

DRAFT FOR COMMENT

# SAFEGROUNDS

## Good Practice Guidance for the Management of Contaminated Land on Nuclear and Defence Sites, Version 2 (LMGv2)

**First full draft**

September 2007

### VERSION CONTROL

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## **Executive summary**

An executive summary will be added at the second draft stage.

## **Foreword**

A foreword will be added at the 2<sup>nd</sup> Draft Stage.

## **Acknowledgements**

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[Other acknowledgements to be added]

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# **PART 1 INTRODUCTION AND OVERVIEW**

## **1 INTRODUCTION**

### **1.1 Scope**

The guidance focuses on the two major types of *site*<sup>1</sup> on which radioactive contamination is likely to be found:

- *nuclear-licensed sites*; and
- non-nuclear *defence sites*.

Nuclear-licensed sites include civil nuclear sites that are being used for electricity generation or other purposes, defence nuclear sites that are being operated for MoD by contractors, and nuclear sites that are being decommissioned and are the responsibility of the NDA. Most of the radioactive contamination on such sites is from past activities and has been there for years or decades.

The most common source of radioactive contamination on non-nuclear defence sites is the production, maintenance and disposal of luminised instruments for vehicles, aircraft and ships. The peak period for luminising was from the 1930s to the 1970s. MoD has a programme of work to assess land quality across the defence estates to ensure that it is suitable for use and not causing harm to human health or the *environment*. Action is taken to manage sites where contamination is an issue.

This guidance is for radioactive, non-radioactive and mixed contamination on nuclear-licensed sites and those non-nuclear defence sites on which there is radioactive contamination. It does not apply to non-nuclear defence sites on which there is only non-radioactive contamination.

Most of the guidance is about radioactive contamination and mixed contamination, including interactions between radioactive and non-radioactive contaminants, and how the presence of radioactive contamination can influence the management of non-radioactive contamination. There is a considerable amount of other guidance on managing land that only has non-radioactive contamination and this is signposted, as is guidance for unique aspects of defence sites (eg the possible presence of explosives and ordnance).

For completeness, limited guidance is given for other types of site on which there is, or could in future be, radioactive contamination. These are:

- nuclear defence sites that would be nuclear-licensed sites if the Nuclear Installations Act 1965 applied to the MoD (these are called here 'non-licensed nuclear defence sites');
- former and current industrial, medical and research sites on which there is long-standing radioactive contamination from past activities; and
- land outside the other types of site that has recently been contaminated by a nuclear accident or radiological emergency.

In the last of these cases the guidance is for dealing with radioactive contamination in the longer term, after short and medium term countermeasures have been taken and when the land is being restored or prepared for new uses.

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<sup>1</sup> Italics indicate glossary definition for the term (used on first usage of the term)

For all types of site, the guidance covers strategic approaches for all the *contaminated land* on a site and case-by-case approaches for specific areas.

## 1.2 Purpose

The guidance has been developed primarily to help those responsible for the management of contaminated land and inform other *stakeholders*. It also supplements government and regulatory guidance on the management of contaminated land.

The guidance deals mainly with general approaches and focuses on issues outside of the technical sphere that practitioners need to be aware of when planning and carrying out their work. The guidance is intended to be relevant both in planning the future management of contaminated land (including making liability estimates) and in managing the land in practice. It can be used in the strategic planning for the overall management of contaminated land on a site, as well as being applied to specific situations or cases.

Importantly, it takes account of the variety of situations which can exist on nuclear-licensed sites and defence sites. It is not intended to be prescriptive.

## 1.3 Status

This is the second version of the guidance and like the first it is a living document that it is intended to be revised at intervals in the future in the light of experience in using it and in response to policy, regulatory and other changes.

The guidance is not binding on site owners/operators and has no legal standing. Participation in SAFEGROUNDS (by organisations or individuals) must not be taken as an indication of support for, or disagreement with, the whole of the guidance.

[Decisions on the nature and prominence of these statements will be taken at a later stage in the drafting process]

## 1.4 Structure

The guidance is structured in four parts:

- Part 1 contains this introduction, the SAFEGROUNDS *key principles* for the *management of contaminated land* on nuclear and defence sites, and an overview of the process of managing contaminated land.
- Part 2 contains guidance for the whole of the management process, in general and for the various types of site.
- Part 3 contains guidance for each stage in managing contaminated land, in general and for the various types of site.
- Part 4 contains a list of references, in which the most important ones are highlighted (eg statutory and regulatory guidance documents), and a glossary, including a key to acronyms).

As described above, the guidance deals mainly with general approaches to the management of contaminated land. More detailed guidance on specific topics is provided in the following SAFEGROUNDS supporting documents:

- *Guide to the comparison of land management options* (Penfold, 2007) - this document provides information on methodologies appropriate for the identification of a preferred land management option for a particular site and situation. The focus is on practical guidance and specific advice on application.

- *Guidance for site characterisation guidance* (Baker et al, 2000) – this is a largely technical document providing specific guidance on the process of site characterisation.
- *Guidance on assessments of health and environmental risks of management options for contaminated land* (Smith, 2005) – this guidance focuses on risk assessments that are to be carried out as part of comparisons of land management options, as input to the identification of the preferred land management option.
- *Guidance for land quality records management for nuclear-licensed and defence sites* (Cruickshank & George, 2007) – this document provides guidance on land quality records and record keeping, addressing why information should be kept, what information should be kept and how record keeping systems should be structured and maintained.
- The UK regulatory framework for contaminated land on nuclear-licensed and defence sites Paper (new version about to be published on the website) – this information paper provides a factual summary of the key features of the UK regulatory framework for the management of contaminated land on nuclear-licensed and defence sites.

These supporting documents are essentially for a technical audience. In response to requests from community groups a complementary 'Citizens' Guide' (Collier, 2007) has been produced that provides a non-technical overview of the principles which underpin the SAFEGROUNDS guidance and the approach it recommends to decision-making and community involvement. It has been prepared for *people* with little technical knowledge and technical people whose background is from outside the civil and defence nuclear industries. SAFEGROUNDS have also produced guidance on community stakeholder involvement (Collier, 2005)

## 1.5 Definitions

### 1.5.1 Contaminated Land

The guidance uses the terms contaminated land, *radioactively contaminated land* and *non-radioactively contaminated land* with the following meanings:

*contaminated land* – any land in, on or under (including groundwater) which there are radioactive or non-radioactive contaminants above natural and artificial background levels that are typical of the area of the UK in which the site is located.

*radioactively contaminated land* – any land in, on or under (including groundwater) which there are radioactive contaminants above natural and artificial background levels that are typical of the area of the UK in which the site is located.

*non-radioactively contaminated land* – any land in, on or under (including groundwater) which there are non-radioactive contaminants above natural and artificial background levels that are typical of the area of the UK in which the site is located.

These definitions are for the purposes of SAFEGROUNDS only. They have been chosen because they best reflect the views of stakeholders on the levels of contamination with which the SAFEGROUNDS guidance should be concerned.

Guidance on determining background levels typical of an area is given in Section 10.2 and expanded in the site *characterisation* guidance (Baker et al, 2000).

Where it is necessary to refer to other definitions in statutory, government or regulatory guidance quotation marks are used and the source of the definition given, eg “contaminated land” as defined in the Part 2A regime for England and Wales. Details of these other definitions are given in the Regulatory Framework Paper (Hill, 2007).

#### 1.5.2 Management and Remediation of Contaminated Land

The terms *management* (of contaminated land) and *remediation* (of contaminated land) have the following meanings in this guidance:

*management of contaminated land* – the taking of any actions to detect, characterise, control, monitor or remove (wholly or partially) contamination in, on or under land (including the groundwater), and all the processes that lead up to decisions to take such actions.

*remediation of contaminated land* – the taking of any actions to reduce the risks to humans or other organisms from contamination in, on or under land (including the groundwater).

These definitions are for the purposes of SAFEGROUNDS only and have been chosen to be consistent with the scope of SAFEGROUNDS guidance. With the definition above, remediation is a part of management, because control or removal of contamination reduces risks. Prevention of contamination is excluded from management because it is outside the scope of SAFEGROUNDS.

Where it is necessary to refer to other definitions in statutory, government or regulatory guidance quotation marks are used and source of the definition given, eg “remediation” as defined in the HSE safety assessment principles (SAPs). Details of these other definitions are given in the Regulatory Framework Paper.

#### 1.5.3 Strategies and Options for the Management of Contaminated Land

In this guidance an *option* is a method, approach or technology that can be used for the management of a specific area of contaminated land. A *strategy* is a broad plan for the management of all the contaminated land on a site. It will often include different options for various areas within the site.

#### 1.5.4 Stakeholder Involvement

*Stakeholders* are all the people with an interest in the management of the contaminated land. They include regulators, local authorities, government departments (both central and devolved administrations), site owners, site operators, local residents, community based organisations (CBOs) and non-governmental organisations (NGOs).

*Involvement* includes communication, provision of information, consultation and participation in decision-making processes. It does not include taking final decisions on how to manage contaminated land because these are always the sole responsibility of the site owner or operator (on nuclear-licensed sites the *licensee* and on defence sites MoD). Within SAFEGROUNDS the term “involvement” is used in preference to “engagement”. This is because “engagement” usually includes communication, provision of information and consultation, but excludes participation in decision-making processes.

The extent to which stakeholders can participate in decision-making processes for contaminated land is addressed in Section 7.

## KEY PRINCIPLES FOR THE MANAGEMENT OF CONTAMINATED LAND

SAFEGROUNDS has identified five key principles for the management of contaminated land on nuclear and defence sites. The principles are complementary and apply at various stages in land management (see Section 3). They are:

### **Principle 1: Protection of People and the Environment**

*The fundamental objective of managing contaminated land on nuclear-licensed sites and defence sites should be to achieve a high level of protection of people and the environment, now and in the future.*

### **Principle 2: Stakeholder Involvement**

*Site owners/operators should involve stakeholders in the planning and decision-making processes for the management of contaminated land.*

### **Principle 3: Identifying the Preferred Land Management Option**

*Site owners/operators should identify their preferred management option (or options) for contaminated land by carrying out a comprehensive, systematic and consultative assessment of all possible options. The assessment should be based on a range of factors that are of concern to stakeholders, including health, safety and environmental impacts and various technical, social and financial factors.*

### **Principle 4: Immediate Action**

*Site owners/operators should take measures immediately to monitor and control all known (or suspected) contamination and continue such measures until an acceptable management option has been identified and implemented.*

### **Principle 5: Record-Keeping**

*Site owners/operators should make comprehensive records of the nature and extent of contamination, the process of deciding on the management option for the contaminated land and the findings during the implementation and validation of the option. All records should be kept and updated as necessary.*

The application of each principle is discussed mainly in the following sections of this document:

Principle 1	Section 6 ' <i>Protection of people and the environment</i> '
Principle 2	Section 7 ' <i>Stakeholder involvement</i> '
Principle 3	Section 11 ' <i>Establishing long-term management strategies and options</i> '
Principle 4	Section 10 ' <i>Planning and short-term actions</i> '
Principle 5	Section 8 ' <i>Record Keeping</i> '

### 3. OVERVIEW OF THE PROCESS OF MANAGING CONTAMINATED LAND

Figure 1 shows a generic flow diagram for the management of contaminated land. In the diagram, P1, P2 etc are the key principles (see Section 2).

Principles 2 (stakeholder involvement) and 5 (record-keeping) apply throughout the land management process and are therefore included in the vertical boxes to the right and left of the land management stages in Figure 1. The arrows between the boxes for these principles and the boxes for the various land management stages are all two-way. This reflects the on-going processes of stakeholder involvement including communication, consultation and participation, and the need for site owners/operators to continuously use records, as well as make records (see Section 8 and Record Keeping Guidance (Cruickshank & George, 2007)).

It should be noted that in practice, several parts of the whole land management process (Stages 1-6) are iterative. For simplicity, these have been omitted from the generic diagram in Figure 1. An example would be the review of the long-term management strategy for the site in the light of experience obtained in implementing options for specific areas.

#### **Stage 1: SAFEGROUNDS application**

The process begins with a decision as to whether this guidance applies (box 1 in Figure 1). It applies if it is known or suspected that radioactive contamination is present on the site, with or without non-radioactive contamination. In this context, 'radioactive contamination' is defined to be any concentration of radionuclides above the ubiquitous natural and artificial background for the area in which the site is located (see Section 1.5.1). The guidance does not apply if it is certain that there is only non-radioactive contamination on the site.

The arrow to and from 'stakeholder involvement' represents asking some stakeholders whether there is information about possible radioactive contamination, then providing feedback to all stakeholders on the known or suspected radioactive contamination on the site. In practice stakeholders may not be asked for information or informed that radioactive contamination is known or suspected to be present until later, when they are consulted about the site owner's/operator's plans for how to proceed.

At this stage the site *owner/operator* should identify the relevant legislation and statutory and regulatory guidance as soon as possible after deciding that the SAFEGROUNDS guidance applies (see Section 5).

#### **Stage 2: Formulation of plans**

The next stage is the formulation of plans (box 2 in Figure 1) for stakeholder involvement throughout the rest of the land management process. Site characterisation, record-keeping and decision taking on short-term and long-term strategies for the management of the contaminated land should also be planned.

The appropriate level of stakeholder involvement varies from one type of site to another and from one stage in land management to another. The stakeholder involvement strategy should be tailored to the situation (see Section 7).

