



Remediation Strategy

Turing House Free School, Hospital Bridge Road, Hounslow

Presented to **Bowmer and Kirkland**

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Delta-Simons Project No. 18-0170.08






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Report Details

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Report Title	Remediation Strategy
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Quality Assurance

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About us

Delta-Simons is a trusted, multidisciplinary environmental consultancy, focused on delivering the best possible project outcomes for customers.

Specialising in Environment, Health & Safety and Sustainability, Delta-Simons provide support and advice within the property development, asset management, corporate and industrial markets. Operating from ten locations - Lincoln, Birmingham, Bristol, Dublin, Leeds, London, Manchester, Newcastle, Norwich and Nottingham - we employ over 100 environmental professionals, bringing experience from across the private consultancy and public sector markets.

Delta-Simons is proud to be a founder member of the Inogen® Environmental Alliance, a global corporation providing multinational organisations with consistent, high quality and cost effective environmental, health, safety, energy and sustainability solutions. Inogen assists multinational clients by resolving liabilities from the past, addressing today's requirements and delivering solutions for the future. With more than 200 offices located on every continent, more than 6,430 staff worldwide, and projects completed in more than 120 countries, Inogen provides a single point of contact for diverse markets as Automotive, Chemical, Consumer Products & Retail, Financial, Food & Beverage, Healthcare, Insurance, Manufacturing, Non Profit Organisations, Oil & Gas, Real Estate, Services Firms, Technology and Transportation, among others.

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1.0 Introduction, Context and Purpose

Delta-Simons Environmental Consultants Limited (Delta-Simons) has been instructed by Bowmer and Kirkland (the 'Client') to prepare a Remediation Strategy (RS) prior to the commencement of development at land located off Hospital Bridge Road, Hounslow, TW2 6LH (hereafter referred to as the 'Site').

The purpose of this document is to provide a formal statement for the proposed construction phase mitigation requirements to facilitate the development following the completion of a Geo-Environmental investigation undertaken by Delta-Simons. Previous third-party investigations have also been undertaken at the Site, for information on the Site setting, and full details of intrusive investigations including third-party information completed at the Site, this RS should be read in conjunction with the previous reports relating to the Site:

- ▲ *Geo-Environmental and Geotechnical Desk Study, Hospital Bridge Road, Hounslow, Project No. 11677-14, dated September 2017, by Campbell Reith Hill LLP;*
- ▲ *Phase II Environmental and Geotechnical Site Investigation Report, Hospital Bridge Road, Twickenham. Project No. HLEI49195/001R. Dated August 2017, by RPS Health, Safety & Environment; and*
- ▲ *Geo-Environmental Report-Geotechnical Category 1, Turing House Free School, Hospital Bridge Road, Hounslow, TW2 6LH, Delta-Simons Project No. 19-0170.01, dated April 2018.*

It is understood the Site is proposed for the construction of a new secondary school with associated vehicle car parking and hard and soft landscaping. The Proposed Development Plan is included as Drawing 1.

2.0 Previous Report Review

Geo-Environmental and Geotechnical Desk Study, September 2017

Campbell Reith undertook a desk study for the Site in September 2017. At the time of the walkover the Site comprised an open field with a number of small buildings in the central area, assumed to have been used for horses. Three earth mounds were noted in the south western area and were considered potentially representative of fly-tipped material.

The Site is mapped as being underlain by superficial River Terrace Deposits (Taplow Gravels) which the EA classify as a Principal Aquifer. The recorded bedrock of the London Clay Formation is classified as Unproductive Strata. The Site is not located with a groundwater Source Protection Zone (SPZ) and no licensed groundwater abstractions are located within 1 km of the Site.

The Site is within an area considered to be at low to medium risk from WWII unexploded ordnance.

Historically the Site was undeveloped and likely in agricultural use from the earliest map edition dated 1869. From 1920, the south and north-eastern parts of the Site are occupied by orchards. By 1966, a drain is mapped along the northern boundary. Bridge Farm Nursery and likely associated small buildings are noted by the 1999 map edition.

Windsor Railway Line is noted off-Site along the eastern boundary from the earliest map edition dated 1869. The surrounding area has historically been developed for a mixed end use, with residential properties to the south east and north. A cemetery is noted to the west of the Site by the 1966 map edition.

Based on the information provided by the desktop assessment, the likely sources of contamination identified comprise Made Ground, vehicle parking areas, potential fly tipped material associated with mounds and railway associated fill material being used for levelling grounds. Based on the Site history and surrounding land use, the Site therefore was considered to present a low risk with regards to potential contamination.

Phase II Environmental and Geotechnical Site Investigation Report, dated August 2017

RPS undertook an intrusive investigation in August 2017 which comprised the drilling of 3 No. cable percussion boreholes (BH1-BH3) and 12. No hand dug pits. Ground conditions generally comprised a limited thickness of Made Ground underlain by sandy gravels of the Taplow Formation and the London Clay Formation.

