The Redevelopment and Value of Contaminated Land

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ABSTRACT

KEYWORDS

CONTAMINATED LAND REDEVELOPMENT LAND VALUE
SITE INVESTIGATIONS TREATMENT METHODS VALUATION MODEL

This study examines the effects of contamination on the redevelopment and valuation of industrial land. The period covered by the study was one in which environmental legislation in the United Kingdom was undergoing significant changes. The Government's proposal to introduce registers of 'potentially contaminated sites' was fiercely opposed by different interest groups and was abandoned. New legislative proposals followed but will not take effect before 1997. During the same period, the guidance given to the valuers of industrial properties, and of other properties which may be affected by contamination, has been limited in scope and difficult to implement.

It is argued that contaminated land is an important resource and that a 'risk assessment' approach should be adopted for valuation purposes and the appraisal of redevelopment proposals. The processes involved in the investigation of contaminated sites, the selection of treatment methods and the role of the valuer in these actions are considered. Alternative approaches to the valuation and appraisal of contaminated sites are described, both in situations where the existing industrial use is to continue and where redevelopment is proposed. Value was found to be affected both by the cost to treat the contamination and perceived 'risk factors', which are collectively termed 'stigma'.

Besides valuers, many different actors are involved in the property development process. These actors are likely to hold differing views in respect of treatment methods, the value and desirability of redeveloping contaminated sites, according to the nature of their involvement. Questionnaire surveys were undertaken of valuers and other professionals involved in redevelopment, in order to test their perceptions of the risks involved. The views of a 'general population' sample were also obtained in respect of a number of environmental issues, in order to compare the views of two 'expert' groups with those of a wider population. Interviews were conducted with a number of leading valuers, so as to assess current practice in reflecting the possibility of contamination in valuations. The surveys enabled professional perceptions of the stigma effect to be determined. Case studies involving the redevelopment of contaminated sites were researched and the impact of stigma upon transaction prices was assessed.

The findings of the research enabled a predictive model to be developed for use in the valuation of contaminated land and this was tested by reference to ten case studies. The perception of risk, associated with contaminated land, held by valuers was clearly identified to be higher than that perceived by the other group of 'experts' involved in the development process. All of the professionals were generally supportive of current Government proposals but with some reservations. Property investors were identified as being the most cautious of all actors involved in property development. Further research proposals are described.

I declare that no portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institution of learning.

Paul Michael Syms

6 July 1996

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CHAPTER ONE

THE PROBLEM AND ITS ORIGINS

1.1 INTRODUCTION

"There are roughly 56 million people in this country and this country is roughly 56 million acres. If all things were equal we would have an acre each, plus perhaps a cow and a beanstalk.

But things are not equal. From the year dot to the year 1900 we built on two million of those 56 million acres. Between 1900 and 1950 we built on another two million acres. In other words, we covered as much land in the first half of this century as we had in all previous centuries.

And since 1950, in spite of, or perhaps because of, planning controls, we have gone mad. When the acres covered are added up at the end of the century they will have to publish them in hectares to make them look fewer. ....

For too long it was assumed that new development required green field sites. There are regions of Britain where, between 1950 and 1980, agricultural land was being built on at the rate of 100 acres a week. Then someone pointed out that developers could look inward as well as outward. Land which had been used once could be used again."

Brian Redhead, Months in the Country, 1992, pp25-26

This thesis is concerned with the re-use of such land, the methods by which it is brought back into use, and the ways in which former industrial sites may be valued before and after redevelopment.

Throughout the 1970's and early 1980's, the demand for land as the raw material of property development encouraged the re-use of former industrial sites. These sites were redeveloped for a variety of purposes but there was no concerted effort on the part of property developers to ensure that land should be re-used before further areas of virgin land were consumed. Redevelopment tended to occur in areas where there was little or no alternative. The 'urban regeneration' of these areas therefore came about as a matter of necessity rather than development or planning policy, although some encouragement was given to the redevelopment of old industrial sites through the enactment of the Inner Urban Areas Act 1978.

In some cases the redeveloped sites were retained in industrial use as new 'industrial estates' but, instead of supporting new manufacturing industries, these estates very often consisted of warehousing and distribution centres, providing far fewer employment opportunities than the old industries which they replaced. The demand for new industrial premises reached a peak in 1980 (King & Co., 1975-1986), accompanied by the abandonment of older industrial sites as manufacturing industry underwent a process of 'down-sizing' and modernisation. Proximity to motorway junctions became an important factor in terms of industrial location (Haywood, 1981), with motorway access perceived as being of greater importance than proximity to city centres, airports and rail facilities in a survey by Adams (1986). Land use criteria, such as a ready supply of raw materials and access to markets diminished in importance as a result of the globalisation of industry, and so the traditional manufacturing areas of the inner cities fell into a state of dereliction (Syms, 1986).

In bringing these derelict areas back into use, site preparation generally consisted of little more than demolition of old buildings and structures and the grubbing up of floorslabs. Frequently the old foundations were left in place, provided that they were not likely to cause a hindrance to the new development, and service pipework and ducts were simply cut off, left to remain in place under the new buildings. Investigations were undertaken by structural engineers, so as to ensure that sites were capable of supporting the steel portal framed buildings which became the standard form of construction for these new estates. Unless, however, the sites were obviously contaminated by some odorous or visibly unpleasant wastes, little thought was given to the chemical composition of materials left behind from the former uses.

Investors in these new industrial estates included pension funds and property companies, as well as companies purchasing for their own occupation. Many of the new developments were on sites which had previously been used for purposes such as coal yards, chemical works, textile mills and engineering works, and may have what Patchin (1988, p7) referred to as "ecologic and economic timebombs" buried beneath them. The investors gave little or no thought to the possibility that they may be acquiring properties affected by contamination and with potential future problems. That is not to suggest that the new developments were in any way unfit for the purposes for which they were intended. In the majority of cases contamination left behind by the past industrial uses was safely contained beneath floors, service yards and car parks, and may be expected to remain so for the economic life of the building.

As few of these developments from the 1970's and 1980's are nearing the end of their economic life, they are more likely to pose problems for future generations than to constitute a 'short term' problem. There are, however, a number of important issues to be considered, especially in respect of the redevelopment and value of contaminated land, and these will be addressed throughout this thesis.

The following definitions have been adopted for the purpose of the research. 'Development is defined in Section 55 of the Town and Country Planning Act 1990, as meaning:

"the carrying out of building, engineering, mining or other operations in, on, over or under land, or the making of any material change in the use of any buildings or land."

For the purpose of the research, 'redevelopment' has been defined as:

"the undertaking of engineering, or other operations of treatment, in, on or under land previously used for non-agricultural purposes, together with any associated infrastructure and building works, in order to achieve realisation of the land's potentialities"

A number of definitions of 'value' are contained in the *RICS Appraisal and Valuation Manual* (RICS, 1995d) and the one most suited for use in respect of the research is that of 'Market Value', which is defined as follows:

"The estimated amount for which an asset should exchange between a willing buyer and a willing seller in an arm's-length transaction after proper marketing wherein the parties had each acted knowledgeably, prudently and without compulsion." (RICS, 1995d)

Reference is made throughout the thesis to various actors involved in the redevelopment and value of contaminated land. Principal among these are the 'developer', the 'valuer' and the 'development surveyor', and these are defined as follows:

'Developer' - the "concept of 'developer' covers a variety of potential actors. Landowners may become developers, or dispose of their land to development companies. Landowners control not only undeveloped land, but also existing vacant premises." (Erickson & Syms, 1986. pp3-4)

'Valuer' - "one who estimates or assesses value professionally". (Oxford English Dictionary)

'Development surveyor' - a person with a knowledge of valuation, employed either directly by a developer or in a professional capacity, who appraises development projects and advises upon their viability.

1.2 THE CONTAMINATED LAND PROBLEM

Land contamination was not generally perceived to be an issue, by the surveying profession in the United Kingdom, until the late 1980's and little consideration was given to the valuation aspect of a problem which was not even seen to exist. This was evident from comments made by Malcolm Grant, Professor of Land Economy, University of Cambridge, in Spring 1992.

"We've only recently come to understand both the extent of the problem of contaminated land and its implications. So far as extent is concerned, we are told that there are several thousand sites in Britain which are contaminated, although that judgement does not carry with it the second judgement which is that they should be cleaned up, or the third judgement which is to what level they should be cleaned up. So it's a multi-layered problem. But it's been brought home to us particularly that our previous safeguards, as we understood them, and particularly the planning system, hasn't operated as effectively as we might have hoped. We have had instances of redevelopment being carried out, particularly on closed landfills, without anybody appreciating at the time that it was a closed landfill and without proper engineering work being in place to deal with the continued process of decomposition underground."

(Grant, 1992, p16)

The subject of contaminated land was addressed by Parliament, in a "very critical report" (Grant, 1992, p16) by the House of Commons Select Committee on the Environment in 1990, the "Rossi Report" (Environment Committee, 1990). This report made a number of detailed recommendations intended to strengthen the framework of legislation and environmental standards to reduce pollution risks and to facilitate the reclamation of land for new uses. The government response (DoE, 1990a) was presented to Parliament in July 1990 which, whilst recognising the report as a valuable contribution to the debate on contaminated land, perceived a number of problems in implementing the report's recommendations. The Government's White Paper "*This Common Inheritance: Britain's Environmental Strategy*" which followed in September of the same year (DoE, 1990b) stated that contamination of land by chemicals and waste products is hard to define and measure exactly, although surveys suggested that 50 per cent of the derelict land in the UK might be contaminated and that contamination is also found on other, non-derelict, land.

It was the Environmental Protection Act 1990, which came into force at the beginning of 1991, that first alerted valuers to the fact that the possibility of contamination may have a serious adverse effect on property values. Section 143 of the Act introduced proposals for the setting up of registers of land and buildings where industrial processes of a potentially contaminative nature had been, or were still being, carried out. The full implications of the legislation were not immediately apparent from reading the section itself and it was not until a consultation paper was published in May 1991 that developers and valuers were alerted to the possible effects of the proposals on property values.

The research which forms the subject of this thesis commenced in the period between publication of the consultation paper and the formal abandonment of the Government's proposals for registers of potentially contaminated sites, and before any alternative measures were brought forward. This was followed by a period which may be described as one of uncertainty.

Following abandonment of the Section 143 registers there was a feeling of relief, amongst developers, surveyors and valuers, that the registers were no longer to be compiled. Lawyers increased the number of environmental type questions in their pre-contract enquiries and bankers exercised extreme caution over the financing of development projects on potentially contaminated sites. The possibility that legislation could leave banks "with an environmental clean-up bill running into billions of pounds" (Bennett, 1992), forced banks to "rethink" their lending policies. "Many pension funds and insurers are [sic] still not prepared to take the risk because many trustees want everything to be squeaky clean" (Beattie, 1992) and resolved not to become involved with contaminated, or even 'suspect', land at any price.

Property developers, including those who had previously undertaken developments on former industrial sites decided to adopt a more cautious attitude than hitherto and the valuation profession pondered over how to reflect actual, or possible, contamination in values and the advice provided to clients. Taken altogether, it now seems likely that the proposal to introduce registers, followed by their abandonment, had a detrimental effect on the process of urban regeneration in the short term but it also had the effect of heightening awareness in respect of contamination.

There can be little doubt that the professional press, and the media generally, made too much of the register issue, using headlines such as "Beware, contaminated site" (Chartered Surveyor Weekly, 1991) but it is probably fair to say that the government could not have introduced the proposal at a more inappropriate time. The property market was in the worst recession since the 1930's and it was feared that the introduction of registers would have depressed property values even further. Some valuers were of the opinion that "land values would be seriously hit by government proposals to register contaminated land" (Estates Times, 1991) and that the asset values of some whole classes of property (used for those purposes specified in the register) would be reduced to nil or negative values. In other cases values would be significantly reduced, with the effect of rendering some properties virtually unsaleable and having an adverse effect on the balance sheets of businesses owning those properties.

A chronology of events which affected the valuation of contaminated land and, to some extent, influenced the formulation of Government policy is set out in Box 1.1.

Whether or not values would have fallen to the extent that was feared can now only be a matter for conjecture. The whole subject of land contamination and its effect on property values is under researched in the United Kingdom and this thesis aims, in a small part, to redress the balance. Because of the lack of British literature on the subject, the valuation aspects of the research must be of a largely exploratory nature, with comparisons being made to work undertaken overseas, notably in North America.

BOX 1.1

CHRONOLOGY OF SIGNIFICANT EVENTS AFFECTING THE VALUATION OF CONTAMINATED LAND - JANUARY 1991 TO APRIL 1996

January 1991	The Environmental Protection Act 1990 brought into effect, having received the Royal Assent in October 1990.	The Act contained provision, in Section 143, for the compilation of "Public registers of land which may be contaminated".
May 1991	A consultation paper "Public Registers of Land which may be Contaminated" published jointly by the Department of the Environment and the Welsh Office. Regulations for the registers to come into effect 1 April 1992.	The registers intended as records of fact, containing details of historic uses as well as present uses, once entered on the registers removal of property details would not be allowed. In respect of blight on property values "the Government takes [sic] the view that, in all but the very short term, it is better for everyone concerned to be aware of possible contamination".
	The consultation paper included Annex C: SCHEDULE OF CONTAMINATIVE USES.	This schedule contained 16 groups of industrial and other operations which were deemed to be potentially contaminative. The groups were divided into 42 sub-groups affecting between 80 and 100 industries.
March 1992	Government announced that implementation of the regulations for the new registers would be delayed.	This was due to comments that the proposed registers would affect an unacceptably large area of the country and have an adverse affect on property values at a time when markets were depressed.
July 1992	Draft Statutory Instrument ENVIRONMENTAL PROTECTION, published by the Department of the Environment and the Welsh Office.	The land uses to be included in the proposed registers reduced to eight specific industries, affecting only 10-15% of the land area covered by the original proposal. Removal of properties from the registers would still not be allowed and Government reserved the right to add other uses in the future.
March 1993	The registers proposal was withdrawn by Government.	Decision made in the light of continued opposition to the registers, an interdepartmental review of contaminated land policies to be undertaken.
October 1993	Valuation Guidance Note 11, Environmental factors, contamination and valuation, published by the RICS.	The first guidance on the valuation of contaminated land published by the valuation profession in the UK, based on the earlier TIAVSC Guidance Note and Background Paper.
March 1994	The consultation paper "Paying for our Past" published by the Department of the Environment and the Welsh Office.	Intended to gather the informed and structured views of interested parties on the key issues arising out of the review set up in March 1993.
November 1994	Policy document "Framework for Contaminated Land" published by the Department of the Environment and the Welsh Office.	Outcome of the Government's Policy Review and Conclusions from the Consultation Paper "Paying for Our Past". Restated the fact that the Government is committed to sustainable development and that there is an already established modern and effective regime for action to deal with future pollution. So far as the treatment of contaminated land is concerned the Government is committed to the 'suitable for use' approach.
January 1995	"Land Contamination Guidance for Chartered Surveyors" published by the RICS.	Intended to embody 'best practice' but not mandatory. The use of 'Land Quality Statements' recommended.
July 1995	The Environment Act 1995, received Royal Assent.	The provisions of the Environmental Protection Act 1990 amended by the addition of a further 32 pages (26 Sections) of legislation dealing with contaminated land. Also contained the framework for the establishment of an Environment Agency for England and Wales and a Scottish Environmental Protection Agency.
December 1995	Guidance Note 2, Environmental Factors, Contamination and Valuation, together with amendments to Practice Statements 2.2.2, 4.14, 6.3 and Appendix PSA 3, published by the RICS as part of the new Appraisal and Valuation Manual, effective from 1 January 1996.	Use of the Practice Statements now mandatory in respect of valuations undertaken by members of the RICS, ISVA and IRRV. The guidance takes account of the Environment Act 1990 legislation changes and practice experience, but will be subject to further revision once Parliamentary Guidance is issued under the legislation.
January 1996	Technical guidelines for dealing with contaminated sites, due to be published January 1996, delayed by Government	Draft guidelines due to be issued late February or early March, followed by a period of consultation, which will include examination by the House of Commons Select Committee on the Environment
February 1996	Working draft of the Statutory Guidance issued..	Consultation guidance due "after Easter" to be followed by a three month consultation period. New regulations expected to be in force January to April 1997.
April 1996	Second working draft to be issued late April/early May	Will take account of comments made in respect of the first working draft. Public consultation to follow "shortly thereafter".

(Sources: various, including informal comment from the Department of the Environment)

1.3 THE THEORY OF VALUE APPLIED TO CONTAMINATED LAND

It is argued that any 'real property' used in connection with a manufacturing business has a value. That value may not be readily realisable in the open market but may instead be deduced by reference to the contribution which the property makes to the income of the business. The value may also be apportioned between the land and the buildings or structures. An apportionment may be made arbitrarily by the owners of the business, or by reference to market transactions in respect of comparable land in the same locality, or by deduction of the Depreciated Replacement Cost of the buildings and plant from the total value.

Economic circumstances may render the property redundant. Demand for the products produced by the business may decline to such an extent that it is no longer viable to continue in production. New methods of production may supersede those currently in use and the buildings, or plant, may be incapable of adaptation at reasonable cost. The availability of raw materials may be extinguished, or no longer be economically obtainable. Market centres may change and the increased costs of transport to market may render the goods uncompetitive. All of these events will affect the value of the property.

In economic terms, value is the price which would be paid for the highest and best use of the property which, in a free market, would be determined through the forces of supply and demand. Such a free market does not exist in the United Kingdom as the uses to which real property may be put are determined by town planning legislation. The price to be paid for real property will be influenced in either a positive or a negative manner by the permitted town planning uses. The economic value may therefore come to be regarded as "the highest and best use as adjusted by the permitted use or uses".

Whilst the property continued in use for manufacturing purposes the buildings and structures had a value which could be calculated. Following the cessation of production, it is quite possible that the buildings and other structures may be totally unsuited to any alternative use. This may be due to obsolescence brought about by age or economic factors, or they may be unsuitable for alternative use by virtue of the nature of the manufacturing processes previously carried out on the property. The buildings, structures and plant may thus be transformed from being valuable assets into costly liabilities.

Some value may be realisable from the buildings and structures, after deducting the costs of demolition or dismantling. A problem may remain if, following removal of the above ground appurtenances, the land itself is left damaged by the former manufacturing activities. Such damage may take the form of underground building foundations, machine bases, abandoned services, storage tanks and contamination or pollution arising out of spillages or the inadequate disposal of residues from the former manufacturing processes. Expenditure will have to be incurred in rectifying the damage before any value for a new, or alternative, use can be realised.

In such circumstances, it can be argued that the value of the highest and best use is the price which would be paid by a willing buyer to a willing seller, in an open market, subject to town planning controls, after deduction of the lowest cost attributable to overcoming the damage to the land. An additional element of risk is introduced to the valuation process by virtue of the fact that the land itself is damaged, or may have suffered damage. The risk arises out of the need to quantify the cost of site treatment required to ameliorate such damage. The damage is unlikely to be visible to the valuer upon inspecting the property, indeed the visual appearance may be one of an undamaged site if it has been 'grassed over' following demolition of the buildings. Even if information is available from other professionals, in order to assist the valuer, the full extent of the damage and thus the cost of treatment may not become known until such time as the redevelopment has been completed.

A factor additional to the financial cost of treating the contamination lying in or on a damaged site is the disquiet, arising out of the presence of contamination, which may be engendered in the minds of the occupiers of neighbouring properties and other actors, including developers and valuers. The concerns of these actors may be attributable to the risk of actual harm or they may be unfounded. In either case the disquiet has the potential to affect the desirability of the site for redevelopment purposes and thereby have an impact upon the value of the land. This potential impact on value, which exceeds the cost of treatment, has been defined as 'stigma' (Patchin, 1988, p12) and Wilbourn (1996) has stated that, in his experience, "it is not possible to define a level of stigma discount".

One purpose of this research has been to ascertain whether deduction of the cost of treatment, on its own, is the correct approach to be adopted in the valuation of land damaged by former industrial uses, or whether any additional allowance should be made to reflect 'stigma' and to identify a method by which the value of contaminated land may be ascertained. It is argued that, in situations where land has been contaminated or polluted by past industrial activities, the approach of 'highest and best use net of lowest amelioration costs' may be inappropriate in ascertaining the true value of the land. In order for a valuation of a contaminated, or formerly contaminated, property to be undertaken it is necessary to also take account of a number of other factors which are specific to such properties. These include governmental policies on the treatment of contamination, emanating from both the United Kingdom and Europe, the attitudes and perceptions of potential occupiers and investors in such properties towards any long term liabilities and the availability, or otherwise, of financial incentives to assist in the treatment of damaged land.

1.4 STRUCTURE OF THE THESIS

A significant body of literature exists in respect of soil contamination, its causes, pathways, targets and methods of remediation (for example, DoE, 1986a and b; Cairney, 1987, 1993; Fleming, 1991; Armishaw *et a,l* 1992; CIRIA, 1995). Most of this literature is of a highly technical nature and virtually incomprehensible to most general practice surveyors and valuers. An important task of the research was therefore to review this literature, in order to gain an understanding of the problem and then to distil it into a form which is readily understood by valuers.

The study employs a hypothetico-deductive approach, (see Furbey, undated, p12 and McNeil 1990) from the review of literature issues and problems are identified. A primary research question is generated, relating to the perceptions of property market actors. The effects which different types of contamination, remediation methods and future uses may have on value are considered through the perceptions of actors from diverse professions, a model is developed and tested through the use of case studies.

The primary research question is set in terms of the following hypothesis:

Contaminated land is an important resource, notwithstanding that in the short term it may be perceived as a liability, and should not be disregarded for that reason. It is hypothesised that a risk assessment approach can identify the future potential of contaminated land and inform the decision making process in respect of its redevelopment and value.

The research methods employed included two questionnaire surveys, in 1994 and 1996, together with an interview survey in 1994. The purpose of these surveys was to assess the perceptions of individuals in property related professions and to compare the views of a group of valuers and development surveyors with those of a 'multi-disciplinary' group drawn from 'more technical' disciplines, including architecture, engineering and environmental science. The perceptions of the two technical groups were also compared with a 'general population' group in respect of a number of environmental issues. Psychometric techniques were, in part, used to analyse the responses to the surveys, as this approach was considered most appropriate in seeking to compare the perceptions of different groups and enabled the hypothesis to be tested.

Six case studies were considered in detail, and four in less detail, in order to determine the extent to which there exists a diminution in the value of contaminated land which exceeds the cost to cure. These actual development examples are then used to test the predictive model.

A critique of the research methodology is contained in Chapter Eight. In order to achieve the research objectives a number of tasks were identified, including:-

1.4.1 to examine the causes of contamination, the pathways and targets of contaminants, site investigation methods and the means of remediation which may be used to overcome the problems associated with contaminated land;

1.4.2 to consider the redevelopment of contaminated land, the methods applied to the valuation of affected land and the relevance of the theory set out in section 1.3;

1.4.3 to assess the perceptions of market actors regarding the extent to which values and desirability for development, occupation and investment may be affected by the presence of contamination;

1.4.4 to estimate the extent to which different types of contamination and treatment methods affect values and if the effects differ according to proposed end use;

1.4.5 to assess the views of market actors regarding government policies relating to the redevelopment of contaminated land;

1.4.6 to examine ways in which the attitudes of investors may be influenced so as to facilitate the redevelopment of contaminated sites.

1.4.7 to identify areas for further research.

Chapter Two defines contamination and looks at the industrial processes, many of which are still in use today, which have been responsible for land becoming contaminated. The extent of the problem is examined in terms of the nature of contaminative substances, their sources, the pathways by which they travel and the ways in which they affect their targets. The number of affected sites in England and Wales is discussed, drawing upon earlier research work including Kivell, 1987; DoE, 1988, 1991b and 1995; and Syms, 1994a.

"Persons involving themselves in property must assess risks before any hard commitments are made " (Graham, 1995, p5) and the likelihood of increased risk is identified as a major influence in respect of the treatment and re-development of contaminated land. Chapter Three considers perceptions of risk and relates these to the development process. The acceptability, or otherwise, of increased levels of risk may be influenced by the attitudes of government and regulatory authorities. Current policies and legislation concerning contamination are discussed and those proposed for use in England and Wales are compared to those in other European countries and regions. The role of the Environmental Agency, in seeking to deal with the problems of contaminated land, is outlined.

Although it can be argued that an ability to undertake site investigations is outside the scope of services which should be offered by general practice valuers, such general practitioners are very often the only property advisers employed by the owners of industrial property, or by developers in the early stages of a project. In order to provide an adequate service to clients, it would seem reasonable to expect the surveyor or valuer to have sufficient knowledge, so as to be able to identify the need for a site investigation and to advise upon the appointment of suitable consultants. The need for adequate site investigations and the ways in which these may be achieved are discussed in Chapter Four.

Once a site has been investigated and the extent of any contamination has been identified, treatment may or may not be required and several alternative forms of remediation may be suitable. For the most part the United Kingdom approach to site remediation has been biased towards civil engineering solutions but these can take many forms, according to the nature of the contamination, the geology and hydrogeology of the site, and the intended future use. Other forms of treatment have suffered from a degree of scepticism and their acceptance has been slow. Available methods, their suitability and likely cost are considered in Chapter Five.

Issues of value are considered in Chapter Six, academic literature and professional guidance issued to valuers, practising in the United Kingdom, are considered. Very little academic literature dealing with the problems of valuing contaminated land has hitherto been published in the United Kingdom, although the issue has been touched upon in Ironside, 1989; Syms, 1994a; Sheard, 1992; Turner *et al,* 1994; and Syms, 1996a. Articles have also been published in the professional press, for example Lockwood, 1994, and the issues have been addressed in conference papers such as Laing, 1992 and Syms, 1994b. For the most part, it is necessary to turn to North American literature for meaningful academic work on the valuation aspects of the subject (e.g. Patchin, 1988, 1991a, 1991b, 1994; Bleich et al, 1991; Dorchester, 1991; Mundy, 1992a, 1992b, 1992c). These works, and others, are considered in depth and their relevance to valuation and development processes in the United Kingdom is considered.

The extent to which valuers should become involved with environmental matters is discussed, especially as some members of the profession appear to hold diametrically opposed views. For example, one faction appears to believe that the valuers should do no more than advise the client that the possibility of contamination has not been taken into account in preparing the valuation, whilst another believes that the valuer should endeavour to ascertain the cost of remediation and take cognisance of this when producing the valuation.

The "Suitable for Use" approach, favoured by British government policies, is discussed in Chapter Seven in the context of determining risk. A very significant difficulty, in tackling the problems of contaminated land in the United Kingdom, has been the paucity of accurate data concerning past uses and the extent of contamination within individual sites. Linked to this has been an understandable reluctance, on the part of both existing landowners and prospective developers, to spend money on site investigation work. Risk assessment methods are also described in this chapter.

The research methodology adopted in respect of the empirical studies is described in Chapter Eight. The studies include interview and questionnaire surveys from which a valuation model has been produced, case studies of actual redevelopment projects are described and are used in order to assess the observable impact of contamination on land values.

Although only a limited amount of academic literature, concerned with the subject of contaminated land, has been produced in the United Kingdom a great deal of practical knowledge is available regarding the remediation and redevelopment of such sites. The majority of valuers have not had much direct involvement in site reclamation, with the advice regarding treatment options being regarded as the responsibility of civil engineers and environmental scientists. Chapter Eight considers the impact which different forms of site treatment may have on the development process.

It is suggested that, in the light of greater environmental awareness and with an increasing range of options becoming available for the treatment of contaminants, valuers need to improve their knowledge so as to be able to provide proper advice as to the valuation implications relating to soil remediation alternatives. Landfilling with contaminated wastes is regarded by many as being environmentally unacceptable, suitable landfill sites are also reducing in number and the costs involved are increasing. Developers must therefore give the fullest consideration to all available options and the valuer has a role to play in ensuring that the most appropriate decisions (based on present technical knowledge) are reached by their clients.

In order to obtain a fuller understanding of site remediation methods, and their relevance to development proposals, it was considered appropriate to critically examine a number of actual projects. Six case studies, from projects undertaken during the late 1980's to the mid 1990's, are described in Chapter Eight. These case studies have been selected so as to be able to provide a comparison between different methods of treatment, under circumstances where sites are to be used for a variety of purposes, to facilitate an analysis of redevelopment and value issues and for the contribution which they make to knowledge of the development process.

A questionnaire survey was undertaken in the first three months of 1994. This was required for the purpose of establishing a base level of knowledge, concerning contaminated land and available treatment methods, in respect of the various professions having a direct involvement in property development. The survey was considered to be an important step in assessing the perceptions of different actors engaged in the development process and was, in part, prompted by advice given by a major firm of London based solicitors to an overseas client intending to have a new factory built on one of the case study sites in Chapter Eight. The advice was to the effect that 'the site was formerly used for chemicals manufacture, is probably contaminated and will undoubtedly appear on any future register of contaminated land; therefore the property is not likely to be a good investment and the company should reconsider its decision to acquire premises on this site'. This advice was given in spite of the fact that the government had already indicated its intention to abandon proposals to set up registers of potentially contaminated land and took no account of the fact that the site in question had undergone a comprehensive programme of remediation. The survey and its results are fully described in Chapter Nine.

Also reported in Chapter Nine is an interview survey which was conducted in mid 1994. The main objective of the survey was to ascertain the extent to which valuers take account of actual or potential contamination when preparing valuations or advising clients on property acquisitions. The survey was conducted at a fairly early stage in the research in order to be able to make an assessment of professional practice in the period between the abandonment of the Section 143 Registers and the setting up of the Environmental Agency.

The final stage of the survey work was undertaken in the first two months of 1996 and comprised a questionnaire survey, part conducted by post and part conducted by face to face interviews. The results of this survey are also reported in Chapter Nine.

Chapter Ten considers the nature of the information required to be included in a model, for use where values have been affected by the possibility of contamination. Ways in which this data may be used in preparing yardsticks by which differing types of contamination, remediation methods and end uses, may impact values before and after development are also discussed. The results obtained from the development of the model and the valuation implications are fully described. The valuation model is tested, using the case studies described in Chapter Eight together with four additional studies.

A summary of findings from the research and the conclusions derived therefrom is contained in Chapter Eleven. The implications of the research for government policies, the redevelopment process and valuation procedures are considered. An agenda for further research is also identified.

CHAPTER TWO

LAND CONTAMINATION: SOURCES AND EFFECTS

2.1 DEFINING CONTAMINATED LAND

"Contaminated land is one of the many complex issues to be addressed by all those involved in ensuring protection of human health and the environment. It should be considered both in terms of its prevention and as part of the overall assessment of land for a variety of purposes and users." (Denner, 1991). In spite of this statement by an official in the Department of the Environment, no standard definition exists in respect of contaminated land, although a legal definition was introduced for the first time in the Environment Act 1995. The problem of definition is perhaps not surprising given that the contamination of land can itself take many different forms.

Contamination and pollution are also often regarded as synonymous (RICS, 1993) and it is therefore appropriate to start by defining what is meant by the word 'contamination' before considering effects upon land and its value. The Collins English Dictionary would appear to support the argument that contamination and pollution are synonymous with the following definitions:-

> Contamination: the act or process of contaminating or the state of being contaminated,
> Contaminate: to make impure, especially by touching or mixing; pollute
> Pollute: to contaminate, as with poisonous or harmful substances.

The Royal Commission on Environmental Pollution (RCEP, 1984) considered the problem of defining contaminated land and attempted to do so by distinguishing between 'contamination' and 'pollution' in the following way:-

> *Pollution* can be defined as the introduction by man into the environment of substances or energy liable to cause hazards to human health, harm to living resources and ecological systems, damage to structures or amenity, or interference with legitimate uses of the environment. Substances introduced into the environment become pollutants only when their distribution, concentration or physical behaviour are such as to have undesirable or deleterious consequences.
> For comparison, *contamination* can be defined as the introduction or presence in the environment of alien substances or energy, on which we do not wish or are unable to pass judgement on whether they cause, or are liable to cause, damage or harm. *Contamination* is therefore a necessary, but not sufficient, condition for *pollution*.
> (RCEP, 1984 p4)

In considering the above definitions, Beckett (1993a) commented that most attitudes and approaches to contaminated land seem to imply that land is polluted rather than merely contaminated. This he attributed to the fact that it is harder to exercise the 'judgement' inherent in the RCEP definition of contamination, with the result that the public, local authorities, and others prefer to assume the definition of pollution, which they see as being more positive.

The Department of the Environment in its evidence to the House of Commons Environment Committee defined "contaminated land" as "land which represents an actual or potential hazard to health or the environment as a result of current or previous use" (Environment Committee, 1990 pxviii). This definition can be contrasted with the one used to define derelict land, which is regarded as being "land so damaged by industrial or other development that it is incapable of beneficial use without treatment" (DoE, 1986a, p2). These two definitions make it clear that, for official purposes, 'contamination' and 'pollution' arise out of human activities. Naturally occurring contamination, such as the emission of radon from certain geological formations and methane from peat, falls outside the definitions and is thus excluded from consideration. It is also implicit from the definitions that both contamination and dereliction are seen as having a direct relationship with land use, previous, current or future.

The Department of the Environment's definition of contaminated land was criticised by a number of witnesses giving evidence to the Environment Committee, who pointed out that this meant that land which contained toxic chemicals would not be classed as contaminated if no use were proposed. (Environment Committee, 1990 p.xix) In other words, if at the end of its working life a chemical plant was simply to be closed and its boundaries secured, above and below ground, with no redevelopment proposed, then the site would not be classed as contaminated. Smith (the original secretary of the government's Interdepartmental Committee on the Redevelopment of Contaminated Land), giving evidence to the committee as a representative of environmental consultants Clayton, Bostock Hill and Rigby stated that:-

> It is not surprising that the Department would wish to limit the definition [of contaminated land] because the acceptance of the broader definition would mean that substantial parts of some urban areas would have to be classified as contaminated - as indeed they are." (Smith, M.A. 1990, p.xix)

The Environment Committee expressed concern that, by defining contaminated land narrowly and solely in relation to end use, the Department of the Environment may be underestimating a genuine environmental problem and misdirecting effort and resources. (Environment Committee, 1990 pxix)

The description of the circumstances leading to the contamination of land, produced by the Interdepartmental Committee on the Redevelopment of Contaminated Land in 1983, is somewhat longer than the definition given to the Environment Committee in 1990 but is nevertheless consistent in referring to land use -

> The use of land for industrial purposes or for waste disposal may result in chemical contamination which can restrict or prevent subsequent redevelopment because of immediate or long-term hazards to human health (directly or indirectly), to plants, to amenity, to construction operations, or to any buildings and services.
>
> (ICRCL, 1983)

The linkage between contamination and land use continued to be government policy, as evidenced by preliminary conclusion 4A.5 of the consultation paper *Paying for our Past* (Department of the Environment, 1994a). It stated that one of the objectives for dealing with contaminated land could be to improve sites in line with the "suitable for use" approach as and when hazards are tackled, the private sector decides to develop land, or public authorities prepare land to promote development. This was subsequently confirmed as government policy in *Framework for Contaminated Land* (DoE, 1994b) and is in marked contrast with the approach adopted in the Netherlands, where the policy adopted by government was that the standard of treatment should be the same, regardless of end use. This approach is known as 'multifunctionality', and the differences between the two approaches will be discussed in Chapter Three.

The British Standards Institution, in its draft Code of Practice (BSI, 1988) on the identification and investigation of contaminated land, offered the following definition:-

> .... land that contains any substance that when present in sufficient concentration or amount presents a hazard. The hazard may
>
> (a) be associated with the present status of the land
>
> (b) limit the future use of the land; and
>
> (c) require the land to be specially treated before use.

Harris (1987) pointed out that definitions of this type had been challenged by the Department of the Environment and that a new operational definition of contaminated land had been proposed by the Department:-

(i) Land which because of its former uses now contains substances that give rise to the principal hazards likely to affect the proposed form of development, and which
(ii) Requires an assessment to decide whether the chosen development may proceed safely or whether it requires some form of remedial action, which may include changing the layout or form of the development. (Beckett and Simms, 1984; Harris, 1987)

Harris also commented that the exact form of these, apparently similar, definitions not only has repercussions for the estimation of the scale of the problem but also provides some insight into how various authorities regard the subject of contaminated land.

One definition which appears to have received fairly widespread acceptance (except, perhaps, with the Department of the Environment as it omits any reference to 'suitability for use') defines contaminated land as:-

> Land that contains substances that, when present in sufficient quantities or concentrations, are likely to cause harm, directly or indirectly, to man, the environment, or on occasions to other targets. (Smith M.A., 1985 p1)

This definition has been adopted by the NATO Committee for Challenges to Modern Society (NATO CCMS), the Welsh Development Agency (Welsh Development Agency, 1993), The European Group of Valuers of Fixed Assets (TEGOVOFA) and by the Construction Industry Research and Information Association (CIRIA) in its draft "*Guidance on the sale and transfer of land which may be affected by contamination*" (CIRIA, 1994). It should however be pointed out that another report published by CIRIA defines contamination and pollution as follows:-

> Contamination: The presence in the environment of an alien substance or agent, or energy, with the potential to cause harm.
> Pollution: The introduction by man into the environment of substances in sufficient quantity or concentration as to cause harm to human health, harm to living resources and ecological systems, damage to structure or amenity, or interference with legitimate uses of the environment. (Harris *et al*, 1994 p1)

The Environment Act 1995 defined contaminated land as being:

> any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that -
> (a) significant harm is being caused or there is a significant possibility of such harm being caused; or
> (b) pollution of controlled waters is being, or is likely to be, caused;

'Harm' is defined in the Act as meaning "harm to the health of living organisms or other interference with the ecological systems of which they form part". In the human context, this is intended to include harm to property. The word 'significant' is not defined in the Act and its use " in the main definition of contaminated land narrows its scope considerably" (Denner and Lowe, 1995), which no doubt will be tested in the courts in due course. A definition of 'significant harm' has been subsequently proposed by the Department of the Environment and is discussed in Chapter Three. The definition has not yet been approved by Parliament and because of these limitations, in terms of both scope and status, the legal definition is not considered to be suitable for the purpose of the research.

In view of all the past attempts which have been made in seeking to define contaminated land it may be inappropriate for this research to introduce yet another variation. The problem which remains, therefore, is one of selecting the definition that is most appropriate to the research. The RCEP definitions call for judgements to be made which are beyond the scope of this research, due to the degree of technical information which would be needed to arrive at informed judgements, whereas the definitions proposed by the Department of the Environment may be regarded as an attempt to artificially limit the extent of land contamination, which would restrict the research. The short definition produced by Smith in 1985, referred to above, has been recently used by the Royal

Institution of Chartered Surveyors (RICS, 1995a) and, in view of the recognition received from five leading bodies concerned with the problems of contaminated land, this would seem to be the most widely accepted definition. It also appears to provide the clearest and most appropriate description when viewed in the context of property valuation and development, as it does not seek to artificially limit the extent of the contamination problem. The definition can also be applied to naturally occurring contamination as well as that attributable to man made activities, however the present research is not concerned with natural contamination. For the reasons set out above, the short definition has been selected as the definition to be used throughout the thesis:-

> Land that contains substances that, when present in sufficient quantities or concentrations, are likely to cause harm, directly or indirectly, to man, the environment, or on occasions to other targets. (Smith M.A., 1985)

2.2 THE CAUSES OF CONTAMINATION

By the 'strictest' definition almost any activity of man has the potential to cause contamination. "The presence of contamination in land does not, however, mean that for a particular purpose, and in the specific conditions of a site, that the contamination has reached an action level where remediation or risk reduction actions are necessary." (RICS, 1995a) In accordance with the selected definition this research is only concerned with contamination which has the potential to pollute and cause damage to living beings or the environment.

Land may become contaminated as a result of a variety of human activities, and the polluted soil may result in problems for centuries to come. "The metal extractive industries are well known for causing soil contamination and mineral processing also frequently leads to contamination. Indeed the toxic effects of spoil from Roman lead and silver mines are still visible in parts of North Wales" (NSCA, 1992, p200). Manufacturing industry is also a contributor to land contamination often resulting from the use of "processes and practices, which by current environmental standards would be judged inadequate." (Beckett, 1993b). Some industries are still contributing to the problems of environmental pollution in the United Kingdom, although stricter town planning and environmental controls should ensure that their potential to exacerbate the problems of contaminated land is minimised in future.

Extractive, mineral processing and manufacturing industries are by no means the only causes of land contamination. Landfilling and accidental occurrences, such as spillages and pipeline ruptures, are also major contributors. A significant part of the problem is one of treating, in a relatively short period of time, the contamination left behind by previous generations on sites which have been used for a variety of different purposes. Very often several uses may have subsisted on a single site, both over time and at the same time as each other. Most probably little or no documentation will exist as to the processes employed and the materials manufactured or stored on the site.

Investigation of the former Royal Dockyard in Woolwich, adjacent to the south bank of the River Thames, revealed that several different stages of development had taken place on the site since the early 16th century, with at least three types of piled foundations existing on top of each other. The ground level had been built higher at each development stage through the importation of a variety of fill materials, the slipways and docks had also been filled. Following closure of the Dockyard in 1869 the site was used by the army as a storage depot until about 1926, when the site was sold into various ownerships. Subsequent uses included a sugar refinery, a food storage depot and the recovery of metals from cables. Fly tipping had taken place and the site was contaminated by a wide range of chemicals from its previous uses. Landfill gas was being produced, with high concentrations of methane[1]. Not one but several different problems on the same site. "Hence contaminated land has a history, but is not a historical problem. This renders the management of contaminated land a twofold process: remedial works for land already contaminated, and the implementation of correct management and standards which will minimise future contamination." (NRA, 1994, p5).

Several attempts have been made at identifying those activities which have the potential to cause contamination. The list produced by the Department of the Environment in connection with the registers proposed to be introduced under Section 143 of the Environmental Protection Act 1990 is an example. The Schedule of Contaminative Uses contained in Annex C of the Department of the Environment's consultation paper (DoE, 1991a) would have resulted in vast areas of the United Kingdom being classed as 'contaminated', whereas the subsequent list of only eight uses was woefully inadequate in identifying the extent of the problem. Harris (1987) produced a list of 18 "contaminating" industries, the Interdepartmental Committee on the Redevelopment of Contaminated Land cited 13 examples of the types of sites on which contaminants may be found (ICRCL, 1987) and the Environment Committee (1990) identified 19 activities as being the

[1] Based on a survey undertaken by Travers Morgan in 1986.

"most common contaminative uses". Many, but not all, are similar to those contained in the other lists. For the purpose of this research, and drawing upon the earlier work, the schedule of 26 uses set out in Box 2.1 has been compiled.

BOX 2-1
POTENTIALLY CONTAMINATED SITES

Asbestos manufacture and use	Oil refining and storage
Chemicals manufacture and storage	Paint manufacture
Dockyards and wharves	Paper and printing works
Dye-stuffs manufacturing works	Pharmaceutical industries
Electricity generating stations	Radioactive materials processing
Explosive industry	Railway land
Gas works and similar sites	Scrapyards
Glass manufacturing	Semi-conductor manufacturing plants
Heavy engineering works	Sewage treatment works
Iron and steelworks	Tanning and leather works
Metal smelting and refining	Textiles manufacture
Metal treatment and finishing	Timber treatment works
Mining and extractive industries	Waste disposal sites

(Source: Syms, 1995b)

The list of uses set out in Box 2.1 should not be regarded as exhaustive. It may, for example, be considered deficient in that it does not include any agricultural activities, although the burying of diseased livestock was included as a contaminative use in Annex C of the Department of the Environment's consultation paper on the Section 143 registers. This reference was deleted from the revised schedule (DoE, 1992a), attached to the draft regulation, as the result of lobbying by farming interests. Food related industries are also excluded from the list yet many of these can cause contamination, especially those using sugar based products which may be harmful to substructures and services. 'High street' uses, such as dry cleaners, with the potential to contaminate have also been excluded.

In spite of these omissions it is considered that the list fairly represents those uses which have the greatest potential to cause serious contamination and are therefore most likely to have an impact in valuation terms and which must be taken into full account when considering development proposals. The list has been substantially adopted in paragraph GN 2.2.3 of Guidance Note 2 of the RICS Appraisal and Valuation Manual (RICS, 1995d), with the omission of "Mining and extractive industries" and "Textiles manufacture", and the addition of Pipelines, Petrol storage sites, Research and Defence Establishments and Animal Products works. Reference is also made in the Guidance Note to "the extent to which unstable or contaminated materials have been tipped into mineral excavations" (RICS, 1995d, para. GN 2.2.4). Valuers are alerted to the possibility that contamination may originate from waste disposal by land fill tipping and from modern farming methods, in paragraphs GN 2.2.5 and 2.2.6 respectively.

The contaminants which may be found on a site will vary according to present or former activities and, where sites have been used for a number of different purposes, different types of contamination may remain from those earlier uses. Parry and Bell (1987) described a number of different types of contaminated sites and the activities which had the potential to cause contamination. It is possible that not all of the earlier uses will have been adequately documented, if indeed any documentary evidence remains, and it is therefore quite possible for sites to contain contaminants which are totally unrelated to the present, or last known, use of the land. Commonly encountered contaminants include: heavy metals, found at sites such as scrapyards, sewage works and tanneries; organic compounds, including chlorinated solvents from chemical industries; asbestos, from power stations and other industries; and combustible substances and flammable gases, for example from gasworks and former waste disposal sites. (Denner, 1991)

Detailed consideration of the nature and origin of contaminants, the pathways by which they travel and the manner in which they may affect their targets, is beyond the scope of this thesis, although some understanding of the subject is required and will be discussed in the next section. A fuller consideration of a number of the most commonly occurring contaminants, their sources and principal hazards has been presented by Haines and Harris (1987). Kruus *et al* (1991) have provided an introduction into the ways in which chemicals enter the environment, whilst Sax and Lewis (1989) have described the dangerous properties of more than 20,000 industrial materials. For the present research, however, consideration has been limited to those contaminants most likely to be found as a result of the activities listed in Box 2.1. These include those contaminants set out in Box 2.2.

