable)	mg/kg	1	MCERTS	12	9.1			
Barium (aqua regia extractable)	mg/kg	1	MCERTS	N/A	N/A			
Beryllium (aqua regia extractable)	mg/kg	0.06	MCERTS	N/A	N/A			
Boron (water soluble)	mg/kg	0.2	MCERTS	N/A	N/A			
Cadmium (aqua regia extractable)	mg/kg	0.2	MCERTS	0.3	< 0.2			
Chromium (hexavalent)	mg/kg	1.2	MCERTS	N/A	N/A			
Chromium (aqua regia extractable)	mg/kg	1	MCERTS	14	19			
Cobalt (aqua regia extractable)	mg/kg	0.15	MCERTS	9.7	11			
Copper (aqua regia extractable)	mg/kg	1	MCERTS	19	19			
Iron (aqua regia extractable)	mg/kg	40	MCERTS	34000	35000			
Lead (aqua regia extractable)	mg/kg	2	MCERTS	40	14			
Manganese (aqua regia extractable)	mg/kg	1	MCERTS	250	540			
Mercury (aqua regia extractable)	mg/kg	0.3	MCERTS	< 0.3	< 0.3			
Molybdenum (aqua regia extractable)	mg/kg	0.25	MCERTS	1.3	1.1			
Nickel (aqua regia extractable)	mg/kg	2	MCERTS	23	24			
Vanadium (aqua regia extractable)	mg/kg	1	MCERTS	26	34			
Zinc (aqua regia extractable)	mg/kg	2	MCERTS	57	46			
Magnesium (aqua regia extractable)	mg/kg	20	ISO 17025	4000	21000			

Analytical Report Number: 10-25323

Lab Sample Number				161883	161884			
Sample Reference				S27	S24			
Sample Number				None Supplied	None Supplied			
Depth (m)				0.22	0.35			
Date Sampled				24/11/2010	24/11/2010			
Time Taken				1100	1130			
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics								
Benzene	µg/kg	1	MCERTS	N/A	N/A			
Toluene	µg/kg	1	MCERTS	N/A	N/A			
Ethylbenzene	µg/kg	1	MCERTS	N/A	N/A			
p & m-xylene	µg/kg	1	MCERTS	N/A	N/A			
o-xylene	µg/kg	1	MCERTS	N/A	N/A			
MTBE (Methyl Tertiary Butyl Ether)	µg/kg	1	MCERTS	N/A	N/A			

Petroleum Hydrocarbons

TPH7 - Aliphatic >C5 - C6	mg/kg	0.1	MCERTS	N/A	N/A			
TPH7 - Aliphatic >C6 - C8	mg/kg	0.1	MCERTS	N/A	N/A			
TPH7 - Aliphatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	N/A			
TPH7 - Aliphatic >C10 - C12	mg/kg	1	MCERTS	N/A	N/A			
TPH7 - Aliphatic >C12 - C16	mg/kg	2	MCERTS	N/A	N/A			
TPH7 - Aliphatic >C16 - C21	mg/kg	8	MCERTS	N/A	N/A			
TPH7 - Aliphatic >C21 - C35	mg/kg	8	MCERTS	N/A	N/A			
TPH7 - Aliphatic (C5 - C35)	mg/kg	10	MCERTS	N/A	N/A			

TPH7 - Aromatic >C5 - C7	mg/kg	0.1	MCERTS	N/A	N/A			
TPH7 - Aromatic >C7 - C8	mg/kg	0.1	MCERTS	N/A	N/A			
TPH7 - Aromatic >C8 - C10	mg/kg	0.1	MCERTS	N/A	N/A			
TPH7 - Aromatic >C10 - C12	mg/kg	1	MCERTS	N/A	N/A			
TPH7 - Aromatic >C12 - C16	mg/kg	2	MCERTS	N/A	N/A			
TPH7 - Aromatic >C16 - C21	mg/kg	10	MCERTS	N/A	N/A			
TPH7 - Aromatic >C21 - C35	mg/kg	10	MCERTS	N/A	N/A			
TPH7 - Aromatic (C5 - C35)	mg/kg	10	MCERTS	N/A	N/A			

Analytical Report Number : 10-25323

Project / Site name:

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 2 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
161878	S20	None Supplied	0.55	Light brown clay and sand with vegetation.
161879	S30	None Supplied	0.05	Black gravel.
161880	S29	None Supplied	0.10	Brown topsoil with gravel and vegetation.
161881	S28	None Supplied	0.12	Brown topsoil and sand.
161882	S13	None Supplied	0.27	Brown topsoil and clay with gravel and brick.
161883	S27	None Supplied	0.22	Brown topsoil and sand with gravel.
161884	S24	None Supplied	0.35	Brown topsoil and clay with gravel.

