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Project

BRITON FERRY GARAGES– ADDITIONAL SITE INVESTIGATION

Client

Swansea Garage Storage

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Introduction	Spectrum Geo Services (SGS) has been commissioned by Swansea Garage Storage to undertake a preliminary contamination assessment at a site in Briton Ferry.
Current Site Use	The site is currently used for for vehicle garages.
Site History	The site has had no particular industrial uses upon it although immediately to the south has an approximately 100 year history associated with gas manufacturing. The majority of the production / processing occurred in the south of the site. The site was however in decline from the late 1930's with production ceasing in approximately the mid 1940's. Whilst in decline the areas to the south and east of the site have been redeveloped with residential housing along Regent Street West and Victoria Road.
Geology, Hydrogeology and Hydrology	The ground conditions at the site are expected to comprise of made ground over estuarine alluvium underlain by glacial drift. The solid geology is expected to be of a sequence of Carboniferous upper Coal Measures consisting of Lower Pennant and Rhondda beds. The superficial deposits and Coal Measures are classified by the Environment Agency as minor aquifers. Shallow groundwater is anticipated to flow to the west.
Conceptual Model and Pollutant Linkage Assessment	Based on the information available a preliminary conceptual site model has been developed for the site. On the basis of this model three potential pollutant linkages have been identified, these are • Human health of occupants • Groundwater
Recommendations	Based on the above its recommended that an intrusive investigation is undertaken to assess the significance of the identified Potential Pollutant Linkages

1.0 INTRODUCTION

1.1 Introduction

Spectrum Geo Services (SGS) were requested by Swansea Garage Storage, to undertake a Site Investigation, of a site at Briton Ferry, between Victoria Street and Shelone Road. The site investigation was undertaken in two phase. Report 2012/R1 should be read in conjunction with this report. This report gives further soils analysis and interpretation.

This report provides a summary of the works undertaken and assesses the results obtained.

1.2 Scope of Works

The objectives of this assessment are:

- Provide a Phase 1 Report;
- To undertake a ground investigation and to obtain soil samples at site;
- To install standpipes to allow water monitoring;
- To undertake chemical testing to develop an assessment of contamination levels,

Others had previously undertaken a Phase 1 Desk Study and Coal Mining Risk Assessment for the site, which are Appended.

1.3 Development Proposals

It is understood that the intention is to develop the site for the purposes of Commercial Garages. Thus, for the purposes of this assessment a Commercial end use is employed.

1.4 Limitations

Subsoils are inherently variable and by their very nature are hidden from view such that no investigation can be exhaustive to the extent that all soil conditions are revealed. Conditions may therefore be present beneath the site that was not apparent from the data available for review.

Unless specifically noted to the contrary, it should be assumed that this report has not been submitted to any regulatory authorities for approval.

Redevelopment sites in particular may have planning conditions attached in respect of contaminated land assessment. Where we are made aware of such conditions in advance of scoping the works, we can tailor the report to the regulatory authority requirements. Where we are not made aware of any such requirements there can be no certainty that our investigation will meet any or all of the regulatory authority requirements.

2.0 EXISTING SITE INFORMATION

2.1 Site Location

The site is located at approximate national grid reference (NGR) SS 738 943 within Briton Ferry, South Wales. The site is bounded by Regent Street to the south. Victoria Street to the East and Shelone Road to the west. The Site Location Plan is given in Drawing SGS/2012/01

The site is triangular in shape. The site consists of an open area, with zones of hardstanding and grass, and numerous existing garages.

2.2 Surrounding Land Use

The site is located in a mixed residential / commercial area. Land use immediately surrounding the site is detailed below.

- South - Remediated Former Gas Works beyond Regent Street West,
- East - Victoria Street beyond which are residential properties,
- West – Shelone Road, beyond which are further residential properties.

2.3 Geology, Hydrogeology and Hydrology

2.3.1 Geology

The site geology is based on information obtained from the published 1:10,660 and 1:50,000 British Geological Survey (BGS) geological mapping sheets (Swansea) Solid and on information from previous investigations.

Ground conditions at the site are anticipated estuarine alluvium underlain by glacial drift. The solid geology is expected to be of a sequence of Carboniferous Upper Coal Measures consisting of Lower Pennant and Rhondda beds. The map indicates two unnamed coal seams one on the northern site boundary and one 100m to the south of the site. Both conjecturally outcrop beneath the superficial deposits and based on the dip direction of the Rhondda beds to the north it is likely that the southern most coal seam will underlay the site. The site is located approximately 100m to the east of the Giants Grave Fault which runs in a north south orientation down throwing strata to the east and has a large effect on the stratigraphy of the region.

Previous investigations close to the site published mapped geology and BGS borehole data have indicated the Geological units and lithology thickness likely to be present at the site, details of this are summarised in Table 2.3.1.

Table 2.3.1: Summary of Site Geology:

Geological Unit or Lithology	Thickness (available Information)
Made Ground: Recent deposits expected to comprise of waste products from gas manufacture, clinker, coal rich materials, coke and reworked drift deposits.	Variable thickness up to 2.0 to 3.0m bgl expected possibly up to 4.50m within former gas holders.
Recent Deposits: Marine or Estuarine Alluvium consisting of clay and peat, then sand with gravel and sandstone fragments in a stiff brown silty sandy clay matrix.	Thickness varies from 1.0-10m.
Solid Geology: Carboniferous, Upper Coal Measures (Pennant), overlying Cefn Bryn Shales. Comprise of sandstone horizons separated by shale, siltstone, seat earth and coal.	Thickness not known. The site is located on a north-south trending fault. The downthrown side of the fault is to the east. The regional dip (30 to 40°) on both sides of the fault is northwards.

2.3.2 Hydrogeology

The Hydrogeology of the site is presented below in Table 2.3.2 and is based on the EAW Groundwater Vulnerability Map sheet 35, West Glamorgan together with an assessment of available geological information.

Table 2.3.2: Summary of Site Hydrogeology

Geological Unit	Aquifer Classification	Aquifer Characteristics	Source Protection Zone	Groundwater Abstractions
Made Ground	Not classified	Highly variable permeability and porosity. Perched water may be present with variable flow directions	No	None recorded within 1km of site
Glacial Drift and Estuarine Alluvium	Minor Aquifer	Variable permeability and porosity. Perched water may be present with variable flow directions	No	None Recorded within 1km of site
Carboniferous, Lower Pennant Beds	Minor Aquifer Cont	Variable permeability. Fractured or potentially fractured rock with low primary permeability. May contain a multi-layered	No Cont	None Recorded within 1km of site

		aquifer system with separate water bodies in each sandstone horizon.		
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Shallow groundwater is likely to be present in the made ground (1.5 to 2.0 m bgl). The shallow groundwater appears to flow west. Groundwater is also anticipated to be present in the Glacial Deposits. Waters with this unit also appear to flow west. There is however uncertainty with respect to the continuity between the two water bodies. The shallow groundwater appearing to be perched above the waters in the superficial deposits.

Groundwater flow direction in the Coal Measures is uncertain; there is likely to be a generally south westerly hydraulic gradient towards the sea, however fractures will have an impact on flow direction and rates.

