

Land contamination and development

Guidance for assessing and addressing land contamination issues to meet the requirements of Contaminated Land regulators in Scotland



**Environmental
Protection
Scotland**

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Statement of use

This publication is intended to help developers, agents, consultants and regulators in their evaluation and management of land contamination.

Regulatory authorities reserve the right to depart from the position outlined in this guidance to; avoid the risk of harm to human health and the environment; or to ensure the effectiveness of regulatory enforcement is not undermined.

This guidance applies only in Scotland and is subject to periodical review.

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DEFINITIONS

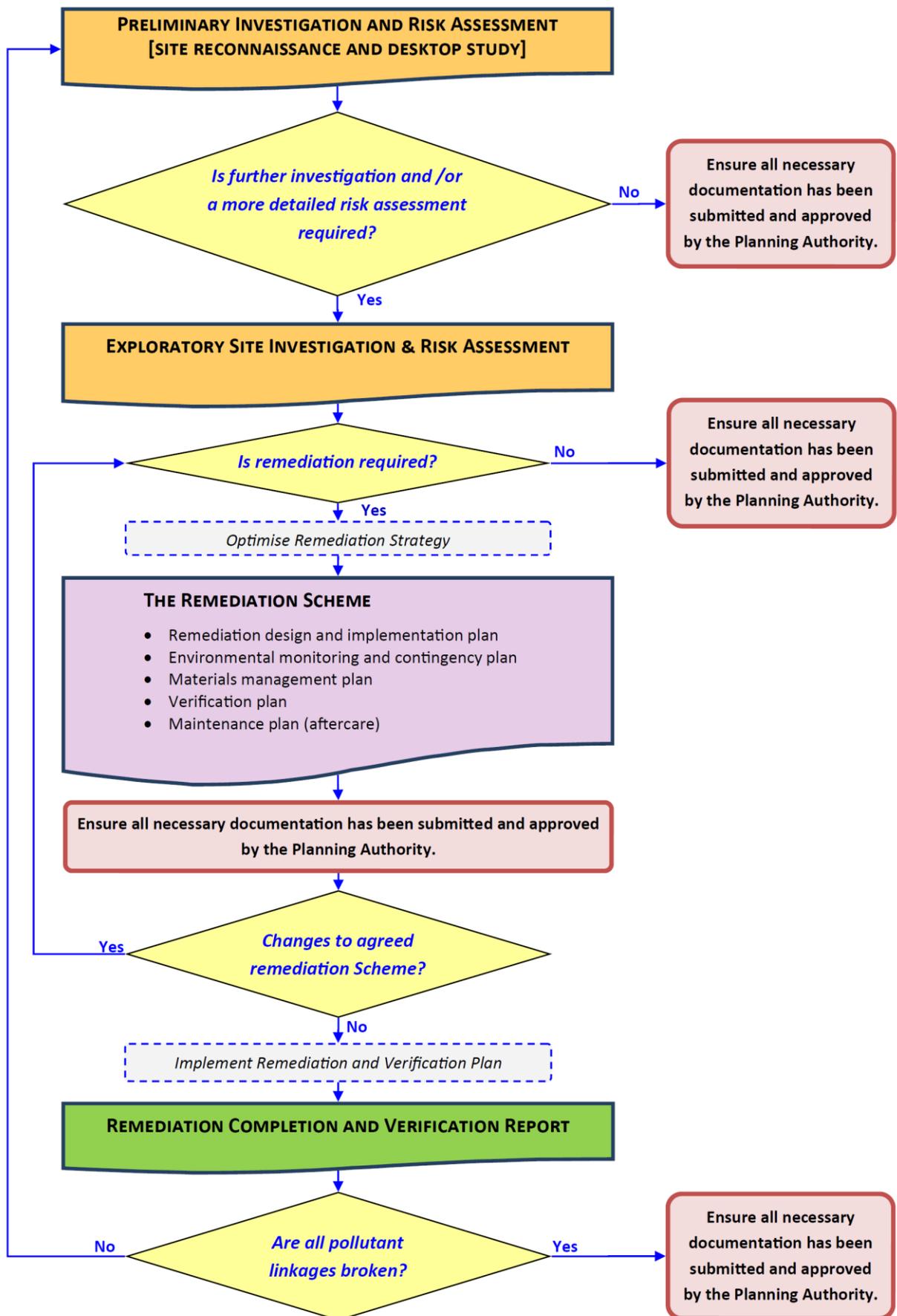
For the purposes of this document the following definitions will be used:

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| Appropriate person(s) | Any persons who caused or knowingly permitted the contaminating substances to be in, on or under the land will be the appropriate person(s) to undertake the remediation and meet its costs. However, if it is not possible to find any such person, responsibility will pass to the current owner or occupier of the land. Defined in section 78A(9) of Part IIA EPA 1990. |
| Brownfield | Land / sites that have previously been developed. The term may cover vacant or derelict land, land occupied by redundant or unused building and developed land within the settlement boundary where further intensification of use is considered acceptable. |
| Conceptual site model | A narrative, tabular or graphical summation of all information about the site and all potential pollutant linkage relationships. The initial CSM should be applied to the design of intrusive investigations and refined when appropriate taking into account investigation results, planned land use, anticipated changes to the environmental setting (i.e. groundwater levels). |
| Contaminated Land | As defined by Part IIA of the Environmental Protection Act 1990 (as amended): any land which appears to the Local Authority, by reason of substance in, on or under the land, that – (a) significant harm is being caused or there is significant possibility of such harm being caused, or (b) significant pollution of the water environment is being caused or there is a significant possibility of such pollution being caused. |
| Harm | As defined by Part IIA of the Environmental Protection Act 1990 (as amended): “harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property”. |
| Land contamination | Any land where contamination may be present irrespective of the significance of its presence. This description has not the same meaning as Contaminated Land, which is a legal definition. |
| Pathway (exposure) | One or more routes or means by, or through, which a receptor: is being exposed to, or affected by, a contaminant, or (b) could be so exposed or affected. |
| Permanent gas | A substance that remains gaseous under normal conditions such as methane, carbon dioxide and carbon monoxide |
| Pollutant linkage | The relationship between the contamination source, a pathway and a receptor. All three elements must be present for a risk to exist and if one of the elements is missing then there can be no risk. There may be more than one pollutant linkage in any given piece of land. |
| Preliminary Investigation | This investigation should be carried out prior to any exploratory investigation exercise. This data collection process comprises i) desk study with appropriate consultations and ii) site reconnaissance. |
| Receptor | In general terms, something that could be affected by a contaminant, such as people, a water body, property or an ecological system. |
| Remediation scheme | Actions taken to prevent, minimise, remedy or mitigate the effects of any identified unacceptable risks. This should also include measures to achieve quality assurance and verification. |
| Remediation strategy | High level overview for the optimised remediation approach required to break identified significant pollutant linkages for the proposed development. |
| Risk assessment | A formal, structured process of identifying, assessing and evaluating the health and environmental risks associated with a particular hazard. |
| Significant possibility of significant harm | Whether the possibility of significant harm being caused is significant shall be determined in accordance with of the Part IIA Statutory Guidance Paper SE/2006/44, A.31 Table B. Section 78A(4) defines "harm" as meaning "harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property" The term "possibility of significant harm being caused" should be taken as referring to a measure of the probability, or frequency, of the occurrence of circumstances which would lead to significant harm being caused. |

| | |
|---|---|
| Site investigation | A site specific, structured and iterative process involving desk studies, walkovers and intrusive investigations to gather information to inform the risk assessment. |
| Site reconnaissance | This is a site inspection or walk-over survey to verify desk study information, identify additional potential pollutant linkages, record observation of the site and surrounding conditions and identify potential constraints/hazards to site works (non-native invasive species, health and safety concerns). |
| Statutory consultee | A generic term for an organisation with expertise and statutory responsibility on certain subject matters, to be consulted by Planning Authorities if an application may affect the interests of that organisation e.g. Historic Scotland, Scottish Natural Heritage, Transport Scotland. |
| Source contaminant, or pollutant | A substance which is in, on or under land and has the potential to cause harm to human health, pollution of the water or wider environment and/or damage to property. |
| Substance | Any natural or artificial substance, whether in solid or liquid form or in the form of a gas or vapour. |
| Sustainable development | Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. |
| Validation | Evidence that the risk assessment model represents site conditions or demonstrating that the remediation method is capable of breaking pollutant linkages. |
| Verification | Routine confirmation, through the provision of objective evidence; that the development has been completed in accordance with the remediation scheme specifications; and that the risk management approach is effective. |
| Water environment | All surface water, groundwater and wetlands [as defined in the Water Environment and Water Services (Scotland) Act 2003]. |