Analytical Report Number : 10-25323

Project / Site name:

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in soil	Determination of ammoniacal nitrogen in soil by extraction with potassium chloride followed by addition of buffer solution followed by ion selective electrode.	In-house method	L035-PL	W	MCERTS
Boron, water soluble, in soil	Determination of water soluble boron in soil by hot water extract followed by ICP-OES.	In-house method based on Second Site Properties version 3	L038-PL	D	MCERTS
BTEX and MTBE in soil	Determination of BTEX in soil by headspace GC-MS.	In-house method based on USEPA8260	L073S-PL	W	MCERTS
Cations in soil by ICP-OES	Determination of cations in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L038-PL	D	MCERTS
Fraction of Organic Carbon in soil	Determination of fraction of organic carbon in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L023-PL	D	NONE
Free cyanide (Low level) in soil	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	NONE
Hexavalent chromium in soil	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry.	In-house method	L068-PL	D	MCERTS
Metals in soil by ICP-OES	Determination of metals in soil by aqua-regia digestion followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L038-PL	D	MCERTS
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L019-UK	W	NONE
Monohydric phenols in soil	Determination of phenols in soil by extraction with sodium hydroxide followed by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080	W	MCERTS
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Stones not passing through a 2 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results are not corrected for the stone content of the sample.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK	D	NONE
Thiocyanate in soil	Determination of thiocyanate in soil by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by spectrophotometer.	In-house method	L049-PL	D	NONE
Total cyanide in soil	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	MCERTS
Total sulphate (as SO4 in soil)	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L038-PL	D	ISO 17025
TPHCWG (Soil)	Determination of pentane extractable hydrocarbons in soil by GC-MS/GC-FID.	In-house method	L076-PL	W	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 10-25555

Project / Site name:	60396	**Samples received on:**	13/12/2010
Your job number:		**Samples instructed on:**	26/11/2010
Your order number:		**Analysis completed by:**	22/12/2010
Report Issue Number:	1	**Report issued on:**	22/12/2010
Samples Analysed:	1 soil sample		

Signed:

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

David Ashworth
Technical Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting

Analytical Report Number: 10-25555

Project / Site name: 60396

Lab Sample Number				163333				
Sample Reference				S12A				
Sample Number				None Supplied				
Depth (m)				0.35				
Date Sampled				22/11/2010				
Time Taken				1400				
Analytical Parameter (Soil Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Stone Content	%	0.1	NONE	< 0.1				
Moisture Content	%	N/A	NONE	15				
Total mass of sample received	kg	0.001	NONE	0.73				
Speciated PAHs								
Naphthalene	mg/kg	0.05	MCERTS	1.8				
Acenaphthylene	mg/kg	0.2	MCERTS	0.37				
Acenaphthene	mg/kg	0.1	MCERTS	< 0.10				
Fluorene	mg/kg	0.2	MCERTS	0.54				
Phenanthrene	mg/kg	0.2	MCERTS	1.7				
Anthracene	mg/kg	0.1	MCERTS	0.60				
Fluoranthene	mg/kg	0.2	MCERTS	1.2				
Pyrene	mg/kg	0.2	MCERTS	0.81				
Benzo(a)anthracene	mg/kg	0.2	MCERTS	0.50				
Chrysene	mg/kg	0.05	MCERTS	0.53				
Benzo(b)fluoranthene	mg/kg	0.1	MCERTS	0.36				
Benzo(k)fluoranthene	mg/kg	0.2	MCERTS	0.25				
Benzo(a)pyrene	mg/kg	0.1	MCERTS	0.38				
Indeno(1,2,3-cd)pyrene	mg/kg	0.2	MCERTS	< 0.20				
Dibenz(a,h)anthracene	mg/kg	0.2	MCERTS	< 0.20				
Benzo(ghi)perylene	mg/kg	0.05	MCERTS	< 0.05				
Total PAH								
Speciated Total EPA-16 PAHs	mg/kg	1.6	MCERTS	9.0				

Analytical Report Number : 10-25555

Project / Site name: 60396

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and topsoil/loam soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content

of a sample is calculated as the % weight of the stones not passing a 2 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
163333	S12A	None Supplied	0.35	Brown clay with vegetation.

