Defence Estates

HMS Daedalus

Phase Two Land Quality Assessment

Radiological Survey Report
Project No: 05002

Final Technical Note - Remediation Proposal

31 May 2007

Entec UK Limited for the
Ministry of Defence under
commission DE11/4471
February 2001

DEFENCE ESTATES
Delivering Estate Solutions to Defence Needs

Report for

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Certificate No. EMS 69090 Certificate No. FS 13881

HMS Daedalus Land Quality Assessment

1. Introduction

This Technical Note has been prepared to accompany the HMS Daedalus Phase Two Radiological Land Quality Assessment (Phase 2 LQA: Entec report 03385rr128i3) and should be read in conjunction with that report. This note outlines the potential liabilities arising from radioactive contamination on the site and includes a proposal for remediation.

This report deals only with radiological issues. Land quality issues arising from other contaminants are dealt with in separate reports.

The objectives and technical requirements for this work from Defence Estates are set out in the Land Quality Assessment Directive, which is presented in Annex A.

2. Summary of Environmental Risk Assessment

2.1 Summary of Contamination

The Phase 2 LQA has established that whilst levels of radioactivity detectable at the ground surface over the majority of the Daedalus site are not above the natural background, there are localised areas where elevated readings were detected (radioactive anomalies). The levels of radioactivity identified are considered to be not sufficiently elevated to warrant any immediate action to protect human health in the context of current site operations, and in this regard the site sensitivity is low. However, this would not necessarily be the case if a change of use were contemplated.

The source of radioactive contamination was the disposal in the past of aircraft cockpit instruments luminised with radium-226. Instruments may have been disposed of whole or in parts (e.g. dials, pointers) or in the form of ash after incineration.

2.2 Summary of Environmental Risk

Radioactive contamination poses risks primarily to humans using the site that may be considered as falling into three groups; existing site users; workers involved in ground disturbing activity and future users post-redevelopment (residential, commercial). Humans can be exposed through three pathways; external irradiation by proximity to sources; internal irradiation from ingestion of sources and internal irradiation from inhalation of sources. Site users may be exposed to a significant does of external radiation if they spend sufficient time in physical contact with contaminated ground. They may be subjected to internal exposure if they ingest or inhale particles of contaminated soil or artefacts that may be liberated when the ground is disturbed.

Current Site Users

For current site use, the worst case scenario envisages site personnel relaxing in the areas identified as containing elevated background readings. For example, for an adult resting on the ground in an area of known dose rate of 1.3 μSv/hr for 10 hours per week would result in an annual dose through external radiation of 0.68 mSv. This simple assessment illustrates that the possibility of an individual receiving an external radiation dose exceeding the conservative 0.3 mSv/yr threshold is theoretically possible, though rather unlikely to occur in practice. On this basis the risk is assessed as low.

Internal exposure resulting from ingestion of a radioactive source is a much greater potential hazard than external radiation dose, but requires physical contact with exposed soils and regular ingestion. In the case of site users merely walking over or resting on the ground surface, the likelihood of such an occurrence is very low and overall the risk is assessed as low.

Although overall the risks are low, there are very localised zones where the dose rate for intervention proposed by NRPB is exceeded and where the risk of ingestion is higher. So although the likelihood of adverse health impact is low, intervention to reduce potential exposure dose rates below 0.3 mSv/yr would be beneficial in removing those risks, thereby enhancing public confidence in the safety of the site.

Site Construction Workers (Involved in Ground Disturbance)

Construction workers involved in ground disturbance have a greater risk of contact with radioactively contaminated material. However, because exposure is transient, the long term external dose would be small and the risk is therefore low. Risks of ingestion and inhalation are higher, and on this basis internal exposure is assessed as a moderate risk. This can be effectively managed by use of appropriate personal protective equipment (PPE), but a worst case risk assessment must assume this is not done.

Future Site Users

The redevelopment of HMS Daedalus presents a variety of possible future land uses which may include residential, hotel use, light commercial, leisure, sports, business, storage, general light industrial use and continued light aviation use.

For future site use, the areas indicated to contain radioactive materials could potentially be incorporated into a domestic garden. If the site were not remediated, the scenario of greatest concern is that of children playing in such a garden and ingesting contaminated soil. The radiation dose effect on children is considered more severe than a similar dose received by an adult.

Additionally, there is a possibility of uptake of radioisotopes into vegetables grown in the garden, though this is very unlikely.

Risks to future site users are assessed as moderate. On a risk basis, remediation is recommended to reduce potential dose to less than 0.3 mSv/yr. This can be achieved by removing all material having an activity concentration greater than 0.34 Bq/g above background.

3. Liability Appraisal in Regulatory Context

3.1 Regulatory Background to Environmental Liabilities

There are a number of ways in which liabilities can arise from the presence of soil and groundwater contamination on a site. Of particular importance are:

i) Statutory liability for clean-up of contaminated land;

ii) Statutory liability for clean-up of water pollution;

iii) Liability to third parties for damage caused by contamination.

3.1.1 Contaminated Land Liability

The principal legislation governing the identification and remediation of contaminated land is Part IIA of the Environmental Protection Act (EPA) 1990 which was implemented in April 2000. The legislation is supported by the Contaminated Land (England) Regulations (2000) and Statutory Guidance (DETR Circular 02/2000 superseded by Defra Circular 01/2006) which together define the regulatory regime governing the nature of liabilities that can be incurred by owners of contaminated land and groundwater. With the introduction of new legislation in 2006, the regime was extended to include radioactivity.

The threshold criterion for a formal determination under Part IIA, in cases of harm from radioactivity relating to lasting exposure, has been set at an individual effective dose of 3 millisieverts/year above local natural background. On this basis, using the Radioactively Contaminated Land Exposure Assessment (RCLEA) methodology proposed by Defra, a range of threshold activity concentrations of radium-226 contamination can be derived, according to end-use criteria. Assuming the most sensitive end-use scenario, and assuming a homogeneous source concentration in the ground to a depth of 1 m, the threshold activity concentration for Ra-226 is 1.1 Bq/g.