Common Abbreviations

| | |
|----------------|--|
| AGS | Association of Geotechnical & Geoenvironmental Specialists |
| BRE | Building Research Establishment |
| CIRIA | Construction industry research and information association |
| CLO | Contaminated Land Officer |
| CSM | Conceptual Site Model |
| DQRA | Detailed Quantitative Risk Assessment |
| GQRA | Generic Quantitative Risk Assessment |
| LNCS | Local Nature Conservation Site |
| mAOD | Metres Above Ordnance Datum |
| mbgl | Metres below ground level |
| PAHs | Polyaromatic Hydrocarbons |
| SEPA | Scottish Environment Protection Agency |
| SINC | Site of Importance to Nature Conservation (<i>see also LNCS</i>) |
| SPOSH | Significant Possibility Of Significant Harm |
| SSSI | Sites of Significant Scientific Importance |
| SuRF UK | Sustainable Remediation Forum - United Kingdom |
| SVOC | Semi-Volatile Organic Compounds |
| UXO | Unexploded Ordnance |
| VOCs | Volatile Organic Compounds |



Land contamination and development management flowchart

1. INTRODUCTION

1. Land can be affected by contamination from a variety of substances in, on or under the land that may be hazardous to health, pollute the water environment, or harmful to the wider environment.
2. It is the developer's responsibility for the safe development of a site and to ensure that contamination risks are adequately addressed. This guide is intended to provide developers, planning agents and consultants with advice on what information is required in relation to land contamination to allow the Local Authority to discharge its statutory responsibility relating to planning applications and building warrants.
3. This guide should be read in conjunction with;
 - Current policy and guidance for the [Scottish Planning System](#);
 - [Planning Advice Note 33: Development of contaminated land](#); and
 - [Building \(Scotland\) Regulations Technical Handbooks](#)

Hyperlinks to these and other commonly used codes of practice and guidance publications including all those mentioned in this publication are provided in Appendix A.

4. The tables in this publication are indicative of the content expected at each phase of reporting. Some Local Authorities have their own detailed guidance available and this document does not supersede these publications. Advice on specific requirements should be sought from the Local Authority.
5. It is the applicant's responsibility to submit reports in an acceptable format and confirm with the Local Authority contact for their preferred format (e.g. hard copy vs electronic).

1.1. Scottish Government policy

6. The Scottish Government support Local Authority and SEPA regulators to enforce the statutory regime for cleaning up historically contaminated land and pollution of the water environment.
7. The contaminated land regime is designed to protect human health and the environment, facilitate the re-use of brownfield sites and promote the regeneration of urban areas
8. Dealing with our contaminated land legacy and prevention of future contamination is integral to meeting the Scottish Government commitment to sustainable development.

1.2. Regulatory context

9. Land contamination can be regulated by the Local Authorities through development management and building standards; or enforcement actions under the provisions of Part IIA of the Environmental Protection Act (EPA) 1990; or voluntarily addressed by landowners outside any regulatory system.
10. When considering information formally or voluntarily submitted for regulatory consultation, the Local Authority may consult with the Scottish Environment Protection Agency (SEPA) for specialist technical advice.
11. Delays in processing submissions for a planning application or building warrant are usually due to missing documentation or noncompliance with current codes of practice.
12. Local authorities are the lead regulator under both the planning and contaminated land regimes (with the exception of 'special sites' for which SEPA is the enforcing authority) and SEPA is the lead regulator for waste management and lead regulator for Radioactive contaminated land under the Radioactive Contaminated Land (Scotland) Regulations 2007, as amended.

1.2.1. Development Management

13. Development management has a key part to play in addressing the problem of historical contamination. In pursuing policies to bring brownfield and damaged land back into beneficial use, developers and Planning Authorities need to be aware of land quality issues and whether confirmed or suspected, contamination is a material planning consideration.
14. The aim should be to ensure that the circumstances of the developed site are such that it is not Part IIA contaminated land. So in addition to human health, consideration of potential contamination risks to water and the wider environment are required irrespective of the proposed development land use.
15. The 'suitable for use' framework used to deal with land contamination at proposed development sites consists of three elements;
 - *Ensuring that land is suitable for its current use by identifying and removing unacceptable risks to human health and the environment;*
 - *Ensuring that land is made suitable for any future use by assessing the potential risks for contamination as planning permission is given for development and, where necessary, remediating the land before the new use commences;*
 - *Limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment from the current use or future use for which planning permission is being sought.*
16. Within this 'suitable for use' framework, the previous use of any particular area of land may cover several different activities (not all will be documented), and some risks arising from contamination (particularly impacts on water and the wider environment) may arise independently of the land use.
17. The development should not create new pollutant linkages i.e. creation of contamination sources following demolition activities or import of fill. The applicant needs to satisfy the Planning Authority that unacceptable risks from contamination have been successfully addressed through remediation actions and with the land being 'suitable for use'.
18. Land contamination issues can be addressed either as a part of the development planning application, or by conditioned requirements. In either approach the planning application must meet the necessary reporting requirements to ensure that the new development is suitable for use.

1.2.2. Building Standards

19. Scotland's building standards system sets out the technical requirements to protect the public interest to ensure buildings are safe, efficient and sustainable. It is administered and enforced by Local Authorities.
20. The Building (Scotland) Regulations 2004 (as amended), Schedule 5, Section 3: Environment;
 - 3.1. *Site preparation – harmful and dangerous substances: Every building must be designed and constructed in such a way that there will not be a danger to the building nor a threat to the health of people in and around the building due to the presence of harmful or dangerous substances.*
 - 3.2. *Site preparation – protection from radon gas: Every building must be designed and constructed in such a way that there will not be a threat to the health of people in or around the building due to the emission and containment of radon gas.*
21. The Scottish Government publishes two versions of the Technical Handbook, domestic and non-domestic, to explain how to achieve these mandatory requirements set out in the Building (Scotland) Regulations 2004.

1.2.3. Part IIA Contaminated Land

22. Under the Part IIA legislation and associated Statutory Guidance, there is a very specific definition of Contaminated Land (definitions page iii).
23. Sites remediated voluntarily or developed without appropriate assessment, remediation or verification and a significant pollutant linkage is subsequently identified, could result in its determination as Contaminated Land under Part IIA.
24. The Part IIA Statutory Guidance for Scotland states “Where new development is taking place, it will be the responsibility of the developer to ensure the required and necessary remediation is carried out. In many cases, the enforcement of any remediation will be through compliance with planning conditions and building standards requirements, rather than through a remediation notice issued under Part IIA.” (Annex 1, Paragraph 44).

1.2.4. Other regulatory regimes

25. Developers should be aware of other regimes relevant to developing land affected by contamination, such as; The Environmental Liability (Scotland) Regulations 2009; The Regulatory Reform (Scotland) Act 2014; River Basin Management Planning, a requirement of the EU Water Framework Directive and the Groundwater Daughter Directive.

1.3. Risk assessment and management framework

26. The UK land contamination risk assessment and management framework is based on a phased approach:
 1. **Preliminary investigation and risk assessment (Desktop study)**
 2. **Exploratory site investigation and risk assessment**
 3. **The remediation scheme**
 4. **Remediation completion and verification reporting**
27. A risk assessment is a site specific, structured and iterative process involving progressively detailed investigations to gather, evaluate and assess information about a site to aid decision making. A risk assessment should identify all the potential contaminant hazards and plausible pollutant linkages, then assess the likelihood of harm caused to human health and the wider environment. There are typically two phases in the risk assessment; the preliminary phase of investigation is predominantly research with site reconnaissance; and if necessary this would be followed by a phase involving exploratory site investigations.
28. The remediation scheme comprises a number of key elements from the overall strategy to the more specific remediation design, verification plan and implementation. Documentation of the entire remediation process provides verification evidence.
29. The remediation completion and verification report is a record documenting the completion of the remediation work with a compilation of all the verification work. This submission provides the Local Authority with the necessary evidence demonstrating that the land and development are in a condition suitable for use.
30. Early engagement with the Local Authority contaminated land officers during investigations and as site remediation progresses is usually beneficial to both developers and regulators. However, any proposed changes to the assessment or works as provided in the original submitted documentation should be issued in writing to the Local Authority.

1.3.1. Professional competencies

31. The site investigation, assessment, remediation, verification and reporting should be carried out by **competent persons**. Organisations or individuals who are appointed or engaged for these tasks should have the correct competencies, be properly trained to carry out their duties and have sufficient resources available to them.
32. Competency is having the necessary skills, knowledge, experience and capability for the needs of a particular task. The development of competence is an ongoing process. There are a variety of personal development professional competency schemes available for most aspects of the industry that can help managers identify **competent persons** to undertake specific tasks as the project progresses.

Competent person(s)

There are multiple roles and tasks to be undertaken and the safe development of a site will rely on the appointment of competent persons.

To be competent an organisation or individual must have; a) sufficient knowledge of the specific tasks to be undertaken and the risk the work will entail; b) sufficient skills, knowledge, training, experience and ability to carry out their duties in relation to the project in accordance with current codes of practice and recognise their limitation and take appropriate action in order to prevent harm to those carrying out construction work, or those affected by the work. The level of competence required will depend on the risk, complexity and scale of the task.

