



# Land Contamination Management – Land Quality Assessment (LQA)

Practitioner Guide 07/12

Estate  
Management



## Document Aim:

MOD Policy on land contamination is set out in the Land Contamination Leaflet in Volume 2 of [JSP 418](#). This Guide provides the framework for carrying out MOD Land Quality Assessments (LQA) and should be used by MOD practitioners, Project Teams, PFI Partners, Industry Service Providers and contractors responsible for the assessment and management of land contamination and associated liabilities. This guide sets out the LQA process together with guidance and signposts to key MOD policies, legislation and Industry Guides. The level and detail of the guidance reflects MOD's experience to date and highlights areas where attention and care is needed in applying industry standards. It also identifies the points at which decisions are required and provides guidance on current good practice within the context of the MOD LQA process as applied to the defence estate. This guide supersedes Practitioner Guide 01/2007.

## Document Synopsis:

This Practitioner Guide sets out the approach that should be taken to MOD LQA practice and process together with useful guidance.

The guide covers every LQA phase and provides details of reporting formats that are to be used as well as the risk assessment process that is to be followed.

This guide is aimed at experienced practitioners, be they MOD or Industry Service Providers. It pulls together good practice from across the industry and integrates key principles into a single coherent document which is focussed on the defence estate and some of its unique aspects.

Points of contact are listed where advice can be sought from the relevant MOD subject matter experts.



# Ministry of Defence

## Document Information

**DIO Secretariat -Strategy & Policy Sponsor:** Date of Issue: 25 January 2013

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**Who should read this:** All DIO Staff including Projects and EM, CESO, CEstO, TLB MOD Trading Fund, MOD NDPBs and Contractor Staff

**When it takes effect:** Immediately

**When it is due to expire:** when rescinded

**Note: to be reviewed post Apr 13**

### Equality And Diversity Impact Assessment

This policy has been Equality and Diversity Impact Assessed in accordance with the Department's Equality and Diversity Impact Assessment Tool against:

**Part 1 Assessment Only (no diversity impact found).**

## Document Control

### Distribution

Document Name:	Land Contamination Management-Land Quality Assessment Practitioner Guide
Version No:	2.0
Version Date:	25 January 2013
Author:	M Hill
Reviewed By:	MOD Contaminated Land Focal Points, Dr S Hobbs (SKM Enviro), J Stothert (AMEC/SoBRA) and M Whitehead (EA)
Review Date:	April/May 13

### Version Control

Date Issued	Version	Author	Reason for Change
19/12/12	1.0	M Hill	Final
25/01/13	2.0	M Hill	Noted to advise this PG supersedes PG 01/2007

### Related Documents

JSP 418 Volume 2 leaflet 2
DIO Information Note 03/09

## GLOSSARY

ACOP	Approved Code of Practice
ASG	Association of Geotechnical and Geoenvironmental Specialists
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research and Information Association
CL:AIRE	Contaminated Land: Applications in Real Environments
CLEA	Contaminated Land Exposure Assessment
CLR11	Contaminated Land Report 11
CoP	Code of Practice
CRA	Closure Risk Assessment
CSM	Conceptual Site Model
DEFRA	Department for Environment, Food and Rural Affairs
DESB	Defence Environment and Safety Board
DIO	Defence Infrastructure Organisation
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standards
EA	Environmental Agency
ELMG	Environmental Liability Management Group (DIO PTS)
EMS	Environmental Management System (DIO PTS)
EOC	Explosive Ordnance Clearance
EQS	Environmental Quality Standards
GAC	Generic Assessment Criteria
GEODE	Geographic Online Data for Estates
GQRA	Generic Quantitative Assessment
GSV	Gas Screening Values
LCF	Land Condition File
LMS	Land Management Services
LQA	Land Quality Assessment
LQS	Land Quality Statement
MCERTS	Monitoring Certification Scheme
MMP	Materials Management Plan
MOD	Ministry of Defence
NAAFI	Navy Army Air Force Institute
NGO	Non-Governmental Organisation
NHBC	National House Building Council

## **GLOSSARY (cont)**

NIEA	Northern Ireland Environment Agency
OCE	Order of Cost Estimate
OME	Ordnance, Munitions and Explosives
PFI	Private Finance Initiative
PRA	Preliminary (Qualitative) Risk Assessment
PTS	Professional Technical Services
QRA	Quantitative Risk Assessment
RCLEA	Radioactively Contaminated Land Exposure Assessment
RPC	Regional Prime Contract
RPL	Relevant Pollutant Linkage
RSGV	Radioactivity in Soil Guideline Values
SDAP	Sustainable Development Action Plans
SEPA	Scottish Environment Protection Agency
SGV	Soil Guideline Values
SiLC	Specialist in Land Condition
SME	Subject Matter Expert
SPOSH	Significant Potential of Significant Harm
SSAC	Site Specific Assessment Criteria
SURF UK	United Kingdom's Sustainable Remediation Forum
TLB	Top Level Budget Holder
UKAS	United Kingdom's Accreditation Service
UXO	Unexploded Ordnance
VFM	Value for Money

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- F. Contaminant/Pollutant Linkage Evaluation Template

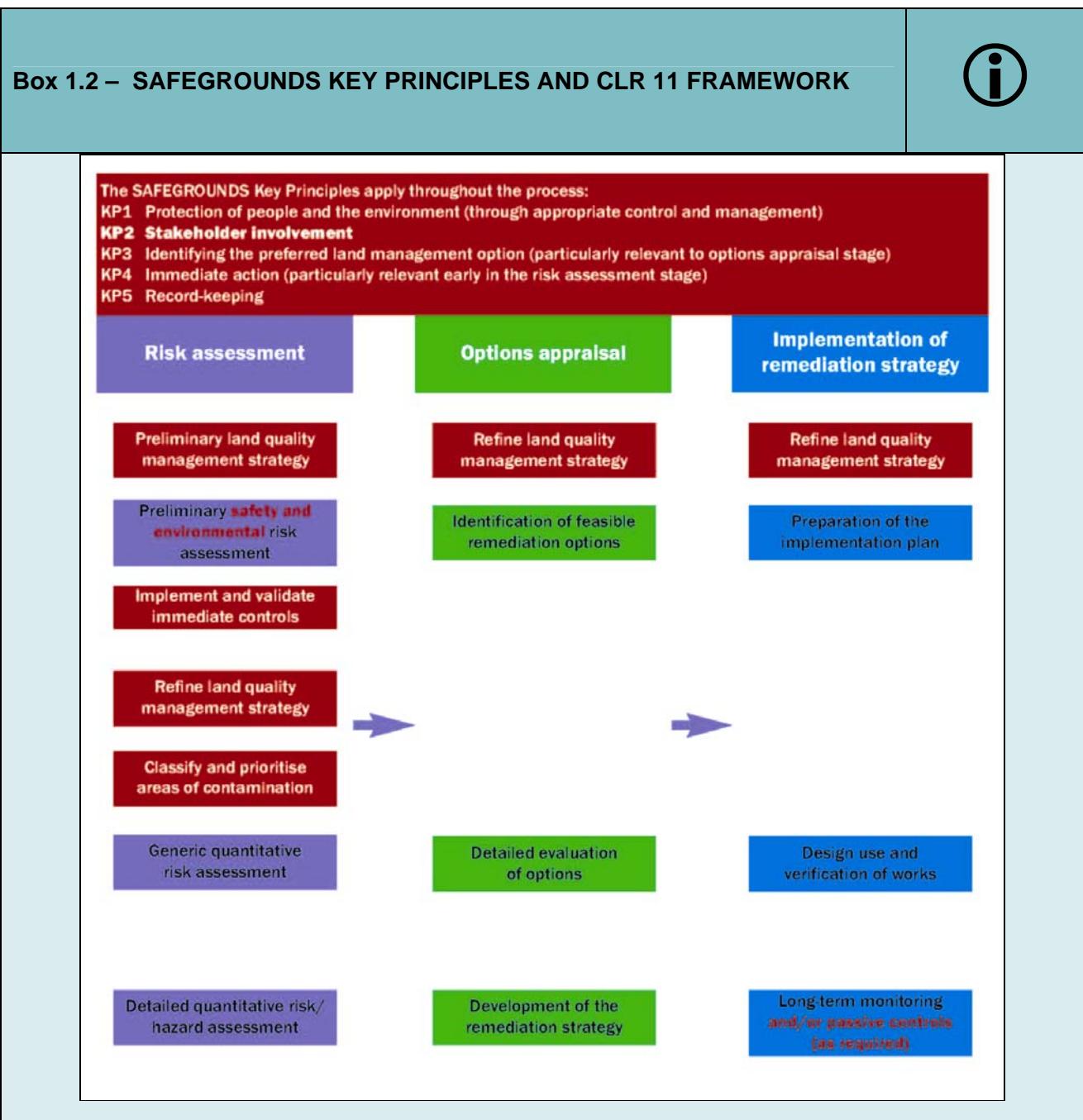
## Legend

<b>Legal Requirements and Mandatory Practice</b> These boxes identify the relevant aspects of the EU Directives and UK Legislation and complying with MOD Mandatory Practice.	
<b>Hints and Tips</b> These boxes provide hints and tips for complying with Advisory practice.	
<b>Illustrative Examples</b> Generic examples have been used to illustrate the recommended approach within the guidance. These examples have been drawn from real MOD projects to aid their interpretation.	
<b>Key Information</b> These boxes provide key information of relevance to the assessment and management of land contamination on the defence estate.	
<b>Stakeholder Requirement</b> This indicates a requirement to engage with relevant stakeholders either internal or external to MOD. These may be a statutory body, Government Department or Devolved Administration, or a Non-Governmental Organisation (NGO).	
<b>Key Guidance</b> This box signposts key guidance that will aid the practitioner.	

## 1. INTRODUCTION

1.1. This guide sets out the approach to be used by practitioners be they MOD staff, contractors or industry partners responsible for the assessment and management of land contamination and the associated liabilities across the defence estate as well as those involved in the development, purchasing, sale or lease of land affected by contamination. A base level of knowledge has been assumed and this guide is not intended to constitute a step by step manual, instead it sets out the process and approach including required MOD reporting formats. The level of detail has been tailored and targeted and key guidance and policy signposted. Key points of contact for advice and support are given in Annex A and consultation at an early stage is recommended.

1.2. This guide is structured to signpost relevant policy, legislation and guidance within the framework provided by the Safegrounds Key Principles (see Box 1.2) and Contaminated Land Report 11, Model Procedures for the Management of Land Contamination.



1.3 The key guidance that will be referred to throughout this guide is detailed in Box 1.3 below.

**Box 1.3 – KEY GUIDANCE**



[Defra Circular 04/12: EPA 1990: Part 2A Contaminated Land Statutory Guidance, 2012. Defra](#)

[DECC Guidance on Radioactive Contaminated Land 2012](#)

[The Contaminated Land Statutory Guidance for Wales 2012, Welsh Government](#)

[EPA 1990: Part IIA Contaminated Land Statutory Guidance: Ed 2 2006, Scottish Government](#)

[Contaminated Land Report 11. Model Procedures for the Management of Land Contamination, 2004. Defra and Environment Agency.](#)

[R&D 66 Guidance on the Safe Development of Housing on Land Affected by Contamination, 2008 Volume 1 and 2. NHBC and Environment Agency](#)

[Towler, P et al Safegrounds LMG V2 W29. Good practice guidance for the management of contaminated land on nuclear licensed and defence sites CIRIA London 2009](#)

[BS 10175:2011. Investigation of potentially contaminated sites – Code of practice, 2011, BSI Standards Publication](#)

[Communicating understanding of contaminated land risks, 2010, SNIFFER](#)

[MOD JSP 418: Volume 2, Leaflet 2 Contaminated Land](#)

[DE \(DIO\) Design and Maintenance Guide 12 – site closure guide, Land and Property Policy: PI 6/2005.](#)

## 2. MOD LQA POLICY, GUIDANCE, COMPLIANCE AND FUNDING RESPONSIBILITY

### Introduction

2.1 MOD policy on the assessment and management of land contamination is detailed within: [JSP 418 Vol. 2 - Land Contamination](#). The following section provides additional clarification and guidance with respect to compliance with MOD policy.

2.2 Practitioners should be up to date with both current MOD policy and the contaminated land regulatory regime as it operates within the UK bearing in mind there are slight differences with and between the devolved administrations. Equally practitioners should be clear as to the role of the local authority versus that of the Environment Agency (EA), Scottish Environment Protection Agency (SEPA) and Northern Ireland Environment Agency (NIEA) as well as the basis on which a site is deemed to be a 'special site'. The latter is summarised in Box 2.1 for ease of reference.

#### Box 2.1 Role of the Regulators and 'Special Sites; that apply to MOD



**The Local Authority is the enforcing authority for all sites which are not deemed 'special sites'. The Environment Agency and SEPA etc are the enforcing authority for 'special sites'. SEPA is the lead regulator with respect to radioactively contaminated land in Scotland.**

The designation of a Special Site cannot take place until the land in question has been formally identified as Contaminated Land by the Local Authority and it meets one or more of the descriptions prescribed in the Regulations. The descriptions for Special Sites include: Any Contaminated Land either located at or is adjacent to current military, naval and air forces bases and other properties, including those of:

- Visiting forces;
- The Atomic Weapons Establishment;
- Certain lands at Greenwich Hospital;
- All land currently or formerly used for the manufacture, production, or disposal of chemical and biological weapons and related materials, regardless of current ownership;
- Land used in the manufacture of explosives; and
- Land which is contaminated land wholly or partly by the presence of radioactivity.
- The descriptions for Special Sites exclude:
  - Off-base housing and Navy Army Air Force Institute (NAAFI) premises;
  - Property disposed of to civil ownership and occupation; and
  - Privately owned training areas and ranges which are used occasionally by the MOD.

## **Assessment and Management of Land Contamination**

2.3 The drivers behind the assessment of land quality across the defence estate are:

- The Secretary of State has a statutory duty to ensure that there are suitable and sufficient processes and procedures in place to both protect the health, safety and welfare of personnel, contractors and visitors on their establishments and the environment.
- To meet statutory requirements of planning controls and the environmental protection legislation to ensure land is suitable for use and substances present do not pose an unacceptable risk to humans or the wider environment.
- Failure to adequately assess and manage land contamination on the defence estate has the potential to impact on defence capability through reducing the availability of training areas, limiting development of the estate, reducing disposal receipts and diversion of funding to meet statutory clean-up obligations.

2.4 MOD has committed to undertake a programme of Land Quality Assessments (LQA) to: 'assess the land quality across the defence estate in order to provide a proper knowledge of the condition of the estate and ensure that it is 'suitable for use' and not causing harm to the environment. Where it is identified that unacceptable risk is posed by the presence of contamination, action must be taken to reduce and control the risks to an acceptable level'

2.5 An appropriate LQA is required to cover all land owned or occupied for defence purposes and for all property transfers. If it can be shown at an early stage that risk is low, then it may be unnecessary to proceed to the next phase.

2.6 Site Users are responsible for using land within agreed parameters or constraints. DIO is responsible for:

- a. Managing an integrated and prioritised MOD estate wide LQA programme
- b. Ensuring that funding is in place for the LQA programme and any necessary remediation.
- c. Coordinating/facilitating the compilation of the information required for the LQA as specified in this Practitioner Guide.
- d. Maintaining the catalogue and electronic library of LQA reports.
- e. Maintaining establishment level records on known and suspected land contamination where DIO is responsible for the Infrastructure
- f. Providing advice to Commanding Officer/Head of Establishment on the management of land contamination risks.

2.7 MOD will meet its statutory commitments and take voluntary action where a risk of significant harm to health and safety or the environment is confirmed and the MOD is the 'appropriate person' to bear the responsibility for remediation action. It is MOD policy to inform the appropriate Regulatory Authority if a risk of significant harm or significant environmental pollution is identified and agree with them the necessary remediation action.

2.8 The location together with details of the associated hazards and risks associated with land contamination identified by a LQA must be transferred to the establishment hazard register and where available the Land Condition File (LCF). This will ensure that land contamination is considered as part of the arrangements for notifying known site hazards to site users, Facility and Project Managers,

contractors and visitors prior to commencement of their activities. Where significant land contamination risks have been identified, these should be regularly reviewed as part of the site Health and Safety and Environmental Management Systems.

2.9 There are a number of methods for managing the risks associated with land contamination. These range from the removal of the contaminant, various physical, chemical and biological treatments or breaking the pollutant linkage by restricting access to the affected area. The choice of management response will be site-specific and depend upon the nature and extent of the contamination, the level of risk and the cost benefit. Where land contamination exists sites can still be suitable for MOD usage and may remain an asset if managed appropriately. Remediation may be a requirement for a change of use or development on a retained establishment.

## **Site Acquisition and Leasing**

2.10 For the acquisition of land after 1990 it is likely that MOD will be deemed to have accepted financial liability for any necessary investigation and subsequent remediation of land contamination that pre-dates MOD ownership/occupation unless otherwise specified in the terms of the contract.

2.11 A reliable and robust LQA must therefore be undertaken to establish the land condition and potential health, environmental and liability risks prior to purchasing or leasing land. As a minimum such a LQA must comply with the requirements of this guide and current best practice.

2.12 Advice on specific LQA requirements is available through the contacts listed at Annex A. For advice on all other aspects of land acquisition and leasing as part of projects etc the local DIO Land Management Services (LMS) representatives must be consulted.

## **Divestment/Disposal**

2.13 Known or suspected land contaminated can have a significantly impact on potential use and disposal value. When deciding which establishments to release from MOD ownership, it is important to understand the nature and magnitude of the contaminated land liability. Hence, it is essential that the nature, extent and associated health, environmental and liability risks are adequately quantified and the LQA is sufficiently robust to provide for auditable and defensible decision making

2.14 A site cannot be divested without:

- An Explosive Ordnance Risk Assessment and explosive ordnance clearance (EOC) if required. Reports should include details of any instrument search, intrusive investigation and clearance/disposal activities carried out on the site;
- An appropriate independent LQA, supported by a collateral warranty is required. The phases of assessment required will be depend upon the site situation; and
- A Closure Risk Assessment (CRA).

2.15 It is essential that a robust independent LQA is prepared as part of a site disposal if a defence against compensation claims arising from any post disposal contamination by the new or subsequent land owner(s) is to be provided. It will also enable MOD to take advantage of the mechanisms available under the UK Contaminated Land Regime for the transfer of the financial liability in respect of clean up to the purchaser. The LQA must be supported by a collateral warranty in order to provide the necessary assurance to a purchaser, their funders and insurers. Similarly site redevelopments under PFIs etc. will require robust independent LQAs supported by collateral warranties in order to establish the baseline land quality that can be relied upon by the PFI partner.

**Box 2.13 – KEY GUIDANCE**

[MOD JSP 364 Joint Service EOD Manual](#)

[MOD JSP 403 Handbook of Defence Land Ranges Safety](#)

[MOD JSP 418: Volume 2, Old Leaflet 2 Contaminated Land](#)

[DE \(DIO\) Design and Maintenance Guide 12 – site closure guide, Land and Property Policy: PI 6/2005.](#)

[C681 – Unexploded Ordnance \(UXO\) A guide for the construction industry, 2009. CIRIA](#)

2.16 Responsibility for organising and funding the LQA and any subsequent work, where required, currently falls to DIO LMS with delivery through DIO IPS...

2.17 Though written before the formation of DIO, the extant guidance for those DIO and site staff involved in the site closure process including the required outputs is detailed in:

[DE \(DIO\) Design and Maintenance Guide 12 – site closure guide, Land and Property Policy: PI 6/2005.](#)

2.18 For disposal sites, remediation is generally confined to the removal of ordnance, and other defence specific contaminants such as chemical agents, radioactive and microbiological materials, where a civilian contractor might not have the relevant experience.

**Box 2.17 LQA Shelf Life and Decision Making**

A LQA provides a snap-shot in time, therefore the risk assessment and management measures detailed within the LQA should be reviewed whenever there is a significant change to site activity, change in relevant legislation, change of statutory guidance and/or a pollution incident occurs.

Where significant land contamination risks have been identified, these should be kept under review through the site Health & Safety and Environmental Management Systems

Where an investment decision is to be made based on a pre-existing LQA the parameters and assumptions within the LQA should be checked to ensure they are still valid. LQAs must be tailored to the situation and undertaken by competent persons.

## **Collateral Warranty**

2.19 Third parties such as purchasers, landlords, PFI partners and/or their funder(s) will seek reassurance that LQAs produced for MOD sites and landholdings, be it freehold or leasehold, are independent and reliable. Hence, it is usually the case that purchasers, PFI partners and their funders require internal MOD investigations to be checked and verified by independent specialists, often at MOD's expense. To overcome this and assist in maximising the sale receipt MOD policy is to commission independent LQAs supported by collateral warranties. Where explosive ordnance risk assessments are produced to inform the need or otherwise for clearance in aide of site disposals, those produced by commercial organisations should be supported by a collateral warranty. Those produced in-house are not supported by such warranties and so the liability will rest entirely with MOD and as such they may not be suitable for disposal purposes. In such cases they may serve only to inform disposal decisions and the need for further investigation.

2.20 Box 2.19 provides a general overview of the form and function of collateral warranties together with the minimum requirement necessary to support a site disposal. Further guidance on the requirement for and form of collateral warranties is available from DIO LMS and DIO PTS. See Annex A for contact details.

### **Box 2.19 Collateral Warranties**



Collateral warranties can be either 'agreements' or deeds and typically extend the duty of care of an author of a LQA to a third party, such as a purchaser or PFI partner, for a period of 6 to 12 years during which time they require the author to maintain a specified amount of Professional Indemnity insurance cover.

The exact form of the warranty, i.e. whether it is an agreement or a deed, the number of assignments possible and any associated costs will be dependent upon the circumstances, but for site disposal purposes the minimum requirement and conditions acceptable to DIO is:

Provision of Collateral Warranties in the standard agreed form, at no additional cost, to the PFI Partner (where appropriate), first purchaser and/or tenant of the whole site or part thereof to a limit of two parts, and to the first funder of those parties. Further collateral warranties should also, at the reasonable request of MOD, be provided in the standard agreed form to second purchasers and/or tenants and their funders of all or part of the site ('Secondary Warranties') at a reasonable fee per warranty not to exceed £1000. Should any party eligible to benefit from the Secondary Warranty require variations from the agreed standard form, the Consultant shall be entitled to levy additional fees and/or expenses to reflect the reasonable costs in negotiating such variations. The level of Professional Indemnity (PI) cover and form of the Collateral Warranty shall be agreed between the Consultant and the party eligible for the warranty.

## **Alienated Estate**

2.21 DIO is responsible for the assessment and where necessary remediation of former MOD sites within the context of Part IIA of the Environmental Protection Act 1990. The lead element of DIO being: Land Management Services supported by DIO PTS.