Fifteen samples were scheduled for a range of chemical testing including heavy metals, speciated Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPH) including BTEX and MTBE and an asbestos screen. None of the samples exceeded the applied Generic Assessment Criteria (GAC) for a residential without plant uptake end use in areas near the school building and a public open space (parks) end use for the sports field areas. However, Chrysotile asbestos fibers were identified within shallow Made Ground within a single location (HP8) at 0.25 m bgl.

Groundwater sampling and analysis did not identify any concentrations above the applied Generic Assessment Criteria for Inland Freshwater, given the lack of groundwater abstractions within 1 km of the Site.

Following three rounds of ground gas monitoring a peak carbon dioxide concentration was identified at 4.6 % v/v with negligible methane concentrations. Oxygen concentrations ranged between 15.7 % v/v and 19.7 % v/v. A peak flow value of 0.3 l/hr was recorded, however steady flow values never exceeded <0.1 l/hr. Atmospheric pressure across all three monitoring events ranged between 1003mb and 1010mb. Volatile organic compounds (VOCs) were identified between <0.1 ppm and 2.6 ppm. As such the Site was classified as a Characteristic Situation 1 (CS1) in accordance with BS8485:2015.

Geo-Environmental Report-Geotechnical Category 1, April 2018

Delta-Simons undertook a Geo-Environmental Assessment in March 2018 to provide supplementary information on the ground conditions and obtain chemical and geotechnical data for the Site.

At the time of the investigation the Site was consistent with previous reports comprising a vacant parcel of land with a number of small buildings in the central area and three earth mounds/ potentially fly-tipped material in the south western area.

Delta-Simons assessment included the advancement of 8 No. dynamic sampler boreholes, 3 No. cable percussive boreholes. 3 No. BRE Infiltration test and 7 No. trial pits.

Following appropriate testing, none of the samples exceeded the applied Generic Assessment Criteria for the proposed end use scenario with the exception of DS104, which identified marginally elevated concentrations of benzo(a)pyrene and dibenz(a,h)anthracene above their respective GAC for a residential with plant uptake end-use, however were identified below the guidance values for the public open space (residential) end use.

Asbestos fibres were not detected in the samples tested from across the Site area. In addition, samples collected from the vicinity of HP08 (previously advanced location by third party) did not identify any further asbestos. Waste Acceptance Criteria (WAC) testing of the earth mounds identified the soil to classify as non-hazardous.

Three further rounds of ground gas monitoring were undertaken which identified low flow rates and low methane and carbon dioxide concentrations, identified at a maximum of 0.2 %v/v and 4.8 %v/v. As such the Site was classified as a Characteristic Situation 1 (CS1) where no ground gas protection measures are required.

3.0 Remediation Requirements and Methodology

Following Delta-Simons contamination assessments, the following construction phase remediation mitigation measures were considered appropriate:

- ▲ Specific ground gas protection measures are not required;
- ▲ Additional, unidentified localised areas of contamination may exist at the Site and an appropriate 'hotspot' protocol should be in place for groundworkers to act upon should such contamination be identified during the construction process;
- ▲ Groundworkers who are required to perform sub-surface work at the Site should be made aware of the known low-level contaminants in soil and groundwater and the possibility of encountering additional localised low levels of contamination (including Asbestos Containing Materials (ACM)). Therefore, good standards of personal hygiene should be observed and appropriate levels of personal protective equipment (PPE) and respiratory protective equipment (RPE) utilised where necessary;

- ▲ A clean cover of 'suitable for use' topsoil may be appropriate in landscaped areas subject to approval with the Local Planning Authority (LPA). The cover layer thickness shall consist of 450 mm in landscaped areas, existing topsoil in undeveloped areas may be suitable for reuse subject to confirmation with the LPA;
- ▲ Confirmation should be sought from the Local Water Authority as to whether they will require upgraded pipework to be installed for new service installations; and
- ▲ Previously identified asbestos is to remain in-Situ.

4.0 Protocol for Addressing Previously Unidentified 'Hotspots' of Contamination

As with any brownfield development, there is a possibility that unknown area(s) of soil or groundwater contamination, including asbestos, may be encountered during excavation works. Should an area of contamination beyond that anticipated from the investigations be identified by visual or olfactory means the following procedure shall be followed:

- ▲ Immediately stop all works in the area where contamination is suspected;
- ▲ Immediately inform the Site Project Manager who should then contact Delta-Simons;
- ▲ Delta-Simons will judge each occurrence on merit and should it be deemed necessary Delta-Simons shall attend Site to oversee the excavation of the 'hotspot' and the collection of validation samples;
- ▲ Any excavated material shall be isolated from all other material at the Site and, if deemed appropriate, be disposed of to a suitably licensed facility. Delta-Simons should be supplied with consignment notes for all off-Site disposal;
- ▲ The excavation should remain open until the validation has been completed; and
- ▲ Any identified hotspot would need to be appropriately classified prior to disposal to landfill (or transferred to a treatment centre). If material is identified as hazardous then the Site needs to be registered with the Environment Agency as a producer of hazardous waste. This can be done online and requires the company's registration code and a code that relates to the industry type.