The competent person(s) must be familiar with the current regulatory requirements for site development in Scotland, which differs in some respects from other parts of the United Kingdom.

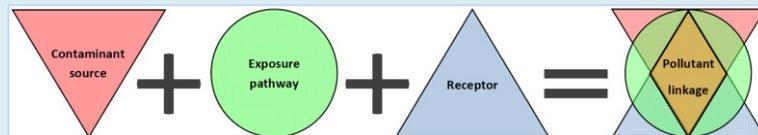
33. The production of a report is a composition from multiple contributors and a rigorous quality check of report content should be carried out before it is issued to the Local Authority. In complex scenarios, it may be necessary to consider appointing an independent peer review (by competent persons) of methodology and reported outcomes.
34. The competency of laboratories and drilling contractors is identified by third-party accreditation to organisations providing internationally-recognised proficiency testing schemes e.g. UK Accreditation Scheme (UKAS); British Drilling Association (BDA); Environmental Agency Monitoring Certification Scheme (MCERTS) etc. Where the accreditation applies to the method of analysis, it might be necessary to review method statements to ensure correct interpretation of results in the risk assessment. The complete documentation issued by the laboratory or contractor should be provided in the reporting submissions to the Local Authority (i.e. the laboratory report deviant sample record).
35. Report submissions are usually rejected where they do not comply with current standards or codes of practice, which can lead to project delays and it is difficult to defend a report that does not adhere to best practice. The references to codes of practice and industry standards provided in this publication (Appendix A) are those most commonly applied but there may be other appropriate standards that could be applied.
36. The Construction (Design & Management) Regulations (also referred to as “CDM regulations”) applies to every construction project. Under the CDM Regulations, the principal contractor and principal designer must satisfy themselves that the designers and contractors that they or the developer (client) engages are ‘competent’ and are adequately resourced. The absence of a principal contractor or principal designer means the client has assumed the role along with the associated legal duties and responsibilities.

2. PRELIMINARY INVESTIGATION AND RISK ASSESSMENT

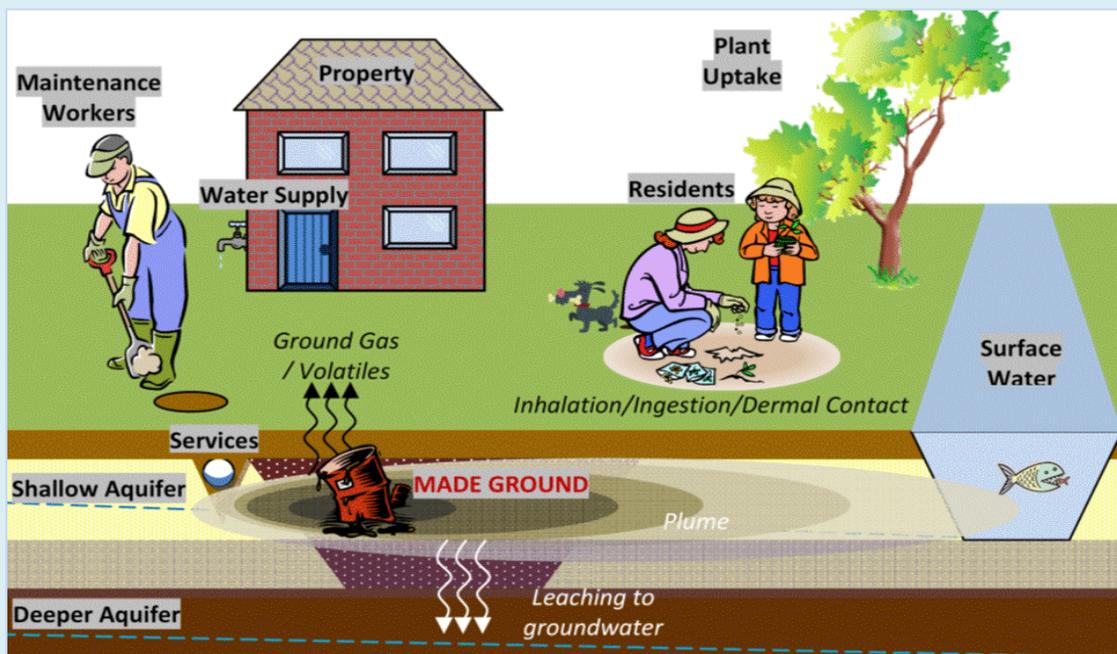
37. This preliminary phase of investigation is typically known as a 'desktop study' as the majority of the investigation is office based research. The aim of this phase is to identify the likelihood for contaminants to be present and assess whether they could pose a risk to receptors that will be present in the proposed development.
38. Site reconnaissance is an essential component of the preliminary investigation and should be carried out by **competent person(s)** able to identify potential investigation/development constraints. Online aerial imagery and street views are useful for examining sites but this will not provide an accurate account of the current site condition and should not be used as a substitute for site reconnaissance.
39. At this preliminary phase developers should be cognisant of other potential site constraints and hazards to investigation, remediation and development; such as underground services, radioactive substances, flood risks, mineral extraction, ground instability, unexploded ordnance, unsafe buildings, subsurface voids and invasive or protected species.

Conceptual site model

The conceptual site model is an essential part of the risk assessment that presents the plausible relationship connections between identified potential contaminant sources, exposure pathways and receptors. The potential for harm only occurs when the linkage is complete.



The conceptual site model must be revised and updated throughout the investigation, assessment and remediation process. In the remediation completion report, the conceptual site model must show the remediated pollutant linkages.



Publications are available with guidance on conceptual site model development; some of these are listed in Appendix A, i.e. BS 10175.

2.1. Identifying potential pollutant linkages

40. An understanding of the site history is crucial to ascertain whether previous activities could give rise to potential contamination sources. The Local Authority and SEPA should be contacted for environmental information held about the site.
41. A commercial environmental search report on its own will not contain the necessary supporting risk evaluation in the context of the current site condition or the proposed development design. In establishing whether pollutant linkages exist there would need to be a review of documented and evidenced remediation scheme completion and verification work.
42. Naturally elevated chemical substances may be present originating in the underlying soil, rock and water environment. Although these are natural sources these must also be investigated to determine whether through the site development there is risk to human health and the environment.
43. Contaminants such as asbestos and non-native invasive plant species observed during site reconnaissance should be cordoned off to prevent spread of contamination plant material during subsequent site works.
44. The **conceptual site model** is the interpretation of the available information collated in the preliminary investigations and identification of all plausible pollutant linkages that require further consideration in a qualitative risk assessment. The **conceptual site model** scenario should be that of the proposed development and should include any significant earthworks or proposed changes to ground levels that would be a significant variation to the existing site condition.
45. On completion of the preliminary investigations, a qualitative risk assessment is undertaken to identify potentially significant pollutant linkages that might require further exploratory investigations in the field. This information is used to develop the exploratory investigation strategy and chemical analysis schedule.
46. The preliminary investigation and risk assessment report may be sufficient to meet Local Authority requirements without the need for further environmental exploratory investigations or remediation work. However, it may be necessary to include land quality control procedures such as; a contingency plan in the event contamination is discovered; and a verification plan for ensuring imported soil or fill meet the specified quality requirements. In the event of exploratory investigations for geotechnical or water supply pipework specifications, environmental observations made during these works would add weight to the findings of the preliminary investigation and risk assessment.

| PRELIMINARY INVESTIGATION AND RISK ASSESSMENT | |
|--|--|
| Technical reporting guidance – suggested structure and contents | |
| Introduction | <p>Purpose, aims and objectives of the investigations with information about the proposed development and anticipated extent of ground preparation works.</p> <p>Plans: site location plan, site boundary plan, planning boundary plan and current site layout.</p> |
| Research methodology | <p>It may be necessary to contact the following for information on the site: Local Authorities, SEPA, Utilities, Scottish Natural Heritage, Historical Environment Scotland, British Geology Society, Archaeologists, National Map Library of Scotland, etc.</p> |
| Geo-environmental setting | <p>Geo-environmental characterisation: an overview of the topography, hydrology, geology and hydrogeology, aquifer resource potential, economic mineral extraction, etc.</p> <p>Review of current and recent land uses on and off-site taking in to consideration the conceptual site model and all plausible pollutant linkages.</p> <p>Review of previous site investigation reports (if available): An objective evaluation of available site information from previous investigations. Should comment on suitability of data in this assessment (including compliance with best practice) and identify any gaps in the information that require further investigation.</p> <p>Site reconnaissance (walkover survey) to assess current land condition supported by photographs, site measurements and observation records.</p> <p>Plans: relevant extracts of historical and environmental plans.</p> |
| Identify potential contaminant sources | <p>Identification of plausible contaminative sources in on or under the site based on research and observational evidence; may be anthropogenic, natural, on or off-site.</p> <p>Plans: spatial plan showing location of potential sources within the site and in the surrounding area.</p> |
| Identify potential receptors | <p>In the context of the intended land use scenario identify all potential receptors: human health categories, water environments and wider environments, such as protected environments e.g. SSSI, LNCs, built heritage, archaeological significance etc.</p> <p>Plans: proposed development layout; a spatial plan showing location receptors in the area; anticipated changes to ground levels.</p> |
| Conceptual site model | <p>Reporting of all plausible potential pollutant linkages - the contaminant sources, exposure pathway and receptor connections that have been identified in the context of the planned development.</p> <p>Illustrations: tabular, flow diagram or other graphical representation of the conceptual site model.</p> |
| Qualitative risk assessment | <p>Evaluate the level of risk associated with each identified potential pollutant linkage in the context of the planned development. This may be presented as a table with reference to a risk matrix (probability/consequence).</p> |
| Identification of other constraints | <p>Non-native invasive species, protected species, unexploded ordnance, radioactive substances, radon gas, asbestos, ground stability, abandoned mine workings, access, utilities etc. that may present restrictions to future investigations and site work.</p> |
| Conclusions and recommendations | <p>Summarise conceptual site model and any critical pollutant linkages that require exploratory or other further investigation.</p> <p>Outline of next phase site investigation and assessment proposals (if required).</p> |