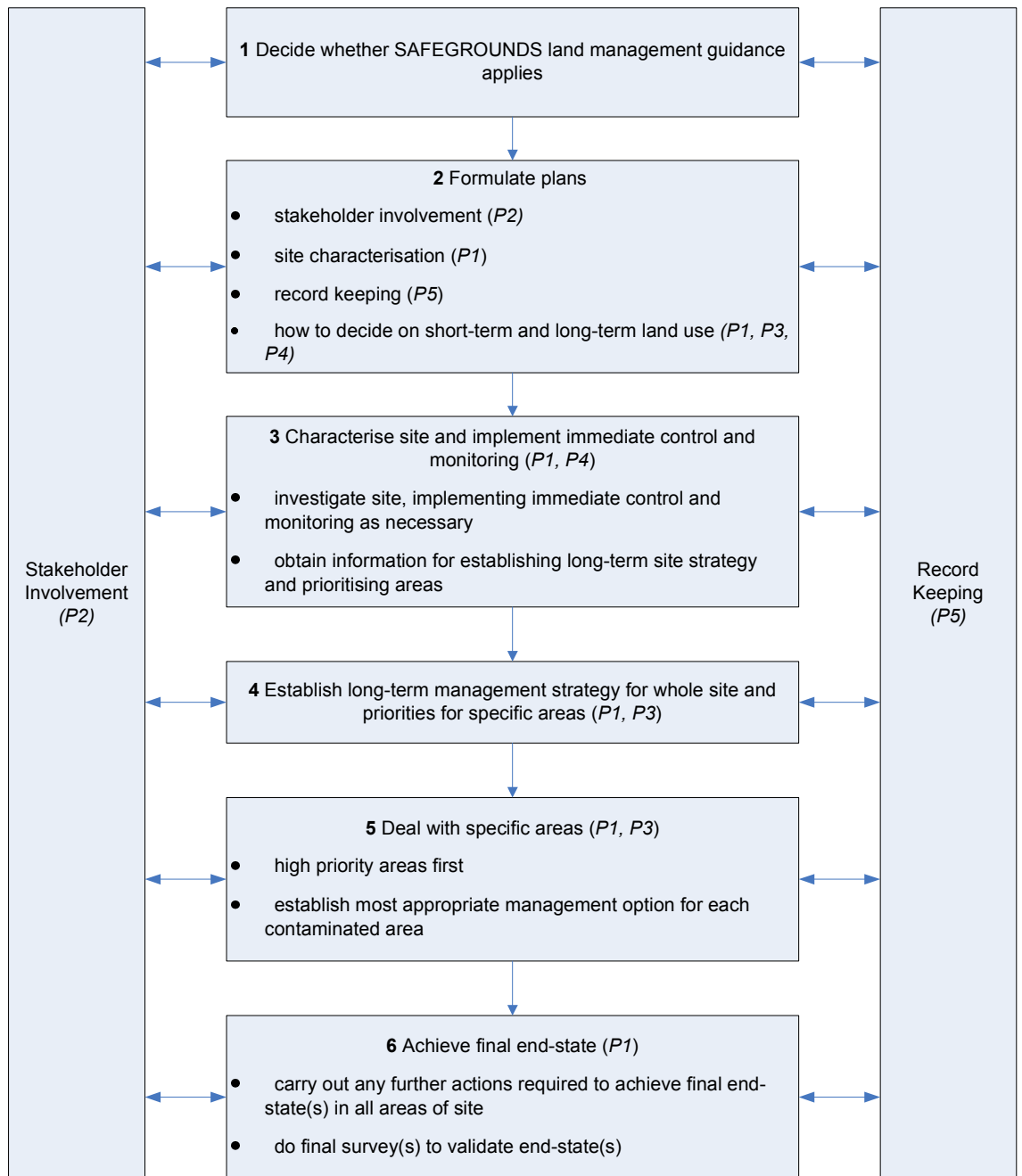
It is good practice to consult stakeholders about site characterisation plans because they may have views on, for example, the contaminants of concern and

the techniques to be used (see Section 10.2 and Site Characterisation Guidance (Baker et al, 2000)).

**Stage 3: Characterisation and immediate control and monitoring**

Characterisation will take place, followed by the preparation of a short-term strategy for managing the contaminated land. This will comprise immediate control and monitoring measures, and criteria for deciding when to implement such measures in a particular area (see Section 10). Information gathering for the development of a long-term management strategy and area prioritisation will also be undertaken at this stage.

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



### Stages 4 & 5: Long-term strategy and area management

There are several steps in establishing the most appropriate long-term management strategy for a site or the most appropriate management option for an area within a site (boxes 4 and 5 in Figure 1):

- defining the objectives, assumptions and *constraints* for the options comparison;
- identifying potential options, screening and selecting the set for assessment;
- determining the assessment criteria;

- assessing the options (*scoring*);
- comparing the options; and
- deciding on final option or progressive development of strategy with increasing level of detail.

Stakeholders should be involved to some extent in all these steps. Further information on the assessment and comparison process, including how stakeholders can be involved in options comparisons, is provided in SAFEGROUNDS supporting guidance on the comparison of land management options (Penfold, 2007)

Impacts of health and environmental risks will be assessed as soon as enough site characterisation data are available. They are particularly important for providing input to prioritisation of areas and comparisons of potential management strategies and options. SAFEGROUNDS supporting document on assessments of health and environmental risks gives further guidance on the types of assessment required at each stage (Smith 2005)<sup>2</sup>.

### **Stage 6: Achievement of end-state**

The last stage in the land management process is to achieve the final end-state, ie the one beyond which no further action is required. There may be one final end-state for a whole site or different final end-states for various areas.

Where the chosen long-term management option does not achieve the final end-state (box 6) at the time of option implementation, then further action may be needed (e.g. if it is long-term control and monitoring to allow radioactive decay). This may be many years later and may involve the removal of residual contamination.

In all cases a final survey or surveys should be performed to validate that the final end-state has been achieved in all areas of a site.

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<sup>2</sup> Scheduled for update in 2008

## **PART 2    GUIDANCE FOR THE WHOLE PROCESS OF MANAGING CONTAMINATED LAND**

### **4    IDENTIFYING MANAGEMENT STAGES**

It is recommended that site owners/operators prepare a site-specific flow diagram for the management of contaminated land on their site. The complexity of the diagram should be consistent with the patterns of contamination that are known or anticipated to be found.

For sites with only one or two areas of contamination, or with relatively uniform contamination over the whole site, the generic diagram in Figure 1 could be used.

Figure 2 shows the type of diagram that would be appropriate for a complex site, such as one of the older nuclear sites on which there have been many different types of activities over several decades.

The differences between the diagrams are in the number of stages involved in site characterisation, establishing management strategies, and implementing them across various areas of a site. On nuclear licensed sites, the route to deciding the management strategy will be complex, since this is driven by the need for prioritisation stemming from HSE's SAPs.

The flow diagram is expanded for complex sites in stages 3-5. Characterisation in the generic diagrams (part of Stage 3) is expanded to take account of a phased approach for a complex site. Initial characterisation still takes place in Stage 3, but further more detailed characterisation occurs subsequently in Stage 7 and Stage 12. Phasing allows assessment and review of each information gathering stage, enabling targeting of resources for further characterisation and/or remediation.

As a result of the initial characterisation a conceptual model is developed and risk assessment performed. Zonation occurs in Stage 4 for complex sites to create more manageable areas. Where contamination is found that presents an immediate risk, due to activity or concentration and the contaminant's mobility, then early control and monitoring are implemented.

The second part of the generic Stage 3 requires information to be obtained for establishing a long-term site strategy and for prioritising areas. Again in the complex site the approach is a phased development of the strategy. Short term management, if necessary, is developed in Stage 5 taking care not to compromise long-term activities. Stage six is an opportunity for review and re-appraisal.

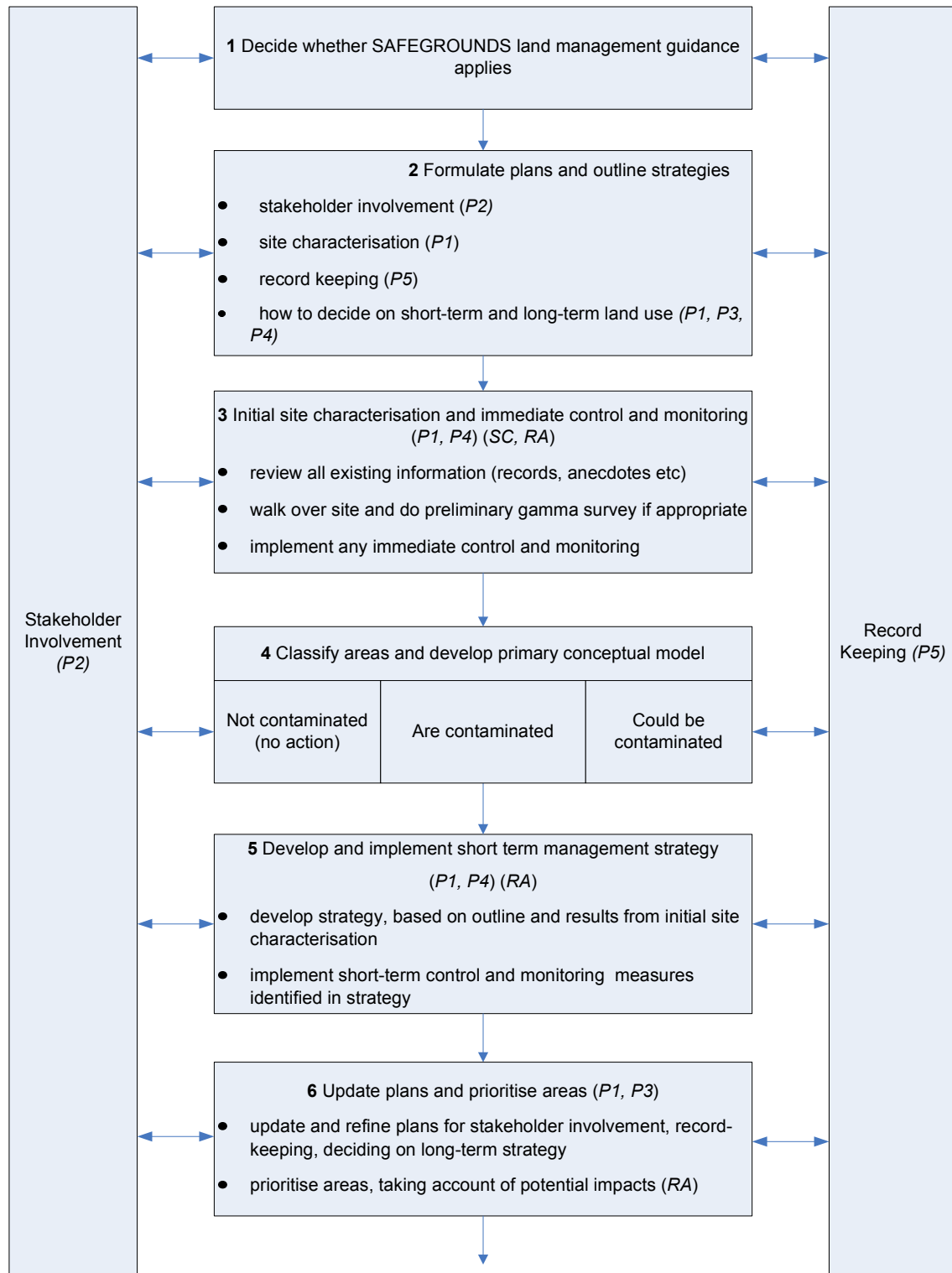
Establishment of the long-term management strategy for the whole site in the generic flow diagram equates to the detailed characterisation (Stage 7) and options assessment in (Stage 8) for the site. Then the most appropriate management option is established for each area, with high priority areas being tackled first.