Based on the EAW Groundwater Vulnerability map sheet 35 and the Envirocheck report, soils are described as being of a high leaching potential (U) over the site.

2.3.3 Hydrology

The hydrology of the study area and surrounding environs is presented in Table 3 and is based primarily on Ordnance Survey Maps and visual observations on information held by the EAW.

Table 2.3.3: Summary of Site Hydrology

Feature	Distance From Site	Flow	Classification	Abstractions	Discharge
Surface Runoff	N/A	Likely to infiltrate directly to ground.	N/A	N/A	N/A
Jersey Canal	250m west from the site.	Not Known	GQA Grade D (Fair) *	No Licensed abstractions within 1km of the site.	N/A
Neath River	400m m west from the site.	North east to south west to Baglan / Swansea bay.	Not Known	No Licensed abstractions within 1km of the site.	N/A

Notes: Based on information obtained from the Environment Agency Wales *GQA – General Quality Assessment scheme based on EA biological and chemical grading scheme. Watercourses are graded from A to F (A being very good and F being bad).

The Jersey canal is located approximately 250m west of the site, it is uncertain whether the canals are tidally influenced; or in hydraulic continuity with the River Neath. The River Neath at its nearest point is approximately 400m west of the site, at this point the river remains tidally influenced.

2.4 Site History

The history of the site and the surrounding area has been based on historic Ordnance Survey Plans, information contained in the Envirocheck report, Gas Works Celtic 2002 Report and EML 1997 Report. The historic land use of the site and adjacent area is summarised in Table 2.4.

Table 2.4: Summary of Site History

Date	Information Source	Site Land Use of Significance	Adjacent Land Use of Significance
1875	EML Report 1997.	Agricultural.	Farmland. Small gas works to the south. Structure details are not given.
1882	OS 1:2500	As previous	Residential dwellings to the southeast and southwest from Regent street. Site intersected by track orientated north east to south west Open fields to the south and west of site. Established railway track is located in the east. Iron Foundry located to the south east. Gas works. Two unidentified tank structures (later identified as gas holders) present to south of the site. Small buildings in south east corner.
1884	OS 1:0560	As previous	As previous
1899	OS 1:2500	As previous	Gas works facility extends north with additional buildings shown on site. Two gas holders are no longer shown. Large Gas Holder tank situated in centre of site. Possible retort house developed in the southeast corner of the site. Residential houses developed southeast on regent street west. School built to the south west. Undeveloped open space to the north and west of site.

			Railway infrastructure developed to the east of the site, known as the Rhondda & Swansea Bay Railway.
1900	OS 1:2500	As previous	The gas works site is extended to the east and north with utility building consisting of stables, cart shed, foreman's house and depot. Briton ferry dock to the south. Jersey canal and River Neath to the west.
1910	OS 6" Sheet 24NE from Celtic 2002, Report	As previous	A larger Gas holder with a small building to the southeast has been constructed in the northeast of the site. Buildings have been removed from the south west corner. Land in the northeast corner of the site is part of the gas works. Buildings forming gasworks continue all along Victoria Street and Regent Street. An iron foundry is indicated to the south of the gasworks.
1918	OS 1:2500	As previous	Residential housing developed to the north of the site along east side of Victoria Street. To the north west residential housing along Shalone Road developed. Sunday school located north east. Tank structure removed. Gas works buildings have been developed along the southern and eastern boundary of the site. A square structure is shown in the west of the site, near to the area occupied by No's 14 and 16 Regent Street West. We believe this to be the purifiers.
1921	OS 1:0560	As previous	Gas works. Two circular tank structures present. Small buildings developed in south and east of the site.
1936	Borough of Neath Briton Ferry Gasworks Undertaking	Not shown	Indicates the Briton Ferry Gas Works layout consisting of two gas holders tanks, purifiers, retort house, depot and coal shed present on site. The purifiers are located on land occupied by Nos 14, 16 and 18 Regent Street

	Scale 41.66 feet to an inch.		West. Land to the west of the purifiers now occupied by No 12 is shown as an open yard.
1938	OS 1:0560	No change	Purifiers and stores have been removed from south west corner of the site which is now undeveloped. Concrete cul-de-sac entrance developed from Regent Street West into the site
1941	OS 1:2500	As previous	Small structures present to the north. Housing developed to north along Victoria Street. Foundry to the south east is now engineering workshops. Residential properties develop north and south along Shelone Road. Allotment gardens are shown approximately 130m to the east of the site. Gas work structures remains are confined to the northern part of north and east of the site, consisting of two gas holder tanks, meter house and some unidentified structures. Residential housing with gardens now occupies the south west portion of the site around the cul-de-sac of Regent Street West.
1951	OS 1:1250	As previous	Industrial estate has been developed to the south east of site. Park Street to north east re-named as Jersey Terrace. Small structures increase to the north of the site. Gas works. Gasholders referred to on site.
1964	OS 1:1250	As previous	Shelone Road residential housing extended north. No's 30-40 no longer shown on Regent Street West.
1970	OS 1:1250	Numerous small structures developed.	South boundary two blocks of flats replace terrace houses No 30-40. Houses developed along eastern boundary, now No's 14-28a Victoria Street. Play ground built south of Jersey Terrace. Residential housing with gardens built on west boundary extending Victoria Street to south.

			Unidentified structure located northwest of large Gasholder.
1971	OS 1:2500	As previous	Gasholder station noted to south on map.
1980	OS 1:10000	As previous	No significant change
1999	OS 1:10000	As previous	All gas works structure have been removed and small structures replaced by open space. Residential housing still remains along Regent Street and Victoria Street.

Notes: * Dates relate to Ordnance Survey mapping and document publishing dates. OS – Ordnance Survey.

Gas Journal, September 25, 1917: Gives a brief account of the nearby Briton Ferry gas works site in 1897. It details production rates, supply costs, prepayment plans and that by 1917 practically every house had a supply of gas. The gas works site was scheduled to have a railway siding constructed into the site to transport coal in on, however at the time of writing it was still economical to bring coal into the retort by horse and cart. The passage describes the site as having four beds of six retort, with shallow generators, it also mentioned that the exhausters though not coupled are driven by a gas engine of shafting, which is also used to drive the rotary scrubber and all the pumps.

2.4.1 Summary of Site History

Based on the information available it appears that the site has been agricultural fields until around 1970, thence garages. The operations at the gas works site commenced pre 1875. Operations appeared to be in decline from the 1930's. By 1941 the southern portion of the site had been sold and had been developed for residential housing. Decline of operations appears to have continued, and in 1976 the eastern portion of the site was also sold on for residential development.

2.5 POTENTIAL CONTAMINATIVE LAND USE

2.5.1 Historic Potential Contaminative Site Use

The site was close to a gas work manufacturing process for over 100 years with prolonged industry on site between 1920's to the late 1970's. In the most part the production (retort/purifiers) appears to have been concentrated to the more southern region away from the site now occupied by Regent Street West. This area ceased being used for gas manufacture in the 1930's following sale of part of the area. The more northern proportion appears to have subsequently been utilised for gas storage and distribution.