3. EXPLORATORY SITE INVESTIGATION AND RISK ASSESSMENT

47. Having identified potential pollutant linkages in the preliminary investigative phase, further investigations will be required to obtain site specific data on the severity and extent of the contaminant sources and the probability of pollutant linkages occurring (frequency and duration). The investigations at this phase should provide greater confidence in defining the uncertainties and assumptions made in the preliminary **conceptual site model**.

3.1. Exploratory site investigation

48. The exploratory investigative phase typically involves fieldwork with environmental sampling, monitoring, chemical and geotechnical analysis.

Exploratory investigation strategy

The **conceptual site model** should be referred to in the exploratory investigation strategy which should reflect the intended development design. This should also account for the proposed changes to ground levels and any other earthworks.

In the absence of development design information, a precautionary risk assessment approach should be adopted. The investigations should enable the assessor to accurately characterise the underlying ground conditions and nature of potentially harmful substances present. Ambiguous field data is likely to require additional exploratory investigation works.

According to the complexity of the development programme, a phased exploratory investigation approach would enable early decision making with additional investigations to follow after major site preparations such as demolition or earthworks.

A contingency plan is required for dealing with the discovery of hazardous materials that could present an immediate risk to human health or the environment should they be disturbed during site works.

49. The exploratory investigation must be designed and carried out by suitably **competent person(s)**. The investigation strategy, investigation and sampling techniques should be carried out in accordance with applicable codes of practice such as BS 5930, BS 8576, BS 10175, Eurocode 7, ISO 15175, ISO 18400 series and ISO 5667 series of standards etc.
50. The exploratory investigation must be detailed enough to allow a comprehensive environmental risk assessment to be undertaken; an exploratory site investigation with no specific environmental investigation strategy is unlikely to meet this requirement.
51. The quality of the risk assessment and subsequent proportionate remediation decisions rely on the quality of the information collected from the site. The environmental exploratory investigation strategy should include;
- Detailed description of artificial deposits, observations of water strikes and standing level, visual and olfactory evidence of contamination, appropriate sample containers and preservation.
 - Adequate sampling and monitoring positions are required to characterise the **conceptual site model** and potential risks identified. In the absence of water at the monitoring positions an alternative strategy should be considered i.e. deeper wells, soil-leachate, or alternative monitoring position.

- Separately designed monitoring installations for gas and groundwater monitoring. Dual purpose gas and groundwater monitoring wells often do not meet the investigation strategy objectives. The pollutant linkages should be considered and the appropriate geology targeted.
 - An analysis suite that reflects both the contaminants of concern identified in the preliminary investigations and the parameters used to model the fate and transport of chemicals in the environment.
 - Adherence to QA/QC procedures. The impact of any deviant samples on the risk assessment should be provided. If this is a critical element in the assessment it may be necessary to repeat the sampling exercise.
 - Data produced using field monitoring equipment (PID, FID, XRF) should be accompanied with methodologies, calibration and validation documentation.
52. Where site data e.g. exploratory hole logs, chemical and geotechnical test results are being submitted electronically, the 'AGS Data Format' is the preferred standard. This allows the data to be analysed in various software, <http://ags.org.uk/data-format/>.
53. If the site is sensitive due to the nature of contamination anticipated or objections to the development it may be necessary to address public and adjoining landowner concerns in advance of any site works.

3.2. Risk Assessment

54. A tiered approach to risk assessment is usually applied and accompanied with data from researches, exploratory site investigations and development design. This allows the assessor to identify contaminants of concern and determine whether identified pollutant linkages merit further investigation in a more comprehensive risk assessment, or if the risk is significant enough to require remedial intervention. Additional exploratory investigations are not always necessary in progressing to more detailed levels of investigation; there may be other supporting evidence available.
55. As the risk assessment progresses through the tiers generic assumptions in the model are replaced with detailed parameters and modelling tools that more accurately represent the **conceptual site model** e.g. characteristics and behaviour of contaminants, exposure pathways and receptor characteristics. The refinement provides a more realistic account of pollutant linkages and can demonstrate the absence of risk or reduce the scope of remedial intervention required.
56. It is the responsibility of the appointed specialist undertaking the risk assessment to ensure the risk assessment approach selected is authoritative, scientifically based, appropriate to the proposed development scenario and that the current version is used. Limitations and applicability of the risk assessment approach should be documented in the report.
57. Statistical analysis of a representative site investigation dataset can be useful in evaluating the chemical characteristics of a deposit. However, it is not always appropriate; for example where investigations are targeted or there is insufficient representative data.

3.2.1. Human health

58. The initial tier in a human health risk assessment applies a precautionary quantitative approach in deriving risk assessment criteria using generic assumptions about the characteristics and behaviour of sources, pathways and receptors within the site and associated with the proposed development, often referred to as the Generic Quantitative Risk Assessment (GQRA). These generic assessment criteria are applied to screen out contaminants of concern; they do not represent a trigger for unacceptable intake and exceedance of a human health generic assessment concentration value does not necessarily imply significant possibility of significant harm.

59. A subsequent Detailed Quantitative Risk Assessment (DQRA) might follow with refinement of the conceptual site model parameters to more accurately assess risk to human health from contaminants of concern.
60. The regulatory authorities need to be satisfied with the proposed human health assessment criteria and the approach used in their derivation. The risk assessor should therefore produce a documented assessment that can be evaluated by the regulator who will be looking for transparency in the derivation of values along with evidence of sound science and clarity in any assumptions made.
61. The human health risk assessment should also consider acute human health effects i.e. from chemical substances, sharps, radioactive substances, low oxygen, vapours and combustible materials.

Human health risk assessment models and criteria

Proprietary generic human health risk assessment criteria, published by commercial and public sector organisations are available for a variety of substances. The methodologies for deriving these criteria should be peer reviewed and published for reference. This requirement for scrutiny by the regulator should be considered when determining the benefits of deriving in-house generic human health risk assessment criteria.

The CLEA model is most frequently used in the UK for deriving human health risk assessment criteria, although there are other models available. The selection is determined by the suitability of the human health risk assessment model or criteria to represent the **conceptual site model**, current codes of practice and Scottish Government policy.

Assessors may need to produce their own human health risk assessment criteria, which must be accompanied by fully transparent justification for all parameters used in their derivation and in some cases a third party independent peer review may be required.

3.2.2. Hazardous gases

62. Consideration should be given to the potential presence or migration of permanent ground gases and volatile organic compounds on or off site.
63. Exploratory investigation and risk assessment will need to be designed and carried out by **competent person(s)** in accordance with the British Standards. The monitoring programme should correspond to the hazard potential and nature of the proposed development. The assessor should ensure the recorded monitoring information is detailed enough to provide a robust assessment (i.e. rising/falling atmospheric levels, changes to the response zone, monitoring period, steady state and peak levels etc). The source of any confirmed hazardous gas should be identified in the assessment.
64. Additional exploratory investigations may be required following any site preparation works that might significantly modify the original ground conditions creating new pollutant linkages i.e. grouting of mine workings, vibro-stone columns or compaction techniques etc.
65. Guidance and codes of practice available for investigation and interpreting permanent gas and VOC conditions include;
 - British Standards BS 8576 Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compound; and BS 8485 Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings.
 - CIRIA Guide C665 Assessing risks posed by hazardous ground gases to buildings; and CIRIA C716 Remediating and mitigating risks from volatile organic compound vapours from land affected by contamination.
 - CIEH (2008) The Local Authority guide to ground gas.

