Norwich Western Link

Environmental Statement

Chapter 13: Geology & Soils

Appendix 13.3: Ground Contamination Interpretive Report

Sub Appendix A: Legislative Context

Author: Ferrovial Construction and Ramboll UK Ltd

Document Reference: 3.13.03a

Version Number: 00

Date: March 2024

Contents

1 Introduction

The regime for contaminated land was set out in Part 2A (ss.78A-78YC) of the Environmental Protection Act 1990 (EPA), as inserted by S.57 of The Environment Act 1995 and came into effect in England on 1st April 2000 as The Contaminated Land (England) Regulations 2000 (SI 2000/227). These regulations were subsequently revoked with the provision of The Contaminated Land (England) Regulations 2006 (SI 2006/1380) (as amended), which came into force in August 2006, and consolidated the previous regulations and amendments. Revised statutory guidance ("the Guidance") for local authorities on how to implement the regime, including the decision-making process on whether land is contaminated land in the legal sense, has been published by Defra and entered into force in April 2012.

Under Part 2A of the EPA Section 78A(2), "contaminated land" is defined as "land which appears… to be in such a condition, by reason of substances in, on or under the land, that:

- significant harm is being caused or there is a significant possibility of such harm being caused; or
- significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused".

"Significant harm" is defined in the Guidance on risk-based criteria and must be the result of one or more relevant 'contaminant linkages' relating to the land. The presence of a contaminant linkage relies on the Source-Pathway-Receptor concept, where all three factors must be present and potentially or actually linked for a potential risk to exist. Under the Guidance, a 'significant contaminant linkage' is one which gives rise to a level of risk sufficient to justify a piece of land being determined as contaminated land. Should the authority consider that there is an unacceptably high probability, supported by robust science-based evidence that significant harm would occur if no action is taken to stop it, the land should be deemed a Category 1: Human Health. Land should be placed into Category 2 if the authority concludes, on the basis that

there is a strong case for considering that the risks from the land are of sufficient concern, that the land poses a significant possibility of significant harm. Both Category 1 and Category 2 cases would be capable of being determined as contaminated land under Part 2A on the grounds of significant possibility of significant harm to human health. If the legal test for significant possibility of significant harm is not met, the authority should place the land into Category 3. If the local authority considers that there is no risk or that the level of risk posed is low, the land should be placed into Category 4.

For six common contaminants (benzo(a)pyrene, cadmium, arsenic, benzene, hexavalent chromium and lead), a set of screening values have been developed and endorsed for use by Defra[1] (the Category 4 Screening Levels, or C4SLs) that describe a level of risk just below the Category 3/4 boundary set in the Statutory Guidance, i.e. where concentrations are below the C4SL, there is no risk or the level of risk is acceptably low. The Environment Agency states under their Land Contamination Risk Management (LCRM)[2] approach that they expect C4SL values to be used in risk assessments for land contamination.

The pollution of controlled waters is defined in Section 78A(9) of the Act as “the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter”. The new Guidance stresses that the Part 2A regime is designed to identify and deal with ‘significant pollution’ and not lesser levels of pollution. As with human health risk, Categories 1 and 2 comprise land where the local authority considers that a significant possibility of significant pollution of controlled waters exists and Categories 3 and 4 comprises cases where the authority considers that a significant possibility of such pollution does not exist. The local authority should be satisfied that a substance is continuing to enter controlled waters or is likely to enter controlled waters.

[1] SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document, Defra, revised December 2014
[2] Environment Agency (2020) Land Contamination Risk Management

2 Risk Assessment Framework

"Significant harm" or "significant pollution of controlled waters" is defined in the Guidance on risk-based criteria and must be the result of one or more relevant 'contaminant linkages' relating to the land.

The presence of a contaminant linkage relies on the Source-Pathway-Receptor concept, where all three factors must be present and potentially or actually linked for a potential risk to exist. For a risk of pollution or environmental harm to occur as a result of ground contamination, all of the following elements must be present:

- A source - a substance that is capable of causing pollution or harm;
- A receptor - something which could be adversely affected by the contaminant; and
- A pathway - a route by which the contaminant can reach the receptor.

