

**GEOENVIRONMENTAL ASSESSMENT
FORMER ST TYDFIL HOSPITAL
MERTHYR TYDFIL
ST TYDFILS DEVELOPMENTS LLP
GEA-21988-21-80
JUNE 2021**

The IDom logo is displayed in white text on a dark blue background. The letters 'IDom' are in a sans-serif font, with the 'I' and 'D' being uppercase and the 'o' and 'm' being lowercase. The background of the entire page is a dark blue gradient with a faint, abstract pattern of light blue and white lines.

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EXECUTIVE SUMMARY

A Geo-Environmental Assessment was requested by St Tydfils Developments LLP. The purpose of the assessment was to identify any contaminative or geotechnical issues associated with former land use at *Former St Tydfil Hospital, Merthyr Tydfil* which might impact on the site's redevelopment.

SITE DETAILS	
Approximate site area	2.12 ha
Current use / historic use	Previous buildings demolished and stored as sorted and unsorted stockpiles / historically hospital site with laundry and boiler room.
Proposed use	Redevelopment as residential properties with gardens.
PHASE 1 NON-INTRUSIVE INVESTIGATION	
Expected geology	Made ground / Glacial Till / Sandstone within Lower Coal Measures
Groundwater	Secondary aquifer in Superficial Till, Secondary A aquifer in Lower Coal Measures / no known abstractions or SPZs
Surface water	No surface waters identified.
Other	Possibility of naturally occurring gas from coal measures.
PHASE 2 EXPLORATORY INVESTIGATION	
Ground Conditions	Stockpiles of sorted 6F2-sized material and unsorted black-grey gravelly to bouldery clay of demolition waste. Strata included made ground of gravels and clays overlying natural clay to silty sandy gravelly clay, rarely gravel or sand.
Contamination	Lead, PAH and asbestos contamination sporadic across the site. Low risk gas regime. Locally hydrocarbon impacted groundwater.
Geotechnical issues	Variable thicknesses of made ground and consistently weak natural clay soils present across the site.
RECOMMENDATIONS	
Geotechnical	Traditional shallow strip / trench footings are not considered to be suitable, therefore alternative solutions such as rafts, ground improvement and piles will need to be adopted. Buried concrete classes DS-1 and AC-1 will apply to new foundation concrete. For the preliminary design of roads and hardstanding areas, a CBR value of 9 % can be adopted in the shallow predominantly granular made ground.
Remediation	Remedial actions should be reviewed following ground engineering works/obstruction removal/stockpile clearance. Generally, provide 600 mm of clean soil in gardens. Remove/remediate visible hydrocarbon contamination if found.
Waste classification	Made ground – non-hazardous. Stockpiles, one hazardous occurrence of hydrocarbons. Buk visible asbestos would render host materials hazardous.

Re-use of site-won materials

Materials Management Plan should be produced to allow import of clean soil and re-use of suitable site-won arisings prior to development.

SECTION 1 INTRODUCTION

- 1.1 St Tydfils Developments LLP proposes to develop an area of land located on the site of the Former St Tydfil Hospital for residential development purposes. From a Spring Design planning drawing, the proposed development comprises 70 dwellings arranged as: eight dwellings in a single apartment block and the remainder as single and double plots with gardens. IDOM Merebrook Limited (IDOM) has been commissioned by St Tydfils Developments LLP to undertake preliminary site investigation works and to advise on the geo-environmental implications of the redevelopment of the site for the proposed end use.
- 1.2 The objectives of the investigation are to:
- i.* Assess surface and sub-surface ground conditions present at the site;
 - ii.* Identify hazards associated with ground contamination which may place constraints on the site and the proposed development;
 - iii.* Evaluate the risks associated with any identified hazards;
 - iv.* Provide preliminary recommendations for the mitigation of any significant risks identified; and
 - v.* Provide preliminary geotechnical recommendations.
- 1.3 A Phase 1 Desk Study (Non-intrusive Investigation) has previously been prepared by IDOM for St Tydfil's Developments LLP in August 2020, reference DS-21988-19-321, the findings of which are summarised as Section 2 of this report. A Phase 2a (Preliminary Exploratory Investigation) has now been undertaken to allow preparation of a geo-environmental assessment of the subject site.
- 1.4 This report presents the findings of the geo-environmental investigation and provides an interpretation of the geo-environmental conditions that exist at the site. The contaminative status of the site and the implications with respect to development have been interpreted in accordance with the current government guidance on source-pathway-receptor risk assessment. This report uses a Tier 1 risk assessment to ascribe a conservative qualitative appraisal of the hazards associated with the site.
- 1.5 This report has been prepared for St Tydfils Developments LLP for the sole purpose described above and no extended duty of care to any third party is implied or offered. Third parties making reference to the report should consult St Tydfils Developments LLP and IDOM as to the extent to which the findings may be appropriate for their use.

