



ENABLING WORKS STRATEGY AND VERIFICATION PLAN FOR SYMMETRY PARK MERSEYSIDE, HUYTON

ISSUE 1.0

TE1163EWS

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1. INTRODUCTION

Tier Environmental was commissioned by Tritax Symmetry Ltd to undertake an Enabling Works Strategy report for the Symmetry Park development, located off Fox's Bank Lane, Cronton, Knowsley L3 5SU (the "Site"). The Site is generally bounded to the north by the M62 motorway, to the south by Cronton Road and to the east by Fox's Bank Lane.

It has been assumed in the production of this report that in the northern and central portions of the Site, the redevelopment is to comprise a series of industrial warehouses each with associated car parking areas, surface water attenuation ponds and areas of soft landscaping. In the south and eastern areas of the Site it is proposed that the site will be redeveloped into a country park, comprising woodland, ephemeral lakes and footpaths. A large-scale earthworks exercise (approximately 450,000m³ of cut/fill) is proposed to provide the appropriate development platforms and highway gradients.

It is proposed that this document is a 'live' document that can be updated throughout the lifetime of the project and has been prepared to document an overarching methodology for the site for agreement with relevant parties.

It is envisaged that this document will need to be supplemented by detailed reports relating to specific materials, phases or areas throughout the lifetime of the redevelopment and in order to discharge relevant planning conditions relating to the redevelopment.

In addition to the need to raise ground levels associated with the proposed development, current ground levels across the site vary. It is anticipated, therefore, that any redevelopment of the site would need to be done in conjunction with reprofiling earthworks and reclamation. In line with the size of the site, it is envisaged that any such works would need to be phased.

The reclamation and reprofiling of each phase is likely to result in the generation of soils and other materials. In line with the objectives of sustainability, the preferred option for the majority of site won materials is to re-use them on site, where it can be proven that these materials are suitable for re-use and can be incorporated into the design.

1.1. Historic Investigations

A series of previous site investigations and desk studies have been conducted across the Site over its history, with the reports collected by Tier Environmental spanning from 1999 to 2017. These include investigations conducted by Parkman, Mouchel, Mott Macdonald, Arup and Barker & Barker.

The above reports were reviewed, and pertinent data incorporated alongside supplementary investigation data obtained by Tier Environmental Ground Investigation Report (reference: TE1163GIR, Issue 1.1, dated 9th December 2021), hereafter referred to as the 'GIR' report. The GIR report included a generic quantitative risk assessment of laboratory chemical analysis data obtained from soil, soil leachate, surface water and groundwater to determine potential risks to human health for the proposed land use and the controlled waters environment.

The results of a generic quantitative human health risk assessment have determined the following:

- Localised low level asbestos impacts were reported that were considered to present a potentially unacceptable risk to human health receptors for a commercial/industrial and public open space / park land use. The dust inhalation pathways associated with asbestos impacted soils may be realised in areas where Made Ground soils remain at the surface (i.e. soft landscaped areas).



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- Additional analysis and detailed qualitative risk assessments were undertaken to determine the suitability of the asbestos impacted soils being retained at surface/shallow depth. A detailed asbestos risk assessment report was conducted, in summary, for the proposed end uses it determined that the asbestos concentrations encountered present a minimal/tolerable risk to future site users.
- No other determinands were encountered across the site in exceedance of their respective GACs relevant to the proposed land uses.
- In accordance with CIRIA C665, the assessment of the gas monitoring data obtained to date produced a maximum Gas Screening Value of 0.3276l/hr, derived using the maximum recorded carbon dioxide concentration of 15.6%v/v and the maximum steady flow rate of 2.1l/hr. Assessment of this gas screening value alone places the Site in a Characteristic Situation 2. A low risk scenario in accordance with CIRIA C665 for **which ground gas protection measures will be required**. At the time of writing the final development layout for the site (Units 02 and 03) is still not established in detail, as such the final locations, post earthworks, of differing material types cannot be confidently discerned. Under each of the current proposed units is an area where ground levels need to be increased. To do this may use any material type found across the Site. It is therefore considered prudent, at this stage, to utilise a worst case scenario from across the entire Site, as undertaken above to adequately protect future end users. Tier Environmental have also considered the risk from the outcropping coal seam and faulting system that underlies the Site, targeting multiple boreholes above these features. After a thorough review of the conceptual site model, gas data to date and development plans Tier Environmental are satisfied that a CS2 scenario across the Site, will adequately protect the proposed development from hazardous ground gases.
- Radon protection measures are not required at the Site

The results of a generic quantitative controlled waters environment risk assessment have determined the following:

- Measured concentrations of chromium, copper, nickel, zinc, anthracene, fluoranthene and benzo(g,h,i)perylene were reported in soil leachate samples in excess of EQS Freshwater Values by between the same and 1 No. order of magnitude. Given the presence of colliery spoil to the north and south of the site, the absence of a persistent shallow groundwater body, the significant potential for dilution within groundwater at depth, the low order of magnitude of the exceedances and the fact that leachable concentrations in excess of the respective WQS appear not to be widespread, it is considered that the measured leachate concentrations do not present a significant risk to controlled waters.
- Marginal EQS exceedances of cadmium, copper, lead, nickel, zinc, benzo(a)pyrene and fluoranthene were reported in groundwater samples taken at the Site. These concentrations are considered representative of assumed background groundwater quality associated with the surrounding areas historical industrial land uses. As such, the measured groundwater concentrations on Site are not considered to represent a risk to controlled waters.
- Fox's Bank Brook enters the Site in the north-eastern section of the Site and meanders around the eastern and southern boundary of the site before exiting the Site in the south-western section of the Site. Representative samples were taken from upstream in the north-east of the brook and downstream in the south-west section of the brook, as the watercourse entered and left the Site area. The results upstream results (sample S1) recorded measured concentrations of copper and fluoranthene above their respective EQS values by between the same order of magnitude and 1 No. order of magnitude. The results also record concentrations of acenaphthylene, acenaphthene, fluorene, phenanthrene



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and pyrene for which there are no screening criteria. These concentrations are only marginally above the laboratory limit of detection. Whilst the downstream results (sample S2) recorded measured concentrations of copper, zinc, sulphate, fluoranthene and benzo(a)pyrene above their respective EQS values by between the same order of magnitude and 2 No. orders of magnitude. The results also recorded concentrations of acenaphthylene, acenaphthene, fluorene, phenanthrene, chrysene, benzo(a)anthracene and pyrene marginally above the laboratory limit of detection but for which there are no screening criteria. The upstream and downstream results were comparatively similar with some determinants increasing slightly whilst others decrease slightly throughout the course of the stream. Overall, the number of PAHs recorded above the laboratory limit of detection has increased marginally downstream.

- A second round of surface water testing was undertaken to expand the suite of analysis to include iron, manganese, thallium, antimony, chloride and sulphide with three samples taken, upstream (SW1), mid site (SW2) and downstream (SW3). The results show very little variability throughout the course of the brook indicating that no contaminants from the Site are leaching into the watercourse. Elevated sulphate concentrations were encountered throughout the entire site area; however, the 5 No. samples taken from the surface water registered the lowest 5 No. sulphate values recorded during the monitoring works with 4 No. of the results recorded below the EQS value.
- It was considered that the Site does not pose a risk to surface waters and that there are no current contamination issues polluting the watercourse running through the Site. No ochrous discharge was encountered throughout the surface watercourse, pH results observed within the surface water samples were all above 7. Mine water is predominantly acidic and acidic water was noted in boreholes within the Site boundary. It is therefore considered that the surface waters that transect the site are not affected by the minewaters. When comparing groundwater data taken from the Site with the surface water data, it is evident that the concentrations of determinants encountered in groundwaters within the Site is not present within the surface waters.

To deal with the ground gas risk and the required protection measures across the Site a separate ground gas verification plan was produced (Report ref TE1163GVP1.0 dated 22/10/2020). Following the production of the asbestos risk assessment (TE1163ARA1.0 dated 23/10/2020) **it is considered that there are no remedial requirements in regards to ongoing contaminative sources in order to make the Site safe for redevelopment and no remediation strategy is required.**

1.2. Enabling Works Requirements

The GIR report included the following measures were recommended in order to make the site safe and suitable for redevelopment:

- General site clearance including hardstanding, vegetation and Topsoil;
- Segregation of Topsoil from the different source areas, i.e. agricultural land and paddock, the imported Topsoil within the motocross track and the manufactured Topsoil above the colliery spoil;
- Chipping of trees and incorporation into site won Topsoil;
- Removal of any below ground relict structures associated with former foundations/basements, notably in the eastern area of the site;
- Bulk earthworks to achieve the proposed development levels, with fill materials compacted in accordance with a recognised specification, such as Specification for Highways Works Series 600 Earthworks. It may be beneficial for the



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fill materials and underlying Till beneath Unit 01 to be lime stabilised to minimise the risk of unacceptable total and differential settlements;

- Removal and verification of any previously unidentified areas of contamination, where required;
- Drilling and grouting within areas of supposed mine workings
- Backfill of resultant excavations with suitable material;
- Installation of hazardous ground gas protection measures in accordance with BS8485: 2015 within affected units;
- Laboratory chemical testing and risk assessment of all imported materials; and,
- Installation of a minimum of 150mm Topsoil to provide a suitable growing medium in any soft landscaping areas.

