

REMEDIATION METHOD STATEMENT

AREA B, PENNYCROFT WAY
UTTOXETER

EAST STAFFORDSHIRE
BOROUGH COUNCIL

DECEMBER 2013



IVY HOUSE
environmental

SUMMARY TABLE: REMEDIATION METHOD STATEMENT	
SITE:	Area B, Pennycroft Way, Uttoxeter, Staffs
CLIENT:	East Staffordshire Borough Council
DATE:	December 2013
DEVELOPMENT PROPOSAL:	Residential
CURRENT LAND USE:	Former gas works, currently occupied by local authority recycling tip, skip yard and commercial units housing a printers and vehicle servicing garage.
HUMAN HEALTH:	Remediation required to protect against elevated arsenic, lead, PAH's, asbestos, TPH and cyanide.
CONTROLLED WATERS:	Remediation required to protect against elevated sulphate, PAH's, phenols, TPH, SVOC, VOC and cyanide
GAS PROTECTION:	Amber 2
WATER PIPES:	Upgraded pipes required.
WASTE MANAGEMENT:	Majority of contaminated materials anticipated to be characterised as hazardous.

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Date:	18 th December 2013	
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1.0 INTRODUCTION

1.1 PREAMBLE

This Remediation Method Statement has been produced for East Staffordshire Borough Council (*The Client*) to provide Phase III recommendations for the site area referred to as *Area B, Pennycroft Way, Uttoxeter*.

Area B was initially investigated in 2010 by BWB Consulting (ref. P2010/01134) and a Phase IIA investigation has recently been completed by Ivy House Environmental Ltd (Ref. IV.58.13.PhIIA, November 2013). The RMS aims to provide site specific target levels and a methodology to protect human health and controlled waters receptors prior to the proposed residential development of the site.

1.2 PROJECT BRIEF

The brief for the Remediation Method Statement incorporates:

- Implementation of the Phase IIA conceptual model.
- Consideration of regulatory authority correspondence relating to site investigation reports.
- Consideration of the development proposal.
- An appraisal of suitable remedial methods.
- Draft a Remediation Method Statement for submission to the regulators and specialist contractors.

1.3 SITE LOCATION

The site is located approximately 500m to the north of Uttoxeter town centre. The National Grid Reference (NGR) for the approximate centre of the site is SK 091 340. The site location is illustrated in Appendix A.

1.4 REFERENCES

- *Phase 1 Geo-Environmental Assessment Report. The Dove Way (Areas A & B) Uttoxeter.* BWB Consulting. Ref. NTE285/01/V1. July 2010.
- *Phase 2 Geo-Environmental Assessment Report. The Dove Way (Areas A & B) Uttoxeter.* BWB Consulting. Ref. NTE285/01/V1. August 2010.
- *Phase IIA Environmental Assessment. Pennycroft Way, Uttoxeter.* Ivy House Environmental Ltd. Ref. IV.58.1.PhIIA. November 2013.
- CLR 11: Model Procedures for the Management of Land Contamination (EA/Defra. Sept 2004).

1.5 SITE DESCRIPTION

The northern section of the site is occupied by the local authority recycling centre, which receives household wastes such as paper, white goods, rubble, wood, oil, batteries and clothing. The west to east flowing Wharf Brook flows along a concrete culvert through the centre of the site, the banks of which are populated by mature trees and shrubs.

The western site area (Skip Yard) is currently used as a skip/waste depot by ESBC and houses a small block of lock up units, old office/admin buildings and stores along the south-western boundary and an area for skip/bin storage.

Along the central southern boundary, a single storey unit is occupied by a printers and a vehicle servicing garage. The majority of the central area is rough tarmac hardstanding and a public toilet is located in the centre of the site.

The eastern section of the site comprises scrubland which has been subject to tipping, as evidenced by an overgrown centrally located mound. The site layout is illustrated in Appendix B.