Please note; should contamination be encountered at variance to the characteristics in the investigation reports it should be reported to the planning authority as soon as possible for further consideration. Action taken would be recorded as part of the validation.

5.0 Clean Cover/Suitable Soil

As part of the proposed development scheme, the Site is to be predominantly covered in hardstanding in the north eastern area with limited areas of soft landscaping and the central area is to comprise sports fields. However, it is required that a layer of clean topsoil and subsoil be imported into any proposed soft landscaped areas in order to further mitigate the risk of direct contact exposure and soil ingestion/ inhalation by future Site users.

This should be carried out in accordance with London Borough of Hounslow: Developed on Land Affected by Contamination, included as Appendix B. The chemical composition of the imported material should not exceed the Generic Assessment Criteria for a residential with plant uptake end use. The applicable criteria are included in Appendix C. Any material imported to Site for use should comply with the testing regime outline in the guidance at a frequency of **one sample per 50 m³ and a minimum of four samples per source**.

It is, therefore, proposed that the following cover system will be adopted:

- ▲ A layer of clean soil, a minimum of 450 mm in landscaped areas. Subject to the final development levels a reduced level dig may be required to facilitate the clean cover layer. Any material requiring off-Site disposal will need to be appropriately classified to determine its final treatment/ disposal destination;
- ▲ The material will be sourced by the Contractor and documentation submitted on its origin that is acceptable to the London Borough of Hounslow Council, the Main Contractor and to Delta-Simons. The documentation should as a minimum comprise information on the origin of the materials and chemical testing of suitable suite of contaminants. Delivery notes should also be supplied;

- ▲ Given significant contamination has not been identified and previously identified asbestos is within proposed public open space (see Section 8.0); and
- ▲ The material shall not exceed the criteria presented in Appendix C.

6.0 Mitigation of Risks to Groundworkers during Development

Low levels of contamination have been identified at the Site and as with any Brownfield development there is the potential for further previously unidentified hotspots of contamination to be present at the Site.

As such, it is recommended that the Contractor provides appropriate inductions to all groundworkers who are required to perform sub-surface work at the Site in order to ensure they are made aware of the possibility of encountering contamination at the Site. In addition, good standards of personal hygiene should be observed and appropriate levels of PPE and RPE, where applicable, provided and utilised in order to mitigate the potential for direct contact.

7.0 Upgrading of Potable Water Supply Pipes

Potable water pipes may require upgrading with 'Protectaline' water pipe, or similar. Confirmation should be sought from the Water Authority, and evidence of any upgraded pipework collected by the Contractor for inclusion within the Verification Report.

8.0 Asbestos Identification

Asbestos has been identified within shallow Made Ground in a single location only (HP8) in the south western corner, following additional delineation, no further asbestos was identified. Given this area is to remain as public open space with no development proposed and the localised nature of the asbestos, it is considered that the asbestos should remain undisturbed in the damp ground where the risk of fibre release is very low.

9.0 Validation Reporting

The validation report should comprise the following items of verification that the Remediation Strategy has been complied with:

1. Details and verification of any Hotspots encountered (Main Contractor and Delta-Simons);
2. Waste disposal tickets for any reduced level dig spoil. (Client's Contractor);
3. Chemical test data and frequency for imported topsoil/subsoil (To be supplied by Main Contractor) in accordance with the London Borough of Hounslow guidance document;
4. Photographic evidence of the installation and thickness of the topsoil/subsoil (To be supplied by Main Contractor);
5. Upgraded water supply pipe delivery tickets, if required. (Client's Contractor);
6. Brief report containing the above. (Delta-Simons).

Drawing 1 – Proposed Development Plan - EFATH-ALA-00- XX-DR-L-0003



Notes
 1. Drawing not to be scaled for construction or setting out purposes.
 2. To be read in conjunction with Project Risk Register REF: XXX
 3. To be read in conjunction with all other Landscape Architect's drawings

KEY

- (A) Entrance Plaza**
40no. Total Spaces
- (B) Car Parking**
3 Disabled Bays
10 Active Electric Charging Points
10 Passive Electric Charging Points
Deliveries / Coach Bay
- (C) New Site Entrance**
- (D) Deliveries and Maintenance Gate**
- (E) Habitat Area**
Planting species designed to encourage insect and bird habitats and enhance the ecological corridor. Indicative design intent shown for illustrative purposes only.
- (F) Pedestrian Boulevard**
- (G) Hard Informal Social Area**
- (H) 6th Form External Social Space**
- (I) External Canopy**
- (J) Cycle Parking**
136no. Pupil Spaces
10no. Visitor Spaces
10no. Staff Spaces
- (K) 3 Court MUGA**
- (L) Playing/Sports Field**
A Space design to maximise the amount of sports played by the school. The North/South orientation results in 3no. pitches
- (M) Boundary Fence**
a 2.4m boundary fence with hedge planting to provide screening
- (N) Grassland & Habitat Creation**
Area seeded with species rich grass and planting with trees to create habitat zones and habitat creation. Indicative design intent shown for illustrative purposes only
- (O) Habitat Corridor**
The existing avenue of trees retained and grassland managed to reinforce the habitat corridor, providing habitat corridor between the rail line, cemetery and retained fallow land
- (P) Pupil Access**
Proposed pupil access from Heathfield Recreation Ground. A low lit self bind gravel path weaving through the habitat area to the school.