Although the vast majority of the HMS Daedalus site is well below this level, there are certain isolated locations where it is exceeded. RCLEA is specifically not designed to evaluate sites containing isolated hotspots of radioactivity; nevertheless, the presence of such hotspots could attract the attention of the Local Authority in pursuance of its duty to inspect potentially contaminated sites under Part IIA. Whether or not it was finally determined as 'radioactively contaminated' would depend upon the selection and sizing of averaging areas within the overall site. An approved methodology for averaging is notably absent from published guidance.

However, in cases where 'voluntary' remediation is being proposed, Part IIA action will not generally be pursued by the Local Authority. The clean-up threshold for remediation at Daedalus, as described in Section 5.2.2 below, is significantly lower than the lowest RCLEA threshold of 1.1 Bq/g, even without averaging. Therefore the HMS Daedalus site, post-remediation, will not be at risk of determination as radioactively contaminated land.

3.1.2 Waste Management

Any remediation activity undertaken at HMS Daedalus that is likely to generate solid waste will be subject to the provisions of the Waste Management Licensing Regulations 1994 (as amended). The regulations allow certain exclusions and exemptions, but otherwise the activities will require licensing in the form of a Site Waste Management licence or a Mobile Plant Licence. A site licence broadly covers the retention of wastes on site (e.g. in a purpose-built

repository), and entails issues of long-term liability and license surrender obligations. Mobile Plant licensing covers waste treatment on site using specialist plant brought in for that purpose (e.g. bio-remediation).

In the case of the Daedalus radiological remediation, the quantities of waste are sufficiently small that the Environment agency's 'Enforcement Position' will be invoked. This will have the effect of excluding remedial operations from the waste management licensing regime.

3.2 Environmental Liability Appraisal

It is unlikely that radiological risks represent a statutory liability in the context of existing site usage. However, if the ground is disturbed in the vicinity of any radiological anomaly, there is the possibility that radioactive waste could be generated that might fall within the statutory regime of the Radioactive Substances Act 1993. There could also be liabilities under the Ionising Radiation Regulations 1999 if, for example, redevelopment works brought to the surface radioactive material currently buried. A liability could arise if the dose rate were to exceed a certain threshold level as defined in the Regulations.

Table 3.1 shows a summary of the potential environmental risks and liabilities. These have previously been detailed in the LQA report.

The following factors have been used to rank the potential liability for different end uses, impact on the environment and continued use of the site of residential purposes.

Liability Classification of Potential Significance

A	Immediate significant risk of health hazard occurring;
A1	Health hazard during demolition or construction;
B	Immediate significant risk of unacceptable damage to the environment;
B1	Significant risk to the environment during demolition or construction;
C	Large remediation liability;
D	Minor remediation liability;
E	Minor significance, no remediation required;
F	No effect on re-use option or site value.

Table 3.1 Summary of Environmental Risks and Liabilities

Area/Building	Potential Pollutant (Source)	Potential Receptor	Potential Pathway to Receptor	Associated Hazard	Potential Consequence of S-R Link	Likelihood of Source-Receptor Linkage	Significance: Risk Classification	Liability Classification
All identified areas	Ionising Radiation (potential radium-226) associated with Made Ground	Humans (Site Users)	External radiation	Health Impact (Cancer)	Severe	Unlikely	Low	D/E
			Ingestion		Severe	Unlikely	Low	D/E
			Inhalation		Severe	Very unlikely	Negligible	D/E
		Humans (Redevelopment/ Maintenance Workers)	External radiation	Health Impact (Cancer)	Severe	Unlikely	Low	D/A1
			Ingestion		Severe	Possible	Moderate*	D/A1
			Inhalation		Severe	Possible	Moderate*	D/A1
		Humans (Future Users)	External radiation	Health Impact (Cancer)	Severe	Possible	Moderate	A/D
			Ingestion		Severe	Possible	Moderate	A/D
			Inhalation		Severe	Possible	Moderate	A/D

* Risks to redevelopment workers may be minimised by following correct procedures including use of suitable Personal Protective Equipment (PPE) during excavation or other works.

4. Assessment of Management Options

Based on the potential liabilities identified, possible future management options available are outlined below.

4.1 Do Nothing

Doing nothing is only an acceptable option if the current site use is retained. Even then, management protocols should be implemented to ensure that the areas of contamination are retained under existing use, that no practices are permitted that might result in prolonged exposure in these areas and that any intrusive works in these areas are subject to appropriate health and safety risk mitigation precautions.

4.2 Undertake Remediation

The benefit of undertaking remediation is that the liability will be removed and the site rendered fit for redevelopment (in respect of radioactivity) if the identified sources are removed from the site. The known quantities of waste requiring removal are relatively small and the site work could probably be completed within a couple of weeks.

4.2.1 Location of Anomalies

Figures 5a, 5b, 5c and 5d in the LQA report show the location of the radiological anomalies where site investigation has indicated that remediation is required. Details of expected volumes of exempt and Low Level Waste are given in Table 4.1.

Table 4.1 Waste Volumes in Remediation Areas

Point No	Location	Maximum In-situ Count Rate (cps)	Maximum Count Rate of Excavated Material (cps) (activity of identifiable artefacts/ strata)	Estimated Volume of Exempt Waste (m^3)	Estimated Volume of LLW (m^3)
2	Grassed area near Building 134	735	1720	0.4	-
3		1362	2260 (6687)	0.6	0.001
4		11304	1411 (6600)	1.0	0.01
5	Small oval area near Building 73	3250	1556 (4276)	0.2	-
6	In grass near fuel bunker	1555	570 (1353)	0.2	-
7	Grassed area south of hangars in west of site	565	450 (814)	0.01	-
8		345	232	-	-

Table 4.1 (continued) Waste Volumes in Remediation Areas

Point No	Location	Maximum In-situ Count Rate (cps)	Maximum Count Rate of Excavated Material (cps) (activity of identifiable artefacts/ strata)	Estimated Volume of Exempt Waste (m^3)	Estimated Volume of LLW (m^3)
9		505	1122 (728)	0.2	-
10		516	140	-	-
11	North of hangars in west of site	175	93	-	-
12	Near Building 296 (seven trial pits)	5380	1640	2.0 (Notional)	0.2 (Notional)
14	Former burning ground	171	95	-	-
TPA2	Area A	1119	512	1.0	-
TPAN05		1650	392	0.2	-
TPAN07		635	380	1.5	-
			Total	**7.31**	**0.211**

5. Remediation Strategy

5.1 General

The regulatory regime governing accumulation and disposal of radioactive waste is defined by the Radioactive Substances Act 1993. The activity concentrations of relevant categories of radium-contaminated material are given in Table 5.1.

