Remediation Statement & Validation Proposal Sheets

To be approved by Barnsley Metropolitan Borough Council

Project reference: 16-384

Site: Lairds Way, Penistone

Carried out by: Richard Stripp

Summary of Contamination Assessment based on the following investigation data:-

- Phase 2: Ground Investigation Report – Ref: 16-384, August 2016 (prepared by Arc Environmental Ltd)

(The above document should be read in conjunction with this Remediation Statement)

It has been determined that the made ground deposits present on site represent a potential risk towards human health (future site end-users) where exposure pathways will be available. Made ground has been recorded across the entire site area, comprising clay, sand and gravel containing predominantly brick, concrete, slag rubble, ash, cinder, clinker, coal and burnt siltstone.

The investigation identified elevated levels of Arsenic, Lead, Benzo(a)pyrene, Benzo(b)fluoranthene and Dibenz(ah)anthracene, as well as the presence of asbestos fibres (Amosite), have been identified within the made ground deposits. Based on the ground contamination risk assessments undertaken, it has been established that all areas of gardens and future soft landscaping / open space, will require the need for a clean cover system (protective barrier) in order to remove several exposure *pathways* (*i.e. ingestion of soil and indoor dust, consumption of home grown produce and attached soil, dermal contact (indoor), dermal contact (outdoor), inhalation of dust (indoor) and inhalation of dust (outdoor)*) and break the established *source-pathway-receptor* pollutant linkage, therefore negating the risks posed towards the future site end-users.

The use of cover systems reduces the hazards posed towards human health from ground contamination and also provides a suitable medium for plant growth.

Although the screening identified asbestos fibres, this is not considered to be representative of heavy or gross asbestos contamination within the made ground as a whole, particularly when considering the lack of visual evidence of asbestos containing materials. Further quantitative asbestos screening was undertaken to assess the level of risk, and the results identified concentrations of 0.002% *w/w*, with the detailed risk assessment assessing the risk as low to future end users. At present whilst these materials are currently buried below ground they do not represent a risk, however the generation potential of asbestos fibres becoming airborne will increase if these materials are to be excavated and reused/removed, although the generation potential will be dependent upon the moisture content of the soils (i.e. presence of dry soils and vehicle trafficking could generate high concentrations of dust clouds).

As such it is felt that there is not a requirement for removal and/or further risk assessment, in order to protect the future end users from potential asbestos within the made ground. However appropriate measures should be put in place during any excavation or during transportation (i.e. suppression by water, appropriately covered, etc.), and any excavated materials should be visually inspected should any unforeseen asbestos containing materials (ACM's) be encountered during the construction phase.

Whilst the results of the contamination screening would suggest that a simple BRE 465 clean cover system could be adopted for this site (between c.300mm up to c.600mm), as the presence of asbestos fibres have been identified and the risks cannot be wholly dismissed, it is felt that the maximum thickness of 600mm clean cover should be adopted for this site, in order to reduce the risks to an acceptable level associated with the presence of elevated metals, PAH's and Asbestos.

The results of the water screening had identified elevated concentrations of Copper, sulphate, speciated PAH's and speciated TPH's within trapped and perched water encountered in the deep boreholes, however this was assessed to not represent a high risk to Controlled Waters or adjacent sites, and therefore no further assessment or remediation is necessary.

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Required Remedial Measures – Emplacement of a Suitable Clean Cover System

The following remedial works will need to be completed, in the order given below, to ensure all risks with respect to the contamination levels identified within the made ground are reduced to acceptable levels;

(i) Determine a source of 'clean cover' and this will need to be tested for a range of analytes to determine its suitability before being brought to site. Typically, any materials deemed appropriate for use will need to be screened prior to transportation and emplacement using the following sampling and testing matrix in Table 1 below:-