- 66. Radon is a naturally occurring radioactive gas which decays into other radioactive species, all of which cause human exposure to radiation. International Standards for investigation and determination of radon; in soils, BS ISO 18589 series and in air, BS ISO 11665-1.
- 67. The Indicative Radon Atlas of Scotland (Myles et al, 2011) provides mapped areas where radon hazards have been identified. A higher resolution GIS dataset of this information has been provided to all Local Authorities. Information and guidance on radon in the environment in Scotland is available from Public Health England, <https://www.gov.uk/government/collections/radon>.

3.2.3. Water environment

- 68. The water environment as defined by the Water Environment and Water Services (Scotland) Act 2003 means all surface water, groundwater and wetlands. Further definitions on these water environments are provided in this act.
- 69. Assessment of potential risks to the water environment should be carried out in accordance with SEPA guidance ‘Water Pollution Arising from Land Containing Chemical Contaminants’ and ‘Position statement WAT-PS-10-01’.

Potential pollutant linkages in the water environment

There is usually more than one water receptor identified in the **conceptual site model**. The selection of the water environment assessment points and criteria should be appropriate for the water receptors that are being assessed.

Groundwater resources are valued for both drinking water supply and ecosystem services; resource protection requirements should be assumed in the assessment until there is adequate evidence to demonstrate otherwise.

The water environment risk assessment should reflect the proposed development design with consideration given to actions that could modify potential pollutant linkages; such as loading and settlement, earthworks, compaction and consolidation works, surfacing, sub/artesian and conditions sensitive to environmental fluctuation.

- 70. The water environment risk assessment must incorporate consideration whether hazardous substances are entering or likely to enter groundwater. If a substance is present in a source material which is immiscible with water, entry means actual dissolution of the substance from the material into the water environment. All measures must be taken to prevent entry of hazardous substances into groundwater and to limit entry of non-hazardous substances to prevent pollution. There are

exemptions to this requirement, for example, where entry of hazardous substances cannot be prevented either because the measures would increase risks to human health or the environment or would be disproportionately costly. The assessment of inputs of hazardous substances into groundwater is described in SEPA Position Statement WAT-PS-10-01.

3.2.4. Wider Environment

71. The assessment should consider the impact of contamination in the 'wider environment', which is described in Part 3 of the Scottish statutory guidance for Part IIA of the Environmental Protection Act 1990 and includes all of the following present in the **conceptual site model** for the proposed development;
 - Any ecological system or living organism forming part of such a system, within a protected location.
 - Property in the form of crops, domestically grown produce, livestock, other owned or domesticated animals and wild animals which are the subject of shooting and fishing rights.
 - Property in the form of buildings - including buried utilities, built and cultural heritage sites.
72. Although approaches to assessing animal and crop effects arising from Contaminated Land are not currently well developed in the UK, building effects are more clearly understood with guidance for the assessment and specification of buried concrete is available in BRE SD1:2005 and guidance publications for the installation of potable supply infrastructure available from Scottish Water. It may be necessary to liaise with the other regulatory bodies (SEPA, Forestry and Land Scotland, Scottish Natural Heritage, Historic Environment Scotland) to ensure the investigations and assessment works meet regulatory requirements.

3.3. Remediation strategy

73. Where unacceptable risks have been identified progression to options appraisal and remediation scheme design is usually the next phase. Depending on the specific circumstances of the site further investigative work may be necessary to; better define and delineate contamination sources; or evaluate the viability of potential remediation techniques.
74. Where the absence of contamination risks has been confirmed further risk assessment and a contamination remediation scheme will not be required. However, a verification plan for the import of soil or fill material and a contingency plan are likely to be necessary.

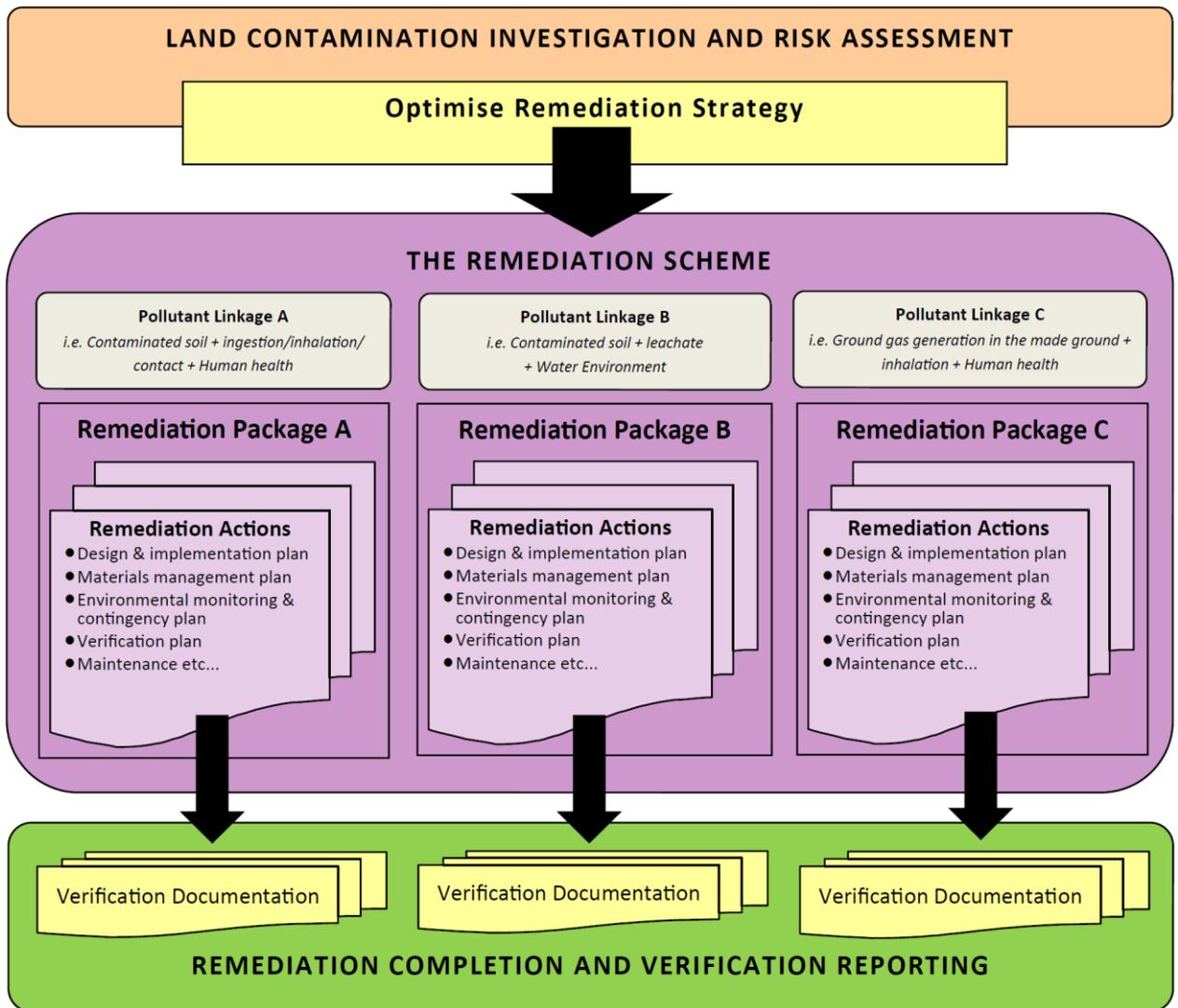
3.3.1. Remediation options appraisal

75. Adequate remedial intervention is required where the risk assessment identifies unacceptable risks to human health, the water environment or wider environment. An options appraisal (LCRM, 2019) would document the decision process in developing a remediation strategy to reduce, manage or remove risks associated with pollutant linkages.
76. The Sustainable Remediation Forum (SuRF-UK) is a framework for assessing the sustainability of soil and groundwater remediation and for incorporating sustainable development criteria in land contamination management strategies. Consideration of material management issues is required at the development design stage to minimise waste soil and develop sustainable remediation solutions. Further information about SuRF-UK can be found at <http://www.claire.co.uk/projects-and-initiatives/surf-uk>