1.3. Objectives of the Report

On the basis of the above, the objectives of this report are to:

- To provide more detail on how the proposed enabling works are to be carried out.
- To provide clarity on the measures proposed with respect to asbestos impacted and potentially impacted materials.
- To provide information on monitoring of the brook to take place during the development.
- To provide information on how the above measures are to be verified.

This report, which was designed to meet the requirements of all relevant current guidance including 'Land contamination: risk management' (LCRM) presents the factual information available during this appraisal, interpretation of the data obtained and recommendations relevant to the defined objectives.



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2. SITE DETAILS AND DESCRIPTION

Table 2-1. Current Site Overview.

Site name	Former Cronton Colliery
Site address	South of Halsnead Farm Livery Stables, Fox's Bank Lane, Cronton, L35 3SU. A site location plan is included as Drawing No. TE1163GIR1 within Appendix A.
National Grid Reference	SJ 47493 89537
Location description	The Site is located south of the M62 in a predominantly agricultural area. The closest town is Whiston which is 2.3 km North of the Site.
Approximate Site area	50.84ha
Site shape	Irregular with the longest axis in the east to west direction and the shortest axis being in the north to south direction.
General topography and ground levels	The Site is generally undulating with ground levels in the north of the Site ranging from 44m AOD in the east to 24m AOD in the west. The southern area of the site is a plateau at 34m AOD with a steep slope towards the south to 25m AOD. Ground levels in the eastern area of the site generally decrease from 48m AOD to 40m AOD in the west and 34m AOD in the east and south.
Current land use	The Site is currently unoccupied with no above ground structures. The northern area of the Site is currently occupied by grazing and agricultural land. The southern and eastern areas of the Site are currently occupied by immature woodland on the regraded colliery spoil slopes. The area of the southern access road is covered with concrete hardstanding with a bridge/embankment structure.
Existing structures	There are 3 No. mine gas vent pipes located within the centre of the site (outside of the development area) overlying the 3 No. old mine shafts used by the former colliery. High voltage overhead electricity pylons transect the site east to west.
Site ground surfaces	The northern agricultural section of the site is covered by arable land. The central and southerly sections are comprised of immature woodland, scrubland with exposed colliery spoil surficial gravelled expanses.
Sub-surface structures	Relict structures associated with historic site use as a colliery may be present in the southern area of the site. A total of 2 No. septic tanks are located within the site boundary, one south of Halsnead Lane and one north of Park Villas in the south of the Site. Additional unrecorded services should be anticipated.
Invasive plant species	Localised Himalayan balsam and Japanese knotweed have been recorded across the site. Further details can be found from the invasive plant survey undertaken by TEP.

The main Site features are shown on Drawing No. TE1163GIR3 within Appendix A.



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3. PROPOSED DEVELOPMENT

It has been assumed in the production of this report that in the northern and central portions of the Site, the redevelopment is to comprise multiple industrial warehouses, each with associated car parking areas, surface water attenuation ponds and areas of soft landscaping. In the south and eastern areas of the Site it is proposed that the site will be redeveloped into a country park, comprising woodland, ephemeral lakes and footpaths. A large scale earthworks exercise (approximately 450,000m³ of cut/fill) is proposed to provide the appropriate development platforms and highway gradients.

This report is designed to provide information to aid the proposed hybrid planning application consisting of:

- Full application for the development of 164,400 sq ft (15,273 sq m) (GIA) of storage and distribution floorspace (Use Class B8), including ancillary offices (Use Class B1) and security gatehouse; site access road; engineering earthworks to form part country park; public car park to serve country park; footbridge over proposed site access road; and associated works; and,
- Outline application with details of point of access (details of part-access, landscaping, appearance, scale and layout are reserved) for the development of up to 835,600 sq ft (77,629 sq m) (GIA) of storage and distribution floorspace (Use Class B8), with ancillary offices and light industrial (Use Class B1); engineering earthworks to form country park and drainage attenuation ponds; pedestrian/cycle/equestrian route connecting existing M62 footbridge with proposed country park; and associated works.



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4. ENABLING WORKS STRATEGY

The information presented in the GIR report summarises the physical conditions of the site, the nature of the soils, the contamination status of the near surface Made Ground soils and presents an overview of the hydrogeological regime. For completeness, however, it would be prudent to refer to the previous site investigation reports, should additional information be required. The following section identifies the strategy that will be utilised to effectively manage the development of the site.

4.1. Asbestos Impacted Material Management

It is noted that there are multiple historic reports produced by Tier Environmental that discuss the asbestos impacted soils at the Site. This report is therefore now considered as providing the overarching strategy describing how asbestos impacted soils will be managed.

The asbestos risk assessment report (TE1163ARA1.0) concluded that the cumulative risk equates to negligible or insignificant risk from mesothelioma and lung cancer due to asbestos exposure. As such, it was assumed that the risk is equivalent to less than 1 per 100,000 limit, which is generally seen to be the limit of minimal risk. This assessment has shown that although there are asbestos fibres and microscopic ACM within bitumen products within the Made Ground soils, and even building a large amount of conservatism into the model, the risks posed to end users from shallow soils (with respect to asbestos for a public open space and commercial land use) is negligible and below the ELCR of 1:100,000 people exposed. It is therefore considered that the shallow soils should be regarded as presenting a minimal/tolerable risk for the proposed land uses and are therefore suitable for use.

It is recommended that any construction works or movement of the localised low level asbestos impacted materials are undertaken in accordance with the Control of Asbestos Regulations 2012 (CAR 2012).

Asbestos Sampling During Earthworks

It is acknowledged that due to the potential large volumes of material re-use, the possibility of additional unidentified asbestos impacted material asbestos containing higher concentrations than encountered in the investigations to date is possible. Due to this, during the course of the earthworks a robust sampling regime will be undertaken with asbestos screens undertaken every 1000m³ of Made Ground material excavated. Tier Environmental will review all the results and provide the data within a Verification Report upon completion of the earthworks exercise.

Proposed Acceptable Concentrations for Forthcoming Earthworks

It is considered that any chrysotile asbestos concentrations reported from future testing in excess of those encountered in the recent site investigation works, or any different types of asbestos (e.g. crocidolite or amosite) will require further risk assessments to be undertaken in a manner consistent with the methodology laid out in the asbestos risk assessment report (TE1163ARA1.0). Therefore, any future chrysotile values at or below 0.029% w/w should be considered to be acceptable concentrations that would result in a minimal/tolerable risk for materials to be re-used at the Site. It is proposed that, for the planned earthworks a sampling regime, as described above, will be undertaken to suitably characterise the material throughout the works. If concentrations of asbestos are encountered above this value they should be identified and further assessed.

Materials Management Plan



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Given the low-level nature of the asbestos reported it is considered that it is best to reduce double or triple handling of the soils that may result from off-site disposal of the materials as this will reduce the risk of fibre release from the soils. The proposed placement of the low-level asbestos impacted soils should be done in accordance with CAR 2012 in such a way that the risks to construction workers are effectively managed. Finally, placement of the materials will be undertaken under a Materials Management Plan in order to demonstrate that the materials do not constitute a waste.

Asbestos Management Plan

All operations involving the disturbance of Made Ground soils will be regularly damped down with water if required, to control the generation of dust to suppress airborne fibre release. If excavation surfaces are intended to be left open for any period of time, then consideration should be made to covering these surfaces temporarily to prevent dust generation potentially impacting on the workforce.

Should any suspicious material be encountered during the redevelopment works, works shall be ceased within this part of the site and the area should then be investigated further by a suitably qualified geo-environmental engineer and sampled as necessary. The Contaminated Land Officer / Environmental Health Officer (or equivalent) at the local authority should also be notified immediately. Samples will be forwarded to a UKAS/MCERTS accredited laboratory for a suite of analytical testing deemed appropriate based upon an appraisal of the material identified.

General Control of Dust

Control measures should be used to ensure that dust levels are kept to a minimum at all times. Where possible, vehicle transit routes and work areas will be damped down. This operation shall utilise an appropriate method which will dampen down soil surfaces effectively. (e.g. a mobile water bowser with a dispersion spray attachment).

Handpicking of Cement Bonded ACMs

Asbestos is usually encountered in two forms:

- Asbestos as loose or clumps of fibres usually not visible to the naked eye
- Cement bonded materials visible to the naked eye (e.g. roof tile fragments)

No occurrences of bulk ACMs have been recorded on site and therefore there is a low risk that further asbestos contamination may be encountered.

The risk assessment has identified that the works are likely to be Non-Licensed works. However, any encounters with gross contamination, such as fragments of insulation/non-bonded asbestos, will require further investigation, sampling and interpretation to determine the anticipated working conditions with respect to CAR-SOIL.

If any ACMs are identified during ground disturbance works and they prove to be isolated occurrences, then removing the asbestos, placing into appropriate bags and appropriate disposal would be an acceptable course of action. The person removing the asbestos would be required to have the appropriate license, risk assessments and method statements.



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Excavation of Made Ground

It will be necessary to develop and document all proposed working methodologies to be adopted by all people involved with the proposed handling of Made Ground soils which may contain asbestos at low quantities. The standard procedures should contain the following minimum activities:

- Toolbox talks on procedures for excavations and handling ACMs making all workers aware of the risks.
- Any movements of Made Ground must be preceded by dampening down. Materials should be loaded directly into vehicles (utilising minimum drop heights) dedicated to moving material potentially containing asbestos.
- Full time operative for dampening down soils during excavations.
- Weather conditions should be assessed continuously by the Site Manager to determine the potential for airborne dust to impact receptors (e.g. workforce, adjacent properties).
- Exposed surfaces should be inspected to determine the presence of any visible ACMS.