If one of these elements is absent there can be no significant risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

The Land Contamination: Risk Management[3] (LCRM) provides the technical framework for structured decision making about land contamination. LCRM advocates a phased approach, commencing with Stage 1 Risk Assessment comprising:

- Preliminary Risk Assessment (PRA) – desk study and qualitative assessment to develop of an outline Conceptual Site Model (CSM);
- Generic Quantitative Risk Assessment (GQRA) – an estimation of risk through assessment of contaminant concentrations against generic assessment criteria; and
- Detailed Quantitative Risk Assessment (DQRA) – an estimation of risk through detailed site-specific risk assessment and

[3] Land Contamination: Risk Management (LCRM), published by the Environment Agency on 8 October 2020

development of site-specific assessment criteria (SSAC) and site-specific risk assessment.

Each stage of assessment is focussed upon the development and refinement of a conceptual site model, which identifies Source-Pathway-Receptor linkages. The conceptual site model has been developed with consideration to guidance including BS EN ISO 21365:2020 Soil quality – Conceptual site models for potentially contaminated sites.

2.1 Risk Estimation

An assessment of environmental risks is made for each potential pollutant linkage identified.

Risk estimation has been completed in accordance with the guidance provided in:

- NHBC and Environment Agency 2008. Guidance for the Safe Development of Housing on Land Affected by Contamination. R&D Publication 66: 2008.

The following is taken directly from NHBC/EA 2008. The key to the classification is that the designation of risk is based upon the consideration of both:

- the magnitude of the potential consequence (i.e. severity) [takes into account both the potential severity of the hazard and the sensitivity of the receptor]; and
- the magnitude of probability (i.e. likelihood) [takes into account both the presence of the hazard and receptor and the integrity of the pathway].

Table 1: Classification of Consequence (after NHBC/EA 2008)

Category	Definition
Severe	Highly elevated concentrations likely to result in "significant harm" to human health as defined by the EPA 1990, Part 2A, if exposure occurs. Equivalent to EA Category 1 pollution incident including persistent and/or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce. Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population. Catastrophic damage to crops, buildings or property.
Medium	Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs. Equivalent to EA Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce. Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population. Significant damage to crops, buildings or property.
Mild	Exposure to human health unlikely to lead to "significant harm". Equivalent to EA Category 3 pollution incident including minimal or short-lived effect on water quality; marginal effect on amenity value, agriculture or commerce. Minor or short-lived damage to aquatic or other ecosystems, which is unlikely to result in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population. Minor damage to crops, buildings or property.
Minor	No measurable effect on humans. Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems. Repairable effects of damage to buildings, structures and services.

For these purposes, disease is to be taken to mean an unhealthy condition of the body or a part of it and can include, for example, cancer, liver dysfunction or

extensive skin ailments. Mental dysfunction is included only insofar as it is attributable to the effects of a pollutant on the body of the person concerned.

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given below.

Table 2: Classification of Probability (after NHBC/EA 2008)

Category	Definition
High Likelihood	There is pollutant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.
Likely	There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.
Low Likelihood	There is pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place and is less likely in the shorter term.
Unlikely	There is pollutant linkage, but circumstances are such that it is improbable that an event would occur even in the very long-term.

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard.

Table 3: The Classification of Risk (after NHBC/EA 2008)

Consequence	Severe	Medium	Mild	Minor
High Likelihood	Very high	High	Moderate	Low
Likely	High	Moderate	Moderate/Low	Low
Low Likelihood	Moderate	Moderate/ Low	Low	Very low
Unlikely	Moderate/ Low	Low	Very low	Very low

Very high risk

There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner/or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.

High risk

Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.

Moderate risk

It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term.

Low risk

It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the site owner/or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.

Very low risk

It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.

No potential risk

There is no potential risk if no pollution linkage has been established.