Coal Gas manufacturing sites like Briton Ferry produced gas through a process of coal carbonisation which involving heating coal within retorts under oxygen deficient atmosphere; yielding a mixture of solid, liquid and gaseous products and leaving coke as the principal residue. On completion of the heating process the subsequent material were separated which in turn produced gas, liquor, tar and various other by products. Table 2.5.1 summarises the historical structures, uses and processes which have been identified as being present on, or near to the site, and details the associated potential contaminants.

Table 2.5.1: Summary of Historical Contaminative Site Uses

Process/ Structure	Location	Process Description	Potential Contaminants of Concern
Gas Holders	No longer present adjacent to the site. Historical maps indicate the presence of two holders located within the Wales and West Utilities Limited site boundary. Another two Gas holder are shown on southern boundary of the site (1882 map).	Storage of gas. Water was to form a gas tight seal. Prolonged contact with the gas may have resulted in contamination with various compounds. Gasholders were often demolished and backfill with waste product from the operation.	Coal tar, sulphide compounds, cyanides and BTEX compounds. Backfill waste could have contained numerous contaminants. Typically waste consists of demolition material generated during decommissioning of site structures. If structures were in filled during operation of the site, the waste generated by coal gas production (spent lime and oxides, tars and liquors, ash and clinker) may have been used as fill materials.

Above Ground Tank	Located to the south of the site	Often used for storage of oils, tars and liquors.	Unknown
Governor / Meter/ Pump House	South of the site	Used for metering and control of gas pressures. Contained valve and control for gasholders.	Lubricants and asbestos lagging of pipes.
Purifiers	Was situated to the south-west of the site but is no longer present. Plans indicate that it is replaced by residential housing.	To remove impurities like hydrogen sulphide, carbon dioxide and hydrogen cyanide from the gas, it was passed through slaked lime or ferric oxide. Waste bi-products were produced in the form of foul lime or spent oxide. The material was often reused on site to fill voids around the gas holder or simply discarded to the edges of the site boundary.	The primary contaminants may include up to 60% free sulphur, sulphate, sulphide and up to 5% cyanides and thiocyanate. Complex cyanides can be created under strong alkaline conditions or during combustion of complex cyanides. Hydrogen cyanide can also be produced from free cyanide.
Retort Cont	Has been replaced by residential housing	Coal was heated to high temperatures in coal ovens with reduced oxygen. The gas stream exiting contained impure coal gas, ammoniacal liquor and tar. The fusion of ash created clinker by products.	Compounds like clinker, coal, tar, phenols, ammonia, sulphate, sulphide, hydrogen sulphide, hydrogen cyanide and acids could be associated by products.

2.5.2 Historic Potential Contaminative off site Uses

The only other potential contaminative site use to have occurred in the area is the operation of a former iron foundry. This is however located over 100m from the site.

2.5.3 Recent Contaminative Site Uses

The central portion of the site is currently occupied by garage structures; these may result in small releases of oils, greases and antifreezes. Additionally

asbestos materials may have been released to environment from cladding. Adjacent to the area the site comprises of residential housing Shelone Road and Victoria Street, this area of the site is not thought to have had any recent contaminative site usage.

2.5.4 Statutory Authorities and Information Sources

Information from the Coal Authority shows that the site is unlikely to be affected by past or present underground workings. At present no feasibility, licences and planning consents have been passed for future works, though workable coal exists in the locality of the site. The Coal Authority Report is appended.

Table 2.5.4: Other Site-Specific Information

Information Source	Information Summary
Envirocheck Report	Discharge consents There are no discharge consents within 250m of the site. There are a total of 29 discharge consents within 1km of the site discharging to the River Neath, estuarial waters of the River Neath and to land.
	Waste Management Giants Grave landfill is located approximately 850m north west of the site, when operational accepted household and industrial wastes equal or greater than 75,000 tonnes per year. There are five Licensed Waste Management Facilities within 1km of the site. Five waste transfer/treatment site's are within 1km of the site.
	Substantiated Pollution Incidents There are 8 substantiated incidents on the pollution register, 2 are within 500m of the site these involve lubricating oils and waste metals.
	Pollution Incidents to controlled water There are 13 recorded pollution incidents to controlled waters within 1km of the site. None are related to the site. Four were recorded within 500m of the site. These are: • Unknown pollutant via leakage from Villiers Street Briton Ferry, category 3 Minor Incident. • Foam/Soap suds from Briton ferry category 2 - Significant Incident • Crude sewerage entered the canal by direct discharge, category 2 – Significant Incident. • Neath Cargo Terminal, adjacent to Giant Grave pollutant unknown, Category 3 – Minor Incident.
	Flooding A Tidal Indicative Floodplain is 250m south west of the site.
	Air Pollution There are three Air Pollution Controls within 1km of the site.

	Sensitive Land Uses Five within 1km of the site have been designated Sites of Special Scientific Interest (SSSI) on a geological merit.
	Compressible Ground Subsidence Hazards Risk rating high. Source British Geological Survey
Coal Authority Report	The report states that the site is not within a zone of likely physical influence on the surface from past underground coal workings. The site is not within a zone of likely physical influence on the surface from any present underground coal workings. There are no mine entries within, or within 20m of the site. The records do not disclose any damage or claim having been given, made or pursued in respect of the property since January 1984.
Glamorgan Gwent Archaeological Trust (GGAT). Celtic, 2002.	GGAT confirm there are no known archaeological sites or finds in the area of the site.
NPTCBC Planning Department	Hold no records for the site before the local Government re-organisation in 1974.
Countryside Council for Wales. Celtic, 2002.	Sites of Special Scientific Interest (SSSI). The nearest site is 2km west at Crumlin Burrows.

2.6 RESULTS OF PREVIOUS INVESTIGATIONS

A number of previous investigations and assessments have been produced within or in close proximity to the study area:

In 1997 Neath Port Talbot County Borough Council (NPTCBC) were contacted by a resident who expressed concern over a 'Blue' material associated with soil in the garden of the property and the lack of plant growth in that area. Following initial contact and the action was taken by NPTCBC and works completed as summarised.

Following the complaint the Environmental Health Section of NPTCBC recovered an initial soil sample from the garden of 12 Regent Street West, Briton Ferry on 16.06.97. The sample revealed excessively high concentration of Total cyanide (CN) 62,000mg/kg and Free CN 2,000 mg/kg.

On discovery of the elevated cyanide concentrations NPTCBC issued a door step questionnaire to 24 properties in the locality requesting information on visual evidence of contamination.

Following completion of the door step survey six of the properties had soils samples removed from the gardens and analysed for total and free cyanide. Two samples were recovered from each property. The exact locations from where the samples were retrieved and the reasons why the properties were chosen is not known. The properties sampled included the following:

28 Shelone Road
10 Regents Street
14 Regents Street
24 Regents Street
20 Victoria Street

The identity of the sixth property identified as G.S is unknown.

The 12 No. soil samples revealed levels of detection for total and free Cyanide (CN) below the guidance concentrations being used at the time (ICRCL trigger levels, for gardens and allotments).