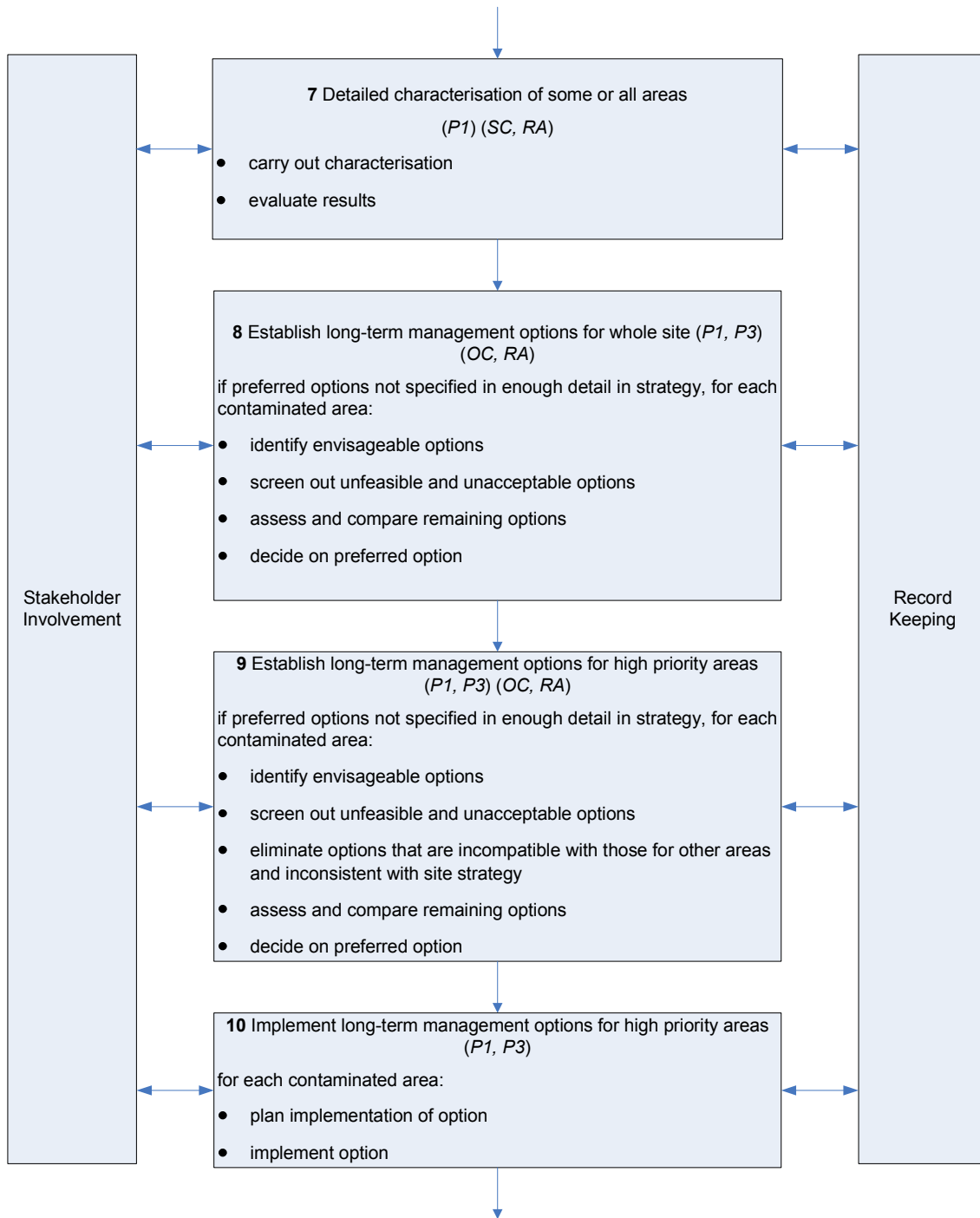
On complex sites further options assessment, may need to take place (Stage 9) before implementation (Stage 10), and validation (Stage 11). The lower priority areas may subsequently be processed (Stages 12-15). Therefore Stage 5 in the generic flow diagram equates to seven stages (9-15) in the complex flow diagram, although this management process should be sufficiently flexible in practice to accommodate whatever sequencing variations and iterations are appropriate for the site.

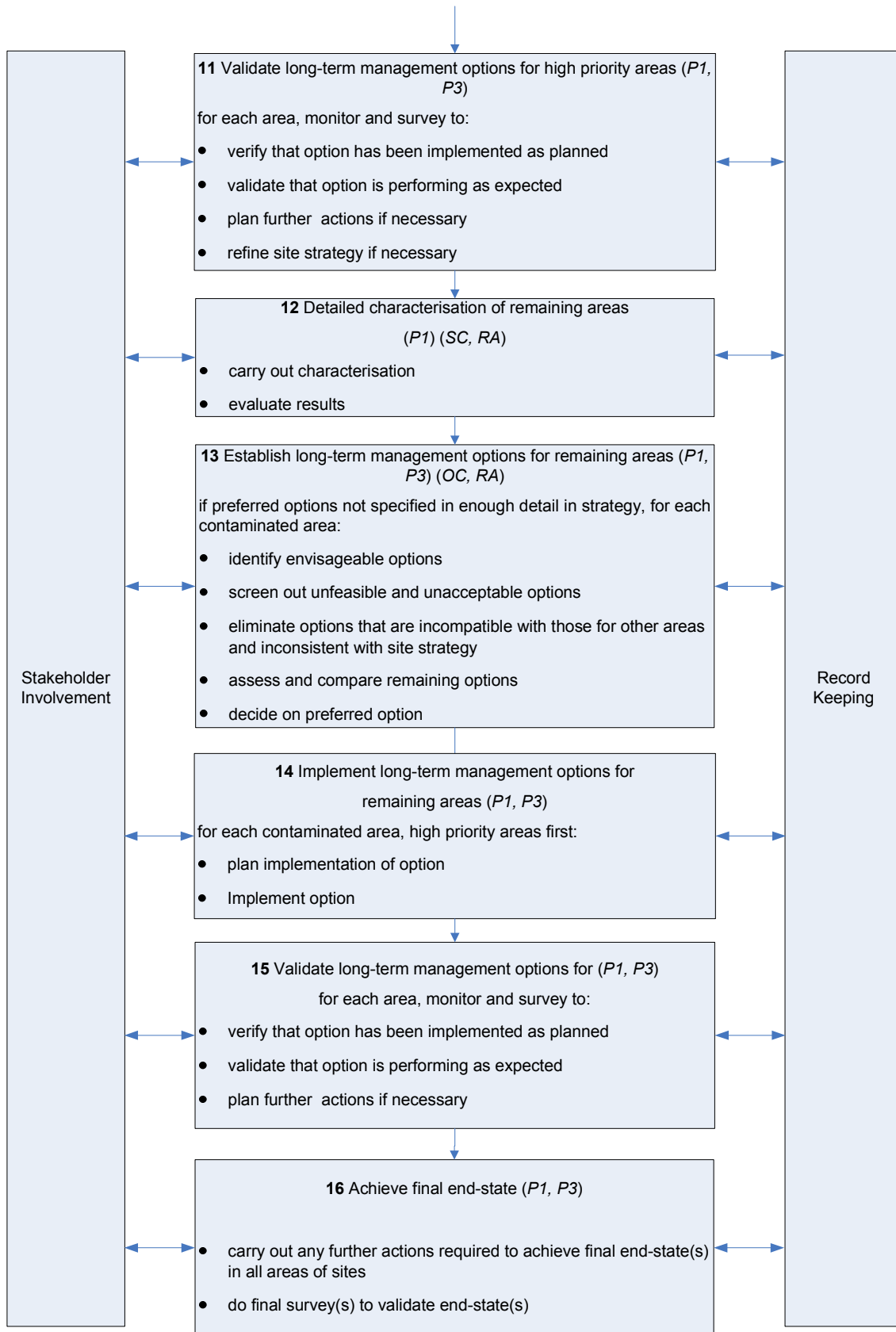
On all sites it is essential that the short-term and long-term strategies for the management of contaminated land are consistent with the objectives and plans for

the whole site. For example, on a nuclear-licensed site that is being decommissioned, the contaminated land management strategy should be consistent with the *decommissioning* strategy for the site, including the chosen end-state(s), and the integrated waste strategy.

**Figure 2 Flow Diagram for Complex Sites**







## **Key to Figure 2**

P1, P2 etc are the SAFEGROUNDS key principles for the management of contaminated land.

SC, RA and OC are the supporting documents for the SAFEGROUNDS land management guidance:

SC – site characterisation

RA – assessments of health and environmental risks

OC – comparisons of land management options

## 5 REGULATORY REGIMES AND GUIDANCE

Once it has been established that there is, or could be, radioactively contaminated land on a site, the site owner/operator should identify the relevant regulatory regime, legislation and statutory, government and regulatory guidance.

The regimes, regulators and guidance are identified in Tables 1, 2 and 3. Further details are in the Regulatory Framework Paper (Hill 2007) and in the regulatory area of the SAFEGROUNDS website<sup>3</sup>.

For radioactively contaminated land on nuclear-licensed sites the principal regime is that of the Nuclear Installations Act 1965 (including relevant Site Licences), the principal regulator is HSE and the main guidance document is the HSE safety assessment principles (SAPs).

For non-radioactively contaminated land on nuclear-licensed sites the principal regime is that of Part 2A of the Environmental Protection Act 1990, and the principal regulators are the Environment Agency and SEPA. When the site is *delicensed* and used for other purposes the planning regime applies. See Table 3 for the main guidance documents for these regimes.

For all contaminated land on non-nuclear defence sites the principal regimes are those of Part 2A of the Environmental Protection Act 1990 (if no change of land use is proposed or if a site had an historic defence use) and of planning legislation (if a change of land use is proposed). The principal regulators are the environment agencies (Environment Agency, SEPA, EHS(NI), local authority environmental health departments and local authority planning departments).

Nuclear safety on non-licensed nuclear defence sites is regulated by MoD's Defence Nuclear Safety Regulator (DNSR), using essentially the same principles as in the HSE SAPs (HSE 2006). Part 2A for radioactive and non-radioactive contamination also applies with the environment agencies as regulators.

The situation on other sites with long-standing contamination is as for non-nuclear defence sites. In addition, the Radioactive Substances Act also applies for the disposal of radioactive wastes from land investigations and remediation.

Nuclear sites, defence sites and sites contaminated by radioactivity are included within the definition of a 'special site' under Part 2A. The Environment Agency, in agreement with the local authority, becomes the enforcing authority for a 'special site' if the land is contaminated.

Land contaminated by a radiological emergency would be regulated under Part 2A by the environment agencies if it met the criteria for "radioactive contaminated land" under Part 2A. New regulations are anticipated for land contaminated by an accident at a nuclear site (More to be added when regulations appear later this year).

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<sup>3</sup> For more information consult [http://www.safegrounds.com/rf\\_overview.htm](http://www.safegrounds.com/rf_overview.htm)

**Table 1 Regulatory Regimes**

Type of site	Radioactive contamination	Non-radioactive contamination	Mixed contamination
1. Nuclear-licensed sites			
1.1 operational sites	NIA, (RSA)	Part 2A	NIA, (RSA), Part 2A
1.2 sites to be delicensed	NIA, (RSA), (planning regime)	Part 2A, (planning regime)	NIA, (RSA), Part 2A , (planning regime)
2. Defence sites (non-nuclear)			
2.1 no change of land use proposed	Part 2A, (MoD)	Part 2A	Part 2A, (MoD)
2.2 change of land use proposed	planning regime, (RSA)	planning regime	planning regime, (RSA)
3. Non-licensed nuclear defence sites	MoD, Part 2A	Part 2A	MoD, Part 2A
4. Other sites with long-standing radioactive contamination			
4.1 no change of land use planned	Part 2A, (RSA)	Part 2A	Part 2A, (RSA)
4.2 change of land use planned	planning regime, (RSA)	planning regime	planning regime, (RSA)

Key

NIA – Nuclear Installations Act 1965 (as amended)

RSA – Radioactive Substances Act 1993 (as amended)

Part 2A – Part 2A of the Environmental Protection Act 1990 (and associated Regulations and Statutory Guidance)

planning regime – see PPS 23 for England, PAN 33 for Scotland, WLGA et al guidance for Wales

Regimes in parenthesis are relevant but subsidiary.

**Table 2 Principal Regulators**

	<b>Radioactive contamination</b>	<b>Non-radioactive contamination</b>	<b>Mixed contamination</b>
<b>Nuclear-licensed sites</b>	HSE	Environment Agency, SEPA	HSE, Environment Agency, SEPA
<b>All defence sites (non-licensed)</b>	Environment Agency, SEPA, EHS(NI), MoD, HSE	Environment Agency, SEPA, EHS(NI)	Environment Agency, SEPA, EHS(NI), MoD, HSE
<b>Other sites with long-standing contamination</b>	Environment Agency, SEPA, EHS(NI), local authorities	Local authorities (environment agencies on “special sites”)	Environment Agency, SEPA, EHS(NI), local authorities

Key

HSE – Health and Safety Executive (in Great Britain, Northern Ireland has its own agency, the Health and Safety Executive for Northern Ireland (HSE(NI)))

SEPA – Scottish Environment Protection Agency

MoD – Ministry of Defence

EHS(NI) – Environment and Heritage Service (Northern Ireland)

Note

There are no nuclear-licensed sites in Northern Ireland.

**Table 3 Statutory, Government and Regulatory Guidance**

<b>Regime</b>	<b>Guidance documents</b>	
	<i>Short ref.</i>	<i>Full reference</i>
NIA65	HSE SAPs	HSE, 2006. <i>Safety Assessment Principles for Nuclear Facilities</i> . 2006 Edition.
Part 2A	Defra, 2006	Defra, 2006. <i>Environmental Protection Act 1990: Part 2A Contaminated Land. Statutory Guidance</i> . Defra Circular 01/2006. London, Defra.
	SE, 2006	Scottish Executive, 2006. <i>Environmental Protection Act 1990: Part IIA Contaminated Land. Statutory Guidance: Edition 2</i> . Paper SE/2006/44.
	WAG, 2006	Welsh Assembly Government, 2006. <i>Part 2A Statutory Guidance on Contaminated Land (2006)</i> .
Planning	PPS 23	ODPM, 2004. <i>Planning Policy Statement 23: Planning and Pollution Control, Annex 2: Development on Land Affected by Contamination</i> .
	PAN 33	Scottish Executive, 2000. <i>Planning Advice Note 33. Development of Contaminated Land</i> .
	WLGA et al, 2006	Welsh Local Government Association, Welsh Assembly Government and Environment Agency, 2006. <i>Land Contamination: A Guide for Developers</i> .
RSA	EA, 2002	Environment Agency, 2002. <i>Environment Agency Guidance on the Characterisation and Remediation of Radioactively Contaminated Land</i> .
	REPs	Environment Agency, 2005. <i>Radioactive Substances Regulation Environmental Principles (Interim). A framework for technical decisions and technical guidance on radioactive substances regulation. Version 1</i>
Part 2A & Planning, Non-Radioactive Contaminated Land	CLR11	Environment Agency and Defra, 2004. <i>Model Procedures for the Management of Land Contamination</i> . Contaminated Land Report 11

## 6 PROTECTION OF PEOPLE AND THE ENVIRONMENT

*The fundamental objective of managing contaminated land on nuclear-licensed sites and defence sites should be to achieve a high level of protection of people and the environment, now and in the future.*

### 6.1 General

In Key Principle 1, 'protection of people' refers to the health and well-being of the public and workers. The 'environment' includes land, water, air, flora, fauna, buildings, animals, crops and sites of historical and cultural importance.