The most appropriate remedial strategy for radioactively contaminated soils is to remove them from site for disposal at a suitably licensed repository.

Table 5.1 Radium-Contaminated Waste Categories as defined by RSA 93

Activity Concentration	Description	Classification
<0.37 Bq/g	Such material is not regarded as radioactive for the purposes of statutory control.	Free Release
>0.37 <4.9 Bq/g	Contaminated soil in this range is exempt from the controls in RSA93 by virtue of 'The Radioactive Substances (Phosphatic Substances, Rare Earths etc) Exemption Order 1962'. Such material is generally disposed of to landfill under normal duty of care arrangements. (Note: whilst some volume averaging may be acceptable in this category disposal of discrete sources would generally have to be isolated and removed).	Exempt Waste
>4.9 Bq/g	Material above this concentration is regarded as Low Level Radioactive Waste (LLW). Such material is normally dispatched to BNFL Drigg in Cumbria for disposal under an authorisation issued by the Environment Agency. The upper activity concentrations for such disposals is 4000 Bq/g for alpha activity and 12 000 Bq/g for beta/gamma activity. For radium and daughters in equilibrium this would equate to a radium-226 concentration of 2000 Bq/g.	Low Level Waste (LLW)

All wastes are disposed of according to their activity concentration. 'Free release' material is not classed as radioactive and therefore does not need to be removed from site. Exempt wastes may be sent to any suitably licensed landfill, subject to the agreement of the site operator. In the case of Low Level Waste (LLW), the only such site available is at Drigg, Cumbria, operated by the British Nuclear Group (formerly BNFL). There is currently no permanent disposal facility in the UK for material exceeding the upper limit of activity concentration for LLW, above which the material would be classed as intermediate level waste (ILW). However, no such material is expected to be found at this site.

A fully detailed remedial action plan would be prepared if and for the purposes of this Technical Note, an outline of the methodology is given below.

5.2 Remediation Methodology

The proposed methodology can be summarised as follows:

- Pre-sentencing of soils in situ by walkover survey;
- Excavation of different categories of material (i.e. LLW, Exempt, Free-release) to a maximum depth of 0.25 m, this being the effective depth within which radioactive sources can be detected. It is recommended that a small machine, e.g. a JCB3CX should be used, as the soil will have to be excavated slowly and gradually;
- Monitoring of each bucket of material at the point of excavation to confirm waste category;
- Segregation and temporary storage of waste-streams according to activity concentration;

- Repeat of procedures above in layers 0.25 m thick until no further contamination is evident;
- Undertaking validation walkover;
- Backfilling of excavations with clean material;
- Disposal of wastes according to category.

A detailed remedial action plan would be prepared and submitted to the regulatory authorities for approval prior to commencement of works on site.

RSA Authorisation

An Authorisation under the Radioactive Substances Act 1993 is required to cover the 'accumulation' of radioactive material during the work. Such an authorisation has been applied for by Entec on behalf of DE, and is expected to be granted by the Environment Agency shortly.

Arrangements are also in hand to expedite the acceptance of the LLW at Drigg. However, DE or an appointed contractor will have to enter into a commercial agreement with BNG for payment of the disposal charges.

Waste Volumes

Waste volumes assessed on the basis of trial pit information are given in Table 4.1 above. As a contingency, it is recommended that 100% increase should be allowed for. Therefore the remediation strategy should be based on disposal of 0.4 m^3 of LLW (equivalent to two drums) and 15 m^3 of exempt waste (approximately 4-5 skips).

Confirmation of Extent of Contamination

As part of the remedial works it is recommended that further trial pits should be dug in the vicinity of the remediation areas, to confirm whether or not further radioactive contamination exists. Should further radioactive sources be found, the scope of remedial work will have to be extended accordingly.

Further confirmatory investigations will be undertaken in certain areas where some doubt remains as to the presence of contamination. These areas are identified as No 1 and 13 on Figure 1. The locations of all pits will be agreed on site with DE, based on visual inspection of the ground, in respect of underground services.

5.3 Outline Cost Estimate

Costs based on an average risk estimate are given in Table 5.2. Since the volume of material requiring disposal is small, these costs are based upon the consultant procuring the necessary plant and equipment and managing the process and not based upon the consultant letting a contract to a civil contractor. If the latter process was followed, this could result in increased costs for the contactors' overheads, management and insurance costs and the consultants' costs for preparing tender documents and managing the tender process. These costs have been included in the maximum risk estimate.

Table 5.2 Cost Estimate for Radiological Remediation (average risk estimate)

Activity		Costs
1.	Detailed Design Protocols and Project Management	8 000
2.	Negotiation	3 750
3.	Site Supervision (including travel and subsistence)	10 500
4.	Plant and Equipment Hire including Mobilisation	9 000
5.	Disposal charges; LLW (based on 2 no. drums); 15 m^3 exempt waste	6 938
6.	Validation	3 250
7.	Reporting	5 000
Average Risk Cost		**46 438**
Maximum Risk Cost (includes £15k contractor costs)		**£67 762**