Although none of the samples recorded concentration exceeding the guidance values used, it should be noted that the samples were in the majority retrieved from flower beds. The results are therefore unlikely to be representative of site wide conditions.

NPTCBC were in consultation with British Gas PLC Property Division regarding ownership of part of the land associated with the former Briton Ferry Gasworks site. Subsequent representation by British Gas stated housing land (Regent Street and Victoria Street) was appropriated to Council Borough of Neath via the Minister of Health on the 24.04.36, following an application by Neath Council under S.65 of the Housing Act 1925. The council then re-developed the site for housing (including Regent Street and Victoria Street). The lease of the site was assigned by The Wales Gas Board to the Council in 1967, although the Council had full control and management of the site since 1936.

Earlswood Material Laboratory, 1997 (12 Regent Street West, Briton Ferry. Investigation of Ground Contamination):

In 1997 following the initial sample from No 12 Regent Street EML (now Jacobs) were commissioned by NPTCBC to undertake an investigation of the ground beneath No 12 Regent Street West. The purpose of the investigation was to assess the nature and extent of ground contamination.

The fieldwork took place on the 11-12th August 1997, nine boreholes were completed at No. 12 Regent Street to depths between 0.5m-3.0m bgl. Groundwater was encountered at depths between 1.1m and 1.30m below ground level (bgl). During the investigation olfactory evidence of contamination

was noted frequently in the made ground. Additionally at one location oily odours were noted in the Peat stratum identified below the Made Ground.

Chemical analysis revealed the Topsoil and Made Ground across the site to be heavily contaminated with cyanides, arsenic, PAH's, phenols and sulphates. Lower levels of other heavy metals, sulphur and mineral oils were also recorded.

The report recommended that additional investigations should be undertaken on the adjoining properties (Nos. 10 and 14 Regent Street West) to determine whether contamination extends beyond No 12. The report details removal of all 2.5m of Made Ground from the site would be ideal though in reality impractical. The suggested remedial works involve the use of a barrier layer between the ground surface and the contaminated soil. The report suggests that a 750mm thick barrier would be sufficient, comprising:

- 150mm topsoil
- 300mm clean subsoil.
- Geotextile filter membrane
- 300mm clean single size gravel, and
- geotextile filter membrane

The report provides an alternative method to reduce the size of excavation by using a 150mm reinforced slab over 150mm thick hardcore bed, which would provide suitable cover; this was subsequently employed at No. 12 Regent Street following the investigation.

Celtic Technologies Limited, (Victoria Street, Briton Ferry, Neath Port Talbot County Borough Council). Factual Environmental Assessment Site Investigation Report. R428B/02/1744. 2002 (Final).

Celtic Technologies Limited was commissioned by Lattice Property Holdings LTD (LPH) on behalf of Transco to produce an Environmental Assessment Site Investigation Report on land at Victoria Street, Briton Ferry. This report is presented in Appendix C.

The objective was to quantify the nature and extent of solid, liquid or gaseous phase contamination at the Victoria Street site in Briton Ferry. The investigation did not investigate the land outside the current Wales and West Utilities Limited boundary. The report detailed that the primary site use between the 1890's to the 1970's was for gas storage. The report states that land to the south of the site (within the NPTCBC site boundary) was involved in gas manufacture from approximately 1870 to the 1940's. Areas to the south and east were formerly part of the earlier gas works but their use is stated as unknown in the Celtic 2002, report. .

Site works were carried out on site between 26th June and 6th July 2002. The investigation comprised nine cable percussive boreholes to depths between 3.10m and 10.70m bgl. Nineteen trial pits and two hand dug pits were excavated to depths between 1.00m and 3.00m bgl. The trial pits and hand dug pits were excavated to provide representative solid and liquid samples, locate below ground structures, locate waste material and assess the made ground and site geology. All of the boreholes were installed with groundwater monitoring wells.

Three of the boreholes were installed in the two former Gas Holders on site. Two of the boreholes were installed with twin monitoring wells to discreetly monitor water in the made ground and the superficial deposits.

The results of the investigation indicated the site was underlain by made ground which extended to a maximum depth of 4.3m bgl. This was encountered inside a gas holder. Outside of the holders made ground extended to a maximum depth of 2.75m bgl. Beneath the made ground alluvial deposits were proved. These extended to a maximum of 4.7m bgl. Beneath these deposits Glacial Deposits were encountered. These were proven to depth of 10.7m bgl.

Groundwater was encountered within the Made Ground at its interface with the Alluvial deposits. Groundwater was also encountered within the Glacial Deposits. The CELTIC report states that the waters in the Glacial Deposits are confined by the overlying Alluvial clays. Review of the results of the monitoring indicates that there is however uncertainty with respect to this statement and the partial continuity between the two water bodies may occur at the site.

Forty-five representative soil samples were retrieved during the investigation. The samples were analysed for a range of toxic and phototoxic metals, inorganics, aromatics, PAH and TPH. Elevated Levels of the following determinants were encountered as shown below. Details of the exploratory excavation locations are given in the Celtic Report.

Maximum Concentrations Reported In CELTIC Technologies Ltd Report

Determinant	Maximum Concentration
arsenic	920mg/kg (BH1)
Lead	10,700mg/kg (BH1)
Mercury	4.3mg/kg (TP7)
Selenium	17mg/kg (BH1)
Copper	5,240mg/kg (BH1)
Zinc	46,000 (HP1)
TPH	8,400mg/kg (TP2/3)
Total PAH	1,189mg/kg (BH1)

Free cyanide	38mg/kg (TP16)
Complex cyanide	287mg/kg (HP1)
Elemental sulphur	6,300mg/kg (BH9)
Water soluble sulphate	6,955mg/kg (BH9)

The spatial distribution of these maximum concentrations is varied across the site. However there does seem to be a connection between the former gasworks structures and elevated levels of analysed determinants, though the relationship and distribution is not clear.

BH1 which is located on the southern boundary of the Wales and West Utilities Limited land recorded the maximum concentrations of determinants. These included PAH's, benzene, arsenic, lead, selenium, copper.

TPH was recorded at its maximum concentration in TP2 and TP3 which were excavated adjacent to BH1. This area of the site is situated north of the former retort houses (1877-1938) associated with the former Briton Ferry gas works.

Four of the soil samples tested for leachability (using NRA method) for a range of determinants. The following determinants were above levels of detection pH 7.9mg/l (TP14), total organic carbon 4.1mg/l (TP9), conductivity uS/cm (BH1), total sulphate 155mg/l (TP2/3), ammonium 3mg/l (BH1) and iron 1.1mg/l (BH3). There seems to be a relatively low leaching potential for most contaminants across the site.

Two rounds of water monitoring were completed at the site. Maximum concentrations are as follows:- total organic carbon 1,301mg/l (BH5 shallow), conductivity uS/cm 14,950mg/kg (BH3), TPH 0.13mg/l (BH5 shallow), thiocyanate 2.3mg/l, total sulphate as SO₄ 670mg/l (BH9), total ammonium 37.9mg/l (BH9), Arsenic 0.17mg/l (BH8), cadmium 0.05mg/l (BH8), lead 4.9mg/l (BH8) selenium 0.02mg/l (BH8), copper 5.6mg/l (BH8), nickel 0.66mg/l (BH8), zinc 11.7mg/l (BH8). Apart from BH9 and BH3 the elevated concentrations indicated above were recorded in samples taken from the perched water.