SECTION 2 PHASE 1 (NON-INTRUSIVE INVESTIGATION)

2.1 INTRODUCTION

- 2.1.1 IDOM were commissioned in July 2019 to undertake a Phase 1 (non-intrusive investigation) and later revised in August 2020 with the report reference DS-21988-19-321 RevA. This section will summarise the aforementioned report, which should be referenced for additional information.

2.2 SITE LOCATION AND SETTING

- 2.2.1 The site is located approximately 150 m east of Merthyr Tydfil High Street and immediately west of the Thomastown Park Recreation Ground. The access to site is along Upper Thomas Street and along the tarmacked road on the southern side of a small public park.
- 2.2.2 The site occupies an area of approximately 2.12 hectares located at National Grid Reference SO 05168 06442.
- 2.2.3 The site is bounded by Thomastown Park Recreation Ground to the west. To the east is open public space and residential buildings. To the north and to the south of the site are residential terraced houses.
- 2.2.4 During Phase 1 walkover completed on 9 July 2019, the majority of the site had undergone demolition works and the space was occupied by stockpiles, with some buildings remaining in the southwest of site. Some screening/crushing of demolition materials appeared to have taken place in several areas however the components were deemed to require additional processing to meet gradings for materials classification. The remainder (and dominant portion) of the piles comprised apparently unprocessed materials containing large concrete, wood, metal, plastic, rubber, glass and other materials. From the previous desk study investigation, it is known that crushing and processing of demolition materials was required to be halted by the local authority due to the presence of asbestos.
- 2.2.5 Evidence of potential contamination included suspected asbestos cement fragments and fibrous materials noted lying across the surface of site, suspected lagged pipes in ducts, and a banded material suspected as being related to fuel storage tanks. In addition, Japanese knotweed was noted in two areas on the eastern site boundary.
- 2.2.6 The site rises in elevation to the east and it is clear that the former hospital site was on various levels with retaining structures and sloping roads. The most marked level difference is the raised westerly area which was most recently used as a parking area and held an assumed fire water tank.
- 2.2.7 Surrounding land use includes housing to the north, north west, south and south west; a recreation ground including tennis courts to the east; and a former cemetery now laid out as a park to the west.

2.3 SITE HISTORY

- 2.3.1 The site history, based on a review of the historic and current maps, dating from 1875 to 2014 is summarised as follows. Historic plans show that the site was originally in use as a corporation workhouse which incorporated an infirmary. Between 1919 to 1945 the site's principal use became a district hospital, with fuel tanks and outhouse buildings noted including a Laundry and Boiler House. Demolition occurred in approximately 2014 and some processing was carried out.
- 2.3.2 Off-site, within 50 m there was a cemetery, a brewery and a works located on the maps which may be potential sources of contamination. Additionally, possible mineral working spoil indicators were noted on early maps.
- 2.3.3 Given the nature of the historical mapping process (scale, representation of conditions at discrete time intervals frequency *etc.*), any such maps and plans may not provide a comprehensive account of a site's history. Identification of pertinent land uses and associated potentially contaminative activities, may therefore be absent from mapping records.

2.4 GEOLOGY

- 2.4.1 The British Geological Survey (BGS) online viewer indicates the presence of superficial drift deposits of Devensian Till (Diamicton).
- 2.4.2 The underlying bedrock geology comprises of South Wales Lower Coal Measures Formation. This comprises sequences of coal-bearing mudstones/siltstones with seatearths and sandstone units. The online mapping from the BGS shows a sandstone unit underlies the superficial deposits.
- 2.4.3 One borehole log published online by the BGS indicates lower coal measures encountered to approximately 25 m below ground level (bgl). Other nearby boreholes describe layers of gravel, hard and soft grey mudstone and siltstone consistent with the South Wales Lower Coal Measures.
- 2.4.4 From historical map evidence there is potentially infilled land due to cemetery along the western border. There are also areas of potentially infilled land immediately to the east of the site with a borehole logs from 1986 located to the school indicating the presence of possible spoil or worked ground.

2.5 HYDROGEOLOGY

- 2.5.1 The superficial Devensian Till deposits on site are classified by the Environment Agency as a Secondary Aquifer with undifferentiated layers. The bedrock South Wales Lower Coal Measures is classified as a Secondary (a) Aquifer with permeable layers.

- 2.5.2 No source protection zones or groundwater abstraction licences were identified within 500 m or 1 km, respectively, of the site.

2.6 **HYDROLOGY**

- 2.6.1 The Nant Morlais located 250 m east west of the site, flows northeast to south west, and is a tributary of the River Taff located 600 m west of the site. There are no surface water abstraction licences within 1 km of the site.