It should not be assumed that protecting people protects the environment or vice versa. The balance between protecting people and protecting the environment has to be resolved in the process of identifying the preferred land management option (see Principle 3). This process should include the identification of appropriate indicators for monitoring any environmental change.

It is necessary to protect people and the environment both from expected situations and those with only a chance of occurring. This means taking measures, if needed, to reduce the likelihood of adverse effects occurring as well as reducing the effects themselves.

In deciding what is a 'high level' of protection (see Key Principle 1) account should be taken of important scientific uncertainties (for example, about the effects of radioactive and non-radioactive contaminants on human health). Differences of view amongst stakeholders about such issues should be recognised and given explicit consideration in decision-making processes.

Protection of people and the environment in the future should be at least to the same standards as used today. This is essential to uphold the concept of 'sustainability'.

Management strategies and options that would reduce contaminant concentrations to levels close to background should always be considered, because these achieve the highest level of protection of people and the environment from the contaminated land. The amount of consideration given to such strategies and options will vary from site to site. In some cases they will be screened out as not practicable; in others they will be assessed in detail and compared to other strategies and options on a range of *attributes*.

Where the regulatory regime allows, the range of strategies and options considered should also include some that just make the site suitable for its present use, or next planned use if that it is to be different.

### 6.2 Levels of Protection from Radioactively Contaminated Land

It is inherent in the principles of As Low As Reasonably Achievable (ALARA) and As Low As Reasonably Practicable (ALARP) that 'acceptable risk' is a relative, not an absolute concept, and that it is situation-specific, not generic. Both ALARA and ALARP require assessment and comparison of options for taking action to reduce radiation risks. The acceptable level of risk for the situation in question is the one corresponding to the option that emerges from the assessment and comparison as preferred on a range of factors.

For radiation exposure, the concept of 'unacceptable risk', or more usually 'intolerable risk', is primarily used in the context of levels above which action must be taken to reduce the risk, whatever the circumstances. For example, dose limits are set to be the boundary between what is tolerable and what is not in routine

situations, and they should never be exceeded. It does not follow that any risk below the intolerable level is acceptable. Further action is always needed below the intolerable level, in the form of an assessment and comparison of options to find out whether action should be taken so as to reduce the risks to ALARA or ALARP.

That said, there is a level of radiation risk to human health that is considered by regulators to be 'broadly acceptable' to society in the UK. This level is a risk of death to an individual of one in a million per year (NRPB 1998, HSE 2001a and 2005, EA and Defra 2004). ALARA and ALARP still apply if risks are assessed to be below one in a million, but only to the extent that it should be shown that there are no low cost actions that could be taken to reduce risks. Figure 3 shows regulatory risk standards.

With this background it is clear that there is no one level of protection that can be specified as appropriate for all radioactively contaminated land. This guidance recommends a case-by-case approach with stakeholder involvement. Here the level of protection is not selected in advance, but emerges from assessment and comparison of strategies or options for the management of the contaminated land. The level of protection is the one that the preferred strategy or option would achieve, if implemented.

This approach is recommended even if an assessment by the site owner/operator shows that risks are below the one in a million per year level. Differing views amongst stakeholders on the health risks from intakes of radionuclides, and on the risks per unit dose of external radiation, are thereby taken into account. Such differences of view are best addressed by involving stakeholders in assessments and comparisons of land management strategies and options. In this way it is possible to explore the practical implications of the various views on radiation risks for management of the land in question.

The case-by-case approach with stakeholder involvement is also recommended when radioactively contaminated land is investigated under the Part 2A regime. This includes radioactive contamination present on the land, but it is not "radioactive contaminated land" in the Part 2A sense (i.e. the individual doses from the land in its current use are below 3 mSv per year). In such cases there is no legal obligation on anyone to take further action. However, it is likely that some stakeholders will request that a more comprehensive *risk assessment* is undertaken, and that options for reducing risks are assessed. This may particularly occur if estimated doses are above constraints applied in other circumstances (eg the 0.3 mSv per year used for radioactive discharges). If the land does not meet the legal definition for Part 2A then no regulatory authority has powers to compel the landowner to act and any works would have to be voluntarily undertaken by the landowner(s) involved.

Part 2A makes the Local Authority responsible for determining whether they consider significant harm or significant possibility of such harm exists. It also states they must consider authoritative and scientifically based guidance in making their decision. Every potential Part 2A site should undergo a site specific risk assessment. In a Part 2A context the advice currently included on sites containing both radioactive and non-radioactive contamination is problematic, and may present a number of issues. These include the relative risks associated with radioactive and non-radioactive contamination, and the engagement with stakeholders to understand what represents an acceptable risk.

It has been necessary to incorporate some of the requirements of the Basic Safety Standards (BSS) Directive into the extension of the Part 2A regime. Radiological protection distinguishes between *practices* where radiation exposures can be

controlled and *interventions* where exposures are already present from either emergency, accidental or historical situations, and action may be needed to reduce them, especially as there is no benefit derived from the situation, in contrast to a *practice*. Under the extension of Part 2A, actions should be taken to reduce the exposure of individuals to radioactivity from land where this will do more good than harm. There is a subtle difference when considering urgent interventions, often associated with recent emergencies, where the management of the situation may have a different focus and time is a key aspect. Where the intervention is required due to legacy issues, particularly where the situation has been in existence for some time, there may be different pressures and a different focus. In both cases the approaches will often be informed by stakeholder involvement.

A consequence of the distinction between interventions and practices is that after intervention, the land could be in a different condition to that which would have arisen if the decision to clean up the land had been taken as part of a redevelopment process of an area previously used as a practice. This is because radiological protection philosophy acknowledges that the intervention can itself incur cost (including non-financial and social costs) as well as benefits. This balance needs to be taken into account in deciding whether intervention to reduce exposure of individuals is justified, and what level of risk reduction the remediation should seek to achieve (DEFRA 2006).

### **6.3 Levels of Protection from Non-Radioactively Contaminated Land**

The UK regulatory approach for non-radioactively contaminated land uses ‘unacceptable risk’ to mean the level of risk below which no action need be taken, and above which options for reducing risks should be assessed and compared [CLR11 EA, 2004, CLAN 6/06 Defra, 2006]<sup>4</sup>. It is acknowledged in the approach that stakeholders may have views on what constitutes an unacceptable risk from a particular non-radioactive contaminant. However, the recommended process for managing non-radioactively contaminated land does not contain any mechanism for taking such views into account in decision-making processes [CLR11 – EA, 2004].

A CLR 11 risk assessment for non-radioactively contaminated land can be one of three types: a preliminary risk assessment, a generic quantitative or a detailed quantitative assessment. Criteria used in an assessment can be either generic or site specific for determining what is an “unacceptable risk”. The criteria are absolute, i.e. they are not linked to any comparison of land management strategies or options. They are risk-based and expressed as guideline values of contaminant intakes or concentrations in soils [CLR11 EA, 2004, CLAN 6/06 Defra, 2006]. Figure 3 shows a comparison of the risk levels for non radioactive and radioactive contaminated land.

This approach was developed for the relatively large number of sites on which there is only non-radioactive contamination. On most of these sites remediation will be carried out in connection with redevelopment. Stakeholders can be involved through the planning regime consultation processes, rather than by any special means.

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<sup>4</sup> CLR11 – Environment Agency Contaminated Land Report 11, Model Procedures for the Management of Land Contamination (2004).

CLAN 6/06 – Defra Contaminated Land Advice Note 6/06, Soil Guideline Values: the Way Forward (2006).

**Figure 3 Illustration of Relationship of Acceptability of Radioactive and Non-Radioactive Contaminated Land Against Regulatory Risk Standards**

<i>Radioactively contaminated land</i>	<i>Non-radioactively contaminated land</i>
unacceptable/intolerable risks – action must be taken to reduce risks	unacceptable risks – action must be taken but this could be only further assessment of risks
<b>Risk Standard :10<sup>-5</sup> (3 mSv)</b>	
tolerable risks (potentially acceptable) – use ALARA/ALARP to determine what action to take (if any)	contaminant intake limits, soil guideline values etc
<b>Risk Standard: 10<sup>-6</sup></b>	
broadly acceptable risks – probably no action but check that there are no low cost actions that could reduce risks	acceptable risks – no action required

Although technically similar, the CLR11 approach is not consistent with regulatory approaches for radioactivity, particularly not with the ALARA and ALARP principles (see Section 6.2). If it is used for sites on which there is both radioactive and non-radioactive contamination (mixed contamination), the owners/operators should discuss and agree with stakeholders the criteria to be used to judge what are unacceptable risks, i.e. to decide when further action is necessary and when it is not. Stakeholders should be involved in assessments and comparisons of options for the management of non-radioactively contaminated land on such sites, in the same ways as they are involved for radioactively contaminated land.

During the last round of consultation on this document the responses received highlighted differences of opinion on the approach that the guidance should recommend for non-radioactive contamination. Some respondents were of the view that the CLR11 approach should be recommended whereas others agreed with the proposal that one approach should be used when radioactive and non-radioactive contamination is present, and that this should be the approach recommended in the LMG for radioactive contamination. The SAFEGROUNDS project steering group agreed that alternative texts for section 6.3 be included in the first draft of the document and that comments be invited through the consultation. The alternative texts are as follows:

Option 1:

On each site where there is radioactive and non-radioactive contamination, there should be a single integrated strategy for the management of radioactively contaminated land, non-radioactively contaminated land and land with mixed contamination. This strategy should be developed using the case-by-case approach to levels of protection discussed in Section 6.2.

Or

Option 2:

On each site where there is radioactive and non-radioactive contamination there should be two separate approaches to cover the radiological and non-radiological contaminated land management. The SAFEGROUNDS approach should be followed for radioactive contamination and CLR11 for non-radioactive contamination. Both approaches use a phased process to characterisation and options appraisal. For radioactive contamination the level of protection is not selected in advance, but emerges from assessment and comparison of strategies, whereas for non-radioactive contamination the risk assessment is undertaken in advance of the options appraisal. Importantly, the key principles of SAFEGROUNDS should be implemented within the CLR11 framework, notably, stakeholder involvement. Use of this overall strategy would be justified where the areas of radiological and non-radiological contamination are distinct and separate.

A key requirement when presenting the information is to ensure a fair comparison of the risks associated with radiological contamination and non-radiological contamination, enabling a balanced and reasoned approach to be taken in determining the appropriate actions. There may be some circumstances when either mixed contamination, or chemically toxic radionuclides, (eg transuranic wastes), are present and careful consideration of both impacts need to be considered in the assessment.

## 7 STAKEHOLDER INVOLVEMENT

*Site owners/operators should involve stakeholders in the planning and decision-making processes for the management of contaminated land.*

### 7.1 General Guidance

The intent of Principle 2 is to ensure effective external participation to meet stakeholder expectations and to improve decision-making, whether it is required by organisational policy or regulatory frameworks

Stakeholders are all the people with an interest in the situation. They include 'institutional' stakeholders, such as regulators, local and national government and senior management within site owner/operator organisations, and others who could be affected by, or have a direct interest in, land management decisions, such as employees, local residents, community-based organisations (CBOs) and non-governmental organisations (NGOs).

The increasingly positive approach to stakeholder relations on contaminated land issues is partly motivated by the sense that good governance, as understood by the community and major shareholders, requires it. However, the wider implications are to make better decisions, to develop approaches that can be implemented with community support, to improve transparency and to build trust. The benefits include acquiring new perspectives on problems, drawing attention to issues that may otherwise escape scrutiny, reinforcement of safety and environmental protection cultures (see Section 9), and generally enhancing safety and environmental protection performance (IAEA 2006).

Stakeholder involvement includes communication, provision of information, consultation and participation in decision-making processes. For legal and practical reasons, final decisions on how to manage contaminated land have to be the sole responsibility of the site owner or operator.

However, the validity of external participation depends crucially on the integrity of those running it and their responsiveness. Contributions should be objectively considered, there should be a genuine willingness to take a different course of action if new information or insights are provided. It is essential that site owners/operators can demonstrate to stakeholders that their views have been taken into account. Establishment of a two-way dialogue between 'experts' and the 'community' on difficult concepts, such as risk perception and acceptability, are effective means of communicating in an open and straightforward way.

Beginning stakeholder participation early in a decision-making process is important. People then have a legitimate opportunity to help frame the questions to be addressed, as well as to participate, and to influence the outcome. Other advantages of early involvement include: not wasting time in carrying out technical work on options that most stakeholders will never accept, shorter formal public consultation processes, and shorter regulatory approval procedures (IAEA 2006).