The report provides factual information on the ground investigation undertaken at the site in Briton Ferry. It states the primary site use was gas storage and later gas distribution. The investigation describes areas to the south and east of the Celtic site boundary which is now replaced with residential housing with gardens which were once part of the former Gas Works, but the extent and nature of contamination were outside the scope of investigation. The CELTIC report also indicated that potential contaminated soil and ground water could affect the properties of Regent Street West and Victoria Road, which had been developed onto the footprint of the former gas work site.

3.0 SITE VISIT

In order for the author to be familiar with the site, a site visit was completed on 9 March, 2020.

The walk over confirmed that the site comprises of a relatively flat triangular area of land, with numerous garage blocks surrounded by grassed and hardstanding areas.

4.0 PRELIMINARY CONCEPTUAL MODEL AND ASSESSMENT OF POTENTIAL POLLUTANT LINKAGES

Based on the information collated Spectrum Geo Services has developed the following site conceptual understanding of the study area.

The site is approximately triangular in shape and occupies.

Source Characterisation

Based on the historical review of the land use the site, the former Briton Ferry Gas works was identified as the most significant potential source of contamination. The Gas Works site evolved over a period of time changing in area, shape and usage.

The Celtic 2002 site investigation identified Made Ground to comprise of mainly reworked natural material, building rubble, clinker and waste product associated with gas manufacture in varying quantities. Evidence of tar staining, oils and odours was noted during some excavations.

The results of chemical analysis of soils from the Wales and West Utilities Limited site have identified elevated concentrations of compounds of concern in the Made Ground (metals, inorganic's and organics). Elevated concentrations were also found in natural stratum underlying the Made Ground in BH9 and BH1. In the absence of site specific information it is anticipated that the conditions encountered beneath the Wales and West Utilities Limited site will be typical of the conditions of the soils outside the site boundary (but within the former gas works site boundary). This assumption appears supported by the results of testing of soils from No 12 Regent Street West.

Groundwater analysis revealed elevated concentration of contaminants predominantly in the perched water body on site. VOC's, production of CO₂ and

reduced concentrations of O₂ were noted in soil atmospheres within some of the boreholes (BH8, 6 and 5) on site. Given the site investigations it is apparent that shallow soils and groundwater now present the main source of contamination on site.

Previous investigation by NPTCBC and Celtic Technologies has highlighted contamination of the near surface soils and the groundwater. However the extent and distribution of contaminants across the total area of the gas works site is still not fully understood.

A key set of unknowns highlighted by these investigations is the extent, concentrations and distribution of contamination below the properties of Victoria Street to the east and Shelone Road to the west.

Pathway Characterisation

Pathways refer to the means by which a contaminant may be exposed to susceptible receptors. This can include direct contact (such as ingestion or inhalation) or pathways where the contaminant has to physically move from its point of origin (groundwater migration, gas porportioning).

Direct contact with the exception of site workers will be minimal. It is envisaged that site workers would be aware of the risks associated.

The groundwater was encountered between 0.90m - 1.00m bgl. Water bodies appear to flow west towards the River Neath 400 m west.

During the Gasworks investigation there was variation in the rest water levels between groundwater in the made ground and the water in superficial deposits. This may indicate partial hydraulic continuity between the two water bodies. The shallow groundwater appears to be perched above the waters of the superficial deposits, with the Alluvial Deposits between the two bodies acting as an aquitard to the downwards migration of contamination. As outlined above the aquitard is however only partial. Absent waters from the made ground have the potential to migrate downwards into the waters in the Glacial Deposits identified previously. The chemistry of the waters appears to confirm this partial continuity, with impact to water in Glacial Deposits being recorded in Celtic BH1 and BH9.

Groundwater is also anticipated in the Lower Pennant Measures, these waters are anticipated to flow south to the sea. The sands and gravels are a highly permeable unit. With the unit horizontal rather than vertical groundwater movement is likely to occur. This is likely to restrict movement of contaminants from the Glacial Deposits into the Pennant Measures

Based on our present understanding of the site and information collated in the desk study,- it is plausible that the following pathways could be present on site:

- Direct Contact (including inhalation)
- Surface water movement
- Chemical attack
- Groundwater movement, and
- Vapour migration within unsaturated zone

Receptors Characterisation

‘Receptor’ is the term used in risk assessments for people or environment which may be exposed to impacted media or at or near an evaluated site.

It is anticipated that workers employed to undertake works at site would be made aware of the potential risk by the site owners. Workers within this area are unlikely to represent a sensitive receptor.

Groundwater has been identified within the made ground and (during previous GIs) the glacial deposits. These waters appear to flow west towards the River Neath 400m away.

Based on the information collated the likely receptors associated with the site are:

- Human Receptors – Site users
- Surface waters in the River Neath, and
- Groundwater in Glacial Deposits

Based on this conceptual understanding a preliminary assessment of the pollutant linkages has been made. This is presented in Table 4 overleaf.

Table 4 Source Pathway Receptor Risk Assessment

Potential Receptor	Potential Source	Potential Pathway	Comments	Impact Event	Risk Ranking
Human Health	Contaminants associated with use as garages	Direct contact Ingestion & Inhalation of dust	The risk of contact with contaminates remains low. It is assumed that ground workers will have the appropriate training and PPE to work on the site. Therefore the risk to site workers in these is low. No growing of crops is to be allowed thus the risk is low.	Moderate	Low - medium
Groundwater In Glacial Deposits	Contaminants associated with adjacent former Gas Works	Shallow groundwater migration	Groundwater in which a range of compounds of concern have been previously detected within the Made ground beneath the Wales and West Utilities Limited site. This groundwater appears to be in a degree of continuity with the waters in the Glacial Deposits. The results indicate that although an aquitard is present beneath the two units. There is partial continuity between the two waters (as evidence by chemistry of Celtic BH9 and BH1) and that vertical gradient for migration of compounds from the Made ground to Glacial Deposits is present. Glacials appear to be absent at the study site.	Moderate	Low

Potential Receptor	Potential Source	Potential Pathway	Comments	Impact Event	Risk Ranking
Surface Waters	Groundwater in marine and estuarine deposits	Horizontal migration of groundwater	Shallow ground water within the made ground and glacial deposits could be in continuity with the surface waters of River Neath. The river is however located 400 m from the site. Given the distance between the site and the River Neath the influence on surface waters is anticipated to be negligible.	Moderate	Low
Ground Waters	Groundwater in the Coal Measures	Horizontal migration of groundwater	Considering the anticipated depth to the coal measures. It is considered that groundwater in the Coal Measures is unlikely to be in continuity with waters within the River Neath.	Moderate	Low

Notes: Definitions of terminology used for Qualitative Risk Assessment are Appended.