BOX 2-2

MAJOR CONTAMINANTS AND WHERE THEY MAY BE FOUND

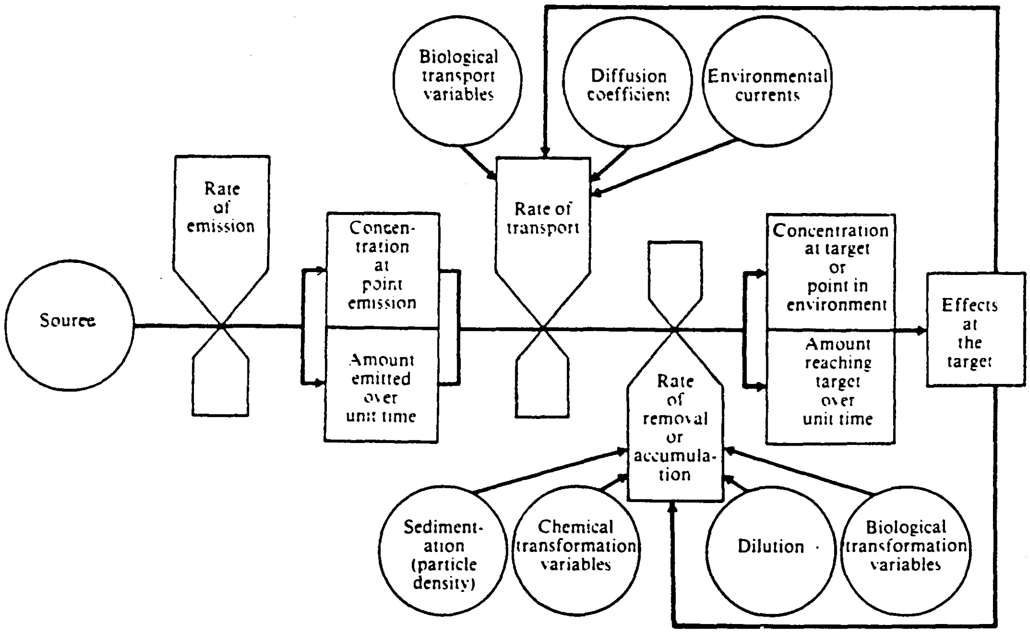
Contaminant	Industry or Land use
1) Metallic contaminants	
Arsenic	Timber treatment, dyestuffs manufacture Glass, Paint, Textiles and Explosives
Cadmium	Plastics, Paint, Mining and Smelting, Scrapyards, (From discarded batteries)
Chromium	Mines and smelters, metallurgy industries, power station ash, sewage sludge, timber preservation, pigments, leather tanning, plating
Cobalt	Pigments, metallurgy industries, hospitals
Copper, Nickel, Zinc	Mining & Smelting, Paint, Plating, Glass
Lead	Mining and smelting, foundries, manufacturing industries Pigments, batteries, plating, anodising and galvanising works, fungicides sewage sludge, landfills
Magnesium	Fireworks manufacture
Mercury	Mining and smelting, paints, plastics, glass, pulp and paper production, fungicides, foundries, iron and steelworks, plating, anodising and galvanising.
Uranium	Nuclear industries
2) Inorganic contaminants	
Cyanide	Waste disposal, Metal treatment and finishing, Gasworks
Sulphates	Waste disposal, Gasworks
3) Organic contaminants	
Phenols	Chemicals manufacture and storage, Gasworks, Waste disposal Manufacture of paper, plastics, rubber, solvents, paints and wood preservatives. Iron and steel manufacture.
Coal tars and PAHs	Gasworks, Chemicals manufacture and storage, combustion of coal, wood and other organic materials.
Oils	Transport and processing of crude oil and related products, animal fats and vegetable oil from food manufacture, soap manufacture.
PCBs	Transformers, capacitors, inks, fire retardants, hydraulic and lubricating systems.
4) Asbestos	Railway land, Heavy engineering, Waste disposal, Asbestos related manufacture, Scrapyards, Power stations
5) Combustible materials	Waste disposal, Mining, Gasworks, Oil refining and storage
6) Gases	
Ammonia	Iron and steel manufacture, coal gas production, refrigerant units.
Carbon dioxide	Filled dock basins, Waste disposal, iron and steel works, organic decomposition
Methane	Landfills, coal mine gas,

Sources: Haines, R.C. and Harris, M.R., (1987) and Applied Environmental Research Centre, (1994).

2.3 PATHWAYS AND TARGETS

Holdgate (1979) advanced the concept of pollution pathways and suggested that all pollution events have certain characteristics in common: (i) the existence of a pollutant, (ii) the source of the pollutant, (iii) the transport medium (air, water or soil) and (iv) the target in terms of the organisms, ecosystems or items of property affected by the pollutant; as shown in Figure 2.1.

FIGURE 2.1
A POLLUTANT PATHWAY



(Source: Holdgate, 1979, p.46)

"Varying degrees of sophistication can be added to this simple model including the rate of emission of the pollutant from the source, the rate of transport, chemical and physical transformations which the pollutant undergoes either during transport or after deposition at the target, amounts reaching the target, movement within the target to sensitive organs, and quantification of the effects on the target." (Alloway and Ayres, 1993, pp16-17) Most of the technical, chemical and biological aspects as to how pollutants travel and affect their targets are beyond the scope of knowledge required by valuers. A broad understanding of the transmission mechanisms involved is important as it can assist valuers in determining the extent to which a property may be impaired. These mechanisms are described in the rest of this section.

Beckett (1993) provided a simplified development of Holdgate's pollution pathway concept, describing it as a chain of inter-linked relationships -

Previous and/or present use	---->	Contamination	--->	Hazard	--->	Target	--->	Protection

The extent to which contaminants are potentially harmful to human beings, to flora, fauna and the wider environment, depends largely on how they occur, their degree of concentration, the methods by which they travel and the nature of the detrimental effects on their targets. The extent of any detrimental effect is also of importance, in view of the government's definition of 'significant harm', discussed in Chapter Three, which is based on the identification of specific environmental risk. For any such risks to be present it is proposed that the following elements must exist:

> **a. a <u>source</u> - the presence on the land of a substance, or substances, with the potential to cause harm or water pollution ("potential pollutant")**
>
> **b. a <u>receptor</u> or target - the presence of something which could be harmed by that pollutant or controlled waters which could be polluted**
>
> **c. a <u>pathway</u> or a number of pathways by which the receptor could be exposed to the pollutant. (DoE, 1996)**

It is therefore necessary to examine the relationships between the contaminants, the means by which they cause harm and their relevance to different existing and potential land uses. Box 2.3 illustrates the linkages between several main contaminants, the method by which they cause harm and the possible nature of that harm to potential targets.

BOX 2.3

CONTAMINANTS, HAZARDS AND HARMFUL EFFECTS

Contaminant	Hazards	Harmful Effects
Heavy metals	Ingestion	May cause respiratory cancers, emphysema and other lung disorders, kidney disfunction. Birth defects (teratogenecity).
Organics	--"--	
Asbestos	Inhalation	Asbestosis (a scarring of the lungs), mesothelioma (cancer of the lining of the chest and abdomen), lung cancer.
Metal dusts	--"--	Respiratory cancers and other lung disorders.
Toxic Gases	--"--	May cause breathing difficulties and may be carcinogenic.
Acids and alkalis	Skin contact	Can cause burning
Organics (e.g. Phenols)	--"--	May be carcinogenic and/or teratogenic
Some metal salts (e.g. chromates)	--"--	May cause irritation
Zinc, Copper, Nickel	Phytotoxicity	Can stunt plant growth, cause discoloration
Sulphates	--"--	shallow root system and dieback.
Landfill Gas	--"--	--"--
Sulphate/Sulphides	Building material degradation	Can corrode and accelerate the weathering of services and structural components.
Organics (e.g. oils, tars, Phenols)	--"--	--"--
Acidity	--"--	--"--
Carbonaceous matter, including PAH's	Fires	May be carcinogenic, cause liver damage and/or teratogenicity.
Sulphur wastes (spent oxide)	--"--	May cause burning or irritation on skin contact
Gases	--"--	May cause breathing difficulties and lung defects
Landfill gas	Asphyxiation	--"--
Landfill gas	Explosion	--"--
Carbon monoxide	Inhalation	Can affect the cardiovascular system and the central nervous system
Nitrogen oxides (NO_2 & NO)	Inhalation and deposition	Can affect the respiratory system and cause damage to aquatic and other ecosystems.
Sulphur dioxide	Inhalation	Can affect lung function

Sources: Beckett, (1993); Alloway and Ayres, (1993); Sax and Lewis, (1989), Haughton and Hunter, (1994); and Department of the Environment, (1994c).

It should be stressed that the harmful effects of the types of contaminants set out in Box 2.3 will vary significantly according to type and degree of concentration. The table should therefore be regarded as a general summary, designed to prompt those persons involved in the valuation and development of land to make further enquiries if references to the listed substances are made in any site investigation report or schedule of materials used on a site. A more comprehensive list of contaminants, their harmful concentrations and adverse effects on their targets may be found in Barry (1991). Box 2.4 indicates those hazards from Box 2.3 that may pose a threat according to the use carried out, or proposed, on a site to be valued or developed.

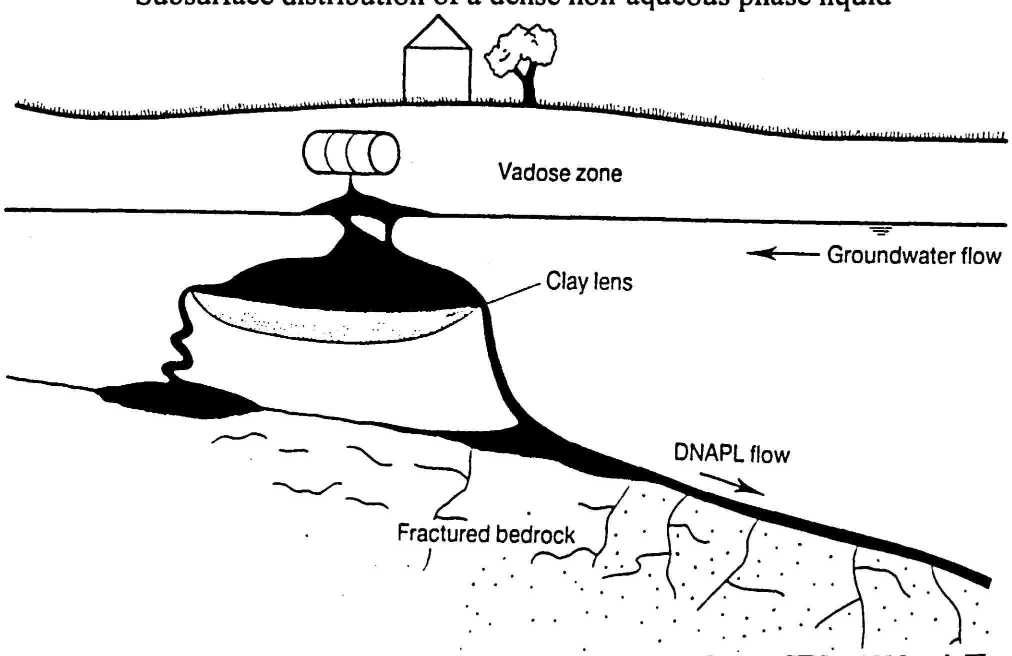
BOX 2-4
LAND USE AND HAZARD LINKS

Proposed use	Principal hazards that may pose a threat
Residential with gardens	All
Residential without gardens (i.e. flats, etc.)	All except phytotoxicity or ingestion
Allotments/market gardens	Phytotoxicity Skin contact
Agriculture:	
Arable	Phytotoxicity
Grazing	Phytotoxicity and ingestion
Public open space/amenity/ recreational	Phytotoxicity Skin contact
Commercial (e.g. offices, retail)	Building material degradation Fires, Explosion
Light industry (e.g. warehouses, factory units)	Building material degradation Fires, Explosion
Heavy industry	Building material degradation Fires

(Source: Beckett, 1993)

One aspect of soil contamination which should be of particular concern to valuers, and to intending developers, is the potential for some types of contaminants to spread or leach for considerable distances from the location at which the contaminants are buried, or the polluting incident has occurred. Consider, for example, the problem caused by a leaking drum of a dense non-aqueous phase liquid (DNAPL), such as lubricating oil, buried in the unsaturated (vadose) zone of the subsurface soil, in Figure 2.2.

FIGURE 2.2
Subsurface distribution of a dense non-aqueous phase liquid



(Source: CIRIA, 1995, vol. III, p62)

The example in Figure 2.2 illustrates a situation where the downward migration of the leaking lubricating oil is initially halted by an impermeable clay lens, until such time as the liquid overspills the lens into the surrounding sands and gravels. The permeability of the adjacent soils allows the oil to be distributed more widely, both with the flow of the groundwater and with the geology of the site, until it reaches the bedrock and penetrates any fissures, causing widespread contamination.

Therefore valuers and developers need to have regard not only for the potential of contaminants to migrate from the site with which they are concerned but also the possibility of inward migration from adjoining or nearby sites which may be contaminated. This aspect is considered further in Chapter Four when addressing the requirements for site investigations.

2.4 EXTENT OF THE PROBLEM[2]

There is comparatively little literature on the subject of reclaiming and redeveloping derelict and contaminated sites. For the most part, published works address the technical issues, for example Cairney (1987) and Fleming (1991), and pay little attention to the financial issues involved. Even where such issues are considered (Haines, 1987; Ironside, 1989), the authors appear to confine themselves to a discussion of the availability of public sector finance to go towards the cost of site reclamation. It is of course very true that, without public sector support in one form or another, many site reclamation projects would fail to come to fruition. However, in many cases, the private sector input is of equal or greater importance.

[2] Part of this section was originally published in Syms 1994a.

Derelict or contaminated sites have previously been used for a wide range of purposes, often over a period of many centuries, during which time the use may well have changed and quite often buildings may have been constructed over the remains of earlier developments. Fleming (1991) has commented that the state of such land is often so poor as to be unsuitable for continued use or re-use without major land engineering works. The Department of the Environment adopts a similar view in its definition of derelict land as 'land which has been so damaged by industrial and other development that it is incapable of beneficial use without treatment' (DoE, 1986a).

Taking the country as a whole, dereliction is not widespread, although the problem of derelict land is by no means insignificant. Kivell (1987) noted that, according to a survey by the Department of the Environment carried out in 1982, the total area of dereliction (in England) had increased from 43,300 hectares (1974 survey) to 45,700 hectares, despite major programmes of reclamation which dealt with 17,000 hectares during the same time period. By 1988, however, the equivalent study indicated a reduction to 41,456 hectares (DoE, 1991b), whilst the 1993 Survey (DoE, 1995) produced a further reduction to 39,600 hectares of land being recorded as derelict in England. Table 2.1 sets out the changes in the amount of derelict land in England between 1974, 1988 and 1993, under the different categories used in preparing the study.

Table 2.1

THE COMPOSITION OF DERELICT LAND IN ENGLAND

Type of dereliction	Stock (ha)	1974 (%)	Stock (ha)	1982 (%)	Stock (ha)	1988 (%)	Stock (ha)	1993 (%)
Spoil heaps	13,118	30.3	13,340	29.2	12,015	29.0	9,191	23.0
Excavation and pits	8,717	20.1	8,578	18.8	6,186	14.9	5,807	15.0
Military	3,777	8.7	3,016	6.6	2,624	6.3	3,275	8.0
Railway	9,107	21.0	8,210	18.0	6,650	16.0	5,615	14.0
Other	8,554	19.8	12,539	27.4	13,981	33.7	15,702[3]	40.0
Total	43,273	100.0	45,685	100.0	41,456	100.0	39,600	100.0

Source: Kivell,1987; Department of the Environment, 1991b, Department of the Environment, 1995.
Note: Kivell's 1987 figures transposed two digits in the 'other' category. This has been corrected.

Taken as a percentage of the total area of England, this is equal to only 0.31 per cent, but it is still 150 times the area of the City of London, where so many property investment decisions are made. It should also be borne in mind that not all derelict land can justify reclamation. For example, in the 1988 study only 32,010 hectares (77 per cent) were considered to justify reclamation, although by 1993 some 34,600 hectares (87 per cent) were considered to justify reclamation. From Table 2.1 it can be seen that spoil heaps, arising from mineral extraction and other industrial processes, account for the largest area of dereliction. Many of these sites, especially those of a metalliferous nature, are considered to be so badly contaminated, or in such remote locations, as to not justify reclamation.

The survey of derelict land provides only a small part of the overall picture. There are many other sites which are still in use, or may be semi-derelict, which suffer from the same instability or contamination problems as those sites which are officially classed as derelict. Kivell cites as an example Stoke-on-Trent which, in

3 The 1988 and 1993 surveys included separate figures for Mining subsidence and General Industrial Dereliction, which had been included within the "Other" category in the earlier surveys. In 1993 the area of land identified as suffering from General Industrial Dereliction amounted to 9,749 hectares, or 25% of the total area.

1984, identified 332 hectares of derelict land, but added 291 hectares of potential dereliction (where existing industrial activity is [sic] expected to cease shortly, leaving behind land which is unsuitable for use without treatment) and a further 538 hectares of neglected land (at present uncared for, untidy and in a condition detrimental to the environment) (Kivell, 1987).

Of the 34,600 hectares of derelict land justifying reclamation, and the industrial land still in use, an unknown but believed to be very significant percentage is undoubtedly contaminated. This contamination, lying in or on the ground, takes many forms: heavy metals, PCBs and coal tars to name but a few. Recent estimates suggest that 50,000-100,000 sites may be considered to be contaminated, affecting perhaps 50,000 hectares. Only a small proportion of these, however, are likely to pose an immediate threat to public health or the environment (Hobson, 1991).

The 1988 survey provided details of the post-reclamation use of almost 12,000 hectares of derelict land which was reclaimed between 1982 and 1988 Table 2.2. A similar analysis was provided in the report on the 1993 survey, in Table 2.3.

TABLE 2.2

DERELICT LAND RECLAIMED AND BROUGHT BACK INTO USE, 1982-88; THE USE OF LAND AFTER RECLAMATION (hectares)

Land use	By local authority with grant	By local authority without grant	By other agencies[4]	Total
Industry	901	44	622	1,567
Commerce	118	11	460	589
Residential	294	79	675	1,048
Sub total (hard end use)	1,313	134	1,757	3,204
Sport and recreation	793	96	251	1,140
Public open space	3,078	251	475	3,804
Agriculture/forestry	1,282	199	1,212	2,693
Sub total (soft end use)	5,153	546	1,938	7,637
Other	289	103	736	1,128
Total	6,755	783	4,431	11,969

Source: Department of the Environment, 1991b

TABLE 2.3

DERELICT LAND RECLAIMED AND BROUGHT BACK INTO USE, 1988-93; THE USE OF LAND AFTER RECLAMATION (hectares)

Land use	By local authority with grant	By local authority without grant	By other agencies	Total
Industry	579	54	687	1,319
Commerce	120	18	518	656
Residential	89	16	816	922
Sport and recreation buildings	82	17	82	181
Other development	281	60	301	643
Sub total (hard end use)	1,152	165	2,404	3,721
Agriculture	226	4	607	837
Forestry/woodland	561	5	51	617
Public open space	1,269	103	192	1,564
Outdoor recreation	906	133	336	1,375
Nature conservation	180	54	94	328
Sub total (soft end use)	3,142	299	1,280	4,721
Total	4,293	465	3,684	8,442

Source: Department of the Environment,1995

As can readily be seen, local authorities play a major role in the reclamation of derelict land, accounting for the reclamation of 35 per cent of land reclaimed for hard end uses and 73 per cent of land reclaimed for soft end uses in the most recent survey. It should be noted however that the local authority percentages in the latest survey are down from 45 per cent and 75 per cent respectively in the

[4] Including private sector developers and commercial organizations

previous survey, against an overall decline of 29 per cent in the amount of land reclaimed. The area of land reclaimed and brought back into use by other agencies, which includes private sector developers and investors, is therefore of considerable importance, representing many millions of pounds worth of development projects.

Whilst the Department of the Environment reports provide a useful insight into the extent of the derelict land problem in England, they do not cover the whole of the United Kingdom, nor do they provide information in respect of the redundant industrial land still controlled by manufacturing companies and not officially classified as 'derelict'. "John Handley, professor of land reclamation at Manchester University, suggests that there are 270 square *miles*[5] (699km^2) of derelict, disused and neglected land in Britain, made up of about 150,000 individual brownfield sites." (Richards, I. 1995) Based on his experience of investigating previously used land in many parts of the world, Richards suggests "that the Pareto Principle (after the Italian economics professor, whose Parkinson-like laws, apply to all manner of activities) will hold good throughout Britain's 270 sq.miles. (699km^2) of brown sites." Therefore, according to Ivor Richards (1995), 80% of the total area "is likely to have few problems and could be prepared for redevelopment using conventional civil engineering techniques". So far as the remaining 54 square miles (140km^2), Richards suggests that 80% "is probably contaminated or presents serious engineering problems, but could be made ready for redevelopment economically through existing techniques", whilst

[5] Italics in the original.

the remaining land "is likely to be too contaminated or problematic for any commercial development" (Richards, I. 1995).

Therefore, if Richards' estimates are accepted, a total area of 14,000 hectares (34,594 acres) of land, in either present or past industrial use, throughout Britain could be affected by contamination. Co-incidentally, the area of contaminated land in Britain, calculated by Richards, is almost identical to the area of land in England (34,600 hectares in 1993) considered to justify reclamation (DoE, 1995). Whether or not this is a reasonable estimate of the extent of the problem is open to debate. In practice the full extent of the problem is impossible to assess and, as stated in the consultation paper *Public Registers of land which may be contaminated* (DoE, 1991a), the cost of requiring investigation of all sites suspected of containing contamination "would be prohibitively expensive". The British Government has therefore sought to limit the extent of the problem in the form of words used to define contaminated land, as discussed in this chapter, and such attempts are still continuing, as described in Chapter Three.

CHAPTER THREE

PERCEPTIONS[1] AND POLICIES

3.1 INTRODUCTION

It will be argued in the empirical studies that the values ascribed to properties by valuation professionals, and the decisions taken by property developers, as to whether or not a contaminated site should be redeveloped, will be influenced by individual perceptions of land contamination issues. Those perceptions will be affected by a number of factors, such as personal experience and press reports. Government policies in respect of liabilities for the registration and treatment of contaminated sites will also influence the perceptions of property market actors. Similarly, as was demonstrated by the response to the registration proposals contained in Section 143 of the Environment Act 1990, the perceptions of property market actors concerning adverse impacts may be so strong as to result in a complete re-evaluation of Government policies (see Box 1.1). Perceptions and policies are therefore linked and have the potential to impact upon each other, with resultant implications for valuation and the redevelopment of contaminated sites.

In seeking to answer the question "what is property development?", the Government's Advisory Group on Commercial Property Development offered this response:

"Development comprises the following tasks:

- (i) the perception and estimation of demand for new buildings of different types;
- (ii) the identification and securing of sites on which buildings might be constructed to meet that demand;

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[1] The word *perception* is used here and in the literature on risk to refer to various kinds of attitudes and judgements.

(iii) the design of accommodation to meet the demand on the sites identified;
(iv) the arrangement of short and long term finance to fund site acquisition and construction;
(v) the management of design and construction; and
(vi) the letting and management of the completed buildings."

(Government Advisory Group on Commercial Property Development, 1975)

Twenty years later this description of the development process may still apply but is it valid in situations where the development site is affected by contamination? The redevelopment of contaminated sites is reliant upon the perception and estimation of the developer in respect of the demand for new buildings, perhaps even more so than in respect of uncontaminated sites. In addition to assessing potential demand for the new buildings, the intending developer of a contaminated site will need to assess the extent to which prospective purchasers and/or tenants may be discouraged by the history of contamination.

In identifying and securing sites for development the intending developer, and his or her professional team, will need to carefully weigh the attributes of a contaminated site, in terms of price, location and physical aspects, against the problems of dealing with contamination and the attractiveness of alternative greenfield sites. This may result in the developer requiring a higher rate of return from the contaminated site. The development of contaminated sites may also impose design constraints, in respect of both the decontamination work and the proposed new buildings. All of these factors will have a direct effect on the cost of the development and its profitability.

Finance for developments on contaminated sites, both for the development period and long term, may be more difficult to arrange than for greenfield sites. This may be due in part to the perception of bankers and other funding institutions that developments on contaminated sites involve a much higher degree of risk than those on uncontaminated sites. The providers of development finance may also require higher margins in respect of loans for the redevelopment of contaminated sites, further investigative work and the availability of additional collateral, as confirmed by a recent survey of lenders in the United States (Kinnard and Worzala, 1996). Such requirements may be justifiable given the problems of definition discussed in Chapter Two and the lack of any set standards of treatment, both of which will affect the funder's perception of risk.

Management of the design and construction aspects of developing a contaminated site will almost certainly involve the developer in the employment of additional specialist consultants and the implementation of stringent controls in order to protect the health of building workers and subsequent users of the buildings. The letting and management arrangements will need very careful consideration, especially in situations where residual contaminants are to be left in the ground, or where the generation of methane, or other gases, is a possibility which requires to be monitored.

Therefore, whilst it would appear that the definition produced by the Government's Advisory Group can be applied to the redevelopment of contaminated land, a prospective developer must factor into his or her perceptions of the project additional cost and design influences, as well as the perceptions of other actors, such as bankers and future occupiers, with regard to the risk and uncertainties attaching to development. This chapter will consider perceptions of risk and uncertainty, and the extent to which these may be influenced by government policies.

3.2 PERCEPTIONS OF RISK AND UNCERTAINTY

"Perceived risk is the risk seen by the public in the marketplace" (Mundy 1992a, p11). According to Slovic (1992, p119) risk does not exist "out there", independent of minds and cultures, waiting to be measured. Instead, risk is inherently subjective, 'invented' by human beings "to help them understand and cope with the dangers and uncertainties of life. There is no such thing as 'real risk' or 'objective risk'." (Slovic 1992, p119) and a "hazard has no meaning except in human terms" (Lee, 1981, p7).

"Ordinary people form their own assessments of risk" (Lee, 1981, p6) and it is possible that the public's perception of risk may be at variance with "the objective assessments made of the same risks by scientists" (Lee, 1981, p6). A study by Thomas (1981) "showed that the public does conceive risk issues in differentiated terms, taking into account several substantive dimensions of both risk and probable benefits. While such dimensions might well be specific to the risk issue in question, it does seem likely that both risks and probable benefits will form part of belief systems in most instances where risk acceptance, or otherwise, is an issue." (Thomas, 1981, p35). The higher the perceived risk of a hazard, "the more people want to see its current risks reduced", whereas "experts' perceptions of risk are not closely related to any of the various risk characteristics" but are instead seen as being "synonymous with expected annual mortality" (Slovic, 1992, p121). These differences in perception between 'experts' and the 'general public' may result in many conflicts about risk and when this occurs "expert recitations of "risk statistics" will do little to change people's attitudes and perceptions." (Slovic, 1992, p121)

Perceptions of risk will directly influence decision making processes, as observed by Wharton (1992) who stated that:

> "Individuals, organizations and governments make decisions based on perceptions about the likely consequences of their actions. Some of the inevitable consequences may not be recognised, there may be gross misconceptions about the likelihood or magnitude of those that are recognised, and yet other perceived consequences may be more imagined than real. In short, there may not be much overlap between the set of real and the set of perceived potential outcomes." (Wharton, 1992, p5)

The property development process is an activity which will be affected by the perceptions of individuals, organisations and governments, about the likely consequences of their actions, and the outcome of those perceptions will directly influence the financial viability of a development project. Redevelopment of land which has been affected by contamination is likely to be extremely sensitive to variations in perception of risk and Mundy (1992a, p11) considered that perceived risk "is an individual's disinclination to believe that a source of contamination is safe". He went on to express the view that the perception of risk varies with the nature of the event's cause and whether or not the source might result in a catastrophic accident.

"It is often claimed that people perceive a risk as less serious if they accept it voluntarily." (Lee, 1981, p12) Thus, the discovery of a previously unknown landfill found to be generating landfill gas, close to a housing development, is likely to be perceived as a serious risk. If, however, the same development is situated in a low lying flood plain, the perception of risk from flooding is likely to be much lower than the risk from potentially explosive landfill gas. This is because the risks associated with flooding are voluntary whereas those associated with the landfill gas are involuntary.

"Another factor that is often thought to influence public perception is people's degree of familiarity with a hazard." (Lee, 1981, p14) Mundy also expressed the view that "the level of risk associated with contamination varies according to the level of familiarity with the particular contamination" (Mundy, 1992a, p11). Given this assumption, it may be that residents living in an area dominated by an aluminium smelter which had been in operation for almost one hundred years would be unlikely to have a very high perception of the risks associated with contamination caused by the smelter. Research by Kinnard *et al* (1995) found that this had in fact been the case, until such time as the existence of contaminated soil in the neighbourhood of the smelter became publicly known. This was followed by closure of the smelter, the commencement of legal action by the owners of the affected properties and commencement of the soil treatment operations, all of which produced 'down-turns' in property values.

The smelter was situated in Tacoma County, Washington, USA and in a study of property transactions covering an eighteen year period, spanning the closure of the smelter, Kinnard *et al* (1995) compared property values within the area immediately adjacent to the smelter (one and a half mile radius) with those in a control area more than two miles from the smelter. They found that there was no significant difference in values between the two areas, except following periods of high publicity, for example after initial discovery of the contamination, commencement of the legal action and the "clean-up" operation. This was in spite of the fact that there was no change in the actual hazards or contamination over the study period, leading the researchers to conclude that, at least in the United States, "perceptions of potential buyers of residential properties about the character, extent and meaning of on-site soil contamination may not necessarily be informed and rational, but they are very real" (Kinnard *et al*, 1995, p11).

Slovic (1992, p118) reviewed several studies which had used questionnaires "to ask people directly about their perceptions of risks and benefits and their *expressed preferences*[2] for various kinds of risk/benefit tradeoffs". This approach appealed to Slovic and his fellow researchers for several reasons, including the ability to elicit current preferences and to consider many aspects of risk besides financial considerations and/or the numbers of persons to whom actual harm had been occasioned. A questionnaire approach also enabled "data to be gathered for large numbers of activities and technologies, allowing for the use of statistical methods to disentangle multiple influences on the results" (Slovic, 1992, pp118-119).

A distinguishing feature of the work reviewed by Slovic (1992) was the use of a variety of psychometric scaling methods "to produce *quantitative*[3] measures of perceived risk, perceived benefit, and the other aspects of perceptions" (Slovic, 1992, p119). Petts and Eduljee (1994) draw a number of generalisations, in respect of risk, from the psychometric literature:

- Perceived risk is greater for hazards whose adverse effects are considered to be involuntary, uncontrollable, unfamiliar, catastrophic, fatal, delayed and therefore

[2] Italics used in the original.
[3] Italics used in the original.

present a threat to future generations, generated by man, and not offset by direct (to the individual) compensating benefits.

- These characteristics of risks are highly correlated with one another. For example, risks that are regarded as voluntary are also regarded as controllable and understandable (e.g. driving a car). Conversely, risks regarded as involuntary are often also regarded as potentially catastrophic and a threat to future generations. ....
- Experts tend to apply equal weight to consequences and probabilities, whereas the public tend to put more weight on consequences. (Petts and Eduljee, 1994, p390)

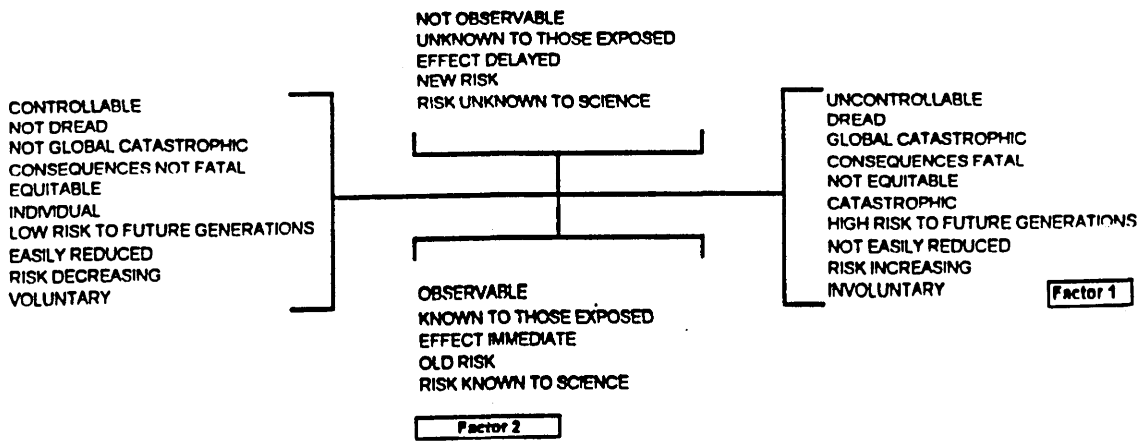
In discussing the psychometric paradigm Slovic (1992) stated that the results are dependent upon the hazards studied, the questions asked about those hazards, the types of persons questioned and the data analysis methods. He acknowledged that the use of psychometric studies does have limitations but "the studies using this approach have invariably produced coherent and interesting results" (Slovic, 1992, p119).

One aspect of the psychometric work undertaken by Slovic and his co-workers was to examine the role of perceptions in respect of environmental hazards and to compare the responses of laypeople with those of experts. They observed that

> "many of the qualitative risk characteristics that made up a hazard's profile were highly correlated with each other, across a wide range of hazards. For example, hazards rated as 'voluntary' tended also to be rated as 'controllable' and 'well-known'; hazards that appeared to threaten future generations tended also to be seen as having catastrophic potential, and so on." (Slovic, 1992, p121)

As a result of this research they classified the risks into two groups of factors, Known or "Dread" Risks and Unknown Risks, which they represented spatially to show the respective influences of the two groups of risks, see Figure 3.1. Most important is the factor "Dread Risk" (Factor 1), shown on the horizontal scale, with the result that the higher the hazard's score on this factor, the further to the right it will appear, reflecting the higher level of perceived risk. The Unknown Risks (Factor 2), those perceived to be less catastrophic and unlikely to threaten future generations, are represented on the vertical scale and the nearer to the top a hazard's score appears, the higher the perceived level of risk attaching to that hazard.

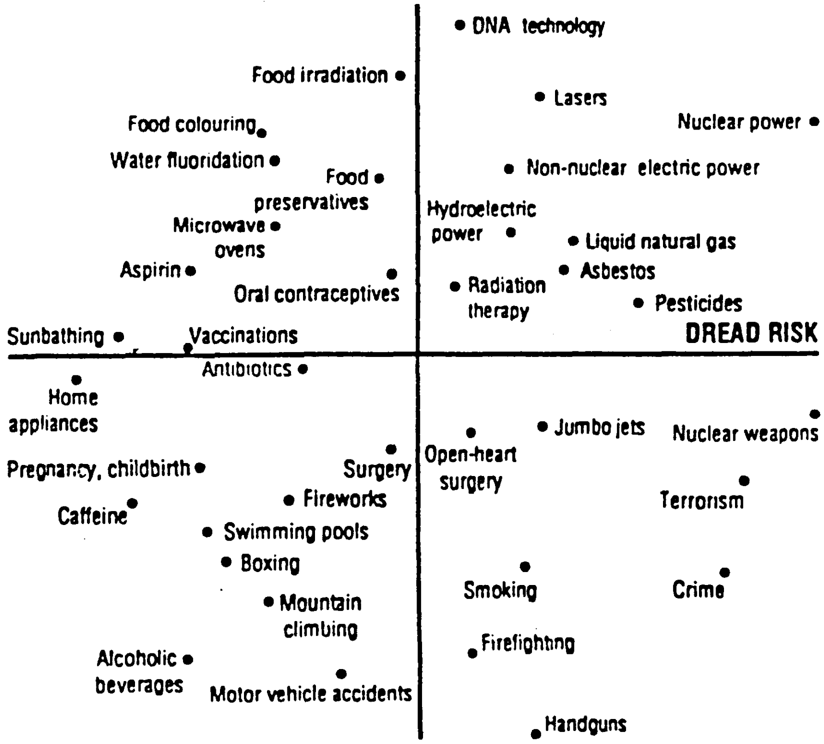
FIGURE 3.1
FACTORS OF KNOWN AND UNKNOWN RISKS



(after Slovic, 1992)

Figure 3.2 presents in a spatial form the results of a psychometric study into the perceived Unknown Risks and Dread Risks of a number of every day activities and environmental issues. The risk effects of some of the activities and issues considered are only likely to manifest themselves on a personal basis, affecting only the individual and his or her immediate family. Other activities and issues are known, or may be perceived, to have much wider reaching impacts, with the ability to affect whole communities and the wider environment. This approach has been adopted for use in Chapter Nine in an attempt to assess the importance of land contamination when compared to other environmental issues.

Figure 3.2
HAZARD LOCATIONS ON 'UNKNOWN' AND 'DREAD' RISK FACTORS



(Adapted from Slovic *et al*, 1981, p27, cited in Petts and Eduljee, 1994, p391)

The psychometric approach has direct relevance to the research as it enables comparisons to be made between the perceptions of members of the general public (the end users of development projects), valuation professionals and other professionals involved in the redevelopment of contaminated land. If the psychometric approach is to be used in studying perceptions of risk associated with the redevelopment of contaminated land, then it is reasonable to assume that perceptions will vary according to factors such as the nature of the contaminants, their exposure route to potential targets, the nature of the targets (e.g. adults, children, animals, plants or buildings) and the proposed use of the site. The results of any study will also depend upon the questions asked, for example, if they relate only to land contamination or if they are framed in a wider environmental context, and whether they are directed to 'experts', representatives of government, or the 'general public', providing scope for varying degrees of uncertainty.

The problem of dealing with uncertainty was considered by Morgan and Henrion (1992) when they stated that "probability is certainly the best known and widely used formalism for quantifying uncertainty" and went on to distinguish between the Frequentist, or Classical, view of probability and the Personalist, Subjectivist, or Bayesian, view. The former seeks to define the probability of an event occurring as the frequency with which it occurs in a long series of trials. The latter view is based on the belief of a person that the event will occur, given all the relevant information currently available to that person, and is probably most closely associated with the individual's risk perception of contaminated land.

The characterisation of uncertainty, and the methods by which its influence may be limited, will depend upon the individual problem under consideration. Nevertheless, it should be possible to measure, or obtain an indication of, uncertainty in empirical terms, relative to the kinds of source from which it can arise. These include the following:

- Statistical variation
- Subjective judgement
- Linguistic imprecision
- Variability
- Inherent randomness
- Disagreement
- Approximation

(Source: Morgan and Henrion, 1992, p56)

Morgan and Henrion (1992), discounted the frequentist view in favour of the personalist approach for their consideration of the nature of probability but they did cite an early influential text (Luce and Raiffa, 1957), which may be relevant to the study of risk and uncertainty in the redevelopment and value of contaminated land. The authors distinguished between 'risk' events as being those whose probabilities are 'knowable' and events of 'uncertainty' whose probabilities are 'unknowable'. Morgan and Henrion (1992, p49) found this distinction unhelpful as "it renders the theory of probability virtually inapplicable to real world decision making".

Whilst such a distinction may be seen as unhelpful to the statistician, there is a link which will be found in the reality of property markets, where, as identified by both Mundy (1992a) and Kinnard *et al* (1995) seemingly irrational decisions are commonplace. Property market decisions may not appear in any way irrational to the purchaser or occupier of the property in question. The decision to purchase a certain house, at a price which exceeds that paid for a nearby property of similar type, may be determined by its orientation to the afternoon sun or the view from the living room window. Similarly the decision in respect of a commercial property may be influenced by proximity to a specific customer or supplier.

In the redevelopment of contaminated land, a developer's perception of risk may be based upon the best available technical and professional advice but it will still be tempered by the uncertainties imposed as a result of the differing perceptions of other individuals, organisations or governments. The perceptions of those individuals, organisations and governments may be less well informed about the specific risks than the developer. Alternatively, they may have placed a different interpretation upon the same information and thus have arrived at a different conclusion. If the perceptions of any of the actors in the property market, such as future tenants, institutional investors or the local authority, differ from those of the developer a high degree of uncertainty is introduced into the project. The developer may find that development finance is not available or that, if finance can be obtained, the project is stigmatised by the previous use of the site and is unattractive to potential occupiers.

In order to reflect the influence of those actors beyond the control of the developer, throughout this research the term "**Risk**" has been used in respect of those factors which are perceived by property market actors to directly affect the redevelopment of contaminated land and which are identifiable, although not necessarily quantifiable, such as the adequacy of site investigations or alternative forms of soil treatment. The term "**Uncertainty**" has been used in respect of factors which are not readily identifiable, and are invariably almost incapable of economic quantification, such as perceptions of possible future changes in environmental legislation and changes in the attitudes of end users.

Associated with risk perception is the concept of 'stigma' which is defined in the Oxford English Dictionary as a 'mark of disgrace or infamy, stain on one's good name' and as a 'definite characteristic of some disease'. "The term *stigma* is taking on new uses, particularly with regard to real estate and its valuation. When a property has been contaminated with wastes or hazardous materials, it is becoming fashionable to suggest that such a property acquires a *stigma*." (Elliot-Jones, 1995, p1) This may manifest itself as having an impact on the individual's perception of the desirability or utility of a particular property, for its present or intended purpose, and hence affecting its value.

> "In the world of 'fair market value', what knowledgeable and prudent buyers and sellers do free from duress and compulsion is of paramount

> importance. However, why they do the things they do can be of equal significance.
>
> Some reasons for behavior can be purely subjective. They may be based in half-truth or even fiction. Sometimes, as with the concern over asbestos, a legitimate issue can be raised to unreasonable proportions or, as in the case of environmentally blighted land or leaking landfills, the subjective fear may be well-grounded in scientifically measurable and objective fact. Even where an adverse effect on property value is apparent, it may be extremely difficult to describe, measure, and quantify. .... Public fear can and will affect market transactions so long as market participants actually share those fears." (Jaconetty, 1996, p63)

Where land is contaminated as a result of industrial activities, through the disposal of waste materials, the effect of stigma in terms of public fear and reduced property values may extend beyond the boundaries of the site in which the contaminants are located. "The stigmatization of environments has several important implications for hazardous waste management in general. First, it implies that, whatever the health risks associated with waste products, there are likely to be significant social and economic impacts on regions perceived as polluted, or as dumps. Second, it also gives additional importance to managing wastes so that stigmatizing incidents (even ones without significant health consequences) will not occur." (Slovic, 1992, p145)

Katz (1981), discussing stigma arising out of physical deformity, disability, age, disease or membership of a minority group, referred to "differences in the stimulus properties of stigmas that seem to determine the extent to which an observer will: (1) be aware of a particular stigma; (2) feel threatened by it; (3) feel sympathy and/or pity for its possessor; and (4) hold the possessor responsible for having it." (Katz, 1981, p2). Stigma is an important factor affecting the value of contaminated land, as considered by Patchin (1988, 1991 and 1994) and Mundy (1992), discussed in Chapter Six (pp 142-157), and Katz's work has a relevance to land related issues.

Although referring to personal factors, it is argued that the four aspects of stigma identified by Katz hold good in respect of properties affected by contamination, as follows:

(1) *visibility and related variables* - the extent to which the stigma of land contamination is known about, or its obtrusiveness in visual or other sensory form;

(2) *threat* - "most stigmas probably hold an element of threat for people who are exposed to them, but the kind and severity of threat seem to vary greatly among different stigmas." (Katz, *op cit*, p3), this may be especially true of properties affected by contamination originating from different types of industrial use;

(3) *sympathy arousal* - at first sight this may appear to be the least relevant of the aspects of stigma identified by Katz, as there is unlikely to be much public sympathy for the individual or firm responsible for having caused contamination, even if it arose out of accepted industrial practices, however there may be some sympathy for the innocent purchaser of a contaminated property;

(4) *perceived responsibility* - this is in keeping with government policy on contaminated land, which looks first to the polluter to pay for the cost of treatment and, failing that, then to the present owner.

To some extent, the impact of stigma may be heightened or reduced by the way in which the nature of the hazard and the risks involved are communicated to those individuals, or firms, who are most directly involved and to the wider public. It is argued that this is especially relevant to the way in which the British government handled the proposed registers of potentially contaminated sites. Whilst the government and its advisers may have genuinely believed that "it is better for everyone concerned to be aware of possible contamination" (DoE, 1991a, p11), the manner in which it was expressed in the consultation paper engendered widespread apprehension amongst those most directly concerned, including valuers, developers, financiers and investors. Media attention then ensured that the proposed registers were presented to the wider public in a way which was not intended by government.

According to Petts (1994b),

> "The communication of information is an inherent and critical component of the contaminated land risk management system. The communication pathways are not just from authority to affected public, but form a complex web of pathways with information flowing within and between multiple parties and interests (authorities, consultants, advisory agencies, landowners/site users, financial institutions, local communities, the media and doctors). As complexity increases in any communication system so does the inherent potential for distortion, inaccuracies, over-simplification and disagreement. (Petts, 1994b, p178)

"Thinking clearly about risk is difficult. Unfortunately, it is also necessary." (Slovic *et al*, 1992, p478) Where the health and lives of individuals, and their families, are concerned, the communication of information about risks associated with land contamination is fraught with problems. A statement to the effect that the likelihood of contracting cancer from the hazardous materials contained on a site is less than 10^{-6} is unlikely to be given much credence if a child living near to the site is dying of leukaemia. Local perceptions are more likely to outweigh the opinions of experts and will probably be given far greater prominence in the local press. "Doing an adequate job [of communicating information about risk] means finding cogent ways of presenting complex, technical material that is often clouded by uncertainty" (Slovic *et al*, 1992, p478) but, it has to be admitted, in the emotive situations which often surround land contamination, the most carefully thought out and sympathetically worded presentation may still not succeed in calming the fears of local residents.

From a study of perceptions in respect of the risks associated with hazardous waste sites, Bord and O'Connor (1992) concluded that,

> "trust in government, industry, and in the possibility of controlling environmental contamination plays a major role in determining the level of concern, especially after cleanup. Trust has to do with the credibility of those providing the information, the integrity of those chosen to deal with the problem, the effectiveness of the technology brought to bear on the problem, the training and monitoring of those involved in long-term care, and the funds necessary to do an effective cleanup." (Bord and O'Connor, 1992, p415)

Information on contaminated sites provided must be as comprehensive as possible and "it is important that the providers of information are sensitive to the hazards which are likely to be of particular concern, and hence when information could be misinterpreted". (Petts, 1994b, p178) They should not attempt to conceal important facts and should be presented to those most directly concerned as early as possible. This can present problems, for example, presenting information on potential contamination in advance of a site investigation will undoubtedly result in the public being provided with an incomplete picture but to delay until after the site investigation has been completed is likely to result in inaccurate rumours being generated once neighbours observe investigative activity on the site. It may therefore be appropriate to communicate information through a series of public meetings, as work progresses, and to encourage the involvement of local residents by taking heed of information which they may have to offer in respect of the site. "In other words, the task is to build trust by promoting safety." (Bord and O'Connor, 1992, p415)

3.3 GOVERNMENT POLICIES IN THE UNITED KINGDOM

As stated in Chapter One, it was not until after the publication of a consultation paper concerning the proposed preparation of registers of land which had been subjected to 'potentially contaminative uses' that valuers were alerted to the implications of Section 143 of the Environmental Protection Act 1990. Prior to this time valuers were unlikely to take account of industrial contamination when preparing valuations of industrial land and buildings. They would, however, have been expected to make provision for the cost of overcoming abnormal ground conditions, demolition and the removal of plant and equipment where appropriate. Such cost allowances may incidentally have resolved any contamination issue and the valuer would not have been expected to make an additional allowance to cover unknown matters or 'stigma'. Unless specifically instructed by clients, valuers were not usually expected to undertake searches of local authority or other records which might contain details of contamination.

The consultation paper, "*PUBLIC REGISTERS OF LAND WHICH MAY BE CONTAMINATED*", published jointly by the Department of the Environment and the Welsh Office stated *inter alia* that the "main purpose of registers will be to alert local authorities, landowners and potential purchasers to the possibility of contamination, and to indicate the types of contamination to be expected" (DoE 1991a para 6.1). They were not however intended to be registers of actual contamination as this would have required local authorities to investigate many of the sites considered for inclusion, which would have been prohibitively expensive, taking many years to complete. There were also technical reasons why registers of actual contamination were impracticable, as the compilation of such registers would have involved the setting of highly complex standards for both site investigations and treatment methods, covering all types of contaminants and soils.