ID	RISK	MITIGATION	Date Mitigated

RESIDUAL PROJECT RISKS

DATE	SUITABILITY	REV	DESCRIPTION OF REVISION	DRAWN BY	APPROVED BY
10.07.18	S2	P09	Amendments to redline	LA	LA
20.08.18	S2	P08	Fence line amended to protect Habitat Corridor	EZ	RA
30.05.18	S2	P07	MUGA surface colour changed to green	LA	LA
22.05.18	S2	P06	Red line amended at 116 Redfern Ave.	LA	LA
14.06.18	S2	P05	Planting Species amended	LA	LA
02.04.18	S2	P04	MUGA and pitches relocated to allow for 10m habitat corridor to the northern boundary	LA	LA
07.02.18	S2	P03	Car parking and tree removal strategy amended to reflect updated tree survey and bin store and consultation moved to accommodate ecology comments	HT	LA
13.11.18	S2	P02	Red Line Amended	HT	LA
			Highways entrance and adjacent area updated	HT	LA

REVISIONS

SUITABILITY
S2 - For Planning

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CLIENT:
Bowmer and Kirkland

PROJECT TITLE:
Turing House School

DRAWING TITLE:
Illustrative Masterplan

DRAWING SCALE: 1:1000
 DRAWN BY: EC
 DRAWN DATE: 02.03.2018

PLANS SIZE: A1
 APPROVED BY: LA

DRAWING NUMBER: EFATH-ALA-00-XX-DR-L-0003
 SUITABILITY: S2
 REVISION: P09

Appendix A – Limitations

Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

Appendix B – London Borough of Hounslow: Developed on Land Affected by Contamination Guidance

Development on Land Affected by Contamination

A guide to help developers meet planning requirements

1. Introduction

This guidance is primarily for property owners, developers, architects and surveyors who want to know what information they should submit to the planning department when they apply to re-develop, or significantly change the use of a piece of land, which could potentially be contaminated. This document is a guidance note only, developers and their consultants are expected to refer to current applicable guidance and good practice.

Contamination, in most cases, is likely to arise from a previous use of the site or an adjacent site that had an industrial activity on it at one time or another. There may also be a ground gas risk to the site from nearby landfills.

A substantial amount of land in Hounslow is at risk of being contaminated as the borough has an extensive industrial history. Factories, landfill sites, gas works and the military have all operated here. These industries have sometimes polluted the land where they operated. This pollution, or contamination, where present has the potential to harm human health, water supplies, natural habitats and property.

The Department of Environment (DoE) Industry Profiles (published in 1995) provide a general background on the types of contaminants associated with individual industries¹.

2. The Planning Process

The role of the planning process is to ensure that land is made suitable for its proposed end use. All planning applications (including prior approval and permitted development applications) have to be considered for potential contamination issues to ensure compliance with the Town and Country Planning Act 1990, the National Planning Policy Framework (NPPF) and the Hounslow draft Local Plan. The NPPF states that 'the effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potentially sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account'².

On any site where there is a potential for contamination to influence the site the Planning Officer will consult the Land Quality Department. For sites that have been previously developed or are situated on agricultural land a Phase I Preliminary Risk Assessment (PRA) is required. An exception to this is small permitted developments (i.e. an extension at a single dwelling, permitted developments to a more sensitive end use i.e. offices to residential will still require a PRA/standard conditions). The PRA should be submitted with the original planning application.

¹ DoE Industry Profiles Available from:

http://www.claire.co.uk/index.php?option=com_content&view=article&id=198:doe-industry-profiles&catid=76&Itemid=662

² Department for Communities & Local Government 2012

As a result of consultation with the Land Quality Department, the planning officer may make one of the following recommendations for planning applications on potentially contaminated sites;

- Consent is refused outright (this is very rare)
- Consent is refused and/or the decision deferred until further supporting information is provided
- Consent is granted conditionally³ requiring certain information to be provided and possibly remediation and validation works to be undertaken to discharge condition(s).
- Consent is granted without conditions.

It is essential that the applicant provides as much information as possible to the Local Planning Authority (LPS) as possible, at every stage of the planning process. Withholding information, however trivial, may cause a delay to the application. The onus is on the applicant to keep the LPA well informed about the development at all times.