Table 1

Type	Number of Samples	Testing Schedule	Assessment Criteria
Virgin quarried material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Standard metals/metalloids (should include as a minimum As, Cd, Cr (III), Cr (VI), Cu, Hg, Ni, Pb, Se & Zn)	This needs to be agreed with the Local Authority. The Assessment criteria needs to be UK based, e.g. SGV's, LQM or other similarly derived GAC's.
Crushed hardcore, stone, brick	Minimum 1 per 1000m^3.	Standard metals/metalloids (as above) PAH (16 USEPA specification) Asbestos	
Greenfield soils / manufactured soils	Minimum 3 or 1 per 250m^3 (whichever is greater).	Standard metals/metalloids (as above) PAH (16 USEPA specification) Asbestos	
Brownfield soils / screened soils	Minimum 6 or 1 per 100m^3 (whichever is greater).	Standard metals/metalloids (as above) PAH (16 USEPA specification) TPH (CWG banded) Asbestos Any additional analysis dependant on the history of the donor site	

(Table taken from the Verification Requirements for Cover Systems – Technical Guidance for Developers and Consultants – Yorkshire and Humberside Advisory Council, October 2014)

(ii) Testing ideally should be undertaken at both the source (once established) to confirm that the donor soils are suitable for residential end use, and following emplacement to re-affirm that the imported soils have not been cross-contaminated during loading, transport and emplacement. The testing frequency to be adopted for this site should typically be one in every three plots.

(iii) The emplacement of the clean cover system should be witnessed, where possible by a suitably qualified Geo-environmental Engineer. Clean cover of at least 600mm in thickness will be required and this will need to be made up of 2 individual layers. A cross section showing the make-up of the clean cover has been attached for your reference. The clean cover should consist of a minimum of 450mm of imported clay, virgin quarried stone or imported crushed stone/ inert demolition type material (no dig layer), then a minimum of 150mm of clean subsoil/topsoil (growing medium), with the overall thickness of topsoil dependent upon the type of planting (increased to accommodate shrubs & larger trees).

Upon completion of the proposed residential development a comprehensive Validation Report will need to be produced by Arc Environmental Limited documenting the remedial works undertaken. The following items will be included within the report;

(i) Geographical location from which the imported clean cover material was sourced
(ii) Description and chemical analysis for the clean cover material brought to site
(iii) Confirmation of clean cover thickness – minimum of 600mm
(iv) Photographic evidence – photographs showing the emplacement / confirming thickness of the required clean cover. Photographic evidence should be representative and include a scale
(v) Plans – showing pertinent information relating to the remediation

Required Remedial Measures – Emplacement of a Suitable Clean Cover System (Cont'd)

Action Items & Persons Responsible:

(i) Sourcing the necessary clean cover materials (Strategic Team Group)

(ii) Confirming suitability of clean cover materials (Arc Environmental Limited)

(iii) Emplacement of clean cover materials (Strategic Team Group)

(iv) Confirming the correct thickness and make up of clean cover is placed within all garden and areas of soft landscaping (Arc Environmental Limited)

(v) A Validation Report will be required to validate removal of affected soils and implementation of clean cover materials (Arc Environmental Limited)

Accompanying Documents:

- Clean Cover Remediation Plan
- Cross section showing make up of clean cover system
- Validation Screening Assessment Values

This document has been completed by Richard Stripp, for and on behalf of Arc Environmental Limited

Signed:…….. Date: 20th October 2016

Richard Stripp *BSc. (Hons) MSc. FGS*
Senior Geo-Environmental Engineer



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LEGEND	
	APPROXIMATE SITE BOUNDARY
	AREAS OF PROPOSED SOFT LANDSCAPING REQUIRING A MINIMUM 600MM THICKNESS OF CLEAN COVER