Notwithstanding the fact that the Government's consultation paper stressed that the registers were not intended as records of actual contamination, the press and professional bodies immediately referred to them as the 'Contaminated Land Registers' and expressed serious concern over the possible blighting effect on property values. The question of blight had been considered in the consultation paper but "The Government takes [sic] the view that, in all but the very short term, it is better for everyone concerned to be aware of possible contamination so that appropriate investigations can be carried out on a basis of knowledge." (DoE 1991a para 4.3). This approach completely ignored the emotive reaction of houseowners, whose homes were for example built on the sites of former town gasworks, or the shareholders of industrial companies, all of whom could see the value of their investments being severely reduced. A further point of concern was the intention that, even if it could be proved that a registered property was free from contamination, or had been "cleaned up", removal from the register was not to be allowed. This was because the registers were intended as records of historical fact concerning past uses, although provision was made for the results of any site investigations or "clean up" operations to be recorded on the registers.

The schedule of contaminative uses, annexed to the consultation paper, covered 16 industrial groupings, divided into forty-two sub-groups, plus demolition operations. If all of the activities and profiles described in the schedule are taken into account, then up to 100 industrial, or quasi industrial, activities could have been affected by the proposals. The view which came to be generally adopted by the valuation profession was that the impact on values of premises used for the scheduled purposes, or built on land previously used for any of those purposes, could be so detrimental as to render the properties virtually unsaleable. It was feared by the land contamination group of the RICS Asset Valuation Standards Committee that "registers of contaminated land will result in some property assets of big companies having negative values" (Estates Times 1991) The proposed list of 'contaminative uses' also included a number of 'High Street' trades such as dry cleaners, printers and electrical repairers; (DoE, 1991a). From an investment point of view, the inclusion of 'High Street' uses was seen as having a potentially catastrophic impact on the values of many purpose built shopping centres.

So great was the outcry against the proposed registers that the Government was forced to reconsider the way in which Section 143 was to be brought into operation. The vast majority of the written responses to the consultation paper were actually in favour of the concept of registers (Denner 1992) but the strength of the minority opposition, including the Royal Institution of Chartered Surveyors, the British Property Federation and the National Farmers Union, was such that there was no real alternative but to reconsider the scope and operation of the registers. A Ministerial decision was taken to reduce the area of land likely to be subject to registration to between 10 and 15 per cent of that which would have been included under the schedule contained in the consultation paper. Ms. J. Denner at the Department of the Environment commented, during an interview, that this was achieved by deleting uses from the schedule until the required reduction in land area had been obtained. Once uses relating to certain vested interests had been removed, such as those on the High Street, agriculture and railways, further deletions were made on a purely arbitrary basis until the required reduction was obtained.

The result of the reconsideration, intended to reduce the area of land affected by the proposals, was published in July 1992. This took the form of a revised schedule of eight very specific uses (Appendix 1b), attached to the draft regulation (DoE 1992a) which was intended to bring the legislation into effect. It was still intended that once on the register a property could not be removed but provision was made in the draft for landowners to be notified of the intention to include their premises in the register and to have the opportunity to appeal as to matters of fact regarding past or current uses. Furthermore the registers were to be divided into two parts, Part A containing details of premises where nothing was known other than past or present use and, Part B containing details of premises where site investigation or remediation works had been undertaken. However, no criteria were laid down defining the nature of the works to be undertaken for properties to be included in Part B. Therefore the testing of a single sample, or the introduction of a thin cover layer over contaminated material, could have been sufficient to qualify a site for inclusion in Part B, notwithstanding the fact that the work undertaken was totally inadequate.

Rather than removing the opposition to the proposed registers, the draft regulation had precisely the opposite effect and, according to Ms. Denner, far more letters of objection were received by the Department of the Environment than had been received in respect of the original consultation paper. A view within the property profession was that by reducing the scheduled uses to only eight specific industries, these were perceived by the Government as being the most contaminative of all industrial processes. Therefore, in the opinion of some valuers, land and buildings currently or previously used for these purposes could be expected to have nil, or even negative, values. To make matters even worse, the letter which accompanied the draft regulation stated that "The Government has it in mind to extend the list of uses by further regulations in due course in the light of experience" (DoE 1992a), thus potentially condemning other groups of properties to the same fate at some future date. As much as anything else, it was this uncertainty that brought increased opposition, even from those members of the valuation profession who had previously been in favour of the registers.

In the face of such opposition to the proposed registers, the Government announced in March 1993 that they were to be abandoned (Howard, 1993) and that an interdepartmental review of contaminated land policies was to be undertaken. This review resulted in the publication of a further consultation paper "*PAYING FOR OUR PAST*" (Department of the Environment 1994a)and the outcome of the review was published in a report *Framework for Contaminated Land* (DoE 1994b), followed by the Environment Act 1995.

So far as contaminated land is concerned, the Environment Act 1995 brought two major changes:

- amendment of the Environmental Protection Act 1990, with the introduction of new legislation relating specifically to contaminated land and,
- the establishment of an Environment Agency with responsibility for England and Wales, and a Scottish Environmental Protection Agency.

The legislation will come into effect during 1997, following the publication of Parliamentary Guidance, and the agencies have taken over responsibility for the functions previously undertaken by the National Rivers Authority, Her Majesty's Inspectorate of Pollution and the Waste Regulation Authorities.

Prior to the establishment of the two environment agencies -

> "The main control for ensuring contaminated land is not used for any unsuitable purposes has been through the planning system; thus controls or conditions could be put on the use of land for a particular purpose or remedial work specified as part of the development permission. The fact that no - or only very patchy - records exist of former uses of land means that this system of control is not very satisfactory, particularly with the increasing pressures for release of land for development purposes." (NSCA, 1992, p202)

Even though the Government failed to introduce registers of potentially contaminated land, a great deal of the information needed in order to arrive at informed decisions in respect of land and buildings affected by land contamination is in fact available. Diligent research is however required on the part of valuers, developers, lawyers and other interested parties in order to obtain relevant information (the sources of information are described in Chapter Four).

A detailed consideration of the law relating to contaminated land has been undertaken by Tromans and Turrall-Clarke (1994), who expressed the view that policy on contaminated land is at a sensitive and formative stage in both the UK and EC. This is particularly so in relation to registers, clean-up standards and the design of any liability regime. Graham (1995, p.5) stated that the "law relating to contaminated land is currently characterised by its uncertainty, and this creates a considerable challenge for all those involved in land". This state of uncertainty has had to be reflected in the approach adopted in this research, as new legislation and case law may bring about significant changes over the forthcoming months and years.

Part II of the Environment Act 1995, which received the Royal Assent on 19 July 1995, has brought a number of major changes to the law relating to contaminated land, although these will only be introduced in stages, as a new Part IIA of the Environment Act 1990. The 1995 Act contains a total of 32 pages of new legislation in respect of contaminated land, introduced by way of amendment to the Environmental Protection Act 1990, through the insertion of 26 new clauses, 78A to 78YC, into that Act. In addition, the 1995 Act repeals Section 143 of the 1990 Act, in respect of the registers of potentially contaminative uses, and Section 61 of the 1990 Act, in respect of the duty of local authorities to inspect closed landfills. Neither of these Sections had in fact been brought into force.

A 'working draft' of the statutory guidance to be published by the Department of the Environment was issued on 20 February 1996. This draft deals with the definition and identification of contaminated land; the exclusion of persons otherwise liable and the apportionment of liability; the recovery of remediation costs and draft regulations to define special sites. The covering note issued with the papers stresses their 'working draft' status, emphasises that they do not constitute a 'consultation document' and that the "Department is not committed to the texts as they stand - working drafts are, after all, for working on". (DoE 1996)

Although the statutory guidance has, to date, only been issued in 'working draft' form, the definition of "significant harm", in Part II of Chapter 1, should be noted. For the purpose of identifying contaminated land, as defined in section 78A(2) any actual or potential harm must meet the test of being "significant".

"The following types of harm are to be regarded as significant harm:

a. chronic or acute toxic effect, serious injury or death to humans;

b. irreversible or other adverse change in the functioning of an ecological system, ...;

c. substantial damage to, or failure of, buildings, plant and equipment;

d. disease, other physical damage to, or death of livestock or crops kept, reared or grown on the land in question or adjacent land, such that there is a substantial loss in their value. (DoE, 1996)

For the purpose of the 'significant harm' definition, substantial damage to buildings, plant and equipment is to be regarded as occurring "when the building, plant or equipment ceases to be capable of being used for the purpose for which it was intended" (DoE 1996) So far as the impact on livestock and crops is concerned "substantial loss" is defined as occurring "when the loss is more than 10% in value of the total value of the stock or crop on the land" (DoE 1996). The 'working draft' definition would therefore seem to accord with the definition of contaminated land offered by the Department of the Environment to the Environment Select Committee (Environment Committee, 1990) and the comment made by Denner and Lowe (1995), and has the effect of restricting the scope of the contaminated land legislation.

According to Seidl (1996), the latest timetable of contaminated land legislation is now understood to be as set out in Box 3.1:

BOX 3.1

Timetable of contaminated land legislation

Environment Act receives Royal Assent	July 1995
Working draft	February 1996
Environment Agency launched	April 1 1996
Second working draft	End April 1996
Landfill tax	October 1996
Public consultation draft	Autumn 1996
Environment Act goes live	April 1997

(Source: Seidl, 1996)

At the same time as the United Kingdom government has been reconsidering its policies in respect of contaminated land, other European countries have been reviewing their policies, in the light of realisation that the full extent of the problem, in accordance with the 'strictest' definition of contaminated land, may be greater than had been realised. A number of these policy reviews are described in the following section.

3.4 POLICIES IN OTHER EUROPEAN COUNTRIES AND REGIONS

"Many countries are developing approaches to deal with contaminated land. Many of the issues are common and there are benefits in collaborative work and exchange of information." (Denner *et al*, 1995) The fifth International Conference on Contaminated Soil was held in Maastricht, Belgium in November 1995 and provided a forum for such an exchange of information. Most of the policy outlines described in this section are based on papers presented at that conference and may therefore, to some extent, reflect the views of the individual authors rather than confirmed government policies.

In Germany, the 'clean-up' of contaminated land has historically been tackled through the use of liability orders administered by the different Länder under the soil protection provisions contained in various types of legislation. As a result, the approaches differed quite significantly throughout the country and in order to establish nationally uniform criteria a draft *Federal Soil Conservation Act* was published in August 1995 and due to come into force during 1996. The proposed legislation is intended as a framework law encompassing waste, building codes, building regulation, emission control, nature conservation, regional planning and statistics, with three main objectives:

- elimination of the proliferation of lists on soil values;
- removal of blockages in respect of urban and economic development, and
- the prevention of future contamination.

The "polluter pays" principle will apply and a suitable for use approach is to be adopted in respect of soil treatment, with only one licence being required in respect of proposed remediation operations. The federal legislation will seek to encourage cost effective clean-up in preference to low cost remediation and aims to reduce pressure on greenfield sites keeping contaminated land in beneficial use. The possible effect of land contamination in putting "a block on urban and economic development" is recognised and uniform standards are seen as providing "investors with a measure of legal security and make it easier to calculate the risks involved in soil damage." (Sanden, 1995).

Soil "clean-up" policy in the Netherlands has evolved through three distinct phases; in 1982, the contaminated soil problem was perceived as being associated with landfills and gas works, however in 1987 it was "realised that general industrial sites should be added" (Deelen, 1995). By 1995 it had come to be accepted by the government that the problem was in fact one of diffuse pollution, with social processes coming to a standstill. In describing the effect of these three phases Drs. A. Deelen, Deputy Director in the Department of Soil Protection (part of the Netherlands Ministry of Housing, Spatial Planning and the Environment), cited the case of the City of Maastricht:

- in 1982 there were 52 known cases of contaminated soil in the city;
- by 1987 the number of identified sites had increased to 175 and
- in 1995 there existed widespread diffuse contamination affecting an unknown number of sites.

Recognition of the widespread nature of the problem has led to a reconsideration of Dutch policy on contaminated land, treating soil as a capital asset, and recognising that the country "will have to learn to cope for many years with the problem of soil pollution" (Deelen, 1995). This change has brought with it a moderation of the 'multifunctionality' approach to the treatment of contaminated land, under which all sites affected by contamination had to be remediated to the same standard of "cleanliness", regardless of proposed future use. Instead the current policy has three main 'strategy lines':

- **Strategy Line 1** - Spread the financial responsibility and involve industry on a voluntary basis, for example, an individual petrol filling station may be unable to afford the cost of remediating its own contamination and therefore the problem should be tackled by the industry as a whole - the sustainable quality of soil should be seen as a social responsibility;
- **Strategy Line 2** - Improve the returns of tackling soil pollution, using public/private sector partnerships to increase the number of sites remediated, encourage the wider use of in-situ biological treatments and the re-use of slightly contaminated soil, for example in roads and embankments, in preference to landfill disposal - changing to function orientated soil management;
- **Strategy Line 3** - Government concentration on designing and implementing standards and regulations changing to one of government becoming an active participant and co-investor - seeking "win-win" solutions in which all participants derive benefits in spite of conflicting interests.

In a rather less industrialised country such as Finland it may be that the "problems are known to a large extent and authorities have become more and more involved" (Sappänen, 1995). A contaminated sites survey was completed in 1994, excluding military and nuclear sites, which identified 25,000 suspected contaminated sites, including sawmills, wood impregnation sites, waste disposal sites and scrap yards. It is estimated that possibly as many as 90% of the identified sites may be contaminated.

"Some legislation exists in Finland but amendments may be needed" (Sappänen, 1995). A handling policy was implemented by the State Council in 1988 and a *Waste Act* has been in force since 1 January 1994. The need for a systematic approach has been recognised and the polluters pay for treatment so far as is possible to enforce, failing which it is the responsibility of the site owner, although the State can step in if the owner is unable to pay. Links have been established between waste management and strategic land use planning. Future soil pollution has been banned, a site survey and information on any remedial actions undertaken must be provided to purchasers and to the authorities. Permits are required in respect of remediation works and fees are to be charged from 1996 for the disposal of contaminated soil to landfill.

In Belgium there is regional responsibility for contaminated soil and in October 1995 a new *Soil Remediation Act* came into force in Flanders, the Northern region of the country. Under the terms of this Act OVAM, the Public Waste Agency, is charged with the task of identifying affected sites and compiling a register of contaminated soils. The Agency also has the power to step in and 'clean-up' contaminated land in default of action by the site owner and recover appropriate costs.

The 'polluter pays' principle applies, as does the BATNEEC principle (Best Available Technique Not Entailing Excessive Cost). There are provisions to protect the innocent land owner under which the costs will be borne by the government, which will then seek to recover the expenditure from the original polluter.

When land is to be sold a certificate must be obtained from OVAM in respect of the contamination situation. If any contamination found on the site is historic, i.e. before 29 October 1995, remediation may not necessarily be required but severe penalties will be imposed if the contamination has occurred since the Act came into force. The policy in Flanders may therefore be described as a "pragmatic approach towards historic contamination but seeking to ensure that new pollution does not occur" (van Dyck, 1995).

The *Law for Clean-up of Contaminated Sites* (Altlastensanierungsgesetz in German (ALSAG)) was enacted in Austria in July 1989. "This law creates a legal basis for detection and evaluation of potentially contaminated sites. Old waste sites and industrial facilities, which might be injurious to the environment, are to be considered as potentially contaminated sites." (Weihs, 1995) The law provides for the establishment of a register of contaminated sites, the first or 'detection' stage of which appears not dissimilar to the registers proposed for England and Wales under Section 143 of the Environmental Protection Act 1990, in that it seeks to identify 'potentially contaminated' sites. Unlike the Section 143 proposal, this detection stage is followed by an assessment procedure, in three phases:

- the preliminary assessment phase, during which the priorities for investigation of the potentially contaminated site are established;
- the risk assessment phase, to determine whether or not treatment is required at that time; and

- a classification phase, when priorities for treatment are determined and the urgency of treatment is documented.

Upon completion of the assessment stage, the contaminated sites are divided into three priority categories, using the same evaluation factors as used in the preliminary assessment, but redefined to reflect the results of the investigation. On 1 January 1995 the Austrian register comprised 1759 potentially contaminated sites with 111 of those sites identified as actually contaminated (Weihs, *op cit*). The total number of contaminated sites in Austria is expected to be around 5,000 to 10,000. (Kasamas, 1995)

In addition to the registers, ALSAG provides the legislative structure for dealing with contaminated sites in Austria including:

- the creation of public funds through the levy of charges in respect of the disposal of certain types of waste to landfill, waste export and the temporary storage of wastes for periods exceeding one year;
- a nation-wide uniform distribution of the funds created to stimulate voluntary activities at contaminated sites, 80% of the funds are assigned to support site remediation with the remaining 20% being used to fund additional site investigations to complete risk assessments;
- the responsibilities of the different authorities in the programme; and
- liabilities and enforcement procedures under the environmental laws.

The Austrian system is therefore one of encouraging land owners to "clean-up" their sites through the allocation of public money derived from the management of wastes which might otherwise have the potential to create further contamination. The "Guidelines for Funding" should encourage co-operation between the public authorities and the potential responsible parties (PRP's). "The prospect of financial support should encourage property owners to come forward to report PCS [Potential Contaminated Sites] for subsequent risk-assessment or to realize remedial measures at the site voluntarily." (Kasamas, 1995)

In summary, it would appear that throughout Europe there is developing a widespread acceptance that the remediation of contaminated land is a long term problem, and that treatments should be selected on the basis of suitability for use. The 'clean-up' of contaminated land to a uniformly 'clean' state may not always be a realistic proposition and regard needs to be paid to the cost effectiveness of any treatments proposed.

Where registers have been introduced, these would seem to go further than was proposed in the United Kingdom, in terms of the evaluation of the actual state of contamination affecting registered sites. That the polluter should pay for the treatment of contamination would seem to be fairly widely accepted as a principle but the extent to which that principle is enforced in respect of historic contamination would seem to vary significantly from country to country. Approaches also differ in the extent of protection offered to the 'innocent landowner' and those who are unable to pay for the cost of treatment.

3.5 CONCLUSION

Carter and Jackson (1992) concluded that:

> "Risk is a human problem. .... Systems which have a high degree of uncertainty/unreliability attached to them are not much use for human purposes"

Any method used to treat contaminated land may be regarded as a system and will have attached to it some degree of risk. The success, or otherwise, of the treatment system will depend upon a number of factors including, the thoroughness of the site investigation, the selection and design of the treatment method, and the implementation of the treatment itself. No site investigation can be certain to identify all of the contamination which might exist in the soil. It is not possible to test every gram of material, site treatment cannot be carried out under laboratory conditions and it may also be affected by climatic changes. All or any of these factors may result in system failure during, or subsequent to, the treatment process.

Associated with the risk of possible system failure will be uncertainties which may have a direct effect upon the viability of development proposals and the value of the land. Risks might include the following:

i) the inadequate design of the treatment leading to the required standard of remediation not being achieved;

ii) possible failure of the treatment system, resulting in harm to humans, animals, plant life and to building substructures;

iii) recontamination of the site resulting from the ingress of contaminants from adjoining properties;

iv) hazards involved in the treatment process itself and any off-site transportation/disposal.

The associated uncertainties might include:

v) the acceptability or otherwise of the treatment method to funding institutions and future users of the property;

vi) future changes in public and professional perceptions of the suitability of the treatment method;

vii) future changes in the law and/or government policies;

viii) future changes in soil treatment technology.

It is argued in this thesis that when redevelopment proposals are being considered, a range of options should be evaluated, including leaving contaminants undisturbed in the ground, subject possibly to some cover and cosmetic treatment of the site and its boundaries. The 'polluter pays' principle may be seen as an ideal policy solution to the problem but whether or not it is always appropriate will be questioned. It may, for example, be appropriate to apply the principle to modern acts of pollution, especially where the practices which lead to that pollution are still continuing. On the other hand it may not be appropriate in circumstances where the land has been damaged, over a period of many years, by practices which were common throughout the particular industry and where those practices have ceased, or have been changed in some way so as to make them more environmentally acceptable.

CHAPTER FOUR

LOCATING AND IDENTIFYING CONTAMINATION

4.1 INTRODUCTION

The first three chapters of this thesis have provided an introduction to the problems associated with the redevelopment and value of contaminated land. They serve to demonstrate the need for detailed knowledge to be obtained in respect of ground conditions and for values to be adjusted in the light of that knowledge. Adequate knowledge of ground conditions, especially the presence and extent of any contamination, can only be obtained through a properly designed and executed site investigation. A well designed investigation consists of a number of clearly defined stages and whether or not it is necessary for all of these stages to be undertaken, in order for the valuer to be sufficiently informed, will depend upon site specific circumstances and the nature of the valuer's instructions.

The question as to whether or not general practice surveyors and valuers should undertake site investigation work is outside the scope of this research. Certainly there are members of the surveying profession who view this area of work as an opportunity to provide clients with a more comprehensive service, whilst others believe that surveyors should adhere more closely to their traditional roles. Regardless of these different views it would seem to be appropriate for the general practitioner to have at least some knowledge about the subject of site investigations.

It is suggested that the extent of such knowledge should be sufficient to advise clients on the appointment of suitable consultants, to prepare briefs upon which those specialist consultants may be invited to submit their proposals and to be able to advise clients as to the strengths and weaknesses of those proposals. Locating and identifying contamination invariably involves a number of parties and, at the outset, the only adviser employed by the landowner or the intending developer may be the valuer or development surveyor. Amongst the other parties who will need to be involved in the investigative process, or may have an interest in its outcome, are the following:

- a specialist consultant or sub-consultant if the main consultant lacks contamination expertise;
- a specialist contractor experienced in the investigation of contaminated land;
- a specialist laboratory equipped to undertake appropriate chemical analyses if the ground investigation specialist contractor does not have such in-house facilities;
- the regulatory and statutory bodies who are not party to the contract but whose requirements may have to be complied with under the contract;
- the landowner, if not the client, and adjoining landowners/users etc.;
- the public who may be affected by on-site works and may have an interest both in the nature of any contaminants found on the site and any future development proposals.

(Source: after CIRIA, 1995, vol. III, p26)

If the valuer or development surveyor is to assume management responsibility for the location and identification of contamination, or is to advise the client on the appointment of suitable consultants, he or she will need to take account of a number of different issues. These will include defining the roles and responsibilities of the various members of the professional team, obtaining any necessary consents and taking account of any legal constraints, insurance requirements, health and safety considerations, environmental protection and long-term monitoring.

Most, if not all, of these issues will need to be addressed in the invitations to tender issued to specialist consultants and contractors. The appointment of suitable specialists is vital to the success of the project and in procuring specialist advice two main options are available:

1. Use of a professional adviser, with the separate employment of a contractor(s) for physical work, testing and reporting as required.
2. Use of a single contract covering specialist advice, physical investigation, testing and reporting. (Source CIRIA *op cit*, p27)

The decision as to which option is selected will depend upon a number of different considerations such as, the size and complexity of the project, the previous experience of the lead consultant, the individual preference of the client and the availability of suitable personnel. Whichever option is selected, competitive tendering will probably be used in making the final choice of the consultant(s) and/or contractor(s) to be appointed. "This has the potential disadvantage that costs can assume greater importance than technical sufficiency, but it can be operated successfully provided the tender list is restricted to a few firms able to tender on an equal footing." (CIRIA *op cit*, p28) The Site Investigation Steering Group recommends that the tender list should contain no more than three firms of equal standing.

4.2 SITE INVESTIGATIONS

The subject of site investigations has been considered by many authors, including Lord (1987), McEntee (1991), Smith (1991) and Beckett (1993a). The Department of the Environment has commissioned reports containing guidance on the investigation and sampling of contaminated land (DoE, 1994c and d), the Welsh Development Agency has produced a comprehensive manual on the remediation of contaminated land (Welsh Development Agency, 1993), a substantial part of which is devoted to the subject of site investigations, and Scottish Enterprise has published its *Requirements for contaminated land site investigations* (Scottish Enterprise, 1993). The Construction Industry Research and Information Association has published guidance on the "best practice" for site investigation and assessment (CIRIA, 1995, vol. III), as part of a comprehensive review of remedial treatment for contaminated land. A number of conference papers have also considered the issues involved, including Fletcher (1992), Ferguson (1993), Waters (1993) and Crowcroft (1994).

This chapter attempts to summarise, in a non-technical manner, the procedures to be followed in ascertaining if a site is contaminated, and is intended to assist valuers and development surveyors when advising on the appointment of specialist consultants to undertake site investigation work. Perhaps the most succinct advice given to those contemplating a new development is set out in the ICRCL guidance note 59/83 (ICRCL, 1987) which stresses that "The aim therefore should always be to check whether a site is contaminated before deciding on the form of development". The outcome of such a check may raise important valuation issues, as the nature and extent of any contamination may influence the developer in making changes to the type of development proposed. For example, an intended residential development may be replaced by a decision to retain the site in industrial use, and may even result in the developer deciding not to proceed with acquisition of the site.

Any site investigation must be sufficiently comprehensive, so as to present a reasonably accurate picture of the site condition and not a misleading impression, as described in some of the case studies in Chapters Seven and Eight. In order therefore to satisfy the principles of good practice and to achieve the objective of the investigative process, the site investigation should be designed with a view to:

- determining the nature and extent of any contamination of soils and groundwater on the site
- determining the nature and extent of any contamination migrating off the site into neighbouring soils and groundwater
- determining the nature and extent of any contamination migrating into the site
- determining the nature and engineering implications of other hazards and features on the site e.g. expansive slags, combustibility, deep foundations, storage tanks
- identifying, characterising and assessing potential targets and likely pathways
- providing sufficient information (including a reference level to judge effectiveness) to identify and evaluate alternative remedial strategies
- determining the need for, and scope of, both short- and long-term monitoring and maintenance
- formulating safe site working practices and ensuring effective protection of the environment during remedial works
- identifying and planning for immediate human health and environmental protection and contingencies for any emergency action. (CIRIA, 1995, vol. III, p9)

In addressing these objectives the topics of interest for the investigation of contaminated land may be classified into six main groups:

a) Physical site conditions
b) Likely contaminants
c) Extent and severity of contamination
d) Effects on users
e) Potential for environmental harm
f) Hazards during construction. (Hobson, 1993, p 34)

Hobson suggested that the process of site investigation "essentially involves the construction of a theoretical 'model', which can be used to assess the condition and behaviour of the ground, and the mechanisms and processes that lead to hazards and other effects". (Hobson, *op cit* p 34) Existing records, including previous site investigations and visual observations must first be used to construct an initial model, so as to facilitate an assessment of both the likely nature of any treatment which may be required and the suitability of the site for the proposed after use. The model should define:

- Natural geology and topography
- Modifications, mining and other alterations
- Filled and disturbed areas
- Locations of potentially contaminating activities
- Historical and modern drainage paths
- Services and other constraints (Hobson, *op cit*, p40)

The model may then be refined in the light of an investigative programme. The site investigation must therefore be designed in such a way as to provide the information required by the project, taking account of physical and other constraints, and the data produced must be capable of logical interpretation.

"As the principal means of gathering data to assess risks and select, design and implement remedial action, it is essential that site investigation is carried out according to good practice principles. It is an iterative process involving the collection and evaluation of information on both the site and its setting. There are at least two distinct phases: the first phase, **preliminary investigation** is non invasive by nature; the second phase uses invasive ground investigation techniques and may be termed the **main** investigation." (Welsh Development Agency, *op cit*, p 3.1) Depending upon site specific circumstances, it may be appropriate to introduce an exploratory investigation between the preliminary and main investigations. This may involve a limited on-site investigation "intended to confirm initial hypotheses about contamination and site characteristics, and to provide additional information to aid design of detailed investigation(s), including health and safety etc. aspects." (CIRIA *op cit*, vol. III p12)

It may be possible to combine the investigative work relating to contamination with a site investigation designed for other purposes, for example a geotechnical investigation required for foundation design, but the differing objectives should not be allowed to come into conflict with each other. It should also be stressed that many of the procedures involved in site investigation of contaminated sites, especially associated with invasive work, are potentially hazardous to the health of the operatives involved, and to the wider public. Health and safety issues must therefore be taken into account in the design of any site investigation and specific advice in relation to contaminated land is provided by the Health and Safety Executive (see Health and Safety Executive, 1991).

The precise nature of any site investigation will be determined by specific conditions and, in many instances, by budget allocation. However, "the importance of undertaking a thorough desk study prior to the field-work cannot be overstressed" (McEntee, *op cit*, p 67). The main components of the two phases of site investigation may therefore be summarised as shown in Box 4.1.

BOX 4.1

MAIN PHASES AND COMPONENTS OF SITE INVESTIGATION

Preliminary investigation	**Main investigation**
Historical Study	Inspection and testing
Site characterisation	Ground investigation
Site reconnaissance	Sampling and analysis
	Supplementary investigation

Source: Welsh Development Agency, 1993, p3.2

Although the two stage site investigation described above may be desirable, such an investigation may not always be necessary, or even feasible. For example, in circumstances where the subject property is to remain in industrial use, and a valuation is required for asset or security purposes, a preliminary investigation may suffice, although it must be recognised that the results obtained from such an investigation may, on occasions, be at variance to those obtained from a subsequent main investigation.

Even when redevelopment is intended, existing operational constraints and a desire to limit potentially abortive expenditure, may mitigate against a full site investigation. In such cases it may be appropriate to consider commissioning a preliminary investigation plus an exploratory investigation, designed so as to take account of information provided by the preliminary stage and operational constraints. This intermediate stage may be followed by additional work to complete the main investigation, thus creating a three stage investigation.

When sites are vacant and immediate redevelopment is proposed and the intending developer is not in a competitive bidding situation for the site, the two stage site investigation approach should be recommended. The additional expenditure at this stage may influence decisions regarding the site and reduce the risk of unforeseen costs at a later stage. When competitive bidding situations are intended or envisaged, it may be appropriate for the vendor to commission a preliminary investigation and, if the presence of contamination is indicated, at least an exploratory stage investigation, making available the information obtained to all prospective purchasers. Whether or not further work is required will then depend on the nature of the development, the findings of the vendor's investigation and whether the consultant is prepared to provide a warranty to the purchaser.

The phases of site investigation and their components will now be considered, with particular consideration being given to those aspects which the valuer or developer needs to bear in mind when commissioning site investigations.

4.3 PRELIMINARY INVESTIGATION

4.3.1 Historical study, site characterisation and reconnaissance

Referred to by McEntee (*op cit*, p 64) as a "desk study" and "generally confined to an inspection of the available geological records", the historical stage of the investigation can not in reality be undertaken by a researcher sitting at a desk, nor should it be confined solely to geological data. The information required for an historical study of a site potentially affected by contamination, will have to be obtained from many different sources, including those listed in Box 4.2.

BOX 4.2
MAIN SOURCES OF INFORMATION FOR HISTORICAL STUDY

Source	Materials
Local library	Maps Books, journals Newspaper records
Ordnance Survey	Current and superseded maps
National map libraries	Various maps
British Geological Survey	Geological maps and memoirs Well and exploration records Hydrogeological records
British Coal	Mining records
Minerals Planning Authority	Mineral extraction records
Waste Regulation Authority	Licensed waste disposal activities
Public utilities	Location of services
Present and previous owners, occupiers and users	Details of activities and processes carried out Plans and photographs
National Rivers Authority and Water undertakings	Surface water run-off Outfall details River details
Drainage authorities	Surface water drainage
Aerial photographs	Historical and modern photography

Source: Hobson 1993, p36

Assembly of the information available from the sources in Box 4.2 should provide an understanding of the stages of development which have taken place on the site. This is most important in situations where sites have been used for different purposes and have probably changed hands on several occasions throughout the period of their industrial use.

Even sites which have been used for the same purpose, or have been in the same ownership, throughout their period of use "may also have been subject to a succession of enlargements and extensions, often bearing no relation to later layouts on the site" (McEntee *op cit*, p 67). It is therefore most important that a comprehensive historical study is undertaken, even if the present owner is adamant that the site was a greenfield when production commenced fifty years earlier. Waste products may have been disposed of, quite legally, to the public sewer but the practice may have been discontinued years ago, leaving behind a latent problem. Parts of the site may have been raised and levelled using contaminated materials, now hidden under buildings or yard areas.

Much of this information may be available in the valuer's files or those of the architect, where they have acted for the company over a number of years. Alternatively, relevant documents may be found in the records of the site owner, and where possible should be summarised in the site investigation brief.

Once the historical study has been completed, or even whilst it is still under way, "it is important to characterise the public health and environmental context so that critical hazard, pathway and target scenarios can be identified and assessed" (Welsh Development Agency, *op cit*, p 3.3). A number of factors, both internal and external to the site, need to be considered at this stage, as shown in Box 4.3.

BOX 4.3
FACTORS TO BE CONSIDERED IN A SITE INVESTIGATION

Human beings - those who currently live or work on the subject property, or by whom it was previously occupied, and those who will use the property in the foreseeable future. This includes building operatives who will be employed on the site during the construction phase of any proposed development and any casual visitors to the site, including trespassers. In the case of residential developments, special consideration needs to be given to the possible ingestion of surface material by young children, known as Pica syndrome.

Geology, soil and surface material - particular consideration needs to be given to the potential for any contamination to be carried away from the site through the ground, or from its surface by humans (for example on the soles of shoes or on vehicle tyres), by animals, birds and invertebrates.

Surface and ground water quality - the existence of any potable water supplies in the vicinity of the property needs special consideration, in respect of the potential of contaminants to cause pollution. Even if there are no potable supplies of concern and the only surface or ground waters are already contaminated to such an extent that contaminants leaching from the subject property are unlikely to make any significant difference, the possibility that a pathway may exist needs to be considered. For example, a decision may be taken at some future date to "clean up" an affected water course, say following closure of the major polluter, and riparian owners may be faced with having to meet part of the cost.

Climate and air quality - including the possibility of the deposition, or "fall out", of contaminants from the manufacturing processes undertaken on the subject property, onto other properties lying downwind of the site and also the possibility that any contamination found on the property might originate from upwind of the site.

Flora and fauna - in particular are any species being adversely affected by conditions on the site, or emanating from within the locality? Conversely are any species thriving on the site conditions? Consideration also needs to be given to the possibility of finding rare or endangered species on the site, the existence of which may mitigate against the use of certain types of remediation methods, such as total removal of contaminated material, and in favour of other, in situ, methods. The ability to use the site for the proposed after use may also be affected, with a resultant impact on value.

Cultural heritage - this can cover many different aspects of the former uses of a property and its suitability for alternative uses in the future.

Landscape - regard needs to be paid to any discontinuities between the landscape of the subject property and the surrounding area, these may, for example, indicate areas of unrecorded filling of the site. Landscape may also be important in considering the likelihood of contaminants migrating onto the subject property from other industrial activities in the vicinity.

The built environment and services - the historical study should have provided information as to the past development of the property and the characterisation stage should include consideration as to how these might impact on its continued use and/or redevelopment.

Regulatory framework - consideration must be given to any regulations affecting the particular industry carried out on the site, as well as to more general legislation dealing with the control of pollution, and health and safety. The impact of Local Plans, both those currently in force and any proposed changes, affecting not only the property itself but also the surrounding area, needs to be taken into account. For example, it may be proposed that land adjoining the property be allocated to a potentially contaminative use.

Interaction between any of the above - none of the these factors should be considered in isolation but they should be used to build up a composite understanding of the property, so as to assess the likely significance of any contamination and thereby provide essential background information in order to determine the most appropriate response.

(Source: expanded from Welsh Development Agency, 1993, p3.4)

The purpose of a site reconnaissance is to check the information obtained from documentary evidence and to add further detail. (Hobson *op cit*, p42) It is suggested that wherever possible the valuer and the person(s) responsible for the past management and maintenance of the site should accompany the site investigation specialist on the site reconnaissance. This is especially beneficial in cases where any of these individuals have any knowledge of landfilling activities, wastes disposal procedures and other potentially contaminative activities.

"A visual assessment of the site may disclose evidence of unrecorded events and activities, particularly those which post-date available records, e.g. fly-tipping" (Welsh Development Agency, *op cit*, p 3.4), site reconnaissance should not be carried out unless a desk study has indicated that it is safe to do so. Before commencing the reconnaissance it is advisable to sub-divide the site into identifiable areas of interest, say by former uses or by topography, and to mark up the site plan with points of interest, possibly by use of an overlay. Hobson (*op cit*, p42) suggested that "the reconnaissance should, wherever possible, be conducted on foot and it is usually best to walk around the perimeter of the site first, before inspecting the central area and points of detail. This gives an understanding of the overall scale of the site and allows landmarks to be easily located."

Completion of the reconnaissance stage should enable the Preliminary Investigation Report to be prepared. This should describe all completed work, report on the findings (including a summary of those hazards, pathways and targets likely to be most important at the site) and provide recommendations for future action. (Welsh Development Agency, 1993) The theoretical model, described by Hobson (1993) should be adjusted and refined in the light of the information obtained.

At this stage the preliminary report should be submitted to the client and, where appropriate, to the other members of the professional team with advice as to whether or not the main investigation should be undertaken. The brief to the consultants and their terms of appointment should provide for the possibility of the investigation being terminated following submission of the preliminary report. This will provide for the event that the degree of contamination identified is beyond that which the developer is prepared to consider and therefore decides against continuing with the project. In situations where only a valuation is required, the information provided from the preliminary investigation should be sufficient either to enable the valuer to complete his or her valuation, or to determine the extent of any additional information, or exploratory investigation, which may be required.

4.4 MAIN INVESTIGATION

4.4.1 Ground investigation

The principal objectives of the ground investigation are to determine the nature of the contamination present on the site, its likely behaviour and volumetric extent. (Welsh Development Agency, 1993) Assuming that the decision is taken to proceed with the main investigation, the preliminary investigation may be regarded as a type of 'screening device' or filter which should have the effect of enabling a worthwhile and cost effective main investigation to be designed. To proceed direct to a main investigation may be regarded as being foolhardy and may well result in potential contaminants being overlooked. Such an omission may necessitate partial repetition of the invasive investigation.

Before commencing with the ground investigation some further inspection and testing may be required "to refine the preliminary hazard identification and assessment, and to assist in the design of the main investigation programme" (Welsh Development Agency, *op cit*, p3.8) This may take the form of an exploratory phase between the preliminary investigation and the main investigation, as referred to previously, or even an extension of the site reconnaissance stage. The amount of work needed at this stage will depend to a large extent on the nature of the previous, or current, activities on the site, the size of the site and its complexity.

Sufficient detail is needed for:

- assessing health and environmental hazards and risks
- evaluating financial and technical options for the subsequent development if one is planned
- selecting and planning any remedial work
- designing the works
- ensuring safe working for personnel on-site
- ensuring health and safety of the public
- assessing requirements for both short- and long-term monitoring.

(CIRIA *op cit*, p19)

Ferguson (1993) stated that each site must be judged individually taking into account the available information and the objectives of the investigation but sampling is usually designed to answer three key questions

(i) which hazardous substances, if any, are present in the soil?
(ii) do contaminant hotspots exist on the site, and if so where?
(iii) what size and shape are the hotspots, if they exist? (Ferguson, 1993)

No ground investigation can guarantee to locate all contaminants which may exist within a site and to quantify their extent and volume. The objective of an investigation should be to assess, with a reasonable degree of certainty, the likelihood of any contamination being present, the nature of the contaminants themselves and the media within which they are located. The information thus obtained can then be used in selecting the appropriate method, or methods, of treatment and designing the programme of remediation. Therefore the ground investigation must be sufficiently comprehensive, so as to achieve these objectives. "A decision needs to be made on the largest hot-spot that could be accepted or dealt with economically if it were missed in sampling. This *critical hot-spot size*[1] is an important design parameter". (DoE 1994d, p2) Deciding upon the economics of the sampling pattern may involve the development team in preparing sensitivity analyses for several different options and may well necessitate some consideration being given to alternative site layouts, should the extent of contamination be greater than envisaged. In general, however, an under designed site investigation has the potential to result in unexpected costs during the development period.

Sampling patterns assume that any contamination is likely to be generally distributed throughout the site, however the preliminary investigation may have provided sufficient data to enable the location of possible contaminants to be determined with a reasonable degree of accuracy. It may therefore be appropriate to design the sampling pattern, for at least part of the site, with the specific objective of confirming the boundaries of hot-spots. Investigation of the

1 Italics in original

remaining site area should not however be ignored, in case there are other hot-spots which were not identified during the preliminary investigation and to ascertain whether there has been any migration of contamination. The ground investigation may therefore comprise a mixture of specifically targeted trial pits or boreholes with others conforming to a grid or herringbone pattern.

The British Standards Institution's "*Draft for Development 175*" (BSI, 1988) gives the minimum number of sampling points required, according to different site areas, in order to have a 95 per cent probability of locating one contaminated sample from a contaminated area of a minimum specified size, see Table 4.1. ICRCL 18/79 recommends a grid spacing of 10-25 metres for small sites and a 25-50 metres grid spacing for larger sites. On a 1 hectare (1 ha = 10^4 m^2) site a 10 m. grid would give a probability of only 63.4% of finding a contaminated area of 100 m^2 (i.e. the size of the grid). (Hobson, 1993, p47) For gas works and similar sites, sampling densities of 20-50 trial pits per hectare are suggested by the Department of the Environment for suspected hot spot areas (DoE, 1987), with 5-10 trial pits per hectare elsewhere.

TABLE 4.1
MINIMUM AREA OF CONTAMINATION LOCATED BY BSI DD175 SAMPLING FREQUENCY

Area of site (hectares)	Recommended number of sampling points	Minimum contaminated area to provide one contaminated sample (at a 95% confidence level)
		m^2
0.5	15	905
1.0	25	1,129
5.0	85	1,732

The ground investigation should be designed in such a way as to characterise the contamination present within the site with respect to:

- lateral and vertical extent

- chemical composition and concentration
- physical characteristics (e.g. volatility, solubility)
- biological characteristics (e.g. pathenogenicity, degradation potential)

(Source: Welsh Development Agency, 1993, pp3.11-3.12)

Design of the ground investigation must therefore take account of any constraints which may prevent adequate characterisation. This is one aspect to which the surveyor should pay particular attention when analysing site investigation proposals and reports. For example, if the preliminary investigation has indicated the presence of fill material with depths of up to five metres and a trial pit investigation is to be undertaken, then it is of no use employing a wheeled excavator with a maximum reach of only three metres but even leading consultants have been known to make such an error. Trial pits in fill material need to be excavated down to natural, undisturbed, ground so as to facilitate the taking of samples from below the fill, to determine whether or not the contamination is mobile. A report which contains phrases such as 'natural ground was not found in trial pits numbers ...' or 'the excavator was unable to penetrate to the full depth of the fill material' is of limited use and it may be necessary for further investigation work to be undertaken, at further expense, and a possibility that further disturbance of the ground will cause a more widespread distribution of the contaminants. Similarly, design of the sampling and testing procedures must be sufficiently rigourous so as to maximise the likelihood that any possible contaminants will be identified.

4.4.2 Sampling and analysis

In many cases the site investigation for contamination will be undertaken at the same time as, or even as part of, a wider investigation designed to ascertain the geotechnical, geological, hydrological and hydrogeological attributes of the site.

Whilst it may be possible to combine the different aspects into one investigation, the sampling requirements and techniques may be different. The actual method used to carry out the ground investigation may be determined by criteria related to the other aspects of the investigation, rather than the nature of contamination, and some compromises may be necessitated. For most forms of contamination, a trial pit or trench investigation is likely to be most appropriate, as these methods facilitate visual inspection of both the contaminants and the media within which they are contained. For volatile contaminants, however, trial pits and trench methods are inappropriate, due to the problems of sample collection, and a borehole investigation will produce better results. Other forms of investigation include hand sampling of surface materials (to depths of about 0.5 metre), dynamic probes and soil gas surveys.

At least three samples should be taken at each sampling location, from near the surface (150-200mm depth), the depth of greatest concern and a random intermediate sample (BSI, 1988) and the consultants' proposals should include for testing at least this number. In addition, it is advisable, on sites which have been subjected to fly tipping, to take at least one sample from each discrete tipped load and, from within trial pits to sample any materials which appear not to conform to the general nature of the ground. "It is therefore essential that, at the design stage, an anticipated testing programme is formulated and the appropriate sample sizes selected for each material to be sampled. This will of course need to be refined as the investigation proceeds," (Hobson 1993, p51).

Health and safety regulations must be adhered to, especially when taking samples from trial pits and trenches, which may need to be shored up if the sampling method requires the investigator to enter the pit or trench. "Data recorded during the investigation must be accurately recorded, in a manner that can be subsequently understood. If this is not done, the value of the entire exercise will be seriously impaired." (Hobson, 1993, p57) The sampling method must ensure that material of interest is sampled, which includes any contaminants and the background media, and that the sample remains stable until analysed. The state of the sample must also be compatible with the method of analysis to be used.

Consideration of the methods of analysis available for the testing of potential contaminants is beyond the scope of this research but Lord (1987), McEntee (1991), Smith (1991) and Hobson (1993), provide a comprehensive review of techniques. Analysis may take place both on-site and in the laboratory, and the location of testing will quite often be determined by site specific circumstances. For example, on-site testing may be required:

(a) To support health and safety remedial measures by indicating the presence say of toxic vapours or acidic liquids etc.
(b) Because immediate measurement of contaminant is the only way to quantify its concentration i.e. because of its instability, volatility etc.
(c) To speed up analysis of site materials i.e. by having immediate analytical response.
(d) To reduce the costs of analysis i.e. by avoiding transport costs.

(Lord, 1987, p89)

Throughout all stages of the site investigation quality control is of the utmost importance. "The methods and techniques used must be standardised so that reproducible results are obtained both between sites and within the same site; reference to published sampling and analytical protocols and the use of NAMAS (National Measurements Accreditation Service) accredited laboratories will help to ensure these requirements are met." (Welsh Development Agency, 1993, p3.17)

4.5 SUPPLEMENTARY INVESTIGATION

"Good practice during the main investigation will generally limit the need for supplementary investigation, although logistical and phasing constraints may dictate that further work is undertaken." (Welsh Development Agency, *op cit,*) The extent of any supplementary work will be site specific and may arise as the result of the discovery of contaminants, during laboratory analysis, which were not previously expected. It may also be the case that part of the site was unavailable during the main investigation, due to the fact that it was still operational or in another ownership, although it should normally be possible to allow for this type of situation through phasing of the main investigation.

Any supplementary investigation must be subject to the same quality and safety standards as the main investigation, and may comprise some or all of the same types of works carried out in the main investigation. In situations where supplementary investigations are unavoidable, the additional work should be specifically targeted, for example with the objective of obtaining further information about a specific contaminant or to investigate a particular area of the site in more detail.

Supplementary investigations, for example the obtaining of larger samples of contaminants and media, may also be required in order to assist in the design and selection of remedial works. They may also involve pilot studies of treatment processes, or in-situ testing of ground bearing capacities (see McEntee, 1991).

4.6 THE REPORT

The outcome of the investigative process should be a report which is readily understandable by the 'non-technical' client, the other members of the professional team and the appropriate regulatory authorities. A high standard of presentation is therefore important and the report should describe the various stages of the work undertaken, together with the findings obtained and any assumptions which may have been made.