3. Competency

Any assessment on land potentially affected by contamination will need to be undertaken by a competent suitably qualified person, i.e an environmental consultant specialising in land contamination with demonstrable experience in dealing with similar sites. Certain sites are likely to require a consultant with specific expertise. For example;

- A high risk site such a petrol filling station with Total Petroleum Hydrocarbon (TPH) groundwater contamination and a TPH plume extending from a redundant tank would require a consultant with extensive hydrogeological experience able to model the plume and derive remedial targets.
- A former chemical manufactory site presenting extensive contamination of soils with a range of solvents likely to require detailed risk assessment and should be undertaken by a consultant with extensive human health risk assessment experience, particularly where contaminants present do not have generic assessment criteria.

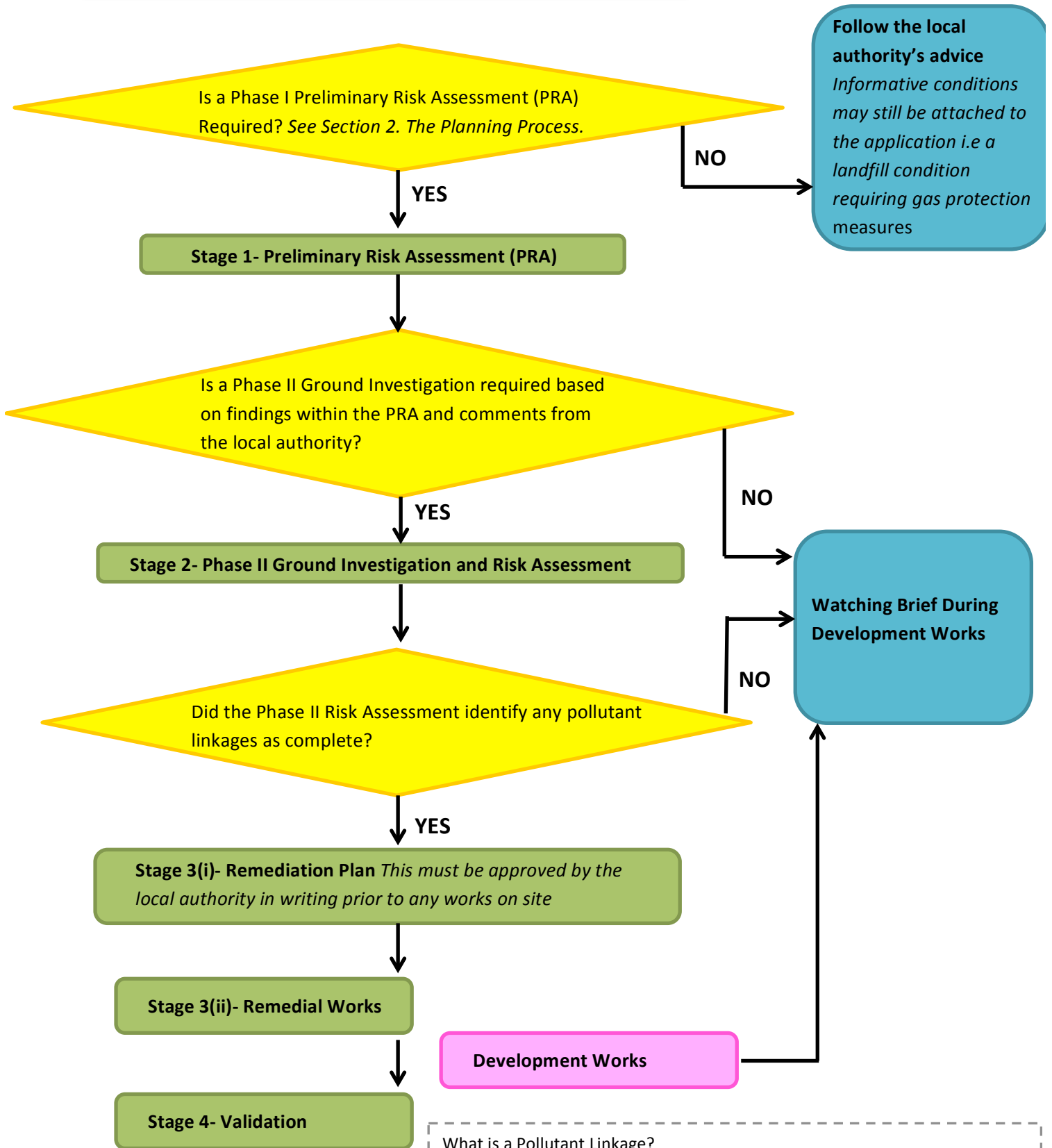
Failure to use a competent consultant will likely result in delays to the development and further costs incurred for additional phases of work that could otherwise have been avoided. Conditions cannot be discharged until the site has been suitably assessed and potentially investigated, remediated and verified to the satisfaction of the local authority.