3 Waste Classification

3.1 Reference Documents

Ramboll's assessment of waste soils was completed in accordance with the following UK guidance documents:

- The Waste Hierarchy as set out in Article 4 of the revised Waste Framework (Directive 2008/98/EC);
- Technical Guidance WM3: Waste classification – Guidance on the classification and assessment of waste (1st Edition v1.1) May 2018;
- The European Waste Catalogue (EWC 2002); and
- The Hazardous Waste (England and Wales) Regulations 2005, or Special Waste Regulations 1996 and its amendments (Scotland).

3.2 Methodology

The first step of the assessment confirms whether soil is deemed to be a 'waste'. If there are no legitimate options for reusing, recycling or recovery of the soil, then the soil is a waste requiring onward management.

In terms of the EWC coding system, soil excavated from sites will typically be classified under Section 17 construction and Demolition Wastes (including excavated soil from contaminated sites). If this material is identified for off-site disposal, then it may be classed as either:

- 'Soil and Stones containing Dangerous Substances' (EWC Code 170503); or
- 'Soil and Stones other than those mentioned in EWC Code 170503' (EWC Code 170504).

Both 170503 and 170504 are known as a 'Mirror Entry wastes' and they need to be assessed against Threshold Levels for certain dangerous substances in order to confirm whether the soil needs to be classified as hazardous (170503) or non-hazardous (170504).

Soil chemical testing results (total soil analysis – not WAC testing) are used to inform the classification of waste soil to be removed from the site. The results are inputted into HazWasteOnline™ (a web-based tool) which allows the waste to be classified as either hazardous or not hazardous. The software utilises Environment Agency guidance and European regulations to classify samples in line with current requirements.

Waste Acceptance Criteria (WAC) testing has been undertaken on soils classified as hazardous to ascertain the class of landfill that could be used to accept the waste for off-site disposal. WAC testing may also have been undertaken on soils considered to be inert.

Where wastes have been classified as hazardous, Ramboll has considered options for pre-treatment in the report text. The requirement for pre-treatment is set out in Environment Agency guidance on Dispose of Waste to Landfill[4].

The presence of asbestos or asbestos containing materials (ACMs) in waste soils requires additional consideration. The Hazardous Waste (England and Wales) Regulations 2005 requires that any waste having an asbestos content greater than 0.1% weight/weight (w/w) be classified as Hazardous Waste. Any waste with an asbestos content of less than 0.1% w/w can be classified as non-

[4] Environment Agency 2020 Dispose of Waste to Landfill

hazardous waste, unless there are other contaminants present which would make the waste hazardous.

Where the asbestos is deemed to be of a fibrous nature the Health and Safety Executive (HSE) require that the handling in accordance with The Carriage of Dangerous Goods (etc) Regulations 2009 (CDG2009) and the Control of Asbestos Regulations (2012).

Where friable asbestos is present but at concentrations which are below the hazardous waste threshold, escape of respirable asbestos fibres (i.e. both during packaging and transportation) must be assessed and mitigated where required.

3.3 Generic Assessment Criteria

Soils

In accordance with current UK guidance on legislation including Part 2A of the Environmental Protection Act 1990 and based on the principles of risk assessment, Ramboll Environment and Health has derived generic criteria for interpretation of soil and groundwater chemical analysis (Norfolk County Council's Generic Assessment Criteria – Norfolk County Council's GAC). The assessment of chemical data from an intrusive investigation is undertaken in a tiered approach, and the first stage is a Generic Quantitative Risk Assessment (GQRA). Norfolk County Council's GAC are considered to be threshold-based screening concentrations, at which a significant risk is not considered to be present to the relevant receptors.