**Box 2.20 – MOD Position Statement – Voluntary Inspection and Remediation – Alienated Estate**



Alienated Land

1. In the case of land previously owned or occupied by the Ministry of Defence, the Ministry of Defence will look to the regulatory authority to act in accordance with the provisions of the Contaminated Land Regime as set out under Part IIa and the Statutory Guidance. Further the Ministry of Defence will look to the regulator to demonstrate that land is 'contaminated land' within the definition provided under Part 2A of the Environmental Protection Act and Statutory Guidance and the Ministry is an 'Appropriate Person'.
2. Where the Ministry of Defence is found to be an 'Appropriate Person', it will fulfil its legal obligation to meet its portion of the liability and carry out voluntary action including remediation where appropriate. In cases of two or more Appropriate Persons being identified by the regulator, the Ministry of Defence will work with the other Appropriate Person(s) and interested parties including the regulatory authorities to reach agreement on the management actions required and the necessary funding.

### **3. LQA AND MANAGEMENT PROCESS**

#### **Objectives**

3.1 A robust assessment of land quality is essential to inform investment, development and divestment decisions and where necessary, identify appropriate remediation options and pollution prevention and control measures. The objective of a LQA is therefore, to quantify the contaminated land risks and the associated liability (health, environmental, legal and financial) in a logical and rational manner achieving both economy in the expenditure of resources and confidence in the end result in the process, such that the LQA provides the basis for defensible and auditable decision making. For this reason, a phased approach to this stage of the investigation process is recommended. As soon as sufficient information is obtained the investigation should cease.

#### **Process**

3.2 Figure 1, taken from the [Safegrounds](#) Land Management Guide, shows the process diagram for the assessment and management of land contamination adapted from CLR 11 to take account of the Safegrounds key principles and aspects specific to radiological contamination on defence sites. This is a systematic process which follows three stages: 1. Risk Assessment, 2. Options Appraisal, and 3. Implementation of the Remediation (Management) Strategy.

3.3 The systematic process outlined in Figure 1 can be best achieved by adopting a phased approach to the assessment and management of land contamination in line with the MOD Land Quality Management Strategy and site specific strategies. Within MOD this is achieved using the LQA process which is divided into the phases shown in Box 3.3, each of which has been superimposed onto Figure 1. These phases differ in terms of the terminology adopted by the recent [BS 10175:2011](#), but are compatible and remain consistent with CLR11.

#### **Box 3.3 MOD LQA Process Phases**



##### **STAGE 1 - Risk Assessment**

- PHASE 0 LQA - Preliminary Hazard Assessment;
- PHASE 1 LQA - Desk Study; and
- PHASE 2 LQA - Site Investigation (this may be phased).

##### **STAGE 2 - Options Appraisal**

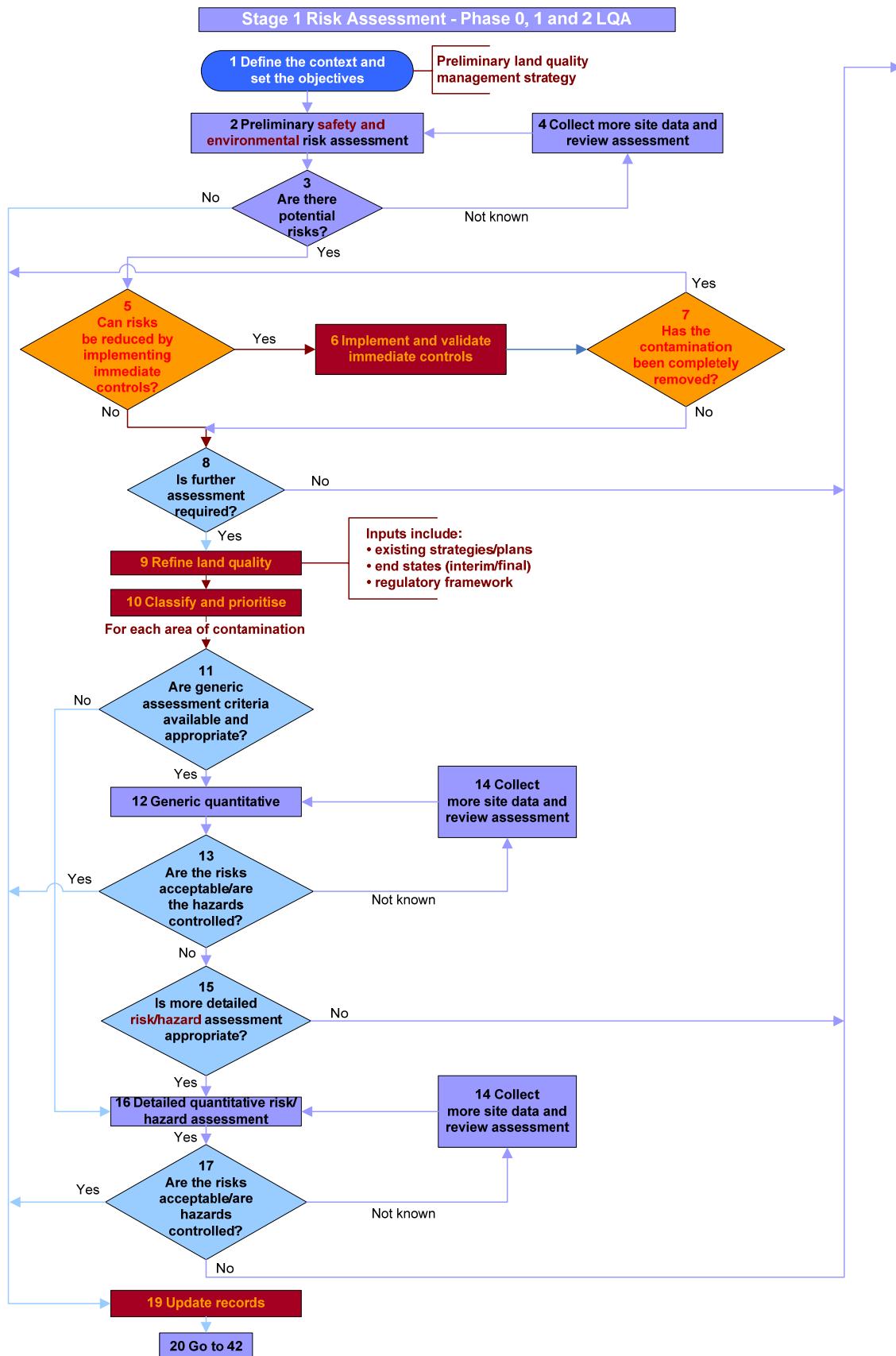
- PHASE 3 LQA - Management Option Appraisal/Decisions.

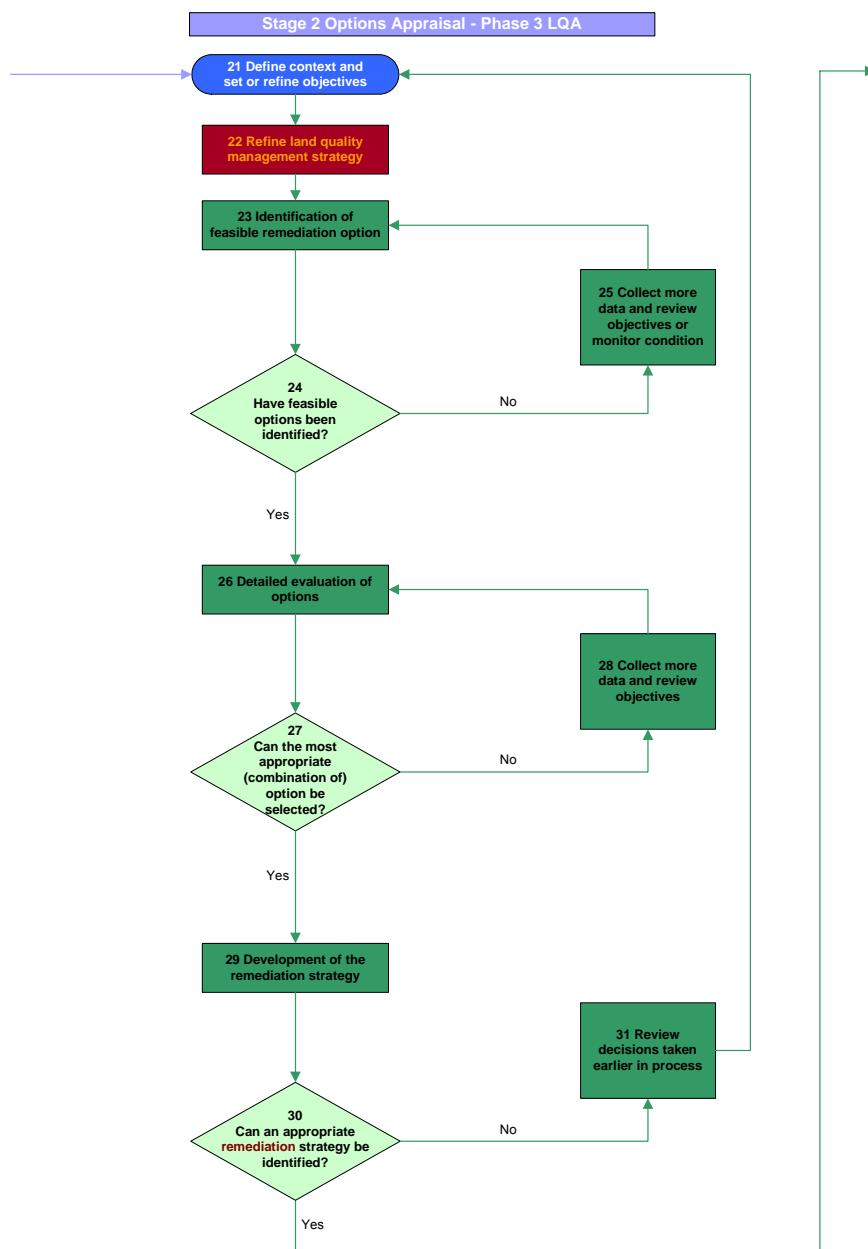
##### **STAGE 3 - Management Response**

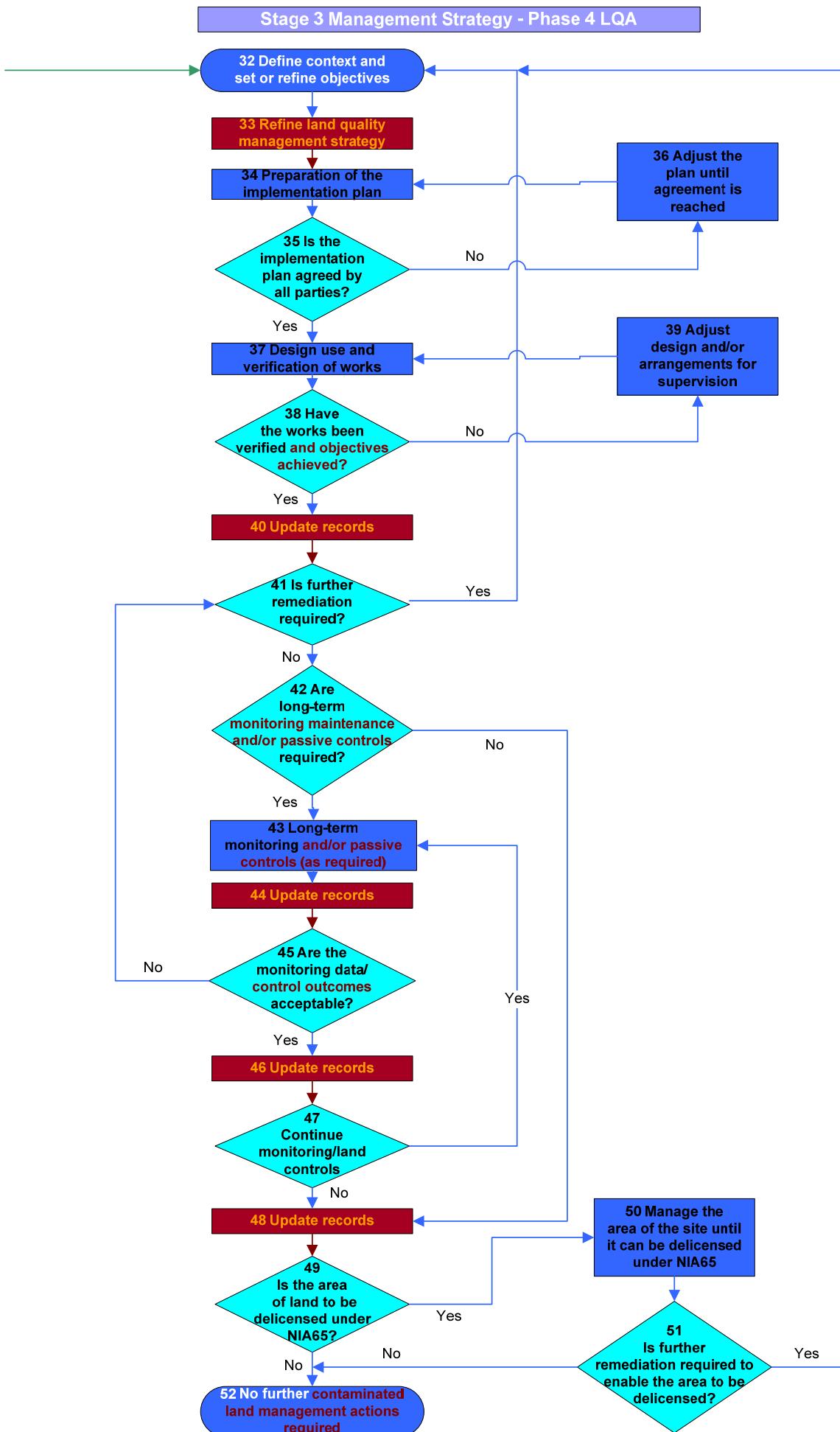
- PHASE 4 LQA - Implementation of Management Option(s) (Management Response – this may also be phased and involve long term monitoring).

**Figure 1 Generic Flow Diagram for Management of Contaminated Land**

Note: The modifications to the CLR 11 decision flow diagram for SAFEGROUNDS are highlighted in dark red boxes with tan lettering.







3.4 It will not be necessary to carry out every phase for each site. For instance the potential environmental, health and safety risks identified at Phase 0 may be sufficiently quantified not to warrant proceeding to Phase 1 and so on. The need for further investigation and remediation must be commensurate with the objectives of the LQA and the degree of confidence required in the decisions.

3.5 The decision on whether to progress a LQA to the next phase must be taken after consultation with key stakeholders, see Box 3.5, and advice from the relevant specialists detailed at Annex A, taking account of the situation and cost benefit. In the case of sites in disposal, alienated land and the MOD Estate-wide Phase 2 LQA Programme, DIO will take the lead with respect to stakeholder involvement.

### **Box 3.5 Stakeholder Involvement**



Stakeholders are individuals or groups with a legitimate interest in the management of land contamination. They range from regulators and employees through to the Head of Establishment, Non-Governmental Organisations and local residents.

The level of involvement namely communication (including provision of information), consultation and participation in the decision making process will depend on the situation and context.

Responsibility for the final decisions on the management of land contamination falls within the jurisdiction of the DIO.

It is more effective to involve stakeholders throughout the planning and decision process/cycle rather than intermittently on individual issues.

Specific guidance on stakeholder involvement is available in: [Safegrounds, Community Stakeholder Involvement. A report prepared within the Safegrounds project.](#)

3.6 The cost of and time taken to complete each phase will be dependent upon the nature of the site activities, setting, accessibility and to an extent the size and complexity of the site/establishment in question.

3.7 Guidance on reporting formats for LQA Reports, Technical Notes and Land Quality Statements (LQS's) are presented at Annex B1 to B3. These are the MOD standard formats which are to be adopted and tailored to the site and situation.

### **Quality Assurance and Sign-off**

3.8 All LQA reports commissioned through commercial consultants should in addition to being prepared by Suitable Qualified and Experienced Persons (SQEP), be reviewed and signed-off by Specialists in Land Condition (SiLC). Further information on SiLC registration is presented in Box 3.8.

### **Box 3.8 Specialist In Land Condition (SiLC)**



#### **What is a SiLC?**

'A registered Specialist In Land Condition (SiLC) is a senior practitioner/professional able to demonstrate a broad awareness, knowledge and understanding of land condition issues, who can give impartial and professional advice in their field of expertise'.

Initially developed to support the use of Land Condition Records (LCR), SiLC is recognised as a much broader registration. It is the only Professional Registration of its type for experienced individuals involved in the assessment and management of land condition/contamination.

The registration is supported by a number of professional bodies including IEMA and CIWEM.

#### **SiLC Vision Statement**

To develop and maintain a high quality unifying qualification for assessment and remediation of Brownfield sites which fulfils the needs of public and private sectors and society as a whole.

#### **More information**

Details are available from: [www.SiLC.org.uk](http://www.SiLC.org.uk)

3.9 For further advice on the LQA process or whether a site should be included on the MOD Estate-wide LQA Programme contact the Defence Infrastructure Organisation PTS - Environmental Liability Management Group (ELMG). Contact details are enclosed in Annex A.

#### **Explosive Ordnance**

3.10 The presence of UXO is a health and safety at work and public safety risk, and an explosive ordnance risk assessment (EORA) should be carried out in addition to a LQA. The LQA will cover the environmental risk of land contamination on a site from residues due to known firing or disposal of ordnance, munitions and explosives. The EORA will identify the likelihood of encountering items or ordnance and the resulting H&S risk from those types of explosives or ordnance to identified receptors. Specialist advice is to be sought on the assessment of explosive ordnance risks.

3.11 In the UK the explosive threat from UXO is primarily treated as a health and safety at work and a public safety issue. Following consultation with the EA MOD's position statement on the assessment of significant contaminant linkages in relation to UXO is presented in Box 3.11.

### Box 3.11 UXO Position Statement



In the UK the explosive threat from UXO is primarily treated as a health and safety at work and a public safety issue.

#### Defence Sites/MOD controlled Property:

Defence sites are subject to clearance operations to ensure they are safe and suitable for use. Clearance operations are conducted by trained personnel using the appropriate in-service equipment and in accordance with the accepted operating procedures at the time. Statements given following any of these operations cannot provide a 100% guarantee that all items have been recovered.

However, if ordnance is left undisturbed, it will under normal circumstances not pose an explosion threat. The accepted procedure is that if a suspicious object is found, the finder should contact either the Local Range Officer or Police who will contact one of the Service EOD Teams. The Service EOD Teams will then assess the risk and deal with the immediate problem under Military Aid to the Civil Powers arrangements. They will also make an assessment on the need for further investigation/clearance work. Under normal circumstances UXO is not considered to pose a significant possibility of significant harm with regard to explosion at defence sites.

#### Alienated Sites/Former MOD Property:

MOD treats the explosive threat from UXOs as a health and safety issue.

If ordnance is left undisturbed, it will under normal circumstances not pose an explosion threat. The accepted procedure is that if a suspicious object is found, the finder should contact the Police who will contact one of the Service EOD Teams. The Service EOD Teams will then assess the risk and deal with the immediate problem under Military Aid to the Civil Powers arrangements. They will also make an assessment on the need for further investigation/clearance work.

If there is the possibility that ordnance may be disturbed, MOD believes that it is usually possible to put in place suitable and sufficient risk management measures, including the provision of information to potentially affected parties on accepted procedures, to prevent significant harm from occurring.

3.12 Whilst there are no UK specific generic assessment criteria for explosives residues, values have been developed by BAe Systems (formally Royal Ordnance) and other organisations. However, these are to be used with care as they may not be applicable to the UK situation and are not necessarily compliant with UK policy and guidance.

### Box 3.13 Explosives Residues



- [Environment Agency, Collation of toxicological data and development of guideline values for explosive substances, P5-065/TR, 2000.](#)
- Rudland, D J et al. [Contaminated Land Risk Assessment, A Guide to Good Practice. CIRIA C552, London 2002.](#)
- Royal Ordnance. [Explosive Materials – Determination of Toxicological Hazards and other Properties, 1990.](#)
- LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment. 2<sup>nd</sup> Ed July 2009

#### **4. STAGE 1 - RISK ASSESSMENT**

4.1 The process is tiered as shown in Figure 2 and starts with the identification and assessment of the potential site and situation specific hazards (contamination sources) culminating in an Initial Conceptual Site Model (CSM) and Preliminary (Qualitative) Risk Assessment (PRA) in the Phase 1 LQA which establish the potentially unacceptable risks. In doing so the potential sources, receptors and likely pollutant linkage are identified.

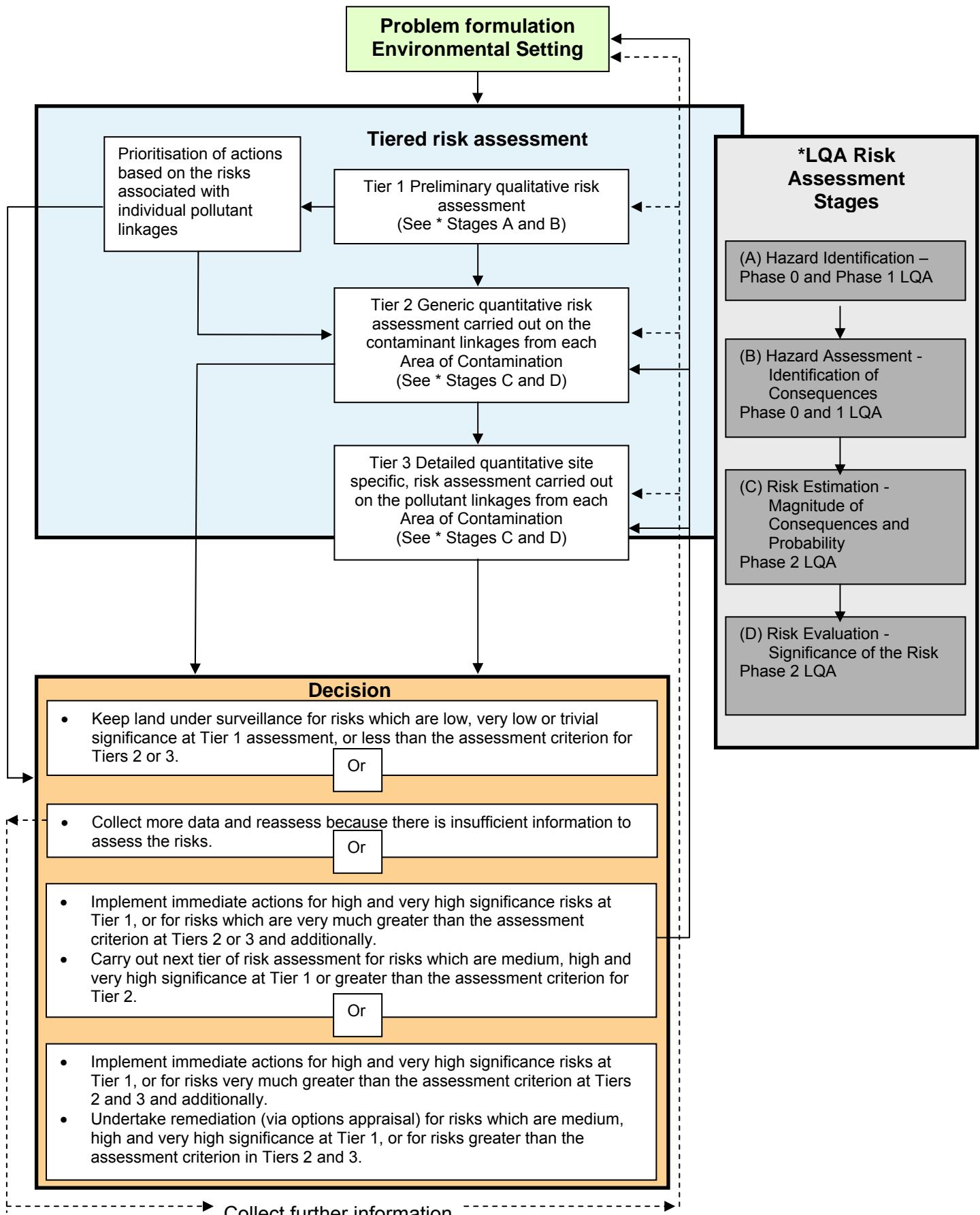
4.2 In the Phase 2 LQA the potentially unacceptable risks are estimated and further evaluated by testing and refining the Initial CSM using site specific data such as laboratory derived concentrations of contaminants in the soil. Risk estimation is concerned with assessing the likely magnitude and probability of harm that may result from an identified hazard (contaminant source) and which receptors will or are likely to be affected. Risk evaluation on the other hand is about deducing whether the risk is or has the potential to become unacceptable i.e. the focus is on identifying the '[significant contaminant linkage](#)'.