4. Discharge of conditions

To discharge land contamination conditions the Local Planning Authority will require, at all relevant stages that works undertaken are satisfactory. Reports submitted must demonstrate that the site is suitable for use and does not pose an unacceptable risk to the wider environment.

³ Conditions will be specific to each site but will generally comprise of the requirement for a Phase I Preliminary Risk Assessment and dependant on findings a satisfactory site investigation, remediation plan, remediation works and verification works.

Procedure for dealing with land potentially affected by contamination



What is a Pollutant Linkage?
 A Pollutant Linkage is the relationship between a contaminant, pathway and receptor. A Pollutant Linkage is considered complete when a contaminant is found to be present at unacceptable levels and a viable pathway exists for that contaminant to reach and adversely impact an identified receptor (such as river or residents at a property).

Stage 1- Phase I Preliminary Risk Assessment (PRA)

The PRA will be undertaken in line CLR11.

The PRA will establish;

- Site location and setting (including a site boundary)
- Current land uses on and in the vicinity of the site
- Historical land use on and in the vicinity of the site
- Any landfill or waste sites within 250m of the site
- Details of pollution incidents
- Environmental Permits
- Potential sources of contamination and associated contaminants of concern
- Geology and potential for Made Ground
- Hydrogeology and hydrogeology including any abstraction and discharge licenses
- A site reconnaissance or site walkover survey will need to be carried out as part of this assessment. This will involve physically visiting the site to assess current use, surface conditions and any visible evidence of contamination such as asbestos debris, staining or waste drums, tanks etc.

You will need to review sources including historical maps, geological maps, hydrogeological maps and relevant environmental searches. For more complex sites such as filling stations or more recent chemical sites it may be necessary to obtain more detailed information such as detailed site plans or information on former operations and processes.

The PRA will develop a site specific conceptual model (CSM). *The CSM must identify potential **receptors** such as human health and controlled waters, potential **pathways** and **potential sources** of contamination. The conceptual site model will then identify which potential **pollutant linkages** are plausible given the information obtained from the PRA. The conceptual site model should be as detailed as possible and in line with current guidance assign potential severity and probability of risk to potential pollutant linkages through a risk ranking evaluation. An excerpt from a good, robust conceptual site model is provided below. It is always recommended that conceptual site models are given in table form, for complex sites it may be of benefit to also produce a graphic conceptual site model to aid understanding of the CSM.*

Source	Pathway	Receptor	Severity	Probability	Risk	Pollutant Linkage	Comments
Redundant tanks, interceptors and residual contaminants within made ground Potential contaminants including TPH, BTEX and MTBE	Migration by surface run-off	Surface Water Drainage	Medium	High Likelihood	High	Plausible	Plans obtained from client and GPR survey indicate two redundant tanks remain on site. Site walkover survey identified free product within interceptors on site. Site sits directly on superficial Principal Aquifer and River Crane is present 100m south.
	Migration in solution or via product via groundwater	Underlying Principal Aquifer River Crane 100m south	Severe	High Likelihood	Very High	Plausible	
	Inhalation of vapours	Future site residents	Severe	High Likelihood	Very High	Plausible	
	Ingestion and adsorption via direct contact		Severe	High Likelihood	Very High	Plausible	

The PRA will produce conclusions and recommendations *i.e. to inform the scope of the site investigation, if required.*

The Phase I PRA must be completed before moving onto the Phase II Ground Investigation.

Stage 2- Phase II Ground Investigation and Risk Assessment

Ground Investigation

Where the Phase I PRA indicates plausible pollutant linkages for the site, or at the request of the Local Authority a Phase II will be required. The scope of the Phase II should have been set out in the PRA (which the council would generally provide comment on as part of their initial response). The Phase II report should be undertaken in line with relevant British Standards and current UK guidance i.e. BS10175, BS5930 and CLR11.

The **sampling density** should be appropriate for the size of the site, former land uses, proposed end use and achieve a good coverage of the site. The investigation should also **target potentially contaminative current or historical features** such as tanks, electricity sub-stations, areas of infilling, building footprints etc. An example of a good, targeted initial ground investigation plan is shown below for a dye works.



Investigation methods should be suitable for the nature of the site with regard to geology (i.e. window samples are generally not suitable to progress into gravels or hard clay) and necessary installations/required sampling. Requirements and frequency of gas monitoring, soil sampling, groundwater sampling and surface water sampling will follow relevant guidance.

Stage 2- Phase II Ground Investigation and Risk Assessment continued...

Samples must be tested for contaminants of concern identified within the PRA and made ground from the site should always be screened for asbestos. Labs used should be accredited in accordance with guidance. When analysing Total Petroleum Hydrocarbons (TPH) the TPH-CWG method should be used to avoid complications during risk assessment works and unnecessary further sampling.

For sites where contamination is identified it may be necessary to undertake more than one Phase of site investigation to fully characterise the site, such as where hotspots of contamination are identified and the extent needs to be confirmed (i.e. delineation works).