1.6 DEVELOPMENT PROPOSAL

A planning application (ref. P/2013/00206) has been submitted for the demolition of the existing structures and the construction of 49 residential units and associated infrastructure. A copy of the outline proposal is contained in Appendix C.

2.0 PHASE II REVIEW

2.1 HISTORICAL REVIEW

The site area has been in industrial use since the 1800's, where a gas works occupied the whole area up until the 1960's. Two gas holders were located in the western section of the site, with a third located on land to the north-west. A railway line ran through the eastern section of the site up until the 1980's, when the cutting was infilled.

Since the 1960's the site has been used as a depot, with commercial units and a refuse tip (recycling centre) also on site.

2.2 SITE INVESTIGATION REPORTS

Two site investigation reports have been submitted to the client for the site. A 2010 report, produced by BWB Consulting, and a 2013 report, produced by Ivy House Environmental Ltd.

The BWB report assessed two parcels of land, a southern parcel (Area B) which is the area subject to a residential development scheme, and a parcel to the north-east of Area B (Area A) which is subject to a commercial development scheme. An adjoining strip of land was also subject to assessment by BWB.

Ivy House Environmental Ltd completed a supplementary investigation of Area B, which also included an additional parcel of land to the west of Area B. This parcel is referred to as the *Skip Yard*.

BWB completed seven window sample boreholes to between 2.0 and 3.0mbgl; three cable percussion boreholes to between 5.3 and 9.0mbgl and two trial pits to 2.7 and 3.4mbgl. Ivy House Environmental Ltd completed nine trial pits and trenches to a maximum depth of 3.4mbgl, thirteen window sample boreholes to a maximum depth of 4.25mbgl and three shallow hand dug pits. Plans illustrating the site investigation boreholes and trial pits are presented in Appendix D, alongside exploratory hole logs.

2.2.1 Ground Conditions

The site can be divided into three distinct areas to summarise ground conditions:

1. General Site Area: Operational refuse tip, southern section (80%) of the skip yard and open hardstanding to the front of the commercial units.
2. Gas Holders: Located in the northern section of the skip yard and to the south of the entrance to the commercial units.
3. South-Eastern Area: Overgrown with scrub and subject to unregulated historical waste disposal.

The plans contained in Appendix E illustrate the above site areas.

2.2.2 General Site Area

Ground conditions across the majority of the site comprise:

- Made Ground:** Sandy gravelly clay and clayey gravelly sand with gravel of coal, brick, quartzite and sandstone to a maximum depth of 3.2mbgl in the commercial area.
- Natural Strata:** Alluvium present along the bank of the Wharf Brook and along the western boundary of the refuse tip at 0.5 – 4.45mbgl.
- Medium dense sand and gravel with gravel of quartzite from 1.7 – 7.2mbgl.
- Weak red-brown mudstone from 1.5 – 9.0mbgl.
- Contamination:** Localised very soft blue clay (Blue Billy) in TP137 (2.0mbgl).
Ash, Clinker and tar staining (WSC 0.45 – 3.0mbgl, WSG 0.1-2.4mbgl).
Asbestos tile fragments in Refuse Tip (WSJ 0.1-1.3mbgl)

2.2.3 Gas Holders

The footprints of the two historical gas holders were investigated using trial pits and trenches and window sample boreholes.

- Made Ground:** Fill of ash, clinker, bricks, concrete, wood, coal, black, tar stained and strong tar odour to 3.2mbgl.
- Natural Strata:** Very sandy clay observed in the base of trench TPA at 1.6mbgl and beyond the outer brick wall to the gas holder in TPB1 at approximately 1.5mbgl.
- Clayey sand and gravel from 0.6 – 1.4mbgl and very sandy clay at 1.4 – 3.0mbgl were observed in borehole WSA1.
- Contamination:** All made ground to a depth of 2.5mbgl in the western gas holder and 3.2mbgl in the eastern gas holder. The diameter of the gas holders is estimated at around 15m.

2.2.4 South-Eastern Area:

Infilled ground with spoil heaps extending to two metres above ground level.

