REMEDIATION STRATEGY
KINGSPAN, SHERBURN-IN-ELMET

REFERENCE: 1CO108742P3R2

PREPARED FOR: FISHER GERMAN LLP

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1. INTRODUCTION

1.1 Background

Ensafe Consultants (as Resource and Environmental Consultants Ltd (REC)) has been instructed by Fisher German ("the Client") to prepare a Remediation Strategy to support the proposed development of Land at Kingspan, Sherbert in Elmet, Leeds, LS25 6NF (the 'site'). A Site Location Plan (Drawing ref: 108742-001) is presented in Appendix I.

Ensafe had previously been commissioned to undertake 2no. Phase I Geo-Environmental Assessments as well as a Phase 2 Site Investigation to assess the potential risk associated with contaminants within the underlying soil. The findings of the investigations are summarised within Section 2.0 and are presented in detail within separate reports;

- Phase 1 Environmental Site Assessment, Aviation Road, ref 45378p1r0, January 2014;
- Phase 1 Geo-Environmental Site Assessment, Kingspan, Sherburn in Elmet, ref 101374p1r0, June 2016, and;
- Phase II Geo-Environmental Site Investigation, Kingspan, Sherburn in Elmet, ref 101374p2r0, February 2020.

1.2 Proposed Development

The site is proposed for a potential industrial development, comprising the installation of a refuse derived fuel (RDF) plant and factory extension to the pre-existing Kingspan Insulation Ltd factory. Additional associated infrastructure including new internal roads are proposed. Supercraft Structure Limited Figure 1 in Appendix I details the location of the proposed developments.

1.3 Objectives

The purpose of this Remediation Strategy is to identify and account for undertaking additional investigations, remediation and/or validation works to support delivery of the proposed development. The strategy focusses on providing information to support reuse of materials where possible, development of a materials management plan, and additional works to allow the safe, cost effective, and regulatory compliant redevelopment of the site.

2. SITE SETTING

2.1 Site Location and Description

Table 2.1 Site Location Details

Site Address	Kingspan Site, Sherburn in Elmet, Leeds, LS25 6NF
National Grid Reference	451223, 433337
Site Area	1.14 ha

2.2 Site Description

The subject site is located within the grounds of the Kingspan Insulation Plant facility, northeast of Aviation Road. The site is accessed off Enterprise Way to the east. The site is a situated within a primarily industrial area, within an industrial park located south of the B1222.

The site comprises a level grass field adjacent to the Kingspan factory to the north. The majority of the site is mostly surfaced in grass with a level topography and limited areas of hard landscaping on the west of site including a tarmac road and car park hardstanding.

A man-made deluge pond for spillages is located along the eastern border of the site. A small pump/electricity substation is associated with, and located adjacent to, the balancing pond and located on concrete hardstanding. A 'step' in the land is evident running east-west across the northern section of the site, where the culvert is located. A submerged culvert, known as Green Dyke, flows east-west across the centre of the site and emerges into an open channel approximately 20m to the east.

2.3 Site History

The site comprised undeveloped agricultural land until 1950 when it became occupied by an airfield. The airfield became disused from circa 1957 and remained as such until it was redeveloped to comprise an industrial unit, now Kingspan Insulation, in 1985. Additional industrial buildings and infrastructure have been constructed on site since this time.

2.4 Geology and Hydrogeology

The British Geological Survey (BGS) maps and GeoIndex indicate that the site is underlain by the geological sequence presented in Table 2.2.

Table 2.2 Summary of Geological and Hydrogeological Data

Geological Unit	Classification	Description	Aquifer Classification	Sensitivity
Superficial	Hemingbrough Glaciolacustrine Formation	Silts and Clays	Unproductive Strata	Low
Bedrock	Roxby Formation	Calcareous Mudstone	Secondary B Aquifer	Low - Moderate

2.5 Hydrology

The nearest surface water feature is a man-made deluge pond for spillages located along the eastern border of the site.

Green Dyke is culverted flowing east-west across the northern section of the proposed development site; the dyke emerges into an open channel approximately 20m to the east. Green Dyke is not located under any proposed structure at this time and is situated between the proposed factory extension and biomass plant area.

2.6 Desk Study Information

Potential contamination sources identified within the conceptual site model (CSM) provided within the January 2014 and June 2016 reports and are listed in Table 2.3 below.