Analytical Report Number : 10-25555

Project / Site name: 60396

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests""	L019-UK	W	NONE
Speciated EPA-16 PAHs in soil	Determination of PAH compounds in soil by extraction in dichloromethane and hexane followed by GC-MS with the use of surrogate and internal standards.	In-house method based on USEPA 8270	L064-PL	D	MCERTS
Stones content of soil	Stones not passing through a 2 mm sieve is determined gravimetrically and reported as a percentage of the dry weight. Sample results are not corrected for the stone content of the sample.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK	D	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 10-25523

Project / Site name:	60396	**Samples received on:**	10/12/2010
Your job number:		**Samples instructed on:**	/ /
Your order number:		**Analysis completed by:**	23/12/2010
Report Issue Number:	1	**Report issued on:**	23/12/2010
Samples Analysed:	7 leachate samples		

Signed:

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

David Ashworth
Technical Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting

Analytical Report Number: 10-25523

Project / Site name: 60396

Lab Sample Number				163167	163168	163169	163170	163171
Sample Reference				Sample2 - S2	Sample5 - S5	Sample9 - S9	Sample12- S12	Sample30- S30
Sample Number				161735	161737	161739	161743	161879
Depth (m)				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Date Sampled				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10	< 10	< 10
Free Cyanide	µg/l	25	NONE	< 25	< 25	< 25	< 25	< 25
Thiocyanate as SCN	µg/l	30	NONE	< 30	< 30	< 30	< 30	< 30
Sulphate as SO_4	µg/l	100	NONE	18000	5100	11000	3400	16000
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	68	63	67	74	61
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	10	ISO 17025	< 10	< 10	45	< 10	18
Cadmium (dissolved)	µg/l	0.5	NONE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Chromium (dissolved)	µg/l	1	ISO 17025	2.6	< 1.0	8.0	13	< 1.0
Cobalt (dissolved)	µg/l	1	ISO 17025	< 1.0	< 1.0	2.5	< 1.0	< 1.0
Copper (dissolved)	µg/l	1	ISO 17025	18	9.8	33	11	8.1
Iron (dissolved)	mg/l	0.2	ISO 17025	2.2	2.6	3.3	12	0.2
Lead (dissolved)	µg/l	5	ISO 17025	11	< 5.0	9.5	< 5.0	6.6
Manganese (dissolved)	µg/l	1	ISO 17025	8.7	33	80	75	3.0
Mercury (dissolved)	µg/l	1.5	ISO 17025	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Molybdenum (dissolved)	µg/l	3	ISO 17025	14	< 3.0	6.2	< 3.0	15
Nickel (dissolved)	µg/l	1	ISO 17025	5.3	2.3	7.4	3.5	3.2
Vanadium (dissolved)	µg/l	5	ISO 17025	5.0	21	8.8	31	< 5.0
Zinc (dissolved)	µg/l	1	ISO 17025	11	5.7	44	18	1.9
Magnesium (dissolved)	mg/l	0.1	NONE	4.7	0.8	7.0	1.4	7.0