- Made Ground:** Clayey sand and sandy clay fill with waste materials (e.g. polythene, road cones, rope), brick, concrete, kerbstones, asbestos sheet fragments, pottery, ash and clinker in trial pits TPG, TPI, TPJ, TPK and borehole WSI.

Ash and clinker with sulphurous odour in trial pits TPH and TP137.

Ground at the southern end of this area appears to have been backfilled with ash and clinker, whilst the eastern and northern sections contain general fill materials and some tarry residues.

Natural Strata: Alluvium present along the bank of the Brook and underlying the fill at 1.5 – 3.5mbgl.

Contamination: All made ground from >2m above ground level to 3.2mbgl, including ash, clinker (Blue Billy), asbestos fragments and general waste.

2.2.5 Groundwater

Groundwater was present in the majority of boreholes at depths of 0.51 – 2.65mbgl. The BWB report concludes that the groundwater gradient is towards the east, commensurate with the flow in the Wharf Brook.

2.2.6 Surface Water

The Wharf Brook flows through the centre of the site along a concrete culvert. Sampling of the Brook in 2010 reported elevated concentrations of lead and zinc.

2.3 CONTAMINATION – HUMAN HEALTH

An assessment of the site investigation data for the residential with plant uptake model is summarised in tables 2.1 and 2.2. Soil analysis results for both the 2010 and 2013 investigations are contained in Appendix F.

2.3.1 Asbestos

The presence of asbestos fibres was reported in one sample taken from trial pit TPG (+1.0m). Fragments of asbestos cement sheet were reported within the fill materials in the northern section of south-eastern area (WSI, TPG) and in borehole WSJ in the refuse tip section of the site.

2.3.2 Ground Gas & Soil Vapours

The maximum gas readings for the boreholes installed by BWB and Ivy House Environmental are detailed below:

- Carbon Dioxide: 6.6% v/v
- Methane: 0.2% v/v
- Oxygen: 6.4 – 21.1% v/v
- Flow: 0.4l/hr

It has been agreed with the client that the site is characterised as Amber 2 and gas protection will be required for the proposed residential units. The vapour analysis and risk assessment implemented by Ivy House

Environmental concluded that soil vapours do not pose a risk to human health.

Table 2.1: General Contamination Summary

Determinand	SGV/GAC (mg/kg)	Exceedances	Comment
Arsenic	32	TP137 (50.8mg/kg) WS7 (44.2mg/kg)	Outliers
Lead	450*	TP137 (594mg/kg)	Outlier
Cyanide (Complex)	213**	TP137 (22,200mg/kg)	Outlier
Naphthalene	8.7	TP137 (44.7mg/kg) HDB (14.2mg/kg)	Outlier
Benzo(a)anthracene	5.9	UCL 10.38mg/kg	Outliers removed
Chrysene	9.0	TP136 (16.7mg/kg) TP137 (63.2mg/kg) WS5 (17.7mg/kg) WS6 (64.1mg/kg)	Outliers
Benzo(b)fluoranthene	7.0	UCL 16.18mg/kg	Outliers removed
Benzo(k)fluoranthene	10	TP137(27.1mg/kg) WS6 (29.3mg/kg) HDB (15.0mg/kg)	Outliers
Benzo(a)pyrene	1.0	UCL 9.86mg/kg	Outliers removed
Dibenz(a,h)anthracene	0.9	UCL 1.57mg/kg	Outliers removed
Indeno (1,2,3-cd) pyrene	4.2	UCL 6.84mg/kg	Outliers Removed