rev.	date	amendments	drawn	chckd

Client:
STRATEGIC TEAM GROUP

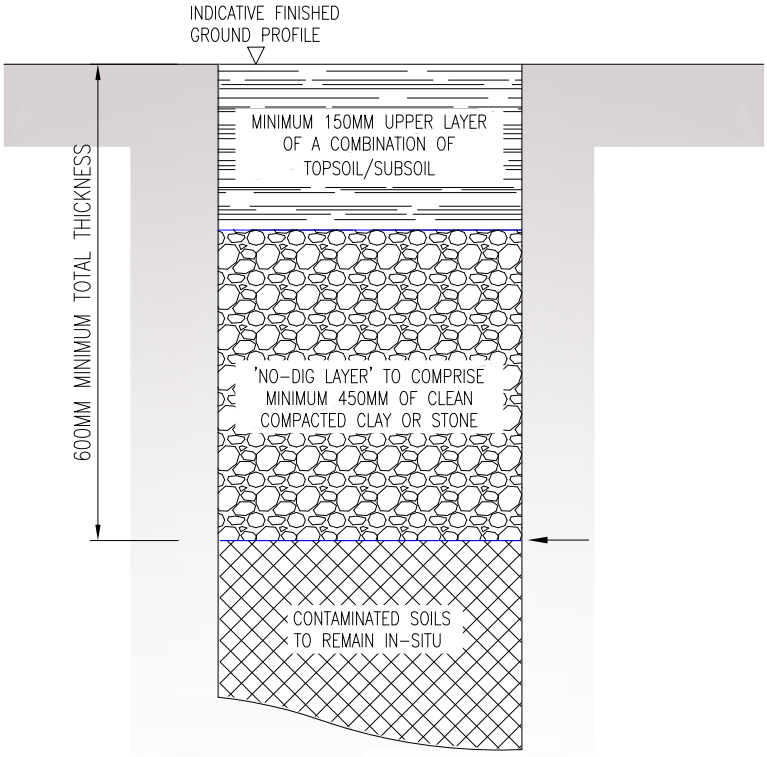
Project Title:
Proposed Residential Development
Lairds Way
Penistone, South Yorkshire

Drawing Title:
Clean Cover Remediation Plan

Scale at A3:	Date:	Drawn by:	Approved by:
NTS @ A3	19.10.16	P.D	R.S

Job Ref:	Drg no:	Rev:
16-384	–	–

TYPICAL SECTION THROUGH CLEAN COVER BARRIER SYSTEM (SCALE AS SHOWN)



SAMPLING AND TESTING MATRIX TABLE

TYPE	NUMBER OF SAMPLES	TESTING SCHEDULE	ASSESSMENT CRITERIA
Virgin quarried material	1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material.	Virgin quarried material 1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material. Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se & Zn)	This needs to be agreed with the Local Authority. The Assessment criteria needs to be UK based, e.g. SGV's, LQM or other similarly derived GAC's.
Crushed hardcore, stone, brick	Minimum 1 per 1000m3.	Standard metals/metalloids (as above) PAH (16 USEPA specification) Asbestos	This needs to be agreed with the Local Authority. The Assessment criteria needs to be UK based, e.g. SGV's, LQM or other similarly derived GAC's.
Greenfield soils / manufactured soils	Minimum 3, 1 per 250m3 or every 1 in 3 plots.	Standard metals/metalloids (as above) PAH (16 USEPA specification) Asbestos	This needs to be agreed with the Local Authority. The Assessment criteria needs to be UK based, e.g. SGV's, LQM or other similarly derived GAC's.
Brownfield soils / screened soils	Minimum 6, 1 per 100m3 or every 1 in 3 plots.	Standard metals/metalloids (as above) PAH (16 USEPA specification) TPH (CWG banded) Asbestos Any additional analysis dependant on the history of the donor site	This needs to be agreed with the Local Authority. The Assessment criteria needs to be UK based, e.g. SGV's, LQM or other similarly derived GAC's.

Client:
STRATEGIC TEAM GROUP

Project Title:	Drawing Title:
Proposed Residential Development Lairds Way Penistone, South Yorkshire	Section Showing Installation of Required Clean Cover System

rev.	date	amendments	drawn	chckd

Job Reference:	Drawing Number:	Revision:
16-384	-	-

Drawn by:	Date:	Scale at A4:
R.S	20.10.2016	As Shown

Checked by:	Approved by:	
R.S	R.S	The contractor shall check all dimensions on site before commencement of any works. No dimensions to be scaled off this drawing.
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Validation Screening Criteria –Residential End Use

- Any materials brought on to site, including topsoil and subsoil, for use in areas of future gardens and soft landscaping should be suitably screened and tested for human health assessment prior to delivery, with these results sent to ARC a minimum of 1 week before delivery to site. To confirm the suitability of these materials, validation testing of these materials will also be required following emplacement and/or importation onto site.
- Validation screening will be undertaken on all materials brought onto site for the areas of private gardens/soft landscaping to ensure they are suitable for use on this site. The number of samples screened will be dependent upon the final volumes brought to site and the origin of the imported materials. Once the source of imported materials has been determined, the sampling regime will be agreed with the LA. We would propose to adopt the Yorkshire & Humberside Pollution Advisory Council (YHPAC) 'Verification for Cover Systems', October 2014, and the sampling frequency as follows:

  Virgin Quarried Material – The suite of screening will include standard metals, metalloids and non-organics. Sampling numbers 1 or 2 to confirm the inert nature of the material.