The Soil Guideline Values (SGVs) for 11 compounds published in 2009 by the Environment Agency, are based on a sandy loam soil with 6% soil organic matter (SOM). The 6% SOM and sandy loam soil type is not considered by Ramboll to be realistic of 'typical' UK soil conditions, and EA guidance[5] states that at 6% SOM, SGVs may not be sufficiently protective (i.e. the values are too high to be sufficiently certain that they describe land where there is no risk to

[5] 'Using Soil Guideline Values' published by the Environment Agency March 2009 SC050021/SGV

human health or the risk is negligible). For Norfolk County Council's GAC, all the SGV inputs have been used apart from the SOM and soil type, which were amended to 1% and sand; thereby ensuring a suitably conservative Norfolk County Council's GAC appropriate for most soils and Made Ground encountered in the UK. It is noted that none of the screening criteria used in the UK, including the SGVs, have a statutory basis.

The Norfolk County Council's GAC for soil assessment are based on the generic scenarios outlined in the Contaminated Land Exposure Assessment (CLEA) methodology and guidance documents, and include inhalation, ingestion, dermal contact of soil and dust as pathways for commercial and residential scenarios; as well as ingestion of homegrown produce for residential with gardens scenario. In addition, Norfolk County Council's GAC have also been derived for the two Public Open Space land uses defined in C4SL guidance (outlined below). These have been calculated by use of two proprietary risk assessment models (CLEA Version 1.071 and the ASTM RBCA[6] Tool Kit Version 2.6 for Chemical Releases) which have been altered, where necessary, to reflect the current UK approach to human health risk assessment as set out in Land Contamination: Risk Management[7] (LCRM) and the CLEA guidance documents (incorporating Science Reports SC050021/SR2 (January 2009), SR3 (January 2009), SR4 (September 2009) and the SGV reports (2009)). The physiochemical data has been taken from or derived using the methodology detailed in SR7 (November 2008) and SGV reports (2009), where feasible. The toxicology data has been taken from the current published EA toxicology documents. We have referred to all current publications and guidance issued up until June 2019.

This approach by Ramboll follows the withdrawal of CLR 7-10 (and proposed withdrawal of CLR 11 in December 2019), CLEA UK (beta), and CLEA Model

[6] American Society for Testing Materials – Risk Based Corrective Action Model
[7] The Land Contamination: Risk Management guidance document (published by the Environment Agency on 5th June 2019) is based on the Model Procedures for the Management of Land Contamination - Contaminated Land Report (CLR11). The scope, framework and purpose remain the same. The EA proposes to withdraw CLR11 in December 2019.

versions V1.04 to V1.07 by the Environment Agency and DEFRA. The approach has been applied to all contaminants with the exception of lead and nickel, as the respective SGV has been withdrawn by the Environment Agency.

In the absence of published EA data, reference has been made to further UK published guidance in the first instance.

Reference has been made to the Defra-funded research project (SP1010), which developed a methodology to derive Category 4 Screening Levels (C4SLs) for six contaminants (benzo-a-pyrene, cadmium, arsenic, benzene, hexavalent chromium and lead). SP1010 provides technical tools and advice to be developed to help regulators and others to conform to the requirements of revised Part 2A Statutory Guidance. The C4SLs are therefore less conservative than GAC developed in accordance with published CLEA guidance as they describe a low risk as opposed to minimal risk scenario.

On this basis, Ramboll has adopted the use of a C4SL value for lead only, given that no alternative minimal risk value exists. Minimal risk assumptions have been applied to in-house REH GAC for all other contaminants of concern within the screening assessment for the Proposed Scheme.

Ramboll also attended the Land Quality Management and Chartered Institute of Environmental Health workshop for the collaborative development of 'Suitable 4 Use Levels' (S4ULs) and reference has been made to their publication ‘The LQM/CIEH S4ULs for Human Health Risk Assessment, 2015’.

Review of additional UK organisation guidance including Contaminated Land: Applications in Real Environments (CL:AIRE) and partners GAC, including addendums up until 10 April 2012 has also been made. Finally, where necessary, other published sources of (non-UK) information, such as the RBCA V2.6 database has also been reviewed.