Personal Protective Equipment (PPE)

Site operatives, such as surveyors, labourers, etc, should not be permitted to enter the immediate vicinity where potential asbestos impacted soils are being disturbed. In general accordance with the HSE Guidance Note EM6 (non-licensed asbestos works) if these site operatives are required to enter excavations where potential asbestos impacted soils are being disturbed, they should be supplied with the following PPE and guidance:

- Disposable overalls - Type 5 (BS EN ISO 13982-1).
- Disposable respirator to standards EN149 (Type FFP3) or EN1827 (Type FMP3).
- Half mask respirator to standard EN140 with P3.
- Single use protective gloves filter; semi-disposable respirator (to EN405) with P3 filter (only if visible ACMs are exposed).

It is considered that the need for a decontamination unit will not be necessary at this stage. Should gross contamination/insulation/non-bonded asbestos be encountered, works in that localised area should cease and an assessment undertaken in consultation with a suitably licenced contractor to determine whether a decontamination unit should be mobilised.

4.2. Earthworks

The GIR recommended that the following measures should be undertaken to make the site suitable and safe for development:

- General site clearance including hardstanding, vegetation and Topsoil,
- chipping of trees and incorporation into site won Topsoil,
- Removal of any below ground relict structures associated with former foundations/basements, notably in the eastern area of the site,



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- Bulk earthworks to achieve the proposed development levels, with fill materials compacted in accordance with a recognised specification, such as Specification for Highways Works Series 600.

The above works will be undertaken and verified under a Materials Management Plan (MMP) in accordance with CL:AIRE Definition of Waset Code of Practice, an earthworks specification and an MMP Verification Report. No further remediation requirements and or remedial verification works are required in relation to the above works.

4.3. Identification and Removal of Historic Culverts

Multiple historical culverts relating to the former colliery were identified during a review of historic maps and aerial photographs undertaken within the preliminary risk assessment (report ref TE1163PRA1.2). To confirm that the culverts cannot act as a potential pollutant pathway further works will be undertaken to identify the exact location of the culverts and remove any remnants of them that remain in place. During the site strip a series of trenches will be undertaken during a watching brief by Tier Environmental. The trenches will be targeted within the locations of the former culverts. Once identified they will be removed by mechanical excavation under Tier Environmental supervision. The resultant excavation will be backfilled with suitable material. These works will be recorded and presented in the Verification Report to be complied by Tier Environmental.

4.4. Segregation of Topsoil

Segregation of different topsoil types from across the site will be undertaken based on the source areas identified within the GIR as: agricultural land and paddock, the imported topsoil within the motor cross track and the manufactured topsoil above the colliery spoil (where present). Due to the low number of topsoil samples tested within investigations undertaken to date, further topsoil analysis is required to determine the Topsoil's suitability for use across the development. Once segregated the topsoil will be tested in accordance with Table 4.1, dependent on the source area. The results of the additional chemical analysis will be presented within the Verification Report.

4.5. Topsoil Growing Medium

The GIR stated that no remedial measures were required for the site except the need for ground gas protection measures which are covered by the ground gas verification plan. However, the GIR recommended that a 150mm growing medium was to be installed within soft landscaped areas. The final depth and makeup of planted areas will be confirmed by the landscape architects.

4.6. Drilling and Grouting of Mine Workings

The methodology for the drilling and grouting works will be set out in a specification for the stabilisation of mineworkings document in accordance with C758D, to be produced by Tier Environmental in due course. These works will then be verified by a subsequent Verification Report. It is noted that these works are not required for the detailed planning application and will only be required under Units 02, 03 and 04.

4.7. Imported Material Verification

It will be necessary to ensure that the development of the site does not cause an increased risk to receptors. All materials imported to the site will be tested prior to being brought to site to determine its chemical suitability for use on the site. The imported material will be tested against Table 4.1 below. The results will be screened against LQM/CIEH Suitable 4 Use Levels (S4ULs) GACs for a commercial/industrial land use or a public open space



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land use dependent on which part of the site the material is destined for. The purpose of the testing is to verify the quality of any materials imported to the site and to determine the contaminant concentrations of materials.

Table 4.1 Imported Material Testing Criteria

Type	Number of samples	Testing Schedule
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, Cu, Hg, Ni, Pb, Se, Zn)
Crushed Hardcore, Stone, Brick,	Minimum 1 per 1000m ³	Standard metals/ metalloids (As above) PAH (16 USEPA speciation) Asbestos, Phenol, BTEX and MTBE.
Greenfield / Manufactured Soils	Topsoil – Minimum 3 or 1 per 500m ³ (whichever is greater) Subsoil – Minimum 3 or 1 per 1000m ³ (Whichever is greater).	Standard metals / metalloids (As above) PAH (16 USEPA Speciation) Asbestos, pH and soil organic matter.
Brownfield /Screened Soils	Topsoil – Minimum 6 or 1 per 250m ³ (Whichever is greater) Subsoil – Minimum 6 or 1 per 500m ³ (Whichever is greater)	Standard metals/ metalloids (As above) PAH (16 USEPA speciation) TPH (CWG banded) Asbestos, Phenol, BTEX and MTBE Any additional analysis dependant on the history of the donor site.

Upon completion of the development a Verification Report will be compiled by Tier Environmental presenting all chemical data.

4.8. Monitoring of Fox's Bank Brook

To ascertain that the development does not adversely impact the quality of the surface water feature that transects the Site, it is proposed that ongoing water sampling and monitoring is undertaken throughout the earthworks and drainage installation works. It is proposed that every 3 No. weeks for the duration of the works a total of 3 No. water samples will be taken, one up gradient of the development, one down gradient and one within the centre of the site. The results will be screened against appropriate EQS values protective of the water environment and the results and assessment presented in the Verification Report.

4.9. Site Turnover and Obstruction Removal

A number of obstructions were encountered during the Site's ground investigations. It is therefore proposed that the Site is turned over to a depth specified by the earthworks contractor determined by the nature and extent of anticipated obstructions. Such features will be surveyed in as required and assessments will be made throughout by the supervising engineer, Any materials (soils and concrete / brick etc) to be re-used on Site should be done so under an appropriate end-of-waste protocol such as a U1 Exemption / Wrap Protocol or Materials Management Plan in accordance with the CL:AIRE Definition of Waste Code of Practice.



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4.10. Contingency for any Unknowns

Whilst ground conditions have been determined during the previous investigation, a small risk exists of the presence of localised unidentified contamination of Made Ground soils.

Should any suspicious material be encountered during the redevelopment works, works shall be ceased within this part of the site and the area should then be investigated further by a suitably qualified geo-environmental engineer and sampled as necessary. The Contaminated Land Officer / Environmental Health Officer (or equivalent) at the local authority should also be notified immediately. Samples will be forwarded to a UKAS/MCERTS accredited laboratory for a suite of analytical testing deemed appropriate based upon an appraisal of the material identified.

Once the results of the analysis are known and have been interpreted, the required remedial action (if any) will be determined and approved with the relevant regulatory authorities.

4.11. Environmental Monitoring and Mitigation

Introduction

In order to mitigate the environmental impacts of the works on nearby residents and sensitive areas, a programme of measures will be implemented during the works.

Dust Mitigation

Appropriate measures shall be implemented at all times during the redevelopment works, to minimise dust emissions. Soils will be dampened down, as necessary, and activity will be minimised in extremely windy conditions to prevent dust nuisance. An adequate supply of water shall be maintained on site at all times to allow for dust suppression activities to be carried out at short notice.

When dusty material is being loaded onto trucks, extra care will be taken to ensure that the drop height is minimised. Trucks will be suitably covered when leaving the site with contaminated material to prevent dust migration.

Areas of disturbed surface left exposed for significant time periods will be minimised. Stockpiles of fine or loose materials should be tamped down or covered if necessary, to reduce the production of dust. Traffic both entering and working on the site shall obey a maximum speed limit of 10 mph.

As asbestos has been reported at the Site, works in the impacted areas should be conducted in accordance with the Control of Asbestos Regulations (CAR) 2012 and has been summarised in Section 4.1..

Noise

The requirements of BS 5228:1997 "Noise and Vibration Control on Construction Sites" shall be adhered to at all times. All machinery shall be fitted with effective silencers and shall be serviced at regular intervals. No plant shall be operated with engine covers raised.

Run-off into Drains

All potential drainage on site and any discharge points will be identified, including land drains, foul sewers, surface water drains and any combined drains. These will be marked, as appropriate, for easy identification. Works will be minimised during periods of heavy rainfall to reduce the likelihood of contaminated run-off. Temporary containment and cover measures or tamping down of stockpiles to reduce run-off shall be used where necessary.



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4.12. Waste Soils

It is currently anticipated that all soils will be retained on Site under a Materials Management Plan. However, in the event that localised previously unidentified contamination or other materials unexpectedly require removal from the Site then the impacted material exported from the site to landfill shall be hauled by a registered waste carrier in accordance with Duty of Care Regulations, 1991 and the Hazardous Waste Regulations, 2005.

There will be requirement for the waste producer to provide appropriate Waste Acceptance Criteria (WAC) testing of the soils for disposal to ensure that the soils are appropriately classified and that the landfill is licensed to receive such soils.