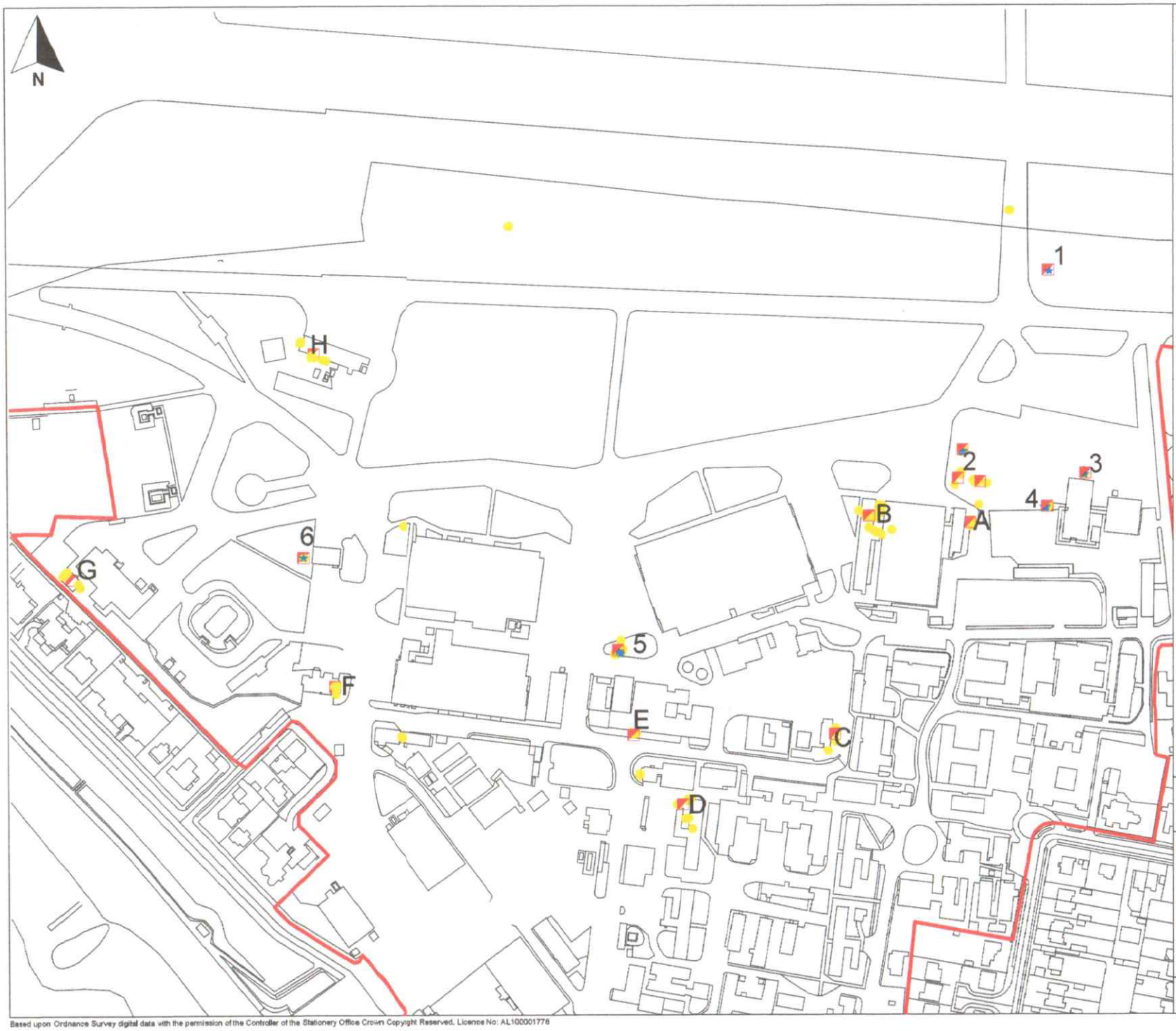
The maximum risk estimate also includes allowances for increases in both exempt and LLW disposed quantities (100%).

6. Conclusions and Recommendations

The Daedalus site is suitable for continued MOD use. It is not suitable without remediation for a change of use where residential development might be contemplated.

The presence of radioactive contamination has been confirmed and quantified by walkover and intrusive investigation. A minor amount of remedial work is required to remove identified sources of radioactivity above the risk-based threshold of 0.34 Bq/g. It is estimated that a maximum of 0.4 m^3 of LLW and 15 m^3 of exempt waste will need to be removed. The average risk estimate for undertaking these works is £46 438.

Figure



Key

Site boundary

Proposed TP location (indicative)

Elevated radioactivity results

<0.34 Bq/g (Areas: A, B, C, D, E, F, G & H)

>0.34 Bq/g <0.49 Bq/g (Areas: 1, 2, 3, 4, 5 & 6)

Not to Scale

Prepared for the Ministry of Defence, Defence Estates, contract DE11/4471

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HMS Daedalus
Radiological Survey

Figure 3
Locations of Radiological Anomalies

July 2005
03385-R07.wor reynm

Entec

Annex A
DE LQA Directive

19 Pages

MINISTRY OF DEFENCE

DEFENCE ESTATES

SITE – HMS DAEDALUS

LAND QUALITY ASSESSMENT

PHASE TWO: Site Investigation and Radiological Survey

Project No. 05002

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West Midlands
B75 7RL

Date: 1 November 2005

DE Project Ref: 05002

Clients Ref:

SITE-SPECIFIC INFORMATION

Site Name	HMS DAEDALUS	
Site Address	HMS Daedalus Lee-on-the Solent Hampshire PO13 9NX	
Background		
Anticipated Future Use	Industrial, Commercial and Residential	
Other Considerations		
Target Delivery Date (Draft)	May 07	
Deliverables	**Type**	**Number Required**
	Draft LQA Report and Technical Note	4
	Final LQA Report and Technical Note	7
	Electronic Copy	1

References to the 'Site' in the following directive relate to the site or sites listed above under 'site name' and the area or areas indicated on the attached plan/s.

LAND QUALITY ASSESSMENT: PHASE TWO – INTRUSIVE SURVEY

Contents

LAND QUALITY ASSESSMENT: PHASE TWO - INTRUSIVE SURVEY

Background

1. The MOD needs to know more details of the land quality on the site and the health & environmental risk that any contamination may present currently or in association with changing the use of the land.

2. MOD propose to achieve this by undertaking a phased investigation of the site as described in DE Technical Bulletin 95/28 entitled Land Quality Assessment Management Guide. A Desk Study (Phase One LQA) has already been undertaken. The report of the Phase One LQA assessed the potential for contaminated land to exist on the site. It also recommended the further action necessary to confirm the conclusions presented within the report. The next phase of the Land Quality Assessment aims to address the recommendations made in the Desk Study and to identify the actual extent and implications of any contamination on the site. This Directive initiates the Phase Two LQA.