| EXPLORATORY SITE INVESTIGATION AND RISK ASSESSMENT | |
|--|--|
| Technical reporting guidance – suggested structure and contents | |
| Introduction | <p>Where ongoing phased investigations result in multiple reports i.e. development sub-areas, tier of assessment or interim, the relevant reports should be clearly defined (title, date and plan).</p> <p>Summary of the conceptual site model established in preliminary investigations.</p> <p>Purpose, aims and objectives of the proposed exploratory investigation and risk assessment.</p> |
| Site investigation & sampling strategy | <p>Design and scope of investigations with justification for approach in relation to the conceptual site model for the proposed development. Limitations and constraints in undertaking the investigation (i.e. access, services, obstructions, Japanese Knotweed, hazards etc.)</p> <p>Methodology for exploratory investigations and schedule for sample geotechnical and chemical analysis: sufficiently low limits of detection must be employed within the laboratory analysis to enable comparison of data against appropriate assessment criteria.</p> <p>Plans: Accurate site investigation plans marked with information of any suspected contamination source; plan of any contamination delineation investigations.</p> |
| Geo-environmental setting | <p>Interpretation of investigation data, describing variations to the original CSM assumptions.</p> <p>Water Environment characterisation should consider; shallow and deep groundwater pathways to other water bodies or potential aquifer resources, flow direction, hydraulic gradient, hydraulic conductivity, identifying whether groundwater is in continuity with watercourse, influencing factors i.e. modifications to drainage, urban sewerage, artificial deposits, proximity to major discharge zone etc.</p> <p>Identification of likely preferential pathways (both natural and man-made).</p> <p>Plans: Groundwater contour plan (m AOD), spatial distribution of deposits of interest and contoured depth/thickness, current and proposed cross sections.</p> |
| Risk Assessment | <p>Rationale for the selection of appropriate assessment criteria and model in respect to the proposed development conceptual site model for the protection of the identified receptors.</p> <p>Reference sources and justification for selection of model parameters in respect to the conceptual site model for the proposed development.</p> <p>Limitations of the data and model, any inherent safety factors and sensitivity analysis to identify the critical conceptual site model parameters (where appropriate).</p> <p>Interpretation of chemical analysis and environmental monitoring data results.</p> <p>Plans: Delineation of contamination extents, spatial distribution of contaminants, illustration of measured parameters and indicating assessment/compliance points.</p> |
| Revised conceptual site model | <p>Revised geo-environmental characteristics and/or development design (earthworks), providing a more accurate account of source, pathway and receptor relationships.</p> <p>Identification of pollutant linkages that require further assessment or remediation.</p> <p>Limitations, assumptions and uncertainties associated with the conceptual site model.</p> <p>Illustration: tabular, flow diagram or other graphical representation of the revised CSM.</p> |
| Recommendations | <p>Options appraisal of various approaches to pollutant linkage interventions, remediation strategies and/or specific remediation packages.</p> <p>Outline scope and design for any additional supporting investigation and assessment work.</p> <p>Discussion on uncertainties and any requirements to validate the models.</p> <p>Identification of potential remediation constraints.</p> |
| Appended | <p>Exploratory investigation logs, reference location, levels (m AOD) and NGR co-ordinates, monitoring installation details, response zone and horizon/strata, method of sealing annulus.</p> <p>Environmental quality monitoring logs; surface water levels (m AOD), atmospheric pressure if it is rising, falling or stable; calibration certificates. Any other relevant field records and observations (include location and date).</p> <p>Laboratory certificates, chain of custody records, evidence of quality control. Compiled chemical and geotechnical laboratory analysis results.</p> <p>Model calculation datasheets, reports or other outputs etc. Data should be available in excel or AGS format if requested.</p> |

4. THE REMEDIATION SCHEME

77. When the remediation strategy is decided it will be necessary to expand on this and agree with the Planning Authority a Remediation Scheme (Scot.Exec., 2006) that includes detailed design specification and an implementation plan detailing how all the remediation works will be managed, monitored, verified and reported (LCRM, 2019). Both the risk assessment and remediation scheme must be complete and approved by the Local Planning Authority before commencing any remediation work.



Adapted from Part IIA Contaminated Land Scottish Statutory Guidance (2006) and LCRM (2019).

4.1. Remediation scheme design and implementation

78. The remediation scheme design must be based on the **conceptual site model** and address unacceptable risks identified throughout the development.
79. Further investigations may be necessary to delineate and characterise contamination. The proposed scheme should be demonstrated to be suitable to deal with these risks in a manner that is protective to human health, the water environment and wider environment. The remediation target concentrations must be clearly presented along with derivation calculations and assumptions.

80. The assessor should ensure that they fully understand the wider development proposal including the extent of ground preparations and earthworks. Reductions in ground level could remove contamination and the need for further intervention; or it could relocate or expose contamination. Increasing ground levels for flood prevention or platforming may provide substantial coverage over existing contamination, or the loading could mobilise contamination that was previously stable. The potential impacts of these changes to the site conditions if not known at the time of the original investigations would need to be considered in a revised risk assessment and incorporated with the remediation scheme design.

Soil and groundwater treatment

The development team should consult SEPA directly during the design stages of the remediation scheme where treatment of soils or groundwater may require licensing, or authorisation for off-site soil disposal, or where the water environment may be affected by remediation actions.

81. The consultant/developer should satisfy themselves and be able to provide supporting evidence that the selected remediation methods are capable of achieving the desired end-point within an acceptable time frame and budget.
82. Materials used in the remediation scheme should be suitable for its intended purpose i.e. Geotextile membrane barriers should be chemically resistant if being used as a barrier to contamination and the ground gas protection membrane should be of a specification that corresponds to the remediation requirements.
83. The developer should advise the Local Authority Environmental Health Office of any planned site works that may have a significant impact on local residents. It is also useful to have a communication strategy in place to deal with enquires from members of the public about the progressing works.
84. Any revisions to any part of the original submitted remediation scheme documentation should be agreed with the Planning Authority and other regulatory authorities before being implemented.

4.2. Material management plan

4.2.1. Reuse of material onsite

85. The SEPA “Land remediation and waste management guidelines” is aimed at helping site developers, contractors and consultants understand how SEPA regulate the treatment and reuse of contaminated materials at the excavation site and where the waste regulatory regime applies; enforcement action will be carried out in accordance with SEPA’s enforcement policy.
86. The remediation scheme or material management plan must be agreed with the local authority. The legitimate reuse of material must meet all the following criteria;
1. The use is a necessary part of the planned works.
 2. The material is suitable for that use.
 3. The material does not require any processing or treatment before it is reused.
 4. No more than the quantity necessary is used.
 5. The use of the material is not a mere possibility but a certainty.
 6. The use of the soil will not result in pollution of the environment or harm to human health.

Where all criteria cannot be met, the activity will be regulated by SEPA under waste management legislation. The reuse of waste materials away from the site of origin will also be regulated under waste management legislation.

87. Contaminated soil not suitable for use and groundwater can be treated on site for reuse under the waste management legislation, for example by a licenced contractor. The treated materials must still meet the criteria listed in the 'Land remediation and waste management guidelines' and be suitable for use once remediated.
88. The evidence of the site-specific suitability of a material for a particular use must be provided to the Local Authority in the remediation scheme or material management plan. Guidance for characterising quality of excavated soil intended for re-use is available in BS ISO 15176.

Material management plan

If the developer wishes to reuse excavated contaminated materials within the site, a remediation scheme or material management plan must be agreed with the Planning Authority before implementation. Failure to do this would mean that the excavated contaminated material would be regulated by SEPA under waste management controls and these materials would need to be treated prior to reuse, removed from site as waste, or disposed to landfill.

4.2.2. Importing material to site

89. It is recommended that consultation with the regulatory authorities takes place prior to the importation of soils so that the details can be agreed; furthermore the appropriate supporting documentation should be provided to the regulators before importing such materials and/or presented within verification reports to demonstrate that imported soil and fill materials are suitable for the intended use.
90. Where ground works require the import of materials for soil or fill onto the site, these must be suitable for use and depending on the origins of the material it may be necessary to comply with criteria for registering an exemption from waste management licensing with SEPA. It is the developer's responsibility to ensure that all appropriate documentation and permissions for the activity is obtained from SEPA. This also applies where materials are to be imported from a "greenfield" source.
91. Cognisance should be given to trade quality specifications for topsoil and subsoil i.e. British Standards BS 3882 and BS 8601 respectively. It is expected that all topsoil and subsoil (imported or site-won) used in gardens and soft landscaped areas will be verified to demonstrate that it is physically and chemically suitable for use.

4.2.3. Waste management

92. All waste soil removed off-site for further use or disposal is subject to the Duty of Care. Every organisation and business that produces waste must adhere to duty of care requirements by checking that the waste will be passed to someone authorised to accept it as a waste. The producer could be held responsible if such checks are not made and the waste is subsequently disposed of illegally.
93. Waste must be classified before it is moved, disposed or recovered. Technical guidance (WM3) publication for waste classification and assessment is a comprehensive reference manual for anyone involved in producing, managing and regulating waste. The assessor will need to be specifically competent on hazardous waste assessment (i.e. with knowledge of chemistry).
94. Landfill WAC analysis are not appropriate for waste classification and hazardous waste assessment purposes. This analysis is only applicable for landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.
95. It should be noted that whilst the Local Authority may agree on remediation objectives and targets, these may be subject to additional review by SEPA in respect of mobile plant licencing, Controlled Activities Regulations or Waste Management Regulations, including exemptions.

96. All special (hazardous) waste produced in Scotland must be consigned using a SEPA-issued consignment note or code, regardless of its final destination within the UK. Compliance with waste management regulations is required if special waste is produced, collected, transported or disposed of as part of the site development.