Analytical Report Number: 10-25523

Project / Site name: 60396

Lab Sample Number				163172	163173			
Sample Reference				Sample13- S13	Sample15- S15			
Sample Number				161882	161748			
Depth (m)				None Supplied	None Supplied			
Date Sampled				None Supplied	None Supplied			
Time Taken				None Supplied	None Supplied			
Analytical Parameter (Leachate Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10			
Free Cyanide	µg/l	25	NONE	< 25	< 25			
Thiocyanate as SCN	µg/l	30	NONE	< 30	< 30			
Sulphate as SO_4	µg/l	100	NONE	26000	38000			
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	59	57			
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	10	ISO 17025	< 10	15			
Cadmium (dissolved)	µg/l	0.5	NONE	< 0.5	< 0.5			
Chromium (dissolved)	µg/l	1	ISO 17025	< 1.0	1.2			
Cobalt (dissolved)	µg/l	1	ISO 17025	< 1.0	1.3			
Copper (dissolved)	µg/l	1	ISO 17025	14	13			
Iron (dissolved)	mg/l	0.2	ISO 17025	0.2	0.4			
Lead (dissolved)	µg/l	5	ISO 17025	13	< 5.0			
Manganese (dissolved)	µg/l	1	ISO 17025	2.7	4.3			
Mercury (dissolved)	µg/l	1.5	ISO 17025	< 1.5	< 1.5			
Molybdenum (dissolved)	µg/l	3	ISO 17025	60	63			
Nickel (dissolved)	µg/l	1	ISO 17025	4.5	2.8			
Vanadium (dissolved)	µg/l	5	ISO 17025	< 5.0	< 5.0			
Zinc (dissolved)	µg/l	1	ISO 17025	5.7	< 1.0			
Magnesium (dissolved)	mg/l	0.1	NONE	7.3	8.3			

Analytical Report Number : 10-25523

Project / Site name: 60396

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in leachate	Determination of ammoniacal nitrogen in leachate by addition of buffer solution followed by ion selective electrode.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L035-UK	W	ISO 17025
Free cyanide in leachate	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	NONE
Metals by ICP-OES in leachate	Determination of metals in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-UK	W	ISO 17025
Sulphate in leachates	Determination of sulphate in leachate by acidification followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-UK	W	NONE
Thiocyanate in leachate	Determination of thiocyanate in leachate by acidification followed by addition of ferric nitrate followed by spectrophotometer.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L049-UK	W	NONE
Total cyanide in leachate	Determination of total cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	ISO 17025

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

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Analytical Report Number : 11-25801

Project / Site name:	Cinderford	**Samples received on:**	14/01/2011
Your job number:	60396	**Samples instructed on:**	14/01/2011
Your order number:		**Analysis completed by:**	27/01/2011
Report Issue Number:	1	**Report issued on:**	27/01/2011
Samples Analysed:	3 water samples		

Signed:

Dr Claire Stone
Quality Manager
For & on behalf of i2 Analytical Ltd.

Signed:

Thurstan Plummer
Organics Technical Manager
For & on behalf of i2 Analytical Ltd.

Other office located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting

Analytical Report Number: 11-25801

Project / Site name: Cinderford

Lab Sample Number				164726	164727	164728		
Sample Reference				WS1	WS3	WS2		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				0.36	0.85	2.29		
Date Sampled				13/01/2011	13/01/2011	13/01/2011		
Time Taken				0950	1015	1100		
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
General Inorganics								
Total Cyanide	µg/l	10	ISO 17025	< 10	< 10	< 10		
Free Cyanide	ug/l	10	NONE	< 10	< 10	< 10		
Thiocyanate as SCN	µg/l	30	NONE	< 30	< 30	< 30		
Sulphate as SO_4	µg/l	100	NONE	160000	87000	100000		
Ammoniacal Nitrogen as N	µg/l	15	ISO 17025	< 15	35	340		
Total Phenols								
Total Phenols (monohydric)	µg/l	10	ISO 17025	< 10	< 10	< 10		
Speciated PAHs								
Naphthalene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Acenaphthylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Acenaphthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Fluorene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Phenanthrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(a)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Chrysene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(b)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(k)fluoranthene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(a)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Indeno(1,2,3-cd)pyrene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Dibenz(a,h)anthracene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Benzo(ghi)perylene	µg/l	0.01	ISO 17025	< 0.01	< 0.01	< 0.01		
Total PAH								
Total EPA-16 PAHs	µg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2		
Heavy Metals / Metalloids								
Arsenic (dissolved)	µg/l	10	ISO 17025	< 10	< 10	< 10		
Cadmium (dissolved)	µg/l	0.5	ISO 17025	< 0.5	< 0.5	< 0.5		
Chromium (dissolved)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Cobalt (dissolved)	µg/l	1	ISO 17025	3.4	< 1.0	< 1.0		
Copper (dissolved)	µg/l	1	ISO 17025	19	13	12		
Iron (dissolved)	mg/l	0.2	ISO 17025	< 0.2	< 0.2	< 0.2		
Lead (dissolved)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0		
Manganese (dissolved)	µg/l	1	ISO 17025	1500	13	70		
Mercury (dissolved)	µg/l	1.5	ISO 17025	< 1.5	< 1.5	< 1.5		
Molybdenum (dissolved)	µg/l	3	ISO 17025	11	6.2	19		
Nickel (dissolved)	µg/l	1	ISO 17025	16	4.2	5.7		
Vanadium (dissolved)	µg/l	5	ISO 17025	< 5.0	< 5.0	< 5.0		
Zinc (dissolved)	µg/l	1	ISO 17025	9.3	6.6	11		
Magnesium (dissolved)	mg/l	0.3	ISO 17025	60	32	27		