- 2.6.2 The site itself is not located in an area identified by Natural Resources Wales as being at risk of flooding from rivers and the sea (RoFRaS), although there is a medium flood risk area 18 m west of the site.

- 2.6.3 British Geological Survey groundwater flooding susceptibility areas have been identified within 50 m of the site boundary. Further consideration of groundwater flooding should be made as part of a flood risk assessment as the areas are close to the site boundary.

- 2.6.4 The site is located in an area identified by the British Geological Survey as having a potential at surface for groundwater flooding. The BGS indicates there is potential at the surface for groundwater flooding to occur, meaning that the groundwater flooding hazard should be considered on all land-use planning decisions. The confidence rating in this classification is, however, low.

2.7 **COAL MINING**

- 2.7.1 The site is not shown to be within a High Risk Development Area. Such areas are defined by the presence of coal resources and workings including: coal outcrops, recorded past shallow workings and probable shallow workings, surface/opencast workings, mine entries (shafts and adits).

2.8 **CURRENT SITE ISSUES**

- 2.8.1 Potentially significant environmental issues have been investigated within relevant distances of the site are outlined in DS-21988-19-321 RevA. A brief summary is outlined below:

- i. Multiple water discharge or pollution incidents were identified but deemed unlikely to have affected site;
- ii. There are no records of waste management sites within 250 m of site;
- iii. There are no records of any statutory authorisations within 50 m site;
- iv. An electrical substation and tank were identified onsite, with two additional entries noted within 50 m of site. All were deemed unlikely to affect the contaminative status of site;

- v. There are no recorded special protection or conservation areas within 50 m of site.

2.8.2 Data provided by the British Geological Survey (BGS) on six natural ground stability hazards have been assessed. The maximum hazard rating of each risk was identified as negligible to very low, except for Landslides which had a hazard rating of very low to moderate risk.

2.8.3 The site does not lie within a Radon Affected Area as defined by the former Health Protection Agency or Air Quality Management Area (AQMA).

2.8.4 There are no potentially relevant ecological receptors as indicated from information from environmental and ecological datasets was obtained from a review of the MAGIC (Multi-Agency Geographic Information for the Countryside) website and the Groundsure report.

2.9 PREVIOUS INVESTIGATIONS

2.9.1 No previous ground investigation data is known or has been provided for this site.

2.9.2 An asbestos survey was carried out on structures in 2012 by Santia Asbestos Management Ltd (Santia). At the time of the Desk Study, Santia was unable to provide a copy of the full report but advised that if the Health Authority permits, the report would be made available.

2.9.3 The asbestos register shows that asbestos was present in the structures in a number of forms including bitumen, vinyl floor covering, gasket and cement sheet. The majority of materials identified were assessed as "very low" or "low" risk materials in the context of continued use of the structures at the time. A number of low and medium risk materials were found including: lagging, gasket, insulating board and rope which have the potential to generate significant levels of airborne fibres if disturbed.

2.9.4 An ecological survey has been undertaken at the site. Two stands of Japanese Knotweed were confirmed on the eastern boundary of the site.

2.9.5 As part of the Phase 1 site appraisal undertaken by IDOM in 2019, a number of potentially asbestos containing materials were observed at the site surface. Bulk samples were collected and submitted to a UKAS / MCERTS accredited laboratory for analysis. Results of the analysis are reported in IDOM report DS-21988-19-321 RevA.

2.10 PRELIMINARY CONCEPTUAL SITE MODEL AND RISK ASSESSMENT

2.10.1 From the Phase 1 assessment a preliminary site conceptual model and risk assessment have been produced using the framework established in Part IIA of the

Environmental Protection Act 1990 and detailed in Contaminated Land Report CLR11 - Model Procedures for the Management of Land Contamination.

- 2.10.2 Risk from contamination has been assessed using the source-pathway-receptor and pollutant linkage methodology, whereby a risk can only exist if all elements of: source, pathway and receptor, are present.
- 2.10.3 The following land uses have been identified as potential sources:
- i. Fuel storage associated with heating/ emergency backup generation;
 - ii. Asbestos containing materials associated with former construction and demolition materials;
 - iii. Medical waste;
 - iv. Gas from coal measures and any made ground that may be present;
 - v. Other unknown contaminants arising from site use; and
 - vi. Drug paraphernalia.
- 2.10.4 The following potential pathways are identified:
- i. Airborne exposure to particulates especially asbestos; and
 - ii. Migration of liquid/ soluble contaminants vertically and horizontally.
- 2.10.5 The following receptors are identified under the current use:
- i. Illegal users of the site;
 - ii. Neighbours and neighbouring land; and
 - iii. Sensitive water courses/ bodies.
- 2.10.6 In the case of the proposed development the following additional receptors are identified:
- i. Construction workers; and
 - ii. Future site users/ Residents.
- 2.10.7 From the Phase 1 assessment a preliminary site conceptual model has been produced as Table 4 which identifies the potential pollutant linkages. These have been used to inform the Phase 2 intrusive investigation presented in the subsequent sections.