4.3 Hence, there are 2 parts to this stage:

- **Part 1A Hazard Identification and Assessment** (Phase 0 Preliminary Hazard Assessment and Phase 1 Desk Study); and
- **Part1B Risk Estimation and Evaluation** (Phase 2 Site Investigation).

**Figure 2 Summary of Tiered Risk Assessment Process**

Adapted from the NDA Direct Research Portfolio: Draft Practitioners' Guide TSG (10)0664 2010



4.4 Figure 3 shows the process starting with the Phase 0 LQA, progressing to the Phase 1 LQA and if required the Phase 2 LQA. The following sections and paragraphs are not intended to provide a definitive guide to risk assessment within the context of the LQA process, but outline best practice and identify current guidance. Risk assessments should not be undertaken in isolation and Specialist support and advice should be sought. Appropriate contacts are listed in Annex A.

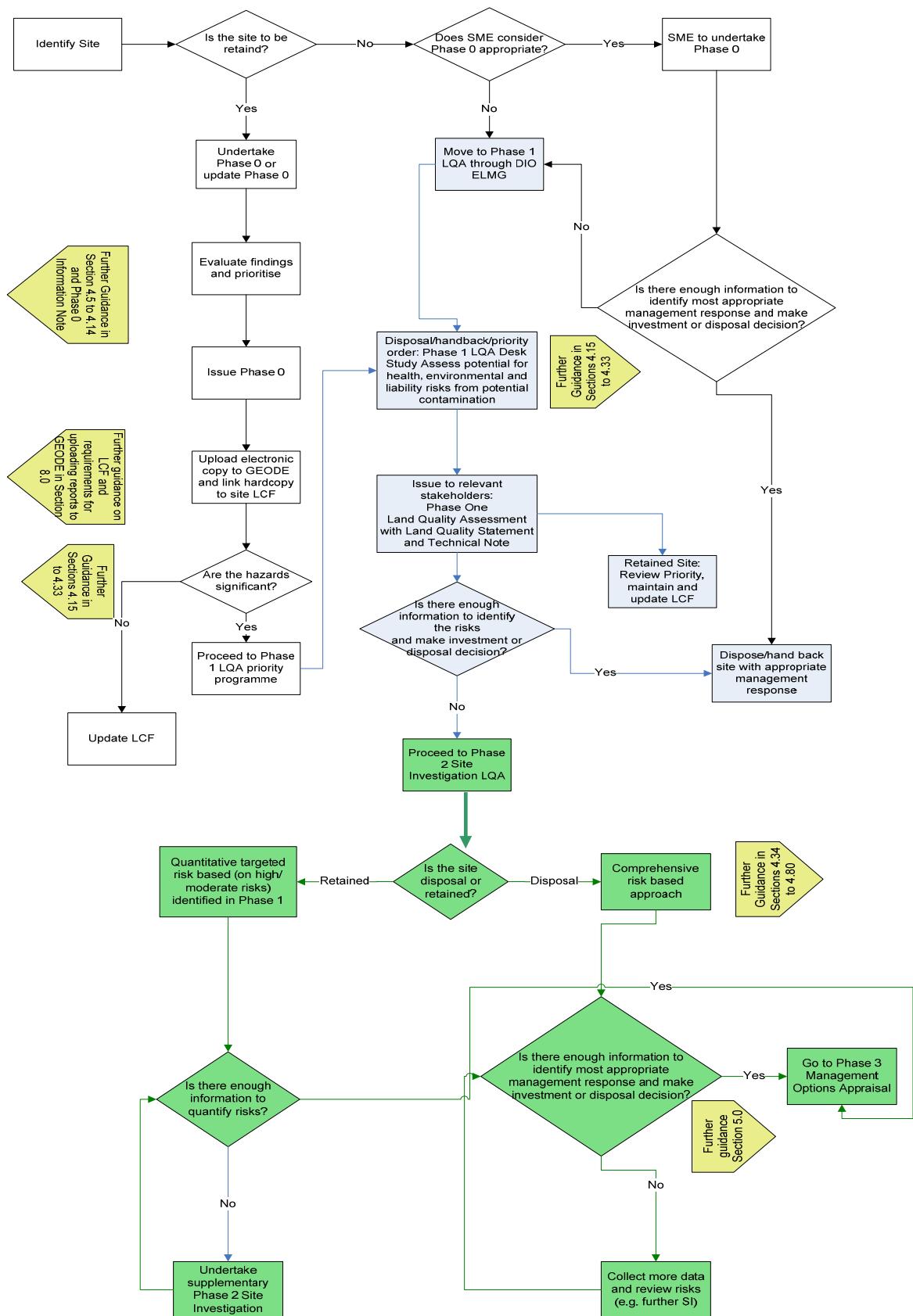
**Box 4.4 Risk Assessment Good Practice Guidance**



A useful overview of the Risk Assessment Process is provided by:

- Rudland, DJ et al. [Contaminated Land Risk Assessment, A Guide to Good Practice.](#) CIRIA C552, London 2002.
- [R&D 66 Guidance on the Safe Development of Housing on Land Affected by Contamination, 2008 Volume 1 and 2. NHBC, CIEH and Environment Agency](#)
- [Green Leaves III Guidelines for Environmental risk Assessment and Management. PB13670. November 2011](#)

**Figure 3 LQA Process Flow Chart Phase 0 to Phase 2**



## PART 1A HAZARD IDENTIFICATION AND ASSESSMENT

### PHASE 0 LQA – PRELIMINARY HAZARD ASSESSMENT

#### Introduction

4.5 As resources are finite it is essential that MOD identifies and targets the highest risk priorities i.e. where there is an immediate significant risk of significant harm or pollution or breach of legislation. The first step in achieving this is for each TLB (requirement may transfer in entirety to DIO) to carry out a Phase 0 LQA – Preliminary Hazard Assessment for all their establishments and land holdings to identify potential environmental and health hazards and formulate a prioritised Phase 1 LQA Programme.

4.6 This appraisal and prioritisation exercise will involve a stakeholder plan/programme, refer to Box 4.6.

#### Box 4.6 Stakeholder Involvement Plan and Programme



Before beginning a Phase 0 or subsequent LQA phases it is good practice to identify the key stakeholders and develop a Stakeholder Involvement Plan and Programme. These are tailored to the situation and are living documents.

The level of involvement must be proportionate to the situation. They do not need to be involved in every decision. If in doubt consult and involve.

At Phase 0 stage stakeholder involvement may involve only site representatives, DIO LMS and those who may be directly affected e.g. occupants of Service Family Accommodation etc.

Guidance on deciding on the scale and level of stakeholder involvement is available in:

- [Penfold, J \*Safegrounds. Guide to the comparison of contaminated land management options\*, CIRIA W28, London 2009.](#)

Whereas guidance on developing Stakeholder Involvement Plans is available from:

- [Collier, D \*Safegrounds. Community stakeholder involvement\*, CIRIA W16, London 2005.](#)

Additional guidance is available from:

- [CL:AIRE, \*Communicating risk on contaminated sites. How best to engage with the local residents\*. SUBR:IM Bulletin 6 London 2007](#); and
- [CL:AIRE, \*Community engagement, urban regeneration and sustainability\*. SUBR:IN Bulletin 8 London 2008.](#)

4.7 A Phase 0 LQA provides a summary of the likely land quality based on readily available information by providing a preliminary review of potential contaminants and receptor sensitivities.

4.8 The source of a potential contaminant must be linked to a receptor by a pollutant linkage. Although the Phase 0 LQA does not consider pollutant linkages directly, the receptor sensitivity review and assessment does consider the potential for a pathway to be present, thus identifying which sites are most likely to fall under the statutory definition of contaminated land.

4.9 If the site is to be disposed of, the LQA report should make note that the findings of the report are of the express opinion of MOD for determining the suitability of the site for sale and cannot be relied upon by third parties. Therefore the purchaser is invited to satisfy themselves as to the condition of the land and suitability for use prior to purchase by contacting the DIO Land Agent to arrange site access. See Annex A for additional guidance on the appropriateness of carrying out a Phase 0 LQA for a disposal site.

<b>Box 4.9 Phase 0 LQA Objectives</b>	
The objective of a Phase 0 LQA is to achieve the following: <ul style="list-style-type: none"><li>a. Identify context and objectives for hazard assessment;</li><li>b. Establish outline conceptual model for site;</li><li>c. Identify potentially unacceptable hazards; and</li><li>d. Identify further actions.</li></ul>	

## Reporting

4.10 The Phase 0 LQA is usually reported using a standard 2 to 3 page template either singularly or else collated and presented with an overview of the key findings and recommendations. The standard Phase 0 LQA template is available upon request from DIO PTS.

4.11 The Phase 0 LQA is an unrestricted document and as such will contain predominantly factual information together with the Initial CSM and Category/Priority Assessment of the overall land quality and suitability for redevelopment that sets the presence of any land contamination and pollution for controlled waters in context.

4.12 Full details of the Generic MOD Phase 0 LQA Reporting Format and content is provided in Annex B1 with Annex B4 setting out the requirements for GEODE compatible electronic copies. Please note that Annex B represents the standard default formats which are designed for retained and disposal sites alike, but may need to be tailored to the situation. For instance the requirements for a LQA undertaken in support of a planning application or voluntary inspection (LQA) under Part 2A of the Environmental Protection Act 1990 can differ from the default format. Advice must therefore be sought from the relevant authority and key stakeholders at the earliest opportunity to avoid unnecessary expenditure and delay. In the case of disposals, retained sites, voluntary inspections and planning applications the technical authority is DIO and the relevant contacts for advice and guidance are detailed in Annex A.

## Methodology

4.13 There are a number of published methodologies for accomplishing this, most notably the DoE/DET Contaminated Land Report (CLR) 6, (Appendix 1) "Prioritisation and categorisation procedure for sites which may be contaminated".

4.14 DIO has developed the Phase 0 approach taking account of CLR 6 and the Source-Pathway-Receptor concept also known as the pollutant linkage model. The approach referred to as the 'Strategic Land Quality Appraisal and Prioritisation Methodology' has been established in order to provide a systematic and auditable methodology that will not only enable sites to be screened and prioritised, but will produce a Land Quality statement (LQS) for each site otherwise known as a Phase 0 LQA Report.

4.15 The LQS provides a summary of the likely land quality based on the readily available information together with an initial identification of potential hazards and the likely risks. As such it allows the relative significance of the site in terms of the potential for significant harm to be determined together with the need or otherwise for further assessment. In this way it enables a prioritised programme of Phase 1 LQAs to be developed and assists in identifying the immediate and longer term need or otherwise for institutional controls to mitigate potential risks. As such it allows DIO to take a holistic view of the land quality across their sites and develop a coherent, defensible and prioritised management programme that will target resources where there is greatest need. This will minimise the risk of both regulatory action and nugatory work and allow effective budgeting.

4.16 Whilst the methodology has been developed to assist the MOD in identifying hazards, risks and liabilities with respect to land contamination on the retained/core estate it is insufficiently detailed to allow a determination of a site's status under the Part 2A Contaminated Land Regime. It does however, enable MOD to identify those sites which are most likely to fall within the statutory definition of 'contaminated land' and will assist local authorities in discharging their statutory obligations in terms of inspecting the land in their area and minimise the risk of sites being inappropriately designated as 'Contaminated Land'.

4.17 The detailed methodology is available as a standalone document from DIO PTS who is also able to advise you on its application or else undertake the assessment and prioritisation for you.

4.18 Subsequent phases of LQA will be required if the potential for SPOSH is identified. Figure 3 provides a simple guide through the Phase 0 process.

## **PHASE 1 LQA - DESK STUDY AND SITE RECONNAISSANCE**

### **Introduction**

4.19 Where the Phase 0 appraisal and prioritisation identifies the need for further assessment and or a site is identified for disposal, the next step is the Phase 1 LQA which is to be undertaken as part of a prioritised programme. This phase involves a site reconnaissance visit, interviews with key staff and a more detailed review of factual data concerning the site history, geology, hydrology, hydrogeology, regulatory issues, planning and site operations etc to validate and refine the findings of the Phase 0 leading to the creation of an Initial CSM and the undertaking of a Preliminary (Qualitative) Risk Assessment to better establish the associated potential health, environmental and liability risks. In conclusion the Phase 1 will identify the need for and scope of any further work be it additional desk based research, intrusive investigations that will form the basis of the subsequent Phase 2 LQA or use of institutional controls to manage and mitigate the risk.

4.20 There may be circumstances where a Phase 0 LQA was not undertaken. In such circumstances the Phase 1 LQA will establish for the first time the potential hazards together with the Initial CSM and Preliminary (Qualitative) Risk Assessment.

### **Box 4.19 Phase 1 LQA Top Tips**



Always treat each site and therefore each Phase 1 LQA as unique as there will be combinations of factors that are specific to each one.

Establish clear, relevant objectives that reflect the site situation and context such as whether the LQA is in aid of a disposal or voluntary inspection, as this will avoid confusion, misunderstanding and potentially inappropriate conclusions/recommendations.

Always include a 6 figure National Grid Reference as MOD sites often have several names reflecting the fact that they have been occupied by different Services and undergone changes in use. Where appropriate the relevant Spec 005 codes should also be considered.

Consult DIO PTS and GEODE for existing LQA data.

Scope the Phase 1 LQA appropriately. Under or inappropriately scoped Phase 1 LQAs cost time and money.

All assumptions, caveats and limitations should be clearly stated so there are no misunderstandings.

Seek advice from MOD SMEs as soon as possible.

## **Reporting**

4.21 The Phase 1 LQA will normally contain three elements:

- LQS;
- Land Quality Report; and
- Technical Note.

4.22 The LQS is a 2 to 3 page document which takes the place of the executive summary within the LQA report. It provides a non technical summary of the land quality based on the available information and site reconnaissance and includes the potential risks to human health and the environment, including controlled waters (groundwater and surface water). It also identifies the available historical records, details of known environmental pollution and previous investigations and remediation that have taken place and provides an indication of the suitability of the land for both the current use and redevelopment. The LQS must be written in such a way that it can be used as a freestanding document. It should not reference specific sections of the LQA report or figures and must not contain any recommendations.

4.23 The LQA Report is an unrestricted document and as such will contain predominantly factual information together with the initial CSM, Preliminary Risk Assessment and an assessment of the overall land quality and suitability for redevelopment that sets the presence of any land contamination and pollution of controlled waters in context i.e. is it localised, limited in extent and confined to shallow soil horizons etc.

4.24 The Technical Note is a restricted document that carries a 'Restricted-Commercial' protective marking. The note provides: an assessment of the liabilities associated with any known or potential contamination including a view on whether the site is likely to be determined 'Contaminated Land', an evaluation of the management options, cost estimates for each option and a defensible recommendation that is consistent with current best practice and affords VFM.

4.25 Full details of the Generic MOD Phase 1 and 2 LQA Reporting Format and content is provided in Annex B2 and B3 respectively with Annex B4 setting out the requirements for GEODE compatible electronic copies. Please note that Annex B represents the standard default formats which are designed for retained and disposal sites alike, but may need to be tailored to the situation. For instance the requirements for a LQA undertaken in support of a planning application or voluntary inspection under Part 2A of the Environmental Protection Act 1990 can differ from the default format. Advice must therefore be sought from the relevant authority and key stakeholders at the earliest opportunity to avoid unnecessary expenditure and delay. In the case of disposals, retained sites, voluntary inspections and planning applications the technical authority is DIO and the relevant contacts for advice and guidance are detailed in Annex A.

#### Box 4.25 LQA Content Guidance – Phase 1



Guidance on the content of Phase 1 LQAs depending upon the situation and purpose are provided by:

- [\*Guidance for the Safe Development of Housing on Land Affected by Contamination.\* NHBC and Environment Agency, R&D 66, 2008.](#)
- [\*CLR2. Guidance on preliminary site inspection of contaminated land.\* Report by AERC Ltd. DoE 1994.](#)
- [\*CLR11. Model Procedures for the Management of Land Contamination.\* EA and DEFRA 2004.](#)
- [\*EA Technical Report P5-042/TR/01. Land Contamination: Technical Guidance on Special Sites: MOD Land.\*](#)

## Methodology

4.26 Current best practice is set out in [CLR11](#) and useful guidance on the scope, approach and content including the Initial CSM and the Preliminary Qualitative Risk Assessment is available in R&D 66 and generic technical guidance on conceptual models can also be found in the [Environment Agency's R&D publication NC/99/38/2](#) (refer Appendix 1). Additional guidance is provided in Annexes C1, C2 and D respectively to this guide.

4.27 For MOD sites the Phase 1 LQA will include a Site Reconnaissance which must be tailored and involve as a minimum, an appraisal detailed below. It is essential that the appropriate stakeholders are consulted and involved to ensure the scope is fit for purpose

- Site infrastructure, drainage and services;
- Site operating procedures both past and present; and
- Potential environmental issues requiring urgent attention.

#### **Box 4.27 Stakeholder Involvement**



At the Phase 1 stage the level of stakeholder involvement may not vary from that of the Phase 0.

However, depending upon the situation there may be a need to involve the regulators either directly in the planning and scoping of the LQA or else by keeping them informed of what is intended and why.

The Stakeholder Involvement Plan and Programme should be amended to reflect any changes.

4.28 Where the site reconnaissance involves the inspection of fuel infrastructure and entering confined spaces etc then full adherence to the relevant health and safety legislation and regulations is required together with the appropriate MOD Safety Rules and Procedures (SRPs). The latter are managed and enforced by DIO through the Senior Authorising Authorities located within the Professional and Technical Services (PTS) Team. Contact details are presented in Annex A.

4.29 The review and assessment of factual data should involve the collation and appraisal of the entire available desk based information relating to the site that is deemed to be appropriate together with anecdotal evidence collected from site staff. This data combined with the site reconnaissance should be used to refine the Outline CSM into the Initial CSM where all the potential pollutant linkages are identified and qualitatively assessed, with the objective of establishing the potential health, environmental, infrastructure and liability risks, likelihood of pollutant linkage, potential consequence of the pollutant linkage and likely significance. The outcome is the Preliminary Risk Assessment which should be presented both as a summary narrative and as a summary table, refer Annex D. The risk assessment should also include the potential for unexploded ordnance (UXO) to be present. Though not a contaminant per se (refer Box 3.11 for the MOD UXO position statement agreed with the EA), UXO does represent both a significant H&S risk and a potential source of contamination such as explosives residues and metals.. Guidance on assessing the severity, probability and ultimately the classification of the risk is also provided at Annex D together with specific guidance for radioactively contaminated land.

4.30 Detailed checklists are available in [CLR2](#) and [EA Technical Report P5-042/TR/01](#) (refer to Appendix 1). Additional requirements that are specific to the site or the commission will be set out in the commissioning paperwork. Good practice is to use a LQA Directive to achieve this, examples of which are available from DIO PTS.

#### **Box 4.30 LQA Directive**



The LQA Directive should set out clearly and succinctly:

- background to and purpose of the LQA;
- site location;
- statement of requirement;
- constraints and considerations such as security;
- standards that apply;
- deliverables/reporting requirements;
- deadlines; and
- requirements for collateral warranties etc

4.31 The Phase 1 LQA should ultimately place the potential and/or known contamination in context i.e. is it likely to be limited in extent, localised and what is the level of potential risk to human health and the environment? The LQA should also identify the management options and costs necessary to address the immediate and longer term risks and liabilities including, but not limited to Phase 2 LQA (site investigation). Where the need for a Phase 2 LQA is identified then a number of options setting out the degree of uncertainty associated with each should be provided. The recommended option and level of uncertainty must be justified.

### **Immediate Management Action**

4.32 If the Preliminary Risk Assessment or the site reconnaissance identifies immediate risks then action must be taken to mitigate and manage those risks in advance of any Phase 2 LQA work.

4.33 The objectives should be to protect human health and the environment by:

- Stopping the situation getting worse by preventing the spread of contamination or further pollution of a controlled waters;
- Controlling exposure through the use of access restrictions etc; and
- Implementing monitoring regimes if required pending the outcome of further assessment and a decision on the long term management approach.

4.34 The nature of the risk will dictate the need for and level of regulator involvement, MOD policy is quite clear: the regulators are to be made aware of pollution incidents etc immediately. Whilst it is good practice to develop an Immediate or Interim Management Plan in situations such as this, this should not be at the expense of delaying the necessary action.

### **Policy Process and Responsibility**

4.35 Responsibility for procuring and funding a Phase 1 LQA rests with DIO PTS with the exception of those commissioned as part of a project or PFI etc. In the case of the latter technical advice and assistance is available from DIO PTS and the SME contacts given in Annex A. The TLB however, retains overall responsibility for the establishment, this includes all Health, Safety and Environmental issues in addition to being responsible for ensuring access to the site, the provision of key personnel and that the necessary documents etc are compiled and made available. The TLB is also responsible for compiling background information on the site such as current and historical practices and maintenance of the site Land Condition File.

4.36 The Phase 1 LQA must only be undertaken by competent specialists, be they the in-house MOD specialists identified at Annex A or independent external vetted specialists from commercial consultancies under their management. All LQAs commissioned through commercial consultants must be reviewed and signed off by a registered SiLC, refer Box 3.8.

## PART 1B RISK ESTIMATION AND EVALUATION

### PHASE 2 LQA- SITE INVESTIGATION

#### Introduction

4.37 The findings and evaluation of the Phase 1 LQA Desk Study will determine the need and scope for a Phase 2 LQA intrusive and/or non-intrusive site investigation using geophysical and other such techniques.

4.38 The aim is to provide a reliable assessment of land quality and in doing so confirm the presence and quantify the nature and extent of contamination setting out the level of uncertainty (inherent in the sampling, sampling preparation and analysis), assess the significance in terms of the risks and associated environmental, health and financial liability, provide an appraisal of the management options together with reliable order of cost estimates and make recommendations on how to manage the risk and liability cost effectively. The options looked at will include, but not be limited to: institutional controls, remediation and further investigation and/or monitoring. These may be tackled in a single stage or in a number of targeted phases that may be spread over a number of months or financial years.