Within the constraints of the site and available information the report should indicate the location of those parts of the site affected by contamination and identify the nature of those contaminants. Potential pathways and targets should be described and the report should clearly define the options available to the client. Potential risks should be evaluated and, when environmental harm is noted during the investigation still to be occurring, recommendations should be made in respect of immediate actions required to prevent further harm

The report should conclude with firm recommendations, regardless of whether or not immediate redevelopment is proposed, and advice in respect of future monitoring. An executive summary should be provided, together with a table of contents, a schedule of documents consulted and a bibliography.

CHAPTER FIVE

THE TREATMENT OF CONTAMINATED SOIL

5.1 INTRODUCTION

The purpose of this chapter is to consider the options available to an intending developer and to discuss a number of soil treatment methods currently available in the United Kingdom, or at various stages of development, and to consider their suitability for use in development situations. It is not a detailed critique of current technologies but is intended as an overview and a discussion as to the suitability of the processes for redevelopment purposes.

It is unlikely that the selection of a suitable treatment method will be a straightforward decision. Ellis (1992, pp31-33) grouped the factors which influence the choice of remedial strategy and design under nine category headings as follows:

- Legal
- Political
- Commercial
- Geographic
- Environmental
- Engineering
- Health and Safety
- Managerial and,
- Technical. (Ellis, 1992, pp31-33)

It is likely that, in selecting a treatment method, or methods, for a site the developer will have to consider the available options in terms of their appropriateness under these nine categories and these may have markedly different effects on the final decision.

5.2 AVAILABLE OPTIONS

Any urban renewal project will, almost certainly, bring with it a multiplicity of problems. It should always go without saying that, when contemplating the redevelopment of a site which has previously been used for some other purpose, great care should be taken so as to overcome any problems which may remain hidden from sight (Syms, 1993, p307). Fleming (1991, p1) observed, that in an industrialised community, such as Europe, "much of the land used for redevelopment has a history of previous uses" and he went on to point out that "the state of such land is often so poor as to be unsuitable for continued use or re-use without major land engineering works". The cost of such works will, in very many instances, have a significant impact upon the viability of a redevelopment project. Such costs may be far in excess of the reclaimed value of the land and a potentially successful urban regeneration project may be tipped from profit into substantial loss. (Syms, 1993, p307)

In the absence of public sector grants and the unwillingness, or inability, of the polluter to meet the cost of soil remediation, the high costs associated with reclaiming contaminated sites may simply result in ever increasing areas of industrial dereliction and eyesores across the landscape of the United Kingdom. According to Haughton and Hunter (1994), "there is evidence that environmental degradation may be a key contributory element in instigating and maintaining a spiral of urban decline, influencing the investment intentions of industrialists." The authors also expressed the view that, "the legacy of environmental external costs such as contaminated land and derelict buildings imposes further costs on those attempting to break out of the downward spiral of urban change, whether through reindustrialisation or residential, leisure or commercial usage." (Haughton and Hunter, 1994, p59)

Before a decision can be taken in respect of site options, investigation work needs to be undertaken and a risk assessment prepared, so as to ensure that contaminants are safely contained and are not likely to present an environmental hazard in the future.

When considering a 'do nothing' approach, it may be found that the hazard risks are such that it is not safe to leave the site in its untreated state and that some work, of partial treatment or containment, is required. The 'do nothing' option should not therefore be regarded as a 'no cost' option. Such measures may fall short of returning the site to a developable state, at least in the short term. Bardos (1993b) has considered the process constraints on innovative soil treatment technologies and Bardos and van Veen (1995) have studied 'extensive' treatment methods which are discussed later in this chapter.

Assuming that the 'do nothing' approach is unacceptable then the options available to a developer or land owner seeking to extract an economic return from a contaminated site may be simply stated as either:

a) excavate and remove the contaminated material for safe containment (on or off the site) or for treatment, or
b) leave the contamination where it is and contain or treat it in-situ.

In order to be able to decide which of these options is most appropriate and then to identify the technical aspects of any possible treatments, it is necessary to consider a number of factors, as set out in Box 5.1.

BOX 5.1
FACTORS TO BE CONSIDERED WHEN SELECTING REMEDIAL MEASURES FOR CONTAMINATED SITES

a)	present and intended topography and relation of site levels to surrounding areas, roads, etc.;
b)	adjacent land areas (e.g. proximity of buildings and current and future uses);
c)	surface drainage, adjacent water courses, groundwater levels and movement, underlying aquifers;
d)	propensity of site for flooding, etc.;
e)	location of existing services;
f)	maximum depth of excavation required for services or foundations (major services, especially sewers, usually have to be installed at considerable depths and this inevitably means digging into the contaminated materials even if all the other work can be kept within any clean cover material laid over the site);
g)	the consequences of settlement within any imposed clean soil cover and settlement of the underlying ground due to imposed loads from cover or buildings, or for other reasons;
h)	the safety of workers and neighbours during site works;
i)	environmental impact of site works;
j)	the significance of a future pollution incident on the site (e.g. acid spill)
k)	effect of building works (e.g. foundations and services) on any completed reclamation works;
l)	the significance of any future site works (e.g. extensions to buildings, repairs to services);
m)	possible future changes of land use;
n)	safety of workers engaged in future site works;
o)	need for long term monitoring;
p)	need for long-term maintenance; and
q)	who is going to be responsible in the long term for monitoring, maintenance and enforcement of any controls on what may be done on the site.

(Source: Smith, 1993, p27)

Removal, containment and treatment methods will now be considered in turn.

5.3 REMOVAL AND CONTAINMENT METHODS

Soil clean-up was defined by Armishaw *et al* (1992) "as treatment to remove, stabilise or destroy contaminants", such treatments would not usually include landfill and containment systems, the methods most frequently used in the United Kingdom as, on their own, these are not true clean-up techniques. Nevertheless, they are widely used and are of considerable importance in the context of redevelopment and value, they are therefore considered first.

"Excavation should be regarded as a process preceding the disposal, or treatment, of contaminated material. Post-excavation options include:

- off-site disposal to a suitably licensed facility
- controlled disposal of contaminated material on-site to a licensed depository or pursuant to a licensing exemption
- treatment of the contaminants present in the excavated material to permit reuse or reduce disposal requirements. (CIRIA, 1995 vol. V, p.1)

5.3.1 **Excavation and disposal**

According to Smith (1987, p123), the first and most obvious solution will appear in many cases to be simply to excavate the contaminated material for deposition elsewhere and to replace it with clean imported fill. "Off-site disposal to a licensed tip has been by far the most widely used reclamation solution" (Beckett and Cairney, 1993, p74) but the authors noted that "this situation is changing" due to the fact that "suitably licensed tips are now scarcer and more expensive".

The objective of the excavation and disposal method may be to either totally remove the contamination from the site, so far as this is physically possible, or to reduce the concentration of the contaminants, and their accessibility to potential targets, to an acceptable level of risk. In situations where the source and physical distribution of the contamination can be readily identified, say as the result of a single polluting incident, total removal of the contaminated material may be the best solution and may also be financially viable. If however the contamination has been occurring over many years, is widespread throughout the site and is heterogeneous, total removal of the affected material may be both unnecessary and prohibitively expensive. The alternative solution may then be to consider on-site disposal but it should be noted that any on-site disposal operation must:

- be appropriately approved, in terms of planning permission and waste management licensing

- comply with all waste regulation, planning, environmental and occupational health and water quality protection requirements specified in planning or licensing conditions or general legal requirements
- be of a design and construction acceptable to the regulatory authorities
- incorporate appropriate provision for monitoring and maintenance to ensure the long-term security of the deposit and the performance of any control measures. (CIRIA, 1995, vol. V, p3)

Failure to comply with any of these requirements, or to retain documentary evidence of such compliance, may result in a serious adverse impact on the value of the treated site and any subsequent redevelopment.

A detailed site investigation and accurate classification of the in-ground materials can achieve significant reductions in disposal costs by facilitating the accurate identification of material for disposal. "It is then often possible to visually identify these more contaminated materials and to separate them when a site is excavated" (Beckett and Cairney, 1993, p74). The most heavily contaminated material, i.e. that which will attract the highest tipping charges, can then be transported separately from that which is affected to a lesser degree, thus reducing the cost of site reclamation. Alternatively, as demonstrated by the case studies in Chapter Eight, uncontaminated or lightly contaminated material may be re-used on site.

The new buildings may either be constructed at the reduced level or, alternatively, the original site levels or new levels may be created through the import of material in order to fill the voids left by the removal of contaminated 'hot-spots'. The import of fill material brings additional risks and it is essential that the imported material is subjected to chemical analysis, so as to ensure that it is clean or inert, before it is placed in the ground.

"The predictable decline in the amounts of off-site tipping has the significant advantage that it will remove the cheapest reclamation option and so make other newer techniques more cost effective. It also has the wider benefit of reducing the past policy of simply relocating environmental problems, and limiting the possible hazards when large volumes of contaminated soils are moved by road transport" (Beckett and Cairney, 1993, p74).

There are already signs that this is happening and that developers are less inclined towards the indiscriminate disposal of material to landfill. Nevertheless, it is likely that the excavation and disposal method of treatment will play a significant part in the reclamation of contaminated land in the United Kingdom for the foreseeable future.

According to Armishaw *et al*, (1992, p31):

"The range of material types that are disposed of to landfill are generally considered to be very diverse and include the whole spectrum of soil types and particle sizes including construction and demolition debris. Similarly the range of contaminants that are landfilled is also broad, probably wider than for any other treatment method."

Although not normally regarded as a treatment system, a properly designed landfill may facilitate attenuation of the contaminants, for example by adsorption or degradation, thereby reducing their toxicity. The principal mechanisms of attenuation are set out in Box 5.2.

BOX 5.2

PRINCIPAL TYPES OF ATTENUATION MECHANISMS OCCURRING IN DECOMPOSING WASTE

Process	Mechanism
Physical	Absorption, adsorption, filtration, dilution, dispersion
Chemical	Acid-base interactions, oxidation, reduction, precipitation, co-precipitation, ion-exchange, complex ion formation
Biological	Aerobic and anaerobic microbial degradation

Source Department of the Environment, 1986b.

Not all materials can be safely disposed of to landfills, polychlorinated biphenyls (PCB's) are very persistent in the environment and are unlikely to degrade through chemical or microbiological activity within an acceptable period of time. Cyanides are also unlikely to degrade when mixed with inert wastes but have been found to degrade in the presence of organic material. Caution is also needed when disposing of arsenic, mercury, selenium, antimony, heavy metals, phenols, oily wastes and pesticides.

Problems associated with the landfill of contaminated land can be divided into design/construction and long term uncertainties (Armishaw *et al*, 1992, p33). From the developer's point of view, the ability to transfer any future problems to a third party, in return for a pre-determined payment, must be attractive but the question must be asked as to whether or not the full legal liability has in fact been removed from the developer.

5.3.2 Clean cover and containment

When large scale industrialization commenced and produced volumes of unwanted wastes, covering was often seen as the obvious answer to the problem.

The wastes were tipped into whatever convenient hollows existed, capped with soil or hardcore, and usually became the foundations for later generations of the industrial activities. (Cairney, 1987, p144) Whilst simple covers may have been adequate in terms of rendering the contaminants inaccessible to potential targets on or above the surface of the ground, they were unable to prevent migration of the contaminants sideways or downwards through the soil and especially did nothing to prevent the possibility of groundwater becoming contaminated. It follows therefore that, if contaminants are to remain on site, close attention needs to be paid to the design of a suitable cover or containment system.

Cairney and Sharrock (1993) described a design methodology, for cover systems, in the form of a few simple questions:

- What does a particular cover have to do?
- How long does it have to remain effective?
- What materials can be included in the cover?
- How can the design properties of these materials be defined?
- How is the design quantified?
- Have possible failure modes been checked and potential failure pathways been closed?
- How quickly can failure occur?
- Does the client clearly understand the design basis and any possible liabilities this could present? (Cairney & Sharrock, 1993, p85)

The performance requirements of a particular cover will depend upon the proposed end use of the site and the mobility of the contaminants themselves. For example if all that is required is a clean site surface, upon which no buildings are to be constructed and no services laid, and the contaminants are limited in their mobility, then the design and specification of the cover is a simple matter. If on the other hand the intention is to prevent the upward migration of contaminants, then the design will have to include a capillary break layer, similarly, if the intention is to prevent rainwater from reaching the contaminants, an impermeable barrier may need to be incorporated within the cover. The design of such covers requires a knowledge of the material properties of the cover materials and the contaminants, in order to produce a satisfactory design.

Failure of the cover system is most likely to occur for one or more of the following five reasons:

- siltation of the pore voids in granular covers,
- dessiccation, cracking of clayey covers,
- chemical attack on a cover's materials,
- settlement,
- erosion.

In addition to the possible causes of failure listed above other, more site specific, factors may need to be taken into account; according to Cairney and Sharrock (1993, p94) the most common of these would seem "to arise from the location of buried services. If these are installed within the clean cover, later maintenance and repair should not pose a hazard".

Sudden and catastrophic failure of a cover system is unlikely. Provided that the cover has been adequately designed and constructed it is unlikely to show signs of any failure for many years and even after failure it may be many months before the failure becomes apparent. The client, future users and investors in the property should be made aware that it is not a treatment system in itself (although some attenuation may occur) and the contaminants remain on the site in an untreated form.

Cover systems on their own are only of use where there is no risk of the contamination migrating in a sideways or a downwards direction, if this is a possibility then it may be appropriate to incorporate a barrier system so as to ensure full containment or isolation of the contaminants.

In principle the containment system must completely surround the pollution source. That is there must be barriers above, below and around the source. For sites such as new landfills the barrier systems employed usually will be a combination of geomembranes, clay layers and drainage layers. For in-situ containment of existing contamination the most common procedure is some form of vertical barrier wall taken down to a natural geological aquiclude. The site may then be covered with a low permeability cover layer. (Jefferis, 1992, p.59)

In principle, the ideal containment design would be one which ensured that no leakage of the contaminated material can occur but in reality this is an ideal which can not be achieved or maintained. Jefferis (1992) suggested that it was necessary to consider three conceptual designs:

a) - Design for total containment for a defined period. Thereafter no control.
b) - Design for continuous controlled release to the environment.
c) - Design for total containment with monitoring and built in procedures for recovery of the contained material or remedial if the containment fails.

(Jefferis, 1992, p59)

Many different forms of barrier system are currently available and their suitability will depend upon the nature of the contaminants to be contained as well as the ground in which they are to be installed. Several systems are listed in Box 5.3:

BOX 5.3

TYPES OF BARRIER SYSTEMS

Jet grouting - may be used to form both vertical and horizontal barriers by the injection of materials under pressure into pore spaces of permeable soils or rocks so as create a barrier of low permeability.

Shallow cut-off walls - formed by excavating a narrow trench and inserting an impermeable membrane, which must reach an aquiclude.

Driven barriers - formed by driving steel sheet piles, or concrete or HDPE membrane elements into the ground.

Vibrated beam wall - a combination of the driven barrier and injected barrier methods.

Secant piling - often used in civil engineering to provide structural walls which also function as a cut-off, there may be problems in respect of the joint formation between the piles.

Slurry trench process - a trench filled with an appropriate fluid the so that the trench can be kept open and excavated without collapse. The fluid must exert sufficient hydrostatic measure to maintain the stability of the trench and it must also not drain away into the ground to an unacceptable extent.

5.4 TREATMENT METHODS

Denner and Bentley (1991) provided an overview of clean-up technologies and, so far as true treatment methods are concerned, Armishaw *et al* (1992) and Bardos (1993a) have described five generic treatment categories, derived from the work into waste treatment processes which they had undertaken at Warren Spring Laboratory[1], as being:

1) **Biological systems** of soil treatment [which] depend on the biological transformation or mineralization of contaminants either to less toxic, more mobile forms or a form which is both mobile and less toxic. Biological processes can also be used to fix and accumulate contaminants in harvestable biomass.
2) **Chemical systems** in soil treatment systems are used to destroy, fix or neutralize toxic compounds. Chemical processes do not necessarily destroy contaminants. Chemical processes of fixation have been grouped with solidification for convenience since solidification based processes tend to be associated with stabilization processes and vice versa.
3) **Physical systems** used in soil treatment are used to remove contaminants from the soil matrix, concentrating them in process residues requiring further treatment or safe disposal.
4) **Solidification systems** are those which encapsulate the waste in a monolithic solid of high structural integrity. Solidification may or may not be accompanied by the destruction or stabilization of contaminants in the solidified mass.

1 A research laboratory formerly operated as an agency of the Department of Trade and Industry, subsequently merged with the Atomic Energy Authority's laboratory at Harwell to form the National Environmental Technology Centre (NETCEN).

5) **Thermal systems** are those based on incineration, gasification, or pyrolysis at elevated temperatures.

(Armishaw *et* al, 1992, pp27-28 and Bardos, 1993a, p37)

Within each of these generic categories there are numerous different types of treatment, some of which may be commercially available, whilst others are only at experimental or pilot study stages.

5.4.1 Biological systems

Bioremediation is a process that uses soil's naturally occurring micro-organisms to decompose contaminants such as toxic or hazardous substances. Bioremediation works because most of the organic compounds that comprise hazardous wastes can be used as food by micro-organisms (ENSR, 1992, p24).

The biological treatment of contaminated soils is primarily based on the actions of microbes to oxidise (metabolise) organic compounds and reduce them into their constituent parts, producing by-products such as cell matter, carbon dioxide, water and other inert materials. This may be caused by the action of a single micro-organism but "more often involves the interaction of two or more microbial species" (Armishaw *et al*, 1992, p126). Biodegradation can occur in a number of different ways but the success, or otherwise, of the treatment process will depend upon factors such as the chemical composition of the substance to be treated and the micro-organisms involved, as well as the chemical and physical, e.g. aerobic or anaerobic, environment within which they are located.

Not all contaminants are amenable to treatment by biological processes, "although they are effective against a wide range of common contaminants under the correct conditions" (Armishaw *et al,* 1992, p127), with even some man made (xenobiotic) compounds being amenable to treatment. It is therefore necessary to have a good understanding of the nature of the contaminants, their locations and concentrations before the appropriate biological treatment can be selected.

If "the natural microbial community does not display the desired ability to remove the site contaminants, provision can be made to investigate the feasibility of treating the site with non-indigenous/commercially available bacterial innoculants if a biological treatment is still the desired option" (Armishaw *et al*, 1992, p.130), nutrients may also be added and the physical structure of the soil can be modified so as "to enhance mass transfer of oxygen to the site of microbial activity" (Bewley, 1992, p272).

Biological treatments can be undertaken *in situ* but for difficult soils *ex situ* methods may be preferred. The *in-situ* treatment of contaminated soil does not require excavation but may involve the addition of surfactants, or other agents, to water lying within or infiltrating the contaminant so as to increase its mobility. *Ex-situ* biological treatments, such as composting, require the excavation of the contaminated soil and its placement in a purpose designed treatment bed, where it may be mixed with a suitable bulking agent, such as wood chips or sand, to aerate the material and inoculation with water, nutrients and, if necessary, additional microbes.

5.4.2 Chemical systems

Chemical treatment processes alter hazardous constituents in waste streams to reduce their toxicity or mobility, or produce inert compounds from the original material (ENSR, 1992, p36). A wide range of chemical treatments may, in theory, be applied to the remediation of contaminated soil and these may be categorised according to the chemical processes involved, for example, oxidation, reduction, neutralisation, mobilisation, hydrolysis and polymerisation. The majority of the chemical treatment processes require soil to be in a slurry form or for the contaminants to be mobilised in a liquid medium such as groundwater (Armishaw *et al*, 1992, p9).

As with bioremediation, chemical treatments can be applied both *in-situ* and *ex-situ*, although "relatively few chemical processes have been applied directly to contaminated soils" but "have been used more widely for cleaning of a wide range of other contaminated materials" (Armishaw *et al*, 1992, p96). The ENSR Report (1992) describes two chemical methods which have been used at hydrocarbon contaminated sites:

- *in-situ* (chemical) oxidation and,
- ultraviolet-enhanced oxidation.

In certain case, chemical oxidants may be used to decompose or oxidise hydrocarbons in the subsurface (ENSR, 1992, pp36-37). The process is similar to chemical burning and the oxidant is usually a dilute hydrogen peroxide solution, which is injected into the contamination through injection wells at carefully controlled rates. This method is beneficial where hydrocarbons are too highly concentrated, or are too toxic, for successful bioremediation.

Ultraviolet oxidation uses the injection of oxidants, usually hydrogen peroxide or ozone either alone or together, to chemically decompose the hydrocarbons, with the injected stream of material being passed through a bank of ultraviolet lamps to 'activate' the oxidisers. "This very active solution then rapidly attacks the hydrocarbons to produce carbon dioxide, water and chloride ions (when chlorinated hydrocarbons are present)" (ENSR, 1992, p37). Ultraviolet oxidation is only effective on clear aqueous streams but it is capable of destroying some chlorinated hydrocarbons. Pre-treatment may be needed in order to remove suspended solids, colloidal or other material which may plate the ultraviolet lamps but a benefit of the system is that it does not produce any secondary waste streams. Other forms of chemical treatment include those listed in Box 5.4.

BOX 5.4
TYPES OF CHEMICAL TREATMENT

Reduction - the addition of chemical reducing agents, such as aluminium, sodium and zinc metals, alkaline polyethylene and glycol, which are then oxidised.

Chemical dechlorination - uses reduction reagents to cleave chlorine atoms from hazardous chlorinated molecules to leave less hazardous compounds, the process can be applied to liquid wastes, sludges and soils.

Extraction - includes techniques such as the use of organic solvents, supercritical extraction and metal extraction with acids.

Supercritical Fluid Extraction - a form of solvent extraction which uses highly compressed gases as the solvent, this requires the temperature and pressure of the solvent to be maintained close to its critical point so that the gas is in its liquid phase and able to dissolve the contaminant.

Electrochemical - has been used for the destruction of PCBs in contaminated fluids and involves mixing the contaminated liquid with a conducting solution in an electrochemical operating at low temperature and low voltage, in the presence of a reagent.

Neutralisation - refers to the adjustment of soil or groundwater pH to an acceptable level (usually in the range pH 6 to 9) using dilute or weak acids or bases (Armishaw *et al*, 1992).

Precipitation - used to render contaminants insoluble and thus facilitate their removal from liquids, such as groundwater, by physical processes, for example flocculation, sedimentation or filtration.

5.4.3 Physical systems

"Physical processes do not destroy contaminants and can therefore be considered as first-stage treatment techniques in a multi-stage process; the final step being the destruction or stabilisation of the contaminant" (Armishaw *et al,* 1992, p45). The objective of physical processing is to separate or isolate the contaminants from the uncontaminated host material, or to concentrate the contaminants, thereby reducing their bulk.

Perhaps the best known physical process is soil washing, which "provides one of the few rapid, relatively cheap, contaminated soil treatment systems. .... The principle of a soil washing system is to:

- separate from the soil those particles containing the contaminants and so produce a concentrate, or
- transfer the contamination into an aqueous medium that can subsequently be treated using a sorbent or by precipitation."

(Pearl and Wood, 1994, p1)

Much of the equipment used for soil washing originated in the minerals processing and metals extraction industries, is therefore widely available and has been well tested, albeit for other purposes. "Soils washing, therefore, does not fall into the category of developing or unproven technologies" (Boyle, 1993, p157). Whether or not soils washing will be suitable to treat a particular contaminated soil will depend upon the extent to which it can reduce the bulk of the contaminated residues, leaving a smaller volume of material, with a more concentrated level of contamination, for further treatment or disposal.

"As a generalization, if soils washing is to prove cost effective on a given site, it should be possible to recover 70-90% of the mass of the feed material as cleaned, leaving 10-30% as contaminated residue" (Boyle, 1993, p158). The cleaned material can then be disposed of as uncontaminated, or can be returned to the development site for re-use. As a general rule, coarse, sandy, soils or fill materials with a high proportion of gravel, ash or clinker are best suited to soils washing, as the contaminants tend to adhere to the finer particles of the soil. Therefore the process of washing the finer particles out of the coarser medium should result in maximisation of the recovery of cleaned material. "If the recovery of cleaned product drops much below 70%, it is unlikely that the application of soils washing will be justified" (Boyle, 1993, p158). Other physical processes include those listed in Box 5.5.

BOX 5.5
PHYSICAL TREATMENT METHODS

Ex-situ Steam Stripping - the compounds are evaporated by the steam and the vapours produced are treated by a number of downstream processes which separate the volatile contaminants from water, such as, steam condensation, water-immiscible oil separation and activated carbon adsorption.

Soil Vapour Extraction or Air Venting Techniques - may be used for the *in situ* treatment of volatile or semi-volatile organic compounds (VOCs or SVCs). A series of pipes or wells is sunk into the contaminated ground. These are either connected to vacuum pumps, in which case the negative pressure gradients induce sub-surface air flows which volatise the contaminants, or hot air and steam are injected into the ground so as to volatise not only the VOCs but also many SVCs.

Electroremediation can be applied to the clean-up of soils with a relatively high moisture content, a direct current (DC) is passed through an array of electrodes embedded in the soil and this induces contaminant flow in the pore water to the electrodes by a number of processes;
(a) electrolysis, (b) electro-osmosis, and (c) electrophoresis.

5.4.4 Solidification systems

In the context of waste management "the term 'solidification' means the conversion of a liquid or a sludge into a solid with good physical characteristics (such as high compressive strength, low permeability etc.) so that the physical handling involved in disposal is made easy. However, solidification does not guarantee stabilization of the hazardous waste". (Soundararajan, 1992, p160) In order to effect treatment through the use of solidification it may be necessary to either accept that the material will still retain its hazardous properties, or to undertake some form of treatment or stabilisation as part of the solidification process.

According to Soundararajan (1992, p161) the entire phenomenon of organic stabilization may be explained in the following two phases:

Phase 1: a binder is used with an organic compound or compounds in its matrix. The compound(s) would have a similar polarity to the contaminant, so that the organic waste is selectively dissolved in itself. Since the organic compound is part of the binder this may be called the stationary phase.

Phase 2: once the organic molecule has been retained in the stationary phase several chemical reactions, producing different kinds of chemical bonds, can be created between the binder and the waste molecule. A strong interaction between the binder and the waste molecule, reduces the availability of the contaminant to the environment by leach processes.

Solidification systems are generally classified according to the binder system as either inorganic or organic (Armishaw *et al*, 1992, p198) and the most important of each includes the following techniques:

- Inorganic - cement based, pozzolan[2] based, lime based, liquid silicate and vitrification
- Organic - thermoplastic microencapsulation, thermosetting and macroencapsulation.

The most commonly used binder systems are those which are cement based, often with cement being used in conjunction with pulverised fly ash (PFA) and sodium silicate solution. According to Armishaw *et al* (1992) lime based systems must always be used in conjunction with a pozzolan material and most contaminated soils could be expected to contain a significant proportion of pozzolan.

Vitrification involves heating the contaminated soil to temperatures exceeding 1,000°C, at which point the inorganic toxic components are incorporated into a hard glass or ceramic-like substance, with any organic pollutants being incinerated. An effective emission control system is required to remove volatile toxic metals and any organic products formed during the process. At the time of

[2] A substance that contains silicates or aluminosilicates that can react with lime and water to form stable, insoluble, compounds which possess cementing properties.

the Armishaw report (1992) both *in-situ* and *ex-situ* vitrification systems were being investigated. The same report also stated that "organic binder systems have not been used for the remediation of contaminated soil as the process is very expensive, although a bench-scale test has been described" (Armishaw *et al*, 1992, p199).

5.4.5 Thermal systems

There are two principal ways of using heat treatment to remove contaminants:

(i) removal of the contaminant by evaporation - either by direct heat transfer (convection or radiation) from heated air (or other gases), or an open flame, or by direct heat transfer, and

(ii) destruction of the contaminants by direct or indirect heating of the soil to an appropriate temperature. (Smith, 1987, p130)

Thermal treatment methods are based upon the fact that all organic and inorganic contaminants have a definite vapour point (Bohm, 1992, p199). At this point the compound transfers from the solid to the gaseous state and, depending upon the energy input, chemical reactions take place. Oxidation will occur if oxygen is present but if it is not then vaporisation of the compounds will result. The residual compounds can be collected and either condensed out or incinerated.

Most thermal systems are applicable to as wide a range of soil types as their associated handling systems will permit (Armishaw *et al*, 1992, p167) and every installation for the thermal treatment of soil basically contains three process stages (Bohm, 1992, p199), as follows:

preliminary treatment - to sort the soil so as to remove unsuitable material, such as metal parts, following which the soil is pulverised and any unsuitable soil portions removed;

thermal treatment - when the soil is dried, the contaminants driven off and partially destroyed, following which the soil is cooled, with care being taken to recover heat for recycling;

exhaust air treatment and cleaning - which guarantees that the pollutants are fully destroyed or removed and that emission control regulations are complied with.

5.5 EXTENSIVE TREATMENTS

For the most part the treatment methods described in the previous section are intended to remediate the contaminated land in a relatively short period of time, so as to prepare the land for redevelopment, to prevent harm to potential targets or to mitigate harm which is actually occurring. Some of the treatments are still at the experimental stage, whilst others may involve such high levels of cost as to render them commercially unacceptable. This is especially the case when immediate redevelopment is not contemplated, only a restricted type of development is to be permitted, or when the 'do-nothing' option has been selected. In such circumstances it may be appropriate to select a long term or extensive form of treatment, in order to ameliorate the contaminative state of the site over a period of several years.

Bardos and van Veen (1995) identified the opportunities for extensive technologies as including:

- the polishing of partially remediated sites under development though still subject to restrictions on use, to ensure continued remediation of the site during the lifetime of the development and hence increase its value by the end of the lifetime of the proposed development;

- remediation of active industrial sites over the remainder of their operating lifetime so that they are remediated by the time disposal of the site is envisaged;
- remediation of sites which have been dealt with by isolation, monitoring and containment, so that the site is remediated within the design lifetime of the containment measures;
- treatment of sites that are too large to be cleaned economically using "intensive" technologies; managing downstream contamination from persistent and inaccessible sources;
- treatment of excavated material removed from sites.

(Bardos and van Veen, 1995, p1)

Research is being undertaken into the use of hyperaccumulator plants, active as opposed to passive containment barriers, the stimulation of natural on-site processes of attenuation and decay, and the promotion of biological activity through the use of plant roots. Extensive methods under consideration for use include composting or digestion for soil and waste co-treatment, *in-situ* precipitation of metal sulphides under anaerobic conditions and *in-situ* treatments contained in emplacements across aquifers or other drainage pathways. Technologies with the potential for use in extensive treatments include bioventing and various containment methods coupled with *in-situ* treatments.

Risk management is a key issue in the selection of an extensive treatment approach (Bardos and van Veen, 1995, p3) and the fact that the lifetime of the contaminant will be extended must be taken into account in the risk assessment exercise. It may therefore be necessary to contain the contaminated soil within a secure area, which may for example require its excavation and re-deposition within a bunded area formed with an impervious material such as clay or a geomembrane. A treatment technology which is gradual and exploits the natural processes occurring within the ground can then be employed to break down the contaminants. Monitoring of the containment area will be required, in order to ensure its security and to assess the effectiveness of the process.

Although extensive treatments are not relevant in situations where immediate, or short term, redevelopment is desired, there may be a place for them within the development process, especially when sufficient land is available within the overall site for a containment area to be established. For example if it is intended that only part of a site will be redeveloped, with the remainder being allocated to public open space, it may be appropriate to remove contaminated soil from within the development site and establish a secure containment in the public open space area. Whether or not it will be able to put the open space area to its intended use within the short to medium term will depend upon the nature of the contaminants and the type of treatment selected, but deferring the availability of the public open space may be preferable to disposing of the contaminated soil into landfill.

5.6 COST AND EFFECTIVENESS OF TREATMENTS

The cost and effectiveness of available treatment options will have a direct impact on most, if not all, of the nine categories of factors which influence the choice of remedial strategy and design, listed in section 5.1. Certainly effectiveness of the treatment will be important when considering the legal implications, as the authorities responsible for ensuring compliance with the legislation will need to be convinced that satisfactory standards of remediation are achieved. Cost would, at first sight, seem to be less important from the legal viewpoint, however the general principle laid down in the Environmental Protection Act 1990 is one of Best Available Techniques Not Entailing Excessive Cost (BATNEEC), therefore it would seem that cost is a relevant issue when considering treatment options. Similarly cost and effectiveness are important issues in the political context, as government and even international policies may rule out certain types of treatment.

Cost is perhaps the most important commercial issue but the effectiveness of the treatment should be of equal concern to the intending developer, because unless the effectiveness of the selected option can be satisfactorily proven the likelihood is that it will be unacceptable to future users of the site and funding institutions. Geographic conditions may rule out certain types of treatment, even though they might be well proven and cost effective, especially in situations where excessive noise, dust and transport movements might cause annoyance to nearby residents. Environmental considerations may similarly mitigate against certain types of treatment if there are risks of air, water or noise pollution.

Some treatment options may be unsuited to the site ground conditions, or to the type of future development proposed, and the potential adverse health effects and associated handling problems of the contaminants may exclude other forms of treatment. Finally, managerial and technical capabilities may remove other alternatives, regardless of their effectiveness or cost benefits, thereby reducing even further the number of treatment options remaining available for consideration.

The types of contaminants amenable to treatment by the various methods described in this chapter, and the most suitable soils for treatment are set out in

Box 5.6 and the chapter concludes with a discussion as to the effectiveness and applicability for use in the United Kingdom, of the different methods.

BOX 5.6

SUITABILITY OF TREATMENT METHODS ACCORDING TO MEDIA AND CONTAMINANT TYPES

Treatment method	Media types	Contaminant types
Excavate and dispose of to Landfill	All soil types	Most contaminants, with the exception of PCBs and perhaps cyanides. Care should be taken to prevent exceeding loading rates, especially for cyanides, phenolics, heavy metals, arsenic, mercury, selenium and antimony.
Clean cover and Containment	All soil types, but liners and/or barriers required in permeable soils and rock.	Most contaminants but subject to the same qualifications as for landfill. Some liners may also be prone to acid attack from contaminants and systems will need to be installed for the collection and disposal of leachate.
Bioremediation	Most soil types but a high content of natural organic material may assist the process.	Spent halogenated and non-halogenated solvents, compounds from the manufacture of chlorinated aliphatic hydrocarbons, wastes from the use and manufacture of phenols, and benzenes, wastes from metal plating and cleaning industries, petro-chemical products and wastes.
Oxidation	Liquids only	Volatile Organic Compounds, organic pesticides, heavy metals, metalloids and cyanides.
Ultra-violet oxidation	Liquids only	Organic compounds.
Chemical reduction	Liquids and slurried soils	Organics including paraquat and PCBs, metals including chromium, selenium, lead, silver,
Chemical dechlorination	Liquids, sand, silt, clay, in sludges and soils.	Volatile halogenated hydrocarbons, PCBs, and organochlorine pesticides
Chemical extraction	Liquids, sand, silt, clay	Organic and metal contaminants.
Supercritical fluid extraction	Sand, silt, clay, in soils and sludges	Polynuclear Aromatic Hydrocarbons, PCBs, DDT and VOCs.
Electrochemical	Liquids only	PCBs and metals.
Neutralisation	Liquids, sand, silt, clay	Organic, inorganic and metallic contaminants.
Precipitation	Liquids, sand, silt, clay	Organic, inorganic and metallic contaminants.
Soils washing	Most soil types but more successful on coarse, sandy, soils.	Heavy metals, PAHs, PCBs, cyanides, non-ferrous metals.
Steam stripping	All soils but best suited to water unsaturated soils.	VOCs and some SVCs, volatile inorganics including hydrogen sulphide and ammonia.
Soil Vapour Extraction / air venting	Sand, silt and peat, best suited to water unsaturated soils.	VOCs and SVCs, hydrocarbon mixtures including petrol, jet fuel, diesel, kerosene and heavy napthas.
Electro-remediation	Clays, peat and fine sand, can be used for soils with a relatively high water content.	Heavy metals, including arsenic, cadmium, cobalt, chromium, mercury, manganese, molybdenum, nickel, lead, antimony and zinc.
Solidification	Silt and clay, some methods may be effective on other soil types.	Organic and inorganic contaminants.
Thermal	Sand, silt, peat, clays present handling problems.	Organic and inorganic compounds.

Sources: Armishaw *et al*, 1992, ENSR, 1992, Pearl and Wood, 1994

The costs associated with the excavation of contaminated material and its disposal to landfill in 1991, were in excess of £30/m^3 for tipping costs alone and current charges for tipping controlled wastes in, for example, north west England, are between £40/m^3 and £50/m^3 (approximately $1^1/_2$ to 2 tonnes per m^3) with significantly higher sums being charged for some 'special wastes'[3]. "Total waste arisings in the UK are currently estimated to be about 402 m. tonnes a year of which about 140 m. tonnes is controlled waste from domestic, industrial and commercial sources" (Murley, 1995, p206). Of the total amount of controlled waste, approximately 86 per cent (120.4 m. tonnes) is disposed of to landfill.

Excavation and transport costs have to be added to the tipping charges, together with the costs associated with importing clean fill material, when this is required to replace the contaminated soil, and consolidation works needed to prepare the site for redevelopment. The total cost of site reclamation, by excavation and disposal, can therefore amount to between £60/m^3 and £80/m^3 or, looked at another way, assuming that the depth of contamination is no more than one metre £600,000 to £800,000 per hectare (£242,800 to £323,750 per acre).

Significant regional variations may be experienced in respect of this option, according to the availability, or otherwise, of suitable landfill sites. The cost of this option will also be greatly influenced by the distance between the site to be treated and the point of disposal, as this will determine the cost of transport.

3 Costs based on information from landfill operators in November 1995. A detailed definition of special waste is given in Section 62 of the Environmental Protection Act 1990.

The cost of a clean cover and containment solution will be subject to the influence of a number of factors, such as the extent to which barriers have to be constructed to the sides and underneath the containment area, and the availability of suitable material for cover, either on or in close vicinity of the site. The

possible loss of developable site area has to be taken into account with this option and it would seem reasonable to assume that, at least for the time being, clean cover and containment will only be used in situations where it is more cost effective than disposal to landfill.

The effectiveness of bioremediation will depend upon the biodegradability of the contaminants, as well as the ability to stimulate and maintain microbial activity. The persistence of organic compounds "in contaminated sites is an indication that conditions on that site do not support microbial activity" (Armishaw *et al*, 1992, p144) and the inoculation of the site with bacteria will need careful research so as to ensure that the contaminants are fully degraded. ENSR (1992, p29) quoted typical costs for landfarming of $70-$120 per cubic yard[4] for sites with over approximately 1,500 cubic yards, the costs being dependent upon the volume to be treated, the contaminant loading and the type of containment required. The cost of this method would therefore appear similar to the landfill and containment options, but an extended treatment period may be required.

The cost of chemical treatments would appear to be highly variable, depending upon the nature of the contaminants and the treatment method to be employed.

4 £54.00-£92.60 per square metre, based on an exchange rate of $1-55 to £1.

For example, Armishaw *et al* (1992, p99) quoted process costs for the Ultrox (ultra-violet oxidation) process of between \$0.06 per m^3, for slightly contaminated groundwater, to \$9 per m^3, for highly contaminated industrial wastewaters; whereas the 1990 treatment costs for the KPEG (chemical dechlorination) process were estimated to range from \$270 to \$700 per tonne of soil, depending upon facility size (Armishaw et al, 1992, p104).

The United States Environmental Protection Agency has supported a number of Demonstration Projects, intended to assess the suitability of proprietary treatment processes, some of which have been completed whilst others are ongoing. The current state of these programs was summarised in a report *Superfund Innovative Technology Evaluation Program: Technology Profiles, Seventh Edition* (USEPA, 1994). One of the completed chemical process projects was CF Systems Corporation's 'Liquified Gas Solvent Extraction [LG-SX] Technology', which was found to be 90-98 per cent efficient in the removal of PCBs from sediments at a cost of \$150 to \$450 per ton [£106 to £319 per tonne] (USEPA, 1994, pp.48-49).

Boyle (1993) cited two examples where soils washing had been used to reduce the volumes of contaminated materials. In the first case, the cost of treating 300,000 m^3 of contaminated soil was put at £11m^3 and in the second case the cost of treating 32,500m^3 was estimated at £14-50 per cubic metre. In both cases the treatment costs excluded on-site handling and the disposal of the contaminated residues. Boyle calculated that, in respect of the first example, unless the site could be treated by disposal to landfill or some other method for less than £15 per cubic metre "then soils washing will reduce overall costs. Once disposal or other treatment costs rise to £25/m^3, the savings are considerable" [approximately 29% in respect of the quoted example] (Boyle, 1993, pp161-162). The 'break-even' figure in respect of the second example, comparing soils washing with disposal was between £10 and £13 per cubic metre.

The cost of *ex situ* treating 30,000 cubic yards (22,937 cubic metres) of waste material highly contaminated with hexavalent chromium, by stabilization and solidification, was found to be $73 per ton (£51-80 per tonne), including mobilization, labor, reagents and demobilization, but not disposal (USEPA, 1994, pp22-23). By comparison, the destruction of PCBs using thermal desorption was estimated at $400 to $2,000 per ton (£283-87 to £1,419-35 per tonne (USEPA, 1994, pp.62-63)).

The technologies available for the treatment of contaminated soil, and their associated costs, are changing on a daily basis. At the present time the United States Environmental Protection Agency is monitoring and assessing some 235 treatment methods[5] at various stages of development. So far as the United Kingdom is concerned, it would seem that methods such as soils washing and bioremediation offer viable alternatives to landfill and containment options. Chemical and stabilisation/solidification methods may still be some way from acceptability, in terms of both cost and technological advancement, to receive wide scale acceptance as part of the redevelopment process. Thermal processing

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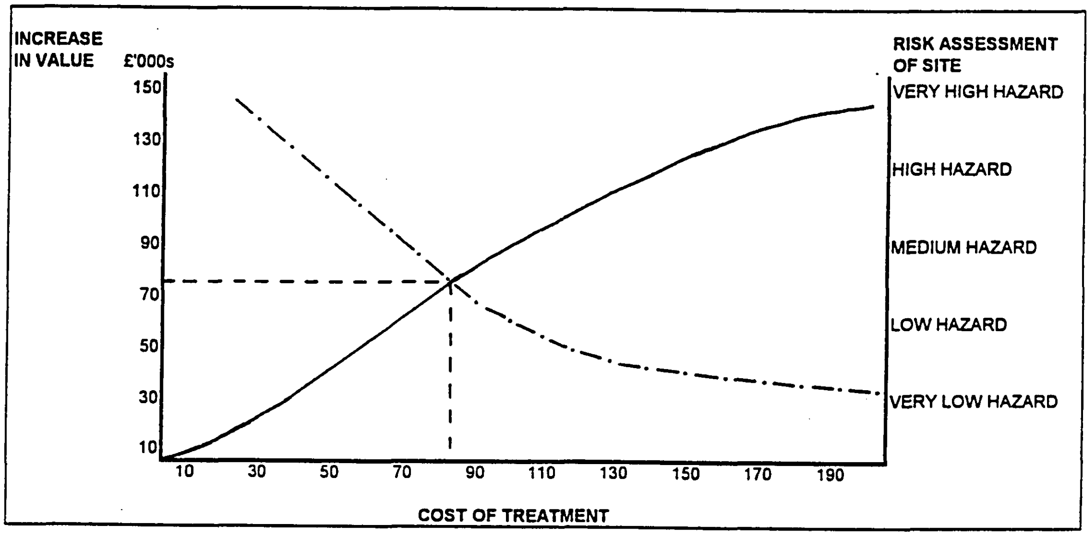
5 Based on information from a USEPA Workshop at the 5th International Conference on Contaminated Soils, held in Maastricht, Belgium, November 1995.

costs would seem to be unacceptably high, except for very small volumes of highly toxic material, and public fears about emissions from mobile plants may well rule out the use of these methods for on-site clean-up purposes.

The selection of an appropriate methodology for the treatment of a contaminated site will depend upon both the cost and effectiveness of the treatment methods under consideration. Also of importance will be the impact of the remediation work on the post-treatment value of the site. Inappropriate site treatment, regardless of cost, may not produce any improvement in site value. Similarly, the environmental optimum may be so expensive as to significantly exceed any resultant improvement in value. In both of these situations there is no incentive for a developer to acquire and redevelop a contaminated site. It would also seem to be of little benefit to require a landowner to 'clean-up' a contaminated site, regardless of legal requirements, if the cost is so onerous as to cause the financial collapse of that firm or individual.

Therefore both economic (value) and environmental considerations need to be taken into consideration in the selection of a treatment methodology, as part of the overall process of redeveloping a contaminated site. It is suggested that the decision making process be performed in accordance with Figure 5.1:

FIGURE 5.1
The relationship between value, treatment cost and environmental improvement in the selection of soil treatment methods



In the example in Figure 5.1, the Cost of Treatment is shown as being the same as the Increase in Site Value but the change in site risk assessment only shows an improvement from Very High Hazard to Medium Hazard. This degree of improvement may well be acceptable if the site is to continue in some form of industrial use and the residual contamination is securely contained within the site. If, on the other hand, it is required that the risk associated with the site be further reduced to Low Hazard or even Very Low Hazard, then the increased cost involved will not produce a corresponding increase in value. It is argued that situations such as this will frequently occur in practice, leading to demands for planning consents for higher values uses, or for the input of public sector funds in order to assist the process of site remediation and redevelopment.

CHAPTER SIX

THE VALUATION OF CONTAMINATED LAND[1]

6.1 INTRODUCTION

In Chapter One it was suggested that the "theory of value as applied to contaminated land" may be defined in terms of the value attributable to the highest and best use of the property or "the price which would be paid by a willing buyer to a willing seller, in an open market subject to town planning controls, after deduction of the lowest cost attributable to overcoming the damage to the land". The impact of environmental issues on asset values has been considered by Hillier Parker (1993) and this chapter now seeks to identify the way, or ways, in which that value might be determined.

6.2 PROFESSIONAL GUIDANCE

Simm (1992) stated his hypothesis that "the capital comparison based approach to valuation of contaminated land is no longer tenable and is, in fact, dangerous". In his opinion, the only way in which valuers can effectively approach the problem, whether in terms of valuing existing portfolios or appraising land for development, is to adopt residual valuation techniques. Laing (1992) suggested that "the market perception of contaminated land ...... will in reality vary considerably depending on location, strength of the market and the type of development to be carried out". He too advocated a residual approach to the valuation of contaminated land and proposed that contamination be looked at in relation to four key variables:

[1] Parts of this chapter have been published in Syms 1995 and 1996b.

time - a disposal may be delayed as a result of the need to deal with contamination, resulting in increased interest charges;
cost - the direct costs associated with overcoming the problems of contamination;
value - the value of the property may diminish because of the previous contamination;
risk - the existence of contamination may mean that potential purchasers of land will no longer be interested and that the land is therefore likely to be sold to a more restricted market. (Based on Laing, 1992)

Both Simm (1992) and Laing (1992) acknowledged the possibility that the existence of contamination may result in negative property values. Where the properties in question comprised part of the assets of a company, Information Paper 5 (IP5) of the "Red Book" (RICS, 1990) stipulated that negative values must be reported separately in the valuation certificate and not set off against positive values on other properties and the instruction is retained in Practice Statements PS 3.4 and 7.4.12 of the RICS Appraisal and Valuation Manual. This at least means that, in looking at company assets, the problems will now be recorded (Simm, 1992). It is also "inappropriate to place a nil value on such land because it will not reflect the true position" (Laing, 1992). Quite clearly, a requirement to identify potential liabilities, in the form of negative values, brings with it a need to formulate a method by which properties suffering from contamination may be valued.