Table 4: Preliminary Conceptual Model from Phase 1 (non-intrusive) Study.

POSSIBLE POLLUTANT LINKAGE			RISK CHARACTERISATION
POTENTIAL SOURCES	PATHWAYS	RECEPTORS	
Asbestos in soil/ material piles	Airborne exposure	Neighbours/unauthorised members of public accessing site	Low Risk identified without disturbance to material present, dust generation is considered to be low.
		Construction Workers & neighbours.	Moderate to high risk identified Potential for dust generation to occur during site works
		Future Residents	Moderate risk identified to users from exposure to contaminated garden soils
Hydrocarbons	Contact with contaminated soil/ water	Neighbours/unauthorised members of public accessing site	Low risk identified Low potential for onsite spills and for hydrocarbons to impact offsite sources.
	Contact with contaminated soil/ water	Future residents and construction workers)	Low to Moderate risk Construction workers are initially at the greatest risk. Potential for made ground to contain hydrocarbons.
	Migration to sensitive water body	Groundwater/ surface water	Low to Moderate risk identified Potential for made ground to impact groundwater. No surface water features located within the vicinity.
	Contact	Services/ pipes	Moderate Risk identified Potential for made ground to contain Hydrocarbons. Cannot be ruled out at this time.
Medical clinical waste/ drug paraphernalia	Direct exposure	Unauthorised public access of the site. Construction workers	Moderate Risk identified Items have been identified onsite during site walkover. Greatest risk identified during site works.
		Future residents	Low to Moderate identified Without mitigating measures, potential for worked ground to contain materials identified.
Hazardous Gas/Vapours In soil	Ingress into buildings and voids	Future residents	Moderate risk identified Potential for natural geological gas sources from coal measures. Cannot rule out fuel spillages as source of vapours
Adjacent Land	Horizontal migration through made ground materials	Future Residents and Offsite Receptors	Moderate Risk identified Cannot rule out the potential for made ground to impact offsite land uses.

SECTION 3 SITE INVESTIGATION RATIONALE

3.1 INTRODUCTION

3.1.1 A site investigation rationale has been devised in accordance with the findings of the Phase 1 investigation and the resultant preliminary conceptual site model and risk assessment. The scope of the investigation was to investigate and categorise the various stockpiles across the site, complete trial pitting with soakage tests, CBR plate load tests, window sampling and deep boreholes.

3.1.2 Intrusive sampling locations were chosen on the basis of providing broad spatial coverage of the site while also providing insight into the compositions of the demolition material within stockpiles.

3.2 SITE INVESTIGATION METHODS

3.2.1 An intrusive investigation was carried out by IDOM on 01 to 10 February 2021 and comprised the following scope of work:

- i. Three rotary drilled boreholes (MBH01 to MBH03) to depths of 9.20 to 15.00 metres below ground level (m bgl) to obtain in situ geotechnical test data and allow installation of groundwater monitoring pipes;
- ii. Four of a proposed six shallow windowless sample probe holes (MWS02, MWS03, MWS05 and MWS06) to a maximum depth of 4.20 m bgl to obtain in situ penetration test data and allow installation of pipes for ground gas monitoring. Locations MWS01 and MWS04 were not undertaken due to limited access;
- iii. 13 machine-dug trial holes (MTP01-MTP13) excavated to a maximum depth of 3.80 m bgl for the purpose of observing shallow ground conditions and obtaining soil samples for laboratory analysis;
- iv. Nine machine-dug soakage test pits (MSP01-MSP09) excavated to a depth of 2.00 to 2.62 m bgl;
- v. 10 California Bearing Ratio (CBR) tests (CBR01-CBR10) undertaken in shallow test pits excavated to a maximum depth of 0.80 m bgl for roads and pavement design;
- vi. 33 machine-dug trial holes were excavated as part of a Stockpile Audit, either into the top or side of each stockpile onsite.