NOTE: * Withdrawn SGV. **BWB 2010 value

Table 7.2: Hydrocarbon Contamination Summary

Determinand	SGV/GAC (mg/kg)	Exceedances	Comment
EPH	500*	WS2 (510mg/kg) WS3 (3710/1170mg/kg) WS4(2640/1080mg/kg) WS5 (789mg/kg) WS6 (3090mg/kg) WSC (1045mg/kg) WSD (901mg/kg)	In made ground across general site area from 0.1 – 2.0mbgl
		TPG (707mg/kg) TP135 (896mg/kg) TP136 (1830/1210mg/kg) TP137 (773/8970mg/kg)	South-Eastern Site Area
		WSA2 (565mg/kg) TPA (4993mg/kg)	Gas holders
Aliphatic C10 – C12	110	TPA (119mg/kg)	Western gas holder
Aliphatic C12 – C16	540	TPA (606mg/kg)	
Dibenzofuran	0.815	WSC (15.9mg/kg) WSG (1.1mg/kg)	In made ground across general site area from 0.1 – 2.0mbgl
		TPA (10.3mg/kg) TPB (13.2mg/kg) WSA2 (3mg/kg)	Gas holders
		TPG (6.6mg/kg)	South-Eastern Site Area

2.4 CONTAMINATION – CONTROLLED WATERS

The site is underlain by a Secondary A aquifer and the Wharf Brook, which flows through a concrete culvert, bisects the centre of the site from west to east.

Table 7.4 illustrates an assessment of the groundwater analysis results presented against their respective GAC. The groundwater, leachate and surface water analysis results for 2010 and 2013 investigations are contained in Appendix G.

Table 7.4: Groundwater Contamination Summary

Determinand	SGV/GAC ($\mu\text{g/l}$)	Exceedances	Comment
Sulphate	250mg/l	WSA2 (985mg/l) WSB (1250mg/l)	Skip yard, eastern gas holder and eastern section.
PAH(UKDWS4)	0.1	WSA2 (0.28 $\mu\text{g/l}$) WSB (26.75 $\mu\text{g/l}$) BH8 (15.96 $\mu\text{g/l}$) BH9 (20.25 $\mu\text{g/l}$)	
TPH	10	WSA2 (149 $\mu\text{g/l}$) WSB (496 $\mu\text{g/l}$) WSI (40 $\mu\text{g/l}$) BH8 (823 $\mu\text{g/l}$) BH9 (1880 $\mu\text{g/l}$)	Skip yard, eastern gas holder & eastern section
Phenols	0.5	WSA2 (0.5 $\mu\text{g/l}$) WSB (37.8 $\mu\text{g/l}$)	Skip yard & eastern gas holder
Benzene	1	WSB (384 $\mu\text{g/l}$)	Skip yard
Dibenzofuran	N/A	WSA2 (5.2 $\mu\text{g/l}$) WSB (3.3 $\mu\text{g/l}$) WSI (2.3 $\mu\text{g/l}$)	No thresholds available.
Carbazole	N/A	WSI (1.5 $\mu\text{g/l}$)	
2,4 dimethylphenol	N/A	WSB (36.6 $\mu\text{g/l}$)	
Cyanide	50	BH8 (957 $\mu\text{g/l}$) BH9 (1630 $\mu\text{g/l}$)	

An assessment of the leachate results illustrates that the materials sampled from within the western gas holder contain leachable concentrations of the following contaminants:

- TPH: 287 $\mu\text{g/l}$
- Benzene: 43 $\mu\text{g/l}$
- Ethylbenzene 20 $\mu\text{g/l}$

2.5

3.0 PHASE III CONCEPTUAL MODEL

The Phase III conceptual model is illustrated below.

HUMAN HEALTH			
SOURCE	PATHWAY	RECEPTOR	SOLUTION
Made ground and natural strata contaminated with Arsenic, Cyanide, Lead, PAH's, TPH, Dibenzofuran and asbestos fibres.	Ingestion of contaminated soil and contaminated vegetables, direct contact (dermal) with contaminated soil and soil dust; ingestion and inhalation of contaminated soil dust.	Construction Workers	Basic PPE for all workers (overalls, gloves, dust mask if required) and wash facilities/personal hygiene
	Inhalation of Carbon Dioxide and asbestos fibres.	End Users (Residents)	Remediation required in the form of off site disposal or stabilisation of grossly contaminated soils and provision of a clean capping layer in gardens. Excavation and disposal of asbestos containing materials. Upgraded membrane and vented void required for each plot. No requirement for vapour protection. DQRA and remediation in the form of bio-remediation or stabilisation of gas works related contamination.
	Leaching into water supply pipes	Water Supply/End Users	Requirement for upgraded water pipes, e.g. aluminium sheathed or steel pipes.