4.13. Verification Report

The Site Engineer should ensure that the requirements of the strategy are complied with. On satisfactory completion of all remedial works, a Verification Report should be produced. This report will comprise all relevant site records and act as certification that the remedial preparation works have been carried out in accordance with this report. The Verification Report shall include the following:

- A description of the works undertaken;
- Records of the works;
- Progress photographs;
- Waste Transfer Notes; and,
- Chemical verification test results;

It is acknowledged that any minor exceedances of the criteria set out in this report from materials left in the ground may require further assessment and/or discussion with Knowsley Council. Due consideration will be given to the viable pathways and the locations of any such minor residual exceedances and qualitative assessment of the potential risks may also be provided in the Verification Report, where appropriate.

4.14. Earthworks Monitoring

Throughout the earthworks, material movements will be tracked on a 25m grid with materials location and volumes moved recorded. Record sheets of movements and total volumes will be reviewed by Tier on a weekly basis. Tier will be undertaking weekly visits to confirm all procedures are being adhered to. Furthermore, at the start of the earthworks a toolbox talk will be provided by Tier detailing any potential unexpected contamination procedures including the due process to follow if any unexpected contamination is encountered as described above. Records of Tier visits will be provided within the verification report.



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5. REGULATORY APPROVALS

The conclusions and recommendations presented above are considered reasonable based on the findings of the site investigations. However, these cannot be guaranteed to gain regulatory approval and, therefore, the report should be passed to the appropriate regulatory authorities and/or other organisations for their comment and approval.

It is noted that on the planning consultation response from Knowsley Council dated 4th March 2021 no objection in principle to the development was recorded.



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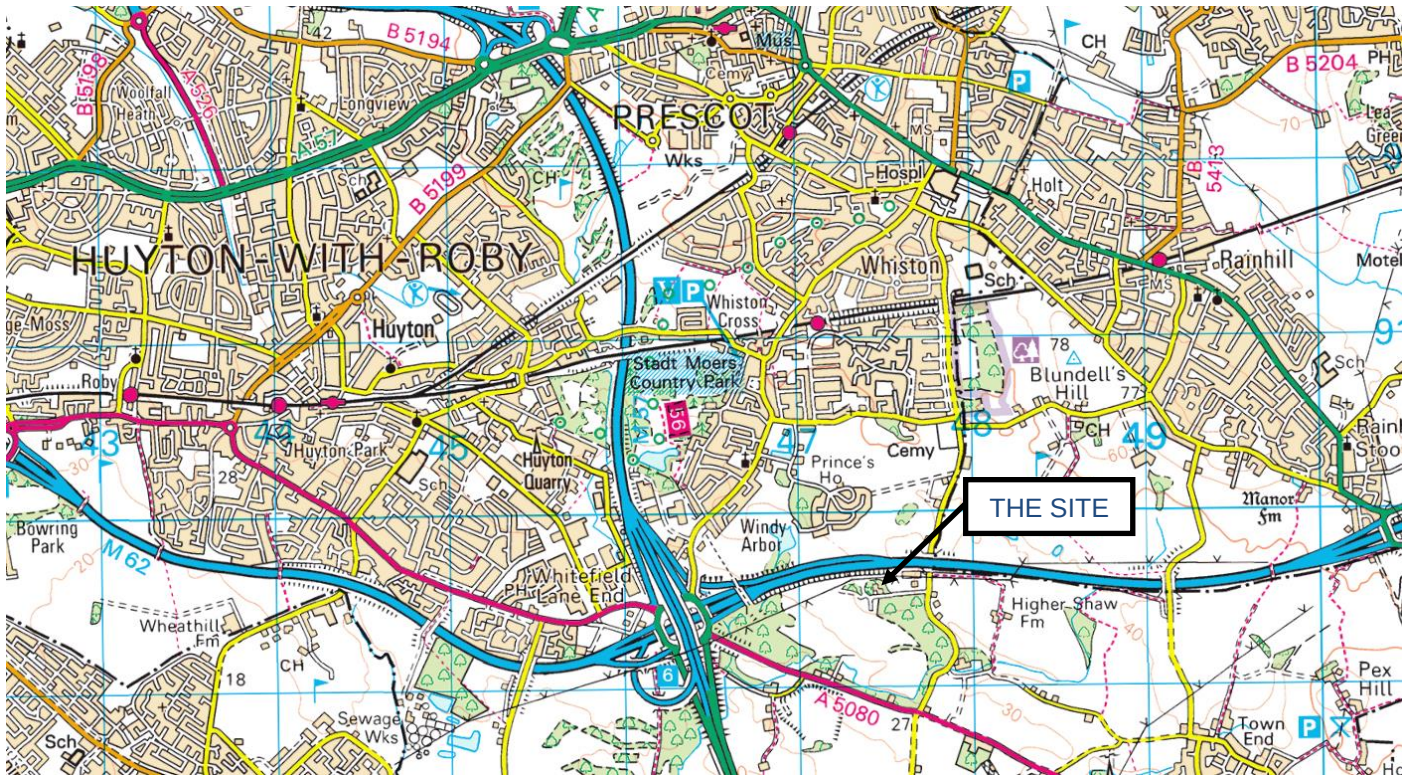
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APPENDIX A – FIGURES AND DRAWINGS



Contract Number	TE1163
Contract	Former Cronton Colliery Site
Client	Tritax Symmetry

Site Location Plan



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Scale	NTS		
Drawn by	JC	Approved	SL
Drawing Number	TE1163GIR1		

APPENDIX B – GLOSSARY OF TERMS

ACEC	Aggressive Chemical Environment for Concrete (classification)
aOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
Designated location	Site (and the ecosystem on that site) protected under national or international legislation. A potential ecological receptor to be considered as part of the assessment of land contamination. Example designated locations include SSSIs (q.v.), SACs (q.v.), national nature reserves, Ramsar sites and bird special protection areas.
DQA	Data Quality Assessment
DQO	Data Quality Objective
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
K _{ow}	Octanol-water partition coefficient
LEL	Lower Explosive Limit
LL	Liquid Limit
LoD	Limit of Detection (analytical)
LoQ	Limit of Quantification (analytical)
Mean Value Test	Statistical test (described in the CIEH Guidance) to estimate the mean value of a normally distributed population of data at a given level of confidence. Normally for contaminated land assessment, the 95th percentile (referred to as the 95%UCL or US95) is applied as a reasonable but conservative estimate of the mean concentration for comparison with the relevant assessment criteria.
Maximum Value Test	Statistical test (described in the CIEH Guidance) to identify whether an elevated concentration within a normally distributed data set forms part of the underlying population from which it has been sampled or whether it is an outlier (such as a localised area of contamination) that merits further consideration.
MC	Moisture Content
NGR	National Grid Reference
NIHHS	Notification of Installations Handling Hazardous Substances (regulations)
OS	Ordnance Survey
PI	Plasticity Index
PID	Photoionisation Detector
PL	Plastic Limit
ppm	Parts per million
ppmv	Parts per million by volume
QA	Quality Assurance
QC	Quality Control
SAC	Special Area of Conservation
SOM	Soil Organic Matter
SPT	Standard Penetration Test
SPZ	Source Protection Zone (see Appendix E)
SSAC	Site-Specific Assessment Criterion

SSSI	Site of Special Scientific Interest
SVOC	Semi-Volatile Organic Compound
TEF	Toxicity Equivalent Factor
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
US95	95 th percentile estimate of the true mean value of a data population (also known as 95%UCL).
VOC	Volatile Organic Compound

APPENDIX C – DEFINITIONS OF TERMS USED IN QUALITATIVE AND QUANTITATIVE RISK ASSESSMENTS

For the qualitative and quantitative assessment of risks posed by potential pollutant linkages have been undertaken using the risk matrix adapted from CIRIA C552 and outlined in the table below.

	Category	Definition
Potential severity	Severe	Acute (short term) risk to human health, Major pollution of sensitive controlled waters, ecosystems or habitat. Catastrophic damage to buildings or property or crops.
	Medium	Chronic (Medium / long term) risk to human health Pollution of sensitive controlled waters, ecosystems or species, Significant damage to crops, buildings or structures
	Mild	Easily preventable permanent health effects on humans. Pollution of non-sensitive controlled waters. Minor damage to buildings or structures.
	Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soil. Easily repairable damage to buildings or structures.
Probability of risk	High Likelihood	Pollutant linkage may be present, and the risk is almost certain to occur , or there is evidence of harm already occurring.
	Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term.
	Low Likelihood	Pollutant linkages may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
	Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

		Potential Severity			
		Severe	Medium	Mild	Minor
Probability of risk	High Likelihood	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

APPENDIX D – CHEMICAL TEST SAMPLING

Samples were selected by a representative of Tier Environmental during the site investigation works in accordance with the sampling approach described elsewhere in this report.

Samples for chemical analysis

All samples for chemical analysis were placed into clean new containers as summarised in Table 1. Unless explicitly stated elsewhere in this report, no preservatives were used to eliminate the risk that preservatives cause contaminant dissolution or analytical interference. Containers for VOC analysis were fully filled to exclude headspace.

Soil samples were dispensed as soon as possible after collection using reusable stainless-steel spatulas, trowels or similar implements.

Ground water samples were collected from boreholes using single-use Teflon bailers or dedicated Waterra tubing with foot valves, except as otherwise noted within this report. Caution was taken to avoid excessive agitation during collection

New disposable gloves were used by the engineer for the collection of each sample.

Reusable equipment was washed down with distilled or deionised water between samples, except where tarry or similarly sticky materials were present. In such cases specific cleaning procedures were adopted as specifically described elsewhere in this report.