PAH Assessment

Ramboll has adopted a surrogate marker approach for the assessment of PAHs in soil. This approach provides a generic (minimal risk) assessment screening value for coal tar (rather than the C4SL for benzo(a)pyrene applied for sites

located in England and Wales) which is used to represent risks from all eight genotoxic PAHs (benzo(a)pyrene, chrysene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(123-cd)pyrene and benzo(ghi)perylene).

Non-genotoxic PAHs continue to be assessed using individual GACs.

The Surrogate Marker approach relies on the Culp study[8] 'coal tar' mixture. The PAH in soil mixture must therefore conform to the "coal tar" mixture for the SM approach to apply. This is determined via a screening tool used to compare results with the 'coal tar' mixture. All PAHs are tested for in soil samples to assess PAH mixture suitability.

Water

In the absence of relevant published water assessment criteria, the potential risk to human health from contaminated surface and groundwater and the potential risk to controlled waters from entry of pollutants (either directly or via a groundwater pathway) has been assessed using commonly accepted UK guidelines including the Water Supply (Water Quality) (Scotland) Regulations 2001 (known as the Drinking Water Standards, or DWS), the Private Water Supplies (Scotland) Regulations 2006 and the Environmental Quality Standards (EQS) defined in European legislation such as the Water Framework Directive (WFD) (2000/60/EC).

Revised EQS were published in December 2009 under the Priority Substances Directive (PSD) (2008/105/EC), a daughter directive of the WFD. The PSD establishes EQS for Priority Substances which have been set at levels of concentration which are safe for the aquatic environment and for human health. A list of such dangerous substances (including those from other European legislation e.g. the Dangerous Substances Directive (76/464/EC)) and EQS has been established and is listed in the December 2009 Scotland River Basin

[8] Culp, S.J., Gaylor, D.W., Sheldon, W.G., Goldstein, L.S. and Beland, F. A. (1998). A comparison of the tumors induced by coal tar and benzo[a]pyrene in a 2-year bioassay. Carcinogenesis, 1998, 19(1), 117- 124

District (Surface Water Environmental Standards, Condition Limits and Groundwater Threshold Values) Directions 2009. The EQS are detailed in Schedule 5 (Environmental standards for dangerous substances) and Schedule 6 (Threshold values for groundwater) of the Directions.

For those determinants included in the analytical suite which do not have a corresponding UK drinking water or environmental screening criteria, reference is made to international guidance in accordance with SEPA guidance.

A methodology for the generation of the GAC for groundwater vapours (GAC_{gwvap}) was published by the Society of Brownfield Risk Assessment (SoBRA) in February 2017[14], which is based on the CLEA model. Ramboll has adopted SoBRA's approach and modified the model input parameters to reflect site conditions and generate site SSAC for groundwater contaminant sources designed to be protective of site users for a residential and/or commercial/industrial scenario as appropriate.

The SoBRA (GAC_{gwvap}) methodology uses the Environment Agency's CLEA software model. The CLEA software was originally provided for deriving assessment criteria for soils, not groundwater; however groundwater assessment criteria can be extracted from the calculations within CLEA. CLEA assumes a steady state equilibrium between the sorbed, water and vapour phase concentrations in soil. Consequently, as part of the process of calculating soil phase concentrations, the software also calculates the vapour phase concentration and the pore water dissolved concentration (soil solution concentration) at the soil GAC. Therefore, for given soil assessment criteria derived to be protective of health, a soil solution concentration is also available within the CLEA calculations which would give rise to this vapour concentration at the tolerable risk level. This soil solution concentration is used as an inferred groundwater SSAC.

[14] SoBRA (2017) Development of Generic Assessment Criteria for Assessing Vapour Risks to Human Health from Volatile Contaminants in Groundwater. Version 1.0
[15] American Society for Testing Materials – Risk Based Corrective Action Model, Version 2.6

The proprietary risk assessment model, the ASTM RBCA[15] Tool Kit Version 2.6 for Chemical Releases, has been used for compounds which could not be run in CLEA. The RBCA model has been altered where necessary to reflect the current UK approach to human health risk assessment.