CONTROLLED WATERS			
Made ground and natural strata contaminated with Inorganics, TPH, VOC and SVOC.	Leaching and vertical migration through the vadose zone to the saturated zone and lateral migration towards the surface watercourse.	Secondary A Aquifer & Wharf Brook	DQRA and remediation in the form of bio-remediation or stabilisation of contaminated made ground and gas works related contamination.

4.0 RISK ASSESSMENT & TARGET CONCENTRATIONS

4.1 INTRODUCTION

A Detailed Quantitative Risk Assessment (DQRA) is required to produce target values for the remediation of contaminated soil and groundwater to ensure that human health and controlled waters receptors are protected.

The human health risk assessment has utilised the CLEA v1.06 model in the production of Remedial Target Values (RTV) whilst the Environment Agency's *Remedial Targets Worksheet (version 3.2)* has been used to draft RTV's for the protection of controlled waters. Copies of the relevant data spreadsheets and models are contained in Appendix H.

4.2 REMEDIAL TARGET VALUES

Table 4.1 illustrates the RTV's.

Table 4.1: Remedial Target Values

Determinand	Controlled Waters			Human Health		Target RTV (Soil)* (mg/kg)
	Max Concentration (mg/l)	T3 GW (mg/l)	T3 Soil (mg/kg)	Max Concentration (mg/kg)	RTV (mg/kg)	
Asbestos	N/A	N/A	N/A	Chrysotile Fragments & Fibres	0%	0%
Arsenic	N/A	N/A	N/A	50.8	32	32
Lead	N/A	N/A	N/A	594	450	450
Cyanide (Total/Complex)	1.63	0.128	8.15	22,200	213	8.15
Naphthalene	N/A	N/A	N/A	44.7	8.7	8.7
Benzo(a)anthracene	N/A	N/A	N/A	10.38	5.9	5.9
Chrysene	N/A	N/A	N/A	64.1	9.0	9.0
Benzo(b)fluoranthene	0.0028	6.67E-4	2.48E-3	16.18	7.0	2.48E-3
Benzo(k)fluoranthene	0.003	3.39E-4	2.53E-3	29.3	10	2.53E-3
Benzo(a)pyrene	0.0063	2.56E-4	2.81E-3	9.86	1.0	2.81E-3
Dibenz(a,h)anthracene	N/A	N/A	N/A	1.57	0.9	0.9
Indeno(1,2,3-cd)pyrene	0.00423	3.39E-4	2.46E-3	6.84	4.2	2.46E-3
Sulphate	1250	2670	3390	N/A	N/A	3390
Phenols	0.0378	1.28E-3	6.62E-3	N/A	N/A	6.62E-3
Dibenzofuran	N/A	N/A	N/A	13.2	0.815	0.815
Benzene	0.384	2.56E-3	1.56E-2	N/A	N/A	1.56E-2
Aliphatic C10 – C12	N/A	N/A	N/A	119	110	110
Aliphatic C12 – C16	N/A	N/A	N/A	606	540	540
Aromatic C12-C16	0.08	3.39E-3	2.06E-2	N/A	N/A	2.06E-2
Aliphatic C16-C35	0.307	2.56E-3	2.17	N/A	N/A	2.17
Aromatic C16-C21	0.075	2.56E-3	2.2E-2	N/A	N/A	2.2E-2
Aromatic C21-C35	0.604	2.56E-3	2.51E-2	N/A	N/A	2.51E-2

4.3 COMMENT

The RTV's have been produced using site specific data. It is understood that a number of the RTV's may be below conventional laboratory limits of detection and, therefore, it is proposed that remediation contractors should state in their method statements whether such values can be attained. If re-assessment of the RTV's is required, contractors should provide full justification in their proposals.