4.39 Where the Phase 2 LQA is being undertaken for disposal purposes (divestment) then consideration must be given to the potential future land uses, the associated risks and costs of making the land suitable for use and potential for contamination to be caused as a result of demolition.

#### Box 4.39 Stakeholder Involvement



At the Phase 2 stage the level of stakeholder involvement may vary from that of the Phase 1.

There may be a need for and greater involvement of the regulator, site personnel and local community particularly if site works have the potential to cause nuisance.

The Stakeholder Involvement Plan and Programme should be amended to reflect any changes.

#### Reporting

4.40 The Generic MOD Phase 2 LQA Reporting Format is essentially the same as for a Phase 1 LQA (refer paragraph 4.23). Generic guidance on content etc. is set out in Annex B3. Annex B4 sets out the requirements for enabling electronic copies to be loaded onto Geographic Online Data for Estates (GEODE). As with Phase 1 LQAs the generic format represents the standard default format which is designed for retained and disposal sites alike, but may need to be tailored to the situation. The requirements for a LQA undertaken in support of a planning application or voluntary inspection under Part 2A of the Environmental Protection Act 1990 can differ from the default format. Advice must be sought from the relevant authority and key stakeholders at the earliest opportunity to avoid unnecessary expenditure and delay. In the case of disposals, retained sites, voluntary inspections and planning applications the technical authority is DIO and the relevant contacts for advice and guidance

are detailed in Annex A. Any site or project specific requirements should be set out in the commissioning paperwork. Ideally this should take the form of a LQA Directive.

## Methodology

4.41 The Phase 2 LQA is intended to estimate and evaluate the potential risks identified by the Phase 1 LQA through testing and refining the Initial CSM using site specific data such as laboratory derived concentrations of contaminants in the soil.

4.42 The key steps are:

- Define/set clear objectives;
- Develop Investigation Strategy;
- Scope the investigation
- Sampling, field testing and analysis;
- Quantitative Risk Assessment;
- Evaluation and Conclusions; and
- Reporting.

### Box 4.41 Site Investigation Guidance – Phase 2 LQA



- [CLR11. Model Procedures for the Management of Land Contamination. EA and DEFRA 2004.](#)
- [Guidance for the Safe Development of Housing on Land Affected by Contamination. NHBC and Environment Agency, R&D 66, 2008](#)
- [BS 10175:2011. Investigation of potentially contaminated sites – Code of practice. 2011. BSI Publications](#)
- Technical Aspects of Site Investigation in Relation to Land Contamination Vol 1 and 2 Environment Agency Publication P5-065/TR

## Objectives

4.43 The objectives must be appropriate and achievable and the site investigation must reflect both the objectives and adequately test the Initial CSM thereby enabling it to be refined and a robust Quantitative Risk Assessment to be undertaken. The latter is key to identifying the associated risks and liabilities together with the measures necessary to manage and mitigate them. To achieve this, the investigation may comprise more than one phase with each subsequent phase being informed by the preceding ones.

## Planning

4.44 When planning the site investigation care must be taken to minimise the environmental impact and risk of making the situation worse through, for instance, short circuiting contamination with a borehole and creating a preferential pathway to an aquifer. To this end it is good practice to develop a Sampling Strategy supported by a Sampling and Analysis Plan as described in [Contaminated Land Report \(CLR\) 4](#). This sets out the locations of sampling points, the spacing/density, describes what they are to be they boreholes, trial pits or window sample locations etc. and explains why samples are being collected in that location and by that method. As part of this the plan should explain where and why targeted and/or non-targeted sampling is to be undertaken. The plan should also set out the sampling protocols and any gas, groundwater or surface water monitoring together with an estimate of the degree of uncertainty. Guidance is provided by [BS 10175:2011](#)

#### **Box 4.44 Sampling Density and Uncertainty**



The number and density of samples i.e. the spacing is dictated by the Initial CSM and the LQA objective. There is no set rule of thumb.

Even so, regardless of how many sampling points there are, the number of samples, number and range of chemical analyses there will always be a level of uncertainty inherent in any site investigation.

The site investigation design must be appropriate, proportional and keep uncertainty to a minimum. It is useful to quantify and document the level of uncertainty so that this can be factored into the risk assessment and overall evaluation of the sampling data.

Guidance on this is provided by: [R&D 66](#) and [BS 10175:2011](#)

4.45 The choice of sampling and monitoring method such as trial pits and standpipes must be undertaken in such a way that the risk of cross contamination and the short circuiting of contamination through the creation of a migration pathway is minimised if not avoided.

#### **Sampling and Analysis**

4.46 Soil, water and soil gas/vapour samples must be representative and collected and stored in such a way as to avoid cross contamination or compromising the sample integrity. In the case of surface and groundwater samples these must be sampled in accordance with [BS6068/BS ISO 5667](#) and both stored and preserved in accordance with the requirements specified by the laboratory undertaking the chemical analysis. The latter is also the case with respect to soil and gas/vapour samples.

#### **Box 4.46 Guidance on the collection and assessment of soil gas and vapours (volatiles)**



- [CIRIA C665 Assessing risks posed by hazardous ground gases to buildings, 2007](#)
- [BSI BS8485 Code of practice for the characterisation and remediation of ground gas in Brownfield developments, 2007](#)
- [CIRIA Investigation and Assessment of Volatiles at Brownfield Sites, 2008](#)
- [NHBC Guidance on Evaluation of Development Proposals on sites where methane and carbon dioxide are present, 2007](#)
- [BS 10175:2011. Investigation of potentially contaminated sites – Code of practice. 2011. BSI Publications](#)

4.47 An appropriate Quality Assurance Regime should be put in place involving the use of blank samples including trip and equipment blanks together with duplicate samples to provide a check on the accuracy and precision of the sampling and analyses.

4.48 All trial, boreholes and window sample holes must be logged in accordance with [BS5930](#) ensuring odours and visual evidence of contamination and water ingress are recorded.

4.49 As a minimum the chemical analysis of samples must be carried out by UKAS accredited laboratories. Where possible the analyses should be undertaken using the Environment Agency's Monitoring Certification Scheme (MCERTS) as this provides the greatest assurance of both quality and reliability.

4.50 Health and safety are paramount when designing and undertaking a site investigation. Fundamental requirements include: adequate health and safety risk assessment and the employment of suitable and sufficient safe systems of work. In addition to the various legislation and regulations that must be adhered to site investigations that exceed 30 days or 500 person days are subject to the Construction Design and Management regulations (CDM) as revised in 2007. A key requirement of CDM is the need to undertake a risk assessment to inform and develop a Health and Safety Plan which sets out the risks, mitigation measures and responsibilities. Advice should be sought from a health and safety SQEP.

### **Waste Management.**

4.51 It is essential that waste arising from intrusive investigations is minimised and managed appropriately. Guidance on sustainable waste management is provided at Annex C.

### **Risk Estimation**

4.52 This is concerned with assessing the likely magnitude and probability of harm that may result from an identified hazard (contaminant source) and which receptors will or are likely to be affected. It therefore involves the refining of the Initial CSM and moves from qualitative to quantitative risk assessment.

### **Refined Initial CSM**

4.53 The Initial CSM must be refined once all the chemical analyses and site specific data has been derived to confirm or exclude/discount the potential pollutant linkages identified by the Phase 1 LQA. Only then should the process of risk estimation by means of Quantitative Risk Assessment (QRA) begin. Guidance on the presentation and construction of the CSM is provided at Annex D1 and D2.

### **Quantitative Risk Assessment - Tier 2 and 3**

4.54 There are two types of QRA: Tier 2 - Generic QRA (GQRA) and Tier 3 - Detailed QRA (DQRA). Ordinarily you should start with a GQRA whereby the determined contaminant concentrations are compared to Generic Assessment Criteria (GAC) such as the UK CLEA Soil Guideline Values (SGVs), UK Drinking Water Standards (DWS's) and Environmental Quality Standards (EQS's) before moving to DQRA if the respective GACs are exceeded. As GACs take into account a degree of uncertainty they are inherently conservative. Where measured concentrations of contaminants fall below them it can be concluded that there is no significant risk providing the guidelines have been applied correctly. It is therefore essential to understand the limitations of the application of the various GACs, in particular the exposure scenarios to which they relate. In the case of the CLEA SGVs they are not suitable for situations where the CSM does not match the CLEA exposure scenarios.

4.55 The 2012 revision to the statutory guidance for England and Wales introduced a framework comprising four land/ human health risk categories with which to determine whether non-radioactive land contamination presents a significant possibility of significant harm.

- Category1 : Human Health: unacceptably high probability that significant harm will occur if no action is taken
- Category 2: Human health : the risks posed by contamination are sufficient for the land to be deemed to meet the legal test for posing a significant possibility of significant harm

- Category 3: Human health: whilst the risks posed by contamination may not be low, the legal test with respect to the land posing a significant possibility of harm is not met.
- Category 4: Human Health: there is considered to be negligible risk to human health.

4.56 Category 1 and 2 will constitute statutory contaminated land whereas Category 3 and 4 will not.

4.57 The level of conservatism within the 2009 SGVs is such that Defra consider them to fall within category 4 i.e. they represent concentrations of contaminants below which the risk to human health is negligible and the land is 'very unlikely to pose a significant risk of significant harm'.

4.58 Where GACs are either not available or deemed inappropriate or for that matter there is sufficient knowledge to indicate that GACs will be exceeded it is good practice to move immediately to a DQRA to derive, in the case of human health, Site Specific Assessment Criteria (SSAC) from published toxicity and exposure data or in the case of controlled waters, to derive remedial target concentrations. The aim is to identify those pollutant linkages that are significant in terms of posing an unacceptable level of risk. These are often referred to as Relevant Pollutant Linkages or RPL.

4.59 Guidance on the use of GACs and other tools for risk assessment is provided in [Defra Circular 04/12](#) and [CL:AIRE bulletin CSB 10](#) dated March 2012.

#### Box 4.59 QRA Guidance



A useful overview of QRA including statistical analysis is provided by:

- [\*R&D 66 Guidance for the Safe Development of Housing on Land Affected by Contamination.\* NHBC and Environment Agency, R&D 66, 2008](#)

This signposts further reference material and includes ecological QRA together with controlled waters where in the case of the latter Environmental Quality Standards come into play.

4.60 As part of the risk assessment the potential for future land contamination and pollution of controlled waters occurring as a result of the demolition of existing buildings should be considered unless otherwise specified. This is particularly important for Phase 2 LQAs being prepared in support of site disposal or redevelopment.

4.61 Guidance on the presentation of the risk assessment is provided at Annex E and mirrors [CIRIA C552](#) as amended and updated by [R&D 66](#).

#### Human Health - GQRA

4.62 The Environment Agency's Contaminated Land Exposure Assessment (CLEA) model focuses on the long-term chronic exposure contaminants through a number of pathways for standard land use scenarios. Unfortunately the number of the resulting GACs, or Soil Guideline Values (SGVs) published by the Environment Agency is very limited as is the number of land use scenarios.

4.63 To overcome this, the published SGVs can be used to screen for land uses for which no SGVs exist. For example residential land use SGVs may be used as screening values for land uses such as parks, playing fields and such like. However, this must be done with care as an overly conservative assessment of risk may result. You can develop your own GACs using CLEA and other models or use one of three published sets of GACs produced by: Atkins (ATRISK<sup>soil</sup>) Soil Screening Values

(SSVs)), EIC/AGS/CL:AIRE and CIEH/LQM. In the case of the Atkins SSVs these have been updated to reduce conservatism, these too must be used with care. Whilst they may be suitable for screening purposes they have neither been peer reviewed by nor formally endorsed by the Environment Agency. The same is true of non UK GACs such as the ‘Dutch Values’ which may not fit with the UK situation or legislative and policy regime. Ideally the Environment Agency’s preferred approach of developing SSACs in the absence of published SGVs should be followed. Whichever approach is taken it must be appropriate and justified within the LQA report as should the soil type used and soil gas ingress rate. The default soil gas ingress rate for residential properties used to develop SGVs does not apply to suspended wooden floors. The key differences between the three published UK GAC sets is provided in [CL:AIRE bulletin CSB 10](#).

4.64 Care needs to be taken when assessing the risk posed by Petroleum Hydrocarbons. Where the GAC exceeds the theoretical soil saturation limit the Environment Agency recommend that modelling other than 3-phase partitioning should be used to derive SSAC/screening values or else the saturation limits should be used. However, reliable theoretical saturation limits are difficult to derive owing to the multiplicity of variables and the model assumptions for vapour formation break down where free phase is or is likely to be present. This means that the model will over predict how much vapour can be formed and the calculated screening values will, as a result, be overly conservative potentially resulting in unnecessary remediation. In view of this and the fact that the prediction of theoretical saturation limits using a model is not sufficiently accurate the only way of being sure free phase is present is to look at the soil and to use gas standpipes to assess the presence and nature of any associated vapour hazard.

#### Box 4.64 Petroleum Hydrocarbons Quantitative Risk Assessment Guidance



- [Environment Agency Science Report P5-080/TR3: UK approach for evaluating the human health risks from petroleum hydrocarbons in soils 2005.](#)

4.65 The preferred Environment Agency/Defra approach to GQRA of radioactive contaminants is to use the [Radioactively Contaminated Land Exposure Assessment Methodology \(RCLEA\)](#) to generate GACs known as RSGVs (Radioactivity in Soil Guideline Values). RCLEA is aligned to Part 2A and as such complements the CLEA Model. However, there are other approaches and early consultation with the regulator is essential.

#### Box 4.65 Radioactive Land Contamination Quantitative Risk Assessment Guidance



- CLR13 – Using RCLEA – the Radioactively Contaminated Land Exposure Assessment methodology. 2011 V1.1.
- CLR14 – The Radioactively Contaminated Land Exposure Assessment Methodology – Technical report 2011 V1.2
- CLR15 – The RCLEA Software application. 2011 V1.3
- [NRPB Vol 9, No2 Radiological Protection Objectives for Land Contaminated with Radionuclides. 1998.](#)
- [NRPB Methodology for estimating the Doses to members of the Public from the Future Use of Land Previously Contaminated with Radioactivity.](#)
- [Guidance on Characterisation and Remediation of Radioactively Contaminated Land. EA 2002.](#)

- [Smith G. Safegrounds. Review and commentary on site end-points and radioactively contaminated land management. CIRIA W20. 2005.](#)

## DQRA – Human Health

4.66 Whilst exceeding a SGV or other GAC does not in itself constitute an unacceptable risk to human health or for that matter a Significant Possibility of Significant Harm, they should be assessed further by deriving SSACs. However, care must be taken to ensure the SSACs are robust. Ideally the DQRA should incorporate the relevant bioavailability and bio-accessibility data. However, there is much uncertainty inherent in the available bio-accessibility data.

## GQRA - Controlled Waters

4.67 Though dated, risks to controlled waters should be assessed in accordance with CLR1 and remedial targets for both soil and groundwater that derived by the [Environment Agency's tiered methodology Remedial Targets Methodology](#) which can be used ascertain whether remediation is required. At GQRA stage Tier 1 leaching tests are used to identify whether there is a risk to controlled waters and which if any contaminants need to be considered further in the DQRA (Tier 2 and 3) are as important as the chemical analyses of water samples in assessing the risks to controlled waters.

4.68 The leaching test results should be compared to water quality standards. Drinking Water Standards (DWS) can be used as an initial screen, but it is better to use published Environmental Quality Standards (EQS) where available taking care to ensure any parameter that can affect the EQS such as pH or water hardness etc is included in the Sampling and Analysis Plan. As EQSs were derived primarily to assess surface water bodies care should be taken in the application of these GACs to groundwater. Alternatively Water Screening Values (WSVs) can be derived using commercial software. Atkins have derived WSVs for groundwater containing VOCs specifically to address the risk posed by vapour inhalation.

4.69 International GACs may be used at this stage but as with soil GACs their use must be justified as they may not be applicable to the UK situation.

## DQRA – Controlled Waters

4.70 If the leaching tests exceed the selected generic criteria then you should move to Tier 2 of the Environment Agency methodology which focuses on dilution and water infiltration at Tier 2 and then degradation etc at Tiers 3 and 4. The ultimate outcome being: the identification of the need or otherwise for remediation and the derivation of appropriate targets. The DQRA should always take into account the relevant legislation and where appropriate proposed changes.

## GQRA and DQRA – Vapours and Gas

4.71 The risk posed by ground/soil gas should be assessed by means of deriving Gas Screening Values (GSV) and establishing the risk and need or otherwise for mitigation measures

### Box 4.71 Gas Risk Assessment Guidance



- [CIRIA, Investigation & Assessment of Volatiles at Brownfield Sites 2008](#)
- [CIRIA, C665, Assessing risks posed by hazardous ground gases to building, 2007](#)
- [CIRIA, C659, Assessing risks posed by hazardous ground gases in buildings, 2006](#)
- [NHBC, Guidance on Evaluation of Development Proposals on sites where methane and carbon dioxide are present, 2007](#)
- Wilson et al, Ground Gas Handbook 2008.
- The Local Authority Guide to Ground Gas 2008

## GQRA and DQRA – Ecological

4.72 This must consider impact on protected species, areas of natural and ecological importance such as SSSIs, trees, hedgerows etc. Care will need to be taken to ensure an appropriate assessment. Merely using EQSs for instance to assess the ecological risk within the aquatic environment may not be enough. Of the available GACs the ‘Dutch Values’ contain a number of ‘intervention’ values that reflect the eco-toxicological risk and so may be appropriate to use as screening values.

### Box 4.72 Ecological Risk Assessment Guidance



- [EA Science Report. An ecological risk assessment framework for contaminants in soil. Sc070009/SR1. 2008.](#)
- [CL:AIRE. Research Bulletin RB 12. May 2010](#)

## GQRA and DQRA – Other Factors

4.73 Other factors you may wish to consider include: the effect of sulphate on concrete and hydrocarbons on the integrity of plastic pipes etc, asbestos, Ordnance, Munitions and Explosives (OME) and invasive species such as Japanese Knotweed.

### Box 4.73 Other Factors Risk Assessment Guidance



- [Rudland, D J et al. \*Contaminated Land Risk Assessment, A Guide to Good Practice\*. CIRIA C552, London 2001](#)
- Paul, V. Performance of building materials in contaminated land. BRE 1994.
- Invasive Species – key guidance is available from: [www.netregs.gov.uk](http://www.netregs.gov.uk) and [Environment Agency - Home](#)
- Royal Ordnance. Explosive Materials. Determination of Toxicological Hazards and other Properties 1990.
- [CIRIA P2767](#) – Proposed CIRIA Guide: Use of buried services in land affected by contamination. Currently being considered.

4.74 OME should be included where appropriate. This will comprise two parts:

- Health and safety risk posed by kinetic effects in the event unexploded ordnance and munitions are triggered; and
- Health and environmental risk posed by the leaching or deposition of explosives residues and metals from expended ordnance and munitions.

## Statistical Analysis

4.75 The statistical analysis necessary to derive representative contaminant concentrations from the analytical data must be appropriate. Guidance issued by Defra and the Environment Agency in 2002 (The contaminated land exposure assessment model (CLEA) technical basis and algorithms ([CLR 10 2002 Update 2008](#)) advocates the ‘mean value test’ where a representative mean or US95 is compared against the GAC or SSAC. This is in essence a 95<sup>th</sup> percentile value and as such provides a reasonable assurance that the average concentrations of specific contaminants are below or above the respective GAC or SSAC. More recently the CIEH and CL:AIRE published advice on the statistical assessment of soil contamination data and quantifying the uncertainty associated with mean

concentration estimates. As with all guidance this must be used with care. If in doubt seek advice from the SMEs listed in Annex A.

4.76 In tandem with this an appropriate averaging area must be established the use of which can be justified based on the refined CSM. For instance it may be appropriate to zone the site according to former uses and group the chemical analytical data accordingly. Alternatively it may be appropriate to group the data according to the presence and nature of fill materials. Whatever approach is taken, and it can differ for each of the contaminants, it must be defensible. Also statistical outliers must be properly accounted for and never treated as anomalies or errors even if that means a review of the sampling and analytical error. DEFRA and the Environment Agency recommend that the ‘maximum value test’ be used to identify statistical outliers, but other methods exist. Whichever method is used it must be justified.

## Risk Evaluation

### Acute vs. Chronic

4.77 This is where the need for options to mitigate and manage unacceptable acute (short term) and chronic (long term) health risks as well as significant environmental and safety risks are determined. As there are no UK GACs and other guideline values to assess acute risks from exposure to soil contamination it may be appropriate to use a combination of available occupational exposure limits for vapours and dusts or else derive an SSAC using a one-off high soil ingestion rate and maximum concentrations. Alternatively it may be more appropriate to remediate rather than attempt to derive an SSAC.

4.78 Risk evaluation should therefore, be done at the GQRA stage as well as the DQRA stage. It may be more cost effective and politically expedient to remediate following the GQRA, compared with the cost and time involved in collecting further data to inform the DQRA and reduce the level of uncertainty. Investing in a DQRA can significantly reduce the scope of any remediation or discount the need for it completely. It is essential that all the factors including stakeholder expectations, technical feasibility, political acceptability, budget availability and cost are considered when assessing the need for a risk management response.

### Management Options

4.79 In terms of identifying the management options consideration should be given to: source removal, pathway disruption and receptor protection as well as the cost benefit of undertaking further site investigation, data collection and risk assessment to reduce the level of uncertainty. It is advisable to consider the ‘do nothing’ and ‘do minimum’ options as well as the optimum.

4.80 For LQAs in support of site disposal consideration should also be given to the most likely future uses of the land and the remediation necessary to ensure the land will be suitable for use.

### Financial Appraisal

4.81 A **Reliable Order of Cost Estimate** (OCE) must be provided for each mitigation and management option which should include whole life costing in order that the options can be compared and a recommended option identified. This information should be restricted to the Technical Note. Guidance on order of Cost estimating is available through the guidance cited in Box 4.73 below:

#### **Box 4.81 Order of Cost Estimate**



A reliable Order of Cost Estimate (OCE) is required for each option, and shall be carried out in accordance with [DIO Technical Bulletin 99/19](#), entitled Order of Cost Estimates, dated July 1999. Costs are to be current quarter price levels without inflation and the relevant cost index and its source should be quoted. VAT and fees should be itemised clearly.

The OCE should include a Financial Risk Analysis, carried out and presented in accordance with [DIO Technical Bulletin 99/21](#), entitled Estimating using Risk Analysis, dated July 1999. Costs for both "Average Risk Estimate" and "Maximum Likely Risk Estimate" cases are required and full details of the risks and their individual contribution to the risk element shall be identified in the Technical Note only.

## **Part 2A Risk Assessment Guidance**

4.82 All LQAs should include an assessment of whether the site meets the criteria for designation under Part 2A. Ordinarily this assessment would be presented in the Technical Note as part of the assessment of liability within the 'regulatory context'. The following guidance is intended to assist with this assessment as part of the overall risk evaluation following changes to the statutory guidance for England and Wales introduced in April 2012.