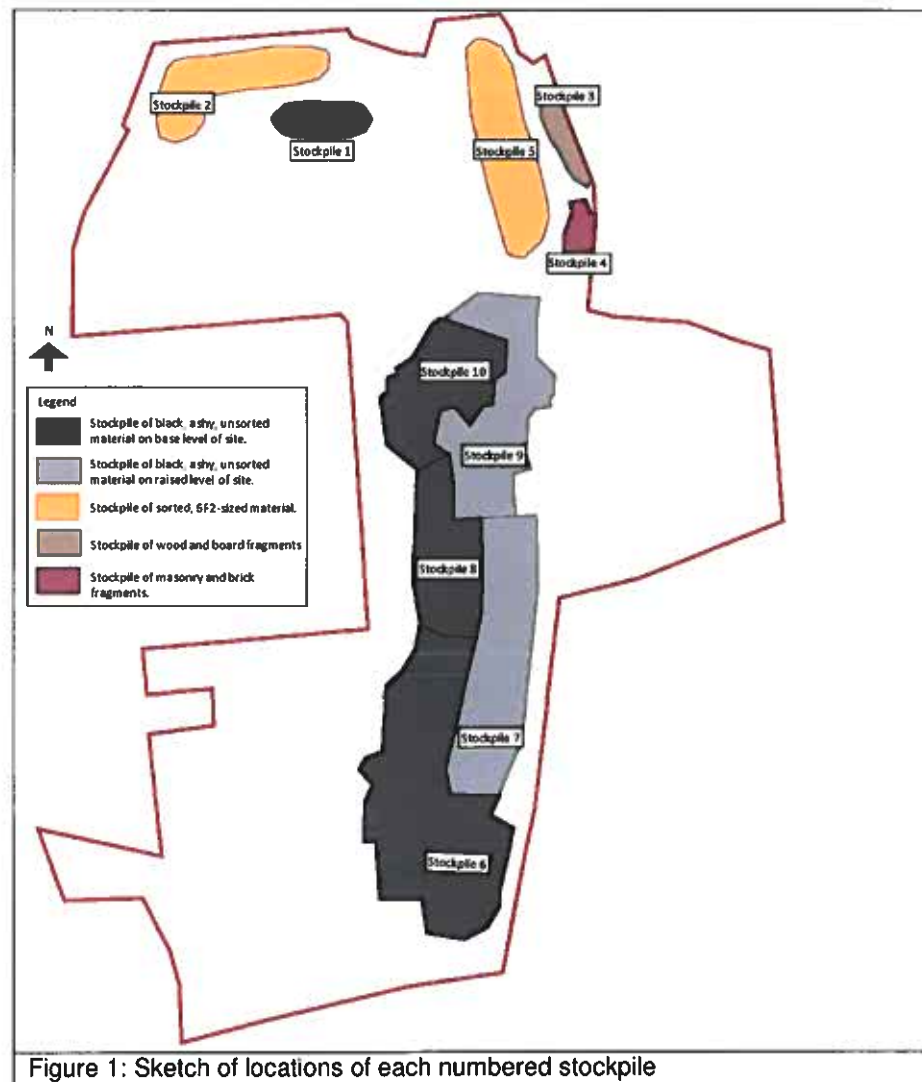
3.2.2 Exploratory hole locations are indicated on drawing 21988-304-001 in Appendix 1. Logging of exploratory holes was undertaken by a IDOM engineer. Exploratory hole logs are contained in Appendix 3.

- 3.2.3 A combined percussive/rotary drilling rig with Odex casing system was used to advance boreholes MBH01 to MBH03. Percussive methods advanced holes to depths of 4.0 to 8.1 m bgl and continued with rotary drilling in solid rock to a depth of 9.2 to 15.0 m bgl.
- 3.2.4 Standard Penetration Tests (SPTs) were performed at approximate 1 metre intervals. The tests involved driving a steel cone tipped series of rods into the ground over a distance of 450 mm using the repeated blows of a 63.5 kg weight allowed to free fall over a distance of 760 mm. The total number of blows required for the final 300 mm penetration (the 'N' value) is recorded on the window sample logs.
- 3.2.5 Monitoring pipes of 63 mm OD, comprising an upper 1m section of plain pipe with slotted pipe and gravel filter pack below 1 m, were installed in all three boreholes to allow ground gas and water sampling. Installations were to the depths listed below:
- i.* MBH01 installed to a depth of 6.00 m bgl,
 - ii.* MBH02 installed to a depth of 6.00 m bgl,
 - iii.* MBH03 installed to a depth of 6.00 m bgl.
- 3.2.6 A tracked windowless sampling rig was used to advance MWS02, MWS03, MWS05 and MWS06. This comprised a rig-mounted drop hammer to drive a hollow steel barrel into the ground. The barrel is recovered along with a removable plastic sleeve, which lines the barrel and holds a core of soil which is retracted for logging and sampling. SPTs were performed at approximate 1 m intervals in all windowless sample holes.
- i.* MWS02 installed to a depth of 4.00 m bgl,
 - ii.* MWS03 installed to a depth of 3.00 m bgl,
 - iii.* MWS06 installed to a depth of 2.60 m bgl,
 - iv.* MWS05 was not installed and backfilled with arisings.
- 3.2.7 Representative soil samples were taken from various depths and strata to assess the contaminative status of the site. Soil samples were submitted to an MCERTS/UKAS accredited laboratory for chemical analysis of a broad suite of potential contaminants. The results are provided in Appendix 4.
- 3.2.8 A programme of geotechnical laboratory testing was performed on selected soil samples obtained from the boreholes, comprising classification and strength tests. Chemical testing was also undertaken to assess the aggressiveness of the ground with respect to buried concrete. The results are provided in Appendix 5.