Involvement of stakeholders throughout a cycle of planning and decision-making is more effective than separate consultations on a number of issues. It should not simply be when a particular project is in the late stages of planning or carried out, but at the outset. At sites where management of contaminated land will continue over many months, years, or even decades, means should be established to

involve stakeholders throughout this period. An example of good practice is given in the health industry (Tritter & Wilson, 2007).

Adherence to Principle 2 does not mean that all stakeholders have to be involved in all decision-making steps for every contaminated land issue on every site. The presumption, in case of doubt, should be for inclusion. The range of stakeholders to involve, and the extent of their involvement, depends on both the significance of the contaminated land problem (technical and societal) and the stage in the land management process. A broad range of stakeholders should be involved in informing strategic decision-making for problems that are seen as significant by many groups within society. Lower profile decisions for smaller problems warrant less involvement.

If there is doubt about who to involve and how, then the best course of action for the site owner/operator is to consult key stakeholders about what should be done. Communities remote from the site also need to be consulted if they may be affected by management of the contaminated land for a site, for example, where communities live near a disposal facility that could be used for remediation wastes.

Each stakeholder involvement program is unique and needs to be tailored for its purposes and its audience using appropriate communication tools and techniques. In general, the larger the scope and reach, the better defined and more formal the stages will be. In a smaller consultation the stages may be implicit or merged together. More information on communication tools and techniques is included in the supporting SAFEGROUNDS paper on community stakeholder involvement (Collier, 2005).

Stakeholders should be given enough information to enable them to participate effectively. Every effort should be made to avoid relying on national security or commercial confidentiality as reasons for failing to involve a wide range of stakeholders, or for denying them information.

The resources required by stakeholders should be discussed with them at the planning stage. The stakeholder involvement programme should be designed to be reasonable in terms of the time, effort and financial resources required from all concerned, and commensurate with the scale of the problem. Where there is less experience of involvement, there may need to be an initial capacity-building stage (provision of funds and expertise) to strengthen community institutions to allow them to participate fully.

For legal and practical reasons, final decisions on how to manage contaminated land have to be the sole responsibility of the site owner or operator. It is essential that site owners/operators take stakeholders' views into account in making these decisions and that they demonstrate to stakeholders that they have done so.

## **7.2 Guidance for Nuclear-Licensed Sites**

Stakeholder involvement activities for the management of contaminated land should be integrated with the engagement programme for all the activities on a site. This is because there are close links between a site's decommissioning strategy, integrated waste strategy (IWS), contaminated land strategy and related issues such as choice of end-state(s). Many of the same stakeholders need to be involved in each case.

It is important that site owners/operators build and maintain relationships with their stakeholders, particularly local communities. Events such as consultations on

particular topics should be recurrent features in an on-going programme, not self-contained, one-off exercises.

Where they exist, site stakeholder groups (SSGs) could be a starting point for involvement in contaminated land matters. However, it will generally be necessary to involve a wider range of stakeholders than are represented on SSGs. In some cases there will be a need to consult communities affected by waste transport and disposal. It is also possible that local communities will wish to employ experts in particular aspects of contaminated land to advise them.

There are examples of on-going stakeholder involvement in decommissioning and restoration of nuclear sites in the US, where a variety of techniques are used to improve public participation, for example:

[www.sandia.gov/about/community/environment](http://www.sandia.gov/about/community/environment) for the Sandia site and [www.ecy.wa.gov/programs/nwp/index.htm](http://www.ecy.wa.gov/programs/nwp/index.htm) for the Hanford site, Washington State.

Examples of stakeholder engagement at UK nuclear sites will be provided in the second draft. Suggestion and input are invited from consultees.

The appropriate level of stakeholder involvement in the management of contaminated land varies from one stage in the process to another, as shown in Table 4. The level of involvement is highest when plans are being formulated and when a long-term strategy for the management of all the contaminated land on a site is being established.

**Table 4 Levels of Stakeholder Involvement at Nuclear Sites**

<i>Stage in contaminated land management process</i>	<i>Box no. in Figure 3</i>	<i>Level of stakeholder involvement</i>
Deciding this guidance applies	1	Low
Formulating plans	2	High
Site characterisation and immediate control and monitoring	3-7	Low
Establishing long-term land management strategy	8	High
Dealing with high priority areas	9-11	Medium
Dealing with other areas	12-15	Low
Achieving final end-state	16	Medium

It is a legal requirement that final decisions on the management of contaminated land on nuclear-licensed sites be taken by the site licensee. See Section 10 for information on regulatory procedures and stakeholder involvement in these.

### **7.3 Guidance for Non-Nuclear Defence Sites**

Non-nuclear defence sites vary greatly in terms of their size and the extent of contamination, and hence in the time it will take to carry out the contaminated land management process. The nature of stakeholder involvement for sites that are to be sold for redevelopment differs from that for sites that are to remain in MoD ownership, differs due to the application of the planning and Part 2A regulatory regimes.

For large, complex sites that are to be sold, the guidance in Section 7.2 is generally applicable, but there will be no SSG or equivalent group in existence.

Where sites are to continue in their current use consideration should be given to setting up a 'project liaison group', made up of representatives of the local community, other affected communities, CBOs, regulators, local authorities and perhaps consultants, contractors and prospective developers. Such a group would work throughout the land management process, with levels of involvement varying as shown in Table 5. Where a site is to be sold and redeveloped then stakeholder involvement is most likely to occur during the planning consultation process, usually initiated by the developing organisation.

For smaller, high profile sites that are to be sold and retained in current use then the stakeholder involvement programme can be of shorter duration, but it should involve as broad a range of people as for larger sites. Meetings should be held with stakeholders at which candidate strategies and options for the management of the land are discussed and compared. Where such sites are to be sold and redeveloped then stakeholder involvement is again most likely to occur during the planning consultation process.

For smaller, low profile sites that are to be sold, and for sites that are to remain in MoD ownership, more limited stakeholder involvement is appropriate. Regulators, planners, owners of neighbouring land, local authorities and representatives of the workforce should be informed and consulted but this may be all that is necessary.

At all defence sites that are to be sold, stakeholders should be made aware that government ministers have a role in final decisions. In practice it is very rare for ministers to refuse to approve strategies and options agreed between MoD and its stakeholders.

Examples of stakeholder engagement at UK nuclear sites will be provided in the second draft. Suggestion and input are invited from consultees.

## **7.4 Guidance for Other Sites**

### **7.4.1 Non-Licensed Nuclear Defence Sites**

The situation for non-licensed nuclear defence sites is similar to that for nuclear-licensed sites but there are additional security considerations. These should not restrict interaction with stakeholders but should be assessed when planning a stakeholder involvement programme.

At non-licensed defence nuclear sites that are next to nuclear-licensed sites run for MoD by contractors, stakeholder involvement for contaminated land can be via the nuclear-licensed site's SSG or equivalent and integrated with other involvement activities.

### **7.4.2 Industrial, Medical and Research Sites**

The guidance in Section 7.3 is also largely applicable to former and current industrial, medical and research sites. If the site is large and complex it may be best to set up a project liaison group made up of key stakeholders. They can be involved to varying extents throughout the process of managing the contaminated land, and any related demolition or redevelopment activities.

At smaller sites simpler stakeholder involvement mechanisms can be used but it will be necessary to involve a broad range of stakeholders in high profile situations. If such sites are to change use and be redeveloped then consultation will take place through the planning process.

Stakeholders should always be informed as soon as it is known or suspected that radioactive contamination is present. Full information should be given about the contamination, the likely health risks and the process that will be used to decide on and implement an appropriate land management strategy and options. This is particularly important for sites that were contaminated by past activities and are now being used for other purposes.

#### 7.4.3 Sites Contaminated by Accidents or Emergencies

The stakeholders in this case are people who used the land before the accident and may use it again after remediation. This includes nearby communities, local authorities, regulators and others who have been involved in the short and medium term emergency response.

The involvement approach depends on the size of the affected area and the severity of the contamination. The 'project liaison group'<sup>5</sup> approach could be appropriate for large areas that will take a long time to remediate, especially if the land was and will be used for a variety of purposes. One-off consultation exercises could be carried out for smaller areas with less diverse land use patterns.

There may be a difference in approach between "legacy" accidental situations, i.e. those that have happened in the past where there is time to consider the options and attention is focussed solely on the contaminated land issue, and those situations that arise today. In the latter case, contaminated land is just one issue amongst many that the Recovery Working Group would need to consider (NEPLG 2006). It would be misleading to think that contaminated land would necessarily be the only or key issue. Guidance on dealing with the Recovery phase following an accidental or emergency situation is provided in the Health Protection Agency Recovery Handbook (2005).

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<sup>5</sup> This may be a sub group of the formal recovery working group (RWG) that would be set up in response to an accidental or emergency situation, as advocated in the Nuclear Emergency Planning and Liaison Group (NEPLG) Consolidated Guidance (2006)

## 8 RECORD-KEEPING

*Site owners/operators should make comprehensive records of the nature and extent of contamination, the process of deciding on the management option for the contaminated land and the findings during the implementation and validation of the option. All records should be kept and updated as necessary.*

### 8.1 General Guidance

SAFEGROUNDS key principle 5 requires site owners/operators to make comprehensive records about the management of contaminated land, to keep these records, and to update them as necessary.

The records should cover all site characterisation work, the process of deciding how to manage the contaminated land, implementing the chosen strategy, validation, and interactions with stakeholders throughout the process.

Practical guidance on record-keeping is given in a separate SAFEGROUNDS document (Cruickshank & George, 2007). This guidance recommends that a 'land quality file' (LQF) be set up for each nuclear or defence site so that information about contaminated land can be held in a formalised structure. The LQF should be part of the record management system of the organisation that owns or operates the site and should be accessible to stakeholders.

The LQF concept is applicable to other types of site covered by this guidance. Which organisations make and keep the records will depend on the situation. For example, at a former industrial site that is being remediated under Part 2A, whoever is responsible for remediation should make the records but they could be kept by the current owner of the site. If the organisations concerned have no formal system for managing records of this type it would be sensible to create one, either on their own or together with other organisations involved in the management of radioactively contaminated land.

There is an unresolved national problem of how to keep records of radioactively contaminated land in the long term. Nuclear site licensees have to keep records until their 'period of responsibility' ends, which may be decades away. There is no mechanism for keeping records in an accessible form after this, nor for updating records for land that has been delicensed and sold for use for non-nuclear purposes.

MoD has arrangements for keeping records for considerable periods but would not update these once it has sold the land. Local authorities and the environment agencies maintain registers of 'special sites' and of other land that has been designated as "contaminated" under Part 2A and subsequently remediated. These registers are not suited to keeping or maintaining detailed records such as in an LQF.

It is recommended that site owners hold records that can be readily accessed for the duration of their ownership of the site and pass the records on to new owners. This course of action should be maintained until some form of national system is established for keeping records of radioactively contaminated land in the long term.

## **9 ORGANISATIONAL CULTURES AND MANAGEMENT SYSTEMS**

### **9.1 Safety Culture**

The IAEA and the HSE define a safety culture as: 'the assembly of characteristics and attitudes in organisations and individuals that establishes that, as an overriding priority, protection and safety issues receive the attention warranted by their significance' (IAEA Safety Glossary 2007, HSE 2006). Such a culture enables an organisation to achieve and maintain high standards of safety. It minimises the number of incidents and accidents, and saves time and effort in meeting regulatory requirements.

There are already strong safety cultures at UK nuclear sites. These should apply in the management of contaminated land as they do in all other activities on the site (HSE 2006).

At other sites that are covered by this guidance there may be a weaker safety culture or, if the site has not been used for a number of years, no permanent workforce within which a safety culture could be established. In such cases it is important that organisations that fund the management of contaminated land choose consultants and contractors that demonstrate a strong safety culture and have a good safety record.

### **9.2 Environmental Protection Culture**

The environment agencies try to encourage the growth of an environmental protection culture in all the organisations that they regulate, including nuclear-licensed sites. A strong environmental protection culture helps to reduce the numbers of incidents and accidents that have off-site consequences, and saves the effort and time of site operators as well as regulators.

It is recommended that site owners/operators should establish an environmental protection culture and maintain it throughout the management of contaminated land. Other organisations that fund the management of contaminated land should choose consultants and contractors that have a strong environmental protection culture.

### **9.3 Stakeholder Involvement Culture**

In addition to its other benefits (see Section 7), timely and appropriate stakeholder involvement increases openness and accountability, and helps to strengthen safety and environmental protection cultures.

A culture of stakeholder involvement will make it easier for a site/owner operator to sustain an involvement programme throughout the management of contaminated land. Such a culture is particularly important for long programmes, in which effective participation depends on building and maintaining good relationships with stakeholders.

### **9.4 Security Culture**

There is a well-established security culture at nuclear sites and operational MoD sites. The management of contaminated land may require temporary or permanent changes to security plans and arrangements. Approval for such changes should be gained before work commences.

### **9.5 Quality Management Systems**

All the main organisations involved in the management of contaminated land should have an appropriate quality management system (QMS).

The QMS should be based on national and international standards and should be reviewed periodically.

## **PART 3      GUIDANCE FOR EACH STAGE IN THE PROCESS OF MANAGING CONTAMINATED LAND**

### **10            PLANNING AND SHORT-TERM ACTIONS**

#### **10.1        Planning for the Management of Contaminated Land**

##### 10.1.1    General Guidance

After deciding that this guidance applies and identifying the relevant regulatory regime(s), the next steps are to make plans for stakeholder involvement (see Section 7) and for record keeping (see Section 8 and SAFEGROUNDS supporting guidance on land quality records management (Cruickshank & George, 2007)).