Table 2.3 Summary of Potential Contaminant Sources

Potential Source	Potential Contaminants	Potential Impact
Made Ground associated with historic construction site buildings / hardstanding areas.	Heavy metals, sulphates, polycyclic aromatic hydrocarbons PAH's, asbestos, hydrocarbons and hazardous ground gases.	Potential human health risk through ingestion, dermal contact and inhalation.
Former operation and maintenance of aircraft on site.	Volatiles, solvents, ethylene glycol and total petroleum hydrocarbons (TPH).	Potential human health risk through ingestion, dermal contact and inhalation.
Cadmium known to have been released into the Green Dyke 260m west.	Cadmium.	The hydraulic flow of the stream would carry the contaminant through the site via the culvert. The potential for contamination would be dependent on the integrity of the culvert and the flows involved. Possibility that concentrations of cadmium dissolved within stream water may locally impact the water surrounding the culvert but are unlikely.

3. GEO-ENVIRONMENTAL ASSESSMENT RESULTS

3.1 Human Health & Controlled Waters Risk Assessments

A generic qualitative human health risk assessment (GQRA) was undertaken using adopted S4UL assessment criteria (Suitable for Use Levels reference values published by LQM/CIEH in 2015) or, where not available, CLEA derived assessment criteria. Given the proposed development, soils were screened against generic assessment criteria (GAC) for a commercial development.

3.2 Soils

The geo-environmental assessment completed identified the following Contaminants of Concern (CoC) which exceed the GAC for a commercial development.

- **Beryllium** (WS107 @ 1.00 mbgl);
- **Asbestos** (WS101 @ 0.10 - 0.20 mbgl); and,
- **Dibenzo(a,h)Anthracene** (WS107 @ 1.00 mbgl).

Beryllium and Dibenzo (a, h) anthracene

Elevated levels of beryllium and dibenzo (a, h) anthracene were recorded within WS107 at 1.00 mbgl in the south of the site. The main exposure pathway for both beryllium and dibenzo (a, h) anthracene is through soil ingestion/inhalation of dust. The exceedance of beryllium and dibenzo (a, h) anthracene appear to be localised within the made ground strata described as grey slightly clayey sandy GRAVEL with a slight hydrocarbon odour, which is only recorded within the south of the site.

Asbestos

One the eight samples tested during the investigation recorded the presence of chrysotile asbestos in the form of a cement fragment. The sample was sent for quantification analysis, the results are presented in Table 3.1 below:

Table 3.1 Summary of asbestos results

BH Location	Depth (mbgl)	Asbestos Identified	Quantification
WS101	0.10 – 0.20	Chrysotile – Cement	<0.001

Although the asbestos quantification has come back low, due to the historical use as an old airbase, with asbestos detected in the ground it is advised that a watching brief along with background and personal air monitoring is undertaken during site works.

3.3 Ground Gas

Based on the results of ground gas monitoring, the Site is characterised as Characteristic Situation 2 (CS2).

3.4 Controlled Waters

No notably contaminated Made Ground or areas of free phase hydrocarbons were noted and no ongoing contaminating activities are active which could continue to leach contaminants to groundwater over time. The isolated areas of soil contamination identified will have reducing contamination concentrations over time and as such are assumed to have negligible affect to controlled waters.

4. REMEDIATION STRATEGY

4.1 Key Points

The remediation strategy is based on the redevelopment of the site for an industrial/commercial end use. The key points are:

- Soft landscaping areas in the south of the site should be capped with a clean cover system;
- Should materials need to be removed offsite, this must be done in accordance with waste regulations and thus classified as hazardous/non-hazardous to comply with current legislation;
- Earthworks will likely be required for the development to achieve formation and finished levels. A Materials Management Plan (MMP) or exemption from environmental permitting will be required to support reuse of site won materials and where necessary imported materials; and,
- To manage the presence of asbestos, a watching brief accompanied by personal air monitoring should be undertaken during site works.

4.2 Clean Cover System

Ensafe has recommended that a suitable growing medium comprising a minimum of 300mm clean cover, in areas where Made Ground is to remain in the south of the site, should be incorporated into all areas of soft landscaping.

The samples would then be analysed against their suitability for an industrial end use development for human health. Physical and other chemical analysis of the growing medium will also be required in order to determine phytotoxicity and physical suitability requirements of the growing medium in accordance with BS:3882 2015 and BS8661:20131. This is outside the remit of Ensafe.

In order to ensure that the growing medium is chemically suitable Ensafe has recommended that chemical testing of source samples be taken in accordance with Table 4.1.

4.3 Validation Site Won and/or Imported Materials

Re-use of materials on site should be undertaken via development of a 'Materials Management Plan' (MMP) to be created in accordance with Version 2 of the CL:AIRE Definition of Waste - Industry Code of Practice. The MMP should be declared by a Qualified Person and a signed declaration submitted to the EA prior to reuse of materials on the site.

Validation samples are required from all materials that are to be re-used or imported to site where there is the potential for contaminants to be present, as presented within Table 4.1 below.