Risk Assessment

The Phase II report should present a tiered risk assessment and should address the plausible pollutant linkages identified within the PRA. For generic screening criteria, current UK guidance must be used, at present (February 2017);

- LQM/CIEH S4ULs (2015) can be used for human health risk assessment, with C4SLs used for constituents without values.
- For groundwater risk assessment, EQS values should be used from the WFD Directions (2015) and drinking water values should be taken from the Water Supply Regulations (2016).

It is the developer and their consultants' own responsibility to keep up to date with any changes in legislation and guidance.

Where values are elevated or screening criteria are not available further more detailed assessment may then be used to assess the potential risk that these constituents pose to the site. Site specific values may be used for assessment such as CLEA derived values or EA remedial targets provided inputs are from site specific values obtained from methods such as pumping tests and all workings are provided.

The Phase II risk assessment should identify which pollutant linkages are complete for the site.

This risk assessment must be undertaken by a competent consultant(s) with relevant experience (see section 3. Competency).

Stage 3- Remedial Works

Where a site is identified as having complete pollutant linkages, remedial works will be required to make the site suitable for use and, where necessary protect the wider environment such as underlying aquifers and surface waters.

Remediation can take many forms such as excavation of impacted materials, placing of capping layers, protective membranes or chemical/biological methods. The methods must be appropriate to the site and approved by the local authority in writing.

A remediation plan must be approved by the local authority prior to any works commencing on site.

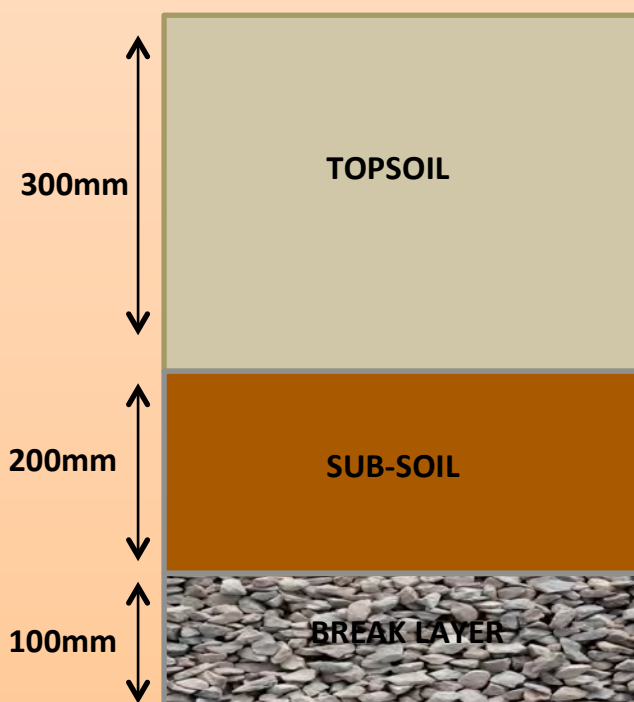
Any remedial works will need to follow industry standard practices and guidance. For soil capping layers the council requires a minimum of 450mm clean cover for areas of landscaping and a minimum of 600mm clean cover for areas of gardens. A break layer or membrane should be included within this layer (max 100mm). A membrane is preferable where asbestos is identified in site soils. A minimum of 150mm topsoil is required as a suitable growing medium, the cover layer should also include sub-soil such as a natural clay. Examples of good cover systems are provided below.

For cover systems, the remediation plan must detail site specific acceptance criteria for chemically validated soils.

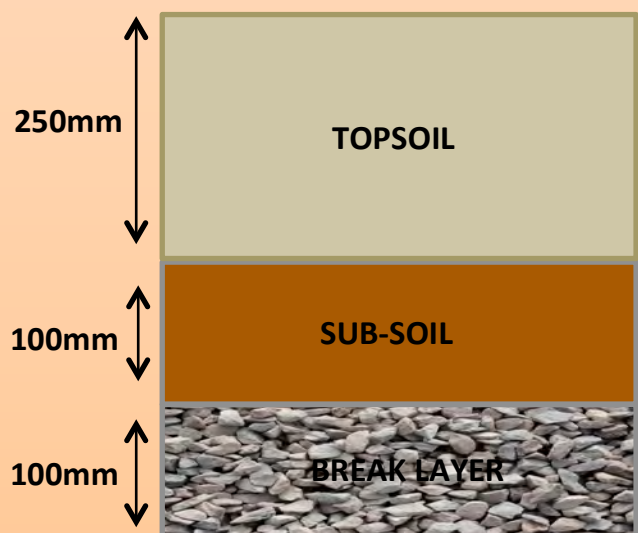
Testing requirements for imported soils are as follows;

- Testing should be undertaken at a frequency of 1 sample per 50m³ of imported fill.
- A minimum of 4 samples per source.