3. The outputs which results from this study (Land Quality Assessment Report and Technical Note) may be used by MOD Property Managers and Selling Agents and as such may be relied upon by third parties such as Purchasers and PFI Partners.

Additional Information

4. MOD held information pertinent to the study is available through the Site Liaison Officer and may include:

   - Phase One Land Quality Assessment for the Site
   - Plans, maps and technical/process drawings (all available dates).
   - Deeds and other estate records.
   - Existing aerial and other photographs.
   - Records/files detailing former and current uses/activities on the site.
   - Anecdotal evidence from former and present employees.

Project Objective

5. The objective of the study is to provide information, in the form of an LQA Report and Technical Note, relating to the environmental quality of the ground and groundwater conditions present on the establishment. Existing information should be appraised and further work undertaken as necessary, to produce a reliable assessment of the Land Quality and Environmental Risk at the site and how different types of future use may affect this. Information should also be gathered relating to the potential for future ground contamination occurring as a result of demolition of the existing buildings. An assessment is to be made of the potential health and environmental risks at the site and the degree of confidence stated. If this assessment shows that there may be a significant risk to health and safety or the environment, then options for remediation of the contamination should be provided.

Scope of the Works

6. The assessment comprises a Phase Two Land Quality Assessment relating to the whole of the establishment as shown on the Site Plan and also its interaction with the neighbouring land and environment.

7. The scope of work includes an assessment of the management options relating to the current and future management of the land and buildings, including financial risk assessment, an environmental risk assessment and other consequences of following each option. A recommended option should be identified. An assessment of potential remediation requirements should also be given together with cost and timescale implications of the remediation work.

8. The scope of work also includes provision of a Collateral Warranty, refer to paragraph 13 for further details.

Requirements of the Study

Hazard Assessment

9. All intrusive investigations have the potential to reveal hazardous substances. The Consultant must make an assessment to ensure that adequate Health and Safety safeguards are employed by his personnel at all times.

10. The site is likely to operate a Permit to Dig system. The programme, locations and character of all intrusive works must be discussed and agreed in advance with the Property Manager.

Explosive Ordnance

11. There may be a potential risk from buried explosive ordnance on military establishments. The Consultant must ensure that the intrusive investigation only takes place on areas assessed as clear of ordnance. Even after clearance of explosive ordnance is completed, a residual risk remains and hence utmost vigilance should be employed at all times. If anything suspicious is found, work should cease immediately, the area should be evacuated and the assistance of the Explosive Ordnance Disposal (EOD) team enlisted through the Property Manager.

Management Requirements

12. The Term Consultant for the LQA is to act in the role of Lead Consultant and is required to employ and supervise all specialist sub-contractors required for the study. The Lead Consultant is ultimately responsible for all technical aspects of the investigation, including design, supervision, interpretation and recommendations arising from the study.

Collateral Warranty

13. The LQA Report and Technical Note produced under this Directive may be used by MOD's property managers and selling agents. Consequently they may be relied upon by purchasers, property managers, tenants and PFI Partners alike. The Consultant shall therefore, provide, if requested, Collateral Warranties regarding their professional work in the standard agreed form to the PFI Partner (where appropriate), first purchaser and/or tenant of the whole site or part thereof to a limit of two parts, and to the first funder of those parties. The Consultant shall also, at the reasonable request of MOD, provide Collateral Warranties in the standard agreed form to second purchasers and/or tenants and their funders ("Secondary Warranties") for a reasonable fee per warranty as agreed under the Term Contract. Should any party eligible to benefit from the Secondary Warranty require variations from the agreed standard form, the Consultant shall be entitled to levy additional fees and/or expenses to reflect the reasonable costs in negotiating such variations. The limit of liability/level of PI cover and form of the Collateral Warranty required (6 to 12 year deed or agreement) shall be agreed between the Consultant and the party eligible for the warranty and will not exceed £5M in aggregate unless agreed otherwise.

Specialist Sub-Consultants

14. A radiological contamination assessment should be undertaken in close co-operation with the Dstl Radiation Protection Service (DRPS). The Consultant should approach DRPS to consult and arrange this liaison. Any work undertaken by DRPS should be incorporated into the LQA and completed to the satisfaction of the Consultant with the intention of it being covered by the Consultant's Collateral Warranty.

Ground Investigation Contractor

15. At least three competitive tenders are to be obtained for sub-contracted aspects of the Intrusive Survey. Sub-contractors must be experienced in the appropriate field of environmental site investigation and should work to accredited quality assurance standards. The Lead Consultant should produce a short report to the Task Officer to summarise the tender exercise and to recommend the Best Value Tender. Task Officer acceptance must be obtained before the Specialist Sub-Contractor is engaged.

Laboratory Analysis

16. At least three competitive tenders should be obtained for the laboratory analysis aspects of the assessment. Laboratories must work to quality assured standards. Laboratories asked to quote rates must have extensive UKAS accreditation for relevant analytical procedures. Laboratories must also participate in the CONTEST and/or AQUACHECK schemes. The Lead Consultant is to ensure that tendering laboratories have performed satisfactorily under these schemes. The Lead Consultant should produce a short report to the Task Officer to summarise the tender exercise and to recommend the Best Value Tender. This report should include information on the CONTEST performance of the laboratories. Task Officer acceptance must be obtained before the specialist laboratory is engaged.

Reconnaissance

17. An initial walk over reconnaissance of the site should be undertaken by the consultant in order to gain an understanding of the establishment and all matters pertaining to the Land Quality Assessment. This is likely to include an appraisal of the site infrastructure, drainage, services and site operating procedures past and present. Information should also be gathered relating to the potential for future ground contamination occurring as a result of any demolition or refurbishment of the existing buildings. Any environmental issues requiring urgent attention should be reported immediately.