4.1 Summary of Potential Pollutant Linkages

The assessment of the site has indicated that a range of potential pollutant linkages are associated with the soil and groundwater contamination potentially present beneath the site. Most are considered to be low risk. The linkages present indicate that the following receptors may be at risk.

- Groundworkers and users of the garages.

5.0 SITE INVESTIGATION OPERATIONS

5.1 Site Works

Site works comprised 2 phases, the first of 12 Window Sample holes, which was undertaken on 09 and 10 March 2020. The 2nd was undertaken on 08 September 2020, and comprised trial pitting by mechanical excavator, to investigate a tighter grid of samples. Conditions during both phases of the fieldwork were mostly wet. The positions are shown on Drawing SGS/2012/02.

The positions of the holes were determined to provide a reasonable spread of data.

The work was undertaken in accordance with BS5930.

Samples were recovered of strata encountered, to allow chemical laboratory testing.

On completion each position was backfilled with arisings, or a 50mm groundwater monitoring pipe was installed.

6.0 LABORATORY TESTING

6.1 Introduction

On completion of site operations, selected soil samples were scheduled for laboratory testing. The following laboratory testing was undertaken and is Appended.

- Soil Chemical Analysis Suite, comprising
 - *Arsenic,*
 - *Asbestos Screen,*
 - *Chromium,*
 - *Copper,*
 - *Lead,*
 - *Mercury,*
 - *Nickel,*
 - *Cyanide,*
 - *Speciated PAH 16MS*
 - *Soil Organic Matter,*
 - *Total Petroleum Hydrocarbon CWG*
 - *Phenols Total HPLC,*
 - *pH, Water Soluble Sulphate*

- Groundwater Chemical Analysis Suite, comprising (dissolved);
 - *Arsenic,*
 - *Chromium,*
 - *Copper,*
 - *Lead,*
 - *Mercury,*
 - *Nickel,*
 - *Cyanide,*
 - *Speciated PAH 16MS*
 - *Dissolved Organic Content,*
 - *Total Petroleum Hydrocarbon CWG*
 - *Phenols Total HPLC,*
 - *pH, Sulphate*

7.0 SITE CONDITIONS ENCOUNTERED

7.1 Ground Conditions

12 Window Sample Holes were constructed, which noted a generalised succession as indicated in Table 7.1.

Stratum	Depth to base (m)	Remarks
MADE GROUND	1.40 – 2.20	Various granular and cohesive lithologies with slag, ash, ceramics, plastic etc
Soft CLAY	1.70 – 3.50	Probable fluvial deposits
Fibrous PEAT	2.00 – 3.50	Relatively thin deposits
Probable weathered SANDSTONE	(3.00) – (4.00)	Resulted in refusal at all positions bar WS12 and 12A

Table 7.1. Generalised Strata

7.2 Groundwater Conditions

During the field operations, water was encountered at between 0.9 and 1.0m depth, in all window samples bar WS01 - although the methods employed will mask accurate water strike data. During the trial pitting strike were noted in TP22, 24, 25, 27, 28 and 29, at between 0.90m and 1.60m depth.

Ongoing water monitoring was undertaken at the site, the results are appended. It was noted that a piezometric surface existed at approximately 1 to 1.50m depth.

It should be noted that groundwater levels vary due to changes in climatic and other conditions and may therefore vary from those recorded during these operations.

8.0 CHEMICAL CONTAMINATION ANALYSIS

Chemical contamination testing has been undertaken on soil and groundwater recovered from the site.

The measured concentrations have been compared against the given guidelines where applicable. Where maximum values measured exceed the guidelines then the Values of the contaminants tested are compared to the relevant available threshold values (Soil Guideline Values - SGVs, LQM Generic Assessment Criteria, Water Guideline Values EQS etc.)

Soil Organic Matter contents were elevated and a value of 6% has been employed in the soil assessment.

The Tables 8.1 presents the results of the water analyses. The soil results are shown within Appendix H.

Sample ID	Units	Limit of Detection	WS04	WS05	WS10	WS12	Assessment Value	Standard	No. Exceedences	Multiplier
pH (w)	pH	0.01	6.93	6.93	6.77	7.01				
Sulphate (w)	mg/l	1	56	42	41	21	250	UK DWS		
Cyanide (total) (w)	mg/l	0.005	0.009	0.187	0.038	1.491	0.05	EU DWS	2	29.82
Phenols - Total by HPLC (w)	mg/l	0.01	<0.01	<0.01	<0.01	<0.01	0.50	UK DWS		
DOC (w)	mg/l	0.2	7.9	5.1	7.3	8.2				
Arsenic (dissolved)	µg/l	1	<1	12	2	16	10	EU DWS	2	1.6
Copper (dissolved)	µg/l	1	3	5	1	1	2000	EU DWS		
Chromium (dissolved)	µg/l	1	<1	<1	<1	<1	50	EU DWS		
Lead (dissolved)	µg/l	1	<1	<1	<1	<1	25	EU DWS		
Mercury (dissolved)	µg/l	0.1	<0.1	<0.1	<0.1	<0.1	1	EU DWS		
Nickel (dissolved)	µg/l	1	8	3	6	2	20	EU DWS		

PAH 16MS (w)										
Acenaphthene (w)	µg/l	0.01	<0.01	0.2	<0.01	<0.01		NS		
Acenaphthylene (w)	µg/l	0.01	<0.01	0.11	<0.01	<0.01		NS		
Anthracene (w)	µg/l	0.01	<0.01	0.17	<0.01	<0.01	0.1	EU Standard	1	17
Benzo(a)anthracene (w)	µg/l	0.01	<0.01	0.39	0.01	0.03	0.05	BaP Threshold	1	7.8
Benzo(a)pyrene (w)	µg/l	0.01	<0.01	0.44	0.02	0.03	0.01	EU DWS		
Benzo(b)fluoranthene (w)	µg/l	0.01	<0.01	0.4	0.02	0.03	0.1	EU DWS	1	12.9
Benzo(ghi)perylene (w)	µg/l	0.01	<0.01	0.33	0.02	0.02				
Benzo(k)fluoranthene (w)	µg/l	0.01	<0.01	0.15	<0.01	0.01				
Indeno(123-cd)pyrene (w)	µg/l	0.01	<0.01	0.41	0.03	0.03				
Chrysene (w)	µg/l	0.01	<0.01	0.49	0.03	0.03		NS		
Dibenzo(ah)anthracene (w)	µg/l	0.01	<0.01	0.06	<0.01	<0.01	0.05	BaP Threshold	1	1.2
Fluoranthene (w)	µg/l	0.01	<0.01	0.94	0.02	0.03	0.1	EU Standard	1	9.4
Fluorene (w)	µg/l	0.01	<0.01	0.13	<0.01	<0.01		NS		
Naphthalene (w)	µg/l	0.01	<0.01	<0.01	<0.01	<0.01	2.4	EU Standard		
Phenanthrene (w)	µg/l	0.01	<0.01	0.37	0.01	0.01		NS		
Pyrene (w)	µg/l	0.01	<0.01	0.84	0.02	0.04		NS		
Total PAH 16MS (w)	µg/l	0.01	<0.01	5.43	0.18	0.26	2.81		1	1.93