It is important to make stakeholders aware of any pre-existing objectives for the management of the contaminated land (for example, to enable land on a nuclear-licensed site to be delicensed, or to enable a non-nuclear defence site to be sold). The status of such objectives should be explained and it should be made clear whether they can be changed (for example, in the light of detailed site characterisation and a comprehensive assessment of land management options).

Stakeholders should also be told about any pre-existing short-term or long-term strategy for the management of the land and the status of this strategy.

The context for decisions on the management of the land should be set out, together with the decision-making procedures envisaged, the regulatory procedures, and proposed stakeholder involvement in these.

The programme for stakeholder involvement should be agreed with stakeholders before the end of the planning stage.

##### 10.1.2    Guidance for Nuclear-Licensed Sites

Planning should take full account of the requirements in the HSE SAPs for the control and remediation of radioactively contaminated land. HSE treats radioactively contaminated land, and emplaced radioactive material, on nuclear licensed sites as accumulations of nuclear matter and requires:

- preparation of a strategy for managing radioactively contaminated land up to the time of any delicensing;
- detection of radioactively contaminated land on or adjacent to nuclear-licensed sites;
- when radioactively contaminated land is discovered, identifying and controlling the source of contamination;
- characterisation of the contaminated areas;
- monitoring and surveillance;
- preparation and implementation of plans for the control and remediation of all radioactively contaminated areas;
- record-keeping;
- remediation of radioactively contaminated land before any new facilities are constructed on it; and
- preparation, reviewing and maintenance of *safety cases* for radioactively contaminated land and for facilities on the site that may be affected by it.

At nuclear sites that are to remain operational for many years the emphasis can be on immediate and short-term actions, but a long-term management strategy is also required.

At nuclear sites that are being decommissioned, or where decommissioning will start in the near future, more emphasis needs to be given to the long-term strategy, and to planning how to decide on and implement long-term management options for areas within the site.

In all cases it is essential to integrate the contaminated land strategy with the decommissioning strategy and the Integrated Waste Strategy (IWS) for the site. The IWS sets out how site operators will assess and manage all wastes, both radioactive and non-radioactive, and material that may become waste in the future. Interactions with planning authorities as part of Environmental Impact Assessment for Decommissioning (EIAD) procedures should be considered also at reactor sites that are being decommissioned.

## **10.2 Site Characterisation**

The aims of initial site characterisation should be established. These could be to acquire enough information to enable immediate and short-term actions to be identified and implemented, and/or to gather sufficient data to provide input to assessments and comparisons of long-term management strategies and options.

Stakeholders should be asked for their views on various aspects of site characterisation, for example:

- the contaminants of most concern (e.g. which radionuclides and in which physical or chemical forms);
- the areas of most interest (e.g. around the boundary of the site); and
- characterisation techniques (e.g. based on experience elsewhere).

Plans should be made for making background measurements off-site. There should be enough measurements to establish the concentrations of ubiquitous contaminants (e.g. fallout radionuclides, or natural background radiation) that are typical of the area, and to 'fingerprint' contaminant concentrations due to the site from those due to nearby sites. The plans for background measurements should be agreed with the relevant environment agency, who should be asked whether independent measurements will also be required.

The regulatory regimes for site characterisation activities should be identified, including those for disposal of any wastes generated during characterisation.

At all sites a conceptual model of the site, and models of sub-areas should be produced at an early stage in site characterisation. The model(s) should be used to direct further characterisation and refined as more data are acquired.

On very complex sites initial characterisation data should be used to classify areas as not contaminated, contaminated and potentially contaminated. This classification should be used in modelling and planning further characterisation (see Figure 3).

Further information is given in the SAFEGROUNDS Site Characterisation Guidance.

## **10.3 Selecting Immediate and Short-Term Land Management Methods**

The planning for short and intermediate management can take place based on the finding of the site characterisation. Outline long-term planning may be considered at this stage so that the earlier works do not compromise the long-term plans. The

outcomes of the short and intermediate management may need to be incorporated in the detailed long-term plans (Section 11).

The objectives of immediate and short-term management are to:

1. control the source of the contamination (if it is still present);
2. prevent further spread of the contamination (especially if it is moving towards the site boundary);
3. control exposures to contaminants (for example by limiting people's access to areas); and
4. institute appropriate monitoring until long-term management methods are implemented.

At sites where contamination has been present for a long time it may not be practicable, or necessary, to take immediate or short-term action other than to maintain compliance and reassurance monitoring. This situation can arise where contamination has been built over or sealed by a new surface, because there is no longer a pollutant linkage since the pathway has been broken. However, longer term management will be required if the contaminated area or site is to be redeveloped at a later date.

Immediate clean-up can be appropriate for small spills and incidents, provided that there are management routes for any wastes generated. Where such routes are not in place, an application will need to be made to the relevant environment agency. This can be a lengthy procedure and may require careful interim management of the contaminated land until the authorisation is given. If a situation arises where no management route is available and the contamination poses an immediate risk to human health and the environment then the regulators should be contacted immediately.

In undertaking short-term management it is important that care is taken not to compromise long-term management of the contaminated land. Therefore, ideally both short term and long-term measures should be planned as a continuum.

On some sites it may be necessary to assess and compare short-term management options for particular areas. This can be done using similar techniques to those recommended for long-term management options (see Option Comparison Guidance, Penfold, 2007).

The extent of stakeholder involvement in decisions on immediate and short-term management methods varies from one type of site to another. Site owners/operators do not need to involve anyone in advance when they take immediate action on small patches of contamination. Where the extent of contamination is greater and other factors, such as the sensitivity of the site, are higher then appropriate stakeholder involvement will be required.

At non-nuclear sites where contamination has been present for a long time it may not be practicable or necessary to take much immediate or short-term action. In such cases it is best to proceed as rapidly as possible to establishing a long-term strategy and options, and implementing them.

## 11 ESTABLISHING LONG-TERM MANAGEMENT STRATEGIES AND OPTIONS

### 11.1 Establishing Long-Term Strategies for Whole Sites

#### 11.1.1 General Guidance

The steps in establishing a long-term management strategy for all the contaminated land on a site are:

1. site owner/operator and stakeholders assess and compare candidate strategies;
2. site owner/operator identifies *preferred strategy*, with stakeholder input;
3. preferred strategy is considered in regulators' and others' acceptance procedures;
4. site owner/operator develops *proposed strategy*;
5. regulators and decision-makers assess proposed strategy; and
6. site owner/operator decides on strategy to be implemented.

Guidance on steps 1 and 2 is given in the Option Comparison Guidance (Penfold, 2007). Guidance on the other steps is given below, by type of site.

The length and complexity of the various steps depends on the scale of the land contamination, and on the outcome of the previous step. They also depend on whether the immediate objective is to actually decide on the option or strategy to be implemented, or to reach agreement in principle for the purposes of financial and other planning for the site.

#### 11.1.2 Guidance for Nuclear-Licensed Sites

The main regulatory assessment procedures for a contaminated land management strategy on a nuclear-licensed site are those of HSE. The SAPs indicate the HSE requirements (HSE 2006).

The Environment Agency and SEPA also have an interest. They are the regulators for the disposal of radioactive waste and for non-radioactive contamination under Part 2A. HSE would consult them for radioactive contamination. Where part of a nuclear site falls outside the nuclear licensed site boundary then the local authority should, also be consulted, although it may be agreed that the Environment Agency will take the responsibility.

At sites that are their responsibility, the NDA needs to approve the contaminated land management strategy through acceptance of lifetime plans and funding requirements. Such a strategy should also take account of NDA requirements for an Integrated Waste Strategy and prioritisation.

Stakeholder input should be provided to steps 3, 4 and 5, but this can be more limited than in steps 1 and 2.

#### 11.1.3 Guidance for Defence Sites

At defence sites the timescales for long-term management are much shorter than those considered on nuclear licensed site. The main regulatory assessment procedures for radioactively contaminated land are Part 2A. With the agreement of the local authorities, the environment agencies are the regulators if the land is "contaminated land" or "radioactive contaminated land", since the sites are then classified as 'special sites' under Part 2A.

Ideally there should be stakeholder input to steps 3-5 but this can be quite limited if there has been considerable input to steps 1 and 2, or if it has been determined that the site is low profile (see Section 7.3).

#### 11.1.4 Guidance for Other Sites

If the site is “radioactive contaminated land” in the Part 2A sense, there is a need to carry out ‘justification’ and ‘optimisation’ studies to determine whether remediation is required, and if so what form it should take (DEFRA 2006). The justification study can be included as an extra step in the assessment and comparison of candidate strategies. This assessment and comparison includes all the matters that would be considered in an optimisation study so no further work is needed to fulfil this requirement (see Option Comparison Guidance (Penfold, 2007) for more details).

The primary regulatory role under Part 2A rests with local authority, and it is the enforcing authority for all contaminated land which is not designated a ‘special site’. With the agreement of the local authorities, the environment agencies are the regulators if the land is “radioactive contaminated land”, and the sites become classified as ‘special sites’ under Part 2A.

Ideally there should be stakeholder input to steps 3-5 but this can be quite limited depending on input to steps 1 and 2, or if it has been determined that the site is low profile (see Section 7.3).

### 11.2 **Prioritising Contaminated Areas**

On complex sites it is necessary to prioritise areas firstly according to the urgency for detailed characterisation and secondly, according to the timescale on which long-term management options should be decided and implemented.

It is recommended that a ‘source-pathway-receptor’ approach be used in prioritisation, with consideration given to:

- the nature of the contaminants (their toxicity for people and other organisms);
- contaminant concentration levels (how far they are above background);
- the mobility of contaminants in the environment (especially if they are moving both on and off-site via water, air, burrowing animals etc);
- the locations of potentially exposed people, other organisms, SSSIs and other sensitive areas; and
- climate and landscape changes (including flooding risk) for much longer-term options.

It is useful to do a preliminary risk assessment to assist with prioritisation (see Guidance on Assessment of Health and Environmental Risks (Smith, 2005)).

Prioritisation should not include designating contaminated areas not requiring action to reduce risks. However, such decisions should only be made after a comparison of management options for these areas (see Section 11.3).

### 11.3 **Establishing Long-Term Management Options for Specific Areas**

The guidance for establishing long-term management strategies for whole sites (see Section 11.1 and the Option Comparison Guidance (Penfold, 2007)) also applies to establishing long-term management options for specific areas on a site.

There can be less stakeholder involvement for area options than for site strategies, especially for low priority areas.

The outcome of an assessment and comparison of options could show that no further action is needed to reduce long-term risks, or that it would be best to monitor the area and reassess options at a later date.

It is advisable to review the site strategy at intervals in the light of the further characterisation of areas and decisions on options.

The CLR11 approach can be used in establishing options for areas with only non-radioactive contamination, provided that the non-radioactive contaminants are not affecting the radioactive contaminants, and that there is no link between management options for the radioactively and non-radioactively contaminated areas.

## **12 IMPLEMENTATION AND VALIDATION**

### **12.1 Implementing Options for Areas**

#### **12.1.1 Planning**

Detailed planning should be completed for each area before implementing the long-term management option for that area. Planning is especially important for large projects and those that take place on large and complex sites. Much guidance is available on this topic for example Environment Agency (2004), CIRIA (2004), Environment Agency (2000), HSE (1999) and HSE (1991). This section is only concerned with issues within the scope of this guidance.

The planning should develop a systematic approach to implementing the chosen option using appropriate procedures. Matters to be considered are:

- health, safety and environmental protection procedures;
- monitoring procedures;
- waste management arrangements;
- contingency measures;
- record-keeping arrangements; and
- stakeholder involvement programme.

Performance measures, such as residual contaminant concentrations, should be made clear, as should quality assurance indicators that demonstrate that quality procedures are followed.

#### **12.1.2 Health, Safety and Environmental Protection Procedures**

All actions must be carried out in conformance with regulations under Health and Safety at Work etc Act which applies at all sites. Those that are particularly relevant are the IRRs, MHSW, CDM and COSHH. All subsidiary regulations and guidance identified during establishment of strategies and options should again be reviewed for compliance. Nuclear licensed sites will have operational procedures in place that cover all the requirements of relevant regulations, although as decommissioning progresses and site support diminishes reliance on these systems will need to be reviewed. At defence sites it may be necessary to establish suitable procedures.

If the site has no Radiation Protection Advisor (RPA), then competent Health Physics advice should be sought. Work should be planned and carried out so that all radiation doses are ALARP. Additional guidance is available from CIRIA (1996), HSE (2001b), HSE (1999) and HSE (1991).

Where the site has an environmental protection policy and an environmental management system, work should be planned and carried out so as to comply with them. Elsewhere, clients should satisfy themselves that their contractors will meet appropriate environmental protection standards.

Further information is given in the Site Characterisation Guidance.

### 12.1.3 Monitoring Procedures

Sampling, monitoring and testing requirements for implementation should be specified. These should cover, for example:

- transport and off-site disposal of soils;
- on-site disposal of soils;
- discharges of liquids;
- materials brought on to site;
- workers' exposure to contaminants;
- off-site impacts (eg dust, noise);
- groundwater; and
- residual contaminant levels.

Monitoring can be carried out by those undertaking the work and those managing it. Some independent third party monitoring is also recommended (see Sections 12.2 and 12.3). The Site Characterisation Guidance identifies the main elements of a monitoring programme, as well as referring to supporting guidance.