Document Review

18. The Consultant should review the existing Phase One Desk Study together with any further information that has become available. The Consultant should undertake any further desk investigation considered necessary and if required shall identify (via the Site Liaison Officer) and interview persons with long standing knowledge of the site. Consideration should be given to the recommendation of the Phase One Desk Study.

Intrusive Investigation

19. The Consultant should propose his preferred excavation, sampling and analysis regime for the site, which should employ the industry's current best practice for investigation, sample extraction, preservation and analysis.

20. At all times the objective is to undertake any investigation on a logical and rational basis in order to achieve both economy in the expenditure of resources and confidence in the end result.

21. Information collected should include geotechnical soil properties relevant to contaminant transport and remediation effectiveness.

22. During the course of the investigation the Consultant should make reactive adjustments to the investigation process in the light of information obtained during the investigation. The Task Officer must give written approval to either expand or reduce the scope of the investigation prior to any changes to the overall scope of works.

23. The Consultant (with his Specialist sub-Consultants where appropriate) should supervise and administer all the work of his Contractors and should provide a competent Environmental Engineer on site at all times during the physical investigation to supervise the works.

24. The Consultant shall ensure that all disturbances to the ground caused by himself or a sub-contractor are made good at the earliest opportunity. If there are any locations that cannot be made good by the consultant this must be drawn to the attention of the Property Manager prior to commencement of works.

Presentation of Information

25. Information from the Land Quality Assessment should be provided by way of a single report, the Land Quality Assessment Report and separate Technical Note.

26. The Land Quality Assessment Report is a combined factual and interpretative report which should comprise the factual information and other evidence gathered relating to the environmental quality of the site and a technical qualitative Environmental Risk Assessment. The Land Quality Assessment Report

should be prefaced with a short summary of the environmental condition of the site. This summary is to be entitled 'Land Quality Statement for [SITE TITLE]'. This is a non-technical summary of the environmental condition of the site, its suitability for re-use and the effects of any contamination on development potential. The Land Quality Statement must not include reference to recommendations for further work. For the Final Report, the Task Officer may request that the Land Quality Statement be also issued in unbound form to allow subsequent copying.

27. The Land Quality Assessment Report should include the following minimum information:

- A summary of the factual elements of the Desk Study (Phase One LQA).
- A description of the work carried out during the intrusive site investigation.
- A coloured Site Plan identifying the site boundary, locations of all exploratory work and any other pertinent information.
- The Environmental Engineer's signed logs of exploratory excavations and boreholes etc. with accompanying level information and photographs where appropriate. Detail and presentation of logs should conform to BS 5930:1999.
- Details of the samples taken and the techniques used.
- In-situ test results.
- Presentation of laboratory results including information on preservation methods, analytical procedures used, qualitative and quantitative results.
- Full details of the quality assurance procedures employed.
- **A contamination model of the site**. This should identify and, quantify where possible, the contaminated and uncontaminated areas of the site. Information should be shown on plans and sections etc. and, were applicable, should include contamination concentration isolines.
- An estimate of the percentage area of the site that may be affected by contamination should be included.

28. The Potential Significance category of the Environmental Risk Assessment Summary Table comprises two elements: classification of risk and classification of liability. The Environmental Risk Assessment table in the Land Quality Assessment Report should include the risk classification but exclude the liability classification, which is to be confined to the Technical Note. Hazard – receptor linkage, risk and liability classifications are included in Annex B. Please note that if more than one liability classification is applicable, more than one letter may be quoted.

29. The Technical Note should comprise interpretation and opinions on liability, the complete risk assessment table, costs for any further work, remediation, disposal options and an Option Study into future handling of the site. **In particular it should include a comment on how likely the site is to fall under the statutory definition of contaminated land, and if likely, on what basis. An estimate of the percentage of the site area which could potentially be affected by contamination should also be included**. A copy of the DE LQA DIRECTIVE should be incorporated in an Annex of the Technical Note. In addition, a completed LQA Summary sheet (ANNEX D) should be incorporated into the report. The Technical Note is classified RESTRICTED – COMMERCIAL (see Security).

30. Where the Health or Environmental Risk is considered to be high, then recommendations should be made within the Technical Note regarding any remediation required to meet different types of future land use. This should include outline costs and timescales of any remediation for each scenario. Remediation options should include consideration of source removal, pathway disruption or receptor protection. The Consultant should take into consideration the most likely future use of the site.

31. Costs should be estimated in sufficient detail to provide a reliable basis for identifying a recommended option. This should include a financial risk assessment and whole life costing and presented only in the Technical Note.

<u>Environmental Risk Assessment</u>

32. The Consultant should incorporate a Tier 1 qualitative Environmental Risk Assessment into the study unless instructed otherwise. This should consider individual potential pollutants and their potential hazards, pathways and receptors under current conditions for different types of after use to include, but not be limited to, agricultural, residential, industrial and commercial. The key objective is to identify issues that may lead to significant harm or a significant possibility of such harm or pollution or likely pollution of controlled waters. Hence all areas of potential contamination should be prioritised in terms of health and environmental risk. This information should be shown on a clear plan and related to the

Summary Table as outlined in Annex B. There may be occasions where a Tier 2 quantitative risk assessment is more appropriate.

33. The classifications for Likelihood of Hazard-Receptor Linkage and Potential Significance are given in Annex B. Potential Significance comprises two elements: classification of risk and classification of resulting liability. **The Land Quality Assessment Report should include the risk classification but exclude the liability classification, which is only to be included in the Technical Note**.

34. The Consultant should include an Explosive Ordnance Risk Assessment and Radiological Risks into the risk assessment.

Environmental Impact of Remediation

35. The Environmental Impact of remediation options should be addressed and a firm indication of the Best Practicable Environmental Option given in the Technical Note.

Financial Appraisal

36. A reliable Order of Cost Estimate (OCE) is required for each option, and shall be carried out in accordance with DE Technical Bulletin 99/19, entitled Order of Cost Estimates, dated July 1999. Costs are to be current quarter price levels without inflation and the relevant cost index and its source should be quoted. VAT and fees should be itemised clearly. The OCE should include a Financial Risk Analysis, carried out and presented in accordance with DE Technical Bulletin 99/214, entitled Estimating using Risk Analysis, dated July 1999. Costs for both "Average Risk Estimate" and "Maximum Likely Risk Estimate" cases are required and full details of the risks and their individual contribution to the risk element shall be identified in the Technical Note only.