In October 1993 the Royal Institution of Chartered Surveyors published Valuation Guidance Note 11 (VGN 11), as an addition to its Manual of Valuation (the "White Book") (RICS, 1993). The publication of the guidance note, entitled "Environmental factors, contamination and valuation", essentially adopted the recommendations of The International Assets Valuation Standards Committee which had published its draft guidance note "The effect of environmental factors or pollution on the valuation of fixed assets for financial statements" in September 1990 (TIAVSC, 1990a).

This guidance note and its associated background paper "The Consideration of Environmental Factors and Pollution in the Valuation Process" (TIAVSC, 1990b), attempted to set out the procedures to be followed by valuers when confronted by the existence of contamination on properties being valued for company accounts purposes and provided a brief description of the ways in which contamination and/or pollution might occur. A background paper published by The European Group of Valuers of Fixed Assets "Valuation of Land Subject to Soil Pollution" and its accompanying technical note on the restoration of contaminated land (TEGOVOFA,1988) also provided useful guidance but prior to the publication of VGN 11 none of the recommendations made by the European and International Asset Valuation bodies had been adopted for use in connection with valuations undertaken in the United Kingdom.

Valuation Guidance Note 11 provided a brief history of the legislation applicable to contaminated land and stated that the importance of contamination to surveyors, and valuers in particular, depends upon:

(a) the state of knowledge at any time of the existence and effect of the particular form of contamination;
(b) the current interpretation of the law;
(c) the effect of possible changes in legislation;
(d) current technology and expected changes in technology;
(e) the previous uses of the subject land/buildings and property nearby;
(f) the existing uses of the subject land/buildings and property nearby;
(g) the proposed use of the subject land/buildings and property nearby; and
(h) the financial effect of the above. (RICS, 1993)

Valuation Guidance Note 11 has now been replaced by Guidance Note 2 (RICS, 1995c) in the RICS Appraisal and Valuation Manual (RICS, 1995d) but the above list of factors affecting the valuation of contaminated land remains unchanged. To take account of all the factors described above would undoubtedly involve valuers in considerably more detailed research than they would normally have undertaken in preparing reports and valuations. This is especially the case where valuers have to take into consideration the previous, existing and proposed uses of both the subject property and nearby properties. It would also appear to involve them in areas of knowledge not usually included in the training of surveyors and valuers.

Guidance Note 2 (GN2) (RICS, 1995c) is only a 'stop-gap' measure, reflecting the legislative changes arising out of the Environment Act 1995. The Guidance Note was to be revised during 1996 so as to take account of Parliamentary Guidance issued under the Act but, as detailed in Chapter Three, the delays associated with the introduction of regulations mean that this revision may be deferred until 1997.

When receiving an invitation to carry out a valuation on a property which may suffer from some form of environmental impairment, valuers first of all must decide whether they wish to accept or decline the instruction. Before indicating acceptance to the client, the valuer must determine whether the type of property, disregarding the impairment, is within his or her sphere of competence. If the type of property, and the locality in which it is situated, is such that the valuer feels competent to undertake the instruction, then as much information as possible should be obtained from the client or other sources. With this in mind, the following list of 16 questions has been prepared, to assist the valuer in determining whether or not contamination may be present.

BOX 6.1

QUESTIONS WHICH NEED TO BE ANSWERED

1. What is the present, or last known use of the property?
2. Is there documentary evidence of the past uses and development of the site?
3. Are the present or past uses likely to be potentially contaminative in nature?
4. What is the land use history in the immediate vicinity? Say within one kilometre.
5. What is the geographical and geological setting of the site?
6. Are there any known, or suspected, mineshafts or landfill sites in the vicinity?
7. Has there been asbestos product manufacture or iron and steel smelting in the area?
8. Is there a waterway near the property?
9. Is the site underlain by a producing aquifer?
10. Has any fly tipping taken place?
11. Has there ever been a programme of asbestos removal from the property?
12. Does documentary evidence exist of any tanks or pipeworks having been emptied or flushed?
13. Has there been any on-site disposal of manufacturing wastes or other residues and, if so, is adequate documentation available?
14. Do plans of the buildings or works exist and are they complete?
15. Has the present, or previous, occupier complied with all statutory regulations relating to the nature of the business and, if so, is there documentary evidence of such compliance?
16. Has a decommissioning audit been carried out and/or has any past contamination been dealt with?

Source: based on Syms, 1992

In addition to the questions set out in Box 6.1, there will undoubtedly be other questions, of a site specific nature, which need to be answered. Assuming that adequate answers are received, the valuer should be in a position to decide whether or not it is possible to prepare a valuation on the basis of the information available. If adequate answers are not received, or if they reveal inconsistencies, or simply lead to the conclusion that insufficient records have been maintained, then it may be appropriate to advise the client to commission a comprehensive site investigation, in accordance with the procedures set out in the British Standards Institution's *Draft for Development Code of Practice for the Identification of Potentially Contaminated Land and its Investigation* (BSI:DD175, 1988), with a view to the preparation of a full Land Quality Statement.

On the other hand if the information obtained, albeit confirming that contamination exists, is sufficient to proceed with a valuation in accordance with GN 2 (VGN 11), the valuer then needs to decide how the valuation should be produced. Paragraph GN 2.9.2 (revised from paragraph 7.4 of VGN 11) details eight heads of costs, net of grants or other financial incentives:-

(a) clean-up of on-site contamination and associated requirements, liability therefor and the ability to pay of the person liable;
(b) effective contamination control and management measures;
(c) re-design of production facilities;
(d) penalties and civil liabilities for non-compliance;
(e) indemnity insurance for the future;
(f) compliance with legal obligations relating to migration of the contamination to adjacent sites and its future prevention;
(g) the control of migration from other sites; and
(h) the regular monitoring of the site. (RICS, 1995c)

In spite of having clearly identified the heads of costs to be taken into account, neither Guidance Note 2, nor its predecessor VGN 11, provided the valuer with any guidance as to how the information should be treated in preparing the valuation. The valuation method described in the following section is suggested as one way in which these heads of costs may be taken into account in the valuation.

6.3 VALUATION METHODS

Application of the guidance in Valuation Guidance Note 2 will differ according to the nature of the property and the purpose for which the valuation is required. If the property is to be valued on the basis of immediate redevelopment, then account should be taken of all of the costs (set out in paragraph GN 2.9.2) but, if redevelopment is not expected within the foreseeable future, it may be appropriate to defer at least some of the costs.

A number of alternative valuation methods have been considered for use, both in the United Kingdom and the United States, these include the sales comparison approach (Patchin 1994), the cost approach (Wilson, 1994) and the cash flow approach (Wilson, 1996). Richards, T. (1995) has considered the yield adjustment approach and the discounted cash flow approach, in respect of investment properties affected by contamination. The focus of the present research is not, however, on investment properties but on those types of property which more usually form part of the assets of manufacturing companies and infrequently change hands in the open market, except as part of the assets of a business. This includes those properties used for the purposes identified in RICS Guidance Note GN2 as having the greatest potential to cause contamination (RICS, 1995d). Such properties are rarely found in investment portfolios and, in consequence, it may not be possible to determine appropriate rents and yields for use in an investment type valuation approach.

The valuation method adopted for this research is therefore a traditional approach, essentially a residual valuation, based on the sales comparison approach described by Peter Patchin, (1994). Figure 6.1 sets out a suggested method by which property assets may be valued when the existing use is expected to continue for the foreseeable future. The first step in using the method is to prepare a valuation which assumes that the site is uncontaminated. A number of different methods may be used for this purpose, including comparison of site values, cash flow or Depreciated Replacement cost, as may be appropriate to the type of property involved. This gives an unimpaired value for the property, as a base value from which the effects of contamination can be deducted, as the second step in the valuation.

FIGURE 6.1
ASSET VALUATION OF CONTAMINATED PROPERTY

UNIMPAIRED VALUE (calculated by appropriate method, such as open market value or depreciated replacement cost, disregarding the existence of any contamination)			£1,500,000
REMEDIATION COSTS in accordance with GN 2.9.2 (applicable if the site is to be redeveloped at the date of valuation)			
(a)	clean-up of on-site contamination;	£350,000	
(b)	effective contamination control and management measures;	£ 75,000	
(c)	re-design of production facilities;	N/A	
(d)	penalties and civil liabilities for non-compliance;	N/A	
(e)	indemnity insurance for the future;	£ 10,000	
(f)	the avoidance of migration of the contamination to adjacent sites;	£100,000	
(g)	the control of migration from other sites; and	£ 15,000	
(h)	the regular monitoring of the site.	£ 10,000	
Estimated total cost of treatment		£560,000	
Anticipated ECONOMIC LIFE of buildings - 20 years			
Present Value of £1 for 20 years @ 7.5%		0.235413	
PRESENT VALUE OF TREATMENT COSTS			£ 131,830
ADJUSTED VALUE (excluding allowance for stigma)			£1,368,170
Percentage reduction in value attributable to anticipated future remediation			8.79%

Source: Syms, 1995a

It will be noted from the example that no costs have been included for items (c) and (d) process re-design and penalties/civil liabilities. This is because these should be regarded as immediate costs, not capable of deferment to the end of the economic life of the buildings. There may also be a case, depending upon site specific circumstances, for treating all or part of item (b) contamination control and management measures, in the same way. All such non-deferrable costs should be treated as current liabilities in the valuation and specifically reported upon. The valuer may also consider it appropriate to consult with the company's auditor, so as to determine which, if any, of the liabilities should be treated as general liabilities of the business, rather than related to the specific property.

In the example set out in Figure 6.1 most of the remediation cost has been deferred to the end of the economic life of the buildings on the site, on the assumption that, at that time, the buildings will be demolished in order to facilitate 'clean-up' of the site. In practice it may be appropriate to undertake the site remediation in phases, whilst the manufacturing activities remain in operation. The valuation method would remain the same, except that the cost deferment, using the present value of £1, would be replaced by a discounted cash flow related to the expenditure programme, in order to arrive at the Present Value of the treatment costs.

Consideration was given to the need, or otherwise, to reflect inflation in the valuation method. Whilst it is possible that soil treatment costs may rise during the remaining life of the buildings, it was considered that any increase in costs should be countered by an inflation related increase in the value of the reclaimed development site. It is also possible that, as new treatment methods are developed, the cost of remediation may fall and, on balance, it was considered that the impact of inflation was likely to have little, if any, material effect.

The same valuation method may be applied to the valuation of leasehold interests, with the proviso that the period of deferment in respect of remedial works will be limited by the duration of the lease and not the economic life of the buildings. It may also be appropriate, when using this method to value leasehold interests, to make allowance for the landlord's costs and loss of income during the treatment period.

The principal problem in adopting an approach such as that described above, where detailed costs are not available, is in producing reasonable estimates of the costs involved. There is an obvious concern that any figures which are used may be wildly inaccurate but the situation is not so very different from reflecting the likely cost of dilapidations when preparing a valuation of a building. In both cases the valuer will almost certainly need to consult with other professionals, such as engineers and quantity surveyors, and both valuations inevitably require a degree of subjective judgement on the part of the valuer. Two different aspects of dealing with land contamination are i) that much of the liability may be hidden from sight and ii) the lack of information in respect of site remediation costs. These will require reasoned assumptions to be made and demonstrate the need for a readily available source of costs information.

6.4 THE STIGMA EFFECT

It is suggested that adoption of the procedures and valuation method described above are sufficient to enable valuations to reflect adequately the quantifiable costs of tackling contamination and to provide meaningful advice. There is, however, an unquantifiable aspect to land contamination; that is 'stigma', referred to in paragraph GN 2.9.7 of Guidance Note 2 (paragraph 7.6 of VGN 11). The existence of stigma has been considered by a number of researchers, most notably Patchin (1988, 1991a, 1991b, 1994) and Mundy (1992a, b and c). Patchin used the term 'stigma' to represent a variety of intangible factors from possible public liability and fear of additional health hazards to the simple fear of the unknown (Patchin, 1991a). In the United Kingdom context, and for the purpose of this thesis, stigma is defined as:

> ***"That part of any diminution in value attributable to the existence of land contamination, whether treated or not, which exceeds the costs attributable to a) the remediation of the subject property, b) the prevention of future contamination, c) any known penalties or civil liabilities, d) insurance and e) future monitoring.*** (Syms, 1995a)

In other words, stigma includes all those matters likely to have an influence on value, other than those which are readily quantifiable or for which reasonable estimates can be produced. This is a different approach from the one which was contained in paragraph 7.6 of VGN 11, where stigma was limited as only one of seven influences which might affect market value. It was argued in Syms, 1995a that all of these influences should be regarded as 'unquantifiable' as, in practice, it would be impossible in most cases to distinguish between them; therefore the term 'stigma' should collectively describe all such costs, including the following:

(a) inability to effect a total 'cure';
(b) prejudice arising out of the past use (referred to as stigma in VGN 11);
(c) the risk of failure of treatment;
(d) compensation receivable or payable for disturbance or reduced enjoyment of the property or sites nearby;
(e) risk of legislation/remedial standards changing;
(f) a reduced range of alternative uses of the site;
(g) uncertainty.

This argument was accepted by the RICS and embodied in Guidance Note 2 (RICS, 1995c). The impact of stigma in redevelopment situations is considered in Chapter Eight through the use of case studies, in order to arrive at an 'observable stigma effect'.

The issue of property values possibly being adversely affected by contamination was first considered by Patchin in 1988, when he suggested that the costs involved in cleaning up toxic contamination, together with liability to the public and stigma, often eliminated or significantly reduced a property's value. Many industries had simply disposed of hazardous wastes on site, with "little, if any, concern for the fact that ecologic and economic time bombs were being created". (Patchin, 1988)

Awareness of the potential problem had only recently come to be recognised in the United States and Patchin attributed this to the enactment of the Comprehensive Environmental Response and Liability Act of 1980, otherwise known as 'superfund'. This legislation and other similar legislation passed by various state governments, was to significantly affect the use and valuation of properties which were in some way affected by contamination. He summarised the basic provisions of the legislation as:-

> 1. The party who placed the contamination in the ground must bear the costs of cleanup as directed by either the federal or state agency having jurisdiction.
>
> 2. If the parties originally responsible for the contamination are no longer financially solvent or no longer exist, the responsibility falls on successors in the chain of title; most likely the existing or present property owner.
>
> 3. Other parties associated with the title to a contaminated property may also be held responsible for the costs of cleanup. (Patchin, 1988)

Patchin referred to two court cases[2] where successors in title and "associated parties had been held responsible for the cost of dealing with contamination. The second of these concerned a bank which had foreclosed in respect of a property

[2] State of New York v. Shore Realty Corp., 759 F.2d 1032 (2d. Cir. 1985) and, United States v. Maryland Bank and Trust Co., 16 E.L.R. 20557 (D. Md. April 9, 1986)

loan amounting to $335,000 but was additionally liable to meet cleanup costs of $460,000 because the previous owners were insolvent or no longer in existence. This introduced the notion of 'deep pockets', whereby the most financially secure party in the chain of title, or associated with the ownership, may be held responsible for costs far in excess of any interest they may have in the property itself. This concept caused considerable concern in banking circles in the United States.

In the United Kingdom, similar concerns were expressed by banking organisations in respect of the registers of potentially contaminated land uses proposed under Section 143 of the EPA 1990, see for example the statements made by the British Bankers Association in September 1993 and April 1994 (British Bankers Association, 1993 and 1994). These concerns were subsequently recognised by the government in a policy statement:

> ... regulatory authorities should not be able to treat financial institutions as "deep pockets", being made liable for the costs of any remedial works regardless of any responsibility. (DoE, 1994b)

Patchin (1988) stated that "the tendency of most appraisers in valuing contaminated property is to approach the problem on the basis of discounting the value before contamination". Such a method was, he suggested, "difficult, if not impossible to support with market data". Instead, "market research will disclose that contaminated properties suffer from varying degrees of reduced marketability or total unmarketability". This was very much in keeping with the views expressed by many property groupings in the United Kingdom in response to the registers proposed under Section 143 of the EPA 1990. In

Patchin's opinion, based entirely upon United States property markets, the presence of contamination would have implications extending beyond the costs of simply remediating the land and could be expected to impact upon the yield rate, the mortgage terms available and the future anticipated appreciation or depreciation of the property concerned. In other words, the value of the property will be stigmatised as a result of the contamination, even if the contaminants themselves had been removed or otherwise treated.

Over the course of the next two years Patchin was repeatedly questioned and it was suggested that perhaps the "concept of stigma" was a figment of his imagination (Patchin, 1991a). In 1991, therefore, he revisited the issue of stigma and concluded that the market had become "significantly more aware of the issue of toxic contamination on real estate values". He also formed the opinion that, in attempting to determine the extent of stigma, extensive research would be necessary to disclose the relevant information, including previous uses of the site and contamination related price reductions. In this context, information relating to sales which did not go through could be more important than those sales that actually did occur.

One problem which Patchin identified was the expectation on the part of many appraisers "that there should be a rational or logical cause for any loss in value" and he went on to stress that appraisers "must recognise that there are many irrational factors in the marketplace" (Patchin, 1991a). No matter how well a site remediation programme has been undertaken and regardless of the quality of the supervision and reporting procedures, it must be accepted that there will always be those individuals or corporations, who will refuse to consider a former contaminated site for their own use or development. If a treatment option is selected which leaves some residual contamination in the ground, either safely contained or at a reduced level of toxicity, then the market for such a site is potentially reduced even further. The different impact which alternative treatment methods may have on value is discussed later in this chapter and in Chapters Eight and Nine. Such limiting factors as a reduction in the size of the potential market, also referred to by Laing (1992) as part of the "risk" variable, will have an impact on the sale price achievable for a particular property and hence upon its "open market value", the extent of such impact being determined by the number of remaining bidders and the degree to which they are prepared to disregard the past history of the property - the stigma effect.

Patchin (1991a) suggested that "it may be helpful to think of stigma as a negative intangible" and stated that it is likely to be caused by one or a combination of the following factors:

Fear of hidden cleanup costs, including the uncertainty of cost over-runs if the remediation work has not yet been undertaken, continuing market resistance after treatment and the possibility of further, unforeseen, contamination;
The trouble factor, the monetary compensation required by a potential purchaser [over and above the straight treatment costs] for the trouble involved in dealing with the problem;
Fear of public liability, the possibility of any future liability to third parties would mitigate against a formerly contaminated property in favour of one which was perceived as being more problem free, and
Lack of mortgageability, the inability to obtain financing, either for the sale of a property or its future development, which Patchin regarded as being "one of the most frequent causes of stigma related loss". (after Patchin, 1991a, p168-9)

In the conclusion to his 1988 paper Patchin had stated that:

There is no quick fix to appraising contaminated property. The results are very dependent on individual circumstances. The extent and nature of the contamination are the crucial factors in estimating the after-value of a contaminated property. (Patchin, 1988, p16)

This view was confirmed by his later empirical work (Patchin, 1991b) based on four case studies, from which he found that the diminution in value attributable to stigma, taking account of the four factors described above, varied between 25 and 65 per cent. From these studies he concluded that "the nature, extent and circumstances of environmental contamination have the greatest influence upon the final value of a property".

In a further development of his research, Patchin described a further four case studies where agreed transactions had failed to be completed, or had been completed at reduced sales figures, as a result of contamination. (Patchin, 1994a) From these, and four more case studies, which were not fully detailed, Patchin postulated that the impact on property values, attributable to the stigma of contamination, was between 21% and 94% of the unimpaired value of the properties. In all cases remediation work had been undertaken, so as to render the site "fit for use", or the site itself was not contaminated, but merely suffered from the effect of being adjacent to a contaminated property. The wide variation in impacts was, he suggested, due to differences in the severity of contamination and whether the site itself was contaminated, or merely adjoining contamination.

The most severe impact, in Patchin's 1994 case studies, (at 93.7%) was in respect of a former chemical works which was on the EPA Superfund list. The impact on value in respect of this case study property was so much greater than the next most severely affected property, a vacant site where the stigma was assessed at 69% of the unimpaired value, that it seemed possible that part at least of the reduction in value may be attributable to causes other than contamination.

Following closure and sale of the former chemical works the new owner intended to sub-divide the premises for "rental to multiple tenants". As some of the buildings had been constructed in the 1930's, with others built in the 1950's and 1960's, it is therefore likely that the new owner would have had to deal with a degree of functional obsolescence in sub-dividing the property and presumably would also have required a return for risk, finance and profit.

This was confirmed by Patchin in 1994, in a letter to the author (Patchin, 1994b) when he acknowledged that he had failed to take full account of non-contamination factors in his most severely impacted case study. He also confirmed that in all of the other cases he had made adjustments to the transaction figures, so as to take account of non-contamination factors. In view of the questions raised in respect of the case study apparently suffering the greatest stigma it would be safer to disregard this example and rely upon the remaining seven case studies, which indicate a stigma effect of 21% to 69% of the unimpaired value. This would appear to be more in keeping with the results of Patchin's 1991 studies.

Patchin suggested that the case study examples should be used as comparables in respect of other properties for which values have to be determined. The basis of comparison would not be the usual valuer's method of comparing the similarities and dis-similarities of properties, in terms of location, site, size and specification. Instead, comparisons would be made as to the nature and extent of contamination so as to assess the percentage stigma effect to be applied in respect of the property to be valued.

The impact of contamination could be applied to the valuation method through the introduction of an additional variable, however Patchin suggested that a value be obtained for the property in its unimpaired state. The percentage stigma effect could then be applied to the unimpaired value so as to arrive at a value for the property as impaired by contamination. Patchin considered that, whilst this approach should only be used at present (July 1994) "as a confirming approach to value", the development of further market data may well result in this becoming "the primary approach to valuation of contaminated properties" (Patchin, 1994a). Until such time as sufficient data, in respect of transactions in contaminated land, is available, valuers will have to rely heavily on their professional judgement when assessing the extent of valuation impact attributable to stigma.

Patchin acknowledged, in both 1991 and 1994, the problems involved in obtaining data on transactions, failed or completed, concerning contaminated property. This is an even greater problem in England and Wales where there is no public, or professional, access to information regarding property transactions. It is stressed that, in using any case study or sales comparables methods in attempting to identify the extent of stigma on real estate values, values and prices paid may be impacted by a number of factors other than contamination. Therefore, it is important to identify those factors which relate most directly to the contamination issue. An approach to the assessment of stigma, adapted from Patchin's method for use in the United Kingdom, is shown in Figure 6.2.

FIGURE 6.2
A METHOD OF ASSESSING STIGMA

UNIMPAIRED VALUE (a medium hazard risk property as used in the example in Figure 6.1)			£1,500,000
PRESENT VALUE OF REMEDIATION COSTS (as from Figure 6.1)			£ 131,830
IMPAIRED VALUE 1 - NOT ALLOWING FOR STIGMA			£1,368,170
COMPARABLE CASE STUDIES			
Case Study Number	Indicated percentage of Impaired Value 1 lost to Stigma	Comparison to the property to be Valued	
1	25.9%	Treatment completed, stigma caused by fear of additional contamination, less severe than subject property.	
2	29.2%	No treatment proposed at present, continued industrial use, similar risk level to subject property.	
3	20.9%	Site not contaminated but is situated adjacent to a contaminated site.	
4	32.7%	Similar type of contamination to subject property but slightly more severe.	
5	45.4%	Heavily contaminated site, derelict land, more severe than the subject property.	
Range of stigma effects indicated by comparables 20.9 to 45.4% Comparables closest to subject property numbers 2 and 4, 29.2 to 32.7% Therefore percentage stigma applicable to the subject property is 31%			
AMOUNT OF STIGMA @ 31% OF IMPAIRED VALUE 1.			£ 424,133
IMPAIRED VALUE 2 (taking account of treatment and associated costs and stigma)			£ 944,037
		say	£ 944,000

Source: Developed from Patchin, 1994a

The total fall in value, reflecting both the physical and non-physical aspects of the contamination impact, is therefore £556,000 or 37.1% of the open market value of the property disregarding the existence of the contamination. Whilst it is appropriate, in circumstances such as the example described above, to defer most of the physical costs of remediation, the stigma effect is a current liability. This is because the calculation of stigma reflects present day attitudes to the former use of the premises, the type of contaminants and the associated hazard level. These attitudes may vary in the future.

Care is needed in using the 'sales comparables' method described by Patchin and adapted above, in order to ensure suitability of the comparables. The method can be used to prepare valuations of land and buildings as well as development sites. If a site is to be valued complete with buildings, then the valuer should ensure that the comparables used also include buildings and that due allowance is made for any differences between the buildings in the 'sales comparables' and the subject property. Ideally, the method should be applied in respect of the land element only of the property to be valued and the comparables adjusted on a 'land only' basis.

A more mathematical approach to the assessment of stigma was considered by Mundy, although he did acknowledge that "a mathematically derived conclusion regarding an effect may not correspond with the opinion of the public at large. In other words, real risk may not be synonymous with perceived risk." Mundy (1992a). The impact on value would be greater than the cost required to cure the problem, due to the environmental stigma resulting from "perceptions of uncertainty and risk" and he suggested that the following influences might be expected with regard to investment properties:

Rent - For a stigmatized property rent could be less than for the same property unstigmatized. This is the simple market demand phenomenon.
Occupancy - Occupancy would also be expected to be less as a result of such stigma.
Expenses - For such a property, higher operating expenses could be expected for such items as marketing to maintain rent and occupancy levels and professional services to determine whether contamination exists.
Rate - The capitalization or discount rate could be influenced by lending institutions' desire to alter the loan-to-value ratio, interest rate, or term of the loan to offset perceived risk. (Mundy, 1992a, p12)

It can be argued that the selection of these influences may be inappropriate as there can be a degree of double counting. For example, if the rent to be paid in respect of an impaired property is reduced by an amount sufficient to attract a tenant, who would compare the premises with other unimpaired properties, then it should not be necessary to make an allowance for expected lower occupancy of the building. In other words market forces would act so as to compensate for the degree of impairment existing in the building. Realistically, however, the landlord of an investment building will seek to minimise the rent reduction attributable to impairment and may thus be prepared to accept a potentially lower occupancy rate in return for a lower reduction in rent.

From a review of earlier research by others, using statistical methods, (including hedonic price models and multiple regression) Mundy drew several conclusions:

> "First, a general adequate theory of how contamination affects property value has not been developed. A link has not been established between a general theoretical model and a site specific empirical model. Second, property values are affected by many complex events over time. While both the severity and the persistence of contamination have an effect, these factors are not necessarily related. Third, the statistical models have not been properly used. Data sets are too small and the variables are neither properly specified nor adequate. (Mundy, 1992b, p.158)

He therefore advocated the use of a theoretical model designed to take account of both market factors and the effect of effluxion of time. In developing his model, Mundy suggested that "initially, a clean property has a value equal to full market value". This unimpaired value may also be attributed to a contaminated property where the presence of contamination is an unknown factor but when the existence of contamination becomes known (regardless of whether or not there is any actual risk) "the property is transformed into a problem property, which will affect value" (Mundy, 1992b).

Mundy also suggested that when the market (which he broadly defined as buyers and sellers together with all of the professional and technical actors involved in a property transaction) "perceives a property as a problem, value will be significantly affected in several ways". The uncertainty surrounding the property will affect its marketability and hence its value. Once the extent of the problem is understood the value of the property should increase "to a point at which the difference between its contaminated value and its [unimpaired[3]] market value is the sum of the cost to control the problem plus any residual stigma" (Mundy, 1992b).

One aspect which would appear to be quite clear from the earlier research is that quantification of the impact on value is virtually impossible. It may be possible to ascribe a range of value impacts to a particular type, or level, of contamination, as in Patchin's work, but these may be liable to significant variations according to market conditions. In any event, it would seem that as time increases from the date when the contamination occurred, or was discovered, then assuming that a programme of remediation has been undertaken, the stigma effect on value is likely to diminish over a period of several years. In the United Kingdom context this is of considerable importance as, in many cases, it may be impossible to distinguish between a fall in value attributable to the presence of contamination and that caused by a general fall in values due to industrial decline.

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3 Mundy was subsequently criticised for using words such as "clean" and "dirty" and amended his terminology to accord with accepted practice.

It can be argued that it is pointless remediating a contaminated site when the surrounding area is made up of other similar sites and derelict or semi-derelict buildings. Such areas are frequently perceived as suffering from high unemployment and high crime rates, and those businesses which remain are, quite often, subsisting at the margin of economic viability. These perceptions can even continue to persist long after a site has been treated or a programme of urban regeneration has commenced. An area with a bad reputation may take a long time to lose that image, rebuilding is not always sufficient, professional and public perceptions of the area will also have to be changed.

The comprehensive treatment of a contaminated site within such an area may, therefore, result in the land being improved to a standard far in excess of the general surroundings, without any significant increase in value, at least in the short term. Consideration must therefore be given as to whether the cost of treatment can be justified, given that it may not be possible to fully recoup the expenditure. Where a single site or building is concerned, within a run-down area, the decision may well be that the random or 'pepper pot' approach to regeneration cannot be justified. Landowners and developers may, therefore, find that it is more beneficial to combine their resources in order to ensure the redevelopment of contaminated sites.

If the site is large enough, or can be made so by bringing together several ownerships, so as to be able to create a 'self-contained' environment within a wider area of deprivation, then it can be argued that the cost of treatment is justifiable, even if the full expenditure cannot be recouped out of the initial project. Such developments may be seen as having a 'catalytic' effect on the surrounding area, from such simple actions as encouraging other landowners to tidy up or repaint their premises, to encouraging the commitment of substantial capital in new developments.

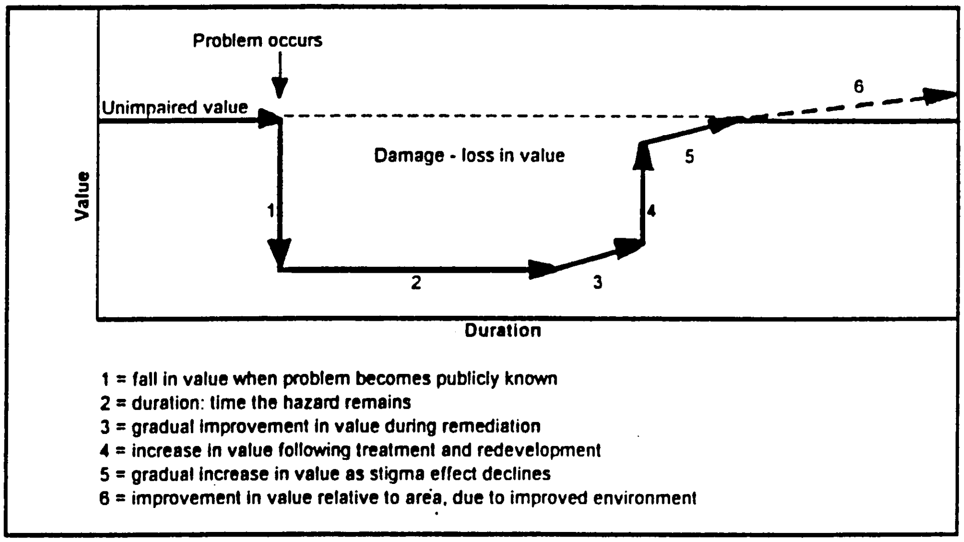
Bleich *et al* (1991) considered the impact that a "bad neighbour" user might have on the values of adjoining, but uncontaminated, properties, specifically the impact of a landfill on a residential neighbourhood. Starting from the premise that "it has always been assumed that buyers would pay less for a house in close proximity to a landfill" (Bleich *et al*, 1991), the researchers undertook an empirical study comparing house sales prices in a neighbourhood adjacent to a landfill, with those on two other neighbourhoods situated one to one and a half miles, and three to six miles from the landfill. After analysing a total of 1,628 transactions, over a ten year period, in the three neighbourhoods, using regression techniques, the results of the research indicated "that there is no significant difference in either current prices or in appreciation rates (and thus prices over time) over a ten-year period" (Bleich *et al*, 1991).

Although Bleich and his colleagues did not use the term 'stigma', they were considering the possible negative impact on property values which may be attributable to the existence of a potentially contaminative use. They argued that "modern laws, restrictions and management techniques, however, make it possible to reduce or remove the negative impact of a landfill during its useful life" (Bleich *et al*, 1991).

Bleich was in fact prepared to go further as he has expressed the view, during a discussion with the author in March 1994, that, since completion of the study, values in the neighbourhood adjacent to the landfill had risen faster than values in the two control neighbourhoods. He was unable to produce any empirical support for his opinion but he had identified it as an area for further research. The landfill had, by this time, been closed and extensively landscaped. The neighbouring householders knew that the closed landfill would never be developed for any 'bad neighbour' use and was starting to provide an attractive environment, which had the effect of encouraging the residents to take a pride in the locality.

It is argued here that, over time, the wider effects of treating the original contaminated site, and bringing it back into full economic use through a quality development, may have the effect of not only removing any stigma effect but may also result in an enhancement of value above that attributable to the surrounding area. The stigma effect on property values would then be similar to that shown in Figure 6.3.

FIGURE 6.3
The impact of contamination on land value: through the cycle of discovery, investigation, treatment, development and subsequent re-use



(Adapted from Mundy, 1992b)

The longevity of any stigmatisation following treatment of the contaminated site will depend upon a number of factors, such as the use to which the treated site is put, the treatment method used and its effectiveness, and general market conditions. It may be postulated that the less sensitive an end use the more likelihood there is that any impact on value associated with an earlier contaminative use will be short lived. But, so far as the United Kingdom is concerned, is this a reasonable assumption given the role of major financial institutions in the industrial and commercial property markets? Indeed, it may be that residential markets are less sensitive to site histories, due to relatively low value (and more numerous) property transaction sizes on new residential developments than may be found on commercial or industrial developments. Unless, of course, trees and shrubs begin to wilt, offensive odours pervade the development and the residents experience increased levels of illness.

It is quite possible that experience in the United Kingdom will differ quite significantly from that in the United States, given the difference in size between the land area of the two countries and the pressures that may arise out of market demand for development sites in the former. Similarly, differing perceptions of contamination may result in different stigma effects and approaches to clean-up standards in the two countries.

6.5 HOW CLEAN IS CLEAN?

Laing (1992) expressed the view that "all land is contaminated" and suggested that "if this assumption is adopted when acquiring land, the risks involved in entering into the development process would be reduced". The fact that these opinions were expressed in the context of considering the possible impact of the registers of potentially contaminative land uses (proposed under Section 143 of the Environmental Protection Act 1990) does not make them any less relevant following abandonment of the registers. Clearly, however, there are differing degrees of contamination and, as discussed in Chapter 2, the Royal Commission on Environmental Pollution regarded contamination as being a lesser state than pollution (RCEP, 1984). This study is only concerned with contamination of such severity as to be regarded as pollution and thereby a potential hazard. A number of soil remediation methods were considered in Chapter Five. However, Waters (1993) stated that "whatever remediation measures are undertaken there is likely to be some residual contamination remaining in the soil and groundwater". Statements such as this may prove to be extremely disconcerting to valuers and especially to risk conscious investment funds.

How then should valuers and their clients, whether developers or prospective investors, view the 'cleanliness' of treated sites? The ICRCL guidance applies to a fairly small number of contaminants and, in terms of setting standards, only provides trigger levels for a limited number of potential uses, for example dwellings with gardens and public open space. These standards may be totally inappropriate in circumstances where a site is to be redeveloped as a shopping centre, with most of the site area covered by buildings, car parks and service yards, with only a small area allocated for landscaping. Even the criteria suggested by the ICRCL for public open space may be far more stringent than necessary for a development of this nature, yet a prospective developer may be intending to commit many millions of pound to the project and would rightly expect reassurance that the purchase does not bring with it a future liability of immense proportions.

Government policy is that contaminated land should be reclaimed by adoption of the 'suitable for use' approach (DoE, 1994a and DoE, 1994e), although it has not, to date, produced a comprehensive schedule of standards which would be appropriate to different land uses and it is highly unlikely that it would be prepared to warrant any particular treatment method as being capable of achieving any such standards. It is, therefore, left very much to the developer, the investor and their advisers to determine the acceptable level of treatment appropriate to any proposed land use. There is, therefore, a need for close co-operation between the 'technical' members of a project team, such as the geo-technical engineer and the environmental consultant, and the 'non-technical' members such as the valuer and the solicitor. It is no use for the engineers to propose a method of treatment which would be unacceptable to an investor, for example, because of the need for long-term monitoring of residual contamination, and, similarly, it is pointless for the investment surveyor to insist upon a standard of clean up which is unachievable. Each member of the team needs to have an appreciation of the role of other members and the contribution which they can make to the project.

"To minimise potential dispute and to be fair to all parties, clean up targets should be agreed prior to the commencement of any remediation" but "regrettably, there is no universal answer to the question how clean is clean. The environmental circumstances and sensitivity of the site, its surroundings and the nature and extent of the identified contamination all need to be considered by the interested parties" (Waters, 1993). This will involve discussions with the appropriate regulatory authorities, so as to ensure that the proposed treatment methods are acceptable, especially if any site specific standards need to be agreed in respect of any residual contamination which will remain on site. In the past, this has involved discussions with the National Rivers Authority, the Waste Regulation Authority and the Environmental Health Department of the appropriate local authority.

A considerable period of time needs to be allowed for the consultations, for example the National Rivers Authority indicated that it would require a period of ten months in order to issue its formal opinion in respect of one of the case studies described in Chapter Eight, even though at a site meeting the officer concerned had verbally indicated that the proposed treatment method appeared to be acceptable. Perhaps timescales will be reduced following the merger of the NRA, HMIP and the WRA's to form the new Environment Agency but intending developers need to allow sufficient time for the consultation process. This does of course have implications for the purchase of sites in competitive market conditions where the prudent developer may be out-bid by one who is less risk averse. The attitudes of actors involved in property development are discussed in Chapter Nine.

All sites are unique and rigid standards of soil quality would impose constraints in respect of the selection of remediation methods. Such constraints would probably result in a reluctance on the part of developers and their advisors to use 'innovative treatment technologies', instead they would adhere to 'tried and tested' methods. Constraints in the form of set 'soil quality standards' would impinge directly upon the redevelopment and value of contaminated land, as the ability to negotiate appropriate treatment methods would be limited.

Therefore the question "how clean is clean" must be answered on an individual, site specific, basis. The answer must take account of factors such as background contamination levels, the nature of the contaminants and the media in which they are located, and the future use proposed for the site.

CHAPTER SEVEN

DETERMINATION OF RISK

7.1 SUITABILITY FOR USE

"Greenfield sites are the natural first choice for developers; but in such a small and crowed island as this, they are a finite, and steadily disappearing resource. There is no doubt that, as we move into the next century, the supply of greenfield sites will become more scarce, the conditions attached to developing them will become stricter and their cost will rise." (Richards, I. 1995) Town planning policies, such as the retention of green belts (DoE, 1988), will restrict the outward growth of many towns and should encourage developers to consider the option of redeveloping previously used sites.

The lack of an adequate supply of 'greenfield' sites, the attractive location of many old industrial sites and the widespread nature of contamination has resulted in the need to redevelop many contaminated sites. This development-driven market is gradually becoming more influenced by new and impending legislation brought about by increased public awareness and political pressures to protect human health and the environment (Ellis, 1992). As discussed in Chapter Three, the policy adopted by the British government, with regard to the treatment of contaminated sites, is that they should be remediated only to such an extent as to make them suitable for the actual use undertaken on the site, or the use which is proposed for the site. Inherent in such a policy is the likelihood that some contaminants will remain on the site, either untreated but covered and contained, or following some in-situ treatment. The potential may thus remain for future users of the site and neighbouring properties to be exposed to a higher degree of risk than if the contamination had been removed in its entirety.

Judith Petts (1994a) identified a number of key questions in respect of the risks attaching to contaminated land:

- Who is to bear what level of risk?
- Who is to pay for risk taking?
- Where is the line to be drawn between risks which should be managed by Central Government and risks that are to be managed by individuals, groups, organisations?
- Where is the balance to be drawn between corrective measures to reduce the effects of contamination, preventative measures to reduce the potential for contamination to arise, and acceptance of certain impacts but with the costs or risks appropriately shared?
- What information is needed for rational and defensible risk management and how should it be evaluated?
- Who evaluates success or failure in risk management and how?
- Who decides on what should be the desired trade-off between different risks?

(Source: Petts, 1994a)

Consideration of these questions needs to be undertaken in two broad contexts; firstly the **environmental risk**, in terms of hazards to human health and to the wider environment and secondly, the **economic risk** attaching to the ownership of an interest in an affected property. The word 'risk' needs to be defined and the relationship between environmental and financial contexts has to be examined.

So far as a definition is concerned, the following is considered appropriate in the context of contaminated land:

> ".... a combination of the probability or frequency of an occurrence of a defined hazard and the magnitude of the consequences of the hazard. In the context of land contamination a hazard could relate to a situation which has potential for human injury, damage to property, damage to the environment or economic loss"
>
> (Source: Petts, 1994a)

The question of risk in the context of contaminated land may also be divided into those risks which can be measured or predicted and those which are not readily capable of measurement or prediction. As referred to in Chapter Three, the latter group may be specifically related to the uncertainty which surrounds public and professional perceptions, changing government policies and changing attitudes to remediation methodologies. This chapter considers only the measurable or predictable risks, whilst uncertainty is addressed when considering valuation and redevelopment issues in Chapters Six, Eight and Nine.

It can be argued that any residual risk is unacceptable and that land contamination should be remediated to a uniformly 'clean' state, regardless of current or proposed use. It is also argued that the expense of such treatment is rarely justified and if such a policy was to be applied, then it would be necessary to decide upon a uniformly 'clean' standard to be applied to the treatment of contamination. No doubt developers, environmentalists, government agencies, valuers, investors and occupiers would all have differing views in respect of any such standards.

Achieving the highest possible standard of remediation necessary to fully remove any potential health hazard, or other environmental impairment, may not be financially viable, for example, in situations where the cost of treatment exceeds the economic potential of the site. In such situations contaminated sites may remain untreated, especially if the polluter is no longer in existence or there is no legal liability to undertake remediation work.

This chapter describes situations which may lead to land contamination, suggests procedures which should be adopted in determining the nature and extent of such contamination and considers how appropriate risk management techniques would have assisted the companies involved in respect of the examples under consideration.

The Government's consultation paper *Paying for our Past* (DoE, 1994a) proposed, in paragraph 4A.5, that contaminated sites should be improved in line with the "suitable for use" approach as and when hazards are tackled. This approach was subsequently confirmed as policy in the paper *Framework for Contaminated Land* (DoE, 1994b) and in Planning Policy Guidance Note 23 (DoE, 1994e). Government policy on the subject of contaminated land is therefore quite clear. Sites need not be remediated to a uniformly 'clean' state regardless of proposed end use. From this it may be deduced that the remediation method used in respect of a site which is to continue in industrial use may be less stringent than that applied to a site which is to be redeveloped for residential purposes.

Similarly, it may be acceptable not to undertake any remediation work in respect of factory premises which are currently used for industrial purposes and are likely to remain in such use for the foreseeable future, provided of course that there are no health and safety risks and the contaminants are not leaching or migrating from the site. There may, however, be financial implications, in terms of impact on the existing value of the asset in its contaminated state. The property owner's policy decision may be influenced by commercial factors, rather than property issues, but is of significant importance to the valuers of all types of premises, whether valuations are required for asset, mortgage, insurance, sale or acquisition purposes.

At the Clayton Environmental seminar held in London in October 1994, comment was asked for on the following problem:-

> *"I act for a client who owns a manufacturing business which he is in the process of selling to a public company. Included in the sale is the freehold interest in the manufacturing premises used for the purpose of the business. A site investigation has been undertaken on behalf of the acquiring company and it has been found that the ground is contaminated as a direct result of the manufacturing operations. Both parties and their consultants agree that there is no health and safety risk and that the contaminants are not migrating, nevertheless the purchaser is insisting on a reduction in the purchase price so as to reflect the future cost of having to clean up the site. When the vendor refused to reduce the price because the premises were "suitable for use", the purchaser responded that it was its policy to provide for environmental liabilities in the company's accounts."*

It might appear that the acquiring company is being unreasonable in its demands in attempting to purchase the premises for less than what might be regarded as their open market value. Both parties accept that they are suitable for continued use for their existing purpose and there is no need for the acquiring company to incur any expenditure in improving the ground conditions. If the company decides at some future date to extend the existing buildings or to change the nature of the manufacturing process, then it may be necessary to undertake decontamination work. There is also the possibility that, at some future date, legislation may be introduced which requires the owner of the property to undertake works of a remedial nature.

It is argued, therefore, that, in taking account of contamination when preparing valuations, the valuer should have regard to the suitability of the premises for their existing (or previous) use and any foreseeable future use which is in reasonable conformity with the existing planning consent. Such an approach should have the result of recognising the potential impact of the contamination in the event of a disposal in the short to medium term. The possibility of legislative changes is however far more difficult to take into account and, it is suggested, the likelihood of properties being so affected can only be judged on individual circumstances.

In the event that such use, or uses, would require some improvement of the ground conditions in order to render the premises suitable for use, then the valuation should be undertaken in accordance with the procedures set out in Guidance Note 2 of the RICS Appraisal and Valuation Manual (RICS, 1995d). A suggested method of valuation has been described in Chapter Six but, in outline, the guidance note requires the valuer to take account of the costs of remediation, including necessary changes to production processes, civil and criminal penalties, professional fees, insurance and future monitoring costs .

7.2 CASE STUDIES

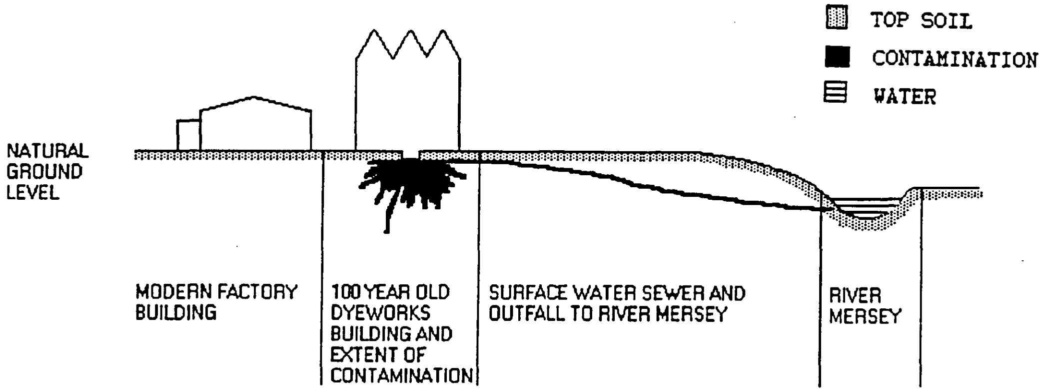
As discussed in Chapter Three, government policy in respect of the treatment of contaminated land is based upon 'suitability for use' but, it is argued, in view of the professional guidance issued by the Royal Institution of Chartered Surveyors, coupled with the attitudes of lenders and occupiers, it may not be sufficient for developers to simply adhere to government policy when considering redevelopment options. The following case studies, all of which are based on the personal experience of the author, provide examples of situations where it may not be appropriate to merely take account of suitability for existing use when deciding whether or not to reflect contamination when preparing a valuation or considering the possibility of redevelopment.