All sub-samples taken for chemical analysis were placed into refrigerators or cool boxes containing frozen ice packs immediately after aliquoting. All samples were transferred in cool boxes containing frozen ice packs to the relevant UKAS/MCERTS accredited laboratory as soon as possible. Recommended maximum holding times before analysis are summarised in Table 1.

Table 1. Sample containers and holding times.

Analysis	Container/special requirements	Max. holding time at 4°C before analysis
Soil and sediment samples		
VOCs	30-60 g brown or green glass jar with VOC-resistant cap and inert cap liner. <i>Must be fully filled.</i>	14 days
TPHCWG	30-60 g brown or green glass jar with VOC-resistant cap and inert cap liner PLUS 250-500 g brown or green glass jar with unwaxed cap liner. ¹ <i>The former must be fully filled.</i>	14 days
All other organics	250-500 g brown or green glass jar with unwaxed cap liner.	7 days
Inorganics	Air-tight 0.5-2.0 kg plastic container (250-500 g brown or green glass jar may also be used).	14 days ²
Water samples		
VOCs	40-50 ml glass vial with VOC resistant screw cap and inert liner. <i>Must be fully filled.</i>	14 days
TPHCWG	40-50 ml glass vial with VOC resistant screw cap and inert liner PLUS 500-1000 ml brown or green glass bottle with screw cap and unwaxed liner. ¹ <i>The former must be fully filled, the latter should be filled if possible.</i>	14 days
All other organics	500-1000 ml brown or green glass bottle with screw cap. <i>Fill if possible.</i>	7 days
Inorganics	500-1000 ml translucent or opaque screw cap plastic or brown or green glass bottles. <i>Fill if possible.</i>	14 days ³

¹ The smaller vessel is used for analysis of the volatile components within the TPH mixture and the larger one is for the non-volatile components.

² 14 days is set as a reasonable limit for all routine analyses of soil for those inorganic components vulnerable to chemical and/or biological breakdown. Samples for sulphate analysis are vulnerable to biological sulphate-reduction but can be held for up to 28 days. For total metals, a holding period of up to 6 months is acceptable.

³ 14 days applies for all routine analyses of most inorganic components that may be vulnerable to chemical and/or biological reactions. In the specific cases of sulphide, nitrite, nitrate and phosphate analyses, storage time must not exceed 48 hours. For total metals, a holding time of up to 6 months is acceptable.

Tier Environmental standard analytical suites

The analyses included with Tier Environmental's standard analytical suites for soil, soil leachate and water samples are presented in Table 2. Other individual analyses were specified as described within this report.

Table 2. Tier Environmental Standard Analytical Suites.

Parameter	Sample type					
	Soil		Leachate ¹		Water	
		LoD ² (mg/kg or as stated)		LoD (µg/l or as stated)		LoD (µg/l or as stated)
Metals and metalloids						
Arsenic	✓	1	✓	10	✓	10
Cadmium	✓	1	✓	5	✓	5
Chromium	✓	1	✓	5	✓	5
Mercury	✓	1	✓	1	✓	1
Lead	✓	1	✓	4	✓	4
Selenium	✓	2	✓	10	✓	10
Copper	✓	1	✓	1	✓	1
Nickel	✓	1	✓	50	✓	50
Zinc	✓	1	✓	8	✓	8
Other inorganics						
Ammonia (as NH ₄ -N)					✓	15
Total sulphate	✓	100			✓	50 mg/l
Water-soluble sulphate	✓	0.1 g/l				
Hardness (as CaCO ₃)					✓	1 mg/l
Organics						
Monohydric phenol	✓	1	✓	0.5	✓	0.5
Speciated PAHs (USEPA 16)	✓	0.1	✓	0.01	✓	0.01
Total Organic Carbon	✓	0.1 wt%				
Others						
Electrical conductivity					✓	NA
pH	✓	NA	✓	NA	✓	NA

NA - Not applicable

1 Leachate preparation according to NRA (1994), 10:1 liquid to solid ratio.

2 The table presents the desired limit of detection for the analysis. Higher LoDs may be reported on analytical data sheets due to interference between analytes within specific samples or if the laboratory needed to dilute samples to achieve results within the calibrated range for that instrument.

Analytical QA procedures

Introduction

Quality Assurance (QA) is a system of review and audit that assesses the effectiveness of that product and assures the producer and user that defined standards of quality have been met. If we consider site investigation and chemical analysis, QA is the management system that ensures these measures are in place and working as intended.

QA within the laboratory form part of relevant certification programmes (such as UKAS and MCERTS) and, indeed, will be undertaken in some form by any reputable analyst, whether for a certified technique or not. Laboratory QA/QC is beyond the control of Tier Environmental and will not be considered further in this document, although the relevant laboratory documentation can be obtained upon request. QA must also form part of the design and execution of a site investigation.

Two parameters often used to assess measurement quality objectives are bias and precision. Bias is a systematic deviation in the data. For example, a positive bias (concentrations higher than in reality) would be introduced if sampling bottles were a source of the analyte and this fact was unknown. Precision is the variation in the measurements around a central 'expected' value. This could be due both to real variability in the environmental medium being measured and random errors in the analytical process. Both precision and bias can be assessed by the use of appropriate blanks and replicates within the site investigation programme.

The objectives of the QA activities undertaken in this present site investigation were to recognise and quantify systematic bias within the analytical dataset and to obtain an indication of precision. In environmental samples, much of the observed variability is likely to result from heterogeneity in the sampled medium, particularly for soil and sediment samples.

Such QA practice within the sampling programme is required by current guidance (e.g., Environment Agency report P5-065/TR (2000); Environment Agency LFTGN02 (2002); BS 10175:2001).

Alternative QA procedures to the generic approach presented in this appendix may be specified for a project, provided case-specific justification is given.

QA checking procedure (data validation)

The responsible Engineer and Project Reviewer are required to undertake data validation and provide comment on data quality within the main body of the report(s) issued, when noteworthy matters arise. This QA checking should involve:

- Confirming that data reported by the laboratory have achieved the standards specified by the certification scheme (MCERTS or UKAS). This will be indicated on the analytical certificates issued by the laboratory.
- Checking that the limit of detection (LoD) and limit of quantification (LoQ) achieved by the laboratory for an individual analyte is appropriate for the purposes of the report. LoD and LoQ will vary dependent upon analyte concentrations, sample matrix properties and interference from co-contaminants.
- A check that the reported range of concentrations are reasonable for the analyte. For example, the dissolved concentration of an analyte in a water sample should not exceed saturation. If it does, then this merits further consideration (e.g., was colloidal organic matter or other solid-phase material present or could there have been unobserved free-phase organic liquid?) and explicit comment. At its simplest, there may be a unit error.

- Where analysis involves reporting of Tentatively Identified Compounds (TICs; normally by mass spectrometry), the reviewers should check that these might reasonably be expected at the site under consideration. The uncertainties in identification by MS mean that it is not uncommon that TICs are incorrectly assigned. In cases of doubt, the analytical laboratory can re-check the raw data and confirm.
- A review of the analytical precision by comparing data obtained for duplicate samples. There is no absolute threshold - variability is entirely dependent upon the sample matrix and manner in which the contaminant has entered the sample. Variability that cannot reasonably be assigned to such factors (for example a very high apparent variability in data for sediment-free water samples) should be reviewed with the laboratory. Variability that is attributable to the sample matrix can nevertheless provide important pointers to improve understanding of contaminant transport pathways and the risks posed by pollutant linkages (e.g., soil heterogeneity, the association of contamination with particular soil fractions, the presence of residual NAPL within soil pores or the role of suspended sediments in contaminant transport).
- Confirmation that no errors have been introduced by data transcription, unit conversion or corrections between preliminary and certificates issued by the laboratory. The reviewer should audit a proportion (typically 5-10%) of all data from the original (final) certificates of analysis through to the equivalent values in the report for those specific samples.

It is important to consult the analytical laboratory if apparent QA issues arise. Many apparent concerns can be adequately resolved on the basis of revisiting the raw analytical data or by obtaining a better understanding of the inherent limitations of the analysis for a particular matrix or sample type.

For the qualitative and quantitative assessment of risks posed by potential pollutant linkages have been undertaken using the risk matrix adapted from CIRIA C552 and outlined in the table below.