SECTION 4 STOCKPILE AUDIT

- 4.1 A detailed audit of the stockpiles was undertaken from 01 to 03 February 2021. The aim was to sample and log trial pits excavated into the top or sides of each stockpile. Figure 1 (below) shows a sketch of the approximate extent and location of each numbered stockpile identified by the walkover, with a description of the composition of each stockpile outlined in the following sections. A photographic record of the stockpile audit is included as Appendix 2. Discussion of the possible waste category of the stockpiled materials and considerations for re-use or disposal are presented in Section 7.4.
- i. Stockpile 1: Visually unsorted demolition waste. Black-grey ashy clayey slightly sandy cobbly gravel made ground containing fine gravel to boulder-sized fragments of concrete, brick, wood, pipes, tiles, slate, polystyrene, linoleum and rare asphalt and tile with bituminous coating on base.
 - ii. Stockpile 2: Sorted and crushed demolition waste. Surface is light with brown-blackish slightly clayey gravel made ground containing fine gravel to cobble-sized fragments of wood, concrete, wire, plastic strips and tile.
 - iii. Stockpile 3: Unsorted demolition material. Fragments of wood, wood flooring boards, orange foam, red foam, thin metal strips and pipes and tile with bituminous coating on base. Slightly organic smelling.
 - iv. Stockpile 4: Fragments of concrete slabs/girders and concrete reinforced with re-bar, red masonry and brickwork, yellow-white brickwork, wood and wood sheeting over in situ tiles and concrete slabs. Part of a window frame remains behind stockpile.
 - v. Stockpile 5: Sorted and crushed demolition waste. Surface is light with brown-blackish slightly clayey gravel made ground containing fine gravel to cobble-sized fragments of wood, concrete, concrete reinforced with rebar, wire, plastic strips and tile.
 - vi. Stockpile 6: Unsorted demolition material. Brown-black-grey ashy clayey slightly silty gravelly cobbles and boulders made ground containing fragments of brick, concrete, concrete reinforced with rebar, metal pipes, ceramic tiles, plastic strips, rebar, blue tiles, wire, glass, tiles with bituminous coating on base and asphalt. Rare fragments include one tank containing gravel covered in black, iridescent, and with strong hydrocarbon odour.
 - vii. Stockpile 7: Unsorted demolition material. Brown-black ashy clayey gravelly cobbles made ground containing fragments of medium to coarse gravel to cobble-sized brick, concrete, concrete with rebar, concrete slabs, wood and burnt wood, decorative stone, white tile, porcelain, and metal pipes. Stockpile 7A identified asphalt over clayey gravel made ground containing medium to coarse gravel-sized fragments of concrete, brick and roadstone overlying natural soft brown-orange clay at 0.76 m bgl.

- viii. Stockpile 8: Unsorted demolition material. Brown-black clayey gravelly cobbles made ground containing fragments of medium to coarse gravel to cobble-sized brick, concrete, white ceramic and plastic tile, masonry with mortar, burnt wood and rebar. This stockpile is base-level of site and natural brown clay to gravelly clay was encountered below made ground. Additional scrapes into the bank exposed to the west of Stockpile 8C identified an area of natural slightly sandy clay with coarse gravel to cobbles of mudstone.
- ix. Stockpile 9: Unsorted demolition material. Brown-grey clayey slightly silty gravelly cobbly boulders made ground containing medium to coarse gravel to boulder-sized metal, concrete, brick, rebar, plastic, fabric, wood, asphalt, concrete reinforced with rebar, plastic, and metal pipes with concrete slabs towards base in some areas. Natural ground was encountered in three pits between 0.2 to 2.1 m below the stockpile surface towards the rear of the stockpile and the site's eastern retaining wall.
- x. Stockpile 10: Unsorted demolition material. Black-brown-grey clayey gravelly cobbly boulders made ground containing fragments of fine to coarse gravel to boulders of brick, copper cables, concrete, wood, roofing slate, concrete with rebar, rebar, masonry with mortar and metal pipes. Natural orange-brown clay was encountered below made ground in three pits, at a depth of between 1.0 to 4.5 m below the stockpile surface.