### **Assessing the Significance of Contaminant/Pollutant Linkages**

4.83 Within the Technical Note the assessment of potential liability within the regulatory context must include an assessment of whether the identified contaminant/pollutant linkages are:

- Resulting in significant harm being caused to the receptor in the contaminant/pollutant linkage;
- Present a significant possibility of significant harm being caused to that receptor;
- Are resulting in the significant pollution of the controlled waters which constitute the receptor, or
- Have significant possibility to result in such pollution.

### **Assessing Significant harm**

#### **1 Non Radioactive Contaminants**

4.84 The revised Statutory Guidance on significant harm is set out within Section 4.1 of [Defra Circular 04/12](#) for England and [Welsh Government Guidance Document WG15450](#) respectively which replaces paragraphs A22 to A26 and Table A of Chapter A, Annex 3 of Defra Circular for England 01/2006 for England (Appendix 1) and paragraphs 1.22 to 1.26, 2.44 and Table A of Chapter 1 the NAW Guidance for Wales (Appendix 1).

4.85 The Statutory Guidance for Scotland on significant harm is set out [Scottish Executive Paper SE/2006/44](#) Annex 2 paragraphs 2.4 to 2.6 and Table A of Chapter A to Annex 3.

4.86 When considering whether "significant harm is being caused" the statutory Guidance requires an appropriate scientific and technical assessment of all the available evidence, before a judgement is to be made on "the balance of probabilities".

## **2 Radioactive Contaminants**

4.87 The Statutory Guidance on harm is set out within Section 4a of the Radioactively Contaminated Land Statutory Guidance published by DECC in April 2012.

### **Assessing Significant Pollution and Significant Possibility of Pollution**

#### **1 Non Radioactive Contaminants**

4.88 The statutory Guidance on significant possibility of significant harm is set out within Section 4.2 of [Defra Circular 04/12](#) for England and [Welsh Government Guidance Document WG15450](#) respectively which replaces paragraphs A27 to A34 and Table B of Chapter A, Annex 3 of Defra Circular 01/2006 for England (Appendix 1) and paragraphs 1.27 to 1.34 and 2.45 to 2.49 and Table B of Chapter 1 of the NAW Guidance for Wales (Appendix 1)

4.89 The Statutory Guidance for Scotland on significant possibility of significant harm is set out [Scottish Executive Paper SE/2006/44](#) paragraphs A28 to A37 and Table B, Annex 3.

4.90 When considering whether “there is a significant possibility of significant harm being caused” the Statutory Guidance requires that a scientific and technical assessment of the risks arising from the pollutant linkage be made using relevant, appropriate, authoritative and scientifically based guidance. A significant risk of harm is considered to exist if the assessment indicates that the pollution linkage in question meets the conditions set out in the relevant Statutory Guidance for England, Wales and Scotland, and that there are no suitable and sufficient risk management arrangements already in place to prevent the harm in question. In considering whether there is a significant risk of significant harm, the Statutory Guidance advises that only the current use of land should be considered and furthermore, that account should be taken of any evidence that the current use will cease in the near future.

4.91 The 2012 revision to the Statutory Guidance for England and Wales introduced a framework comprising 4 land human health risk categories known as the Category 1-4 Approach with which to determine whether land contamination presents a significant possibility of significant harm.

- Category1 : Human Health: unacceptably high probability that significant harm will occur if no action is taken
- Category 2: Human health : the risks posed by contamination are sufficient for the land to be deemed to meet the legal test for posing a significant possibility of significant harm
- Category 3: Human health: whilst the risks posed by contamination may not be low, the legal test with respect to the land posing a significant possibility of harm is not met.
- Category 4: Human Health: there is considered to be negligible risk to human health.

4.92 Category 1 and 2 will constitute statutory contaminated land whereas category 3 and 4 will not.

4.93 The level of conservatism within the 2009 SGVs is such that Defra consider them to fall within category 4 i.e. they represent concentrations of contaminants below which the risk to human health is negligible and the land is ‘very unlikely to pose a significant risk of significant harm’<sup>1</sup>.

4.94 The revised statutory guidance for England and Wales also includes guidance on background or ‘normal’ levels of contaminants in Section 3.

## **2 Radioactive Contaminants**

4.95 The Statutory Guidance on the significant possibility of harm is set out within [Section 4b of the Radioactively Contaminated Land Statutory Guidance](#) published by DECC in April 2012

<sup>1</sup> DEFRA Circular 04/12 – EPA 1990 Part 2A Contaminated Land Statutory Guidance. 2012

## **Assessing Significant Pollution and Significant Possibility of Pollution of Controlled Waters**

4.96 The Statutory Guidance on the interpretation of the occurrence or likelihood of pollution of controlled waters is set out within Section 4.,4 paragraphs 4.34 to 4.46 of [Defra Circular 04/12](#) for England and [Welsh Government Guidance Document WG15450](#) respectively and paragraphs A38 to A42 of Part 4 to Chapter A of Annex 3, and paragraphs B50 and 52 of Part 4 of Chapter B to Annex 3 of [Scottish Executive Paper SE/2006/44](#) for Scotland.

### **Contaminant/Pollutant Linkage Summary Table**

4.97 For LQA purposes contaminants may be grouped as MOD will be treated as a single entity under Part 2A. An example of a completed summary table (Table 10) is presented in Annex E.

### **Policy, Process and Responsibility**

4.98 The Regulatory Authority must be informed if a risk of significant harm is identified. In the instance that notification is required, MOD's relevant subject matter experts (see Annex A) should be notified in order to advise on appropriate consultation and any required future action.

## 5. STAGE 2 OPTIONS APPRAISAL

### PHASE 3 LQA – MANAGEMENT OPTION APPRAISAL/DECISIONS

#### Introduction

5.1 Where the QRA undertaken as part of the Phase 2 LQA confirms that there is an unacceptable risk or risks posed by the presence of contamination then action must be taken to reduce (mitigate) or control (manage) those risks. This will involve some form of management response that focuses on: pathway disruption (breaking), source removal and receptor protection and can involve everything from the use of institutional controls such as fencing and standing orders to remediation or even changing the use of the land to a less sensitive one.

5.2 In general there will be more than one option to reduce or control the unacceptable risks. Therefore, to identify the optimum option or combination of options requires an Options Appraisal. According to CLR11 there are in essence three key stages to an options appraisal:

- Identification of feasible management options;
- Detailed evaluation to identify optimum option to address the RPLs; and
- Production of a Management Strategy.

#### Box 5.2 Options Appraisal Guidance



A detailed guide to good practice that expands on CLR 11 and incorporates the Safegrounds key principles is provided by:

- [Safegrounds. Guide to the comparison of contaminated land management options. CIRIA W28, London 2009.](#)

#### Reporting

5.3 There is no default generic format for an options appraisal. However, the format must be clear, concise and reflect the needs of stakeholders

#### Methodology

5.4 The process must:

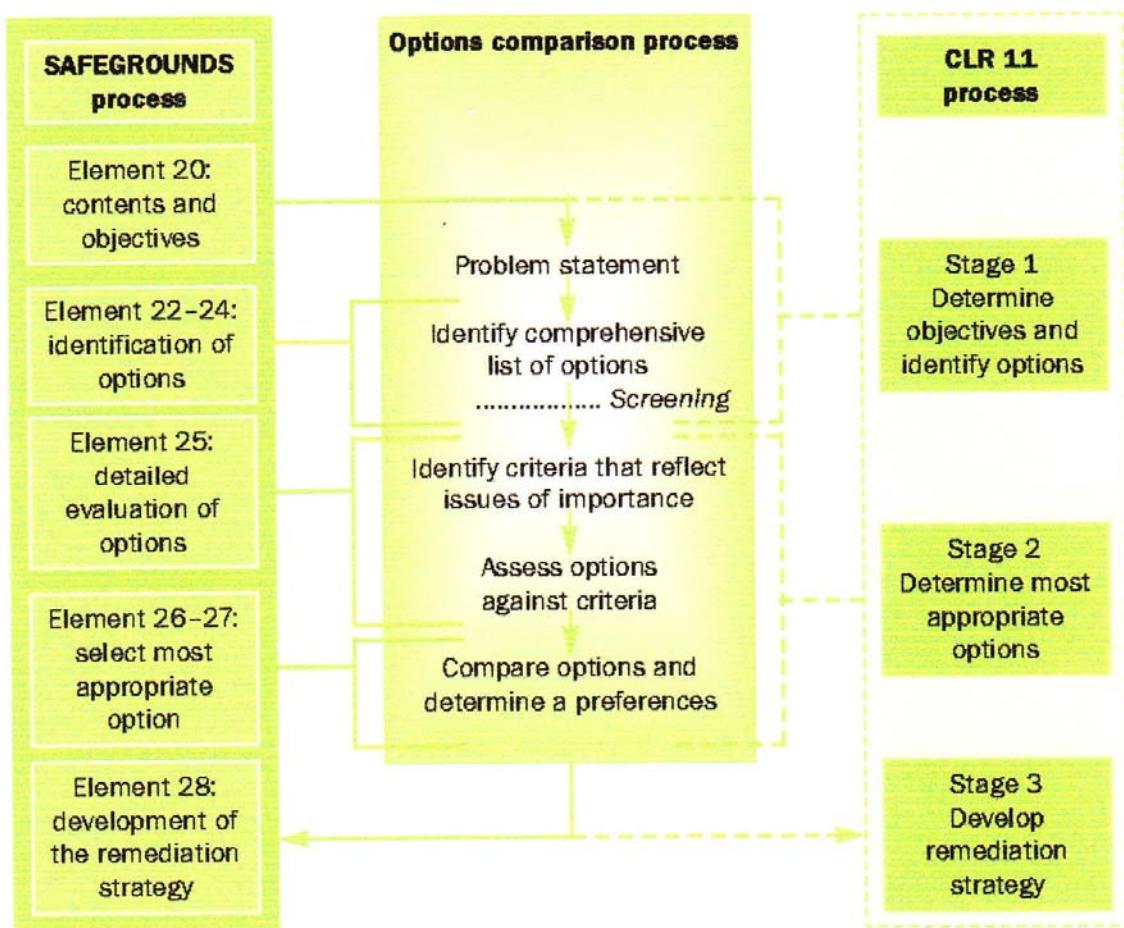
- Be systematic, structured and transparent;
- Involve relevant stakeholders (this is an integral component and the extent of involvement will be specific to the situation);
- Involve a level of detail commensurate with the nature and extent of the contamination issue come risk;
- Consider a comprehensive range of options; and
- Have clearly documented outputs.

## 5.5 The key steps comprise:

- Definition of management objectives, assumptions and constraints as part of establishing the scope and context and setting out a Problem Statement;
- Identification of options;
- Definition of evaluation criteria (practicality, effectiveness, durability, time and VFM etc) ensuring needs of/factors important to stakeholders are reflected;
- Assessment of options against evaluation criteria. This may need to be tiered; and
- Identification of preferred option or combination of options informed by stakeholder views and technical constraints.

The Options Comparison Process is set out below in Figure 4 within the context of the Safegrounds and CLR 11 processes:

**Figure 4 Options Comparison Process (Taken from CIRIA W28 (2009))**



## **Definition of Management Objectives**

5.6 Good practice is to define the strategic management objective, which will be reflected in the Management Strategy, and associated specific objectives that will inform the options comparison upfront in a Problem Statement which could include the need to address or avoid a statutory notice.

5.7 In [R&D 66](#) the specific objectives are grouped as follows:

- Contamination related – these set out the required end point and are related to the CSM and risk assessment. They can be qualitative or quantitative;
- Engineering related - these relate to the modification etc of the ground conditions; and
- Management related – these range from programme requirements through to long term monitoring.

Further information and useful examples are presented in R&D 66.

5.8 The key constraints should also be documented in the statement such as: time, cost, policy, need for licences etc and conditions set by regulators and other stakeholders etc. Also the fate of the land/site may be a key constraint, particularly if it is going for disposal or is to be redeveloped.

5.9 The critical assumptions should also be recorded namely those that address the principal areas of uncertainty such as the extent of the contamination, access and the presence or otherwise of UXO etc. These will of course be site and situation specific

## **Identification of Options**

5.10 These must be practical and address the RPLs such that the unacceptable risks associated with the land contamination and/or controlled water pollution is addressed. The options should be distinct and range from the ‘do minimum’ to the ‘maximum possible’. Whilst [CLR 11](#) focuses on the identification of options to address individual RPLs the more holistic approach advocated by [CIRIA W28](#) is preferable as this should produce a more integrated cost effective solution.

5.11 It may be appropriate to sift the options at this stage in order to whittle the number down to a manageable size. The criteria may include: technical feasibility, acceptability to stakeholders and time available. Whatever set of criteria is selected it must be defensible and ideally should reflect the needs of the stakeholders.

## **Assessment Criteria**

5.12 These must support the objectives and the interests of the stakeholders. Ideally they must avoid bias and reflect factors such as: policy, practicality and economic considerations. The latter should not focus solely on capital cost, but the through life costs and sustainability.

## **Assess Options**

5.13 The assessment must be objective and auditable. It is good practice to use a scoring matrix based on either:

- ‘Relative’ – scores are given in relative terms i.e. rank options worst to best etc; and
- ‘Absolute’ – options are scored according to a scale that defines performance according to a number of categories from low to high.

5.14 For complex sites it may be necessary to undertake a tiered assessment to narrow down the range of options which may need to be combined to deliver the required risk reduction and management.

5.15 SURF UK has in partnership with CL:AIRE developed a framework for assessing the sustainability of remediation options. This should be used to identify the relative sustainability of the available remediation options as part of the investment appraisal of each option. Where the options do not involve remediation or only in part then it may be appropriate to undertake a Sustainability Appraisal.

**Box 5.15 Assessing Sustainability of Management Options**



The key guidance comprises:

- [MOD Sustainability Appraisal Toolkit](#)
- [SURF UK, A Framework for Assessing the Sustainability of Soil and Groundwater remediation. CL:AIRE London 2010.](#)

### **Identify Preferred Option or Combination of Options**

5.16 This must be structured and focus on the pros and cons of each option within the context of the objectives and associated constraints and needs come interests of stakeholders.

### **Development of Management Response Strategy**

5.17 Once the preferred management option is identified the Management Strategy referred to as the 'remediation strategy' must be developed. This strategy must be capable of either managing or mitigating the unacceptable risks associated with the identified RPLs. It is essential that the decision process leading to the strategy is documented, sets out the considerations, assumptions and priorities and reflects the interests of the stakeholders.

5.18 The type of response will be dependent upon the level of risk and the nature of the hazard. In the case of remediation, the strategy, clearance levels and end point need to be agreed with the appropriate regulatory authority. The strategy must address the practicalities associated with the site and situation in question such as how the:

- strategy will be implemented
- site will be zoned
- how the success of the strategy will be measured in terms of the strategic and site specific objectives being met

5.19 The strategy must also take account of:

- Precedents for other sites
- Departmental policy, objectives and commitments
- Needs of stakeholders and whether they will be adequately addressed
- Sustainability

5.20 Finally the strategy must be justified and represent VFM within the constraints that apply. In the words of CLR11 the strategy should be 'acceptable on cost-benefit grounds'.

**Box 5.20 Justification and Optimisation/ Reasonableness of Remediation**

If the site has been designated as ‘contaminated land’ under Part 2A then Justification and Optimisation studies will be required to justify the need for and optimum form of the necessary remediation.

The justification element can be accommodated as an extra step within the Options Appraisal process outlined previously.

The optimisation element should be integral to the process anyway so no additional step is required.

5.21 Effective stakeholder involvement is essential if this phase of the LQA is to be a success. Specialist technical advice is available from the SMEs listed in Annex A. DIO can advise on the technical aspects and application of remediation techniques and both develop and implement the management strategy on behalf of a TLB or project. Equally, DIO can advise on the need or otherwise for remediation in the immediate to long term and whether institutional controls are the most appropriate response.

**Box 5.21 Stakeholder Involvement**

At the Phase 3 stage the level of stakeholder involvement will typically focus on the following:

- Identification, assessment and comparison of management options
- Identification of preferred management option or options
- Decision on which option or options to proceed with

The Stakeholder Involvement Plan and Programme should be amended to reflect any changes.

**Policy**

5.22 Current MOD Policy is to undertake remediation where there is a significant (unacceptable) risk to health, safety and the environment taking account of the current or intended use. In the case of sites in disposal, it is generally confined to defence specific contaminants, such as chemical agents and explosive ordnance, where it is unreasonable to expect a civilian contractor to be able to undertake the work. Otherwise, sites are sold in an un-remediated condition with a view to the purchaser undertaking the remediation necessary to make the site suitable for its intended use. In the case of radiological contamination it is MOD policy to require independent verification of purchaser-managed remediation. Further clarification of MOD Policy on remediation is available from:

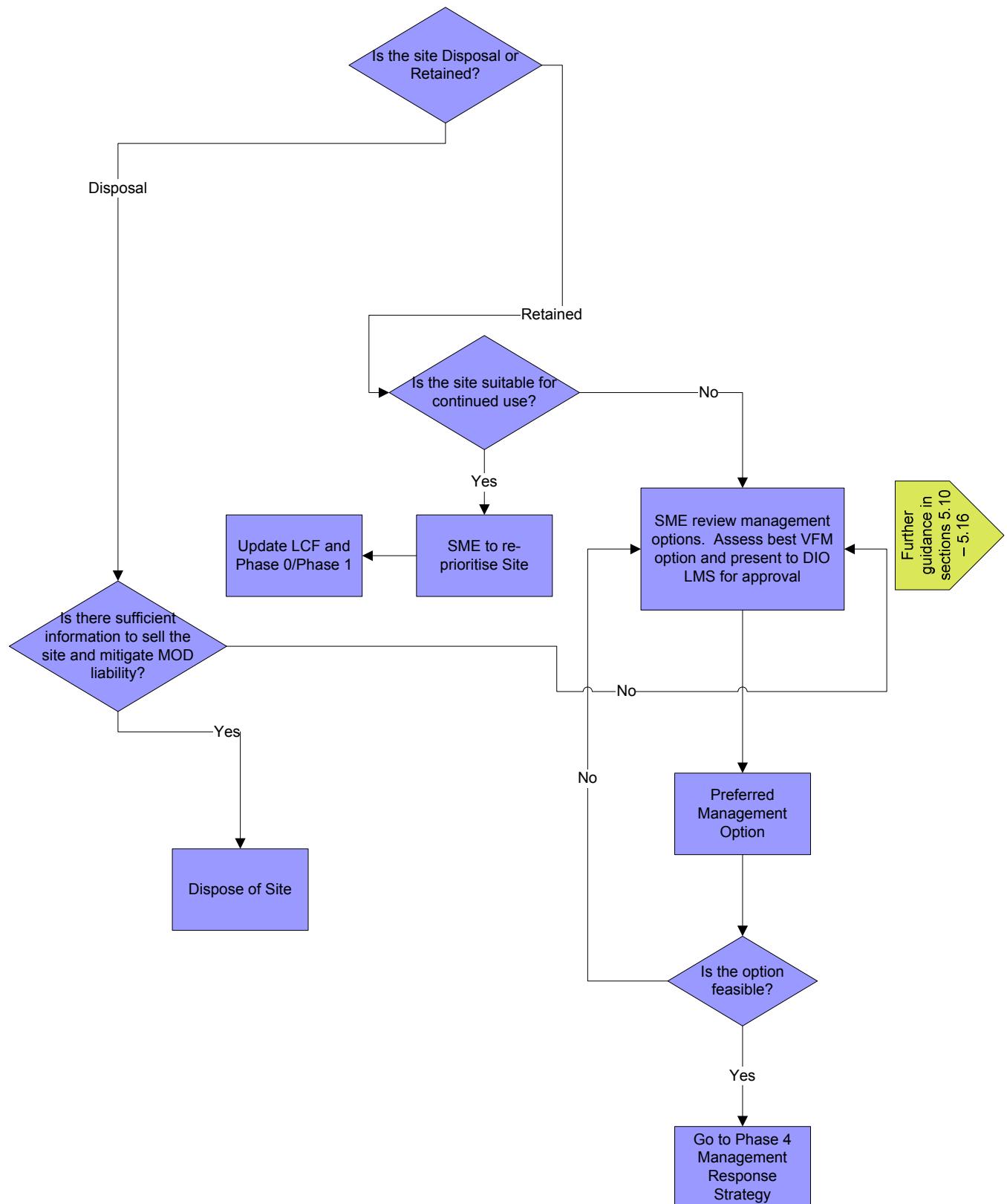
[Design and Maintenance Guide 12, Site Closure Guide, Land and Property Policy: PI 6/2005.](#)

**Waste Management.**

5.23 It is essential that waste arising from any management response, particularly as part of a remediation scheme, is minimised and managed appropriately. Guidance on sustainable waste management is provided at Annex C.

5.24 The Phase 3 LQA process is summarised in Figure 5.

**Figure 5 Phase 3 Management Options Appraisal Flow Chart**



## **6. STAGE 3 MANAGEMENT RESPONSE**

### **PHASE 4 LQA – IMPLEMENTATION OF MANAGEMENT OPTION(S) (THIS MAY ALSO BE PHASED AND INVOLVE LONG TERM MONITORING)**

#### **Implementation**

6.1 The starting point is the development of the Implementation Plan which will set out and define:

- The strategic and site specific objectives;
- Programme;
- How stakeholder interests/needs including those of the regulator will be met;
- How the inherent uncertainties such as the actual extent of contamination will be managed;
- Level of supervision;
- How regulatory compliance will be achieved;
- Financial management process;
- How the work will be documented and validated;
- End points and critical success factors; and
- Scope and duration of long term management and monitoring requirements.

6.2 The plan must also take account of commercial, contractual and policy considerations such as tendering and letting of contracts. For remediation projects a re-measurement contract may be more appropriate than a fixed price as this provides for more equitable risk sharing and avoids contractors having to front load the risk associated with the uncertainty over ground conditions etc and reflect this in their bid.

6.3 In addition the plan must address the financial aspects of the strategy. It may therefore be useful to establish a Financial Management Plan detailing milestone payments etc.

#### **Monitoring and Maintenance**

6.4 Where the management strategy involves on-going monitoring such as groundwater monitoring to check that the situation does not deteriorate and/or the maintenance of physical access restrictions such as fencing then it is good practice to develop a Monitoring and Maintenance Plan. Similarly if the management strategy involves some form of remediation that has a monitoring and/or maintenance requirement such as the use of a capping layer then this too should be covered by such a plan.

6.5 Typically a Monitoring and Maintenance Plan comprises:

- Scope of work;
- Technical specification;
- Locations, frequency and duration of monitoring activities;
- Analytical suite with limits of detection etc;
- Evaluation criteria such as EQSs in the case of groundwater;
- Reporting schedule; and
- Contingency plan in case monitoring indicates the remediation has or is failing or the situation is deteriorating such that remediation may be required.