5.0 REMEDIAL STRATEGY

The remedial strategy should consider the RTV's and earthworks elements of the development proposal in respect of likely finished floor levels, foundation design requirements, infrastructure and the re-grading of the Wharf Brook.

The strategy will also require regulatory approval and should be designed to remain within likely construction timeframes and budgetary considerations.

The remedial strategy should consider the re-use of materials on site wherever feasible and the formulation of a Materials Management Plan for such works.

The following sections state the aims of the remedial strategy for the reported contamination.

5.1 GAS HOLDERS

The Ivy House Environmental investigation confirmed that the basic structure of the western gas holder remains in-situ and, based on the log for WSA1, that gas works waste held within the eastern gas holder also remains in-situ. With respect to the development proposal, plots 20 – 22 are located proximal to the western gas holder; plots 31 – 34 are located proximal to the eastern gas holder.

To ensure that the risk of mobilising the contamination within the gas holders is minimised, the remedial strategy should comprise one or more of the following operations:

- Off-site disposal of grossly contaminated or geotechnically unsuitable materials – materials which are likely to be characterised as hazardous waste.
- Stabilisation of in-situ gas works waste to restrict leaching into the water table.
- Stabilisation of in-situ gas works waste to reduce the leaching of contamination and, thus, reduce the waste classification to non-hazardous or inert.
- Ex-situ or in-situ bioremediation to reduce the risk posed human health and controlled waters.

It is anticipated that approximately 1000m³ of material may require treatment.

5.2 ASBESTOS

Delineation of all asbestos containing materials (i.e. cement sheet fragments) from the locations identified in previous sections will be required. Plots 10 – 17 and 44 – 49 are located in areas where asbestos containing materials have been identified.

The re-use of soils and made ground containing asbestos fibres will be subject to the following specifications:

- Building and garden footprints: 1.5mbgl
- Service trenches: 0.5m below base of trench
- Hardstanding: 0.75mbgl.
- Landscaping: 0.75mbgl.

In all instances, asbestos containing materials should be placed below a layer of non-contaminated material.

5.3 SOUTH-EASTERN SECTION

This section of the site contains over five metres of made ground in some areas, comprising general waste, tyres, sandy clays with brick and concrete, tarmac, ash and clinker with contaminants ranging from asbestos containing materials to *Blue Billy* type cyanide contaminated fill and extensive ash and clinker deposits.

The remedial strategy for this section of the site should comprise one or more of the following operations:

- Off-site disposal of grossly contaminated or geotechnically unsuitable materials – materials which are likely to be characterised as hazardous waste.
- Stabilisation of in-situ ash and clinker to restrict leaching into the water table.
- Stabilisation of in-situ ash and clinker to reduce the leaching of contamination and, thus, reduce the waste classification to non-hazardous or inert.
- Re-use of asbestos containing materials at depth as per section 5.2.

It is estimated that a minimum of 300m³ of material in this section of the site may be classified as hazardous waste.

5.4 CONTROLLED WATERS

With respect to specific groundwater treatment, the works required to remediate the gas works waste, cyanide contaminated made ground and made ground in general will deal with any gross contamination and will, therefore, break the pollutant linkage with respect to controlled waters.

Dependant on volumes of perched water contained within the gas holders, there may be a requirement for treatment or off site disposal of contaminated liquid at these locations.

The regrading of the banks along the Wharf Brook should also be considered within the contractor's methodology, as the works could involve the excavation of up to 500m³ of surplus materials (see proposed profiles on the plan contained in Appendix C). Until an approved design for the watercourse is confirmed, the above figure should be included in any materials balance for the project, with an allowance made for 30% contaminated material.

5.5 MADE GROUND

Shallow made ground (<0.75mbgl) across the site is contaminated with metals, PAH's and petroleum hydrocarbons. It is anticipated that a reduced level dig of around 0.5m will be required to create a formation level prior to the commencement of construction works. Consequently, an estimated volume of 4000m³ of contaminated made ground may be surplus to requirements and will require off-site disposal.