	Category	Definition
Potential severity	Severe	Acute (short term) risk to human health, Major pollution of sensitive controlled waters, ecosystems or habitat. Catastrophic damage to buildings or property or crops.
	Medium	Chronic (Medium / long term) risk to human health Pollution of sensitive controlled waters, ecosystems or species, Significant damage to crops, buildings or structures
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	Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soil. Easily repairable damage to buildings or structures.
Probability of risk	High Likelihood	Pollutant linkage may be present, and the risk is almost certain to occur, or there is evidence of harm already occurring.
	Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term.
	Low Likelihood	Pollutant linkages may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
	Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

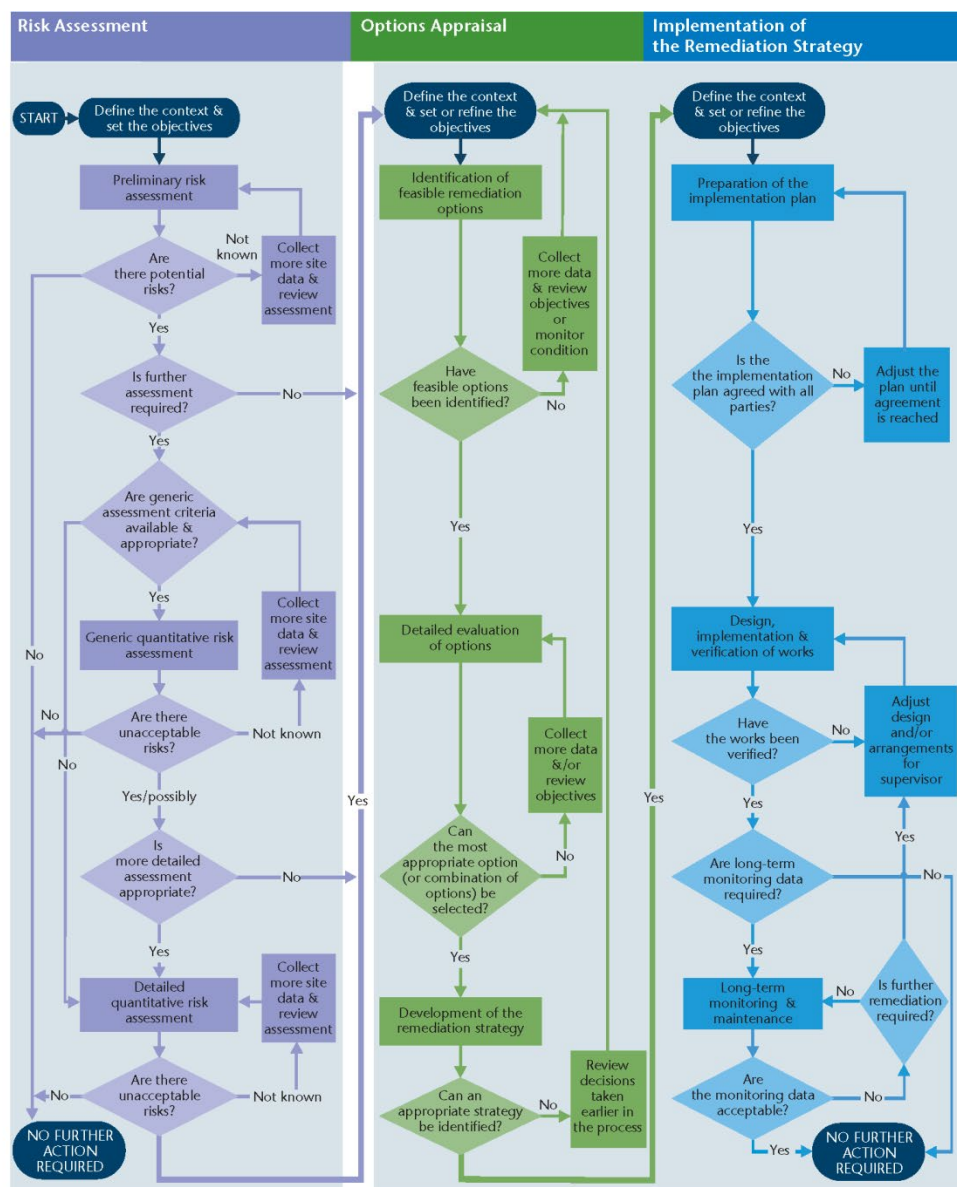
		Potential Severity			
		Severe	Medium	Mild	Minor
Probability of risk	High Likelihood	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

APPENDIX E –HUMAN HEALTH ASSESSMENT CRITERIA

Context

Contaminated Land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995 and associated guidance ("Part IIA"). These specify that a "suitable for use" approach is to be applied in the assessment of potentially contaminated land, implemented through a phased programme of site investigation and risk assessment appropriate to the site under consideration.

The assessment of potential risks posed by contaminated land is based upon the assessment of plausible contaminant source - pathway - receptor linkages ("pollutant linkages") for the current and/or proposed future use of the site. The process for the assessment of contaminated land adopted in this report is in line with guidance issued by DEFRA and Environment Agency (EA) 2004: "Model Procedures for the Management of Contaminated Land (CLR11)". The overall process for the management of land contamination is shown Figure 1 of CLR11 and reproduced below:



Note: The process may apply to one or more pollutant linkages each of which may follow a different route. For some linkages, it may be possible to stop at an early stage – others will progress all the way through the process. The level of complexity of each stage may also vary and in some cases may be very simple.

The risk assessment and subsequent investigation, remediation and verification must address all potential sources of pollutants that may be present on the site (the "hazards"), all receptors that may be harmed by these (e.g. human health, controlled waters, ecological receptors)

and the pathways by which the contamination may be transported from the contaminant source(s) to the receptor(s). This is defined within the conceptual model for the site, which represents the characteristics of the site in a form that shows the possible pollutant linkages. As further information becomes available (for example, through site investigation), so the conceptual model will be refined.

Remedial action can be specified at any phase within this assessment process to break the identified pollutant linkage. In determining whether or not to undertake further assessment or to undertake remediation, the potential cost-savings arising from a more thorough assessment of the pollutant linkages and more tightly defined remedial strategy must be considered against the direct costs involved in the work and the time that this will take to execute and gain regulatory approval.

A different approach to the statistical appraisal of data is required depending on whether the assessment is being undertaken to assess land as Contaminated Land in accordance with the regulations or whether the assessment is to assess whether the site is suitable for new development in accordance with the Planning regime. The statistical approach to assessment is discussed further in CL:AIRE:2009 "Guidance on Comparing Data with a Critical Concentration".

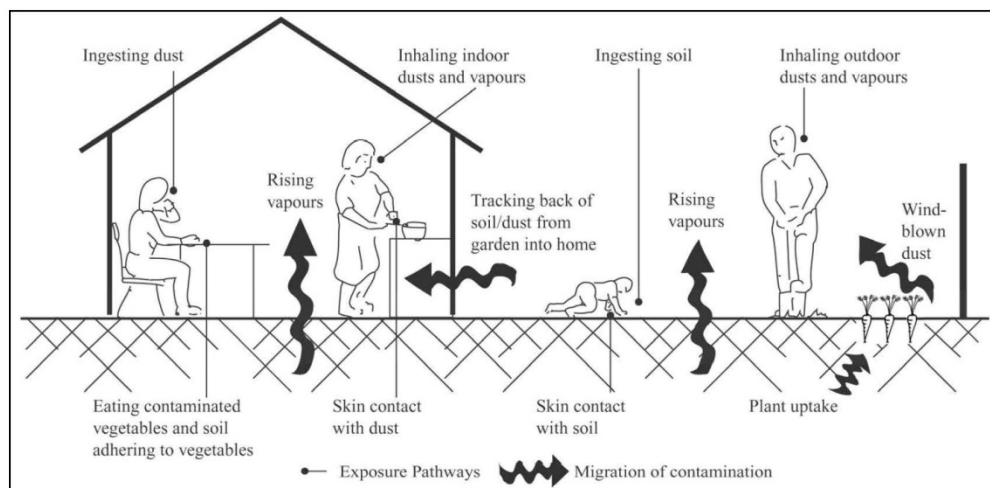
Some form of Detailed Quantitative Risk Assessment (DQRA) will be essential for those cases where appropriate GAC values cannot be established for the contaminant linkages under consideration.

Generic Assessment Criteria for Human Health Risk Assessment

In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports and guidance. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. The initial documents (CLR7 – 10) were withdrawn and replaced with revised guidance issued by the Environment Agency including:

- “Using Soil Guideline Values”; SC050021/SGV Introductions, EA, 2009;
- “Human Health toxicology assessment of contaminants in soil”; SC050021/SR2, EA, 2009;
- “Update technical background to the CLEA model”; SC050021/SR3, EA, 2009;
- CLEA Software (Version) Handbook; SC050021/SR4; EA, 2008;
- Compilation of Data for priority Organic Contaminants for Derivation of Soil Guideline Values; Science Report SC050021/SR7, 2008; and,
- Guidance on Comparing Data with a Critical Concentration; CL:AIRE, 2009.

The CLEA model and associated guidance was developed to calculate an estimated tolerable daily intake (TDI) of contaminants for site users given a set of ‘typical’ human health exposure pathways which are detailed in “SR3: Updated technical background to the CLEA model” (Science Report SC050021/SR3, EA, 2009) and reproduced below.



- **Ingestion**
 - Outdoor soil;
 - Indoor dust;
 - Home grown produce;
 - Soil attached to home grown produce.
- **Dermal Contact**
 - Outdoor soil;
 - Indoor dust.
- **Inhalation**
 - Outdoor dust;
 - Indoor dust;
 - Outdoor vapour;
 - Indoor vapour.

It should be noted that the CLEA model does not include an exhaustive list of potential exposure pathways, e.g. certain compounds can pass through plastic water pipes into drinking water supply.

The potential significance of each of the exposure pathways is dependent upon the type of land use and the nature of the contaminant being considered. The CLEA model considers principal 'default' land use scenarios and makes a series of assumptions with regards to building type (where applicable), identification of the critical human receptor group, exposure frequency and duration. The definitions of the principal land use types given in SR3 (EA, 2009) are:

- **Residential land use:**

A typical residential property consisting of a two storey terraced house built on a ground-bearing slab of 0.15m thickness with a private garden consisting of lawn, flowerbeds, and a small fruit and vegetable patch. The occupants are assumed to be parents with young children, who make regular use of the garden. The critical receptor is a 0 – 6 year old female.

Active exposure pathway are: ingestion of outdoor soil, ingestion of indoor dust, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and indoor dust and vapour.

- **Allotments**

A plot of open space commonly made available by the Local Authority to tenants to grow fruit and vegetables for their own consumption. There are usually several plots to a site and the overall site area may cover more than one hectare. The tenants are assumed to be the parents or grandparents and that young children make occasional accompanied visits to the plots. The critical receptor is a 0 – 6 year old female and there is no building present on Site.