6.6 According to CLR11 these form the ‘lines of evidence’ necessary to demonstrate success.

#### **Verification**

6.7 Upon completion of the Implementation Plan a Verification Plan should be developed that sets out the activities and data necessary to demonstrate that the objectives set out in the Management Strategy have been achieved. This is particularly important where remediation will be undertaken. The plan must therefore also address:

- Planning conditions;
  - Licensing and permitting requirements; and
  - Specific condition imposed by regulators such as control of dust etc.
- 6.8 The verification plan should confirm/verify:
- the nature and extent of the residual contamination and/or pollution
  - that imported materials and those destined for re-use on site are suitable for use
  - whether the management strategy is succeeding i.e. meeting the objectives
  - that the management strategy is not causing land contamination or pollution of controlled water
  - compliance with planning conditions, licences, permits and consents

**Box 6.8 Licences, permissions and permits**



These may include:

- Planning Permissions
- Abstraction Licence
- Environmental Permit  
(Former Waste management licence, PPC permit and discharge consent)

6.9 Ultimately this should be reported within a Verification Report which according to CLR11 should provide 'a complete record of all remediation activities on site and the data collected as identified in the verification plan to support compliance with agreed remediation management objectives and criteria. It also includes a description of the work (as-built drawings) and details of any unexpected conditions (e.g. contamination) found during remediation and how they were dealt with.'

**Box 6.9 Verification Plan Guidance**



- [Environment Agency verification of Remediation of Land Contamination 2008](#);
- [AGS Guide to good practice in writing ground reports 2008](#);
- [R&D 66, 2008](#).

6.10 In addition to the verification report, monitoring reports will need to be produced separately at the required intervals. Once the monitoring confirms that the management strategy or the remediation component has complied with the objectives/compliance criteria then the verification report can be finalised.

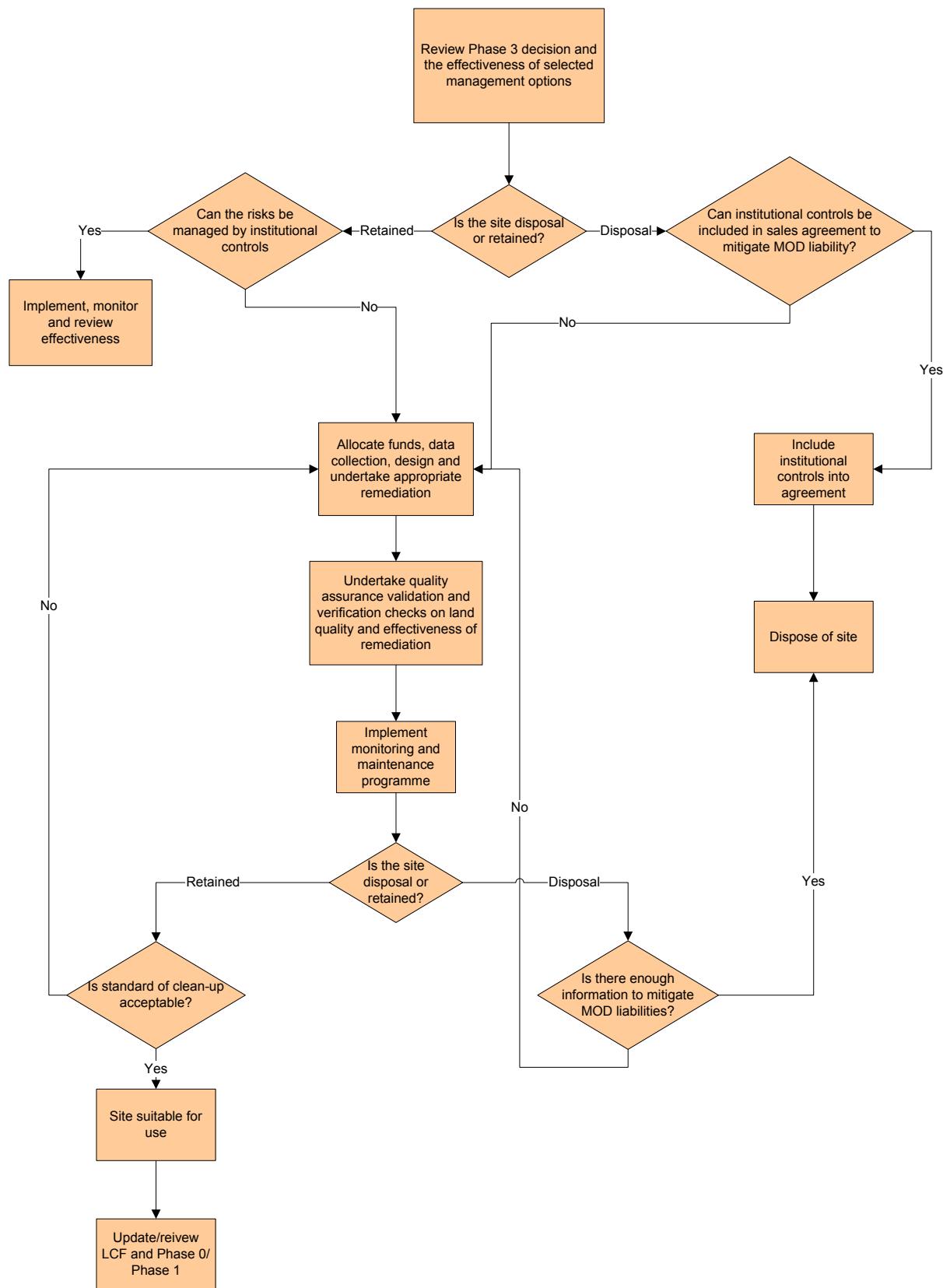
6.11 Management responses include: do nothing, the use of institutional controls, such as standing orders and the permit to dig system, as well as remediation. However, remediation will be of reduced value if not properly documented. Quality control must therefore, be managed throughout the design and implementation of a remediation programme.

6.12 A post remediation validation survey must therefore be carried out together with a post project review and the lessons learnt circulated.

### **Policy, Process and Responsibility**

6.13 The Phase 4 Management Response Process Map, providing guidance on the management process, is presented as Figure 6.

**Figure 6 Phase 4 Management Strategy Flow Chart**



## 7. LQA RECORD RETENTION

7.1 Electronic copies of all LQA Reports, Technical Notes and associated documentation such as Remediation Validation Reports will be uploaded onto the DIO LQA Database hosted on GEODE. Details of the electronic format required to achieve this is presented in Annex B4.

7.2 Once a LQA or for that matter remediation is complete, each TLB is responsible for ensuring the relevant LQA information is kept up to date for land and property retained by MOD. This can be achieved through the use of Land Condition Files (See Box 8.2) and site based EMS's. The latter provides an effective vehicle to identify when an update is required and the former provides a structured means of retaining land quality information and ensuring the hazards and risks are identified.

Box 7.2 – LAND CONDITION FILES	
Guidance on the use and form of the Land Condition File can be found in: <ul style="list-style-type: none"><li>• <a href="#">DIO Information Note IN 03/09 Land Condition File (LCF); and</a></li><li>• <a href="#"><i>Safegrounds: ‘Good practice guidance for land quality records management for nuclear licensed and defence sites, CIRIA W21</i> London 2007.</a></li></ul>	

7.3 A review of Land Contamination Management on the defence estate carried out by DIO StratPol in 2007/08 highlighted the opportunity to improve the communication and awareness of land contamination risks to estate users, contractors and visitors by the introduction of a site level Land Condition File (LCF).

7.4 The LCF is a tool designed to assist in the management of land contamination risks at site level and to support Health and Safety and Environmental Management systems. It provides a template for recording factual information on known land contamination hazards. Information to be recorded includes; a brief history of the site, known areas of concern, historic and potentially contaminating activities and a summary of the findings of LQAs, ground investigations and other relevant information. The LCF is not a substitute for an LQA.

7.5. The key benefits of maintaining a LCF are:

- Known information on land contamination hazards is readily accessible and can be notified to all potentially affected personnel, contractors and visitors reducing the risk of a breach of MOD's duty of care;
- Information gathered on land contamination not lost and is readily accessible; and
- Reducing costs to the department and reducing the likelihood of enforcement action

7.6 The LCF should be prepared by a person familiar with land contamination hazards and risks on the defence estate. Thereafter it can be maintained by site personnel and new information can be added when it comes to light. It is recommended that the LCF is reviewed by a person familiar with land contamination hazards once there is a significant accumulation of new material or a significant new hazard is identified.

7.7 The LCF should be owned by the Head of Establishment and integrated into the site management arrangement in a similar manner to records of other hazardous materials such as asbestos. In some cases the compilation of the LCF may identify gaps or discrepancies in information that require further research or investigation. The decision to pursue any further investigation rests with the owner of the LCF.

7.8 Further guidance on the LCF together with a template is available in [DIO Information Note IN03/09](#).

**SUBJECT MATTER POINTS OF CONTACT – LQA**

1. Land Contamination Policy:

DIO Sec StratPol – Policy 4

Tel: 0121 311 3693

2. LQA Process, Practice, Procedures, Risk Assessment and Reporting and EORA:

DIO PTS ELMG

Tel: 0121 311 2007

DIO PTS ESG

Tel: 01225 468270

3. RAF LQA Programme and Liability Management

RAF LQA Team OC LQAT

Tel 01242 682 551

**GENERIC MOD PHASE 0 LQA FORMAT****LQA REPORT STANDARD FRAMEWORK - UNRESTRICTED**

<b>Phase 0 Land Quality Assessment (LQA)</b>	
<b>Purpose of a Phase 0 LQA</b>	
<b>Site Description</b>	
<b>Site Name</b>	
<b>Address</b>	
<b>Parcel Name(s)</b>	
<b>National Grid Reference (NGR)</b>	
<b>Size (Hectares)</b>	
<b>Project Number</b>	
<b>Previous Reports</b>	
<b>Site History</b>	
<b>Onsite</b>	
<b>Adjoining Land (&lt;500m)</b>	

<b>Buildings and Infrastructure</b>	
<b>Buildings</b>	
<b>Infrastructure</b>	
<b>Services</b>	
<b>Ancient Monument</b>	
<b>Controlled Waters</b>	
<b>Groundwater</b>	
<b>Aquifer Classification</b>	
<b>Groundwater Flow Direction</b>	
<b>Source Protection Zone (SPZ)</b>	
<b>Abstraction</b>	
<b>Leaching Potential</b>	
<b>Sensitivity</b>	
<b>Receptors</b>	
<b>Human Health</b>	
<b>Location</b>	
<b>Activities and Activity Patterns</b>	
<b>Sensitive Subpopulations</b>	
<b>Sensitivity</b>	

Initial Conceptual Site Model (CSM) and Category Assessment					
Source	Receptor	Pathway	Sensitivity	Potential of Occurrence	Category Assessment
<b>Onsite</b>					
<b>Pesticides and Herbicides (Fertilizer)</b>					
<b>Adjoining Land (&lt;500m)</b>					
<b>TPHs; PAHs and VOCs</b>					
<b>Ecological Systems</b>					
<b>Ecology</b>					
<b>Sensitivity</b>					

Land Quality Statement	
<b>Author</b>	
<b>Reviewer</b>	
<b>Date</b>	

**GENERIC MOD PHASE 1 LQA FORMAT****LQA REPORT STANDARD FRAMEWORK - UNRESTRICTED**

Land Quality Statement (takes place of Executive Summary)

- Introduction
- Site description and History
- Site Sensitivity
- Potential Sources of Contamination
- Summary of Potential Risks
- Overall Land Quality and Suitability for Redevelopment

1      Introduction

- 1.1 Terms of Reference
- 1.2 Objectives
- 1.3 Methodology
- 1.4 Structure of this Report

2.     Site Description and Setting

- 2.1 Site Location
- 2.2 Site Layout
- 2.3 Site Activities
- 2.4 Site History
- 2.5 Site Constraints
- 2.6 Surrounding Area

3.     Sources of Information

- 3.1 Site Sourced Information
- 3.2 Public register Information
- 3.3 Additional Information

4.     Environmental Setting and Site Sensitivity

- 4.1 Geology
- 4.2 Hydrogeology
- 4.3 Hydrology
- 4.4 Site Sensitivity

5.     Potential Sources of Contamination

- 5.1 Current On-Site Activities/Operations
- 5.2 Current Off-Site Activities/Operations
- 5.3 Historic On-Site Activities/Operations
- 5.4 Historic Off-Site Activities/Operations

6.     Preliminary Conceptual Site Model and Tier 1 Risk Assessment

- 6.1 Summary of Potential Contaminant Sources
- 6.2 Potential Pathways
- 6.3 Potential Receptors
- 6.4 Tier 1 Preliminary Qualitative Risk Assessment

6.5 Risk Summary - To include headings such as: Current and Future Site Users, Construction Users, Groundwater etc.

7 Overall Land Quality and Suitability for Redevelopment

8. References

Figures

Figure 1: Site Location

Figure 2: Site Layout

Figure 3: Potential Sources of Contamination

Figure 4: Conceptual Site Model

Appendices

**TECHNICAL NOTE FRAMEWORK – RESTRICTED - COMMERCIAL**

1. Background
2. Summary Findings
3. Tier 1 Risk Assessment (with MOD liability classifications)
5. Liability Assessment
6. Options Appraisal
7. Recommendation(s)

**GENERIC MOD PHASE 2 LQA FORMAT****LQA REPORT STANDARD FRAMEWORK - UNRESTRICTED**

Land Quality Statement (takes place of Executive Summary)

**Introduction**

Site description and History

Site Sensitivity

Sources of Contamination

Summary of Risks

Overall Land Quality and Suitability for Redevelopment

**1 Introduction****1.1 Terms of Reference****1.2 Objectives****1.3 Methodology****1.4 Structure of this Report****2 Site Description and Setting****2.1 Site Location****2.2 Site Layout****2.3 Site Operations****3 Summary of PHASE 1 LQA**

- Site History
- Environmental Setting
- Site Sensitivity
- Environmental condition of the Site
- Sources of Potential Contamination
- Preliminary Risk Assessment

**4 Site Investigation****4.1 Objective****4.2 Methodology****4.3 Investigation of Findings****5 Tier 2 onwards risk assessments (GQRA/DQRA)****6 Updated CSM****7 Overall Land Quality and Suitability for Redevelopment**

- Overall Land Quality
- Environmental Risks
- Suitability of Investigated Areas for Continued Use

## 8 References

### Figures

Figure 1: Site Location

Figure 2: Site Layout

Figure 3: Exploratory Hole Location

Figure 4: Sources of Contamination

Figure 5: Areas of Visual/Olfactory contamination

Figure 6: Locations of Exceedances

- Soils
- Waters

Figure 7: Conceptual Site Model

### Photographs

Plates: Photographic record of site investigation

### Appendices

## TECHNICAL NOTE FRAMEWORK – RESTRICTED - COMMERCIAL

1. Background
2. Summary Findings
3. Tier 2 Risk Assessment and beyond (with MOD liability classifications)
4. Liability Assessment
5. Options Appraisal
6. Recommendation(s)

## **EXPLANATORY NOTES FOR GENERIC PHASE 1 AND 2 LQA REPORT AND TECHNICAL NOTE FORMATS**

### **1. For Phase 1 and 2 LQAs**

- a. **LQS:** This is a non-technical summary (2 to 3 pages maximum) of the land condition together with its suitability for re-use that must be capable of being a freestanding document i.e. it should not reference sections and figures etc within the main report. The LQS must present the presence, nature and extent of known contamination and pollution of controlled waters in context establishing whether the majority of the land is likely to be free of contamination. For instance, where present, is contamination localised and limited in extent, associated with and restricted to fill materials within made ground and so on? The effects of the known contamination etc on the development potential must also be addressed particularly where the LQA is in support of a site disposal. The LQS must not include reference to recommendations for further work and all risks must be presented in context. For instance in a Phase 1 LQA the 'Overall Land Quality and Suitability for Redevelopment' section could be phrased along the lines of:

'Overall based on the information available, the majority of the site is unlikely to have been contaminated as a result of historical and/or current activities. Where present land contamination is likely to be limited in extend, comprise..... and be confined to fill materials within areas of made ground. If present contamination will pose a low to negligible risk to health and the wider environment providing the areas affected remain undisturbed.'

The site is currently suitable for use as.....and is likely to be suitable for,,, subject to the necessary investigation and assessment.

### **b. TECHNICAL NOTE (RESTRICTED-MANAGEMENT)**

#### **Content**

- a. **Background:** Brief details of the objectives, methodology, constraints including any anticipated geotechnical problems, any operational, time or security needs stipulated by the MOD Client.
- b. **Interpretative information:** Must include, but not necessarily be limited to: quantitative risk assessment including MOD liability classification and comments, liability assessment including regulatory context, management options appraisal, recommended option/s and conclusions.
- c. **Management Options Appraisal:** Each option to be considered in depth, including the costs and the contractual approach (if any) inherent in each option. Drawings sufficient to explain the option(s) to those unfamiliar with the site should be included. A very brief comparison of advantages and disadvantages of each option considered, including the cost, should be included. Ordinarily the 3 key options will be considered inclusive of the 'do nothing/do minimum'
- b. **Conclusion and Recommendation:** Giving clear-cut recommendations, the option preferred and the operational and economic advantages (including timescales) that justify the recommendation(s).
- c. **Summary of LQA,** also to be completed electronically.

**Ordinarily the Technical Note will not be released to third parties outside of MOD circles.**

## 2. Phase 1 LQA Report

- a. **Introduction:** Briefly set out the terms of reference under the Client commission, together with the objectives of the LQA phase, methodology and structure of the report. This should include any operational, time or security needs stipulated by the Client.
- b. **Site Description:** Set out details of the site, or sites, giving location(s), layout and MOD unit(s) establishing zones where necessary and including brief details of the surrounding area. Include description of the proposed future use where applicable. Where key aspects can be shown more clearly in the drawn form then drawings and/or diagrams should be included. There should be no straying into a discussion of potential sources of contamination. Site Activities section should include details of the site walkover. Site History section should provide detailed description of the information obtained from the various research sources and split into separate subsections where necessary.
- c. **Sources of Information.** This should set out the sources and nature of the information reviewed/considered including interviews with site personnel. Where previous LQA and/or other desk study and investigation reports etc exist then their scope, purpose, limitations and pertinent findings should be summarised
- d. **Environmental Setting.** This should summarise the geology, hydrogeology , and hydrology based on available information before presenting a summary assessment of the site sensitivity as follows:

Box x.x Example Groundwater sensitivity summary



### ***Groundwater sensitivity: Moderate***

The site is underlain by Secondary A and Secondary B aquifers. There are licensed groundwater abstractions within 1km though the site does not lie within a groundwater SPZ.

- e. **Potential Sources of Contamination:** Details of the potential sources and the basis on which they have been identified should be described under relevant subsections with sources grouped accordingly. A summary table should be provided with each potential source provided a unique reference number (URN) which relates to its location on a Potential Sources of Contamination plan.
- f. **Preliminary Conceptual Site Model.** The potential contaminant sources, pathways and receptors need to be identified together with the necessary rationale and summarised pictorially as per Annex C to this guide. The potential sources should summarised in a table with each potential source provided a unique reference number (URN) which relates to its location on a Potential Sources of Contamination plan and carried forward to subsequent risk assessment table and CSM.

Box x.x Example Potential Contaminant Sources Summary



Potential Source Number (carried forward to RA and CSM)	Potential Source	Associated Feature	Potential Source Location (shown on figure xx)
1	Vehicle Maintenance Areas – potential for leaks or spillages associated with current and historic maintenance activities (hydrocarbons, antifreeze, metals, solvents and acids)	Historical aircraft maintenance hanger	1.1
		Historical MT section	1.2
		Current central servicing workshop	1.3
2	Historic Fuel Storage – potential for leaks or spillages associated with historic fuel/oil storage (hydrocarbons)	Redundant BFI1	2
3	Current Fuel/Oil Storage – potential for leaks or spillages associated with current fuel/oil storage (hydrocarbons)	Current main POL area	3.1
		Current MTFI	3.2
etc.	etc.	etc.	etc.

g. **Tier 1 Preliminary Qualitative Risk Assessment.** To comprise text and risk assessment table as per Annex E to this guide.

h. **Overall Land Quality and Suitability for Redevelopment:** Refer guidance for LQS.

### 3. Phase 2 LQA Report

- a. **Introduction:** As per Phase 1 briefly set out the terms of reference under the Client commission, together with the: objectives of the LQA phase, methodology and structure of the report. This should include any operational, time or security needs stipulated by the Client.
- b. **Site Description and Setting:** Set out brief details as per Phase 1 LQA.
- c. **Summary of Phase 1 LQA:** provide brief summary and over view including historical use of the site.
- d. **Site investigation.** Detail: objective, investigation methodology, rationale and findings (including ground conditions). The sampling and analysis strategies must be consistent with accepted best practice, documented and justified. The sampling methodologies must also be consistent with best practice, documented and justified together with the QA and QC measures taken. Similarly the assessment criteria must be set out and the appropriateness documented. All assumptions must be clearly set out.

e. **Quantitative Risk Assessment.** The approach and assessment criteria must be documented and justified and the findings summarised both in the text and as a summary table (refer Annex E).

f. **CSM.** This must be updated in light of the Phase 2 LQA findings.

g. **Overall Land Quality and Suitability for Redevelopment.** This should reflect the summary presented in the LQA and be of a form that is easily understood by the layperson.

#### 4. LQA REPORT AND TECHNICAL NOTE FACE SHEET

This should contain:

- a. Title "DIO" centred at the top of the sheet and the DIO and MOD logos should be shown.
- b. Title as shown on the Directive in the centre of the sheet, with the Project No. immediately below.
- c. Name and address of the relevant TLB office in the bottom left hand corner of the sheet.
- d. The legend "Prepared by (name) for the MOD, TLB, under commission (number)" in the bottom right hand corner of the sheet along with the month and year in which the Study was produced.
- e. Marked areas for signing as 'accepted' by the Task Officer and the Project Sponsor.
- f. Marked areas for 'prepared by' and 'authorised by' including SiLC logo and registration number
- g. The draft and final reports should be signed by the PM and reviewer. A 'pp' or electronic signature will not be accepted.
- h. In order to be compliant with the Data Protection Act, all reports must, with the exception of the cover sheet, have the names and initials etc. of individuals removed from the text, tables, figures and appended documents. Other than the cover sheet there is to be no personal information included in the report.

#### 4. SIZE

This should always be A4 vertical format, but may contain folded A3 or larger sized sheets in clear A4 pocket inserts.

#### 5. MAPS AND PLANS

Maps should indicate the site location and where scale permits should also show the site boundary. Site Plans should include a scale bar and a north arrow.