  Crushed Hardcore, Stone, Brick - The suite of screening will include standard metals, metalloids non-organics, speciated PAH's and asbestos. Sampling numbers minimum of 1 per 1000m^3.

  Greenfield Soils – The suite of screening will include standard metals, metalloids, non-organics, speciated PAH's and asbestos. Sampling numbers minimum 3, 1 per 250m^3 or every 1 in 3 plots.

  Brownfield Source – The suite of screening will include standard metals, metalloids, non-organics, speciated TPH's, speciated PAH's and asbestos and any additional analysis depending on history of donor site. Sampling numbers minimum 6, 1 per 100m^3 or every 1 in 3 plots.

  All validation screening will be assessed against the Level 1 Target Concentrations (C_T) values given in Table 1 below.

Table 1 - (Assessment Criteria for Imported Soils)

Analyte	Critical Conc. (C_C) mg/kg		
Metals/Metalloids			
Arsenic	37[1]		
Cadmium	11[1]		
Chromium III	910[1]		
Chromium VI	6[1]		
Copper	2,400[1]		
Lead	200[2]		
Mercury	40[1]		
Nickel	130[1]		
Selenium	250[1]		
Zinc	3,700[1]		
Cyanide	34[3]		
Asbestos	None Present or Quantification		
Speciated PAH's	1% SOM	2.5% SOM	6% SOM
Acenaphthene	210[1]	510[1]	1,100[1]
Acenaphthylene	170[1]	420[1]	920[1]
Anthracene	2,400[1]	5,400[1]	11,000[1]
Benzo(a)anthracene	7.2[1]	11[1]	13[1]
Benzo(a)pyrene	2.2[1]	2.7[1]	3.0[1]
Benzo(b)fluoranthene	2.6[1]	3.3[1]	3.7[1]
Benzo(ghi)perylene	320[1]	340[1]	350[1]
Benzo(k)fluoranthene	77[1]	93[1]	100[1]
Chrysene	15[1]	22[1]	27[1]
Dibenz(ah)anthracene	0.24[1]	0.28[1]	0.30[1]

Analyte	Critical Conc. (C_C) mg/kg		
Speciated PAH's (Cont'd)	1% SOM	2.5% SOM	6% SOM
Fluoranthene	280[1]	560[1]	890[1]
Fluorene	170[1]	400[1]	860[1]
Indeno(123cd)pyrene	27[1]	36[1]	41[1]
Naphthalene	2.3[1]	5.6[1]	13[1]
Phenanthrene	95[1]	220[1]	440[1]
Pyrene	620[1]	1,200[1]	2,000[1]
Speciated TPH	1% SOM	2.5% SOM	6% SOM
Aliphatic EC5-EC6	42[1]	78[1]	160[1]
Aliphatic EC6-EC8	100[1]	130[1]	530[1]
Aliphatic EC8-EC10	27[1]	65[1]	150[1]
Aliphatic EC10-EC12	130[1]	330[1]	760[1]
Aliphatic EC12-EC16	1,100[1]	2,400[1]	4,300[1]
Aliphatic EC16-EC35	65,000[1]	92,000[1]	110,000[1]
Aliphatic EC35-EC44	65,000[1]	92,000[1]	110,000[1]
Aromatic EC5-EC7	70[1]	140[1]	300[1]
Aromatic EC7-EC8	130[1]	290[1]	660[1]
Aromatic EC8-EC10	34[1]	83[1]	190[1]
Aromatic EC10-EC12	74[1]	180[1]	380[1]
Aromatic EC12-EC16	140[1]	330[1]	660[1]
Aromatic EC16-EC21	260[1]	540[1]	930[1]
Aromatic EC21-EC35	1,100[1]	1,500[1]	1,700[1]
Aromatic EC35-EC44	1,100[1]	1,500[1]	1,700[1]

[1] = LQM S4UL's (2014) – *Residential with home grown produce*, [2] = CL:AIRE C4SL's – *Residential with home grown produce,* [3] = ATRISK^{SOIL} SSV.