Contractor should consider the following for such materials:

- Off site disposal according to the appropriate waste classification.
- Pre-disposal treatment to reduce the waste classification.
- Development of a Materials Management Plan for off site or on-site re-use.

5.6 WATER PIPES

At this stage, barrier pipes will be required for the development. This may be subject to revision on completion of the remedial works if, for example, it can be demonstrated that the pipes are not in contact with, contaminated ground. The utility provider should be consulted to provide guidance on this issue.

5.7 GAS PROTECTION

Gas protection measures specified for the development include the following:

- *Amber 2:* Protective membrane and ventilated sub-floor void. Membranes to be installed by specialist groundworks contractor; ventilation of the sub-floor should facilitate a minimum of one complete volume change every 24hrs. All installations should be inspected and approved as fit for purpose by an experienced consultant or contractor.

5.8 INVASIVE SPECIES

The contractor should ensure that the risks of distributing invasive species are negated by methods and procedures contained within their scope of works.

5.9 WASTE MANAGEMENT

For all materials excavated and scheduled for off-site disposal, the remediation contractor shall ensure that the appropriate duty of care reporting is maintained and that suitably licensed disposal or recycling facilities are used.

5.10 HEALTH AND SAFETY

The contractor shall ensure that all aspects of construction health and safety are covered in their proposals and that the risks posed to third parties by potential migration of airborne contamination and contaminated surface water run-off are considered.

5.11 CAPPING

As the site is contaminated and deficient in clean topsoil, there is a requirement for clean capping for all residential gardens and areas of soft landscaping. It is recommended that a minimum of 400mm of clean subsoil and 350mm of clean topsoil is laid in back gardens and 350mm of clean subsoil and 150mm of clean topsoil are laid in front gardens and landscaped

5.12 ADDITIONAL INVESTIGATION

A post demolition investigation within the footprint of the existing structures should be completed prior to the commencement of the remedial works. The scope for the investigation should be defined by the remediation contractor and approved by the client.

Any additional remedial requirements should be incorporated into this document to the approval of the client.

VALIDATION

Validation requirements for re-use, in-situ materials, treated materials and imported materials will include the following:

- Remediated gas works waste.
- Asbestos containing materials.
- Cyanide impacted made ground.
- Contaminated made ground in general.
- Non-contaminated in-situ materials.
- General materials specified for re-use.
- Imported materials designated for capping.

Specifications will include sample ratios (per volume) and chemical suites. Geotechnical specifications for ground engineering will be specified under separate cover.

5.13 GAS WORKS WASTE

For re-use on site, the gas works waste should be sampled at a ratio of one sample per 100m³, with a minimum of 5 samples taken from each gas holder. Samples should be scheduled for solid analysis and one sample in five should be scheduled for a leachate suite.

The analysis suites for solid and leachate should, as a minimum, contain the following determinands:

- Metals, pH, sulphate and water soluble sulphate, total, complex and free cyanide, speciated PAH's, TPHCWG, speciated phenols, VOC and SVOC.

5.14 ASBESTOS CONTAINING MATERIALS

For material destined for re-use on site which comprises fragments of asbestos containing materials or asbestos fibres, one sample per 50m³ should be scheduled for an asbestos fibre screen. Should fibres be present, then an asbestos I-D and quantification should subsequently be scheduled. Any material containing >0.01% asbestos should not be re-used on site and should be sent to landfill.

5.15 CYANIDE CONTAMINATION REMOVAL

Validation of the cyanide contaminated fill proximal to trial pit TP137 should be undertaken as detailed below:

- Stabilised fill: one sample per 50m³.
- In-situ materials: samples taken on a 5m grid across the base and walls of the excavation.
- Samples to be analysed for total, complex and free cyanide. Leachate analysis for one in five samples to be included for the same determinands.