TPH CWG (w)										
Ali >C5-C6 (w)	µg/l	1	<1	<1	<1	<1	300	WHO DWS		
Ali >C6-C8 (w)	µg/l	1	<1	<1	<1	<1				
Ali >C8-C10 (w)	µg/l	5	11	7	<5	<5				
Ali >C10-C12 (w)	µg/l	5	7	<5	<5	<5				
Ali >C12-C16 (w)	µg/l	5	7	8	<5	<5	300	WHO DWS		
Ali >C16-C21 (w)	µg/l	5	7	22	<5	6				
Ali >C21-C35 (w)	µg/l	5	64	216	11	111	Insoluble	Insoluble		
Total Aliphatics (w)	µg/l	5	96	253	11	117				
Aro >C5-C7 (w)	µg/l	1	<1	<1	<1	<1	1	UK DWS Benzene		
Aro >C7-C8 (w)	µg/l	1	<1	<1	<1	<1	700	WHO DWS Toluene		

Aro >C8-C10 (w)	µg/l	5	22	18	5	7	300	WHO DWS Ethylbenzene		
Aro >C10-C12 (w)	µg/l	5	5	7	6	7	100	WHO DWS		
Aro >C12-C16 (w)	µg/l	5	8	18	<5	9				
Aro >C16-C21 (w)	µg/l	5	19	57	6	19	90	WHO DWS	2	2.39
Aro >C21-C35 (w)	µg/l	10	56	158	31	117				
Total Aromatics (w)	µg/l	10	110	257	48	159	1191			
TPH (Ali & Aro >C5-C35) (w)	µg/l	10	206	510	60	277	1791			
BTEX - Benzene (w)	µg/l	1	<1	<1	<1	<1	1	UK DWS		
BTEX - Toluene (w)	µg/l	1	<1	<1	<1	<1	700	WHO DWS		
BTEX - Ethyl Benzene (w)	µg/l	1	<1	<1	<1	<1	300	WHO DWS		
BTEX - m & p Xylene (w)	µg/l	1	<1	<1	<1	<1	30	EQS Fresh		
BTEX - o Xylene (w)	µg/l	1	<1	<1	<1	<1	30	EQS Fresh		
MTBE (w)	µg/l	1	<1	<1	<1	<1		NS		

Italics - Surface Water

Table 8.1: Water Chemical Assessment

8.1 Soils Assessment

Risk Assessments in accordance with CLEA Guidelines, are undertaken on the basis of the assessment of the linkages between Source-Pathway-Receptor. Where one of these does not exist, then there is no perceived risk of contamination.

SBS believe this to be a commercial development, however NPT have suggested it needs to be assessed as a Residential scheme, as it is not closed to the public. Thus, SGS have assessed in both Residential without Plant Uptake, and Commercial Models.

a) Commercial

Based upon the results obtained herein, as shown in Appendix H, there would not appear to be a SOURCE, due to the fact that none of the contaminant values exceed current assessment criteria.

However, samples from TP28, 29 and WS12A (at the south extremes of the site) contained loose fibres of Chrysotile asbestos.

Thus, as the asbestos occurrences occurrence were localised, hotspot removal is recommended, together with an asbestos management plan for ongoing groundwork, due to the potential for re-occurrence at the site.

b) Residential Without Plant Uptake

Comparing the laboratory testing results with current SGVs for a Residential Without Plant Uptake model indicates exceedances of:

- Arsenic,
- Lead,
- Benzo(a)pyrene
- Dibenzo(ah)anthracene

SGS consider this site development to be a Commercial one. However, should the Local Authority insist that the scheme is to be considered as Residential, then it may be that a capping design is required, which could be incorporated into the surface treatment of the site.

Samples from TP28, 29 and WS12A (at the south extremes of the site) contained loose fibres of Chrysotile asbestos.

Thus, as the asbestos occurrences occurrence were localised, hotspot removal is recommended, together with an asbestos management plan for ongoing groundwork, due to the potential for re-occurrence at the site.

8.2 Waters Assessment

Values of chemical compounds recorded during the laboratory testing, have been compared to current standards and guidelines, as shown in Table 8.2. Most current guidelines relate to drinking water standards, or where these are absent, to surface water standards.

It is clear that the perched waters at the site have some degree of contamination.

WS05 has elevated concentrations of dissolved cyanide and arsenic, elevated PAH values and “heavy” aromatics. Though total Aromatics do not exceed guidelines.

WS12A noted elevated dissolved cyanide and arsenic and “heavy aromatics”. Similarly to WS05 total Aromatics do not exceed guidelines. In general these would be classed as “mineral oils”.

9.0 COAL MINING RISK ASSESSMENT

A Coal Mining Risk Assessment CMRA has been undertaken for the site, by GIL, during 2017 (report P1266-01) and is included within Appendix F. Based upon that CMRA, the following comments are considered relevant.

Based on the information presented within the GIL CMRA, the following conclusions can be drawn in respect of the of shallow coal mine workings beneath the site and associated subsidence risk.

Geological maps and Coal Authority records show the *Brithdir Coal* (also known as *Tillery Rider No. 2*) cropping out in the south of the site. As the rock strata dip to the north, probably at angles of between 22° and 45°, the *Brithdir Coal* is likely to be present at shallow depth beneath a substantial area of the site north of its outcrop. Information relating to the *Brithdir Coal* in the area is sparse, but the information that has been found suggests that its thickness could be between 0.50 m and 1.75 m.

None of the information consulted gives any indication that the *Brithdir Coal* has been worked in close proximity to the site. It is also significant that all workings in the wider area, which are known to the Coal Authority or shown on either geological or historical maps, lie beyond either the unnamed fault to the east or *Giant's Grave Fault* to the west. There is no evidence of any workings within the triangular shaped fault block that encompasses the low lying area on the valley floor where the site is located.

Given the site's topographical and geological setting in an area of superficial Tidal Flat Deposits on the valley floor at low-lying elevations of between 5 and 6 mAOD, it is unlikely that early mining operations pre-dating the 1870s/1880s Ordnance Survey maps would have tackled the challenges of sinking shafts through soft, water-bearing superficial strata when easier access to the coal was possible on the elevated valley sides. In summary, the desk study information indicates that the *Brithdir* is likely to be the only shallow coal beneath the site. Whilst this seam has been worked in the wider area, there is no evidence of any shallow workings have taken place in the *Brithdir* local to the site or within the fault block where the site is located.

Based on the findings of this desk-based assessment, it is our opinion that the *Brithdir* is highly unlikely to have been worked beneath the site and that the risk of subsidence associated with shallow coal mine workings is extremely low. It is therefore concluded that no further assessment of mining subsidence risk is warranted in the context of the proposed development and that no special foundation measures in respect of mining subsidence risk are necessary.

In order to confirm that the above conclusion is consistent with the expectations and requirements of other stakeholders (such as regulators, warranty providers, funders, etc.), it is advised that all relevant parties be consulted prior to final decision making.

10.0 CONCLUSIONS AND RECOMMENDATIONS

The conclusions and recommendations of this report have been compiled based on our general understanding of the site, previous reports, information available at the time of writing and the written conceptual model presented.