Analytical Report Number: 11-25801

Project / Site name: Cinderford

Lab Sample Number				164726	164727	164728		
Sample Reference				WS1	WS3	WS2		
Sample Number				None Supplied	None Supplied	None Supplied		
Depth (m)				0.36	0.85	2.29		
Date Sampled				13/01/2011	13/01/2011	13/01/2011		
Time Taken				0950	1015	1100		
Analytical Parameter (Water Analysis)	**Units**	**Limit of detection**	**Accreditation Status**					
Monoaromatics								
Benzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Toluene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Ethylbenzene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
p & m-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
o-xylene	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
MTBE (Methyl Tertiary Butyl Ether)	µg/l	1	ISO 17025	< 1.0	< 1.0	< 1.0		
Petroleum Hydrocarbons								
TPH7 - Aliphatic >C5 - C6	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aliphatic >C6 - C8	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aliphatic >C8 - C10	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aliphatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aliphatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aliphatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aliphatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aliphatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aromatic >C5 - C7	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aromatic >C7 - C8	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aromatic >C8 - C10	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aromatic >C10 - C12	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aromatic >C12 - C16	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aromatic >C16 - C21	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aromatic >C21 - C35	µg/l	10	NONE	< 10	< 10	< 10		
TPH7 - Aromatic (C5 - C35)	µg/l	10	NONE	< 10	< 10	< 10		

U/S = Unsuitable Sample I/S = Insufficient Sample

Analytical Report Number : 11-25801

Project / Site name: Cinderford

Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Ammoniacal Nitrogen as N in water	Determination of ammoniacal nitrogen in water by addition of buffer solution followed by ion selective electrode. Accredited matrices: SW PW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L035-UK	W	ISO 17025
BTEX and MTBE in water	Determination of BTEX and MTBE in water by headspace GC-MS. Accredited matrices: SW PW	In-house method based on USEPA8260	L036-UK	W	ISO 17025
Free cyanide (Low level) in water	Determination of free cyanide by distillation followed by colorimetry.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	NONE
Metals in water by ICP-OES (dissolved)	Determination of metals in water by acidification followed by ICP-OES. Accredited matrices: SW PW	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-UK	W	ISO 17025
Monohydric phenols in water	Determination of phenols in water by continuous flow analyser. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (skalar)	L080	W	ISO 17025
Speciated EPA-16 PAHs in water	Determination of PAH compounds in water by extraction in hexane followed by GC-MS with the use of surrogate and internal standards. Accredited matrices: SW PW GW	In-house method based on USEPA 8270	L070-UK	W	ISO 17025
Sulphate in water	Determination of sulphate in water by acidification followed by ICP-OES.	In-house method based on MEWAM 1986 Methods for the Determination of Metals in Soil""	L039-UK	W	NONE
Thiocyanate in water	Determination of thiocyanate in water by acidification followed by addition of ferric nitrate followed by spectrophotometer.	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton	L049-UK	W	NONE
Total cyanide in water	Determination of total cyanide by distillation followed by colorimetry. Accredited matrices: SW PW GW	In-house method based on Examination of Water and Wastewater 20th Edition: Clesceri, Greenberg & Eaton (Skalar)	L080	W	ISO 17025
TPH7 (Waters)	Determination of dichloromethane extractable hydrocarbons in water by GC-MS.	In-house method	L070-UK	W	NONE

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.
For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.
Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

APPENDIX D

Summary of soil, leachate and groundwater quality data

(see CD ROM)

APPENDIX E

Human health risk assessment: statistical calculator results

(see CD ROM)