Within the monitoring programme, instrumentation and its detection limits should be specified. Prior to commencement, the monitoring instruments should be checked and calibrated in compliance with the IRRs for radiological instruments. The areas and volumes over which measurements are averaged should be specified and documented. Monitoring can be carried out by those implementing the chosen option and/or by an independent organisation.

The regulators have prepared best practice guidance on undertaking and assessing monitoring programmes e.g Environment Agency (2007), CIRIA (2006) Environment Agency (2000b). These may also be useful to site owners/operators and contractors.

### 12.1.4 Waste Management Arrangements

Waste management requirements will have been considered when establishing the option to be implemented. When planning implementation these arrangements should be put in place. This can take a considerable time if, for example, a new or revised authorisation under the Radioactive Substances Act is required.

SD:SPUR, a network for developing and disseminating good practices on the sustainable management of assets and decommissioning wastes arising from nuclear sites has published further information on disposal of solid wastes<sup>6</sup>.

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<sup>6</sup> For more information consult [www.sdspur.com](http://www.sdspur.com)

### 12.1.5 Contingency Measures

It is important to have contingency measures for situations such as finding higher levels or more extensive contamination than expected, and incidents and accidents during remediation work.

The necessary measures should be identified via hazard and risk assessments that are additional to those carried out to provide input to decisions on long-term management options.

### 12.1.6 Record-Keeping Arrangements

*Records* should be made throughout the implementation process, not completed retrospectively at the end. All those involved should make records and the site owner/operator should keep a collated set.

It is important to record any deviation from the planned implementation of the option, including any contingency measures employed.

See SAFEGROUNDS guidance on land quality records management (Cruickshank & George, 2007) for further information about the records required.

### 12.1.7 Stakeholder Involvement Programme

As a minimum, stakeholders should be kept informed of progress with implementation.

In cases where implementation work extends over a long period, site owners/operators should provide stakeholders with opportunities to review and discuss progress. They should also be involved in deciding on any changes to strategies or options in the light of experience.

## 12.2 Validating Options

The purpose of validation is to check that the management option for the area has been implemented correctly and that it will achieve the desired level of protection of people and the environment.

Surveys are required throughout implementation and when work has been completed. On-going monitoring may also be needed over many years (for example, to check that contaminants are not moving into groundwater).

The results of validation surveys and monitoring should be evaluated against the original objectives of the management option to make sure that these have been met. Once site owner/operator(s) are satisfied the interim or final end-points have been reached, they should provide regulators and other stakeholders with the validation findings to agree that the option has been correctly and/or fully implemented. If it is apparent that further implementation work is required, stakeholders should be consulted about what is to be done.

It is particularly important to keep records of validation monitoring and surveys and of the evaluation of results. Especially where land is to be released for new uses, it is valuable for there to be checks by an organisation that is independent of the site owner/operator and of those who have carried out remediation. The extent of the checks should be agreed with the relevant stakeholders, who may also wish to be involved in choosing who carries out the checks.

Site owners/operators should arrange to hold a complete set of records of validation and check surveys and monitoring.

### **12.3 Achieving the Final End-State(s) for the Site**

There will be cases in which implementing the chosen long-term management options for each area achieves the final end-state for the site, or end-states if these vary from one area to another.

In other cases the long-term management options may not achieve the final end-state immediately, for example when there has been long-term control and monitoring to allow radioactive decay. In such cases it is necessary to revisit some areas of the site, to carry out further characterisation and determine whether further actions are required.

If it is not obvious which actions are needed, an option assessment and comparison should be performed. The chosen option should then be implemented and validated.

## **13 CHECKLISTS**

A checklist for the various stages in the management of contaminated land is provided in the Annex 1. These provide cross-references to the text containing guidance for that stage and to the supporting documents.

## **PART 4    REFERENCES AND GLOSSARY**

### **14        REFERENCES**

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## **Legislation**

### **Acts**

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Health and Safety at Work etc. Act, 1974.

Environmental Protection Act, 1990: Part IIA Contaminated Land (inserted by the Environment Act, 1995).

Water Resources Act, 1991.

Radioactive Substances Act, 1993.

### **Regulations**

Control of Substances Hazardous to Health Regulations, 1999. SI 1999 No. 437.

Contaminated Land (England) Regulations, 2000. SI 2000 No. 227.

Ionising Radiations Regulations, 1999. SI 1999 No. 3232.

Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations, 1999. SI 1999 No. 2892.

Special Waste Regulations, 1996. SI 1996 No. 972, as amended.

Town and Country Planning (Environmental Impact Assessment, England and Wales) Regulations, 1999. SI 1999 No. 293.

### **Other Statutory Instruments**

The Radioactive Substances (Phosphatic Substances, Rare Earths etc) Exemption Order 1962. SI 1962 No. 2648.

The Radioactive Substances (Substances of Low Activity) Exemption Order 1986. SI 1986 No. 1002.

## 15 GLOSSARY

### 15.1 Glossary of terms

ALARA ALARP Attribute	<p>A factor that is used to compare the performance of different <i>options</i>. Attributes should be mutually exclusive and reflect issues of concern to stakeholders. It can be helpful, but is not necessary, if a quantitative measure of performance is associated with an attribute. Attributes generally fall into the following categories: health and safety, environmental, technical, social and cost factors.</p>
Characterisation of sites	<p>Establishing information on the presence and characteristics of contaminants, details of the environment in which they are present and potential pathways to man and other environmental receptors. This can be achieved by various investigative methods. Guidance on site characterisation has been developed by SAFEGROUNDS [Baker et. al., 2000].</p>
Constraint, screening criterion	<p>A basic requirement that must be met for any <i>option</i> to be considered in detail. Constraints/screening criteria should be capable of being agreed to by all <i>stakeholders</i>, be mutually exclusive and unambiguous. They can be identified by considering the SAFEGROUNDS <i>key principles</i> and other factors such as legal or regulatory requirements. Financial issues should not be used as constraints unless all stakeholders agree to this.</p>
Contaminated land	<p>Any land in, on or under (including groundwater) which there are radioactive or non-radioactive contaminants above natural and artificial background levels that are typical of the area of the UK in which the site is located. This is not the same as the statutory definition in Part IIA of the Environmental Protection Act, 1990 which defines the presence of contamination by the possibility of significant harm or the pollution of controlled waters.</p>
Decommissioning	<p>The set of actions taken at the end of a nuclear facility's operational life to take it permanently out of service. It includes actions to systematically and progressively reduce the level of hazard on a site and may include the physical dismantling of facilities. The ultimate aim of decommissioning of a <i>nuclear-licensed site</i> is to make the site available for other purposes. The endpoint for decommissioning may be <i>delicensing</i> or re-use of the site for nuclear purposes, or the keeping of the site under institutional control.</p>
Defence site	<p>In this guidance, non-nuclear sites that have been or are being used for defence activities and for which a change of use and/or ownership is planned. Nuclear sites that are operated for MoD by contractors and that are licensed and regulated by HSE under the Nuclear Installations Act are <i>nuclear-licensed sites</i>.</p>

Delicensing	The process of releasing a <i>nuclear-licensed site</i> from regulation under the Nuclear Installations Act and of releasing the operator from his period of responsibility for any nuclear liability.
Environment	The environment includes, but is not limited to, people's property (e.g. houses and land), existing and potential resources (e.g. groundwater, water quality, air quality) and natural ecosystems. In this guidance, <i>people</i> are regarded separately from the environment. The distinction is made for consistency with health and safety, and radiological protection, terminology.
Envisageable options	All the options that would be effective for managing the <i>contaminated land</i> .
Future	The period over which the potential effects of the <i>contaminated land</i> need to be considered when evaluating the <i>options</i> that may be applied to it. Many contaminants have long half-lives in the environment, and so it may be necessary to consider hundreds of years or more.
Future use	The range of uses to which the <i>contaminated land</i> will be able to be put after the selected <i>option</i> has been implemented successfully. The range of future uses may be restricted to reduce the potential hazards associated with residual contamination. Alternatively, the site may be made available for any future use, in which case lower levels of residual concentrations of contaminants are likely to be required.
High level of protection	The level of potential impacts on <i>people</i> and the <i>environment</i> that all stakeholders agree can be tolerated. SAFEGROUNDS does not recommend a particular level of protection, rather it is recommended that the level of protection should be defined on a case-by-case basis.
Interventions	A human activity that prevents or decreases the exposure of individuals to radiation from sources which is not part of the practice or which control, by acting on sources, transmission pathways and individuals themselves. This is a Basic Safety Standard Directive definition, but in terms of Part 2A is a type of remedial treatment action that ensures the land is suitable for its current use.
Key principle	A fundamental principle that should be adhered to during <i>land management</i> . Through consultation, SAFEGROUNDS has developed five key principles on the protection of <i>people</i> and the <i>environment</i> , <i>stakeholder</i> involvement, the identification of the preferred <i>land management option</i> , taking immediate action and record keeping.
Licensee	The organisation that is the holder of the nuclear site licence on a <i>nuclear-licensed site</i> . The licensee is responsible for nuclear safety on the site and for discharging all the obligations and liabilities associated with the nuclear site licence.
Management of contaminated land	The taking of any actions to detect, characterise, control, monitor or remove (wholly or partially) contamination in on or under land (including groundwater) and all the processes that lead up to decisions to take such actions.

Non-radioactively contaminated land	Any land in, on or under (including groundwater) which there are non-radioactive contaminants above natural and artificial background levels that are typical of the area of the UK in which the site is located.
Nuclear-licensed site	Sites that are regulated by HSE under the provisions of the Nuclear Installations Act 1965 (as amended) with a nuclear-site licence. The Act applies to fixed sites for the purposes of constructing and operating nuclear reactors and other prescribed nuclear installations. The guidance applies to operating sites and those being <i>decommissioned</i> , whether or not they are to be <i>delicensed</i> .
Objective	An aim set for the management of contaminated land. Objectives are set by considering factors such as government policy, corporate/organisational policy and the views of <i>stakeholders</i> . It is recommended that environment, health and safety objectives are established separately from those of a commercial and administrative nature.
Option	A method, approach or technology that can be used for <i>land management</i> . Options can include, but may go further than, some or all of the actions defined as 'remediation' in Part IIA of the Environmental Protection Act, 1990. In evaluating options, consideration should always be given to 'doing nothing more' to the contamination or to removing contamination to background levels. See also <i>strategy</i> .
Optimisation	The form, scale and duration of the intervention (remedial action) maximises the net benefit. The principle of optimisation means that there is no predetermined end point for remediation that is applicable in all circumstances. In the extension to Part 2A, where a remediation scheme addresses significant pollutant linkages, some but not all, of which relate to lasting exposure, any intervention should be optimised having regard to their benefit in respect of any remedial treatment actions relating to non-radioactive significant pollutant linkages.
Owner/operator	The organisation with responsibility for the <i>site</i> and any associated <i>contaminated land</i> . At <i>nuclear-licensed sites</i> the operator is the <i>licensee</i> . Owners/operators are responsible for taking final decisions to implement the <i>proposed option</i> for <i>land management</i> .
People	Those individuals that could be affected by <i>contaminated land</i> . People are distinguished from <i>environment</i> following health and safety and radiological protection convention. Separate consideration may be given to 'workers' (who receive a direct financial benefit from the <i>owner/operator</i> ) and the public (who do not). Consideration should also be given to people at present and in the <i>future</i> .
Practices	A human activity that can increase the exposure of individuals to radiation from an artificial source, or from a natural radiation source where natural radionuclides are processed for their radioactive, fissile or fertile properties, except in the case of emergency exposure. This is a Basic Safety Standard Directive definition,

Preferred option	The option that is identified by an <i>owner/operator</i> as their preferred one following a comprehensive, systematic and consultative assessment in which all the <i>envisageable options</i> are considered.
Preferred strategy	The strategy that is identified by an <i>owner/operator</i> as their preferred one following a comprehensive, systematic and consultative assessment of potential strategies derived by considering the <i>options</i> for the various areas on a site.
Proposed option	The <i>option</i> that is formally submitted by an <i>owner/operator</i> to regulators and decision-makers for approval to implement, following the comparison of options, identification of a <i>preferred option</i> , and consideration of this preferred option in regulatory and other acceptance procedures.
Proposed strategy	The <i>strategy</i> that is formally submitted by an <i>owner/operator</i> to regulators and decision-makers for approval to implement, following the comparison of strategies, identification of a <i>preferred strategy</i> , and consideration of this preferred strategy in regulatory and other acceptance procedures.
Radioactively contaminated land	Any land in, on or under (including groundwater) which there are radioactive contaminants above natural and artificial background levels that are typical of the area of the UK in which the site is located.
Remediation of contaminated land	The taking of any actions to reduce the risks to humans or other organisms from contamination in, on or under land (including the groundwater).
Records	Information including details of site <i>characterisation</i> work, the process of deciding on the <i>land management</i> option/strategy, implementing the option/strategy and validating its implementation, as well as interaction with <i>stakeholders</i> throughout the process. There is a <i>key principle</i> about the keeping of records.
Risk assessment	A systematic process that establishes the existence, nature and significance of risk. Different methods are used to evaluate different types of risks. The approach to assessing risks to <i>people's health</i> and to the <i>environment</i> from non-radioactive contamination is largely described in regulatory guidance. The approach to assessing risks to <i>people</i> and the <i>environment</i> from radioactive contamination is different and an approach is outlined in the guidance.
Safety case	Documentation for a nuclear installation that demonstrates safety. Safety cases must be produced and maintained during the design, construction, manufacture, commissioning, operation and <i>decommissioning</i> of the installation.
Scoring	The performance of an <i>option</i> in respect of a particular <i>attribute</i> , when options are being compared. Scores can be assigned using an absolute (i.e. compared with a scale including ideal and unacceptable levels of performance) or relative (i.e. relative to the performance of other options) measure of performance. The latter approach is sometimes referred to as ranking.

