PRACTICAL DIFFICULTIES ASSOCIATED WITH INVESTIGATION AND SUBSEQUENT REMEDIATION OF CONTAMINATED LAND

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ABSTRACT

This paper reports on the characterisation and subsequent development of a remediation strategy for a seven hectare site in Oxfordshire, England which was used for the burial of waste contaminated with radioactivity and a range of organic and inorganic chemicals.

The method of site assessment is described and any lessons learnt are highlighted. In particular, the shortcomings of various intrusive and non-intrusive site investigative techniques are discussed.

Anyone faced with the problem of developing a site assessment methodology for contaminated land will find this paper particularly useful.

SITE ASSESSMENT TECHNIQUES

In the case under discussion, the purpose of the site assessment was to determine the extent and location of buried contamination within the site, thus allowing identification of an appropriate remediation strategy. The Site Assessment was divided into three main stages:

- desk study (including a preliminary site visit) to identify past usages which may have given rise to contamination and any particular structures or areas where contaminative processes may have been carried out;
- physical investigation of the site using intrusive and non-intrusive techniques to detect and quantify the extent of any contamination;
- data interpretation in order to determine the extent and magnitude of contamination and therefore the likely disposal route for any waste arisings.

DESK STUDY

The desk study is a cost effective way of investigating whether a site has been put to a potentially contaminative use. Typical information sources include:

- site records, e.g. drawings, maps, investigation data;
- company records, e.g. archival information;
- plant personnel, including former employees;
- local literature, e.g. newspapers, local library;
- regulatory bodies, e.g. local councils, waste regulatory bodies, Her Majesty's Inspectorate of Pollution, National Rivers Authority, Health & Safety Executive.

Company records and recollections of former employees indicated that the site had been used as a repository for redundant items of equipment lightly contaminated with radioactive material. In addition, chemically toxic waste, some of which had traces of radioactive contamination, had been buried in unlined, earth-covered pits during the 1950s and 60s. However, there were no accurate records of the nature and quantity of waste deposited in the pits as there was no legislative requirement to record this information at the time of disposal. Recollections of existing and former employees are particularly important in such situations and proved invaluable in this case.

Records confirmed that a preliminary radiological clearance of the site had already been carried out involving the following key tasks:

- decontamination and demolition of buildings;

- decontamination of roadways within the site;
- examination and removal of drains;
- removal of a low level radioactive waste disposal pit;
- trial pitting to confirm approximate locations and contents of the chemical and beryllium burial pits;
- post-clearance contamination and radiation surveys.

However, no attempt had been made to remediate the chemical and beryllium burial pits.

SITE INVESTIGATION

The site investigation forms the major database for the assessment of the degree of contamination and the extent of remediation required. The choice of sampling strategy will depend upon the findings of the desk study and guidance for optimisation of site investigations is given in Reference 1.

1993 Characterisation Programme

The first stage of the site investigation was to confirm the conclusions of the preliminary radiological clearance study, namely that the site is very unlikely to contain any significant burials of chemical or radioactive waste other than those previously identified within the burial pits. This was done via:

- an extensive soil sampling and analysis programme;
- a walkover radiation dose-rate and contamination survey of the entire site;
- general site inspection.

The sampling programme was agreed with the local council prior to implementation and significantly exceeded the sampling density recommended in DD 175 (Ref 1). The main component of the programme was extraction of cores from over 120 locations using a regular grid sampling pattern. A further 70 cores were also sampled where contamination was judged most likely given the existing knowledge of the site. No core samples were taken from the burial pits.

None of the soil cores analysed contained any significant quantities of hazardous material and it was therefore concluded that the site is highly unlikely to contain any disposal sites or areas of contaminated land additional to those previously identified. This was supported by the walkover dose-rate and contamination survey, the findings of the desk study and site reconnaissance which did not indicate the presence of further burial pits.

However, the sampling programme highlighted a number of practical difficulties which may not be obvious to first-time site investigators. Firstly, the importance of ensuring that samples are adequately labelled and logged should not be underestimated. All samples should be clearly marked in indelible ink with the location number and date and time of collection. This allows greater traceability of records and may avoid significant time delays in the future. In addition, the recovered core samples are not discrete and, if particularly accurate data are required, great care should be exercised to ensure that contamination is not carried from one stratum to another. It is also essential to provide analytical laboratories with samples of sufficient size to allow division into representative sub-samples for analysis.

It should be noted that a 'herringbone' sampling regime has since been promoted by some workers in the field in preference to a rectangular grid. This involves the use of four interlocking regular grids and has been shown to be more statistically significant than stratified regular sampling.

Options for Long Term Management of the Hazardous Inventory

An Environmental Impact Assessment of the site identified two potential long term management strategies for the burial pits consistent with modern standards for safety and environmental protection.

- isolation of the pit contents from the environment by the construction of an engineered cap and curtain walls over and around each burial pit;
- removal of the contents of each burial pit and subsequent disposal via an appropriate route.

Either of these options, or a suitable combination of both, would ensure that health risks to members of the public are acceptable and that the environment is adequately protected from hazardous contaminants known to be present at the site.

Trial Excavation of Burial Pit

A trial excavation of one of the chemical burial pits was undertaken in March 1994 in order to demonstrate the practicability of removing the contents of each burial pit. The pit chosen was believed to be relatively free of radioactive contamination and would therefore pose less risk to workers and members of the public.

The trial excavation was performed in accordance with a fully approved safety case and used a combination of manual and mechanical techniques. The pit was found to be significantly larger than indicated by earlier trial pitting investigations and also contained traces of radioactive contamination (i.e. > 0.4 Bq/g). In addition, the degree of chemical contamination was found to be greater than expected and concentrations were generally above typical levels measured in uncontaminated soil.

It was therefore concluded that existing data on the likely size and contents of the burial pits was likely to be inaccurate and that further site investigations should be performed.

Geophysical Survey and Core Sampling of Burial Pits

A geophysical survey of the site was performed and this confirmed the number and approximate locations of the chemical burial pits. The advantage of such techniques is that they are relatively quick and can be used for initial appraisals. However, care must be taken in the choice of technique and the spacing of traverses. It must also be borne in mind that the techniques identify geophysical anomalies which may not correspond to identifiable features upon intrusive investigation.

Once the geophysical survey had confirmed the approximate locations of burial pits, a core sampling programme of the pits was performed in order to provide further information on the nature and quantity of buried contaminants. The results of this programme are not yet available but will be carefully considered when a decision is made as to which long term management strategy should be implemented (i.e. capping or removal). Some general points on data interpretation techniques are given in the following section. It should be noted that the beryllium pits are being characterised as part of a separate DRAWMOPS project.

DATA INTERPRETATION

Once analytical results are available, they must be examined in order to determine the magnitude of any contamination problem. There are a number of documents which can be used in the interpretation of chemical analysis results. For example, the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) have produced a number of guidance notes relating to the re-use of sites with previous contaminative uses. These are particularly useful when setting action levels above which further more detailed analysis will be performed. In the case of radioactivity, the need to show that soil is below the Radioactive Substances Act 1993 exemption level of 0.4 Bq/g is particularly important although this can be problematic given the level of natural radioactivity typically present in soil.

ACKNOWLEDGEMENTS

This work has been funded under the DRAWMOPS programme of the UK Department of Trade and Industry (DTI). The results of this work form part of the UK Government programme on decommissioning and radioactive waste management, but do not necessarily represent Government policy.

REFERENCES

1. Draft for Development DD 175 (1988), Code of Practice for the Identification of Potentially Contaminated Land and its Investigation, BSI.