7.2.1 Former dye works in Stockport

The occupier of a modern industrial building with a successful manufacturing business needed to expand but was unable to do so on his existing site. A building immediately adjacent to his factory had been used for the previous one hundred years as a dyeworks and seemed to offer a much cheaper expansion solution than relocating the entire business to new premises. He therefore bought the building, on the basis of a valuation prepared for his bank. Plans were drawn up for the redevelopment of the site which was completely covered by the dye works building. Tenders were received and a contractor was duly appointed. The contractor moved onto the site, demolished the building and started to break up the floor slab. Beneath the slab was a mixture of earth and black slime.

Following enquiries it was found that, for the previous one hundred years, waste dyes had been poured through a drainage hole in the floor of the building, into the drain which connected to the public stormwater sewer. The public sewer eventually discharged into the River Mersey, approximately half a mile from the premises (see Figure 7.1), one of the most heavily polluted rivers in the United Kingdom due to the large number of industrial concerns discharging liquid and solid wastes into the river and its tributaries.

FIGURE 7.1



SKETCH SECTION THROUGH FACTORY AND DYEWORKS BUILDINGS SHOWING SEWER USED FOR THE DISCHARGE OF WASTE DYES

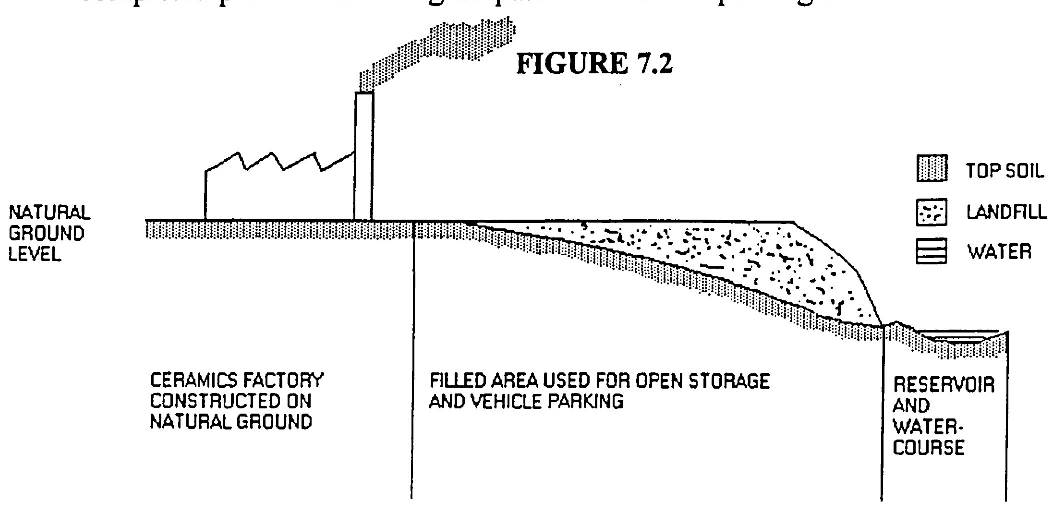
"It appeared that at some time, probably many years earlier, the drainage system had broken and for a considerable period of time most, if not all, of the waste dyes had been getting no further than the ground under the building itself. The entire area was contaminated and had to be excavated to a depth of more than four metres, using special precautions to protect the workforce and in hauling the contaminated material away to a licensed tip." (Syms, 1992) The total cost of the remediation works, including fees and an additional payment to the contractor for delay whilst re-design work was undertaken, added 40 per cent to the cost of the new building. Whilst work on site was stopped for the re-design, an application was made to the Department of the Environment for a Derelict Land Grant which covered a substantial part of the additional expenditure.

The valuer who acted for the company's bank was not expected (in 1988) to know about the problem lying under the floor of the building but, bearing in mind the previous use, the question must be asked as to whether or not he should have recommended that a site investigation be undertaken prior to issue of his valuation. There is no doubt that the dye works building was suitable for continued use for its original purpose, or for any other purpose which did not require demolition of the building, and many years could have passed before the problem was discovered. Indeed, the problem may have lain undetected until such time as the contamination was found to be leaching into adjoining land or a potable water source, at which point the current owner could have been faced with an action for nuisance.

7.2.2 Ceramics factory in Lancashire

The original factory buildings had been constructed over the course of three decades, commencing in the 1930's, on a gently sloping site. The rear boundary of the site is formed by a watercourse feeding the reservoir which served adjoining textile mills, now redundant. Clay wastes and broken or sub-standard ceramic products had been disposed of on the site throughout the entire period that the factory was in production. These waste products had been used to raise the site levels between the rear of the buildings and the watercourse, so as to form a level area, see Figure 7.2. The levelled site was used for open storage of completed products awaiting despatch and for the parking of vehicles.

FIGURE 7.2



SKETCH SECTION THROUGH CERAMICS FACTORY SITE

The waste products in themselves did not constitute an environmental hazard as the amount of heavy metals contained within the glazes was minimal. However, drums of waste glazes had also been buried in the ground and the company had allowed a local building contractor to deposit demolition materials on the site so as to complete the hardstanding. When, in 1990, the company wished to expand its production facilities, the open storage and parking area was considered to be the ideal location for a factory extension but a site investigation revealed extensive contamination by heavy metals and friable asbestos. The additional development costs were considered to be prohibitive and the site was not eligible for Derelict Land Grant as it was in current use. The project was therefore abandoned.

The fact that contamination remains on the site does not in any way affect the use of the factory complex for its existing use but it must be recognised that there is a substantial contingent liability which may need to be met when the buildings reach the end of their useful life. There may also be an earlier liability if any of the contaminants migrate into the adjoining water areas. The valuer, when preparing the company's asset valuation, should therefore take account of the fact that contamination exists on site, regardless of the fact that no disposal or redevelopment is envisaged within the foreseeable future. However, unless the valuer asks specific questions of the client relating to the possibility of contamination, it is quite likely that the potential liability will remain undetected, thus resulting in an erroneous valuation.

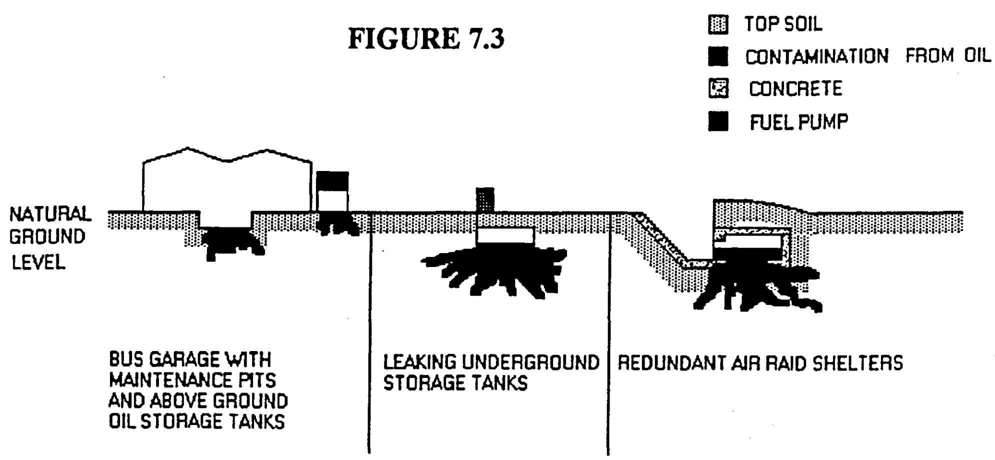
7.2.3 Bus depot in London

A major, publicly quoted, property development company purchased the former depot at the peak of the property market in the late 1980's for a sum of approximately £2,500,000 per hectare. The company subsequently entered into a Section 52 Agreement under the Town and Country Planning Act 1971 (superseded by Section 106 Agreement, Town and Country Planning Act 1990) to provide extensive off-site infrastructure works which added almost £1,000,000 per hectare to the site costs. The intention was to develop the site as a business park and, at that time, the expenditure level could be justified.

Instructions were given, prior to purchase, to a leading firm of consulting engineers to advise on any ground problems but, as the site was still in full operational use, it was not possible to undertake a full site investigation. The site was also being offered in the open market for sale to the highest bidder and the company, quite understandably, was reluctant to commit itself to a considerable amount of potentially abortive expenditure. Invasive site investigation was therefore limited to the excavation of a small number of trial pits in areas of hardstanding where filling was known to have taken place. A 'walk over' of the site showed that spillage of fuel oils and other hydrocarbon based materials had occurred in the maintenance garages and in the areas around above-ground oil storage tanks. Taken altogether the contamination was judged not to be a serious problem and a provision of around £150,000 per hectare was made in preparing the development appraisal.

No work was undertaken by way of research into the past uses of the site and working practices, in other words, a desk study was not carried out. When work started on site it was found that there were a number of leaking underground storage tanks and it was also discovered that it had been the practice of vehicle mechanics working on the site to dispose of waste oils into the redundant underground air raid shelters; leaching had taken place which allowed the waste oil to penetrate the substrata of the site (see Figure 7.3). It is believed that the cost of treating this site eventually escalated to a figure in excess of £500,000 per hectare, at a time when the property market had entered a period of recession. Grant aid could only have been made available if work had stopped on the site, allowing it to become technically derelict, but it was considered that this would have a detrimental effect on shareholder confidence and the work therefore went ahead without public sector support.

FIGURE 7.3



SECTION THROUGH PART OF BUS GARAGE SITE

In this case the valuer would have been perfectly justified in producing a valuation based on the consulting engineers' assessment of the contamination risk, notwithstanding the fact that this was erroneous. It demonstrates the need for accurate information to be obtained in respect of ground conditions and for this to be reflected in valuations and also for the lack of such information to be notified to clients, through the use of contingencies or written warnings.

In all of the case studies the sites were suitable for their existing or previous uses and so far as the owners and their advisors were concerned there were no health and safety risks. So far as could be determined at the time of the relevant site inspections, there were no identifiable hazards likely to affect the wider environment. None of the case studies involved a change to a sensitive use, such as housing, and it could be argued that site investigations were unnecessary, although the case studies demonstrate that the lack of information may result in the land owner being faced with a considerable amount of unexpected additional cost. When considered for intensification of use, or a reasonably substitutable alternative use, it is apparent from the case studies that contamination was a significant issue, requiring costly remediation, and that there was likely to be an adverse impact on value.

A more detailed consideration of the valuation issues is contained in Chapter Six, together with a discussion as to the questions which valuers should address to their clients, or the landowners, when preparing valuations on sites where contamination may be an issue.

7.3 RISK MANAGEMENT

The execution of a well planned site investigation should provide the client, and members of the professional team, with a good insight into any physical problems which may have to be overcome, and their associated risks, in order to render the property 'suitable for use', or for it to be redeveloped. It should not be necessary for the valuer or the development surveyor to be closely involved throughout the various stages of the investigation but it may be desirable for him or her to be present at certain times. This may especially be the case during the site reconnaissance where both the surveyor and the site investigator can draw each other's attention to matters of significance. It may also be appropriate for the surveyor to be on site during part of the invasive investigation, so as to gain an understanding of the ground conditions which will need to be ameliorated before any development takes place. Before any treatment is undertaken however, it will be necessary to assess the risks associated with the site and decide how they can be managed.

> Risk assessment and risk reduction together comprise the overall process of **risk management**. There is an overlap between **risk assessment** (comprising hazard identification and assessment, risk estimation and risk evaluation) and **risk reduction** (comprising risk evaluation and risk control). In the context of contaminated land, the need to assess the risks associated with contaminants and to decide appropriate levels of control, is the primary consideration in the development of the investigation strategy. In developing the remediation strategy the aim is to explicitly remove or control risks in a transparent and justifiable way.
>
> (Smith and Harris, 1994 p2)

The results obtained from the site investigation will need to be analysed and their relevance determined in accordance with the development alternatives proposed for the site, so as to assess the degree of risk involved and the targets likely to be affected. It should, however, be borne in mind that "absolute truths are always beyond the scope of risk analysis in the complexities of land contamination" (Cairney, 1995, p25) There may also be a need to consider other matters, not strictly relating to the development proposals, which may constitute a risk to the land owner, for example the possibility that the site may at, the present time, be the cause of a statutory or private nuisance. The objective of risk analysis is to relate events, such as the emission of toxic substances from a contaminated site, to its effect at some sensitive point, or 'target' in the environment. (Loxham, 1992) For many redevelopment projects on contaminated land, hazard assessment and qualitative risk assessment on a site specific basis are likely to be sufficient to decide the most appropriate form of action. (Welsh Development Agency, 1993)

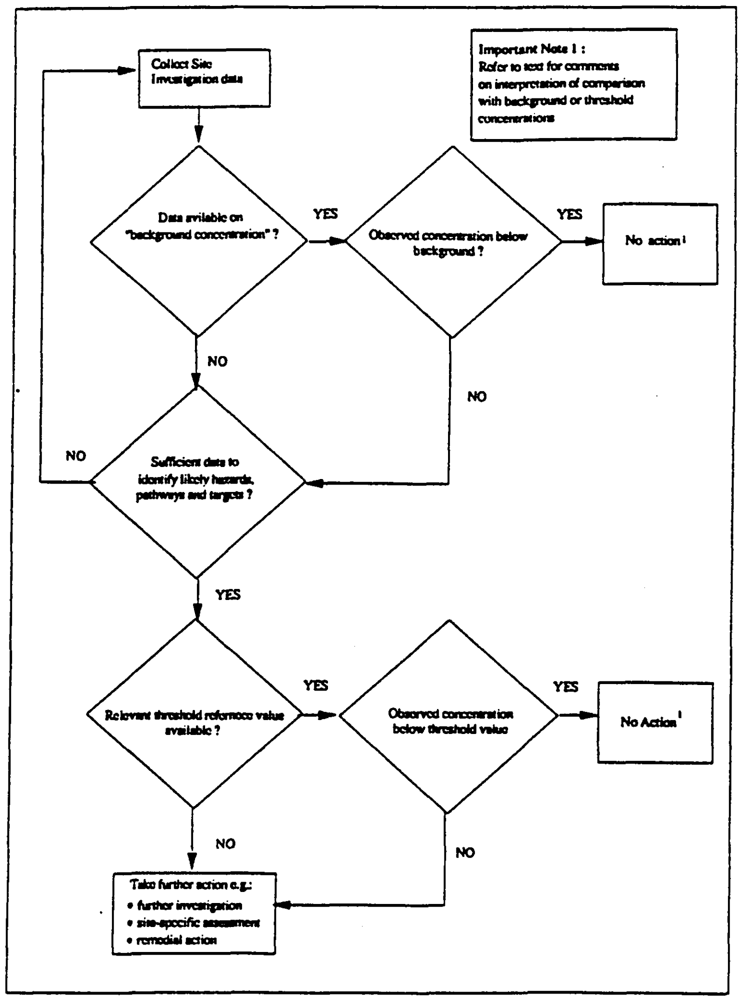
Where a qualitative, or generic, assessment of the risk is deemed to be sufficient, both dedicated values (relating specifically to land contamination) and non-dedicated values may be used. That is values not specifically designed for use in connection with soil contamination, such as those relating to air and water quality. Dedicated reference values would include those produced by the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL, 1987) which, it must be stressed, are guidelines not standards, as well as those published by the governments of other countries, such as the Netherlands, Canada, and Australia/New Zealand. Other dedicated reference criteria may be contained in publications from Her Majesty's Inspectorate of Pollution (now part of the Environment Agency), the Building Research Establishment and the Construction Industry Research and Information Association. Non-dedicated reference values, so far as soils are concerned, might include the criteria applicable to drinking water standards, the standards of bathing beaches and the permitted levels of particulate emissions applicable to specific industries.

Care should however be taken to note the legal status of the reference values used and to consider their validity to both the site itself and to the country in which it is located. For example, Dutch reference values (Dutch Ministry of Housing, 1987) have been compiled with regard to the official Netherlands policy of soil multi-functionality, or suitability for any use. This contrasts with the UK government's official policy of suitability for the actual or proposed use.

A suggested procedure to be followed in determining the level of risk presented by each individual hazard found on the site is shown in Figure 7.4

FIGURE 7.4

HAZARD IDENTIFICATION AND ASSESSMENT



(Source: Welsh Development Agency, 1993)

Risk assessment of a contaminated site will usually result in a decision that either:

- Nothing needs to be done, or
- measures are required to eliminate or reduce the risks.

Once the decision has been made that risk control measures are required, a remediation strategy must be developed. This must, in the case of a development site, take into account not only contamination related risks but also engineering requirements (e.g. minimum bearing capacities) and management objectives - such as the need to make a profit. (Smith, 1994a).

In situations where generic criteria are not available for the contaminants being assessed, or in circumstances where the available criteria are deemed to be inappropriate for the individual site or proposed end use, site specific values may have to be determined. Even in the wider context the use of generic criteria, or "trigger concentrations" has been questioned, for example by Beckett (1993b pp. 67-70) who considered the use of trigger values in the ICRCL guidelines (ICRCL, 1987) and the Greater London Council (GLC) "guidelines" (Kelly, 1979), in respect of arsenic contamination. Beckett concluded that the ICRCL threshold trigger value for arsenic, of 40 mg/kg for non-residential uses of land, "could safely be deleted from future guidance on trigger concentrations" and that "there are likely to be other values included in the current ICRCL guidance on trigger concentrations of which the same can be said". He also expressed the view that the "inclusion of additional contaminants in future guidance may impair, rather than improve, the usefulness of the concept of trigger concentrations" (Beckett, 1993b p.70).

In view of the concerns expressed over the use of generic criteria, and the fact that these are only available for a relatively small number of contaminants, it may be argued that generic criteria should only be used for the purpose of "bench marking" standards to be achieved in soil treatments and that remediation values should be calculated on an individual site basis according to the degree of risk to potential targets. The authors of the *WDA Manual on the Remediation of Contaminated Land* expressed the view however that "full site-specific risk assessment leading to **quantified** estimates of risk to defined targets is unlikely to be justified or economic except when dealing with complex problems" (Welsh Development Agency, 1993), which might include situations where:

- the frequency and level of exposure are likely to be high and the effects significant,
- sites in existing use present, or are likely to present, significant health and/or environmental risks,
- public perceptions of risk are such that, despite the evidence of a generic assessment, quantified estimates of risk have to be produced and,
- where local background concentrations of contaminants are high relative to generic threshold concentrations, prompting a consideration of the contribution of the site to local environmental burdens. (Welsh Development Agency, 1993)

The views expressed in the WDA Manual were written before the Environment Act 1995 came into force, and indeed before publication of the draft Bill, and it is important to note the use of the word "significant" in both the definition of contaminated land contained in the Act and the situations described above as possibly requiring "quantified estimates of risk". It may, therefore, be reasonable to assume that in situations where the local authority and/or the Environment Agency determine that there is a risk of significant harm being caused, or the pollution of controlled waters (section 78A, Environment Act 1995), then a quantified estimate of risk may be required in order to determine what action, if any, needs to be taken in order to overcome the problem.

In the opinion of Cairney (1995) "current inadequacies in national guidelines and standards ... and the scientific uncertainties over the fates and interactions of contaminants as they move through the complexities of air-soil-water environments are such that a fully quantified environment risk assessment approach cannot yet be advocated". He has therefore proposed that a "Semi-Quantified Risk Assessment Approach" be adopted. In using such an approach seven environmental risk situations would be considered:

Group I
(1) Risks of polluting surface waters
(2) Risks of polluting groundwaters
(3) Risks of producing area-wide air pollution

Group II
(4) Risks of gases and vapours entering dwellings and structures
(5) Risks of attack on construction materials
(6) Risks to plant populations
(7) Risks to human health by contaminant contact, ingestion or inhalation. (Cairney, 1995, p58)

The Group I risks are those of interest to the bodies responsible for ensuring compliance with environmental legislation, whilst the Group II risks are those of more concern to individuals and organisations occupying or investing in land which was formerly contaminated. These seven risk categories "adequately cover the risks of concern to the various parties interested in the re-use of a formerly contaminated site" (Cairney, 1995, p58), although Cairney did acknowledge that some workers, (for example Ferguson and Denner, 1993) considered that the human health risks arising from the ingestion and/or inhalation of contaminants should be considered in more detail.

According to Cairney (1995), the semi-quantified approach is capable of assisting the decision making process and meeting the usual practical requirements which tend to fall into one or other of the following categories:

- Pre-purchase decisions when an un-reclaimed and contaminated site is offered for sale.
- Deciding which remediation method best fits the remediation budget, the planned land use, and the liabilities which are of most concern.
- Proving that a reclamation has fully satisfied its aims and that the site is acceptably safe for its projected re-use.

The relationship of these three stages, the essential links between the various stages and types of site investigation are set out in the flow chart in Figure 7.5.

FIGURE 7.5

RISK ASSESSMENT FLOW CHART

Part [A]	**Desk study. Establishing relative potentials of liabilities. Buy/reject option.**

Necessary form of site investigations to establish if potential liabilities are real (Chapter 4, Sections 4.3.1 and 4.3.2)

Selection of that chemical analytical strategy best suited to establish the likely risks (Chapter 4, Section 4.3.3)

Part [B]	**Evaluation of site investigation/analytical data to establish the magnitude of future environmental liabilities. Confirmation that site investigation/analytical coverage has been adequate. Identification of where additional undefined detail may be required.**

Choice of the form of contaminated land remediation which best addresses the liabilities of most concern to the planned re-use of the site. Identification of any additional investigation/reclamation method proving which may be required. (Chapter 5)

Part [C]	**Proving that the reclaimed site is acceptably safe for its planned re-use. Identification of any additional proof needed to reach a decision.**

Relative final weightings of environmental liabilities may be given standardised cost values. This will be necessary in order to assess the impact on value attributable to the contamination and any residual effect on value following treatment, as well as to establish whether or not insurance cover can be arranged and the premiums which should be charged. (Chapters 6, 8, 9 and 10)

(Source, after Cairney, 1995, p60)

Most of the guidance given in literature is directed primarily at the technical aspects of site investigation and remediation, with little or no consideration being given to the economic and valuation aspects, although Cairney (1995) does state in the preface to his book that it has "been written specifically to assist developers who reclaim contaminated land for productive re-use". If the economic and valuation aspects are taken into account then risk assessment and estimation may be justified on a site specific basis in order to satisfy investors, occupiers, purchasers and other parties having an interest in the future use of formerly contaminated sites. In other words, a particularly complex situation may not have to exist in order for a quantified, or semi-quantified, estimate of risk to be required, possibly in order to satisfy non-technical criteria.

7.4 CONCLUSION

Returning to the examples of land contamination described earlier in this chapter, the following lessons may be learned:-

i) The proposed purchase of a manufacturing business; the prospective purchaser of the business had adopted the correct approach in undertaking a site investigation and was justified in seeking a reduction in the purchase price of the business property, so as to reflect the future cost of having to treat the site. The example quoted involved a freehold property but, it is argued, the same approach is valid in respect of leasehold properties, especially those with a relatively short unexpired term, where the tenant may become responsible for the cost of any treatment before the buildings reach the end of their economic life. In such circumstances the tenant may be faced with the cost of demolition and rebuilding, in order to deal with the contamination. A suggested method for tackling asset valuations of damaged properties, whether freehold or leasehold, was described in Chapter Six.

ii) The former dye works (section 7.2.1); no site investigation was undertaken in respect of this property, only a valuation for bank purposes. At the time when the property was acquired for redevelopment, contamination was not perceived, within the surveying profession generally, to be an issue and its impact was not normally regarded as being a factor to be taken into account when preparing valuations. The total coverage of the building to the site area represented a major constraint in undertaking an invasive investigation and it is doubted that the vendor would have been willing to permit holes to be drilled through the floor of the building. Nevertheless, a preliminary investigation should have been carried out, including a review of the former occupier's working practices, which would have assisted in the preparation of a risk assessment and possibly enable the purchaser to negotiate a conditional contract, providing for a reduction in price if contamination was found to exist. The purchaser in this case suffered a substantial financial loss, which was only partly offset by grant aid, and it is argued that, in similar circumstances today, the valuer could be held to have been negligent.

iii) The ceramics factory (section 7.2.2); the problem had been caused by, or under the control of, the occupier of the site, at a time when land contamination was not an issue of any significance, and no third party was involved. A site investigation had been undertaken and the risks, in valuation terms, were assessed as being unacceptable. The company in question had other land available on which to construct the factory extension and it was not therefore necessary for the site to be developed. No remedial work was proposed but the existence of the contamination should be reflected in future asset valuations, provided of course that the company brings it to the attention of the valuer.

iv) The bus depot (section 7.2.3); quite clearly the site investigation work undertaken by the consulting engineers was inadequate for the purpose of identifying the type and extent of any contamination existing on the site. Whether they were negligent or not is a debatable point but perhaps they should have advised their client that it was not possible to undertake an adequate site investigation given the operational constraints and the available budget. They would almost certainly have been better employed in carrying out a preliminary investigation, with particular reference to a study of working practices, than in the limited invasive investigation which was performed.

No two sets of circumstances affecting contaminated sites are ever likely to be identical. However, given sufficient thought and planning, it should be possible to undertake sufficient investigative work to enable a reasoned assessment to be made of both the environmental and the economic risks. Whether or not the "Semi-Quantified Risk Assessment Approach" advocated by Cairney is adopted will depend upon individual choice and the circumstances relating to specific sites. But if, for any reason whatsoever, it is not possible to produce such a risk assessment, then the owner, surveyor or developer should err on the side of caution and regard the property as a potential liability.

CHAPTER EIGHT

RESEARCH METHODOLOGY AND REDEVELOPMENT CASE STUDIES

8.1 INTRODUCTION

Whilst there is a need to reflect the presence of contamination in the valuation process, it is in the development process that the effects of contaminated land come to the forefront. In a valuation the full cost of remediating a contaminated site may be deferred many years into the future, for example, until such time as the existing buildings have become economically or functionally obsolete. When considering the development or redevelopment of a contaminated site the need to tackle contamination assumes an immediacy which can not be ignored. If an intending developer decides to simply disregard the existence of contamination, then he is likely to encounter problems in obtaining development finance and may be unable to sell or let the completed development.

Therefore a prudent developer will take full account of any contamination existing on the site and use an appropriate treatment method, or methods, in order to overcome the problem. The valuation method described in Chapter Six demonstrates how valuers may take account of possible, or actual, contamination when preparing their valuations and the examples in Chapter Seven are illustrative of situations in which valuers need to be aware of the potential effect which land contamination may have on the value of a property. In this chapter, and the succeeding two chapters, the implications of contamination for the redevelopment process are considered, together with the effects on value before and after treatment.

8.2 RESEARCH METHODOLOGY

"A classical view of research might see it as a process composed of four stages: analysis, hypothesis, antithesis and synthesis." In the context of real property, however, "research does carry certain connotations for many surveyors and agents, one of which is that research is purely theoretical or 'academic' and therefore of no relevance to the practitioner." (Waldy, 1989, p1) One of the objectives of the present research has therefore been to ensure that the research outcomes are relevant, understandable and of benefit to general practitioners. This objective has been reflected in the choice of research methodology, which is derived from the social sciences. "Methodology is concerned with the norms of the research process, which claim to be simultaneously logically binding as far as factual context is concerned and factually binding where the researcher is concerned." (Habermas, 1988, p44) Understandable facts and logical conclusions are essential to property related research if the outcomes are to have any validity in the marketplace.

"Many people, including professionals outside of the social sciences, question whether sociology and the social sciences are really sciences." (Newman, 1994, p55) There is a tendency to think only in terms of the natural sciences (physics, chemistry, biology) and their applications, such as engineering and soil science. This attitude appears to be reflected in the approach to contaminated soil treatment methods and government policies in the United Kingdom. Policy decisions would seem to have been made on the basis of engineering criteria alone, with scant regard being paid to economic, valuation and other, social science, aspects. In consequence, developers may have decided to forgo development opportunities and bankers may have declined to provide finance, because they have been under-informed, with the result that some contaminated sites may not have achieved their full economic potential.

Nevertheless, as shown by the case studies in this chapter and Chapter Ten, a market does exist in contaminated land, from which information can be gathered. "The purpose of gathering market information is to establish linkages and relationships" and social science research techniques may be used "in order to make predictions which may be tested by observing the market." (Stapleton, 1989, p61) It is argued that social science research is essential to the redevelopment and valuation of contaminated land and that, without such research, a lack of information may produce inappropriate decisions.

"The research method one adopts is likely to be tied to certain assumptions about how to observe and understand people's behaviour and ideas. Such assumptions can always be challenged by other sociologists who may in turn question the very methods one has chosen." (Bilton *et al*, 1987, p 502). Social science research may produce multiple answers to a single question but that "does not mean that anything goes" (Newman, 1994, p55), instead it means that social researchers may choose from alternative approaches to those engaged in research in the pure sciences. Three approaches to social science research were considered for the present study:

- *positivist social science* - which is the approach of the natural sciences, is "a philosophical concept, and refers to a particular set of assumptions about the world and about appropriate ways of studying it." (McNeil, 1990, p116), with the positivist approach "researchers are likely to do quantitative social research and to use experiments, surveys and statistics" (Newman, 1994, p58).
- *interpretive social science* - which relies upon field research and participant observation, often involving hours of personal contact with those being studied. "Data collected in this way is qualitative in form rather than quantitative, that is, it concentrates on presenting the quality of the way of life described, rather than on statistics." (McNeil, 1990, p120); and
- *critical social science* - this is less common than the other two approaches, "researchers [in critical social science] use many techniques, but tend to favor the historical comparative method because of its emphasis on change and because it helps a researcher uncover underlying structures." (Newman, 1994, p72)

The positivist approach has been criticised because, "the researcher has to deal with a dimension not present in most natural science work - the *consciousness* of the subjects of the research. Human beings are not like stones or vegetables because they are conscious of their own existence. They *think* as well as act." (Furbey, undated, p18) Human beings are not a passive component in the equation, they can react and influence outcomes. In positive research, reality "is constituted of phenomena which are causally linked to one another. What is 'real' can only be demonstrated to be real by reference to *empirical* evidence of its existence." (Bilton *et al*, 1987, p502)

"For interpretive researchers, social reality is based on people's definitions of it. A person's definition of a situation tells him or her how to assign meaning in constantly shifting conditions. .... The interpretive approach criticizes positivism because it does not deal with the meanings of real people and their capacity to feel and think, does not take account of the social context and is antihumanist." (Newman, 1994, p68) The interpretive approach also tends to require extended periods of contact with the human beings being studied but does not produce quantitative results.

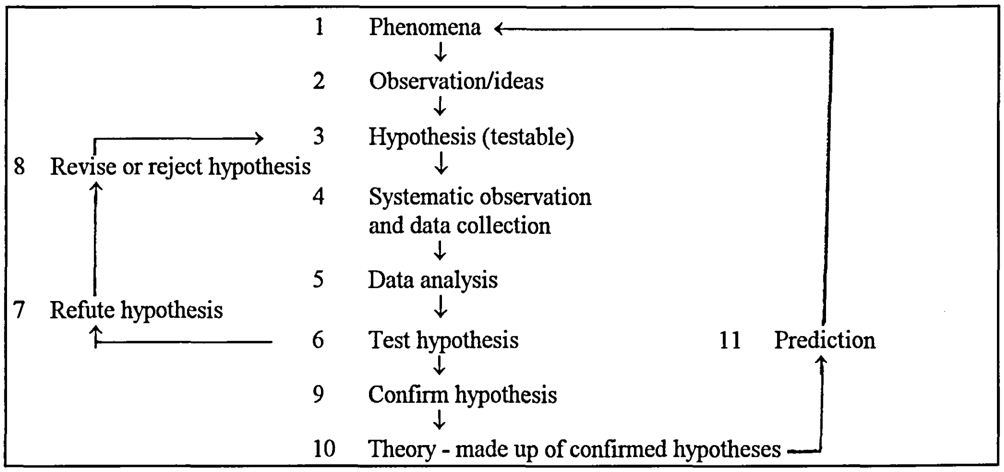
In a study of potentially emotive issues, such as contamination and pollution, there is a possibility that the human beings, whose opinions are being sought, may react in such a way as to produce an unexpected bias to the results. Such a reaction may result from a single adverse personal experience, or a strongly held opinion, and may not represent an objective approach to the subject under consideration. In such circumstances, use of the interpretive approach requires questions to be carefully framed and the research to be conducted in a sensitive manner. For the interpretive approach to be used in the present study, it is likely that comparisons of different group reactions may provide a more meaningful outcome than individual responses. This is not the most appropriate method for research in respect of contaminated land, as the study is concerned more with the impact of physical contamination on property markets in general, rather than with individual or group behaviour.

Critical social science "sees social reality as constantly evolving over time, misleading on its surface, and generated by unobservable and enduring structures. CSS assumes that change is always happening and is rooted in the tensions, conflicts, or contradictions within the historically evolving organisations of social relations or institutions." (Newman, 1994, p67) Critical researchers criticize the interpretive approach for being too subjective and for treating all points of view as being equal. Critical research is used to study and explain issues such as social deprivation and racial conflict, but in general does not provide quantitative solutions, merely identifies critical issues. It is, however, of interest as, "Critical theory informs practical action or suggests what to do in a deductive manner, but theory is also modified on the basis of its use. A critical theory grows and interacts with the world it seeks to explain." (Newman, 1994, p70)

"Instead of the *inductive method* which looks for proof through empirical observation, we have the *hypothetico-deductive method* which combines theory and observation to form the model for mainstream modern science." (Furbey, undated, p12) The hypothetico-deductive approach, which is adopted as the research methodology for the present study, is derived from positivism in that it "portrays scientific research as a coldly logical process, proceeding step by step in a rational manner. It appears to generate more and more knowledge, gradually increasing the total of human understanding of the natural world, which is there, waiting to be understood and explained." (McNeil, 1990, p127) The research methods used, however, do also have some relevance to interpretive and critical social science. Questionnaire and interview surveys were used to assess perceptions in respect of contamination and other environmental issues, a qualitative approach, but some of the results were used to determine valuation impacts and degrees of perceived risk, in other words, quantitative outcomes. Contamination issues have both an historical and a current context and an understanding of both was required in order to develop the predictive model.

The stages in the hypothetico-deductive method are shown in Figure 8.0.

FIGURE 8.0 The hypothetico-deductive method



(Source: after McNeil, 1990, p 50)

Use of the positivist approach presents problems relating to the availability of data to be studied. Although this is true, to an extent, in this study the statistical approaches provide a high level of reliability to the findings. The use of redevelopment case studies enables data analysis to be undertaken, whilst interview and questionnaire surveys enable personal and group opinions to be studied. Thus the different methods enable the research to develop step by step, adding to knowledge as it proceeds.

This study of the effects of contaminated land on redevelopment and value therefore adopts a modified positivist approach, in that it seeks to test a research hypothesis and produce a predictive model, as well as reacting to changes which have occurred during the study period.

8.2.1 <u>The availability of suitable data</u>

"The availability of an adequate volume of good quality transaction and valuation data may be regarded as a pre-requisite for the preparation of valuations of all classes of real estate. This is especially true of land affected by contamination, or other forms of environmental impairment, when the number of transactions is likely to be limited. Sources of data may include assessments for local taxation, sales and leases of property and the exchange of information through multiple listing arrangements." (Syms, 1995b)

Local authorities in England and Wales were traditionally financed through the levying of rates, a local tax based on the annual (rental) values of land and buildings within the authority's administrative area. This system has now been replaced by Council Tax for residential properties, with individual dwellings being allocated to broad value bands. Although rating has been retained for commercial and industrial properties, assessments are not revised annually and the detailed valuation data is not available to valuers. Details of all property transactions are recorded by the Land Registry but only limited access is currently available to valuers. It is possible to obtain details regarding property ownership, easements and other charges, but the price paid is not available. Searches have to be made in respect of individual properties and aggregated data are not available.

"Multiple listing is not a feature of UK real estate markets, even for residential properties. Estate agents are generally instructed to act on the basis of sole agency, or joint sole agency arrangements, for all classes of property and fee sharing arrangements are uncommon. Therefore, there is very little exchange of information between real estate firms, although information is passed through informal contacts. Aggregated data is available in several forms, for example, in respect of investment properties through the Investment Property Databank (IPD) which relies on information supplied to it by member firms, property companies, pension funds, insurance companies and the major surveying practices. Although the IPD monitors a substantial part of the investment property market, in value terms, it deals primarily with prime investments and is of little help when dealing with contaminated properties. Many of the research departments in major surveying practices undertake regular reviews of different aspects of property markets, for example, the King Sturge Industrial Floorspace Survey which tracks changes in the availability of industrial premises. Again, the information is only available on an aggregated basis and the databases are in the very protective ownership of the individual firms.

Some transaction data are available, through organisations such as Focus, using information provided by subscribers and published sources, such as the professional press and newspapers. Such data does not, however, give a full picture of the market and the existence of any contamination is likely to be deliberately omitted from the database or played down in terms of importance. (Syms, 1995b)

The data required to undertake a macro-level study of the impact of contamination on property values in England and Wales is therefore not publicly available, even for research purposes. It is also doubtful that, if the information contained in the records of organisations such as the Land Registry and the Valuation Office Agency, were to be made available, the recorded information would be sufficiently detailed to enable the contamination effect to be adequately separated from other factors affecting value. This is in marked contrast to the situation which exists throughout much of the United States, where a number of researchers have studied the effects of contamination and "bad neighbour" users through the statistical analysis of large sets of property transaction data. See, for example, Simons, (1994) and Kinnard *et al*, (1995).

Data on property transactions is also held by other organisations in England and Wales and an approach was made to English Partnerships with a request that limited access be allowed to the data contained in its files on redevelopment projects. Information from these files would have enabled a sizeable sample to be compiled, with something in excess of 300 developments, although it would have been limited to projects which had received grant aid. This would have the effect of excluding from the sample those sites where the cost of treatment was significantly below the post-remediation value of the site. Also excluded would be any sites in respect of which applications for grant aid had been rejected.

English Partnerships has continued the practice, established by the Department of the Environment, of publishing details of grant aided schemes. The published details include the site location, name of the developer, type of project (e.g. housing or industrial), the number of units or floor area as appropriate, the anticipated end value of the development and the amount of grant awarded. The additional information requested was as follows:

i) whether or not the site was contaminated;

ii) the nature of any contaminants;

iii) the remediation method(s) adopted;

iv) the base value of the site;

v) the cost of treatment; and

vi) the resultant development value of the site.

The research was discussed at a senior level within English Partnerships and, although the objectives of the research were supported, a decision was reached that "the difficulties with commercial confidentiality ..... were felt to be insurmountable". (Richardson, 1995) Access to the files was therefore denied.

In view of the decision by English Partnerships, it seemed most unlikely that it would be possible to conduct a macro-level study, as other organisations were even less likely to co-operate with the research. Two micro-level studies were therefore decided upon, with a view to combining the results into the valuation model.

The first study required the analysis of a limited number of case studies, in order to determine whether or not stigma existed in practice and, if so, to what extent it affected property values. Approaches were made to a number of national and regional surveying practices, as well as to development companies, so as to ascertain whether or not sufficient information could be obtained for case study purposes. Several of the surveying firms indicated a willingness to assist with the research but expressed concern over making information available on the grounds of 'client confidentiality'. From discussing the problem with the individuals concerned, it appeared that there was an even greater reluctance to divulge information in respect of contaminated properties than in respect of normal property transactions. This, in itself, may be regarded as a symptom of stigma. Several property developers were not so constrained and the case studies obtained are described in section 8.4.

"When the value of an uncertain quantity is needed ...., and limits in data or understanding preclude the use of conventional statistical techniques to produce probabilistic estimates, about the only remaining option is to ask experts for their best professional judgement." (Morgan and Henrion, 1990, p102) The second micro-level study therefore took the form of questionnaire and interview surveys of valuers and other professionals associated with the property industry, in order to assess their views as to the impact of land contamination on values and the redevelopment process. When attempting to assess the probability of a certain event occurring, such as the likelihood of a harmful effect from land contamination, "people often resort to the heuristic procedure of *availability*. That is, their probability judgement is driven by the ease with which they can think of previous occurrences of the event, or the ease with which they can imagine they event occurring. For problems with which one has a large amount of direct personal experience this heuristic is likely to perform rather well." (Morgan and Henrion, 1990, pp102-3)

The 'perceptions' study was conducted in three phases over a two-year period. Members of the general public were involved in the final phase, so as to provide a comparison in respect of the 'expert' opinions and to place the contaminated land issue into context with a number of other environmental issues. A number of research methods were used in the 15 studies reviewed by Zeiss and Atwater (1989), in order to determine the effect on property values of noxious waste facilities. These methods included measurement of the distance and angle downwind from landfill sites and incinerators, distance and visibility of landfills to explain percentage changes in values over time, regression and hedonic pricing models in respect of distance from landfills and relationship of properties to landfill road access points. The results from the 15 studies were variable, in some of the studies significant price reductions were observed, whilst in others there was no significant effect.

So far as the present study is concerned, angle, distance and visibility methods are not relevant, as the purpose of the study and the valuation model, relate to the redevelopment and value of land which has actually been contaminated. In other words, it is not a study of proximity effects. Insufficient data is available about industrial property and development land markets, and specifically contaminated land transactions, to enable regression or hedonic pricing methods to be used. The questionnaires and interviews study was used to construct the valuation model and the case studies were used to test its effectiveness. A psychometric technique was therefore used to design and analyse some of the questions in the second questionnaire survey, based on the method described by Slovic (1981 and 1992). It must, however, be recognised that the psychometric approach has its limitations. It is not possible to reflect the views of all valuers, developers and other professionals concerned with contaminated land. Such a study can only consider a limited number of potentially contaminative uses, soil remediation methods and future uses, otherwise it would become unwieldy. A psychometric study can not reflect the harmful effects of specific contaminants, as many of the individuals studied, especially the valuers, are unlikely to possess sufficient technical knowledge to assess the attendant risks.

8.3 ASSESSING IMPACT

According to Lord (1991, p.145) "The success of any development relies on close co-operation between the developer, the architect, the engineer and the quantity surveyor - success being the fulfilment of the developer's requirements at an economical cost". The role of the valuer is not mentioned. However, it is argued, the valuer has a pivotal role to play in the development process - especially where contaminated land is concerned. For, if the valuer is not satisfied with the remediation method selected for the treatment of a particular site, he or she may not be prepared to produce a valuation at a figure needed to provide the developer with a profit. The remediation method recommended by the engineer as satisfying present day requirements, and identified by the quantity surveyor as being the most cost effective, may be unacceptable to a valuer advising a client, for example, either a tenant or an investor, contemplating a long term commitment to the completed development. The valuer therefore needs to be involved with proposed development projects on derelict or contaminated sites from their inception.

At the time of writing, the methods of site remediation most commonly used in the United Kingdom have been the excavation of contaminated material and its disposal to landfill, and on-site containment of the contaminated material. As discussed in Chapter Six, any treatment which leaves behind residual contamination, whether securely contained or at reduced toxicity levels, is likely to result in values below those which may be attributable to a greenfield, but otherwise similar, property. On the other hand, a site which has undergone the most thorough cleansing may still suffer from stigma due to its past use or uses. Therefore the costs and benefits attaching to all possible treatment options need to be carefully weighed in the balance before a final decision is taken.

Environmental objections to the transfer of contaminants from one location to another, more stringent controls arising out of the Environmental Protection Act 1990 and the Environment Act 1995, and the reduced availability of suitable landfill sites have significantly increased the cost of the option of excavation and off-site disposal. Alternative forms of treatment can therefore be expected to become more attractive in both cost and environmental terms but it remains to be seen to what extent the alternatives will be acceptable to actors involved in the development process. It is argued that, in the short term at least, developers, funders, occupiers and other property users will approach untried or unconventional treatment methods with a high degree of wariness, especially if the methods are designed to reduce, rather than remove, contamination.

The following comparison of the excavation and containment methods is taken from an actual case in east Manchester, where a chemical manufacturer wished to construct a new warehouse for its own use on part of its site which had previously been used for open storage (Syms, 1994b). The site was larger than required by the company for its own use and the company also wished to rent, rather than own, its new building. An approach was therefore made to a local developer who would build two identical units, one pre-let to the company and the other to be let in the open market. The site was severely contaminated with heavy metals, which were immobile, and discussion ensued as to the method to be used in treating the site prior to redevelopment. The matter was very complex, involving issues of liability, and was never resolved, with the result that the development failed to take place but the issues were essentially as described below.

The example examines the issues relating to remediation options at three levels; firstly in respect of the land itself, as a site already owned or to be bought for use by an owner occupier; secondly from the viewpoint of the potential tenant of a new development, intending to sign a lease for a term of 25 years on a full repairing and insuring basis with upwards only rent reviews; and finally as perceived by the ultimate investor in the completed development. Reflecting current approaches to dealing with contamination, the two remediation options under consideration are the removal of the contaminated material, and its disposal off site, to be replaced with clean fill, and the containment on site of the contamination under a layer of clean cover.

Box 8.1 compares how the viability of site reclamation may be calculated when using the two selected methods of treatment. Firstly, using the method of excavating contaminated material and its replacement with clean fill, as described in Chapter Five, it can be argued that the value of a site treated in this way with good engineering design, carefully supervised and well documented, is no different to the value of a previously undeveloped 'greenfield' site, and this is reflected in conventional valuation advice. The residue of £60,000 per hectare for finance and profit is, by normal development criteria, a reasonable return (22.22%) for the capital and risk involved in reclaiming the site.

Secondly, the alternative containment method is shown and it will be noted that, in spite of a lower realisable value, the residue for finance and profit is the same as that for the removal option. This is due to the lower level of expenditure on site treatment. The post remediation value of the site is therefore below that which would apply to the use of what may be regarded as the more thorough remediation method. This is due to the fact that the contamination remains on site but the containment option produces a better return, at 33.33%, on capital employed. The risk factor may also be significantly reduced as the remediation becomes less susceptible to outside influences, such as increases in haulage and landfill disposal charges.

BOX 8.1

IMPACT ON DEVELOPMENT LAND VALUES
COMPARISON OF TREATMENT METHODS

• Treatment method (a one hectare site)		Excavate and replace	Contain and cover
• Existing site value		*per hectare*	*per hectare*
say for open storage or lorry parking		£ 60,000	£60,000
• Cost of site remediation			
Excavate contaminated material, cart away to landfill and backfill with "clean" material, inclusive of fees but excluding finance costs	- say	£210,000	
OR -			
Containment of contamination within the site and covering with "clean" material, inclusive of fees but excluding finance costs	- say		£120,000
• Total cost of reclaimed site		£270,000	£180,000
• Value of reclaimed site, reflecting perceived risk	- say	£330,000	£240,000
• Deduct existing value and treatment cost		£270,000	£180,000
Residue for finance and profit		£ 60,000	£ 60,000
• Residue as a percentage of existing site value plus remediation costs		22.22%	33.33%

Either of the remediation methods used in Box 8.1 may be perfectly acceptable to an individual or organisation wishing to construct a building for owner occupation, as in the case of the chemical company referred to above, especially if the occupier can adequately assess the risks involved. Indeed, for a continuation of industrial use the less costly treatment method, with its resultant lower site value, may be preferred and it may be inappropriate to attempt to achieve a higher standard of remediation. Problems may, however, arise in the event of a sale at some future date, or if the owner wishes to use the premises as security for a bank loan. It is therefore necessary to consider how another occupier, in this case a potential tenant, and a funding institution may perceive the two alternative treatment methods.