Conclusions

37. The Technical Note should conclude with discussion and recommendations relating to the land quality issues identified and the most appropriate way to manage the identified environmental health and liability risks and if necessary release the site from MOD ownership. This must take full account of the current regulatory regime, particularly Part IIA of the Environmental Protection Act.

Limitations and Standards

Constraints

38. The following constraints must be taken into consideration:

- The site may operate a Permit to Dig system, which must be adhered to at all times.
- A photographic pass may be needed before site work commences.
- Prior to any work commencing on site, a Method Statement is to be provided for approval by the Client, in consultation with the DE Task Officer. Health and Safety risk assessments are to be completed in advance of all stages of the work.
- Any investigations must be undertaken at such times and in such a manner as to avoid disruption to routine operation and maintenance of the Site.
- Although the survey will take place mainly within the establishment's boundary, it shall be undertaken in such a manner as to avoid concern to the general public. In the event of any approach by the Press or broadcasting media, they are to be referred immediately to the Client's Representative and no comment whatsoever shall be made.

39. The Technical Note should conclude with discussion and recommendations relating to the contaminated land issues including the significance of any contamination for present and other land use. If the site is to be sold, the conclusions should include discussion on most appropriate way to release the site from MOD ownership.

Contact with Regulatory Bodies and Public Information Sources

40. Any contact with the Environment Agency, the Scottish Environment Protection Agency, Local Authorities and other regulatory bodies or public information sources must be specific to this commission. Any enquiries of public information sources should reflect the sensitivity of LQA work.

Environmental Impact of Intrusive Investigations

41. It is MOD policy to minimise the adverse environmental effects of its projects and operations. Recycled or recyclable products are to be used whenever feasible.

42. All work undertaken in relation to this project shall employ the Best Available Techniques Not Entailing Excessive Cost (BATNEEC) to minimise the environmental impact of the project.

43. In particular, the Consultant shall ensure that:

- Industry best practice is followed
- Intrusive investigations are only undertaken using methods that do not create pollution transfer pathways.
- The excavation of trial holes, boreholes or other excavations do not risk contamination of the groundwater regime.
- Polluted soil arisings and water emanating from boreholes or trial pits is disposed of without causing environmental damage and in accordance with the waste management Duty of Care.
- Noise and other potential nuisance from plant is kept within acceptable limits.
- The emission of pollutants, harmful radiation or ozone depleting chemicals is minimised.
- The use of energy is minimised.
- Products that contribute to the destruction of rain forests or endangered wildlife are not used.
- The use of noxious substances, especially DOE "Red List" and EU List 1 substances is minimised.

44. The specific written authorisation of the Project Sponsor is required before use or emission of any product, pollutant, or substance that affects any of the above Clauses. If there is any doubt then the DE Task Officer must be consulted.

Health and Safety

45. All members of the study team are to be suitably briefed. A written Method Statement and Risk Assessment shall be required before any site work is undertaken. All MOD regulations and instructions concerning safe working procedures shall be rigorously adhered to.

46. The Intrusive Survey is to be undertaken in accordance with all relevant Health and Safety Legislation.

47. In cases where the Construction (Design and Management) Regulations 1994 are applicable, the Lead Consultant shall undertake the roles of both Planning Supervisor and Principal Contractor.

48. Recommendations made for remediation shall comply fully with all relevant Health and Safety Legislation.

49. The Study shall identify any special health and safety hazards that should be considered by Site Management for operations on the Site.

Deliverables

Timescale and Distribution

50. The Site Specific Information Sheet supplied with this directive indicates the target delivery date and the number of copies of the Draft Land Quality Assessment Report and Technical Note which are to be delivered to the Task Officer. The Draft Report may be discussed at a meeting to be arranged. The target date for issue of the final Desk Study Reports is 10 working days following the above meeting or receipt of written comments from the Task Officer.

51. The Site Specific Information Sheet supplied with this directive also indicates the number and type (e.g. electronic) of copies of the Final Land Quality Assessment Report and Technical Note which are to be delivered to the DE Task Officer.

Format of Report and Technical Note

ANNEX C1 - Guide to Structure of Report

Land Quality Statement

1 Introduction

1.1 Terms of Reference
1.2 Site Location

2 Site Description
2.1 Site Layout
2.2 Site Operations
2.3 Summary of Phase One Land Quality Assessment
- Site History
- Environmental Setting
- Site Sensitivity
- Environmental condition of the Site
- Sources of Potential Contamination

2 Site Investigation
2.1 Summary
2.2 Methodology
2.3 Investigation of Findings

3 Assessment of Risks

4 Overall Land Quality

5 Suitability for Redevelopment

Figures

ANNEX D

Summary of LQA Findings

1. Site DPR #	2. Site Name	3. Area (ha)	4. Grid Ref	5. LQA Priority	6. Current LQA Phase	7. Start Date	8. Finish Date	9. Total spend to date	10. Overall Land Quality	11. Pollutant Source	12. Pollutant	13. Receptor	14. Approx Area of Site Affected	15. Liability Class
										1. 2. 3. 4.				
Comments:														

Guidance Notes for the Completion of LQA Returns

1. Site DPR Ref. #: This is only to be filled out if known

2. Site Name: Please provide current name and aliases

3. Area: Please provide area in hectares

4. Grid Reference: Please provide 8 figure grid ref. for the centre of the site

5. LQA Priority: Please insert the priority number as follows:

Priority 1:	Land identified for disposal or subject to rationalisation or where significant change in land use is envisaged.
Priority 2a:	Land in sensitive area and with known or suspected contamination
Priority 2b:	Known threat; site in sensitive area such as major aquifer
Priority 2c:	Strongly suspected threat or possible threat from e.g. radioactive substances, dioxins, CW materials
Priority 2d:	No known evidence if threat, i.e. all other sites

6. Current LQA Phase: State whether it is:

0	Prioritisation
1	Desk Study
2	Site Investigation
3	Assessing need to remediate
4	Remediation

10. Overall Land Quality: Please insert appropriate number:

1	No known or potential sources of contamination
2	Majority of the site is unlikely to be contaminated. A number of localised sources of contamination are or may be evident.
3	Majority of the site is or is likely to be contaminated.