#### 6. GUIDANCE NOTES FOR THE COMPLETION OF LQA RETURNS

- a. The excel spreadsheet (compatible with Microsoft Office Version 2003) will be saved on a CD and submitted with the final reports to the Task Officer. A data shape (polygon) containing tagged spatial information should accompany the LQA Data Capture Proforma excel spreadsheet shown below.
- b. The spreadsheet fields will be filled out as follows:

- Site DPR Ref. #: This is only to be filled out if known
- Site Name: provide current name and aliases
- Area: provide area in hectares
- Grid Reference: provide 8 figure grid ref. for the centre of the site
- LQA Priority: insert the priority number as follows:
  - Priority 1: Land identified for disposal or subject to rationalisation or where significant change in land use is envisaged.
  - Priority 2a: Land in sensitive area and with known or suspected contamination
  - Priority 2b: Known threat; site in sensitive area such as major aquifer
  - Priority 2c: Strongly suspected threat or possible threat from e.g. radioactive substances, dioxins, CW materials
  - Priority 2d: No known evidence of threat, i.e. all other sites
- Current LQA Phase: State whether it is:
  - 0 Prioritisation
  - 1 Desk Study
  - 2 Site Investigation
  - 3 Assessing need to remediate
  - 4 Remediation
- Overall Land Quality: Please insert appropriate number:
  - 1 No known or potential sources of contamination
  - 2 Majority of the site is unlikely to be contaminated. A number of localised sources of contamination are or may be evident.
  - 3 Majority of the site is or is likely to be contaminated.
- Approximate area of contamination: Please estimate area likely to be affected in m<sup>2</sup>
- Liability Class: This should be presented as the risk assessment table within the Technical Note.

## **7. ELECTRONIC FORMATTING OF LQA REPORT AND TECHNICAL NOTE**

- a. The format of the LQA Report and Technical Note is to conform to the "Standard Framework" as outlined above and amended where appropriate through the commissioning LQA Directive.
- b. Electronic copies of the LQA Report and Technical Note should be submitted as two pdfs only, with each pdf containing the text, figures and appendices taking full account of the necessary security protocols.
- c. CD1 should contain the finalised LQA report only. CD2 should contain the finalised LQA report, Technical Note, excel spreadsheet and data shape file.
- d. The CD spine should clearly denote the Project Number, Site Name, Phase of Works, Consultant Company and Date e.g. '12345 RAF Banner Phase 1 WatCon Ltd June 2005'. The front of the CD should denote the Site Name, Phase of Works, LQA and Technical Note, Security Classification, Project Number, Report Status, Date of Issue, and the Defence Infrastructure Organisation and the Consultant Company Logos. The CD itself should be similarly marked as the front cover.

## LQA DATA CAPTURE PROFORMA

1. DIO LQA Ref	2. Report Date (Month/Year)	3. Site Name	4. Investigation Phase	5. Report Type	6. Volume No.	7. Author	8. Polygon Area (Ha)	9. Eastings (6 Fig)	10. Northings (6 Fig)	11. Country	12. Priority Rating	13. Polygon Supplied	14. Total spend to date
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1. DIO LQA Ref: 5 numbers identifying project number

2. Report Date: Month/Year e.g. 09/2007

3. Site Name: e.g. RAF Hythe (Site 4),

4. Investigation Phase:

LQA Phase 0

LQA Phase 1

LQA Phase 2

LQA Phase 3

LQA Phase 4

LQA Phase 5

BLANK

5. Report Type:

Technical Note

LQA Report

Regulator Report

Other

6. Volume No:

Vol 1

Vol 2

Vol 3

Vol 4

Other

7. Author: Company Name of Consultant

8. Polygon Area: the area (ha) of the work covered in the report

9. Eastings: centre of the site (6 figures)

10. Northings: centre of the site (6 figures)

11. Country where site is located, please insert country code in accordance with [ISO 3166](#). (E.g. England is GB-ENG).

12. Send an electronic GIS polygon of the site area with attached spatial data to be incorporated into a GIS system.

13. Total spend to date rounded up to the nearest pound.

12. Priority Rating	Comment assuming likely or high likelihood of pollutant linkage occurrence	Action required
Priority 1	Site probably not suitable for present use and/or environmental setting. Contaminants probably or certainly present and probably have an unacceptable impact on identified sensitive receptors.	Urgent action required in the short term
Priority 2	Site may note be suitable for present use and/or environmental setting. Contaminants probably or likely to be present, and may have an impact on identified sensitive receptors	Urgent action required in the short term
Priority 3	Site considered likely to be suitable for present use and/or environmental setting. Contaminants may be present but unlikely to impact sensitive receptors identified.	No immediate action needed while site remains in present use and remains undisturbed. Management options to prevent land contamination may need to be implemented in order to reduce the risk of land contamination
Priority 4	Site considered suitable for present use and/or environmental setting. Contaminants may be present but very unlikely to have an unacceptable impact on key targets.	No action needed while site remains undisturbed. In general management options to prevent land contamination are likely to be sufficient, although a review of preventative measures should undertaken periodically.

## SUSTAINABLE WASTE MANAGEMENT

### Introduction

1 Apart from the cost associated with the disposal of waste arising from LQAs and in particular remediation works, MOD is committed to reducing the amount of waste sent to landfill and following the more sustainable approach set out by [SURFUK](#). It is essential that every effort is made to reduce the amount of waste produced in the first instance and where possible reuse materials.

2 To achieve this with regard to remediation and subsequent work in aide of site development it is essential that the waste management hierarchy is embedded and followed namely:

- prevention
- preparing for reuse
- recycling
- recovery
- disposal.

3 The recently revised industry [Code of Practice \(CoP\) developed by CLA:IRE](#) can assist with this and should be followed for sites in England and Wales. The CoP supports the use of materials in accordance with the waste hierarchy such that waste is minimised, recovered and reused with the result that less is sent to landfill and costs are minimised. This has knock-on effects in terms of reduced energy consumption and emissions as well as reduced potential for pollution.

4 The CoP sets out good practice for establishing on a site by site basis whether excavated materials are ‘waste’ and/or treated excavated waste can cease to be waste for a particular use. In order to work knowledge of the guidance set out in Box 7.4 below will be required:

#### Box C4 Key Supporting Guidance



- [CLR11: Model Procedures for the Management of Land Contamination” \(Defra and EA 2004\);](#)
- Cluster Guide (CL:AIRE, in preparation); “[Guidance on the sampling and characterisation of wastes](#)”; “[Remediation Methodologies](#)”
- [EA “Remediation Position Statements”](#) (EA website);
- [“Industry Profiles” \(Department of the Environment\)](#)
- [“Verification of remediation of land contamination” \(EA, 2010\)](#)
- [BS 10175:2011 “Investigation of potentially contaminated sites – Code of practice](#)
- [SURF UK, A Framework for Assessing the Sustainability of Soil and Groundwater Remediation, 2010.](#)

5 It must be noted that the CoP is voluntary and applies to England and Wales only at this time, but it has the support of the Environment Agency (EA) building on their guidance document: “Definition of waste: Developing greenfield and brownfield sites” (2006). Hence, the EA will take account of the CoP when deciding whether excavated materials should be regulated as waste. If

materials are dealt with in accordance with this CoP they will take the view that those materials are unlikely to be waste if they are used for the purpose of land development

6 The CoP covers excavated materials namely: top soil and sub-soil, underlying geology; soil and mineral based dredgings; ground based infrastructure that is capable of reuse within earthworks projects, e.g. road base, concrete floors; made ground; source segregated aggregate material from demolition work, crushed brick and concrete to be reused on the site of production within earthworks projects or as sub-base or drainage materials; and stockpiled excavated materials.

7 The CoP also applies to uncontaminated and contaminated material for use on the site from which it has been excavated, either without treatment or after on-site treatment as part of the development of that land (Site of Origin Scenario). It also applies to such material for use following treatment at a Hub Site (Cluster Project Scenario) or without treatment at another development site subject to the material meeting the requirements set out in the CoP (Direct Transfer Scenario).

8 However the CoP specifically excludes certain material such as soils contaminated with invasive plant species with the exception of those soils that are used on the site of production in accordance with relevant guidance such as the Japanese Knotweed Code of Practice.

9 A key component of the CoP is the Materials Management Plan (MMP). It is essential that this is both adequate and based on an appropriate risk assessment that underpins the Remediation Strategy. As such the MMP must ensure that using the materials in the specified manner will prevent harm to human health and environmental damage. Ultimately this will need to be demonstrated in a Verification Report.

10 The key enabler is the Qualified Person and DIO has a number of these that may be able to assist. They must review the relevant documents and provide a Declaration to the EA prior to the use of materials in line with the MMP. When the Declaration is provided to the EA demonstrating that the materials are to be dealt with in accordance with the MMP, the EA will take the view that the materials are not waste. If the materials were not used in accordance with the MMP and underpinning risk assessment, are found not to be 'suitable for use', are to be used in 'excessive quantities' or could cause harm to human health or the environment then the EA will view the materials as being waste and subject to regulation.

11 If the material is waste an Environmental Permit will be required to lawfully deposit or re-use it unless the material is "uncontaminated soil and other naturally occurring material excavated in the course of construction activities where it is certain that the material will be used for the purposes of construction in its natural state on the site from which it was excavated", which is excluded from waste regulation by the [Waste Framework Directive \(2008\)](#).

12 Reference must also be made to the requirements under the relevant waste legislation and regulations such as: [The Waste \(England and Wales\) Regulations 2011](#) which specifically require confirmation that the waste management hierarchy has been applied when transferring waste.

## CONCEPTUAL SITE MODEL (CSM)

### Construction, Refinement and Representation

The CSM must present the source-pathway-receptor relationships clearly as pictorial/schematic (2D or 3D) supported by an appropriate written justification.

The starting point is the Outline CSM prepared at the Phase 0 LQA stage. This will normally form the basis of the Preliminary CSM prepared at the Phase 1 LQA stage which will be progressively refined through the various tiers of risk assessment as the LQA proceeds through Phase 2.

The level of detail will vary from CSM to CSM depending upon the site conditions such as the complexity of the geology and nature and likely extent of the contaminants.

Where appropriate to do so contaminants and pathways, be they potential or otherwise, can be grouped together rather than treated individually. This will help keep the model as manageable and simple as possible.

Box D1 CSM GUIDANCE	
<p>Guidance is available in:</p> <ul style="list-style-type: none"> <li>• Environment Agency. <i>Guidance on good practice for the development of Conceptual Models and the Selection and Application of Mathematical Models of Contaminant Transport Processes in the Subsurface</i>. National Groundwater and Contaminated Land centre Report <a href="#">NC/99/38/2</a>, 2001; and</li> <li>• <a href="#">R&amp;D 66</a> Guidance on the Safe Development of Housing on Land Affected by Contamination, 2008 Volume 1 and 2. NHBC and Environment Agency.</li> </ul>	

### Schematic Representation

In order to present the CSM clearly and to set the identified pollutant linkages in context in terms of the area of land being assessed it is necessary to produce a site plan illustrating the location of potential contaminants and receptors and schematic representation of the conceptual model in cross section. The site plans identify the potential or known location of contaminant sources on the site. A schematic cross-section representation will be required where the distribution and possible migration of contaminants in the sub-surface needs to be illustrated.

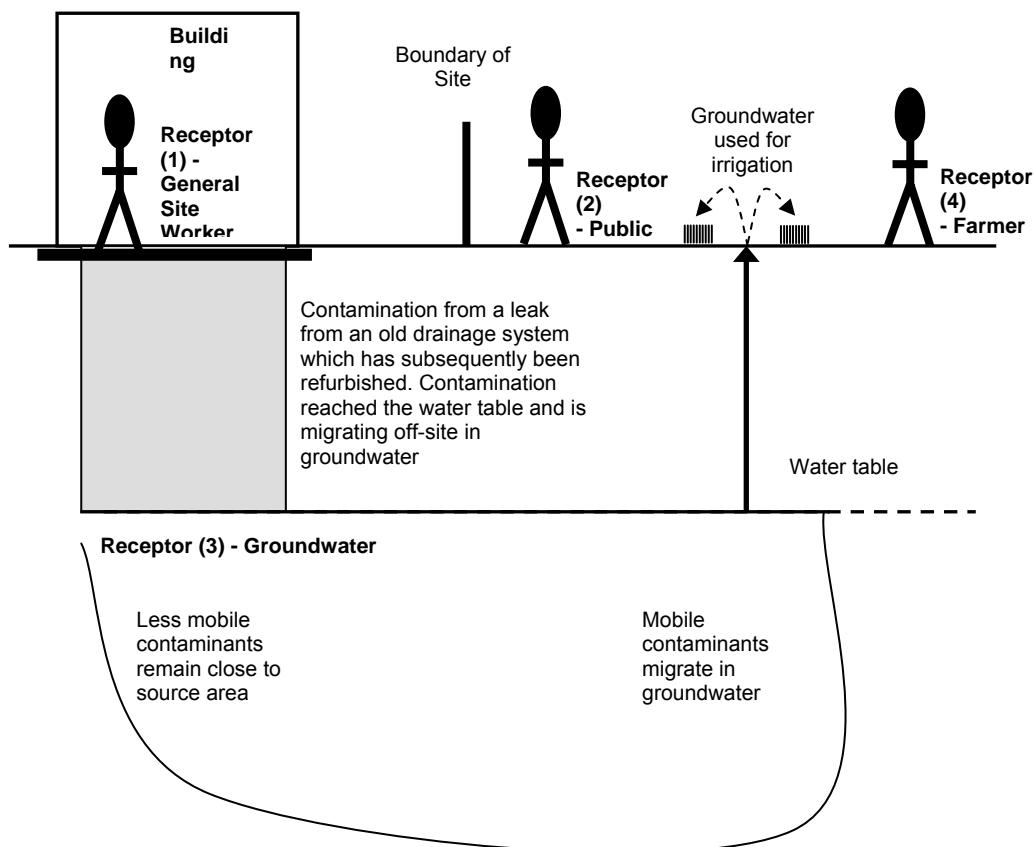
Examples of the simplistic and detailed CSM schematic representations are shown overleaf by means of illustration, use will depend on the LQA Phase and situation. Ordinarily the simplistic form will be restricted to a Phase 0 with the more detailed form being used from Phase 1 onwards.

## Example 1 – Simplistic Schematic Representation (Phase 0 LQA)

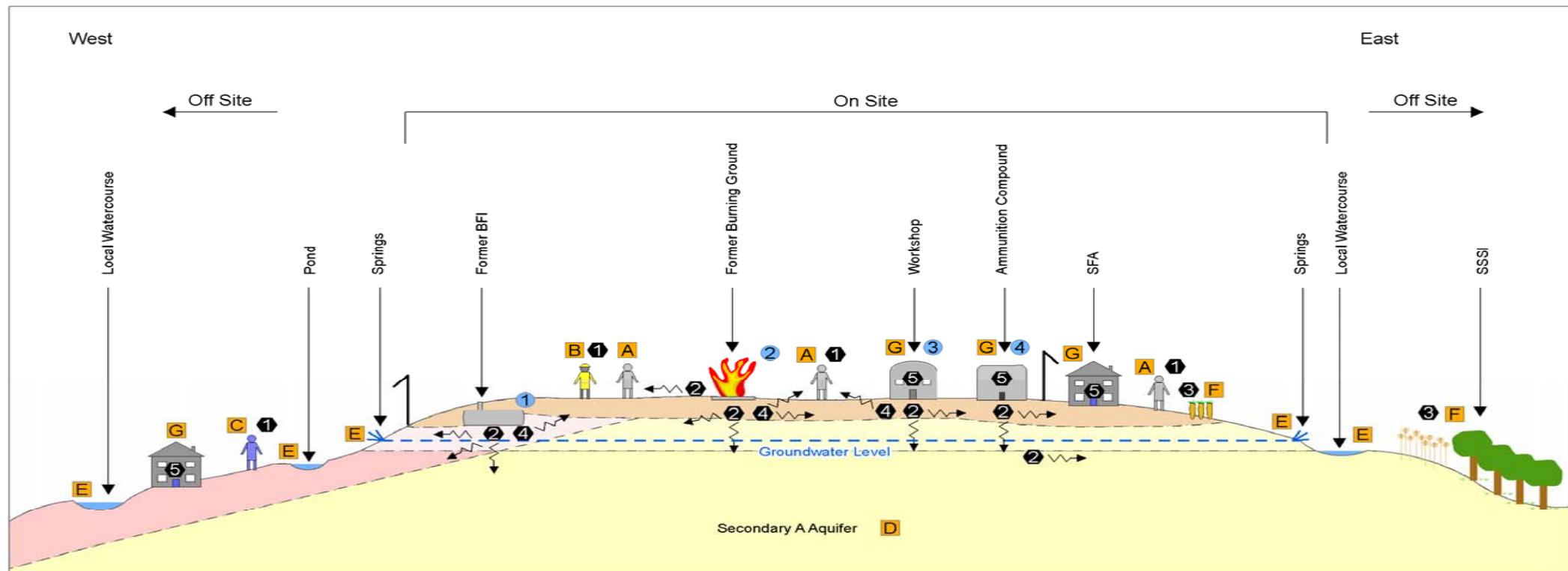
**Scenario:** At the time of the original fuel leak, contamination reached the saturated zone. Even though the leak was subsequently abated, there are pathways to the environment and to other human receptors from residual contamination.

Receptors currently potentially at risk:

- General site worker in the building from vapours;
- Groundwater below the site;
- Public who walk by the boundary - inhalation of dust blown from soil which has been irrigated with contaminated groundwater;
- Farmer - by inhalation and ingestion associated from soils which has been irrigated with contaminated groundwater; and
- Other public and farmers family - from ingestion of crops grown on, or animals grazed on, soil which has been irrigated with contaminated groundwater.



## Example 2 - Detailed Schematic Representation (Phase 1 LQA onwards)



### LAND QUALITY ASSESSMENT - CONCEPTUAL MODEL

Geology
Made Ground
Drift (sands and gravel)
Formation (mudstone and sandstones)
Formation (mudstone)

- Potential Sources**
- ① Fuel storage (Hydrocarbons - Fuels and Oils)
  - ② Former burning grounds and waste disposal (Hydrocarbons, fuel and oils, PCBs, solvents, metals and asbestos)
  - ③ Former and current workshops (Hydrocarbons, fuels and oil, solvents and metals)
  - ④ UXO and residues (Explosive residues and metals)

- Receptors**
- A Current/future site users
  - B Construction and maintenance workers
  - C Neighbouring site users
  - D Groundwater
  - E Surface Water
  - F Ecological and agricultural receptors
  - G Buildings and buried services

- Pathways**
- ① Dermal contact, ingestion and inhalation
  - ② Leaching, run off, vertical and lateral migration in groundwater
  - ③ Uptake, direct contact
  - ④ Vapour migration and explosion
  - ⑤ Degradation and direct contact

Produced by Geospatial Services (North), Catterick Garrison, DL9 3LR. Ref 20110615-N0203 - IEv4

## **Refinement and Written Justification**

From the construction of the Outline CSM through the development of the Preliminary CSM and subsequent refinement it is essential that the inclusion, omission and discounting of plausible contaminants, pathways and receptors are documented and justified with reference to the relevant evidence together with any changes. This provides the necessary audit trail and allows those reviewing the model to understand the thought process and rationale. A checklist for reviewing CSMs is provided at Annex D.

Assessing viable/plausible source-pathway-receptor linkages requires the application of both common sense and general scientific knowledge about the nature of a particular contaminant, including how it may move or be transported, the circumstances of the land in question (e.g. geology, hydrogeology etc) and the behaviour of certain receptor types on the site (primarily applicable to humans and other living organisms).

Only ‘plausible’ sources, pathways and receptors should be considered. By ‘plausible’ we mean ‘more likely than not’.

### **CSM Considerations:**

The following list is not exhaustive and should be taken as a guide.

#### **Site Environmental Context**

- Site boundary, layout and topography;
- Geology/ground conditions;
- Hydrogeology; aquifer designation, distance from source protection zone/flow direction, etc;
- Hydrology; surface water drainage;
- Ecology; and
- Land-Use: Identification of current land uses.

#### **Contaminant (Source) Information**

- Contaminant location, potential and known;
- Contaminant Types: Identification of contaminants of concern based upon site history;
- Contaminant Properties: Physical properties of contaminants such as solubility, density, viscosity etc;
- Contaminant Form: Solid phase (particles), sorbed phase (bound to soil), free phase (NAPL's), vapour phase (in soil & air) and dissolved phase (in groundwater & pore water);
- Contaminant Distribution: Point sources (pipes and tanks), diffuse sources (stack emissions and land-spreading), possible lateral extent, concentration and depth profiles. Complicating Effects: De-commissioning, redevelopment and partial remediation;
- Potential hazard posed by contaminants – phytotoxicity etc;
- Cause of the contamination;
- Likely mobility of contaminants and factors that affect this; and
- Uncertainties and assumptions.

## **Receptor Information**

- Identify plausible receptors that should be considered;
- **Humans:** Site workers, visitors and whether children or adults as this influences the exposure averaging;
- Areas (based upon receptor behaviour);
- **Ecosystems:** Habitat and ecosystem descriptions, species composition, temporal trends & animal and plant distributions;
- **Property (Flora & Fauna):** Identification of crops, domestic produce, livestock, owned or domesticated animals, wild animals subject to shooting or fishing rights and protected species;
- **Property (Buildings):** Buildings (including constituent material types) and ancient monuments; and
- **Controlled Waters:** Identification of coastal waters, inland freshwaters, ponds, lakes, rivers, watercourses and groundwater.

## **Pathway Information**

- **Direct Exposure:** Direct with the contaminant (dermal, plant roots, building materials, etc.), direct ingestion and inhalation of vapours or dust in air; and
- **Indirect Exposure:** Ingestion of contaminated foods, migration into controlled waters.

## **Source-Pathway-Receptor Linkages**

- Identify plausible linkages and place in context (i.e. identified on other sites);
- Consider existing risk management measures; and
- Consider relevant data including monitoring data that shows the presence or absence of pathways.

Once a CSM has been produced, Table 1 should be used as a checklist for reviewing CSMs and proposed detailed inspection. Table 2 should also be used to assess inspection proposals.

**TABLE 1 CHECKLIST FOR REVIEWING CSMS AND PROPOSED DETAILED INSPECTION**

<b>Review of Conceptual Model</b>	
<b>Background Information</b>	
<b>1</b>	<b>Is there sufficient documentary information regarding the site setting and history to construct an adequate conceptual model?</b>
	If not, consider commissioning further desk study work. Use the work instruction on procuring design services to identify the data sets to be obtained by documentary research.
<b>Adequacy of the Conceptual Model</b>	
<b>2</b>	<b>Is the list of pollutants complete, based upon the history of the site?</b>
	If not, amend the CM accordingly having regard to DoE industry profiles & special sites guidance.
<b>3</b>	<b>Have all viable pathways been identified given the form of the pollutant, its likely location and the use of the site by the receptors in question?</b>
	If not, amend the CM accordingly and consider whether any of these pathways need confirming via visual or intrusive inspection or whether they are obvious.
<b>4</b>	<b>Have the possible presence of all Part 2A receptor types (as per Table A &amp; B of the statutory guidance) been evaluated?</b>
	If not, amend the CM accordingly and consider the need to confirm the presence of these receptors by further desk study, visual or intrusive inspection work.
<b>Risk Assessment Information</b>	
<b>5</b>	<b>Is there existing evidence of actual pollution or harm at the site?</b>
	If so, consider whether you need to gather any further information at all via detailed inspection. It may well be all that's required is to pull together the existing data in a summary report.
<b>6</b>	<b>Is there existing evidence of unacceptable risks at the site?</b>
	If so, (e.g. existing risk assessment reports) consider whether you need to gather any further information at all via detailed inspection or just summarise what has already been done.
<b>7</b>	<b>Given the types of pollutant linkages present have you identified the methodology of assessing risks to each receptor?</b>
	If not, consider which risk assessment tools you will use and the data that's required to use them. You may need to gather parameters such as basic soil properties, or develop health criteria values in addition to gathering contaminant information.
<b>8</b>	<b>Is there evidence of the presence of pollutants on the site?</b>
	If so, consider whether you need to gather any further information at all. If evidence is needed to confirm each contaminant is present, can the presence of the contamination be confirmed simply by visual means or will sampling and analysis be required? If so what samples will be required and from where given what you know of the CM?
<b>9</b>	<b>Do you have enough information on the receptors to be able to carry out risk assessment given the methodologies identified in 7 above?</b>
	If not, then information on the presence distribution type and behavior of receptors may be needed via visual or intrusive investigation.
<b>10</b>	<b>Do you have enough information to confirm that the pathways are present?</b>
	You may need to confirm the existence of preferential pathways, geology etc, as part of the inspection work (but only if there is a real doubt as to their existence).