Box 8.2 illustrates a simple residual valuation for the development of an industrial building of 4,250 square metres on the same one hectare site as considered in Box 8.1. The owner occupier would be satisfied with the containment and cover option but a potential tenant and an investor may have a different perception. In other words the speculative unit development in the chemical company example.

So far as the removal and replacement option is concerned, it is assumed that the valuer acting for the prospective tenant is satisfied with the site treatment and so too is the valuer acting for the institutional investor, stigma in this case is considered to be of no significance. The rental and yield rates used in the appraisal are in keeping with those which might be applied to a development on a greenfield site in the same locality, at the time when the development was to be undertaken. The residue for finance and profit is such that the project would be an attractive development proposition for a pre-let development.

If, however, the site had been treated by the cover and containment method a very different result might emerge. The valuer, acting on behalf of the prospective tenant, may take a more cautious approach and, although satisfied with the adequacy of the remediation method for continued industrial use of the site, may be justified in having some concerns with regard to the long term nature of his client's responsibilities under a 25 year lease. He would therefore seek to exclude any liability from attaching to his client in respect of the contamination containment and also demand a reduction in the rent to be paid, of say £5-00 per square metre per annum.

The fact that contamination remains on site, and that the tenant refuses to accept any future liability in respect of that contamination, will have a direct impact on the yield obtainable in the investment market. Any potential investor will require a higher return on capital employed, so as to compensate for the possibility that the contamination may represent a future liability. In this example, therefore, the anticipated investment yield has been moved out by two percentage points, so as to reflect the fact that the completed development may not be attractive to an institutional investor but is acceptable to a private investor. The combined result of the tenant's and the investor's perceptions of the treatment method will, therefore, be one of turning a profitable development into a loss. A prudent developer will tend towards the treatment option which removes, rather than contains or reduces, the contamination risk.

BOX 8.2

IMPACT ON INVESTMENT /MORTGAGE VALUES
IN THE OPEN MARKET

• Proposed development of a light industrial/warehouse building of 4,250 square metres on a site of one hectare, comparing two treatment methods			
• Treatment method		Excavate and replace	Contain and cover
• Rental value 4,250 square metres @ £45-00 per square metre	£191,250 per annum		
• Capitalisation yield 11%	9.09 Years Purchase		
• Investment value of development (gross)		£1,738,600	
OR -			
• Rental value 4,250 square metres @ £40-00 per square metre reduced because of perceived risk	£170,000 per annum		
• Capitalisation yield 13%	7.69 Years Purchase		
• Investment value of development (gross)			£1,307,700
DEDUCT COSTS			
• Site cost as Figure 8.1		£ 270,000	£ 180,000
• Building (design and build package), same for both options		£1,130,000	£1,130,000
• Total cost		£1,400,000	£1,310,000
• Residue(deficit) for finance and profit		£ 338,600	(£ 2,300)
• Residue as a percentage of existing site value plus remediation costs		24.19%	-0.18%

Source: Boxes 8.1 and 8.2 based on Syms, 1994b

The simplified example described above considers only two methods of dealing with contaminated land and assumes that, once treated, the site will remain in industrial use. There are, of course, many other methods of site treatment available today, as discussed in Chapter Five, and it is also quite possible that, following remediation, the formerly contaminated site will be redeveloped for another, non-industrial use.

8.4 CASE STUDIES

As discussed in Chapter Six there is, at the present time, no readily accessible source of information relating to property transactions in respect of contaminated land. In spite of the lack of a comprehensive database it is possible to make assessments as to the likely impact of industrial contamination on values, using case studies for which transactional data are available. The following case studies describe six actual developments undertaken between 1987 and 1996 on sites which had previously been used for a number of different purposes, were treated by different reclamation methods and redeveloped for a variety of end uses.

In all the case studies, the information required to be considered was as follows:

- site location, including a description of its size and topography;
- history of the site, especially past uses of a potentially contaminative nature, site ownership and problems associated with assembly;
- site geology and, where appropriate, hydrology and hydrogeology;
- details of the contamination found on the site and its severity;
- details of the professional and contracting team and the methods by which they were appointed;
- methods of site remediation considered and eventually selected;
- details of how the project was financed;
- type of development undertaken following site remediation;
- site values, before and after treatment;
- conclusions to be drawn from the case study, especially those concerned with redevelopment and value.

The case studies selected for the purpose of the research are located in the North West Region of England and North Wales. They were chosen on the basis of their different past uses and forms of contamination, differing methods of site remediation and end use. All of the information contained in the case studies has been obtained from confidential files, site investigation reports, marketing reports, development appraisals and grant applications with the consent of the developers concerned.

8.4.1 Piccadilly Village, Manchester[1]

Immediately to the north of Piccadilly Station, Manchester's main line railway terminus, was an area of industrial dereliction. The area in general is bisected by the Manchester and Ashton Canal and includes the junction of that canal with the Rochdale Canal. In the 19th and early 20th Century this was a very important traffic hub, both in connection with the canal system and following the introduction of the railway. The former cotton mills became disused or passed into alternative uses, many of which were un-neighbourly, most of the other manufacturing concerns either went out of existence or managed to subsist at the economic margin. Such residential accommodation that had existed in the area, mostly 'back to back' terraced housing, had been demolished as a result of slum clearance programmes.

The initial land use study, commissioned by Manchester Phoenix Initiative, a private sector urban regeneration organisation, identified a site of approximately four acres (1.62 hectares), bisected by the Ashton Canal which, due to the fact that many buildings had already been demolished, could be developed at an early date. The Canal was still in use as part of the Cheshire Ring of the leisure waterways, although it was in need of dredging. The canal structure, in the form of its walls and adjacent footpaths, was in an unsound condition and totally unsuitable for the new development. Water was leaking from the canal into the

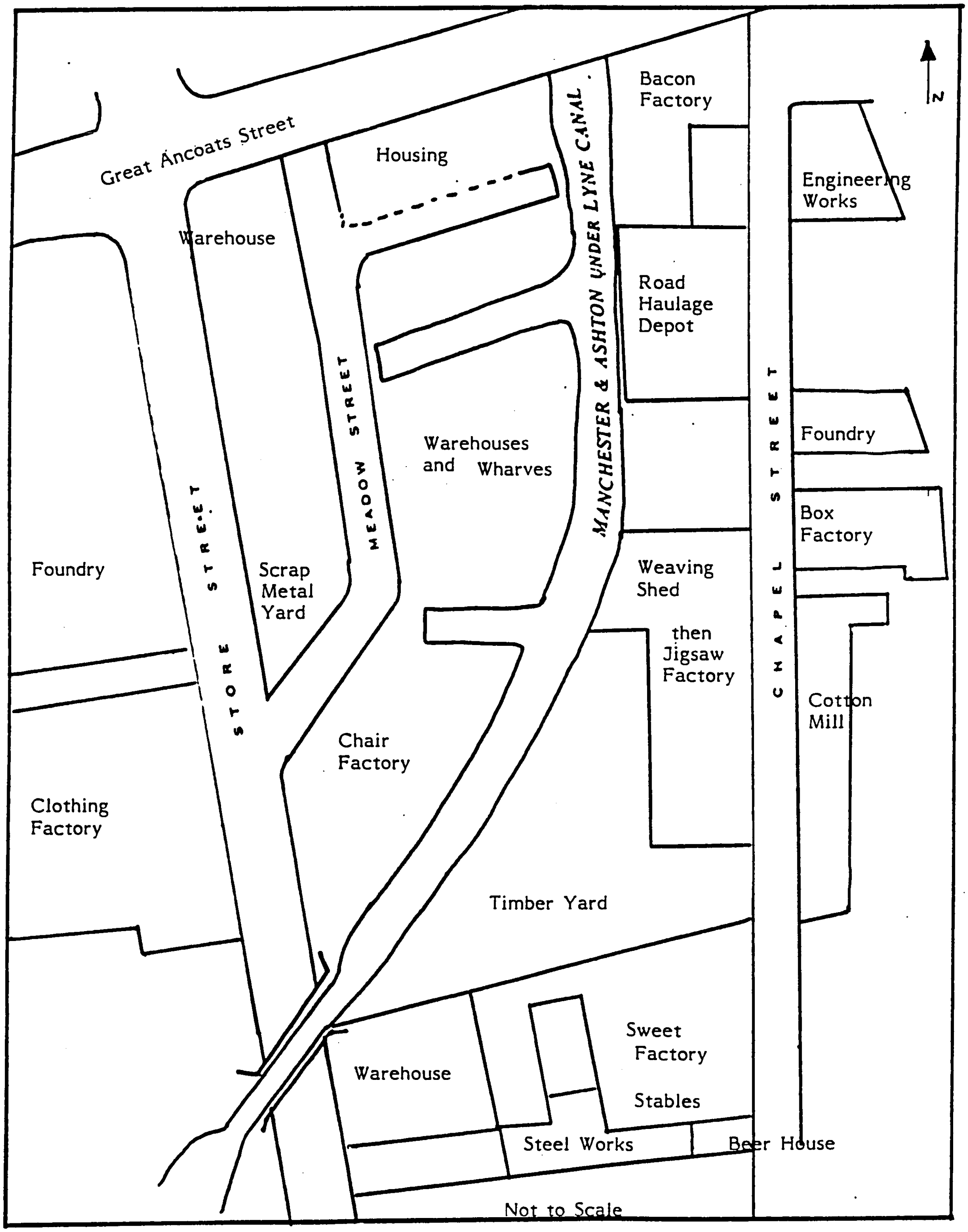
1 This case study was originally published as part of Syms 1993 and has been revised.

site and there was a potential risk of damage to the foundations of the new buildings. The two parts of the site had, during the commercial lifetime of the canal, contained a total of three canal basins but these had been filled in at some time in the past.

Previous land uses had included canal warehousing, a timber yard, a cotton weaving shed, later to become a jigsaw puzzle factory, and stabling for the shunting ponies used by the railway company, with a beer house next door. Several terraced houses, mostly with the ground floor converted to shops, occupied one road frontage and a former chair factory had been destroyed by fire, see the land use plan in Figure 8.1.

By the early 1980's most of the original uses had ceased and a number of other uses had taken their place. The warehousing had been demolished, replaced for some years by a scrap yard then used for depositing canal dredgings, the jigsaw factory had been demolished with the concrete floor left in place and had been fly-tipped. The timber yard had closed and was also affected by fly-tipping, the stables had been demolished but, as the site was surrounded by a high brick wall, had not been seriously affected by fly-tipping. The beer house had closed and was occupied by a rag sorter. A number of the terraced houses had been demolished and were in use as a car sales lot, and the site of the chair factory remained derelict.

FIGURE 8.1
FORMER USES PLAN OF PICCADILLY VILLAGE, MANCHESTER



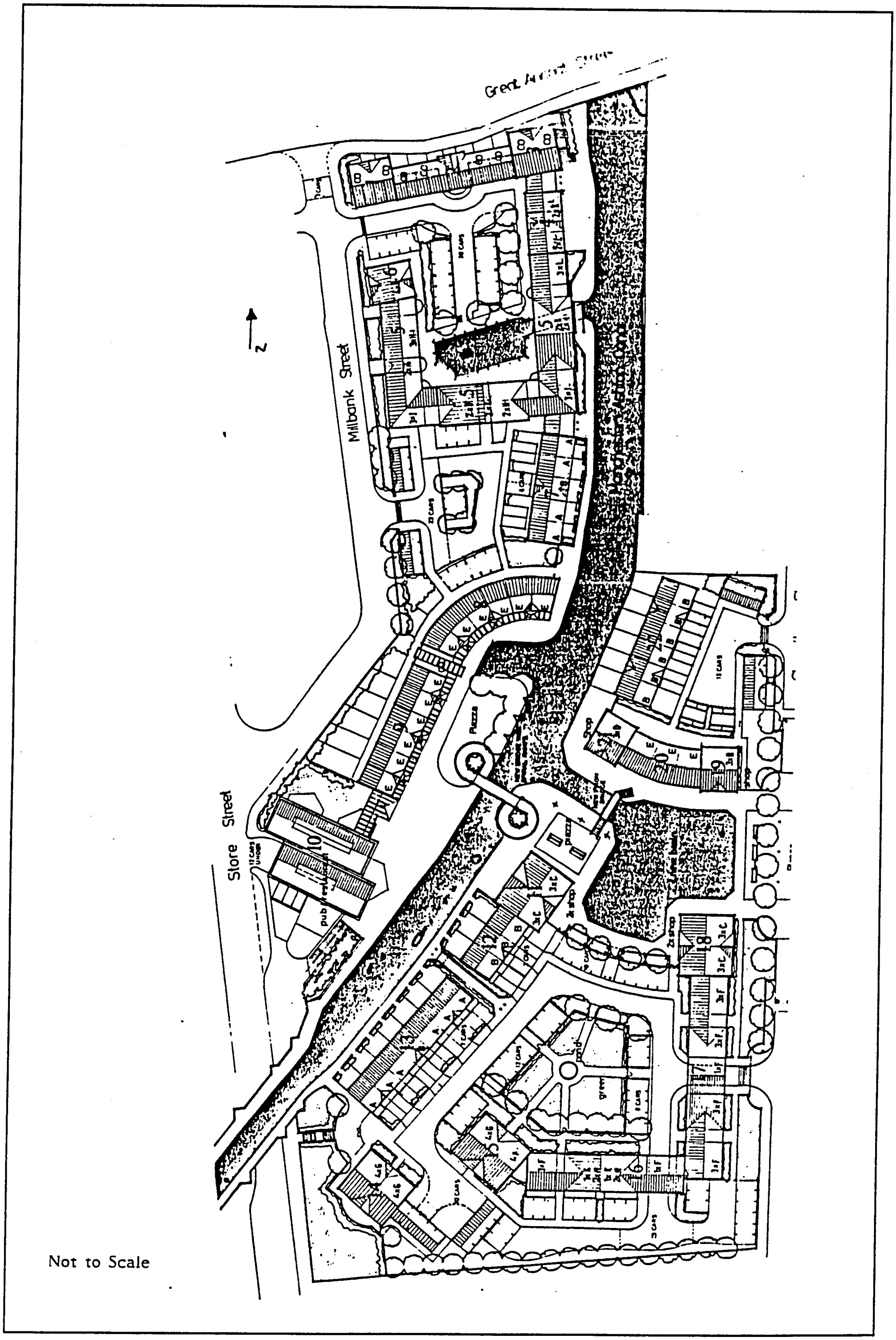
At the time of the land use study, the initial four acre site was in eighteen different ownerships, which included bodies such as British Waterways, Manchester City Council and British Rail. Fortunately the first two of these bodies agreed to include their land in a comprehensive redevelopment scheme The City Council made a Compulsory Purchase Order in respect of a number of the ownerships, along the Great Ancoats Street frontage, for the purpose of widening that street in order that it may form part of the City's Inner Relief Road. British Rail, on the other hand, decided that it could not wait for a comprehensive regeneration scheme to be put together and made the decision to sell, by auction, its totally derelict portion of the site. That small, but essential, piece of land eventually had to be acquired from the successful bidder with the help of the Department of the Environment.

Contamination affecting the site consisted mainly of heavy metals and coal tars. The worst affected areas were the filled canal basins and the dredged spoil deposited on the North side of the site. The fly-tipped materials were found to be generally uncontaminated. Other than the material deposited on, or within, the site the soil was found to be high in sulphates, probably due to fall out from the former town gas works located near to the site.

A joint development company was set up between one of the landowners, Moran Holdings Plc of London, and a north west based developer, Trafford Park Estates PLC. Other than the development consultant, who had been part of the original study team, no other professionals were employed by the joint development company in the early stages of the project and it was therefore necessary to assemble a full team, capable of undertaking a project of this size and nature. A development brief was prepared, setting out the requirements for a mixed commercial and residential development, and used to appoint the architect. The quantity surveyors and consulting engineers were appointed from firms with which the joint venture partners had worked on previous occasions. The consulting engineers were also responsible for advising on aspects of contamination. So far as the water related engineering aspects were concerned, it was decided to appoint British Waterways' own civil engineering department for their expertise in the design of canals and bridges. The successful design for the development is shown in the layout plan in Figure 8.2.

Reclamation of the site was carried out in 1988-1989, prior to the introduction of the Environmental Protection Act 1990. Nevertheless the site was reclaimed in a controlled manner, with the contaminated material being removed to a licensed landfill. Thus the clean site option was chosen, so as to render the site suitable for any end use. Where contaminated material was contained in voids, such as old canal basins, these were excavated and either refilled with clean material or re-opened to the canal. Following reclamation, the ground was left with a high sulphate level, probably no different to that found in the surrounding area, and sulphate resistant cement had to be used in the construction of foundations and ground floor slabs.

FIGURE 8.2
PICCADILLY VILLAGE REDEVELOPMENT PLAN -
winning competition entry



When the Piccadilly Village project was conceived in 1987 the property development industry was fairly buoyant and the banks were prepared to bid against each other for the privilege of providing competitive finance rates for what they perceived to be prestige projects. Thus it was possible for the development partnership to obtain a very attractive package of bank lending. Private sector funding on its own, however, was not sufficient to ensure the commercial success of the project. Public sector support was necessary so as to provide the right environment for urban renewal, by overcoming the ground and water engineering problems. Discussions were held with the Department of the Environment and the fledgling Central Manchester Development Corporation, with the result that a City Grant of £1.13 million was awarded to the project. This equated approximately to the estimated costs of reclaiming the site and the restoration works to the canal, the new development itself did not receive any commercial subsidy. City Grant was a shortfall grant, funded entirely by central government, intended to bridge the gap between project cost and end value (including a reasonable profit level), when the cost was higher than value. Any excess profit was normally shared between the government and the developer. City Grant was the successor to Urban Development Grant and Urban Regeneration Grant, both of which owed their origin (in 1981) to the United States Urban Development Action Grant. City Grant has now been replaced by English Partnerships' Investment Fund.

The project was initially designed to provide 125 residential units, 15 craft studios, six shops and 16,000 square feet (1,486 square metres) of office accommodation. During the course of construction a number of changes were made, which increased the number of residential units to 150 and omitted the craft units. The contractors for the site treatment work, rebuilding of the canal walls and the underground infrastructure works were appointed on the basis of a competitive tender. Construction, roads and landscaping work was undertaken by the joint venture company owned by the development partners.

Following the formation of the development partnership, negotiations were commenced in order to acquire the other land ownerships and all of these were eventually acquired, by agreement, producing a total cost for the site of just in excess of £76,000 per acre (£187,800 per hectare). The consideration paid for the site included the sum of £40,000 paid to the rag sorter for the loss of his business and a 'ransom' of £30,000 paid to the car park company in respect of the land sold at auction by British Rail. If these sums are deducted from the total price paid the net cost of the land, excluding fees, was only £58,500 per acre (£125,600 per hectare).

This relatively low price for land close to the City Centre was attributable to the fact that major changes in level existed between the canal and the adjoining streets, the configuration of the plots themselves made redevelopment extremely difficult and ground problems, including contamination, were anticipated. At the time of the site assembly prime industrial land in the Manchester area, with good road connections, was selling at between £125,000 and £150,000 per acre (£309,000 to £370,500 per hectare), with good quality residential development land in the suburbs fetching almost twice these figures[2].

2 Based on records maintained by leading Manchester estate agents.

Adams *et al* (1985) had undertaken a study of inner city land values in Manchester shortly before the site assembly commenced and this provides an invaluable means of comparing land values. Most inner city sites suffer from problems in respect of small plot sizes, inadequate road access, poor services and, in the case of Manchester in the mid-1980's, a declining industrial base. The study undertaken by Adams and his co-researchers examined land transactions in the inner city during a study period 1978-1983. This included sites which had subsequently been redeveloped and those which had remained vacant.

The previous owners of the study sites included both public and private sector organisations and the proposed future developments included industrial, commercial and residential uses. The study period was divided into two sub-periods, 1978-80, and 1981-83, and the researchers found that the highest mean price obtainable for land within the inner city was a "figure of around £77,000 per acre [£190,267 per hectare] for commercial land in inner Manchester" (Adams, *op cit*, p165). No transactions had been recorded in respect of sites for residential development in the earlier period and only four in the latter period, with prices of between £50,000 and £71,500 per acre (£123,550 and £176,677 per hectare).

Given the mixed commercial and residential nature of the Piccadilly Village development, and its proximity to the city centre, it is reasonable to assume that if the site had been uncontaminated and available for sale in a developable state, that it would have commanded a price between the highest recorded for a residential development site and the mean price for commercial sites. On this basis, therefore, an uncontaminated value has been assumed for the site of £74,250 per acre (£183,470 per hectare). The cost of site reclamation, including rebuilding of the canal walls and basins, was covered by the public sector grant aid without any private sector subsidy. Therefore the difference between the value indicated by Adams' study and the price actually paid, £15,750 per acre (£38,918 per hectare) may be regarded as the discount required by the developer over and above the cost of dealing with the site problems. This represents a 'stigma' effect of 21.21 per cent.

Even in one of the worst markets for residential property, a good level of sales was achieved. During the eighteen month period following release of the first phase, a selling programme was maintained three to four months ahead of completions. Whilst the residential properties had to be priced at full market value, a requirement of the City Grant, they were fixed at a realistic level so as to attract purchasers into this previously untested part of the inner city. Prices ranged from £39,950 for a 'bedsit' and £50,000 for a one-bedroomed apartment, up to £140,000 for a four-bedroomed house. "At these prices it is not difficult to understand why people are [sic] willing to consider moving back to the centre" (Hanson, 1991). Sales of the commercial properties were slower than the residential units, much more in line with market conditions.

The fact that the site was previously contaminated does not appear to have presented any significant problems and, so far as the development company is aware, has not resulted in any potential purchasers being refused mortgages.

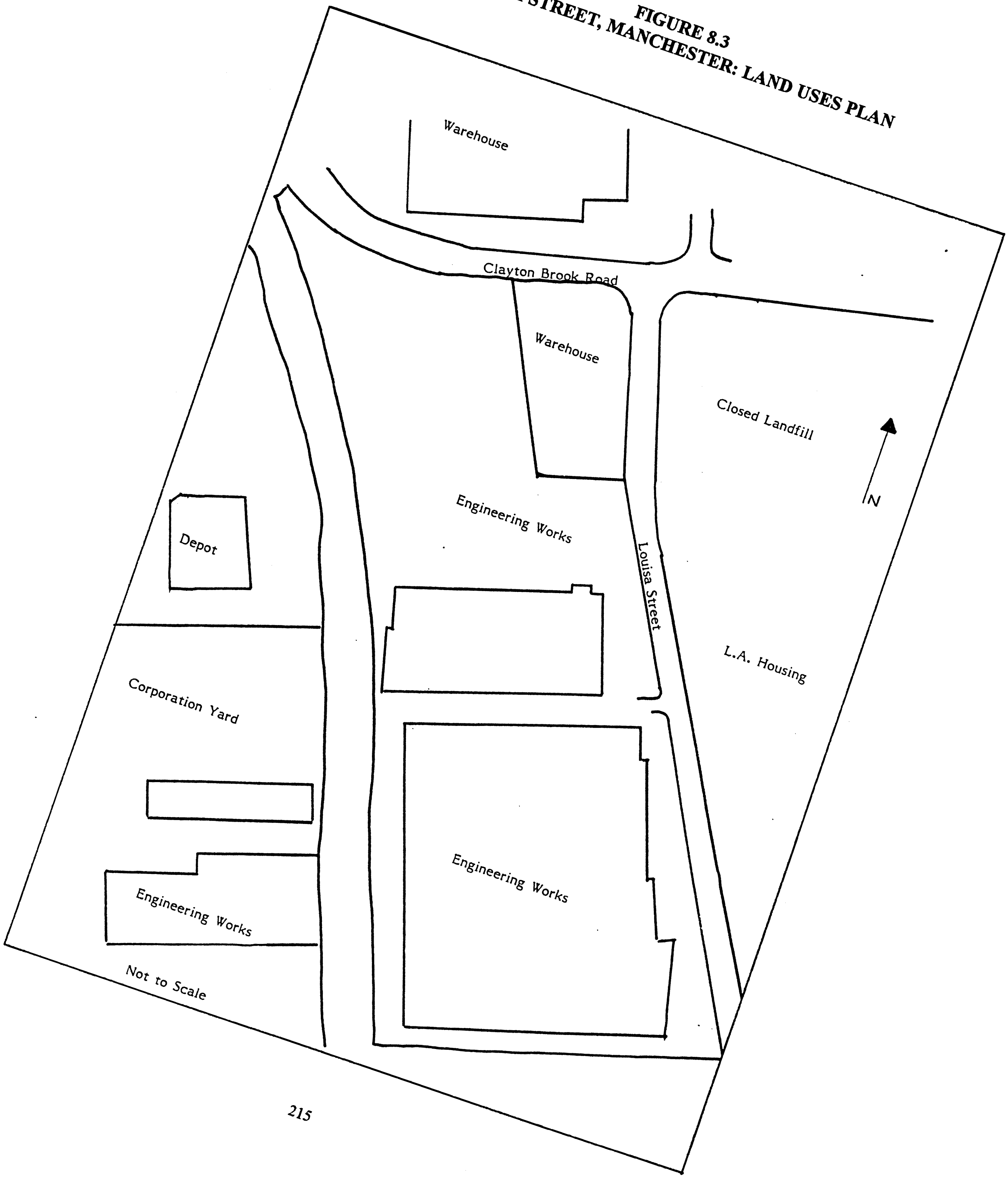
Information concerning past uses on the site and the treatment method used was made available to solicitors and building societies. The Piccadilly Village development was unique in terms of its waterside location, design and proximity to the city centre. Selling prices of up to £1,075 per square metre (£100 per square foot) were achieved on the development, compared to around £700 per square metre (£65 per square foot) for conventional housing developments, lacking the water aspect, approximately half a mile further from the city centre. It is, therefore, not possible to identify any post development 'stigma' effect and, so far as the developer is aware, no prospective purchasers were discouraged by the site's industrial history. As an exercise in urban renewal the project has transformed a run down area of the city and is starting to demonstrate a 'catalytic' effect in encouraging adjoining landowners to embark upon development projects.

8.4.2 Louisa Street, Manchester[3]

This was a 7.2 acre site in East Manchester, located in an area which until 1980 was totally dominated by heavy industry, especially engineering. Today virtually all of the industrial businesses have closed, as a result of going out of business, reduction in the number of plants or relocation to greenfield sites. They have left behind a legacy of redundant buildings, mostly vandalised, or cleared but contaminated sites. A plan of the site, showing adjoining uses, is in Figure 8.3.

3 A fuller account of this case study was originally published in Syms 1995a.

FIGURE 8.3
LOUISA STREET, MANCHESTER: LAND USES PLAN



The case study site was once the location of a long running industrial dispute in the early 1980's, when the workforce was locked out by the management. After many months of bitterness the matter was brought to an end, the factory was demolished and the site was eventually sold for £500,000 as a residential development site. Following the sale, site investigations revealed extensive contamination, caused by the previous industrial use. Part of the site appeared to have been filled with waste materials from the former metal finishing operations, whilst other areas were clearly filled with demolition rubble, some of which contained contaminants from the same source.

There was no recourse to the vendor. *Caveat emptor* applied and the purchaser had neglected to undertake any investigation work before entering into the contract. In time the intending developer became the victim of financial difficulties and the bank stepped in as mortgagee, owed £750,000 in principal and 'rolled up' interest charges.

After more than two years, and many abortive negotiations, the bank agreed to sell the site to Maunders Urban Renewal, a division of John Maunders Group Plc, a volume house builder, for £325,000 and the Department of the Environment offered a City Grant of £765,000 to ensure the redevelopment of the site. As the estimated cost of dealing with the contamination was only £569,000, it can be seen that the grant included an element of commercial subsidy, supporting the provision of new housing in a depressed part of the city. The private sector funding was provided from the internal resources of the developer, and all of the design work, other than in respect of the site remediation, was undertaken by the in-house team.

The entire site was covered with demolition rubble and industrial wastes, up to three metres in thickness, over a layer of ash material on top of the natural clay. The site had been levelled following completion of the demolition work and banked along the road side to prevent fly-tipping and use of the site by itinerants, then left to naturally vegetate. A disused canal which formed the western boundary of the site had been filled with a variety of material of unknown origin.

Following a site investigation commissioned by the bank the fill material was found to be contaminated with a wide range of heavy metals and mineral oils. Most of the contaminants were at concentration levels below the Trigger concentrations for domestic gardens, as set out in ICRCL 59/83, but elevated levels of Lead, Arsenic, Copper, Zinc, Nickel and Boron were found. For all of these contaminants the highest concentrations were found within two discrete areas of the site. The consultant engineer responsible for carrying out the site investigation for the bank was subsequently retained by the developer to supervise the remediation work.

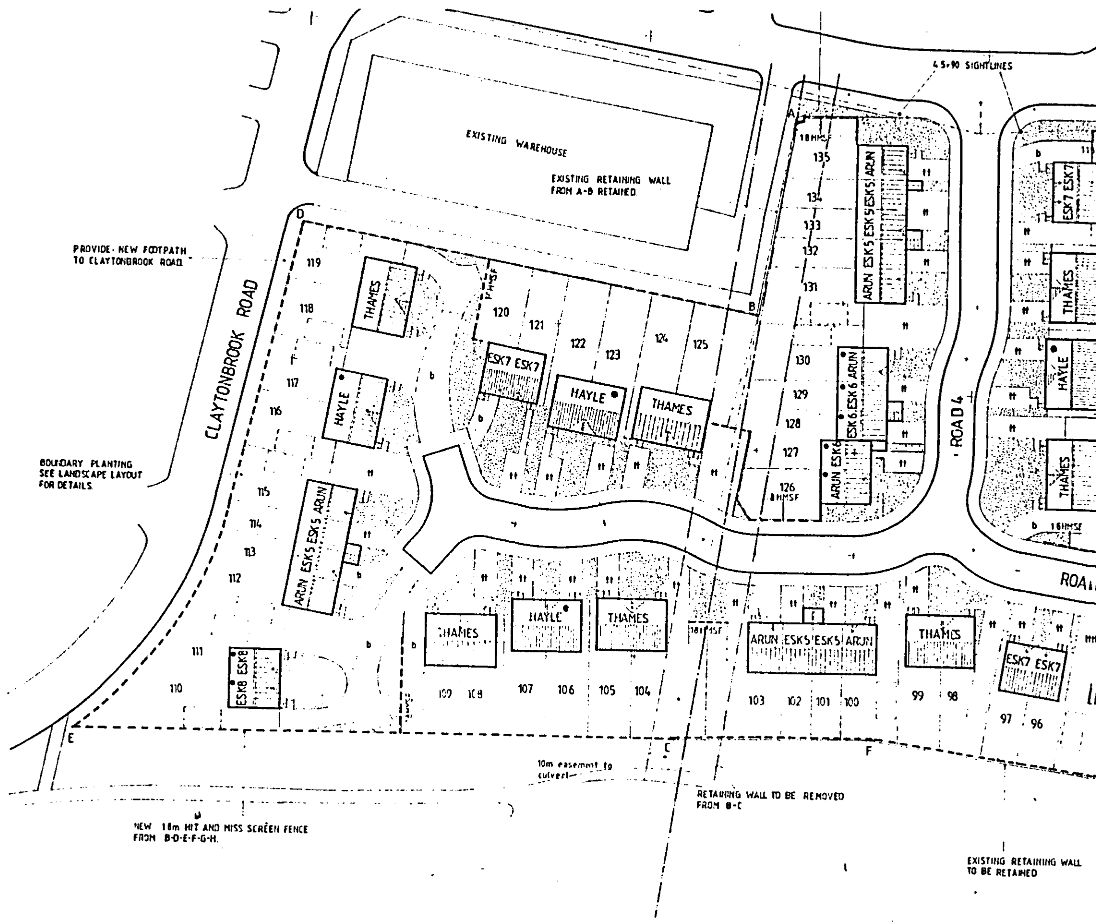
The method of site remediation used for this case study site was based on the safe containment of a residue of contaminated material, at concentration levels which were considered to be safe, under the development itself. Contaminated 'hot spots' were removed and the remaining contaminated fill material was regraded to fill the voids left by the 'hot spot' removal. This had the effect of lowering the ground level throughout the site and reducing the remaining contaminants to concentrations below ICRCL trigger levels. The site was then covered with one metre of clean clay and topsoil.

The alternative of removing all of the contaminated material to landfill, and 'backfilling' with clean material, was considered but this would have cost in excess of £1.2 million. The level of grant aid required for this alternative would substantially have exceeded the Department of the Environment's aid guideline of one part of public money to four parts of private money (DoE, 1992). The money could therefore have been more effectively used elsewhere and this site would not have received grant aid.

Most of the existing housing in the locality comprises two storey terraced houses, of 55 to 70 square metres (600 to 750 square feet) in floor area, built in the latter part of the last century. In good condition these houses sell for around £25,000 to £30,000; which is no more than the construction cost for similar sized new homes, before taking account of land, profit and finance costs. The new development comprises terraced and semi-detached houses of similar size to the existing dwellings, developed at a density of 19 units per acre. These 'starter homes' are aimed to sell in the price range £35,000 to £42,000, excluding central heating and garage. A site plan of the development is in Figure 8.4.

According to Maunders Urban Renewal's market research and grant application research, virtually identical homes in other parts of the Manchester conurbation,

FIGURE 8.4
LOUISA STREET, MANCHESTER: REDEVELOPMENT PLAN



unaffected by industrial dereliction, sell for prices up to 10 per cent higher and the older terraced houses also achieve similarly increased prices. The generally lower selling prices in east Manchester may not be due entirely to the possibility of contamination blight but may also, to some extent, be a symptom of the depressed economy of that part of the city. It is, however, very difficult to separate out the effects.

The developer acquired the site for a cost of around £44,480 per hectare (£18,000 per acre), after taking account of the subsidy contained in the City Grant, compared to the £172,970-£241,700 per hectare (£70-100,000 per acre) which would be paid for problem free high density residential development land in more desirable parts of the city. This represents a discount of at least 70 per cent against the value of an uncontaminated site. Much of the reduction in the price paid is attributable to the expectation of lower selling prices, in this de-industrialised locality, but at least part of the discount is attributable to the developer's perception of increased risk. The developer also considered that an increased marketing budget was required to overcome the possible stigma attaching to the previous use.

If the subsidy element of the City Grant is disregarded, the price of £325,000 paid by the eventual developer represents a reduction of 35 per cent against the price paid by the original developer. The previous price equated to £171,600 per hectare (£69,440 per acre), substantially below residential development land values in other parts of the city, and no doubt reflected the industrial character of the locality. The further reduction is considered to be a discount to reflect 'stigma'.

Such substantial discounts were not unexpected during the period of uncertainty surrounding the Governments policies on contaminated land, Lightbody (1992) warned housing associations which had bought properties on previously used land that the values may be reduced by up to 60 per cent.

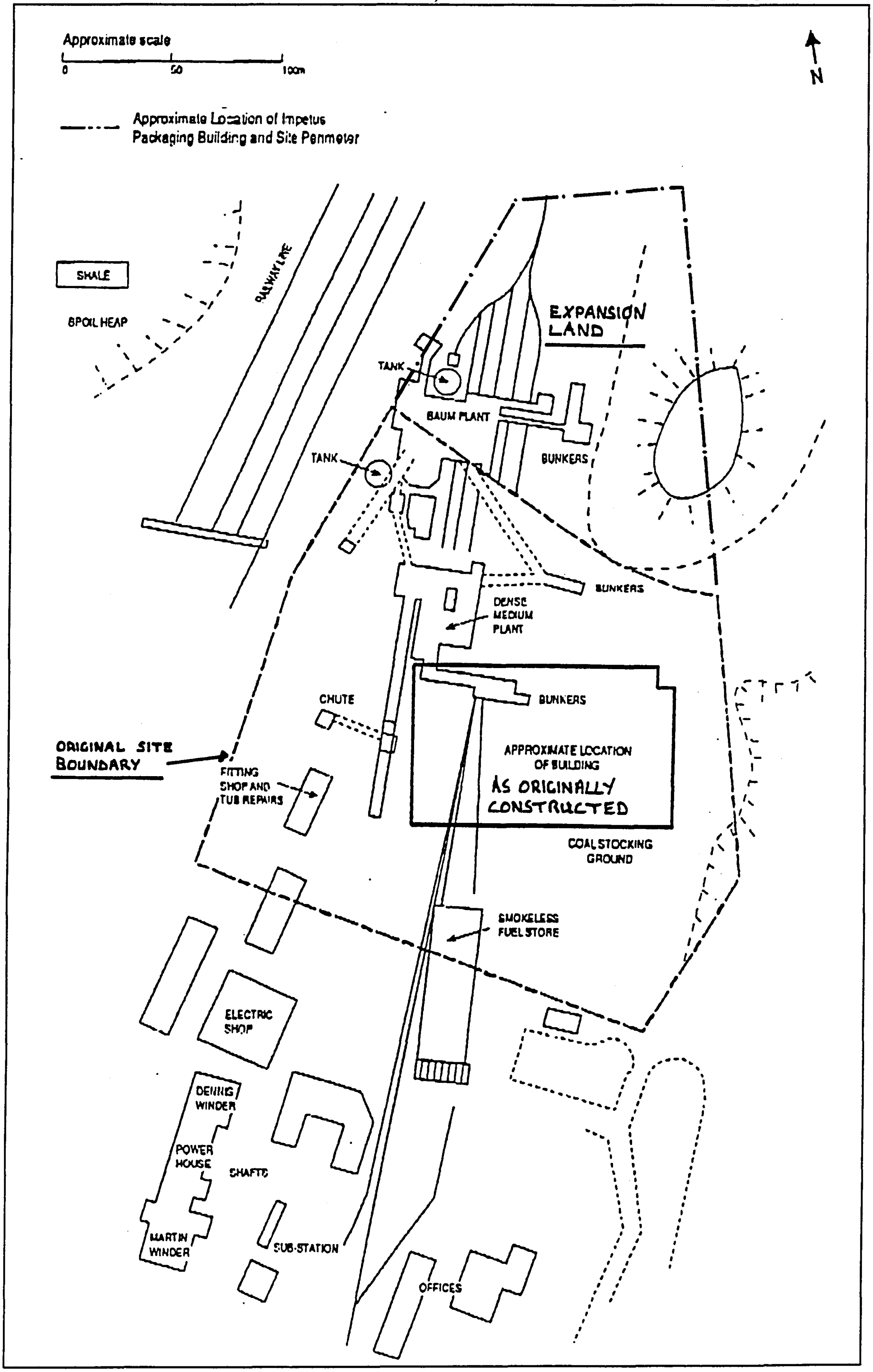
8.4.3 Gresford Industrial Estate, Wrexham, Clwyd

Formerly part of Gresford Colliery, this site of 6.705 hectares (16.57 acres) was originally developed in 1984 by Pochin Plc to provide a factory of 7,480 square metres (80,500 square feet) for Continental PET Ltd. The case study project was to construct an extension of 12,077 square metres (130,000 square feet) on two sides of the original factory.

Gresford Colliery was a deep mine, with workings to 426 metres (1,400 feet) below ground level. A number of previous uses are known to have existed on the site, shown on the site plan in Figure 8.5. These included a Baum plant, bunkers and tanks, including two marked alongside the Baum plant which could possibly have been gasometers. Part of the site had been occupied by a quarry and a number of mine shafts were known to have existed on, or adjacent to, the site. The colliery was closed in 1976 and the shafts sealed up.

At the time of the 1984 development, the site was covered by up to three metres of colliery waste, overlying sands and gravels from the glacial age. The bedrock

FIGURE 8.5
GRESFORD INDUSTRIAL ESTATE, WREXHAM: FORMER USES PLAN



is the Carboniferous Coal Measures, consisting predominately of siltstone, shales and coal. The calorific value of the colliery spoil was so high as to present a potential for spontaneous combustion. The area upon which the original factory was to be constructed, plus a three metre wide strip around the perimeter, was excavated down to natural ground and the waste material removed from site. The excavated spoil was deposited in a nearby quarry, from which stone fill was obtained to make up the void. Thus the remediation undertaken for the original building covered the minimum site area required to enable construction to take place.

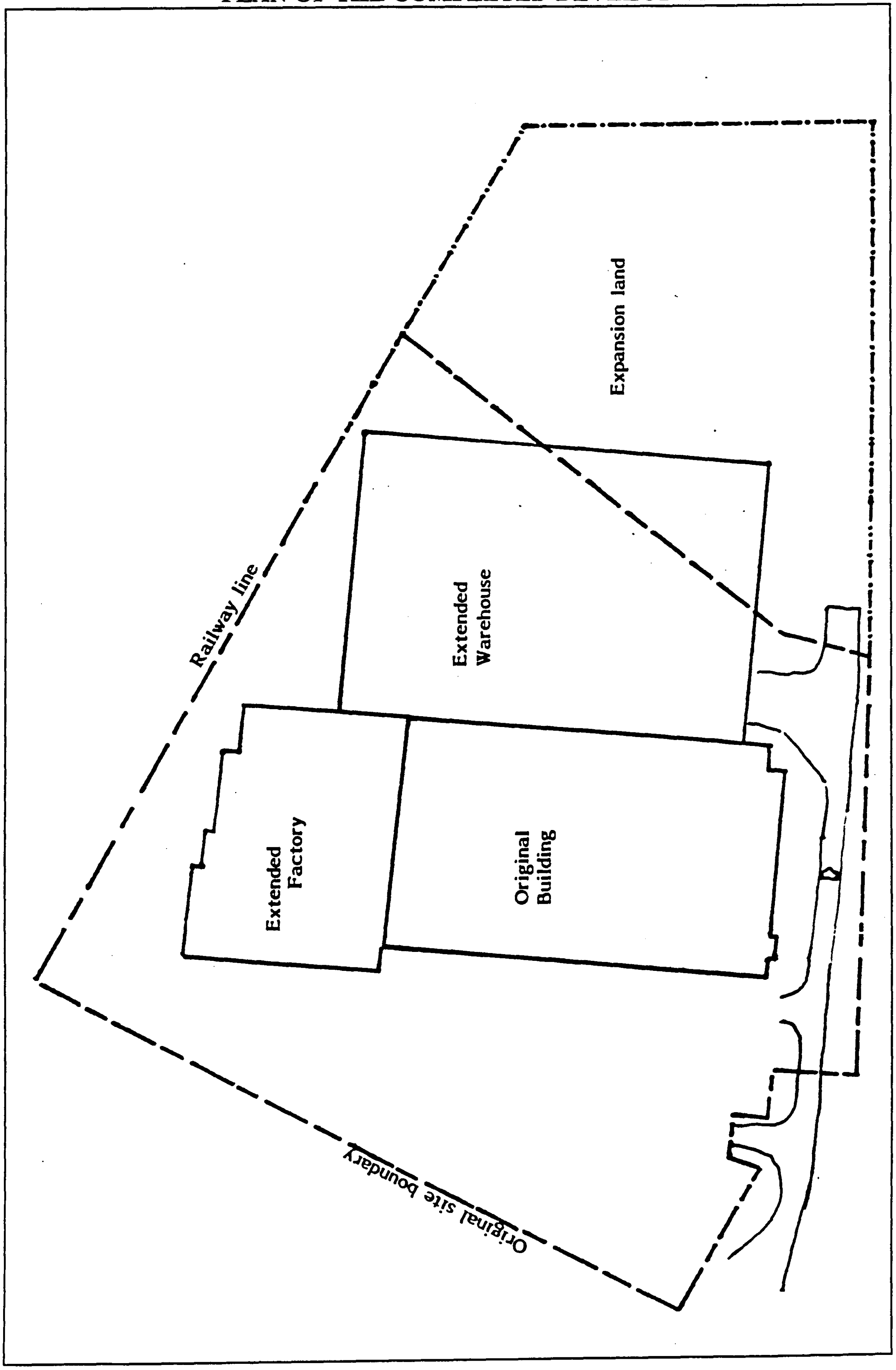
As the result of the method used for the site remediation, when the proposed extension was being considered in 1994, all of the available expansion land, except for the three metre perimeter strip, was covered by colliery waste. A detailed site investigation was undertaken by environmental consultants and in some places the depth of waste material was found to be at least five metres. This investigation also confirmed that the calorific values, an indication of the combustibility of the fill material, were well in excess of the safety level, with values exceeding that level by between 170-230 per cent. The consultants also found that the spoil was contaminated with coal tar products, including semi-volatile organic compounds. There was no evidence of methane generation from the site but concentrations of Carbon Monoxide, above the ICRCL threshold level, were found in some locations.

The original treatment method, of removing the waste to a quarry and refilling with clean material from the same source, was no longer available as the quarry had closed. Alternative treatment methods were therefore considered, with preference being given to on site or in-situ methods. Advice was taken from a specialist engineering consultant, who suggested that it would be possible to remove the risk of combustion by excavating the spoil and then re-interring it in layers with limestone intermediate layers. This would have resulted in raising the level of the expansion land by up to one and a half metres, which was not feasible in the context of the proposed development.

Attention then turned to the identification of an alternative depository for the colliery spoil and an area of adjoining land was purchased, part from British Coal and part from the local authority. This purchase increased the area of the site from the original area of 3.804 hectares (9.4 acres), with the additional 2.901 hectares (7.17 acres) being acquired for the sum of £40,000, £13,785 per hectare (£5,578 per acre). This almost nominal sum reflected the fact that the site was landlocked and could only be developed at considerable expense.

The additional land was immediately adjacent to the existing site and its acquisition enabled the layout of the extension to be re-designed, using part of the additional land. The remaining area of the additional land was then used as a depository for the coal waste, using the natural fall of the land and extending the embankment beside the adjoining A483 trunk road. The newly created spoil heap contains colliery waste up to 12 metres in depth, landscaped with grass and trees. Figure 8.6 is a site plan of the completed development.

FIGURE 8.6
GRESFORD INDUSTRIAL ESTATE, WREXHAM:
PLAN OF THE COMPLETED DEVELOPMENT



The cost of excavating the waste material and replacing it with clean fill was estimated at £600,000, considerably in excess of any economic value attaching to the expansion land. An application was therefore made to the Welsh Office for an Urban Investment Grant, the Welsh equivalent of City Grant, which was subsequently awarded in the same sum as the estimated remediation cost.

At the time of the development, serviced industrial land in the vicinity of the site was available for around £148,250 per hectare (£60,000 per acre), based on information from the Welsh Development Agency and Wrexham Maelor Borough Council. The access road and site servicing for the additional land cost £95,000, £32,747 per hectare. If the access situation is taken into account in respect of the case study site, on the basis of a 50 per cent reduction in value, based on the principle in Rathgar Properties and Merrydale Motor Co. v. Haringay London Borough (1978 EG vol 248 p693), the price paid for the land needed to enable the development to take place equates to a reduction of 67 per cent against the value of industrial development land in the area.

The completed development was let to the existing tenant on a new lease, at a rent of £28-52 per square metre (£2-65 per square foot), on full repairing and insuring terms. The agreed rent was £1-08 per square metre (£0-10 per square foot) less than the previous rent passing in respect of the original building. This reduction was intended to reflect the quantum increase in floor area and not 'stigma'. The tenant entered into a full repairing and insuring lease in respect of the building and operational areas, future responsibility for the spoil heap was retained by the developer.