COVER SYSTEM FOR GARDENS



COVER SYSTEM FOR LANDSCAPING



Watching Brief during development works

For potentially contaminated sites the council will generally put a watching brief condition on the development. This requires the developer to be vigilant to any (further) contamination on the site uncovered during development works which was not identified within the Phase II ground investigation. As Phase II site investigations are generally far less intrusive and expansive than ground works during a development it is not uncommon that further, unforeseen areas of contamination are encountered.

If contamination is suspected then a competent person (see section 3-competency) will be required to attend the site and undertake further investigation, sampling and testing. The remediation plan must then be updated to reflect any further findings during this stage.

Validation

Once remedial measures have been completed they need to be independently validated. This should be undertaken at an appropriate stage, i.e gas membranes are to be validated before the ground-slab concrete is poured and capping layers should be validated prior to turf being laid.

The validation report must be submitted to the local authority for approval in writing. For capping layers photographic evidence must be included for depth validation (i.e. with the use of a measuring staff) and for gas protection measures photographic evidence must be included showing the full extents of the membrane, joints, seals and top hats.

Appendix C – Generic Assessment Criteria for Imported Materials

Generic Assessment Criteria for Imported Materials

The following Generic Assessment Criteria shall apply as absolute limits for all soils imported for re-use as clean cover **regardless of the end use of the Site**.

The criteria selected are based on Residential with Plant Uptake land use scenario on the basis that imported clean cover soils should be 'clean' and not result in an increase in contaminant loading. It may be possible, in some circumstances, to agree alternative, higher criteria with the appropriate regulatory body, however, this is outside of the scope of this assessment.

Soils shall be tested for a suite of contaminants appropriate to the source land use but as a minimum for the contaminants stated below unless otherwise stated within this strategy. The below criteria assume a minimum of 1% Soil Organic Matter.

In addition to meeting the criteria below, imported materials shall be free from deleterious inclusions and shall be free from invasive weeds (Japanese Knotweed).

Any testing for asbestos must be from a UKAS accredited laboratory and the only acceptable criteria is 'Not Detected'. Any detected asbestos, even if reports as <0.001% is not acceptable. Asbestos containing soils must not be used for clean cover materials.

Criteria for Imported Materials			
Compound	GAC	Source	Comment
Arsenic	37	C4SL	
Cadmium	11	LQM	
Chromium (III)	910	LQM	
Chromium (VI)	6	LQM	
Copper	2400	LQM	
Lead	200	C4SL	
Mercury (inorganic)	40	LQM	
Nickel	130	LQM	
Selenium	250	LQM	
Zinc	3700	LQM	
Acenaphthene	210	LQM	
Acenaphthylene	170	LQM	
Anthracene	2400	LQM	
Benzo[a]anthracene	7.2	LQM	
Benzo[a]pyrene	2.2	LQM	
Benzo[b]fluoranthene	2.6	LQM	
Benzo[ghi]perylene	320	LQM	
Benzo[k]fluoranthene	77	LQM	
Chrysene	15	LQM	
Dibenz[ah]anthracene	0.24	LQM	
Fluoranthene	280	LQM	
Fluorene	170	LQM	
Indeno[123-cd]pyrene	27	LQM	
Naphthalene	2.3	LQM	
Phenanthrene	95	LQM	

Criteria for Imported Materials			
Compound	GAC	Source	Comment
Pyrene	620	LQM	
Benzene	0.2	C4SL	
Toluene	130	LQM	
Ethylbenzene	47	LQM	
Xylene – m/p	56	LQM	
Xylene - o	60	LQM	
Total Petroleum Hydrocarbons (TPH)	500		Professional judgement.
Aliphatic EC5-EC6	42	LQM	
Aliphatic >EC6-EC8	100	LQM	
Aliphatic >EC8-EC10	27	LQM	
Aliphatic >EC10-EC12	130	LQM	
Aliphatic >EC12-EC16	500	LQM	Capped at 500 - professional judgement
Aromatic >EC5-EC7	70	LQM	
Aromatic >EC7-EC8	130	LQM	
Aromatic >EC8-EC10	34	LQM	
Aromatic >EC10-EC12	74	LQM	
Aromatic >EC12-EC16	140	LQM	
Aromatic >EC16-EC21	260	LQM	
Aromatic >EC21-EC35	500	LQM	Capped at 500 - professional judgement
Asbestos	Not Detected		

The respective sources are:

- ▲ Soil Guidance Values (**SGV**) published by the EA;
- ▲ Category 4 Screening Levels (**C4SLs**) published by DEFRA;
- ▲ The 2014 Land Quality Management (**LQM**) / Chartered Institute of Environmental Health (CIEH) Suitable for Use Levels for Human Health Risk Assessment (S4ULs);
- ▲ The guidance values produced by the Environmental Industries Commission (**EIC**), the Association of Geotechnical and Geoenvironmental Specialists (AGS) and Contaminated Land: Application in Real Environments (CL:AIRE) in December 2009; and
- ▲ In house Generic Screening Values (**DS-GACs**) derived by Delta-Simons.