4.2 ASBESTOS DETECTION IN STOCKPILES

4.2.1 From the current investigation, evaluation of the asbestos contamination within stockpiles included, firstly, sampling of visible bulk fragments of suspected asbestos containing material (ACM) and analysis for their asbestos content. The results are discussed in the section following immediately. Secondly, analysis of 31 samples of the fine fractions from stockpiles for laboratory microscopic analysis of asbestos as non-visible fragments, loose fibres and fibre bundles and, where present, quantification by weight. The results from this part of the assessment are summarised in Table 5.

4.2.1.1 Asbestos-containing fragments were identified in the following locations:

- i. Asbestos cement at 1.0 m of Stockpile 6B
- ii. Asbestos cement on surface of Stockpile 6C
- iii. Asbestos cement and asbestos-containing tile on surface of stockpile 7B.
- iv. Asbestos cement on surface of Stockpile 9D.
- v. Green asbestos floor tile on surface near Stockpile 10.

4.2.2 A representative sample of soils was taken from trial pits and submitted for laboratory analysis to detect quantities of asbestos fibres within the stockpile.

4.2.3 Table summarises types of asbestos and fibre quantifications in each stockpile, if detected.

Table 5: Summary of asbestos detected in Stockpile samples.

Stockpile	Sample Name	Depth (m below stockpile surface)	ACM		
			Type	Identification	Total (%)
Stockpile 1	A	1.5	Fibres/Clumps	Chrysotile	0.003
	B	Surface	Fibres/Clumps	Chrysotile	<0.001
	C	1.0	Fibres/Clumps	Chrysotile	0.002
Stockpile 2	A	2.0	Fibres/Clumps	Chrysotile	0.001
	C	1.4	No Asbestos Detected		
	D	1.6	No Asbestos Detected		
Stockpile 3		Surface	No Asbestos Detected		
Stockpile 4	Not Tested				
Stockpile 5	A	2.8	Fibres/Clumps	Amosite	<0.001
	B	2.5	No Asbestos Detected		
Stockpile 6	A	2.0	No Asbestos Detected		
	A	3.5	No Asbestos Detected		
	B	1.6	Fibres/Clumps	Amosite	<0.001
	C	1.6	No Asbestos Detected		
	D	1.8	Fibres/Clumps	Chrysotile	<0.001
Stockpile 7	A	0.6	Fibres/Clumps	Chrysotile	<0.001
	B	1.8	Fibres/Clumps	Amosite/Chrysotile	<0.001
	B	2.9	Fibres/Clumps	Chrysotile	0.001
	C	1.7	Fibres/Clumps	Chrysotile	<0.001
	C	3	Fibres/Clumps	Chrysotile	0.001
Stockpile 8	A	0.9	No Asbestos Detected		

Stockpile	Sample Name	Depth (m below stockpile surface)	ACM		
			Type	Identification	Total (%)
	A	1.4	No Asbestos Detected		
	B (bank)	1.8	No Asbestos Detected		
	C	0.2	Fibres/Clumps	Chrysotile	<0.001
	D	0.4	No Asbestos Detected		
Stockpile 9	A	2.0	No Asbestos Detected		
	B	0.1	Fibres/Clumps	Chrysotile	0.001
	C	0.5	Fibres/Clumps	Amosite	0.002
	E	0.4	No Asbestos Detected		
Stockpile 10	A	0.3	No Asbestos Detected		
	B	0.8	No Asbestos Detected		
	B	1.8	No Asbestos Detected		

4.2.4 Stockpile 4 was not tested for asbestos as the coarse grade of the material made sampling unsuitable. No suspected asbestos-containing fragments were observed.

4.2.5 The remaining stockpiles require further consideration as each had at least one sample of concern, and/or a fragment of asbestos-containing material noted nearby.

- i. Stockpile 6: asbestos cement found on the surface at one location and within stockpile at another location.
- ii. Stockpile 7: asbestos containing tile found on the surface at one location.
- iii. Stockpile 9: and asbestos cement found on the surface.

4.3 CHEMICAL CONTAMINATION IN STOCKPILES

4.3.1 Nine samples of stockpile material were scheduled for analysis of a broad suite of potential chemical contaminants to inform re-use and disposal options. Generally, metallic, inorganic and organic chemical contaminant levels were low. Material from stockpile sampling point 6C was found to contain elevated petroleum hydrocarbons (6100 mg.kg⁻¹) which are likely to reflect the observation of black staining and odours, described in the preceding sections.

SECTION 5 GROUND CONDITIONS

5.1 SURFACE GROUND CONDITIONS

5.1.1 An asphalt access road connects to the locked gate into the public park. This road runs towards the north of site.

5.1.2 The northern portion of site is dominated by black-grey made ground consistent with nearby stockpiles. Although mostly flat, the surface contains coarse sharp fragments

and is uneven. Multiple open inspection chambers and manholes are present, which have had their metal coverings removed. Towards the northern margin of site is a small pile of concrete and rebar next to a concreted slope and area of apparent in situ foundations. Stockpiles 1 to 5 plus a portion of Stockpile's 8, 9 and 10 are located in the north of site. See Plate 1 for an overview of the northern portion.