The desk study information has detailed that the dominant land use at the site in Briton Ferry has been as open fields and private garages, with the land to the immediate south as a gas works. That Gas work related industry has spanned approximately 100 years. The site layout has changed some-what over this period, with areas to the south and east of the site being replaced by residential housing. However, it remains clear that the primary source of contamination in the area of this site is likely to be due to the Gas Work industry.

The Residential Without Plant Uptake assessment of the site has indicated that direct contact, ingestion and inhalation of contamination by the occupants of the site is a potential pollutant linkage, particularly with regards asbestos fibres. It is considered that this risk can be mitigated by hot-spot removal and an asbestos management plan. If the site cannot be classified as Commercial, then it may be that the Local Authority will require a capping design undertaken. Groundworkers should be made aware of the asbestos risks and those associated with heavy metal (arsenic and lead) contamination. Foundations for garages with anticipated low loadings should be kept above the water table.

Additional to risk to human health and third-party property the soil and groundwater conditions present beneath the residential properties may also pose a risk to groundwater in the Glacial Deposits. However, this investigation has noted what appears to be an absence of Glacial Deposits. In addition, the Clays and Peats between the Made Ground and the weathered bedrock will act as an aquiclude, preventing downward migration of contaminants. SGS recommend the borehole wells be decommissioned in accordance with NRW Guidelines.

The test results indicate that contamination of the water is not site-wide and appears to be in perched zones. Indeed, given the direction of groundwater flow, the elevated values at WS05 would be expected at the southern boundary – which has not been found to occur. Thus, it is likely to be a discrete perched water with little chance of lateral migration.

Migration of dissolved contaminants to surface water is considered to be unlikely, as the direction of movement would be through the former gas works, which have been previously remediated, and which therefore would likely attenuate the contaminants.

Thus, the asbestos hot spot removal is considered to be the required remediation at site. This, plus possibly a capping design. Once that removal has been undertaken, a verification report will be required to demonstrate that the hotspot has been remediated.

The CMRA indicates that there is low risk of past Coal working beneath the site, at depths which would affect or inform foundation choice.

APPENDIX A

Drawings

Site Location Plan

Drawing SGS/2012/01

Exploratory Hole Location Plan

Drawing SGS/2012/02

APPENDIX B

Window Sample Logs

WS01 to 12a and TP20 to 30

APPENDIX C

Laboratory Test Results

Soil Chemical Testing

Water Chemical Testing

APPENDIX D

Photographs

WS01 to 12a

TP20 to 30

APPENDIX E

GAC Derivations

DERIVATION OF GENERIC ASSESSMENT

Soil Assessment

In accordance with current UK guidance on legislation including Part 2A of the Environmental Protection Act 1990, and based on the principles of risk assessment, Spectrum Geo Services has derived generic criteria for interpretation of soil and groundwater chemical analysis (Spectrum Geo Services Generic Assessment Criteria – SGS GAC). The assessment of chemical data from an intrusive investigation is undertaken in a tiered approach, the first stage being a Generic Quantitative Risk Assessment (GQRA).

The Soil Guideline Values (SGVs) for 11 compounds published by the Environment Agency, are based upon a sandy loam soil with 6% soil organic matter (SOM). The 6% SOM and sandy loam soil type, is not considered by Spectrum Geo Services to be realistic of “typical” UK soil conditions, and EA guidance states that at 6% SOM, SGVs may not be sufficiently protective (ie the values are too high to be sufficiently certain that they describe land where there is no risk to human health or the risk is negligible). For the Spectrum Geo Services GAC, all the SGV inputs have been used apart from the SOM and soil type, which were amended to 1% and sand: thereby ensuring a suitably conservative Spectrum Geo Services GAC appropriate for most soils and Made Ground encountered in the UK. It is noted that none of the screening criteria used in the UK, including the SGVs, have a statutory basis.

The Spectrum Geo Services GAC for soil assessment are based on the generic scenarios outlined in the Contaminated Land Exposure Assessment (CLEA) methodology and guidance documents, and include inhalation, ingestion, dermal contact of soil and dust as pathways for commercial and residential scenarios; as well as ingestion of home grown produce for residential with gardens scenarios. These have been calculated by use of two proprietary risk assessment models (CLEA Version 1.06 and the ASTM RBCA¹ Tool Kit Version 2.6 for Chemical Releases) which have been altered, where necessary, to reflect the current UK approach to human health risk assessment as set out in the Contaminated Land Report (CLR) 11 and the CLEA guidance documents (incorporating Science Reports SC050021/SR2 (January 2009), SR3 (January 2009), SR4 (September 2009) and SGV Reports (2009)). The physiochemical data has been taken from or derived using the methodology detailed in SR7 (November 2008), and SGV reports (2009), where feasible. The toxicology data has been taken from the current published EA toxicology documents. We have referred to all publications and guidance issued up until the 10 April 2012.

In the absence of published EA data, reference has been made to the following sources of information in order of priority:

- Chartered Institute of Environmental Health (CIEH)/Land Quality Management (LQM) (Version 2 dated 2009) GAC, including addendums up until 10 April 2012).
- Contaminated Land: Applications in Real Environments (CL:AIRE) and partners GAC, including addendums up until 10 April 2012.
- Other published sources of information, such as the RBCA V2.6 database.

This approach by Spectrum Geo Services follows the withdrawal of CLR 7-10, CLEA UK (beta), CLEA V1.04 and CLEA V1.05 by the Environment Agency and DEFRA. The approach has been applied to all

contaminants with the exception of lead, as the lead SGV has been withdrawn by the Environment agency.

The Part 2A revised Statutory Guidance created the need for new technical tools and advice to be developed to help regulators and others to conform to the requirements of the guidance. This led to a Defra-funded research project (SP1010), which developed a methodology to derive Category 4 Screening Levels (CS4Ls) for six contaminants (benzo-a-pyrene, cadmium, arsenic, benzene, hexavalent chromium and lead). The C4SLs are less conservative than GAC as they describe a low risk as opposed to minimal risk scenario. However, consistent with the developed GAC, sites below the C4SLs are within Category 4 (lowest risk category) and therefore suitable for use.

Defra's Policy Companion document to the SP1010² project states that where the C4SL value has been derived for a contaminant where an SGV exists, it is anticipated that risk assessors will use the C4SL value in line with Part 2A statutory Guidance. In the absence of a suitable C4SL, risk assessors should identify and select appropriate generic assessment criteria in accordance with established good practice. On this basis, Spectrum Geo Services has adopted the use of C4SLs for the six contaminants for which they are available and will apply in holuse GAC for other contaminants of concern within our screening assessments.

¹ American Society for Testing Materials – risk Based Corrective Action Model

² SP1010: Development of Category 4 Screening Levels for assessment of Land affected by Contamination – Policy Companion Document, Defra, revised December 2014.

APPENDIX F

Coal Mining Risk Assessment

APPENDIX G

Phase 1 Data

APPENDIX H

Soil Chemical Testing SGV Assessments

Residential Without Plant Uptake

Commercial