Active exposure pathways are ingestion of outdoor soil, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil; inhalation of outdoor vapour.

- **Commercial and industrial land use.**

A typical commercial or light industrial property consisting of a three-story office building (pre-1970) with a ground bearing floor slab at which employees spend most time indoors and are involved in office based or related light physical work. The critical receptor is a working female adult aged 16 – 65 years.

Active exposure pathway are ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and inhalation of indoor dust and vapour.

Soil Guideline Values

Based on the assumption of each land use type, the EA and DEFRA developed and published Soil Guideline Value (SGV) using the CLEA model for a number of principal contaminants and 'default' end-use scenarios of residential, allotments and commercial/industrial use. The primary purpose of the SGVs are as trigger value for the tolerable daily intake (TDI), below which it can be assumed that the soil does not pose an unacceptable risk to the identified receptor. Where soils contamination is present above this level further assessment may be required. SGVs were developed for the following contaminants:

- Heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury, nickel and selenium;
- Benzene, ethylbenzene, toluene and xylenes;
- Phenol;
- Dioxins and dioxin-like polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs) – 11 substances

LQM/CIEH Generic Assessment Criteria of Human Health Risk Assessment

In addition, in 2009 CIEH through LQM and EIC published generic assessment criteria (GACs) for 82 substances including metals, petroleum hydrocarbons, PAHs and explosive substances for a variety of soil types and the three 'default' land uses – (residential, allotments and commercial end-uses) as described in SR3 (EA, 2009). These have been superseded as described below.

Category 4 Screening Values

In 2013 "SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination" (CL:AIRE 2013) was issued which detailed findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. This was supplemented in 2014 by "SP1010: Development of Category 4 Screening Levels for the Assessment of Land Affected by Contamination – Policy Companion Document" (DEFRA, 2014). SP1010 proposed several updated toxicology information relating to contaminant behaviour updated assumptions relating to the modelling of human exposure to soil contaminants, derivation of separate C4SLs for residential with the consumption of home grown produce, residential without the consumption of home grown produce, and two new land uses: public open spaces near residential housing (POS resi) and public parks (POS park).

- **Public Open Space: Residential**

For public open space in close proximity to residential housing and the central green area around which houses are located, as on many housing estates from the 1930s to 1970s. It is also applicable for smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting. It is considered to be a generally grassed area up to 0.5ha with up to 50% bare soil. The land use is an important resource for children and the area is near the homes. The critical receptor is a female child age >3 - <9 years old (CLEA age class 4 – 9) as younger children are unlikely to play outdoors unsupervised.

Active exposure pathways are: ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor soil derived dust; inhalation of outdoor and indoor dust and inhalation of outdoor vapour.

- **Public Open Space: Park**

A public park is defined as an area of open space provided for recreational use and usually owned and maintained by the Local Authority. It is anticipated the park could be used for a wide range of activities, including the following:

- Family visits and picnics;
- Children's play area;
- Sporting activities such as football on an informal basis (i.e. no a dedicated sports pitch); and
- Dog walking.

The park is modelled as an area >0.5 ha of predominantly grasses open space with no more than 25% of exposed soil.

The critical receptor is a female child with CLEA age classes 1 – 6.

Active exposure pathway are: ingestion of outdoor soil; direct dermal contact with outdoor soil; inhalation of outdoor dust and inhalation of outdoor vapour.

Furthermore the C4SLs are based on a different toxicological benchmark, the 'low level of toxicological concern' (LLTC). This difference in approach was adopted because the C4SLs were primarily intended for use under Part2A of the EPA 1990 to quickly screen out Category 4 sites where there is *"no risk or that the level of risk posed is low"*. SGVs and LQM GACs are based on the more conservative 'minimal or tolerable level of risk' as defined in SR2 (EA, 2009) and were derived for assessment of contamination for the Planning process.

Lead

The SGV for lead was withdrawn in 2011 and is not used in this report. The C4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling than the withdrawn SGV and derived in line with current science of lead toxicology.

LQM/CIEH Sutable 4 Use Levels (S4ULs)

The publication of the C4SLs resulted in considerable and inconclusive debate about the applicability of the lower level of protection of the C4SL, which are underlain by the LLTC, outside of the Part 2A context for which they were derived. In 2014 LQM/CIEH presented a Sutable 4 Use Levels (S4ULs), which incorporate the updated assumption exposure derived for the production of the C4SLs but within the context of deriving screening criteria above which further assessment of the risks or remedial action may be needed. The S4ULs replace the 82 substances, species and fractions and congeners contained in the previous LQM/CIEH GACs issued in 2009. Additionally, following changes and new land uses proposed in the C4SL research project, S4ULs have also been derived for the majority of substances for which the EA derived SGVs in 2009.

The GAC values adopted in this report are summarised in Table 1, below.

Parameter	Residential <u>with</u> homegrown produce			Residential <u>without</u> homegrown produce			Allotment			Commercial / Industrial			Public Open Space near Residential			Public Open Space - Park			Source
	(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			(mg/kg, unless otherwise stated)			
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
Metals/metalloids																			
Arsenic	37			40			43			640			79			170			LQM (2014)
Beryllium	1.7			1.7			35			12			2.2			63			LQM (2014)
Boron	290			11000			45			240000			21000			46000			LQM (2014)
Cadmium	11			85			1.9			190			120			532			LQM (2014)
Chromium III	910			910			18000			8600			1500			33000			LQM (2014)
Chromium VI	6			6			1.8			33			7.7			220			LQM (2014)
Copper	2400			7100			520			68000			12000			44000			LQM (2014)
Lead	200			310			80			2330			630			1300			C4SL
Mercury (elemental)	1.2			1.2			21			58 (25.8)			16			30 (25.8)			LQM (2014)
Mercury (Inorganic)	40			56			19			1100			120			240			LQM (2014)
Methylmercury	11			15			6			320			40			68			LQM (2014)
Nickel	180			180			230			980			230			3400			LQM (2014)
Selenium	250			430			88			12000			1100			1800			LQM (2014)
Vanadium	410			1200			91			9000			2000			5000			LQM (2014)
Zinc	3700			40000			620			730000			81000			170000			LQM (2014)
Other																			
Total Sulphate	2,400			2,400			2,400			2,400			2,400			2,400			BRE (2005)
Water Soluble Sulphate (g/l)	0.5			0.5			0.5			0.5			0.5			0.5			BRE (2005)
PAHs																			

Acenaphthene	210	510	1100	3000 (57)	4700(141)	6000 (336)	34	85	200	84000 (57)	97000 (141)	100000	15000	15000	15000	29000	30000	30000	LQM (2014)
Acenaphthylene	170	420	920	2900 (86.1)	4600 (212)	6000 (506)	28	69	160	8300 (86.1)	97000 (212)	100000	15000	15000	15000	29000	30000	30000	LQM (2014)
Anthracene	2400	5400	11000	31000 (1.17)	35000	37000	380	950	2200	520000	540000	540000	74000	74000	74000	150000	150000	150000	LQM (2014)
Benzo(a)anthracene	7.2	11	13	11	14	15	2.9	6.5	13	170	170	180	29	29	29	49	56	62	LQM (2014)
Benzo(a)pyrene	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	35	35	36	5.7	5.7	5.7	11	12	13	LQM (2014)
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	0.99	2.1	3.9	44	44	45	7.1	7.1	7.1	13	15	16	LQM (2014)
Benzo(g,h,i)perylene	320	340	350	360	360	360	290	470	640	3900	4000	4000	640	640	640	1400	1500	1600	LQM (2014)
Benzo(k)fluoranthene	77	93	100	110	110	110	37	75	130	1200	1200	1200	190	190	190	370	410	440	LQM (2014)
Chrysene	15	22	27	30	31	32	4.1	9.4	19	350	350	350	57	57	57	93	110	120	LQM (2014)
Dibenz(a,h)anthracene	0.24	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.61	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	LQM (2014)
Fluoranthene	280	560	890	1500	1600	1600	52	130	290	23000	23000	23000	3100	3100	3100	63	6300	6400	LQM (2014)
Fluorene	170	400	860	2800 (30.9)	3800 (76.5)	4500 (183)	27	67	160	63000 (30.9)	68000	71000	9900	9900	9900	20000	20000	20000	LQM (2014)
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	9.5	21	39	500	510	510	82	82	82	150	170	180	LQM (2014)
Naphthalene	2.3	5.6	13	2.3	5.6	13	4.1	10	24	190 (76.4)	460 (183)	1100 (432)	4900	4900	4900	1200 (76.4)	1900 (183)	3000	LQM (2014)
Phenanthrene	95	220	440	1300 (36)	1500	1500	15	38	90	22000	22000	23000	3100	3100	3100	6200	6200	6300	LQM (2014)
Pyrene	620	1200	2000	3700	3800	3800	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000	LQM (2014)
Coal Tar (BaP as surrogate marker)	0.79	0.98	1.1	1.2	1.2	1.2	0.32	0.67	1.2	15	15	15	2.2	2.2	2.2	4.4	4.7	4.8	LQM (2014)
BTEX and TPH																			