**TABLE 2 ASSESSING INSPECTION PROPOSALS**

<b>Assessing Inspection Proposals</b>	
<b>Conceptual Model</b>	
<b>1</b>	<b>Will the proposal deal with all pollutant linkages identified by the CM?</b> It must include provisions to gather information needed to confirm the presence on contaminants, pathways and receptors and whether they form a viable pollutant linkage AND information to decide whether the linkage is significant.
<b>Background Information</b>	
<b>2</b>	<b>Does the proposal adequately summarise the existing documentary information?</b> There must be enough information to give confidence that the existing documentary information has been well reviewed. A good summary of existing information will allow you to assess whether the proposals for gathering further information are actually needed.
<b>Sampling Strategy</b>	
<b>3</b>	<b>Will samples be taken from the right media and at relevant locations and depths given the contaminant distribution and exposure scenarios detailed in the CM?</b> If samples are needed to prove the existence of contamination, it should be clear where they are being taken from and why. Sufficient samples (or other evidence) are needed to confirm the existence of pollutant linkages and allow an assessment of significance. Comprehensive site characterisation should generally be avoided.
<b>4</b>	<b>Will enough samples be taken to allow valid interpretation?</b> The site should be properly zoned and appropriate averaging areas defined in order to allow an adequate assessment of risk in line with established good practice. In general more samples will be required in order to adequately assess risks to human health than controlled waters.
<b>5</b>	<b>Are the methods proposed appropriate for the site?</b> The site investigation methods being proposed should be the most suitable and cost effective way of gathering the necessary data given the site specific setting and constraints. The "Guidance on Site Investigation Techniques" can be used to help assess the general suitability of methods.
<b>Analytical Strategy</b>	
<b>6</b>	<b>Will all contaminants of concern be detected to a level sufficient for risk assessment?</b> The analytical methods being proposed must be capable of detecting the contaminants of concern at a sufficiently low level to allow comparison with either generic or site specific assessment criteria. It's important to know how you will assess the risks for each contaminant before you gather the data, to make sure data is suitable. Will the analysis be MCERTS compliant?
<b>7</b>	<b>Has a phased analytical strategy been considered?</b> Sampling strategies are usually designed to gather sufficient samples to allow statistical analysis should the samples prove to be contaminated. However it may be possible to save a significant sum of money by adopting a phased analytical strategy e.g. testing only a portion of samples from a wider sampling grid/pattern first and only if a potential problem is indicated via screening analysis going on to test the rest of the samples.
<b>Risk Assessment</b>	
<b>8</b>	<b>Have appropriate risk assessment methods and tools been specified?</b> Risk assessment should be carried out in line with established "UK" compliant good practice.
<b>9</b>	<b>Will the proposal collect all the information needed to use the risk assessment tools?</b> Quantitative risk assessment tools in particular may require information on geological, soil or receptor characteristics in addition to contaminant concentrations in order to be used correctly. Wherever possible site specific data should be collected rather than reliance upon generic assumptions.
<b>Quality Control &amp; Quality Assurance</b>	
<b>10</b>	<b>Have appropriate QC/QA measures been identified?</b> The proposal should include sufficient detail to give confidence that samples are being taken, stored, transported and tested in an appropriate fashion.

## PRELIMINARY QUALITATIVE RISK ASSESSMENT

The Preliminary Qualitative Risk Assessment is underpinned by the Initial CSM which identifies the hazards (source of contamination) and sets out the potential pollutant linkages with a view to identifying the nature and magnitude of the potential risks to receptors.

This requires consideration of the probability or likelihood of the linkage occurring and the severity/significance of the potential consequence taking into account the nature of the pollutant linkage and the potential severity of the hazard coupled with the sensitivity of the receptor within the context of the current and/or envisaged land use.

Ultimately, the absence of a pollutant linkage means there is no risk. That said a view will need to be taken on whether there is sufficient data to provide the necessary confidence.

A classification of: consequence/severity, probability/likelihood and risk together with definitions are presented in the various tables within this annex. These tables were developed initially in 1995 in line with the DoE Guide to Risk Assessment and Risk Management for Environmental Protection published that year and has been updated into the [DEFRA 2011 Guide to Risk Assessment and Risk Management Green Leaves III](#) to take account of the following guidance:

- [CIRIA C552 Contaminated Land Risk Assessment. A Guide to Good Practice, 2001](#)
- [Defra Statutory Guidance on Contaminated Land, 2006](#)
- [EA R&D Publication 66, Guidance for the Safe Development of Housing on Land Affected by Contamination, 2008](#)

Most recently [R&D 66](#) introduced the consideration of the ‘immediacy of hazards’.

The tables provide a logical and consistent framework for assessing the potential risk by defining the categories of consequence severity, probability/likelihood of occurrence and levels of risk also referred to as ‘risk terms’ which follows current best practice.

The first step is to establish the consequence/severity (Table 4) and probability/likelihood (Table 5) before combining/comparing them to establish the risk category or term (Table 6). The resultant risk class is defined in Table 7.

It is worth noting that the classification of the consequence (severity) does not take account of the probability (likelihood) of that consequence being realised. Hence a ‘severe’ consequence refers to acute (short term) risk and a ‘medium’ consequence refers to chronic (long term) risk as would be the case of carcinogens and asbestos etc. Both can be classed as SPOSH and ultimately result in death. Therefore, only those contaminants that pose an acute risk to human health i.e. exposure duration of less than 24 hours should be classed as severe. Similarly contaminants that result in temporary health impacts that are non fatal should be classed as ‘minor’ in consequence. Care must therefore be taken and due consideration given to acute versus chronic risks otherwise the severity may be over estimated.

There is also a need to classify the liability (Table 8) to inform management decisions and the priority/urgency with which action is required.

When complete the results should be summarised in Table 10. Table 9 provides guidance on classifying the consequence/severity for sites affected by radioactively contaminated land. Though, it must be remembered that this table was prepared for nuclear licensed sites and so must be used with care.

TABLE 3 LQA RISK ASSESSMENT SUMMARY

<i>Area / Building</i>	<i>Potential Pollutant (Hazard)</i>	<i>Potential Receptor</i>	<i>Potential Pathway to Receptor</i>	<i>Associated Hazard</i>	<i>Potential Consequence of Hazard-Receptor Link</i>	<i>Likelihood of Hazard-Receptor Linkage</i>	<i>Potential Significance</i>
		(specific to pollutant)	(specific to pollutant)	(specific to pollutant)	e.g. Severe Moderate Mild Negligible	e.g. Certain Almost Certain Likely Possible Unlikely Nil Chance	<b>Risk:</b> Very High Risk High Risk Moderate Risk Low Risk Negligible/Negligible Risk No Potential Risk  For use in Technical Note only: <b>Liability Classification:</b> A B C D E F

Classifications are defined on the accompanying Table

**TABLE 4 CLASSIFICATION OF CONSEQUENCES**

Classification	Definition
<b>Severe</b>	<ul style="list-style-type: none"> <li>▪ Acute risks to human health.</li> <li>▪ Short-term risk of pollution of controlled waters or significant impact on controlled waters e.g. large scale pollution or very high levels of contamination 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 operational effectiveness and/or amenity value or major damage to agriculture or commerce.</li> <li>▪ Catastrophic damage to buildings or property (e.g. explosion causing building collapse).</li> <li>▪ Ecological system effects – Immediate risks of major damage which is likely to result in: irreversible substantial adverse changes in the functioning of the ecosystem or harm to a species of special interest that endangers the long-term maintenance of the population.</li> </ul>
<b>Medium</b>	<ul style="list-style-type: none"> <li>▪ Chronic risks to human health.</li> <li>▪ Pollution of sensitive water resources (e.g. leaching of contaminants into controlled waters) that is the equivalent of an EA Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to site operations, agriculture or commerce.</li> <li>▪ Ecological system effects – Immediate risks of significant damage which may result in substantial adverse changes to the ecosystem's functioning or harm to a species of special interest that may endanger the long-term maintenance of the population.</li> <li>▪ Significant damage to buildings, structures and services (e.g. damage rendering a building unsafe to occupy, such as foundation damage).</li> </ul>
<b>Mild</b>	<ul style="list-style-type: none"> <li>▪ Non-permanent health effects to human health (exposure unlikely to lead to 'significant' harm).</li> <li>▪ Pollution of controlled waters or non-sensitive water resources (e.g. pollution of non-classified groundwater) that is equivalent to an EA Category 3 pollution incident or short lived effect on water quality; marginal effect on operational capability, amenity value, agriculture or commerce.</li> <li>▪ Minor damage to buildings, structures and services (e.g. damage rendering a building unsafe to occupy, such as foundation damage).</li> <li>▪ Ecological systems effects – Minor or short term damage which is unlikely to result in substantial adverse changes to the ecosystem's functioning or harm to a species of special interest that may endanger the long-term maintenance of the population</li> <li>▪ Substantial damage to non-sensitive environments (unprotected ecosystems e.g. crops).</li> </ul>
<b>Minor / Negligible</b>	<ul style="list-style-type: none"> <li>▪ No measurable effects on human health including non-permanent health effects to human health that are easily prevented by appropriate use of PPE etc.</li> <li>▪ Minor pollution of controlled waters including non-sensitive water resources with no discernable effect on water quality or ecosystems.</li> <li>▪ Minor damage to non-sensitive environments (unprotected ecosystems e.g. crops).</li> <li>▪ Easily repairable effects of damage to buildings, structures, services or the environment (e.g. discolouration of concrete, loss of plants in a landscaping scheme).</li> </ul>

**TABLE 5 CLASSIFICATION OF PROBABILITY**

(Only applies if there is a possibility of a pollutant linkage being present)

Classification	Definition	Probability
<b>High likelihood</b>	There is a pollutant linkage and an event is High Likelihood to occur in the short term, and is almost inevitable over the long term OR there is evidence at the receptor of harm or pollution.	>95% Likelihood of Consequence Occurring
<b>Likely</b>	There is a pollutant linkage and it is probable than an event will occur. It is not inevitable, but possible in the short term and likely over the long term.	50 – 95% Likelihood of Consequence Occurring
<b>Low likelihood</b>	There is a pollutant linkage and circumstances are possible under which an event could occur. It is by no means certain that even over a longer period such an event would take place, and less likely in the short term.	5 – 49% Likelihood of Consequence Occurring
<b>Unlikely</b>	There is a pollutant linkage and it is improbable that an event would occur even in the very long term.	<5% Likelihood of Consequence Occurring

These tables do not indicate direct correlation between the classification systems shown.

More than one liability classification letter may be used if appropriate, e.g. A, D.

**TABLE 6 CLASSIFICATION OF RISK (SIGNIFICANCE)**

Probability (likelihood)	Consequence			
	Severe	Medium	Mild	Minor
	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Moderate Risk	Moderate/Low Risk	Low Risk	Negligible Risk
Unlikely	Moderate/Low Risk	Low Risk	Negligible Risk	Negligible Risk

**TABLE 7 DEFINITIONS OF CLASSIFIED RISKS/RISK TERMS**

Classification	Definition
<b>Very High Risk</b>	Severe harm to a receptor may already be occurring OR a high likelihood that severe harm will arise to a receptor, unless immediate remedial works / mitigation measures are undertaken. Realisation of that risk is likely to present a substantial liability to MOD
<b>High Risk</b>	Harm is likely to arise to a receptor, and is likely to be severe, unless appropriate remedial actions / mitigation measures are undertaken. Remedial works may be required in the short term, but likely to be required over the long term. Realisation of that risk is likely to present a substantial liability to MOD
<b>Moderate Risk</b>	Possible that harm could arise to a receptor, but low likelihood that such harm would be severe. Harm is likely to be mild. Some remedial works may be required in the long term. Realisation of that risk is unlikely to present a substantial liability to MOD, but further work may be required to determine whether this is the case
<b>Moderate/Low Risk</b>	Possible that harm could arise to a receptor, but where a combination of likelihood and consequence results in a risk that is above low, but is not of sufficient concern to be classified as mild. It can be driven by cases where there is an acute risk which carries a severe consequence, but where the exposure is unlikely. Such harm would at worse normally be mild. Unlikely to present a substantial liability to MOD. Limited further investigation may be required to clarify the risk and liability. If necessary remediation works likely to be limited in extent.
<b>Low Risk</b>	Possible that harm could arise to a receptor. Such harm would at worse normally be mild.
<b>Negligible Risk</b>	Low likelihood that harm could arise to a receptor. Such harm unlikely to be any worse than mild. No liability.
<b>No Potential Risk</b>	There is no potential risk where no pollutant linkage has been established. No liability.

**TABLE 8 LIABILITY CLASSIFICATIONS**

Classification	Definition
<b>A</b>	<b>Immediate risk of severe harm to human health.</b> <i>Requires the potential presence of significantly elevated concentrations of contaminants with high acute toxicity, sufficient to present the significant possibility of significant harm to human health, following short-term exposure.</i>
<b>B</b>	<b>Immediate risk of severe harm to the natural or built environment.</b> <i>E.g. a large fuel spill (or the imminent risk of such an event), the risk of explosion causing building collapse, or the possibility of irreversible adverse changes to a protected ecosystem.</i>
<b>A1</b>	<b>Health hazard to workforce during demolition or construction works.</b> <i>The potential for health hazards to workers involved in demolition or construction projects on site, arising from the potential presence of contaminants.</i>
<b>B2</b>	<b>Risks to the natural and built environment during demolition or construction works.</b>
<b>C</b>	<b>Large remediation liability.</b> <i>Remedial works will be required; large financial liability.</i>
<b>D</b>	<b>Minor remediation liability.</b> <i>Remedial works will be required; minor financial liability.</i>
<b>E</b>	<b>No remediation required.</b> <i>Potential contaminant source identified, but no risks<sup>2</sup> under current site conditions, due to the lack of a pathway and/or a receptor. NB future changes to land use and/or receptor behaviour may change the liability classification.</i>
<b>F</b>	<b>No effect on re-use option or site value.</b> <i>Potential contamination sources may be present or have been identified, however, site is suitable for all potential end-uses, although contaminant concentrations may exceed natural background concentrations.</i>

<sup>2</sup> Risks under current site use deemed sufficiently low that remedial works are not considered to be necessary at this time.

**TABLE 9 DESCRIPTORS FOR ‘POTENTIAL SEVERITY OF CONSEQUENCE’ – RADIOACTIVELY CONTAMINATED LAND**

The summary table below provides guidance specific to assessing the severity and risk classification for radioactively contaminated land associated with nuclear licensed sites and so should be used with care.

	<b>Inconsequential</b>	<b>Negligible</b>	<b>Mild</b>	<b>Moderate</b>	<b>Severe</b>
<b>Radiation Dose to Public</b>	Not Distinguishable from Negligible.	<p>Less than 0.01 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>This level corresponds to a risk of death of <math>10^{-6} y^{-1}</math>, as defined by the BSS Directive 2000, and is not subject to any regulatory controls.</p> <p>May be demonstrated using GRACs for scenarios applicable to site use for 0.01 mSv <math>y^{-1}</math></p>	<p>Of order 0.01 - 0.1 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>May be demonstrate using GRACs for scenarios applicable to site use for 0.1 mSv <math>y^{-1}</math></p>	<p>Of order 0.1 - 1 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>The upper level corresponds to the legal limit for effective dose in a calendar year for any member of the public from sources of ionising radiation originating from a nuclear licensed site.</p>	<p>Of order &gt; 1 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>This level of dose exceeds the legal limit for effective dose in a calendar year for members of the public from sources of ionising radiation originating from a nuclear licensed site.</p>
<b>Radiation Dose to on-Site ‘General Employees’</b>	<p>Less than 0.01 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>This level corresponds to a risk of <math>10^{-6} y^{-1}</math>, as defined by the BSS Directive 2000, and is not subject to any regulatory controls.</p>	<p>Of order 0.01 - 0.1 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>The upper level corresponds to the Basic Safety Objective for “other employees” working on nuclear licensed site - Target 1 in HSE SAPs.</p>	<p>Of order 0.1 - 2 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>The upper level corresponds to the Basic Safety Level target for “other employees” working on nuclear licensed site - Target 1 in HSE SAPs.</p>	<p>Of order 2 - 10 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>The upper level corresponds to the Basic Safety Level target for average effective dose in a calendar year to defined groups of “employees working with ionising radiation” on nuclear licensed site - Target 2 in HSE SAPs.</p>	<p>Of order &gt; 10 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>This exceeds the Basic Safety Level target for average effective dose in a calendar year to defined groups of “employees working with ionising radiation” on a nuclear licensed site - Target 2 in HSE SAPs.</p>
<b>Radiation Dose to on-Site ‘Employees Working with Ionising Radiation’</b>	<p>Less than 0.1 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>This level corresponds to the Basic Safety Objective for ‘other employees’ working on a nuclear licensed site – Target 1 in HSE SAPs.</p>	<p>Of order 0.1 - 1 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>The upper level corresponds to the Basic Safety Objective for “employees working with ionising radiation” on nuclear licensed site - Target 1 in HSE SAPs.</p>	<p>Of order 1 - 10 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>The upper level corresponds to the Basic Safety Level target for average effective dose in a calendar year to defined groups of “employees working with ionising radiation” on nuclear licensed site - Target 2 in HSE SAPs.</p>	<p>Of order 10 - 20 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>The upper level corresponds to the Basic Safety Legal Level Limit for average effective dose in a calendar year to “employees working with ionising radiation” on nuclear licensed site - Target 2 in HSE SAPs.</p>	<p>Of order &gt; 20 mSv <math>y^{-1}</math>, if exposure occurs.</p> <p>This level exceeds the Basic Safety Level Legal Limit for average effective dose in a calendar year to “employees working with ionising radiation” on nuclear licensed site - Target 2 in HSE SAPs.</p>

**TABLE 9 (CONTINUED) DESCRIPTORS FOR ‘POTENTIAL SEVERITY OF CONSEQUENCE’ (CONTINUED)**

	<b>Inconsequential</b>	<b>Negligible</b>	<b>Mild</b>	<b>Moderate</b>	<b>Severe</b>
<b>Harm to Humans (Health Risks from Non-Radioactive Contamination)</b>	No acceptable risk to human health  May be demonstrated by being much less than GACs (SGVs, LQA/CIEH etc.) or indistinguishable from background.	Minimal risk to human health, if exposure occurs, and no perceptible nuisance.  May be demonstrated by non-exceedance of GACs (SGVs, LQM/CIEH etc).	Minimal risk to human health, if exposure occurs, and no perceptible nuisance. (e.g. odour from VOC).  Could be compatible with some minor exceedances of GACs (SGVs, LQM/CIEH etc).	Non-permanent (reversible) health effects to humans, if exposure occurs.	“Significant Harm” as defined for Part IIA is certain, if exposure occurs (Death, disease, serious injury, genetic mutation, birth defects or impairment of reproductive functions).
<b>Harm to Flora and Fauna (Rad and/or Non-Rad)</b>	No significant changes to population densities in the environment or in any ecosystem.	Some change to population densities but with no negative effects on the function of the ecosystem.	A change to population densities of non-sensitive species.	Irreversible adverse change in ecosystem functioning, or danger to population of a species of special interest, for a designated site.	Widespread extinctions of one or more species.
<b>Harm to Property (Rad and/or Non-Rad)</b>	No noticeable effect on crop yield, no harm to domestic animals or damage to other property.	Minor effect on a crop yield.  No noticeable harm to domestic animals or damage to other property.	Noticeable effect on crop yield. Reversible impairment to the health of domestic animals. Minor damage to other property.	Substantial diminution (<20%) of crop yield. Death, serious disease to domestic animals. Repairable damage to other property.	Agricultural land taken out of production.
<b>Harm to Buildings (Rad and/or Non-Rad)</b>	Not distinguishable from Negligible.	No noticeable or actual harm to buildings or structures.	Easily repairable effects of damage to buildings or structures.	Damage to sensitive buildings or structures.	Serious physical damage to other property rendering it unusable for intended purpose. Any part of a building becomes unusable for its intended purpose, or significant impairment of a scheduled monument.
<b>Pollution of the Water Environment (Rad and/or Non-Rad)</b>	Concentrations of contaminants measured are marginally above background levels or indistinguishable from background.	Concentrations at least ~ 10 times less than the most restrictive potentially relevant water quality standard.	Concentrations at, or just below the most applicable water quality standard.	Concentrations slightly above the most applicable water quality standard.  Concentrations in the water environment that result in dose rates $>400\mu\text{Gy h}^{-1}$ to aquatic organisms or $>40\mu\text{Gy h}^{-1}$ to terrestrial organisms. For example, minor unauthorised discharge of radioactivity from the site occurs, of small environmental consequence.	Concentrations well above the most applicable water quality standard.
<b>Regulatory Infringement</b>	No regulatory infringement.	No regulatory infringement.	For example, approaching the discharge limit of the authorisation.		For example, unauthorised discharge of radioactivity from the site occurs, of direct environmental consequence.

Table taken from NDA Direct Research Portfolio Report TSG(20)0664.

**TABLE 10 CONTAMINANT/POLLUTANT LINKAGE EVALUATION TEMPLATES**

<b>Risk Assessment</b>	<b>Comment assuming Likely or High Likelihood of Pollutant Linkage Occurrence</b>	<b>Action Required</b>
Category 1	Site probably not suitable for present use and / or environmental setting. Contaminants probably or certainly present and probably have an unacceptable impact on identified sensitive receptors.	Urgent action required in the short term.
Category 2	Site may not be suitable for present use and / or environmental setting. Contaminants probably or likely to be present, and may have an impact on identified sensitive receptors.	Action may be needed in the short term to medium term.
Category 3	Site considered likely to be suitable for present use and / or environmental setting. Contaminants may be present but unlikely to impact sensitive receptors identified.	No immediate action needed while site remains in present use and remains undisturbed. Management options to prevent land contamination may need to be implemented in order to reduce the hazard of land contamination.
Category 4	Site considered suitable for present use and / or environmental setting. Contaminants may be present but very unlikely to have an unacceptable impact on key targets.	No action needed while site remains in present use and remains undisturbed. In general management options to prevent land contamination are likely to be sufficient, although a review of preventative measures should be undertaken periodically.