Table 4.1 Specification of Materials Validation Laboratory Analysis

Material Use	Testing Frequency	Testing Schedule
Imported Greenfield/ manufactured Topsoil	Minimum 3 or 1 per 250m^3 (whichever is greater)	Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn) PAH (16 USEPA speciation) Asbestos
Site Generated/Imported Sub-Soil	Minimum 6 or 1 per 100m^3 (whichever is greater)	Standard metals/ metalloids (As above) PAH (16 USEPA speciation) TPH (CWG banded) Asbestos Any additional analysis dependant on the history of the donor site.
Imported or Site Generated Fill Material	Minimum 1 per 1000m^3	Standard metals/metalloids (As above) PAH (16 USEPA speciation) Asbestos

[1] BS:3882 2015 'Specification for Topsoil'; BS8601:2013 'Specification for Subsoil and Requirements for Use'

Test results should be compared against screening criteria provided in Appendix II. Where materials are found to contain concentrations of contaminants in excess of the screening criteria further assessment will be required to ensure their suitability for use.

4.4 Management of Asbestos

Site works should be undertaken under an asbestos watching brief, accompanied by personal and background air monitoring.

4.5 Waste Sampling and Frequency

The Environment Agency document 'Waste Sampling and Testing for Disposal to Landfill' provides suitable sampling frequencies based upon whether the material is homogenous or heterogenous and the volume of material to be tested. An excerpt from the document is provided below:

	Population (tonnes)	Homogeneous (number of samples)	Heterogeneous and new wastes (number of samples)
Level 1 Characterisation for Descriptive, Total Concentration & Leaching Tests	<100 t < 500 t <1000 t 10,000 t plus per additional 10,000 t	2 3 5 11 +5 (pro rata)	5 8 14 22 +10 (pro rata)

Sampling density will be reviewed during the work and if material is homogenous sampling number reduced. Significant variances in material encountered or more material is present than first estimated would increase the sampling density. Any increased sampling will be agreed in advance.

Material to be disposed off-site will require to be classified as hazardous or non-hazardous using HazWaste online. In addition, Waste Acceptance Criteria (WAC) testing may be required for provision to haulage contractors and landfills.

Dependant on ground conditions encountered, samples will be scheduled for the below analyses:

- Metal suite comprising of arsenic (As), barium (Ba), beryllium (Be), water soluble boron (B), cadmium (Cd), chromium total & hexavalent (Cr & CrVI), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), selenium (Se), vanadium (V) & zinc (Zn);
- Cyanide (total);
- Asbestos screen;
- Total Organic Carbon & Soil Organic Matter;
- Speciated Polycyclic Aromatic Hydrocarbons (PAH);
- Total Petroleum Hydrocarbons Criteria Working Group (TPHC WG); and,
- Phenols (total).

Analysis will be undertaken on samples as seen appropriate. Asbestos quantification may be required where asbestos is identified.

4.6 Ground Gas Protective Measures

The proposed building type is classified as ''Building Type C'' (medium risk) as outlined within BS

8485:2015+A1:2019, classified as industrial/commercial buildings with small to large room sizes. As the site has been classified as CS2 a minimum gas protection score of 2.5 points is required to safely mitigate ground gas risks within the buildings on site.

A combination of two or more of the following three types of protection measures should be used to achieve that score:

- The structural barrier of the floor slab, or of the basement slab and walls if a basement is present;
- Ventilation measures; and
- Gas resistant membrane.

A breakdown of gas protection scores for each element are given in Table 5, Table 6 and Table 7 in BS 8485:2015+A1:2019. No more than one element of each type (i.e. from each table) should be combined to achieve the recommended gas protection score.

4.7 Previously Unidentified Contamination

Should any significantly impacted material be encountered during the development, potentially associated with sub-surface concrete obstructions, then the following procedure should be followed:

- The contractor shall contact a suitably qualified Environmental Consultant and describe the findings;
- The area will be made inaccessible and signed as containing potentially contaminated materials or alternatively stockpiled on an impermeable surface to allow development on site to continue;
- A suitably qualified Environmental Consultant will attend site to assess and characterise the contamination, including obtaining samples where required;
- Results will be screened against relevant screening criteria depending on the proposed use; and
- The local planning authority (LPA) / environmental health officer (EHO) shall be made aware of the findings.

Recommendations for any further action if required shall be agreed with the LPA/EHO which may include revision of this Remediation Strategy.

4.7 Validation and Record Keeping

Any works undertaken in-line with this remediation strategy require verification and submission of a verification report to confirm the findings and to the satisfaction of the Local Planning Authority (LPA). The verification report shall include as a minimum:

- Summary of pre-development conditions;
- Summary of land regrading / raising and details of any unexpected contamination;
- Description of any remedial measures including excavation volumes, obstructions, soils placement and laboratory analysis;
- Confirmation of depths of topsoil and subsoil in areas of soft standing;
- Validation of gas protection methods;
- Information on waste disposal including waste carriers, receiving sites and volumes of materials moved;
- Details of the source and volumes of imported materials clearly referencing the origin of the materials used and testing carried out to confirm its suitability for use via comparison to the criteria in Appendix II, where required; and
- Certification of asbestos watching brief and background/personal air monitoring.