14. Approximate area of contamination: Please estimate area likely to be affected in m^2

15. Liability Class: This should be presented as the risk assessment table within the technical note.

Annex B
Order of Cost Estimate

1 Page

Table B1

HMS Daedalus : Radioactive Decontamination

Construction Costs	*Amount*	*Unit*	*Unit rate, £*	*Cost,£*
Modilisation		sum		1000
Plant Hire	8	days	800.00	£6,400
Disposal of exempt waste to licensed landfill	15	m³	50.00	£750
Disposal of LLW to Drigg	2	drums	1500.00	£3,000
Disposal of Hazardous Waste	0	m³	130	£0
Validation (laboratory costs,plant,equipment)			Allow	£1,000
Contractor's overheads & insurance		Percentage	0	£0
Risk Free Base Construction Cost				£12,150

Note: Due to the small scale of the works these costs are based on Entec undertaking the management of the whole scheme and not tendering to a civils contractor. The latter would increase the cost and this is reflected in the risk calculation.

Resource Costs				
Consultations and negotiations with Regulators		sum		£3,000
Detail Remediation Design and Project Management		sum		£8,000
Contract Documents and Tendering		sum		£0
Site supervision of Remedial Works (10 weeks)	3	Man weeks	2800	£8,400
Validation Monitoring		sum		£2,000
Completion reporting		sum		£5,000
Risk Free Base Resource Cost				£26,400

Total Risk Free Base Cost	£38,550

RISK ELEMENT CALCULATION

From Procedures outlined in DWS Technical Bulletin 99/21, Table C1 in appendix C presents the Risk Register for the above works. Risk allowances are based on assumptions discussed in section 4.2

				Average Risk			Maximum Likely Risk			Spread	Square the Spreads
Risk Element	Average Risk Value (percentage for variable risk)	Maximum Likely Risk Value (percentage for variable risk)	Type (variable or fixed)	Base Value of Risk Element	Probability Factor (Fixed) or Confidence Limit (Variable)	Value	Base Value of Risk Element	Probability Factor (F) or Confidence Limit (V)	Value	Deviation from the Average (h)	Square of the Deviation (h^2)
CONSTRUCTION RISKS											
Increased excavation, segregation and disposal	25	100	V	11,150	50%	2,788	11,150	90%	11,150	8,363	6.99E+07
Increased disposal cost to landfill	20	50	V	750	50%	150	750	90%	375	225	5.06E+04
Hazardous Waste	25	100	V	2,400	50%	600	2,400	90%	2,400	1,800	3.24E+06
Use of Contractor			F	0	0.5	0	10,000	1	10,000	10,000	1.00E+08
Disposal to Drigg			F	3,000	0.5	1,500	3,000	1	3,000	1,500	2.25E+06
RESOURCE RISKS											
Increased resource costs (site supervision)	25	100	V	8,400	50%	2,100	8,400	90%	8,400	6,300	3.97E+07
Regulatory Approvals	25	50	V	3,000	50%	750	3,000	90%	1,500	750	5.63E+05
Use of Contractor			F	0	0.5	0	5000	1	5,000	5,000	2.50E+07

Construction Average Risk Allowance:	5,038
Resource Average Risk Allowance:	2,850

Sum of $(h)^2$:	1.75E+08
Square root of sum of $(h)^2$:	13,247
Add Average Risk Allowance:	5,038
Construction Maximum Risk Allowance:	18,284

F= Fixed (expressed as a ratio for Average and Maximum Likely Risk)
V= Variable (expressed as a percentage for Average and Maximum Likely Risk)

Sum of $(h)^2$	6.53E+07
Square root of sum of $(h)^2$:	8,078
Add Average Risk Allowance:	2,850
Resource Maximum Risk Allowance:	10,928

NOTE
1) Quantities and rates based on designers estimate of available data.
3) Remediation costs do not include for the removal of buildings, structures, foundations, tanks infrastructure etc.
4) Disposal costs do not include for Landfill Tax

RISK ADDITION

	RISK FREE BASE COSTS			RISK ALLOWANCES		SUM OF BASE + RISK		
	Construction	Resource	TOTAL BASE COST	Construction	Resource	Construction	Resource	TOTAL RISK ESTIMATES
Average Risk Estimate	12,150	26,400	38,550	5,038	2,850	17,188	29,250	46,438
Maximum Likely Risk Estimate	12,150	26,400	38,550	18,284	10,928	30,434	37,328	67,762

Annex C
Risk Register

1 Page

Table C1 Risk Register for Remediation

Ref	Description	Dependencies (ref to)	Effect Time/Cost	Allowance		Status		Comments
				Average	Maximum	Current	Previous	
CI1	Increased excavation and disposal costs		T/C	2 788	8 363	A	N/A	Depends on further investigation at start of remedial works.
CI2	Increase disposal cost to landfill	CI1	C	150	375	A	N/A	Increased risk if work delayed. Regulatory risk.
CI3	Hazardous waste		C	600	1 800	A	N/A	Some waste may be hazardous rather than just 'exempt'.
C14	Use of contractors		T/C	0	15 000	M	N/A	Client decision on approach.
C15	Increased disposal cost to Drigg		C	1 500	1 500	A	N/A	Unlikely unless further material found at depth.
C16	Increased supervision	C16	C	2 100	6 300	A	N/A	
C17	Regulatory approval		C	750	750	A	N/A	No particular problem envisaged.

Note:
T = Third Party Risks
S = Site Risks
CI = Client Risks
D = Design Team Risks
CO = Contractors Risks
O = Other Risks

Ref to is the reference to the dependant risks

T = Time
C = Cost

For use with Quantitative Assessment

A = Assessed and Allowed
M = Managed Out
D = Designed Out
S = shared
I = Ignored

Hold
Current
Urgent
Critical