Benzene	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	27	47	90	72	72	73	90	100	110	LQM (2014)
Toluene	130	290	660	880 vap (869)	1900	3900	22	51	120	56000 vap (869)	110000 vap (1920)	180000 vap (4360)	56000	56000	56000	87000 vap (869)	95000 vap (1920)	100000 vap (4360)	LQM (2014)
Ethylbenzene	47	110	260	83	190	440	16	39	91	5700 vap (518)	13000 vap (1220)	27000 vap (2840)	24000	24000	25000	17000 vap (518)	22000 vap (1220)	27000 vap (2840)	LQM (2014)
Xylene - o	60	140	330	88	210	480	28	67	160	6600 (478)	15000 (1120)	33000 (2620)	41000	42000	43000	17000 (478)	24000 (1120)	33000 (2620)	LQM (2014)
Xylene - m	59	140	320	82	190	450	31	74	170	6200 (625)	14000 (1470)	31000 (3460)	41000	42000	43000	17000 (625)	24000 (1470)	32000 (3460)	LQM (2014)
Xylene - p	56	130	310	79	180	430	29	69	160	5900 (576)	14000 (1350)	30000 (3170)	41000	42000	43000	17000 (576)	23000 (1350)	31000 (3170)	LQM (2014)
Aliphatic EC 5-6	42	78	160	42	78	160	730	1700	3900	3200 (304)	5900 (558)	12000 (1150)	570000 (304)	590000	600000	95000 (304)	130000 (558)	180000 (1150)	LQM (2014)
Aliphatic EC >6-8	100	230	530	100	230	530	2300	5600	13000	7800 (144)	17000 (322)	40000 (736)	600000	610000	620000	150000 (144)	220000 (322)	320000 (736)	LQM (2014)
Aliphatic EC >8-10	27	65	150	27	65	150	320	770	1700	2000 (78)	4800 (190)	11000 (451)	13000	13000	13000	14000 (78)	18000 (190)	21000 (451)	LQM (2014)
Aliphatic EC >10-12	130 (48)	330 (118)	760 (283)	130 (48)	330 (118)	760 (283)	2200	4400	7300	9700 (48)	23000 (118)	47000 (283)	13000	13000	13000	21000 (48)	23000 (118)	24000(2 83)	LQM (2014)
Aliphatic EC >12-16	1100 (24)	2400 (59)	4300 (142)	1100 (24)	2400 (59)	4300 (142)	11000	13000	13000	59000 (24)	82000 (59)	90000 (142)	13000	13000	13000	25000 (24)	25000 (59)	26000 (142)	LQM (2014)
Aliphatic EC >16-35	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	LQM (2014)
Aliphatic EC >35-44	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	LQM (2014)
Aromatic EC 5-7	70	140	300	370	690	1400	13	27	57	26000 (1220)	46000 (2260)	86000 (4710)	56000	56000	56000	76000 (1220)	84000 (2260)	92000 (4710)	LQM (2014)
Aromatic EC >7-8	130	290	660	860	1800	3900	22	51	120	56000 (869)	110000 (1920)	180000 (4360)	56000	56000	56000	87000 (869)	95000 (1920)	100000 (4360)	LQM (2014)

Aromatic EC >8-10	34	83	190	47	110	270	8.6	21	51	3500 (613)	8100 (1500)	17000 (3580)	5000	5000	5000	7200 (613)	8500 (1500)	9300 (3580)	LQM (2014)
Aromatic EC >10-12	74	180	380	250	590	1200	13	31	74	16000 (364)	28000 (899)	34000 (2150)	5000	5000	5000	9200 (364)	9700 (899)	10000	LQM (2014)
Aromatic EC >12-16	140	330	660	1800	2300 (419)	2500	23	27	130	36000 (169)	37000	38000	5100	5100	5000	10000	10000	10000	LQM (2014)
Aromatic EC >16-21	260	540	930	1900	1900	1900	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800	LQM (2014)
Aromatic EC >21-35	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
Aromatic EC >35-44	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
Aromatic EC >44-75	1600	1800	1900	1900	1900	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
VOCs																			
1,2-dichloroethane (1,2-DCA)	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	LQM (2014)
1,1,1- trichloroethane	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	140000	57000 (1425)	76000 (2915)	100000 (6392)	LQM (2014)
1,1,2,2,tetrachloroet hane	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	LQM (2014)
tetrachloroethene	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	45	95	1400	1400	1400	810 (424)	1100 (951)	1500	LQM (2014)
tetrachloromethane (Carbon tetrachloride)	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	LQM (2014)
Trichloroethene	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	LQM (2014)
Trichloromethane (chloroform)	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	LQM (2014)
Chloroethene (Vinyl chloride)	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	LQM (2014)

2,4,6 Trinitrotoluene (TNT)	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	LQM (2014)
RDX	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000 (18.7)	51000	53000	LQM (2014)
HMX	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000 (0.35)	23000 (0.39)	24000 (0.48)	LQM (2014)
Aldrin	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	LQM (2014)
Dieldrin	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	LQM (2014)
Atrazine	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400	LQM (2014)
Dichlovos	0.032	0.066	0.014	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	LQM (2014)
Alpha-Endosulfan	7.4	18	41	160 (0.003)	280 (0.007)	410 (0.016)	1.2	2.9	6.8	5600 (0.003)	7400 (0.007)	8400 (0.016)	1200	1200	1200	2400	2400	2500	LQM (2014)
alpha-Hexachlorocyclohexane	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	LQM (2014)
beta-hexachlorocyclohexanes	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16	LQM (2014)
gamma-hexachlorocyclohexanes	0.06	0.14	0.33	2.9	3.3	3.5	0.0092	0.023	0.054	67	69	70	8.2	8.2	8.2	14	15	15	LQM (2014)
Chlorobenzene	0.46	1	2.4	0.46	1	2.4	5.9	14	32	56	130	290	11000	13000	14000	1300 (675)	2000 (1520)	2900	LQM (2014)
1,2-Dichlorobenzene	23	55	130	24	57	130	94	230	540	2000 (571)	4800 (1370)	11000 (3240)	90000	95000	98000	24000 (571)	36000 (1370)	51000 (3240)	LQM (2014)
1,3-Dichlorobenzene	0.4	1	2.3	0.44	1.1	2.5	0.25	0.6	1.5	30	73	170	300	300	300	390	440	470	LQM (2014)
1,4-Dichlorobenzene	61	150	350	61	150	350	15	37	88	4400 (224)	10000 (540)	25000 (1280)	17000	17000	17000	36000 (224)	36000 (540)	36000 (1280)	LQM (2014)
VOCs Continued																			

1,2,3-Trichlorobenzene	1.5	3.6	8.6	1.5	3.7	8.8	4.7	12	28	102	250	590	1800	1800	1800	770 (134)	1100 (330)	1600 (789)	LQM (2014)
1,2,4-Trichlorobenzene	2.6	6.4	15	2.6	6.4	15	55	140	320	220	530	1300	15000	17000	19000	1700 (318)	2600 (786)	4000 (1880)	LQM (2014)
1,3,5-Trichlorobenzene	0.33	0.81	1.9	0.33	0.81	1.9	4.7	12	28	23	55	130	1700	1700	1800	380 (36.7)	580 (90.8)	860 (217)	LQM (2014)
1,2,3,4-Tetrachlorobenzene	15	36	78	24	56	120	4.4	11	26	1700 (122)	3080 (304)	4400 (728)	830	830	830	1500 (122)	1600	1600	LQM (2014)
1,2,3,5-Tetrachlorobenzene	0.66	1.6	3.7	0.75	1.9	4.3	0.38	0.9	2.2	49 (39.4)	120 (98.1)	240 (235)	78	79	79	110 (39)	120	130	LQM (2014)
1,2,4,5-Tetrachlorobenzene	0.33	0.77	1.6	0.73	1.7	3.5	0.06	0.16	0.37	42 (19.7)	72 (49.1)	96	13	13	13	25	26	26	LQM (2014)
Pentachlorobenzene	5.8	12	22	19	30	38	1.2	3.1	7	640 (43)	770 (107)	830	100	100	100	190	190	190	LQM (2014)
Hexachlorobenzene	1.8 (0.2)	3.3 (0.5)	4.9	4.1 (0.2)	5.7 (0.5)	6.7 (1.2)	0.47	1.1	2.5	110 (0.2)	120	120	16	16	16	30	30	30	LQM (2014)
Phenol	280	550	1100	750	1300	2300	66	140	280	760 _{dir} (31000)	1500 _{dir} (35000)	3200 _{dir} (37000)	760 _{dir} (31000)	1500 _{dir} (35000)	3200 _{dir} (37000)	760 _{dir} (31000)	1500 _{dir} (35000)	3200 _{dir} (37000)	LQM (2014)
Chlorophenols (excluding pentachlorophenol)	0.87 (g)	2	4.5	94	150	210	0.13 (g)	0.3	0.7	3500	4000	4300	620	620	620	1100	1100	1100	LQM (2014)
Pentachlorophenol	0.22	0.52	1.2	27 (16.4)	29	31	0.03	0.08	0.19	400	400	400	60	60	60	110	120	120	LQM (2014)
Carbon Disulphide	0.14	0.29	0.62	0.14	0.29	0.62	4.8	10	23	11	22	47	11000	11000	12000	1300	1900	2700	LQM (2014)
Hexachlorobutadiene	0.29	0.7	1.6	0.32	0.78	1.8	0.25	0.61	1.4	31	66	120	25	25	25	48	50	51	LQM (2014)

(g) derived based on 2,3,4,6-tetrachlorophenol; dir - based on a threshold protective of direct skin contact with phenol (guideline in brackets based on health effects following long term exposure provided for illustration only); (vap) calculated for vapour phase only. SOM – Soil Organic Matter; (4.5) solubility.