5. ABBREVIATIONS

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH=	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation

APPENDIX I - FIGURES

APPENDIX II – REC REMEDIATION / VALIDATION CRITERIA

Determinand	Units	Screening Value for Use Of site won or imported materials			Screening Value Source
Inorganics					
Arsenic	mg/kg	640			(i)
Cadmium	mg/kg	190			(i)
Chromium (VI)	mg/kg	33			(i)
Lead	mg/kg	2330			(ii)
Inorganic Mercury	mg/kg	1100			(i)
Nickel	mg/kg	980			(i)
Selenium	mg/kg	12000			(i)
Copper	mg/kg	68000			(i)
Zinc	mg/kg	730000			(i)
Cyanide	mg/kg	1200			(iv)
Asbestos	%	Non Detected			N/A
Organics – PAHs and Phenol					
		1% SOM	**2.5% SOM**	**6% SOM**	
Phenol	mg/kg	760	1500	3200	(iii)
Naphthalene	mg/kg	190	460	1100	(iii)
Acenaphthylene	mg/kg	83000	97000	100000	(iii)
Acenaphthene	mg/kg	84000	97000	100000	(iii)
Fluorene	mg/kg	63000	68000	71000	(iii)
Phenanthrene	mg/kg	22000	20000	23000	(iii)
Anthracene	mg/kg	520000	540000	540000	(iii)
Fluoranthene	mg/kg	23000	23000	23000	(iii)
Pyrene	mg/kg	54000	54000	54000	(iii)
Benzo(a)Anthracene	mg/kg	170	170	180	(iii)
Chrysene	mg/kg	350	350	350	(iii)
Benzo(b)Fluoranthene	mg/kg	44	44	45	(iii)
Benzo(k)Fluoranthene	mg/kg	1200	1200	1200	(iii)
Benzo(a)Pyrene	mg/kg	35	35	36	(iii)
Indeno(123-cd)Pyrene	mg/kg	500	510	510	(iii)
Dibenzo(a,h)Anthracene	mg/kg	3.5	3.6	3.6	(iii)
Benzo(ghi)Perylene	mg/kg	3900	4000	4000	(iii)
Organics – TPHs					
TPH C_5-C_6	mg/kg	3200	5900	12000	(iii)
TPH C_6-C_8	mg/kg	7800	17000	40000	(iii)
TPH C_8-C_{10}	mg/kg	2000	4800	11000	(iii)
TPH C_{10}-C_{12}	mg/kg	9700	23000	47000	(iii)
TPH C_{12}-C_{16}	mg/kg	36000	37000	38000	(iii)
TPH C_{16}-C_{21}	mg/kg	28000	28000	28000	(iii)
TPH C_{21}-C_{35}	mg/kg	28000	28000	28000	(iii)
TPH C_{35}-C_{40}	mg/kg	28000	28000	28000	(iii)

Screening Value Source

(i) LQM/CIEH Suitable For Use Level (S4UL) (2015)
(ii) Defra Category 4 Screening Level (2014)
(iii) S4UL –1%, 2.5% and 6% SOM
(iv) CLEA v1.06 Derived Value

APPENDIX III - LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between Ensafe and the Client as indicated in Section 1.3.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.

5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.

6. In addition to the above Ensafe note that when investigating, or developing, potentially contaminated land it is important to recognise that sub-surface conditions may vary spatially and also with time. The absence of certain ground, ground gas, and contamination or groundwater conditions at the positions tested is not a guarantee that such conditions do not exist anywhere across the site. Due to the presence of existing buildings and structures access could not be obtained to all areas. Additional contamination may be identified following the removal of the buildings or hard standing.

7. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

8. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.

9. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

10. This report presents an interpretation of the geotechnical information established by excavation, observation and testing. Whilst every effort is made in interpretative reporting to assess the soil conditions over the Site it should be noted that natural strata vary from point to point and that man made deposits are subject to an even greater diversity. Groundwater conditions are dependent on seasonal and other factors. Consequently, there may be conditions present not revealed by this investigation.

11. Ensafe can not be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by Ensafe is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by Ensafe in this connection without their explicit written agreement there to by Ensafe.

12. Rather, this investigation has been undertaken to provide a preliminary characterisation of the existing sub-surface geotechnical characteristics and make up and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

13. This investigation has been undertaken to reasonably characterise existing sub-surface conditions and the findings of this study are our best interpretation of the data collected, within the scope of work and agreed budget. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.