Plate 1: Panorama photograph lower level northern portion of site's flat topography and location of stockpiles.

- 5.1.3 The majority of the southern area of site was dominated an asphalt court-yard and access road, with areas of concrete and vegetated topsoil and sparse tall trees. The asphalt is smooth and flat with few coarse sharp fragments. The listed buildings are present in the southwestern corner of site and along the southern margin. A small pile of concrete is located on the court-yard area, and Stockpile 6, 7 and 8 are located on the southern portion of site.



Plate 2: Panorama photograph of lower level site showing the asphalt court-yard.

- 5.1.4 The central portion of site is dominated by Stockpiles 7 to 10. To the east of the access road is two areas of in situ concrete slabs or foundations, the northern area is slightly raised. See Plate 3 for an overview of the central portion of site.



Plate 3: Panorama photograph of the centre of lower level of site showing the asphalted road with an area of concrete foundations to the east partially covered in stockpiles.

- 5.1.5 The rear or eastern portion of site is dominated by a sloped asphalted road, connected to the elevated parking area in the east of site. This is an even road, with rare to occasional coarse sharp fragments and uncovered inspection chambers/manholes.
- 5.1.6 The eastern parking area is an even, flat asphalted area with a retaining wall to the east and overgrown topsoil areas around the perimeter.



Plate 4: Panorama photograph of the middle level of site (eastern portion near old tank structure) overlooking the asphalt road and top of stockpiles 6, 7 and 8.



Plate 5: Photograph of eastern parking area.

5.2 SUB-SURFACE GROUND CONDITIONS

- 5.2.1 Sub-surface ground conditions encountered across the site were predominantly made ground underlain by natural strata.
- 5.2.2 A summary of the ground conditions encountered is presented in Table 5, whilst a more detailed assessment of the strata is contained in the following sections of the report.

Table 6: Summary of Sub-surface Ground Conditions for Lower level of Site.

STRATA	DEPTH TO TOP RANGE (m bgl)	THICKNESS RANGE (m)
Made Ground	0.0	0.2 – 2.5
Superficial deposits	0.2 – 2.5	1.2 – 7.7
South Wales Lower Coal Measures	4.0 - 8.1	Base not determined

Table 7: Summary of Sub-surface Ground Conditions for the Middle level of site.

STRATA	DEPTH TO TOP RANGE (m bgl)	THICKNESS RANGE (m)
Made Ground	0.0	0.2 – 2.1
Superficial deposits	0.2 - 0.9	2.3 – 3.7
South Wales Lower Coal Measures	2.8 - 4.5	Base not determined

Table 8: Summary of Sub-surface Ground Conditions for upper level at the eastern car park.

STRATA	DEPTH TO TOP RANGE (m bgl)	THICKNESS RANGE (m)
Made Ground	0.0	0.6 – 2.0
Superficial deposits	0.6	Base not determined

5.2.3 Made Ground

5.2.4 Made ground encountered across the site was variable in thickness and composition reflecting the variability in site elevation and lengthy history of development and demolition. Made ground materials included:

- i. Asphalt and/or concrete surfacing with gravel sub-base layers,
- ii. Loose, rubbly clayey gravelly sand with debris including brick, corrugated metal, pipework, asbestos cement.
- iii. Black clayey gravel to gravelly cobbly coal ash containing fragments of brick, concrete and roadstone,
- iv. Reworked grey to brown very sandy clay with inclusions of plastic and rootlets and black-grey clayey gravel.
- v. Clayey slightly gravelly organic topsoil partially overlain by asphalt.
- vi. In situ bonded brickwork (basement walls or foundations)

5.2.5 Superficial Deposits

5.2.5.1 Clay with sandstone and mudstone gravel was encountered across the site which may be attributed the published superficial mapped glacial diamicton geology. This was identified as:

- i. Brown mottled grey clay with rare cobbles of sandstone and mudstone,
- ii. Very soft grey-green clay with blackish-grey organic silty clay,
- iii. Light orange-brown sandy very gravelly to very sandy slightly gravelly clay,
- iv. Soft brown sandy to very sandy clay,
- v. Orange-brown slightly sandy gravel

5.2.5.2 Atterberg Limits tests carried out on ten samples of superficial clay indicate that the soil can be classified as clay of predominantly low and medium plasticity. The plasticity index of the soil was typically found to range between 11 and 15 %, and in accordance with NHBC guidelines, this soil is of low volume change potential. One