4.3. Verification plan and long-term monitoring

97. Proposed methods of validation and verification (e.g. inspection of gas membranes, capping thickness and chemical suitability testing, records of materials movements to and from the site, any long-term maintenance and monitoring requirements) should be included within the remediation strategy for agreement with the Local Authority.
98. Specifying the verification activities before starting work helps ensure that appropriate records are kept before and during works. Adequate record keeping helps minimise the potential for difficulties to arise at the verification report stage, which can be difficult to close out retrospectively and may result in delays to the formal sign off process for the site.
99. The developer should ensure that any verification sampling strategy is agreed with the Local Authority.
100. To prevent contaminated materials being imported to the development site, it is advised that verification testing of imported soil/fill materials be carried out at source before the material is transported to site and prior to placement. This is not a substitute for post verification testing, which is necessary to verify that cross-contamination has not occurred during site works. The sampling strategy provided in the verification plan should take into consideration whether a phased verification sampling approach has been applied, the extent of independent supervision and record keeping protocols for material handling.
101. Each development remediation scheme is unique and Local Authorities may have varying expectations; to prevent any ambiguity the verification plan and any subsequent modifications should be agreed with the Planning Authority in advance of implementing the remediation scheme.
102. In the event that verification or long term monitoring demonstrates that the remediation has been unsuccessful appropriate contingency plans should be in place to report to regulators, mitigate risk and communicate risk with active site users.
103. A remediation scheme that involves long-term monitoring and maintenance beyond completion of the development should ensure that subsequent owners and occupants are aware of these requirements.

4.4. Design, installation and verification plan for hazardous gas protection systems

104. The design of hazardous gas protective measures should be undertaken by suitably **competent person(s)** who can ensure that the design specification is compliant with relevant codes of practice i.e. BS 8485. This design decision process should be documented in the reporting.
105. The design of protection systems for hazardous gases should correspond to the characteristic situation level identified in the assessment, which should account for uncertainties of variable environmental conditions and the quality of the data.
106. The designer should ensure that the specification of materials are appropriate to the level of protection required i.e. hydrocarbon resistant membrane would not necessarily provide suitable VOC protection.
107. Post-installation site conditions can put the protection system at risk and the designer should ensure measures i.e. puncture resistance layer, are incorporated in the design to protect membrane from construction works and that there is adequate verification inspections programmed into the build.

108. Guidance for the design of VOC protection systems is provided in CIRIA C682(2009) and CIRIA C716(2012) with specific guidance on VOC membranes in CIRIA C748(2014).
109. Radon protection may be required to be incorporated in new developments in affected areas. Building Research Establishment BR211 (2015) publication provides guidance on the design of radon protective measures.
110. The protection system installation should be undertaken by suitably **competent person(s)**. The use of non-qualified installers is more likely to require corrections following inspection by the verifier, which could result in both delays and additional costs.
111. Guidance for good practice in testing and verification of hazardous gas protection systems is provided in CIRIA publication C735. An installer verifying their own work is considered to be a conflict of interest and hazardous gas protection systems must be verified independently by **competent person(s)**.
112. A risk-based approach to verification is expected with more rigorous testing of high risk scenarios; reflecting complexity of the protection systems, quality of products used, competence of installer and severity of hazardous gas risk. *Note that VOC protection systems are high risk.*
113. The verification process should inspect each element of the protection system design, e.g. membrane, ventilation and slab. These inspections should be programmed into the site works to permit appropriate verification i.e. the verification inspection of membranes should be programmed in the build shortly before being covered.
114. The verification plan should contain details of the verification inspections that are to be carried out on all elements of the installed protection system to confirm that it is suitable for purpose. The Local Authority may request to see an example report demonstrating the evidence that will be submitted (see example in CIRIA C735, appendix A5).

4.5. Environmental monitoring and contingency plan

115. During site works it may be necessary to carry out environmental monitoring to evaluate and manage issues of air quality, water quality (including groundwater), noise, vibration, dust control, odours etc. It may be necessary to establish a baseline for environmental quality prior to the site works (i.e. airborne asbestos fibre monitoring).
116. Environmental monitoring during site operations can contribute to verification reporting to ensure specifications and methodologies have been adhered to.
117. Should previously unrecorded contamination be encountered during site works this will require additional assessment and revisions to the remediation documents.
118. In the event verification indicates that the remediation has been unsuccessful there will need to be suitable reporting and contingency to manage the risks identified.

4.6. Maintenance requirements

119. The remediation design is expected at minimum to endure the life span of the proposed development and any long-term maintenance requirements should be made clear from the outset.

4.7. Other controls

120. It is the developer's responsibility to ensure that works are compliant with all relevant legislation e.g. the Construction (Design and Management) Regulations, Control of Asbestos Regulations etc., and that appropriate health and safety procedures are in place before work commences.

121. Adequate insurances for the works must be in place i.e. professional indemnity and public liability. Other insurance available include; contaminated land liability insurance for property acquisitions, disposal and development; contractors' pollution liability; etc.

| THE REMEDIATION SCHEME | |
|--|---|
| Technical reporting guidance – suggested structure and contents | |
| Introduction | Background summary of site contamination origins and conceptual site model. Finalised details of the proposed development. Purpose and aims of the remediation. |
| Remediation options appraisal | This is particularly important when trying to demonstrate remediation of the water environment is reasonable (i.e. a cost benefit analysis) if the remediation target cannot be achieved without disproportionate cost. |
| Remediation strategy | An overview of the remediation approach to breaking the pollutant linkages identified in the risk assessments. Consultations: with Local Authority, SEPA and any other appropriate body. Summary of any agreements and correspondence reference. |
| Remediation design | Detailed design specification and methodology. Remediation targets (requires appropriate consultation with regulators). Plans: location plans showing where remediation work will be required, cross sections i.e. for engineered capping systems, or installation of barriers; technical drawings for installations etc. |
| Remediation implementation plan | Explain how the remediation works will be programmed in with other site works and/or if remediation is phased. |
| Environmental monitoring and contingency plan | Methodology for monitoring environmental quality during the works. Describe the process for managing contamination risks in the event that the remediation is unsuccessful. Explain what will happen if unexpected ground conditions or contamination is encountered; Contact information for development parties should be supplied. The Planning Authority and need to be notified of any changes to the remediation scheme (not in the contingency plan) prior to implementation. An amendment to the Building Warrant may also need to be submitted. Plans: monitoring stations. |
| Materials management plan | Provide details for the processing and reuse of materials on site. Provide details for the use of imported soil and fill materials to site. Information on how materials will be managed on site to prevent cross contamination as the development progresses. Details on quality control on all ground materials (may require verification). Plans: storage/quarantine location plans, placement plans. |
| Verification plan | Describe the confirmation methods to meet objectives of the remediation – high risk sites will be expected to undergo a more robust verification approach. Methodology for the verification works – include sampling frequency. Level of competency required to carry out the verification for each element of remediation and if possible provide consultancy/contractor details. Identify the consultancy(s) that will compile the verification information and produce the remediation completion and verification report. Plans: spatial plans illustrating where verification will be carried out etc. |
| Maintenance plan | Lifespan of remediation work and any long term maintenance requirements Information on any warranties for the remediation work. |

5. REMEDIATION COMPLETION AND VERIFICATION REPORTING

122. After completion of the remediation scheme, **remediation completion and verification reporting documents must be submitted** to the Planning Authority for approval before construction begins or prior to occupation as agreed in the remediation scheme. The remediation completion report should comprise the following where applicable;
- Overview of the remediation scheme accompanied with illustrative plans and cross-sections
 - Validation of the model to demonstrate remediation targets have been achieved
 - Validation for remediation techniques (this may be a reference to published technical papers)
 - Verification that the works comply with the remediation scheme design
 - Verification of material quality for topsoil, subsoil and imported fill materials
 - Environmental monitoring during site works to demonstrate contaminant containment and absence of further occurrences
 - Revised **conceptual site model** for the completed development
 - Long-term monitoring and maintenance requirements
123. For a large development or complex remediation scheme interim reports may be acceptable, with the final remediation completion and verification report submitted to the regulators prior to the site being occupied. The purpose of these interim reports is to allow the work to be verified while the development progresses rather than waiting until the site development is complete. This should allow issues to be resolved earlier, avoiding unnecessary delay. These interim reports should be collated and submitted with the final report.
124. In the event that verification work does not meet the agreed requirements, additional investigation, remediation and verification work may be required. The issue of a building standards completion certificate (required to legally occupy a new building) requires a remediation completion and verification report that demonstrates the development is safe.
125. There may be a requirement for long-term monitoring of the site, to verify whether the remediation has been successful, particularly where on-site treatment processes have been used. Where an agreed remediation scheme includes future monitoring and maintenance activities, arrangements will need to be made to ensure that any subsequent owner is fully aware of these requirements and assumes the ongoing responsibilities that are tied to the land, for example via the removal of permitted development rights, or the placing of burdens on deeds.
126. The Construction (Design & Management) Regulations require the 'principal designer' to create and develop a health and safety file to handover on project completion; the developer (client) assumes the role of principal designer if none has been appointed. This file contains health and safety information that is needed to ensure the safety of those subsequently using, cleaning, maintaining or demolishing the building or structure (i.e. remediation installations). The Local Authority can request a copy or relevant extract of this health and safety file to be included as part of the remediation completion and verification reporting.