Site	A contiguous area of land on which <i>contamination</i> is known or suspected to be present. In most cases, a site will have a single <i>owner/operator</i> . Sites considered in this guidance are further classified as <i>nuclear-licensed sites</i> or <i>defence sites</i> .
Stakeholder	A person or organisation that has an interest in the management of the <i>contaminated land</i> . There are various groups of stakeholders: institutional stakeholders include the <i>owner/operator</i> , regulators, government departments and local authorities. External stakeholders are all those outside the <i>owner/operator</i> organisation. Those stakeholders involved in decisions on the management of contaminated land are participating stakeholders and may include local residents, CBOs and NGOs.
Strategy	A broad plan for the management of all the <i>contaminated land</i> on a <i>site</i> , probably comprising of several <i>options</i> .
Weighting factor	A weighting factor accounts for the importance of an <i>attribute</i> relative to others when <i>options</i> are being compared. This is usually done by multiplying <i>scores</i> for an attribute by the chosen weighting factor. Several sets of weighting factors are often needed, so as to reflect the views of various <i>stakeholders</i> .

## 15.2 Acronyms and Symbols

ALARA	as low as reasonably achievable
ALARP	as low as reasonably practicable
BNFL	British Nuclear Fuels plc
BPEO	best practicable environmental option
Bq	Becquerel – a unit of radioactivity (one nuclear transformation per second)
CBO	community based organisation
CDM	New Construction (Design and Management) Regulations 2007
COSHH	Control of Substances Hazardous to Human Health (COSHH) Regulations consolidated 2002
DE	MoD Defence Estates Organisation
DEFRA	Department for Environment, Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions (no longer exists; most of its responsibilities relevant to this guidance have been transferred to DEFRA, the remainder to DTLR)
DNSR	Defence Nuclear Safety Regulator
DRPS	Dstl Radiological Protection Services (formerly Defence Radiological Protection Services)
DTI	Department of Trade and Industry
DTLR	Department for Transport, Local Government and the Regions
EA	Environment Agency
EHS(NI)	Environment & Heritage Service (Northern Ireland)
EIA	environmental impact assessment
EIAD	Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations, 1999
HSE	Health and Safety Executive
HSWA	Health and Safety at Work etc. Act, 1974
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
IRR	Ionising Radiations Regulations, 1999
LLW	low-level radioactive waste

LQA	Land Quality Assessment (see Appendix B)
LQS	Land Quality Statement (see Appendix B)
MADA	multi-attribute decision analysis
MoD	Ministry of Defence
MHSW	Management of Health and Safety of Work Regulations 1999
NDA	Nuclear Decommissioning Authority
NEPLG	Nuclear Emergency Planning Liaison Group
NGO	non-governmental organisation
NIA	Nuclear Installations Act, 1965 (as amended)
NII	Nuclear Installations Inspectorate, part of HSE
NRPB	National Radiological Protection Board
Part IIA	Environmental Protection Act, 1990: Part IIA Contaminated Land (inserted by the Environment Act, 1995)
PPC	Pollution Prevention and Control regime
RCEP	Royal Commission on Environmental Pollution
RPA	Radiation Protection Advisor
RSA	Radioactive Substances Act, 1993
RWG	Recovery Working Group
SAFEGROUNDS	SAFety and Environmental Guidance for Remediation Of Uk Nuclear and Defence Sites
SAP	Safety Assessment Principles
SEPA	Scottish Environment Protection Agency
SI	Statutory Instrument
SoLA	Substances of Low Activity Exemption Order (made under RSA)
Sv	Sievert, a unit of dose from ionising radiation

## Annex 1

### SAFEGROUNDS Checklist for Management of contaminated land

This is based on the flow diagram presented in figure 1. The numbers in the column to the left align with the box numbers in Figure 1. The SAFEGROUNDS reference refers to the specific guidance published under SAFEGROUNDS where more information can be obtained. Additional information provides details on non-SAFEGROUNDS references that may be pertinent. The notes and action columns are left blank to enable practitioners to use this checklist and record their own comments.

#	Activity	SAFEGROUND reference	Additional information	Notes	Action
1	<b>Have you determined if SAFEGROUNDS is applicable?</b>	LMG v2, Section 1.1,1.5, 2.3	-		<input checked="" type="checkbox"/>
2	<b>Formulate plans</b>				
	<i>Stakeholder Involvement</i> Have you <ul style="list-style-type: none"> <li>◆ developed a stakeholder involvement plan?</li> <li>◆ identified the relevant stakeholders?</li> <li>◆ identified the time scales / schedule for involvement?</li> <li>◆ identified on what areas will be consulted?</li> <li>◆ identified what information will be provided?</li> <li>◆ identified how will information be disseminated?</li> <li>◆ identified what mechanisms for</li> </ul>	LMG v2, Sections 3,7,9.3  Community Stakeholder Involvement (Collier, 2005)			<input type="checkbox"/>

obtaining feedback will be used?				
<p><i>Record Keeping</i></p> <p><i>Have you</i></p> <ul style="list-style-type: none"> <li>◆ identified the record deliver milestones?</li> <li>◆ engaged with records management personnel?</li> <li>◆ established a records policy?</li> <li>◆ organised a classification system and linked to a formal management system;</li> <li>◆ set up a land quality file?</li> <li>◆ Ensured a records maintenance system?</li> <li>◆ Organised a periodic compliance audit?</li> </ul>	<p>LMG v2, Section 8</p> <p>Good practice guidance for land quality records management for nuclear licensed and defence sites (Cruickshank &amp; George, 2007)</p>			
<p><i>Site Characterisation</i></p> <ul style="list-style-type: none"> <li>◆ Have you carried out a desk study?</li> <li>◆ Has site reconnaissance been undertaken?</li> <li>◆ Where are the results recorded?</li> <li>◆ Has an outline site conceptual model been developed?</li> <li>◆ Has an outline site investigation plan been developed?</li> <li>◆ Has an outline health and safety plan been developed?</li> <li>◆ Has an outline environmental protection plan been developed?</li> <li>◆ Have you identified, established and agreed the framework of site characterisation activities?</li> <li>◆ Have the characterisation specific</li> </ul>	<p>LMG v2, Section 10.2</p> <p>Best practice guidance on site characterisation (Baker et al, 2000)</p>			□

	<p>objectives been established?</p> <ul style="list-style-type: none"> <li>◆ Have the areas of greatest importance been identified?</li> <li>◆ Has an outline sampling plan been developed, including media, sampling methods, analysis and locations?</li> <li>◆ Has an outline waste plan been developed to minimise any waste produced from intrusive investigations?</li> <li>◆ Has an outline transport plan been developed to manage the transfer of samples to the laboratory for analysis?</li> <li>◆ Has an outline data management and record keeping plan been developed?</li> </ul>				
	<p><i>End points</i></p> <ul style="list-style-type: none"> <li>◆ Have you established the end points in consultation with stakeholders?</li> <li>◆ Have you communicated the final decision on endpoints to the stakeholders?</li> <li>◆ Have you developed a validation plan to show the final end state has been achieved?</li> <li>◆ Has this been agreed with stakeholders?</li> </ul>	LMG v2, Section 6			<input type="checkbox"/>
<b>3</b>	<b>Site characterisation</b>				
	<p>Have the outline plans identified above been reviewed and revised?</p> <p><i>Safety, Health and Environment (SHE)</i></p> <ul style="list-style-type: none"> <li>◆ Do you have a safe system of work established in the site?</li> </ul>	<p>LMG v2, Section 10.2</p> <p>Best practice guidance on site characterisation</p>			<input type="checkbox"/>

	<ul style="list-style-type: none"> <li>◆ Have potential hazards at the site been systematically identified?</li> <li>◆ Has a prior risk assessment been undertaken for the planned works covering: <ul style="list-style-type: none"> <li>○ Health and safety</li> <li>○ Environmental protection</li> </ul> </li> <li>◆ What mechanisms are in place to control radiation exposure?</li> <li>◆ Are staff suitable competent and trained to undertake the work?</li> <li>◆ Are areas suitably designated?</li> <li>◆ Are all workers aware of the safety procedures and instructions on the site?</li> <li>◆ What method is employed to retain records of the site characterisation?</li> <li>◆ Has an environmental protection checklist been completed?</li> </ul> <p><i>Site investigation</i></p> <ul style="list-style-type: none"> <li>◆ What are the detailed objectives of the site characterisation?</li> <li>◆ Have you revised the framework of site characterisation activities?</li> <li>◆ Have the characterisation specific objectives been established?</li> <li>◆ Has a site conceptual model been reviewed?</li> </ul> <p><i>Site characterisation management</i></p> <ul style="list-style-type: none"> <li>◆ Has a review plan and schedule been developed to include site objectives,</li> </ul>	(Baker et al, 2000)			
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	<p>SHE management, conceptual model and information required for next stage of investigation?</p> <ul style="list-style-type: none"> <li>◆ Has a contingency plan been developed?</li> </ul> <p><i>Site characterisation activities</i></p> <ul style="list-style-type: none"> <li>◆ Has a sampling plan been updated, including media, sampling methods, analysis and locations?</li> <li>◆ Has a waste plan been reviewed to minimise any waste produced from intrusive investigations?</li> <li>◆ Has a transport plan been reviewed to manage the transfer of samples to the laboratory for analysis?</li> <li>◆ Has a data management and record keeping plan been developed?</li> <li>◆ Are immediate controls necessary?</li> <li>◆ What monitoring is required?</li> <li>◆ Which areas have been prioritised?</li> <li>◆ Have stakeholder been involved in the decision making?</li> </ul>				
<b>4</b>	<b>Under take assessment phase</b>				
	<p>Have you</p> <ul style="list-style-type: none"> <li>◆ Establish preliminary view of significance of source?</li> <li>◆ Determine features of site and its environment?</li> <li>◆ Construct scenarios?</li> <li>◆ Develop, acquire and apply assessment models?</li> </ul>	<p>Guidance on assessment of health and environmental risk (Smith, 2005)</p>			

	◆ Undertake a sensitivity analysis?				
<b>5 Establish short, medium and long term management strategy</b>					
	<ul style="list-style-type: none"> <li>◆ Have you a clear definition of the objectives?</li> <li>◆ Have you identified the assumptions and constraints for the options comparison?</li> <li>◆ Have you agreed with stakeholders that financial costs should be considered in the screening criteria?</li> <li>◆ Have you identified all of the attributes for use in the assessment, were stakeholder included in this discussion?</li> <li>◆ Have you identified potential options?</li> <li>◆ Have the potential options been short-listed?</li> <li>◆ Have the short-listed options been characterised in details?</li> <li>◆ Have you determined the scoring and weighting criteria?</li> <li>◆ Have you identified those to be involved in the options assessment?</li> <li>◆ Is your method for comparison systematic, open and transparent?</li> <li>◆ Have you assessed the performance of each option against each attribute?</li> <li>◆ Has the overall performance of each option been assessed and compared?</li> <li>◆ Has the robustness of the analysis been tested?</li> <li>◆ Has the proposed option(s) strategy</li> </ul>	<p>LMG v2, Sections 10.3,11.1</p> <p>Options comparison guidance (Penfold, 2007)</p>			<input type="checkbox"/>

	<p>been submitted to regulators / decision makers and stakeholders?</p> <ul style="list-style-type: none"> <li>◆ Is any review or modification required</li> <li>◆ Has the final assessment and decision been communicated to stakeholders?</li> </ul>				
<b>6</b>	<b>Deal with specific areas</b>				
	<ul style="list-style-type: none"> <li>◆ Have you identified the high priority areas?</li> <li>◆ What criteria have been used to determine these areas?</li> <li>◆ Have stakeholder been involved in this process?</li> <li>◆ Have you identified the most appropriate options for each area?</li> <li>◆ What criteria have been used to determine these areas?</li> <li>◆ Have stakeholder been involved in this process?</li> <li>◆ Have you developed an implementation plan including: <ul style="list-style-type: none"> <li>▪ Contract management;</li> <li>▪ SHE procedures;</li> <li>▪ Monitoring procedures;</li> <li>▪ Waste management procedures;</li> <li>▪ Record keeping arrangements; and</li> <li>▪ Stakeholder information programme?</li> </ul> </li> <li>◆ Have monitoring, sampling and instrument requirements been specified?</li> <li>◆ Have you reviewed you validation plan?</li> </ul>	LMG v2, Sections 11.2, 11.3			<input type="checkbox"/>
<b>6</b>	<b>Achieve final end state</b>				

	<ul style="list-style-type: none"> <li>◆ Have you implemented your validation plan?</li> <li>◆ Has all appropriate monitoring been completed?</li> <li>◆ Have all waste management issues been resolved?</li> <li>◆ Have stakeholder been kept informed of the progress?</li> <li>◆ Are all records up to date?</li> </ul>	<p>LMG v2, Section 12</p>			<input type="checkbox"/>
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