5.16 NON-CONTAMINATED IN-SITU MATERIALS

As it is likely that the remedial works and enabling works will be integrated to some extent, the validation of in-situ ground will be required where unrecorded contamination has been removed. The validation of this ground should include the following:

- In-situ materials: samples taken on a 5m grid across the base and walls of the excavation.
- Analytical suite to include metals, pH, water soluble sulphate, total phenols, total, complex and free cyanide, speciated PAH's and TPHCWG.

5.17 GENERAL MATERIALS

Materials excavated during the remedial works which may be designated for re-use on site should be validated according to the following specification:

- One sample per 250m³, minimum of 5 samples.
- Analytical suite to include metals, pH, water soluble sulphate, total phenols, total, complex and free cyanide, speciated PAH's, asbestos fibres and TPHCWG.

5.18 IMPORTED CAPPING MATERIALS

As the site is deficient in clean topsoil and subsoil, the following specification is recommended for imported subsoil and topsoil:

- For greenfield sources and material certified under BS3882:2007, a copy of the analysis certificate (comprising of the specified requirements, plus an appropriate list of contaminants, including TPH) should be submitted to the Local Authority for approval before material is imported. After approval and placement of material, the chemical quality should be analysed, with the frequency of analysis being one sample per 100m³. The depth of placement shall also be recorded (photographed with measuring staff in place) in order to ensure remedial targets are met. The post-placement details shall be submitted as part of the validation report.
- For recycled or brownfield sources and material that has not been certified under BS3882:2007, full details of the location of material source(s), accompanied by representative chemical analysis (including a comprehensive set of parameters, for example: pH, particle composition, and contaminants – including TPH), at a frequency not less than one sample per 5000m³ (with a minimum of at least one sample per source site) should be submitted to the Local Authority for approval before material is imported. After approval and placement of material, the chemical quality should be analysed, with the frequency of analysis being one sample per 50m³. The depth of placement shall also be recorded (photographed with measuring staff in place) in order

to ensure remedial targets are met. The post-placement details shall be submitted as part of the validation report.

5.19 CONTROLLED WATERS

During the remedial works, sampling and monitoring of the Wharf Brook should be instigated at upstream and downstream locations. The sampling locations should be confirmed with the EA prior to the commencement of works and samples should be taken prior to the commencement of works and at four weekly intervals during the remediation works. On completion of the remedial works, sampling should take place on a minimum of two occasions at eight week intervals. The analysis suite for the Wharf Brook is detailed below:

- Metals, cyanide, BOD, COD, pH, sulphate, water soluble sulphate, speciated PAH's, phenols, TPHCWG.

During the groundworks and construction phase of the development, sampling and analysis at upstream and downstream locations should be maintained on a 12 week basis for the duration of the project.

6.0 SITE SUPERVISION & REPORTING

6.1 SITE SUPERVISION

The remedial operations should be supervised by an environmental engineer/consultant operating independently of the contractor. The supervisors responsibilities shall include, but not be limited to the following:

- Ensuring that the remedial strategy is correctly implemented.
- Supervision of the remedial operations.
- Retrieval of soil, surface and groundwater samples and the subsequent scheduling of chemical laboratory analysis according to the requirements of the RMS.
- To communicate with the project manager, client and regulators as required.
- To maintain a site records/diary.
- To produce, or aid in the production of, the remediation completion report.

6.2 COMPLETION REPORTING

The remediation completion report should include, but not be limited to the following:

- A summary of the project works as per the RMS, to include any unforeseen works or ground conditions, health and safety reports, delays and unscheduled works.
- Submission of a site diary, detailing milestone events, progress meetings and regulatory correspondence.
- Validation sampling plans, analysis results and assessment.
- Waste duty of care documentation - to include licence details for all receiving landfills or recycling sites.
- Geotechnical test results as required by the developer.
- Surveys of excavations and backfilling works.
- Details of all imported materials, including validation testing and approvals.
- Verification report for any Materials management plans utilised for the works.
- Regulatory correspondence relating to acceptance and sign off of the remedial works.