| REMEDIATION COMPLETION AND VERIFICATION REPORTING | |
|--|--|
| Technical reporting guidance – suggested structure and contents | |
| Introduction | <p>Overview of the risk assessment and revised conceptual site model.</p> <p>Remediation strategy aims and objectives.</p> <p>Factual summary of the development works and remediation scheme, include any contingencies that were implemented.</p> |
| Remediation | <p>Finalised remediation scheme design updated to include any changes made to the original specification and methodology.</p> <p>Agreed target remediation values.</p> <p>Plans: illustrating the final remediation design, location of remediation work, where installations are in place, verification/validation investigations.</p> |
| Verification plan | <p>Verification methodology updated to include any amendments to the original verification plan.</p> |
| Remediation verification | <p>Validation of the model to demonstrate remediation targets have been achieved.</p> <p>Validation for remediation techniques (reference to published technical papers).</p> <p>Verification that the works comply with the remediation scheme design.</p> <p>Environmental monitoring during site works to demonstrate contaminant containment and absence of further occurrences.</p> <p>Plans: inspection positions and locations where verification work was carried out.</p> |
| Imported ground materials | <p>This applies to; soil, fill materials, crushed aggregate, reused processed demolition material; Material description and any specified standards (i.e. BS or PAS).</p> <p>Information on origin, quantity, haulier, quality control when receiving at the site, verification of chemical and physical quality (sampling and analysis), specification for material quality.</p> <p>Plans: placement plan for each ground material.</p> |
| Long-term monitoring | <p>Any further verification work that will require future reporting, reporting frequency and contingency.</p> |
| Revised conceptual site model | <p>A revised CSM for the completed development to show broken pollutant linkages.</p> |
| Remediation limitations | <p>Maintenance requirements, design lifespan, duration of any workmanship guarantees, relevant title deed burdens.</p> |
| Remediation completion certificates | <p>Supporting documentation issued by each verifying party for each element of the remediation work declaring that the remediation and verification works have been completed in accordance with the specification and methodology agreed with the Planning Authority.</p> |
| Appended | <p>Verification records: These may comprise chemical analysis, monitoring reports, certificates, inspection documentation. All must be dated, provide competency details of verifier, photographs, measurements, plans, corrective actions, etc.</p> <p>Inspection records: Collated inspection certificates and photographic records, test pit logs for barrier systems, ground gas systems and other supervised works.</p> <p>Waste transfer certificates: Final excavation plan; destination; quality; quantity removed from site, transfer notes etc.</p> <p>Environmental monitoring records: observations and field measurements.</p> <p>Relevant extracts from the Health and Safety File: Information for subsequent use, cleaning, maintenance or demolition of the building/structure (i.e. remediation installations).</p> |

APPENDICES

Appendix A: Guidance publications and codes of practice

- British Standards Institution [BS EN 1997-1:2004+A1:2013 Eurocode 7: Geotechnical design – General rules](#).
- British Standards Institution [BS EN 1997-2:2007 Eurocode 7: Geotechnical design –Part 2: Ground investigation and testing](#).
- British Standards Institution [BS 3882:2015. Specification for topsoil and requirements for use](#)
- British Standards Institution [BS EN ISO 5667 series. Water Quality. Sampling](#) (Multi part document)
- British Standards Institution [BS 5930:2015. Code of practice for ground investigations](#)
- British Standards Institution [BS 8485:2015+A1:2019. Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings](#)
- British Standards Institution [BS 8576:2013. Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds \(VOCs\)](#)
- British Standards Institution [BS 8601:2013. Specification for subsoil and requirements for use](#)
- British Standards Institution [BS 10175:2011+A2:2017. Investigation of potentially contaminated sites – code of practice](#)
- British Standards Institution [BS ISO 11665-1:2015. Measurement of radioactivity in the environment. Air: radon-222. Origins of radon and its short-lived decay products and associated measurement methods](#)
- British Standards Institution [BS EN ISO 15175:2018 Soil quality. Characterization of contaminated soil related to groundwater protection](#)
- British Standards Institution [BS ISO 15176:2019 Guidance on characterization of excavated soil and other materials intended for re-use](#)
- British Standards Institution [BS EN ISO 16133:2018 Soil quality. Guidance on the establishment and maintenance of monitoring programmes](#)
- British Standards Institution [BS ISO 18400 series. Soil Quality. Sampling](#) (Multi part document)
- British Standards Institution [BS ISO 18589 series. Measurement of radioactivity in the environment](#) (Multi part document)
- Building Research Establishment, 2005. [Concrete in aggressive ground: Special Digest \(SD1: 2005\)](#). 3rd Edition (with February 2017 amendments). IHS BRE Press
- Building Research Establishment, 2015. [Radon: Guidance on Protective Measures for New Buildings, BR211 – 2015 edition](#). IHS BRE Press
- CIRIA C665D, 2007. [Assessing risks posed by hazardous ground gases to buildings](#) (Revised)
- CIRIA C682, 2009. [The VOCs Handbook. Investigating, assessing and managing risks from inhalation of VOCs at land affected by contamination](#)
- CIRIA C716, 2012. [Remediating and mitigating risks from volatile organic compound \(VOC\) vapours from land affected by contamination](#)
- CIRIA C733, 2014. [Asbestos in soil and made ground: a guide to understanding and managing risks](#)
- CIRIA C735, 2014. [Good practice on the testing and verification of protection systems for buildings against hazardous ground gases](#)
- CIRIA C748, 2014. [Guidance on the use of plastic membranes as VOC vapour barriers](#)
- CL:AIRE, 2016. [Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance](#). CL:AIRE, London.

[Construction \(Design & Management\) Regulations 2015 \('CDM regulations'\)](#)

[Control of Asbestos Regulations 2012](#)

Environmental Agency, 2001. [Assessment and Management of Risks to Buildings, Building Materials and Services from Land Contamination](#). R&D Technical Report P5-035/TR/01. Bristol

Environment Agency, 2004. [CLR 11: Model Procedures for the Management of Land Contamination](#). *This guidance is withdrawn and replaced by LCRM (Environment Agency, June 2019)*.

Environment Agency, 2009. [CLEA Software \(version 1.071\) and CLEA Handbook \(version 1.05\)](#)

Environmental Agency, 2009. [Human health toxicological assessment of contaminants in soil](#). Science Report – [SC050021/SR2](#). Environmental Agency, January 2009

Environmental Agency, 2009. [Updated technical background to the CLEA model](#). Science Report – [SC050021/SR3](#). Environmental Agency, January 2009

Environmental Agency, 2014. [Land contamination: remedial targets methodology \(RTM\)](#)

Environment Agency, 2019. [Land contamination: risk management \(LCRM\)](#). 5th June 2019

Miles JCH, Appleton JD, Rees DM, Adlam KAM, Scheib C, Myers AH, Green BMR and McColl NP (2011) [Indicative Atlas of Radon in Scotland](#). HPA-CRCE-023. Health Protection Agency & British Geological Survey. July, 2011.

NHBC, and Environment Agency and Chartered Institute of Environmental Health (2008) [Guidance for the safe development of housing on land affected by contamination](#). R&D Publication 66, Volumes 1 & 2

Scottish Environment Protection Agency (2009) [Land remediation and waste management guidelines](#)

Scottish Environment Protection Agency (2012) [Water Pollution Arising from Land Containing Chemical Contaminants, v2, 2012](#)

Scottish Environment Protection Agency (2014) [WAT-PS-10-01 Assigning groundwater assessment criteria for pollutant inputs, v3.0, Aug 2014](#)

Scottish Environment Protection Agency (2018) [WAT-SG-53 Environmental Quality Standards and Standards for discharges to surface waters. v6.1, Feb 2018](#)

Scottish Environment Protection Agency *et al* (2018) [Waste Classification: Guidance on the classification and assessment of waste \(v1.1\)](#). Technical Guidance WM3. May 2018.

Scottish Executive (2000) [Planning Advice Note 33: Development of Contaminated Land](#)

Scottish Executive (2006) [Environmental Protection Act 1990: Part IIA Contaminated Land](#). Statutory Guidance: Edition 2

Scottish Government (2014) [Scottish Planning Policy](#)

Scottish Government (2016) [Building \(Scotland\) Regulations 2004: Technical Handbooks](#)

Scotland & Northern Ireland Forum for Environmental Research (SNIFFER) (2007) [Environmental Legislation and Human Health – Guidance for Assessing Risk](#). Project UKCC02. August 2007

[Water Environment and Water Services \(Scotland\) Act 2003](#)

Wilson, S., Card, G. and Haines, S. (2009) [Ground Gas Handbook](#). Whittles Publishing. 1 June 2009

Note: this list is not exhaustive.

All references and hyperlinks were checked June 2019.