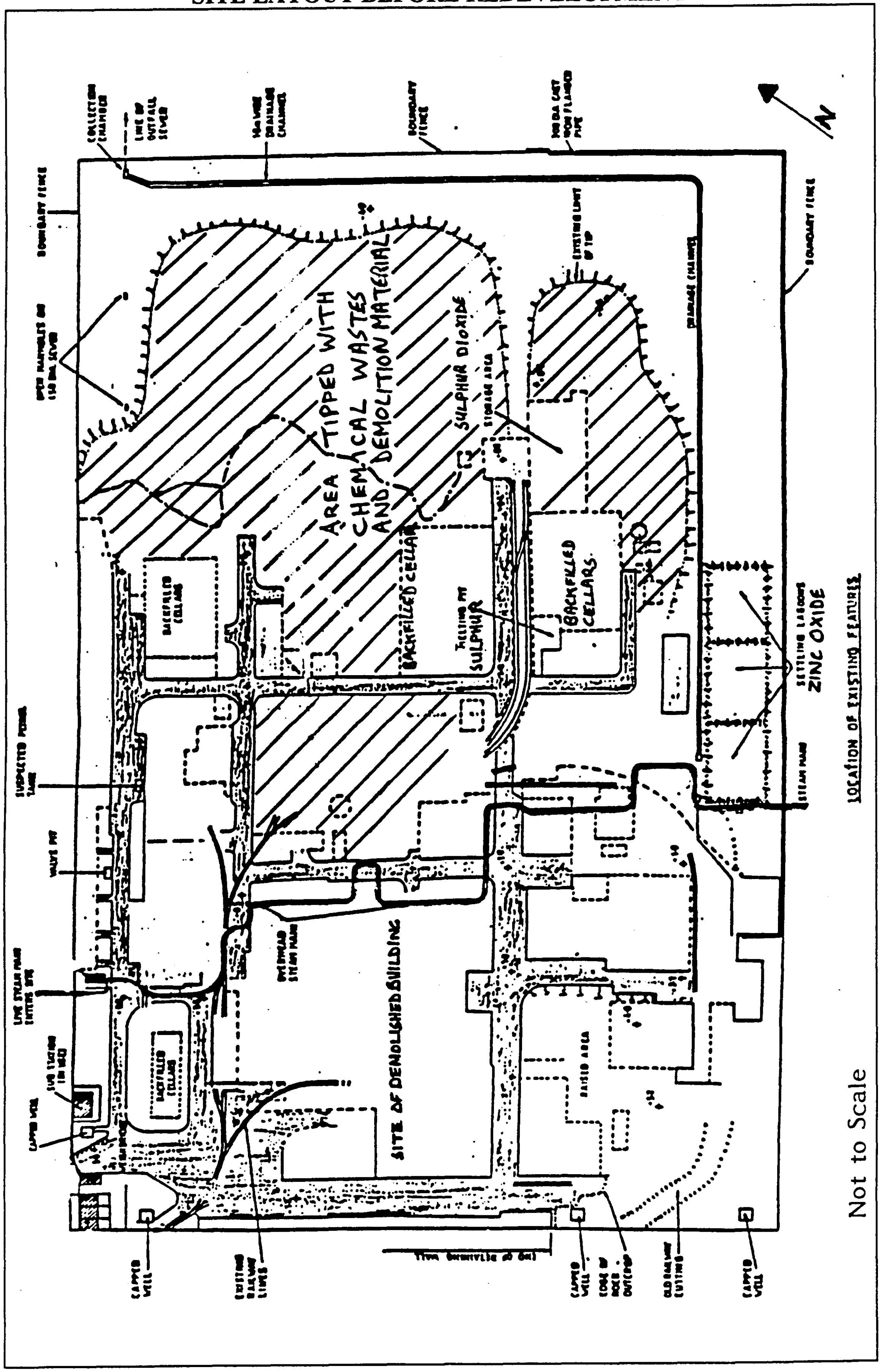
8.4.4 **Bromborough Business Park, Bromborough, Wirral**

The site of this case study is located within an area of mixed industrial uses dominated by subsidiaries of the Unilever Group. Occupying an area of 29 acres (11.736 hectares), the site was acquired by Wardell Holdings Group Limited, for development purposes, following closure and demolition of the chemical works which had been operated by RV Chemicals Limited. All of the buildings had been demolished and the site levelled with most, if not all, of the demolition materials remaining on site. The site had been levelled to form a plateau with fill material at the rear of the site. Prior to demolition all asbestos within the buildings was removed and taken from the site for disposal. Figure 8.7 shows the layout of the site prior to demolition of the buildings and plant.

At the time of closure and demolition, in 1985, RV Chemicals was a subsidiary of RTZ Plc (formerly Rio-Tinto Zinc), it was subsequently sold to Rhone Poulenc and then to Hoechst. A retired employee of RV Chemicals has supplied a history of the industrial activities on the site but at the time of acquisition by Wardell Holdings Group this was not available.

Chemical production on the site started in 1908, when the site was owned by BASF, a German company, it manufactured dyestuffs, a use which continued into the late 1950's. From 1914 to 1919 the site was government run, after which it was owned by Brotherton & Co. From 1952 to 1964 the site was operated by Associated Chemical Company, then by Allbright and Wilson until 1972, when it was bought by BOC Plc. The site was sold to RV Chemicals in 1982.

FIGURE 8.7
BROMBOROUGH BUSINESS PARK, WIRRAL:
SITE LAYOUT BEFORE REDEVELOPMENT



In addition to dyestuffs the plant was known to have produced the chemicals described in Box 8.3

BOX 8.3

Chemicals produced at the former RV Chemicals site Bromborough, Wirral

CHEMICAL	PERIOD OF PRODUCTION	RAW MATERIALS STORED ON SITE	BY-PRODUCTS
SULPHUR DIOXIDE	Late 1920's - 1983	Sulphur Sulphuric acid	none
SODIUM HYDROSULPHITE	Early 1920's to 1984/5	Zinc, Sulphur Dioxide, Sodium Hydroxide, Ethyl Alcohol	Zinc Hydroxide, Zinc Sulphite/ Sulphide sludge
ZINC HYDROSULPHITE	Mid 1960's to early 1970's	Zinc, Sulphur Dioxide	Zinc Sulphite, Sulphide sludge/
SODIUM FORMALDEHYDE SULPHOXYLATE	Early 1930's to 1980	Zinc, Sulphur Dioxide, Sodium Hydroxide, Formaldehyde	Zinc Hydroxide, Zinc Sulphite/ Sulphide sludge
POTASSIUM ACETALDEHYDE SULPHOXYLATE	Late 1950's to 1985	Zinc, Sulphur Dioxide, Potassium Hydroxide, Acetaldehyde	As above
ZINC FORMALDEHYDE SULPHOXYLATE	Early 1930's to 1980	Zinc, Sulphur Dioxide, Formaldehyde, Ethyl Alcohol	Zinc Sulphite/Sulphide sludge
FORMALDEHYDE	Late 1930's to pre 1958	Methanol	
SODIUM METABISULPHITE	Mid 1950's to 1983/4	Sulphur Dioxide, Sodium Carbonate	none
ZINC OXIDE	1977 to 1985	Zinc Hydroxide by-product	none

According to the history provided by the former employee of RV Chemicals "as the small amounts of site contaminants were not toxic no remediation was undertaken and hence no area of the site was sold off as having been remediated". The same source also stated that "small amounts of liquid Sulphur which could not be pumped out were probably left in the base of the Sulphur pits. This would solidify once the heating was turned off. The pits were later filled in". Also mentioned in the site history was the fact that the Zinc Sulphite/Sulphide sludges produced as by-products were retained on site in bunded areas and that there will "be some contamination in this area". Reference was made to the possibility that small traces of Cadmium Sulphite/Sulphide may remain "as some 0.01-0.05% of Cadmium was present in the Zinc dusts used on site".

In 1988 Wirral Borough Council commissioned and paid for a site investigation to be undertaken by a firm of consulting engineers. This investigation consisted of the excavation of 29 trial pits, one per acre, over the entire area of the site. The extent of this investigation fell far short of the recommendations contained in BSI Development Draft 175 (British Standards Institute, 1988) which, if complied with, would have required 200 sampling points on a site of this size.

Chemical analysis on samples obtained in the site investigation revealed the presence of many of the chemicals referred to in Box 8.3, and the consultant noted that some of the chemicals "are extremely aggressive to plants, animals and building materials". From the limited scope site investigation it was recommended that "the thick layers of chemical waste and other surface contamination need to be removed and taken off site. The removal of this material would involve excavating material to depths of up to 2.3 metres". In addition to the contaminated fill material on the site, the sludge lagoons were up to 1.6 metres in depth and contained approximately 2,500 metres of concentrated contaminants.

The fill material on the site was underlain by sandstone bedrock, with minimal surface cover, which out-cropped in the SE corner of the site. The water table was at a depth of between 30 and 45 metres and was a producing aquifer used for industrial purposes. The natural topography of the site was a fall from south to north towards the River Mersey but the fill material had been used to create an almost level plateau, which was steeply banked at the northern end of the site.

On the basis of the information contained in the consultants' reports, an application was made to the Department of the Environment, in April 1990, for a City Grant to reclaim the site, provide the infrastructure for a new development and construct a business park development. The amount of grant requested, at £5.66 million, was more than the Government was prepared to invest, at that time, in a speculative project. A revised application was therefore submitted in respect of a first phase of development, covering the front 10 acres (4.05 hectares) of the site, which was the area believed to be least affected by the contamination. This application was approved and a grant of £2,172,637 was awarded which, as the estimate for abnormal site works only totalled £1,015,000, contained a significant commercial subsidy intended to encourage employment creating development in a depressed area of Merseyside. Private sector funding was provided by the company's bank.

The Phase 1 grant application was based on the removal of contaminated material from site and its replacement with clean fill. The amount of fill material in the front ten acres was estimated as being between 5,000 and 10,000 cubic metres. After 3,000 cubic metres had been removed from site the volume of material was re-estimated at 17,000 to 20,000 cubic metres. The remediation method was therefore re-examined with a view to reducing the amount of material removed from site. As the contaminants of greatest concern were primarily phytotoxic and, as most of the site was to be covered with industrial buildings, yard areas and car parks, it was decided to set a site specific standard for the remediation.

The ICRCL Threshold Trigger Concentration for Zinc is 300 mg/kg for any uses where plants are to be grown. In view of the nature of the proposed end use for the site, a standard of 2,000 mg/kg was adopted and agreed with the Environmental Health Department of Wirral Borough Council. The remainder of the Phase 1 area was remediated to this standard and one factory was subsequently constructed.

During the course of negotiations for the construction of a second factory on the site, for a food processor, the prospective purchaser's environmental consultant enquired as to whether or not the National Rivers Authority (NRA) had approved the site specific remediation standard. This had not been considered necessary at the time of the discussions with the Environmental Health Department but, in view of the proposed use and the fact that consideration was being given to a standard of 10,000 mg/kg for retained material in the Phase 2 area (where Zinc concentrations of up to 150,000 mg/kg had been found), an approach was made to the NRA.

At a site meeting, an indication was given by the NRA officer that the standard adopted for Phase 1 was probably acceptable but that further consideration would need to be given to the revised standard for Phase 2. This issue is of the utmost importance to the future viability of the development, as the Phase 2 area has been estimated to contain around 250,000 cubic metres of contaminated fill material.

Consideration has been given to alternative methods of site remediation, including the construction of an on-site containment area, in the form of a bund formed with an impervious geotextile, but this would have resulted in the sterilisation of almost half the site area. Soils washing has been considered and an initial appraisal was undertaken by Bergman Technologies who concluded that the volume of clean material recovered for re-use on site would probably not be sufficient to make this option financially viable. Enquiries were also made regarding the possibility of recovering the metals, either in-situ or ex-situ, for re-processing and again this was found not to be financially viable.

Wardell Holdings Group purchased the site for the sum of £400,000 on the basis of the reports prepared for the local authority and in the belief that grant aid would be sufficient to overcome the contamination problems. The price of £13,793 per acre (£34,083 per hectare) paid for the site reflected the fact that it was an old industrial site but, as shown in the site history, the vendor did not consider it to be contaminated. The non-contamination related abnormal costs in Phase 1 amounted to approximately £23,250 per acre (£57,500 per hectare). Together with the purchase price, this represents a total of £37,043 per acre (£91,530 per hectare) which might have been foreseen at the outset as the cost of preparing the site for development. At the time of acquisition, industrial land in the area was available for around £50,000 per acre (£123,550 per hectare), excluding infrastructure, thus leaving a margin of £12,957 (£32,017 per hectare) for contingencies, a discount of 25.91 per cent.

After commencing work on the development Wardell Group Holdings formed a joint venture company with P.&C. Casey Limited and Pochin Plc. to develop Bromborough Business Park. At the present time, March 1996, work on the project has halted pending agreement in respect of the remediation standard to be adopted for the remainder of the site. The final development layout has, therefore, to be determined.

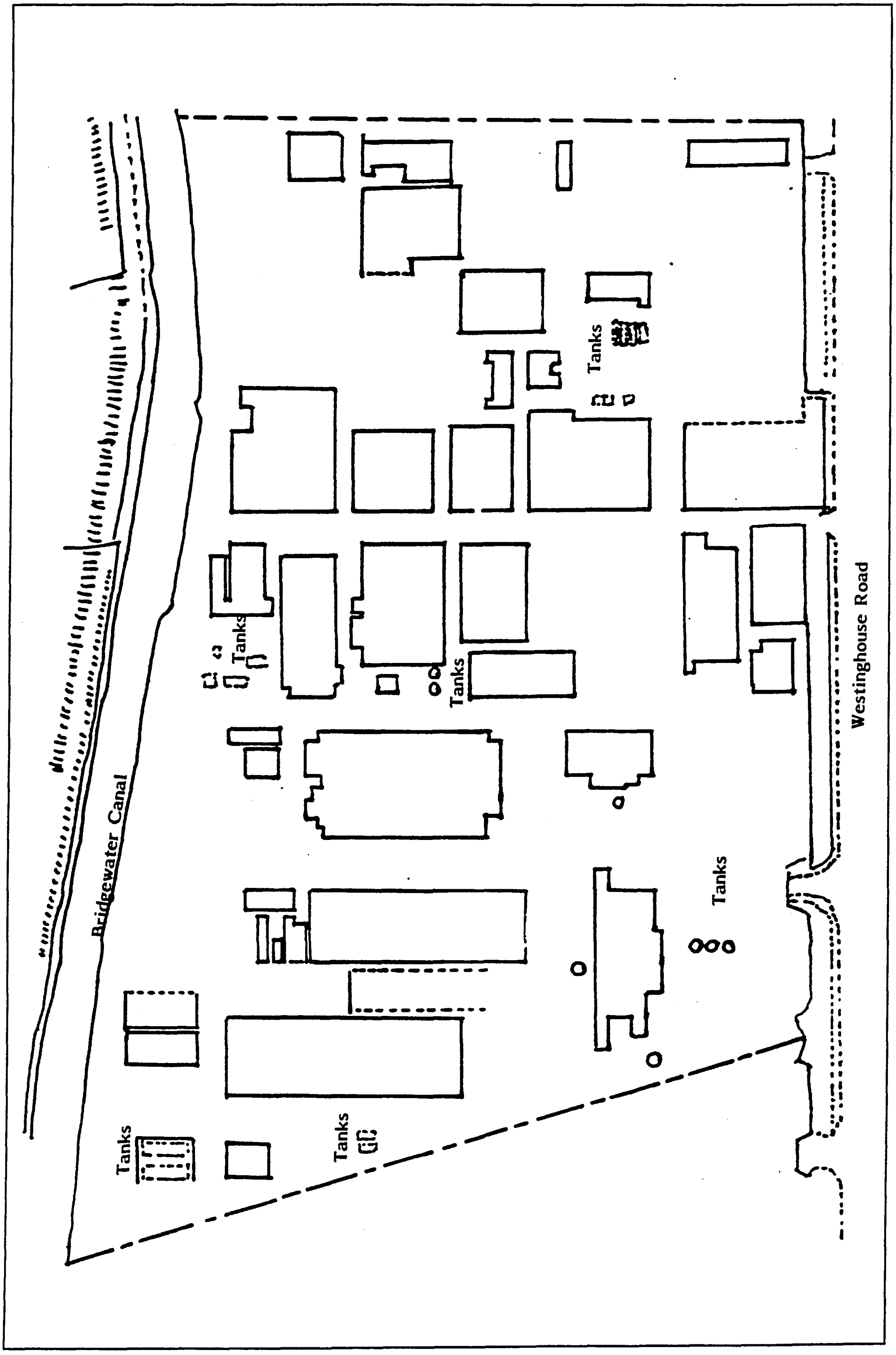
8.4.5 **<u>Centrepoint, Trafford Park, Trafford</u>**

This site has an area of approximately 22 acres (8.90 hectares) and is situated in Trafford Park, once Europe's largest industrial estate with a total area of 2,600 acres (1,052 hectares), immediately adjacent to the Bridgewater Canal. As with the previous site, the site was used for the manufacture of dyestuffs, with the original factory having been constructed in the 1920's and subsequently extended in the 1930's.

Prior to its closure the site was operated by ICI Plc, who made their records available for the site investigation, but for the earlier part of its existence the site had been in other ownerships, with the result that the early records were not available. Figure 8.8 is a plan of the site as it existed prior to demolition.

The site was purchased in 1988 by Monde Developments, a local company with considerable development experience in Trafford Park, for the sum of £1.5 million. The buildings and plant were demolished, with the site being left cleared to ground level. Architects, quantity surveyors, consulting engineers, letting and investment agents and an economic consultant were appointed to advise in respect of the project. All of the appointed consultants had either worked with the developer on previous projects or had been recommended by other members of the professional team.

FIGURE 8.8
CENTREPOINT, TRAFFORD PARK:
SITE PLAN OF FORMER CHEMICAL WORKS



The topography of the site is level and, prior to the commencement of redevelopment, much of the area was covered with buildings and hard surfaces. A site investigation was undertaken in 1988 by Harry Stanger, Consulting Materials Engineers, now part of TBV Science, comprising a desk study and an invasive investigation conducted in accordance with BSI DD 175 (British Standards Institution, 1988). The geology of the site was flood gravels of glacial age, overlying a bedrock of Bunter Sandstone, peat deposits were found to occur over approximately 40 per cent of the site.

From the information supplied to the consultants it was apparent that a number of known carcinogens had been used on site, notably beta napthylamine, and this was confirmed by analysis of samples taken from the site. The analyses also identified high levels of Chromium contamination with concentrations up to 32 times the ICRCL Trigger level (ICRCL, 1987), and of Mercury with concentrations up to four times the ICRCL Trigger level.

Acidic conditions were encountered over much of the site with pH values down to 4.5 over most of the area, at depths down to 3.2 metres. High sulphate concentrations were encountered in the groundwater at depths of between 2.2 and 3.1 metres. The contamination was generally distributed throughout the site and probably originated from a combination of burying industrial wastes and the use of similar material in the substructures of factory extensions and the formation of hardstandings.

Three remediation methods were considered by the consultants;

i) total removal of the contaminated material and its replacement with suitable fill, this would mean that services and sub-structures would not require protection from potentially aggressive contaminants;

ii) partial replacement of contaminated material from 'hot spots' and replacement with suitable fill, remaining contaminated material to be covered with suitable break layers to prevent the upwards migration of contamination, and finished with a suitable capping for the end use envisaged;

iii) leave all of the contaminants in place, finish the site with a suitable break layer and capping as in option ii).

Option iii) was considered to be viable only if the site was not to be redeveloped with new buildings and was used instead for a purpose such as open storage or vehicle parking. The risk of further ground water contamination would remain. The professional team was unanimous in its recommendation to the developer that option i) should be adopted. This recommendation was made because not enough was known about the possible effect the retained contamination, in option ii), may have on the future investment values of buildings constructed on the site.

The drawback to option i) was the high cost of site reclamation, estimated at £4,978,000, excluding professional fees and finance charges for the six month period required for the engineering work. This equated to a cost of £559,120 per hectare (£226,273 per acre) compared to the current value of £370,650 per hectare (£150,000 per acre) for serviced and uncontaminated industrial land in other parts of Trafford Park.

An application was made to Trafford Park Development Corporation for a City Grant in the sum of £6.8 million, which included an element of commercial subsidy in addition to the cost of site remediation. Consultants appointed by the development corporation reviewed the site investigation report and advised that it was feasible, in engineering terms, to reclaim the site by a process of 'hot spot' removal, at a cost of around £1.5 million, in other words they were recommending option ii).

During the course of the City Grant negotiations the remediation work had been put out to tender and one of the tenderers proposed that pulverised fly ash (PFA) be used to re-fill the site, instead of the granular fill specified in the tender documents. The engineering and environmental consultants were initially unwilling to accept this proposal, as PFA is sometimes heavily contaminated. However, the contractor had access to a source of PFA which had been tested free from contaminants, and offered to undertake the whole of the remediation work for a price of £3.9 million, compared to the budget of almost £5 million.

This option was communicated to Trafford Park Development Corporation which, with the approval of the Department of the Environment, subsequently approved a City Grant of £3.9 million. The remediation programme was subsequently carried out under the full-time supervision of an environmental consultant and a chemist, with materials being tested both entering and leaving the site. At the peak of the remediation contract up to 400 vehicle movements a day were taking place under stringently controlled conditions.

In spite of the detailed site survey which had been undertaken prior to commencement of the project, approximately 1,000 tonnes of nitro-benzene, a carcinogen, was discovered under a concrete slab in the centre of the site. The concentration of nitro-benzene in the fill material was up to 26 per cent and the landfill to which the contaminated spoil was being consigned would not accept it in concentrations exceeding 10 per cent. One of the options considered for dealing with this unexpected problem was to transport it in sealed containers to an incinerator in the Netherlands, at a total additional cost of £1.4 million. Eventually a solution was agreed with the receiving tip and the Waste Regulation Authorities, for the contaminated fill to be mixed on site with a similar volume of crushed stone and then to be consigned to the landfill, at an additional cost of around 10 per cent of the incineration alternative.

The total removal option was vindicated when the London based solicitor acting for an overseas manufacturing company, which wished to lease a purpose built factory on the development, advised his client that "the site was formerly used for chemicals manufacture, is probably contaminated and will undoubtedly appear on any future register of contaminated land, therefore the property is not likely to be a good investment and the company should reconsider its decision to acquire premises on this site". At a meeting involving the developer and the entire professional team, the remediation method and the way in which had been managed was explained to representatives of the overseas company. As the result of this meeting, the company proceeded with its acquisition but, if either of the other two options had been adopted, the outcome would undoubtedly have been very different.

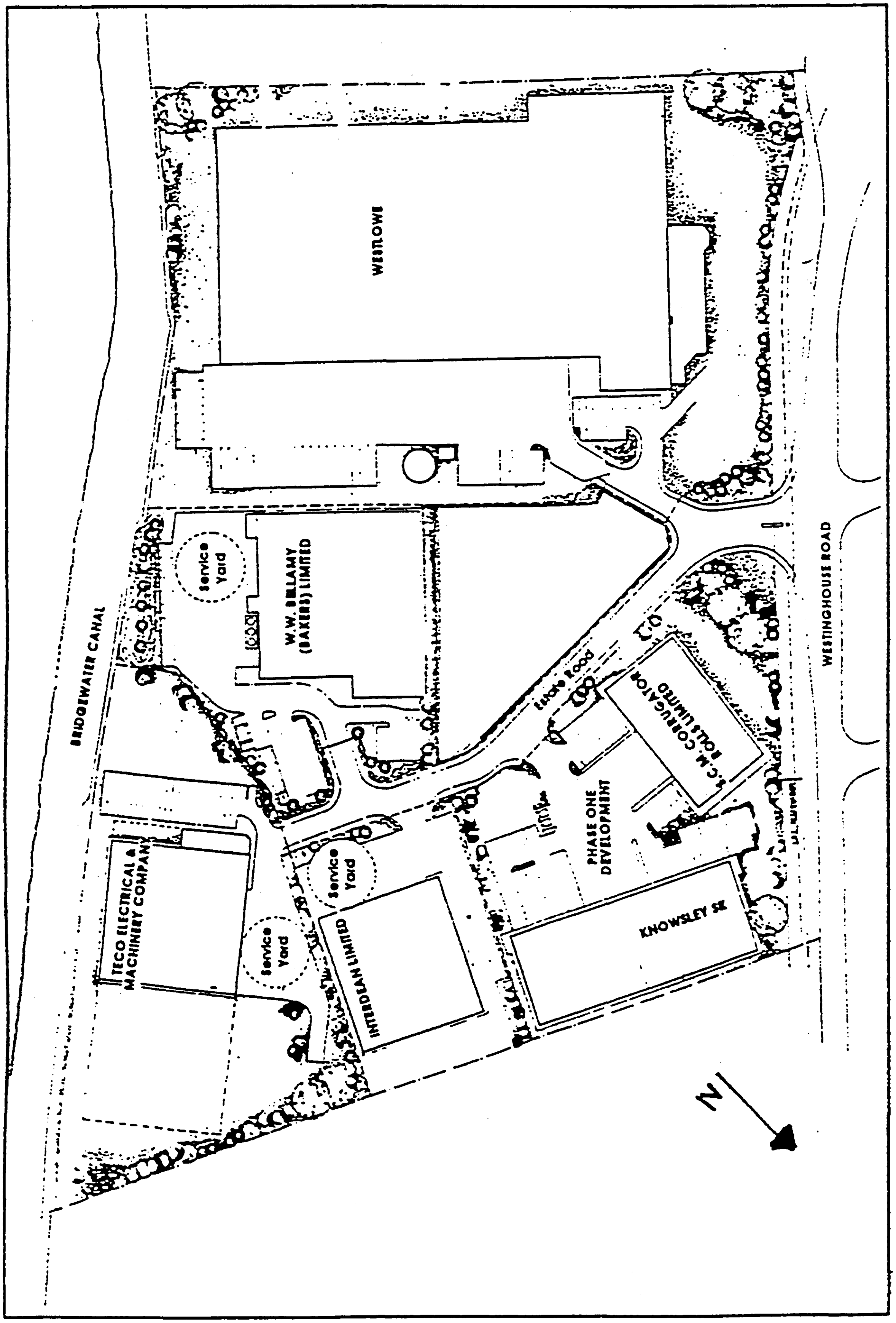
Although Monde Developments had acquired the site for £1.5 million, a figure substantially below the price which would have been achievable had the site been capable of immediate development, it was still more than the Development Corporation's grant appraiser was prepared to accept as base value. Some credits were deemed to accrue to the developer out of the demolition work and the existing value, for grant purposes, was adjusted downwards to £57,000 per acre (£140,850 per hectare) which was considered to be equivalent to its alternative use value for a lower level economic purpose, such as open storage or car parking, not requiring grant aid.

The cost of providing roads, services, infrastructure and structural landscaping for the development was estimated at £521,860, taking the notional cost to the developer to £199,460 per hectare (£80,720 per acre), if the de-contamination expenditure is disregarded. At that time, mid 1989, serviced industrial land in Trafford Park was being offered at around £345,940 per hectare (£140,000 per acre), based on the asking price for a site on Westinghouse Road, Trafford Park, representing a reduction in respect of the Centrepoint site of £146,480 per hectare (£59,280 per acre). This price reduction equates to a stigma discount of 42.34 per cent against the open market value of uncontaminated land on competing developments.

The Centrepoint development is now nearing completion (April 1996), with work having commenced on the final plot. A total of almost 44,590 square metres (480,000 square feet) will have been constructed during one of the worst periods in history for industrial property development in the North West. Part of the development was constructed on a speculative basis, demonstrating the confidence of the developer in the project, but most of the buildings have been constructed to meet the specific requirements of the occupier. A plan of the completed development is shown in Figure 8.9.

In addition to the overseas company referred to above, the solicitors acting for other tenants on the estate requested details of the site remediation work and, so far as is known, were satisfied with the replies received. All leases were entered into on full repairing and insuring terms. The rents achieved and yield rates in respect of investment sales were similar to those obtained elsewhere in Trafford Park.

FIGURE 8.9
CENTREPOINT, TRAFFORD PARK:
PLAN OF THE COMPLETED DEVELOPMENT



Not to Scale

8.4.6 **The Albion, Salford**

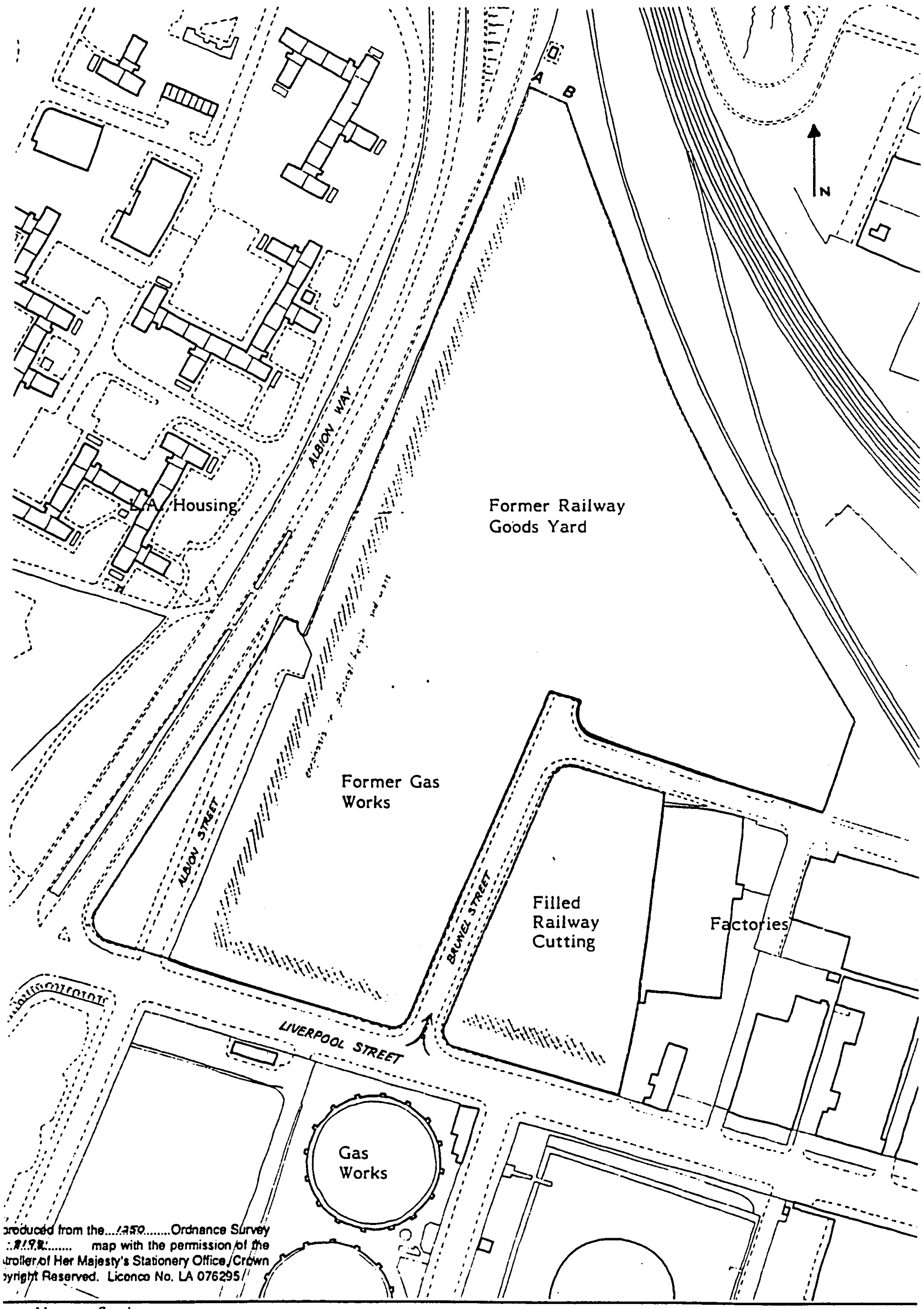
This site of approximately 3.04 hectares (7.5 acres) is located approximately two miles North of Manchester city centre, half a mile from the end of the M602 and fronting Albion Way, a dual carriageway link road to the motorway network. Owned by British Rail, the site was offered for sale by tender in 1990, together with an adjoining site in the ownership of Salford City Council. The site access is from Liverpool Street and the land is divided into two parts by Brunel Street, as shown on the site plan in Figure 8.10.

At the time of the tender sale, the British Rail site was derelict and the Salford City Council land was in use as a winter base for travelling showmen. The railway land had previously been used as a goods yard and a substantial portion was transected by a deep railway cutting leading, in a North-South direction, from the tunnel under Liverpool Street. The cutting had been filled up to ground level by fill material of an unknown nature. The Salford City Council site had previously been occupied as a town gas works, which at an earlier date had been demolished down to ground level. On the opposite side of Liverpool Street were located gas holders and a depot used by British Gas.

The highest tender price offered for the British Rail land was made by Alfred McAlpine Management Ltd., a subsidiary of Alfred McAlpine Plc, in the sum of £750,000, £247,100 per hectare (£100,000 per acre). A soil survey, consisting of 22 trial pits had been undertaken on behalf of the joint vendors, covering both sites, in February 1990 and copies of the report had been provided to prospective bidders.

FIGURE 8.10

THE ALBION, SALFORD: FORMER USES PLAN



Not to Scale

The bid price reflected the fact that ground problems had been disclosed by the survey and was probably only about half to two-thirds of the price which might have been expected for a problem free site in this prominent location. There is however very little transaction evidence for uncontaminated sites in the vicinity of The Albion and the best evidence relates to Trafford Park.

The site investigation report provided by the vendors was considered by the developer to be insufficient for development purposes and Harry Stangers, Consulting Materials Engineers were commissioned to undertake a further site investigation, including chemical analysis. This work was undertaken in August 1991 and, on the British Rail site, comprised eight boreholes, 17 trial pits and one trial trench.

The site was found to be immediately underlain by Glacial Boulder Clay overlying Permo-Triassic Bunter Sandstone. A fault was found to run north west to south east through the south west corner of the site, with downthrow to the north east. The original ground level of the site, excluding the railway cutting, was predominantly an extensive layer of hardstanding material consisting of stone setts, tarmac, roadways and concrete. These hardstanding materials were underlain by fill comprising ash and cinder, railway ballast and sleepers which were associated with the past railway sidings. Irregular thicknesses of variable fill comprising, in the main, fly-tipped material lay across most of the site area.

The railway cutting had been filled throughout its length, with depths of up to 7-8 metres adjacent to Liverpool Street. The cutting had been filled in an unsatisfactory manner with no consideration having been given to any future site development. The nature of the fill material was extremely variable, including very large broken sections of reinforced concrete, brickwork and mortar, metal sections, clays and organic contaminants. Little or no effort had been made to achieve compaction of the material and numerous voids existed.

Results of the chemical analysis confirmed that the site was contaminated and that the contamination pattern was extremely variable in distribution. Elevated levels of cyanide, cadmium, mercury, arsenic and toluene extractable matter were recorded in the results, as were single incidences of mildly acidic and high sulphate levels. Significant levels of methane were also recorded.

The consultants recommended that, prior to commencement of the development, all fill material, made ground and organic clay should be removed from the site. Any uncontaminated material, including concrete and brickwork crushed to a suitable size, could then be used to re-fill the railway cutting. The remediation method proposed was therefore one of careful selection of contaminated material for removal from site and the re-use of as much of the fill material as possible.

Following completion of the decontamination work, it was proposed that the site should be redeveloped as an industrial estate and this proposed end use was reflected in the offer made for the site. Realisation of the full extent of contamination on the site meant that the project was no longer viable and an application was made to English Partnerships for a City Grant. The price offered for the site was not considered to be appropriate for a grant aided scheme, indeed the grant appraiser's initial view was that the site had a nil or even negative value, and the acquisition terms had to be re-negotiated. The terms eventually agreed for the land purchase equated to £111,195 per hectare (£45,000 per acre) but even this reduced figure was higher than the base value which the appraiser was prepared to accept for grant purposes.

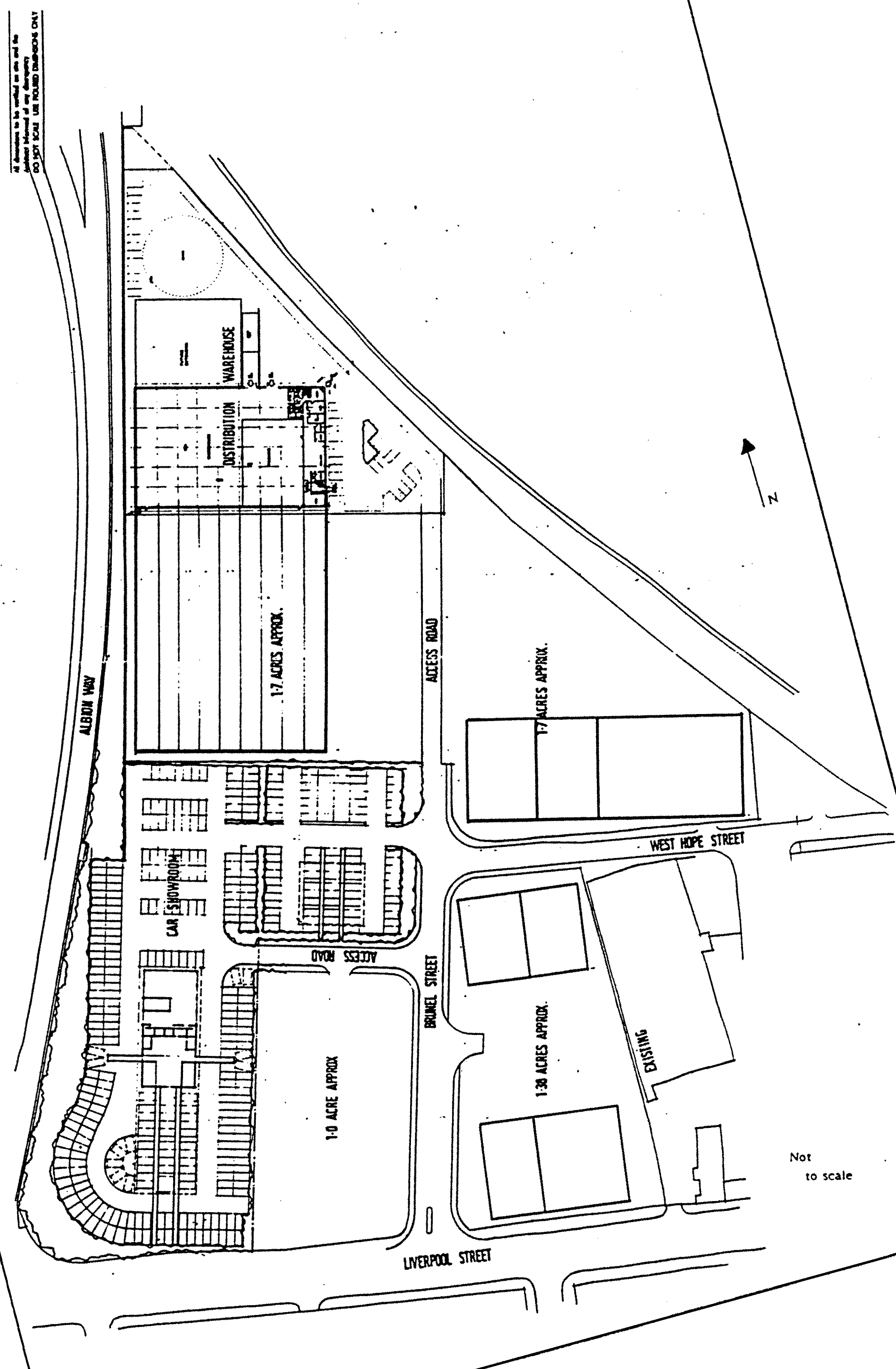
The figure finally agreed for grant aid was £1,550,000, which was almost exactly the estimated cost of overcoming the site problems. Only a small amount of infrastructure work was required, as the main estate road already existed in the form of Brunel Street, and once the site reclamation work had been completed it was possible to proceed very quickly with the development of a new industrial estate of 10,870 square metres (117,000 square feet).

The cost of site treatment was almost entirely covered by the approved grant and the reduction in the price paid for the site may, in its entirety, be assumed as the discount attributable to the uncertainties associated with the land contamination. This indicates a 'stigma' effect of 55 per cent.

The additional site investigation work, grant negotiations and re-negotiation with British Rail took almost two years, during a period in which the market for industrial property was stagnant, or even in decline. By the time agreement had been reached on all points, Alfred McAlpine Plc had decided to withdraw from speculative development in order to concentrate on contracting. The project was therefore in danger of being abandoned, until Maple Grove Developments, a subsidiary of the Eric Wright Group, agreed to become involved with the development as controlling partner, leaving Alfred McAlpine with a minority stake. By the end of March 1996 the project was more than 75 per cent complete, with work about to start on the final phase of construction. Figure 8.11 shows the final site layout. There is no observable post-development stigma effect on either rental or sales prices achieved.

FIGURE 8.11

THE ALBION, SALFORD, DEVELOPMENT LAYOUT PLAN



8.5 GRANTS AND POLICY INCENTIVES

No allowance was made in the example valuation in Chapter Six in respect of any grants or other incentives which may be available towards the cost of dealing with contamination. This is in spite of the fact that VGN 11 and GN2 make reference to the need to reflect grants, or other financial incentives, in the valuation. The government has adopted the principle of "polluter pays" (DoE, 1990a) and does not consider it appropriate to use public money in clearing up contamination resulting from industrial activities. Even in situations where the property is no longer owned by the original polluter, the attitude is that land values should reflect the cost of dealing with contamination. This was confirmed by the Department in its *City Grant Guidance Notes* (DoE, 1992), which states that "if the site value is high it may be reasonable to assume that the land or buildings can be used or developed without grant" and that the appraiser "will ask what the site is likely to fetch if sold now, in its existing physical condition ..... on the assumption that grant will not be available. In many cases this value will be negligible." (DoE, 1992b)

A similar approach to existing site values is being applied by English Partnerships, which has taken over responsibility for the grant regimes [formerly Derelict Land Grant and City Grant] which were administered by the Department of the Environment. Although Government policy is clearly stated in respect of the 'polluter pays' principle, all of the case studies described in the previous section received grant aid from the Department of the Environment, the Welsh Office, English Partnerships or a development corporation.

In some cases, for example Centrepoint and Bromborough Business Park, the application for grant aid was made, and the grant approved, before the stricter policy on base values was introduced in 1992. So far as Piccadilly Village was concerned, the contamination originated from many sources, many of which could not be traced and similar problems existed in respect of the Albion, although here it may be argued that the site owner should have exercised greater control over operations on the site. With hindsight, it would have been far more cost effective for the whole of the Gresford site to have been remediated at the time of the original development in 1985.

All of the case study sites produced 'hard' end uses in terms of new industrial units, offices and residential accommodation. They also fulfilled urban regeneration policy objectives relating to the creation of employment and housing in depressed areas. Piccadilly Village received a MIPIM award as the 'best urban waterside residential development in Europe'. Most important of all, the case study projects resulted in the remediation of six contaminated sites.

The developers of these, and other similar development projects, tend to regard the grant aid as being the input required to overcome the contamination problems, although in reality the need for public sector support is appraised against the project as a whole (see Syms, 1994a) and not simply in respect of the abnormal ground conditions. Where applicable, the developers have regarded any commercial subsidy as a welcome bonus but there is no doubt that none of the case study projects would have been undertaken without public sector support. Whether any of the schemes would have proceeded if an alternative form of incentive, such as rental guarantees, had been available instead, is doubtful. There may, however, be a case for arguing that direct grant aid should be limited to the cost of dealing with contamination, and possibly other abnormal ground conditions, with any required commercial subsidy taking the form of rental or other guarantees.

It is most unlikely that grant aid will, as a general rule, be made available to tackle the problems of land contamination, without the prospect of a worthwhile redevelopment project for the site.

"Nevertheless, the problem remains of what should be done about the pollution and contamination arising out of the activities of previous generations. To compel present-day owners of land to clean up after previous owners would seem to be inequitable, especially as those same owners may well be having to face up to the fact that the property, for which they paid the market price several years ago, now has a nil or even negative value. Even forcing businesses to reclaim land which has been contaminated over earlier years by the industrial processes of the firm may be counterproductive if it has the effect of forcing the company out of business." (Syms, 1994a)

It is likely therefore that exceptions may have to be made in situations where the cost of treatment is significantly in excess of any development value which would accrue from the site, or in circumstances where environmental, as opposed to economic, benefits are the expected outcome of the treatment.

Different methods of appraising the need for government support were applied to the two grant aid schemes administered by the Department of the Environment and these are fully discussed in Syms, 1994a. The essential differences were that applications for Derelict Land Grant were appraised on the basis of existing site value, treatment costs and future site value only, without the costs and benefits attributable to any new construction being taken into account, whereas the City Grant method considered the entire project and was largely determined by the provision of 'hard end use', such as new jobs created or homes constructed. The two schemes have now been replaced by the 'English Partnerships Investment Fund', which places a far greater emphasis on partnerships between public, private and the voluntary sectors, including the taking of equity stakes in developments by the grant awarding body. The method of appraisal used in assessing the eligibility of projects is broadly similar to that used for City Grant but a wider range of benefits is now considered to be acceptable. For example this might include the preparation of a site for development, without the actual provision of any buildings.

There was very little evidence of any 'post-treatment' reduction in value on any of the case study developments. For the most part, the developers concerned approached the task of remediation in a well organised manner and, in all cases, the work was adequately documented and made available to prospective occupiers, their advisors and funders.

CHAPTER NINE

PROFESSIONAL PERCEPTIONS

9.1 INTRODUCTION

The market for any class of property is made up of different actors, some of whom may interact. These actors may be performing a role of principal, as in the case of potential property developers, investors or owner occupiers (whether of residential, commercial, industrial or leisure premises). Alternatively they may be market makers, such as surveyors, valuers and estate agents, advising on the value, or potential value, of real estate and acting in respect of its acquisition and disposal. So far as development projects are concerned, the providers of development finance, such as banks, building societies and insurance companies, can have a major impact upon the market, as they control the supply of both short and long term finance. The market will also be influenced by actors such as architects, quantity surveyors and engineers in respect of the design and costing of buildings and civil engineering projects. Building contractors, sub-contractors and building material suppliers may also have an indirect but important impact upon property markets.

The preferences of the various actors, in respect of matters such as location, age of property, building specification and many other variables, will influence an individual considering the acquisition of a specific property, regardless of whether the proposed purchase is for occupation or investment. The same, or similar, variables will also influence the property developer, the estate agent and the property valuer, the main foci of this research. For the purpose of the research it is essential to gain an understanding of the perceptions of property market actors in respect of land contamination and the treatment methods which might be used in order to overcome the problems associated with contamination.

Such an understanding facilitates the construction of a model, to determine the extent to which the values of contaminated, or previously contaminated properties, may be affected under various circumstances. The purpose of the model is to assist in quantifying the assessment of stigma, both for asset valuation purposes and as part of the appraisal process, when the redevelopment of a contaminated site is under consideration.

In the absence of sufficient transaction data in respect of industrial properties, affected by similar types of contamination, the valuer will have to use his or her professional judgement in order to arrive at an assessment as to the extent to which a specific property has been affected by stigma. The valuer's professional judgement will be influenced by such factors as the past use or uses of the property and the degree of hazard associated with the contaminated soil at the date of valuation. If redevelopment is envisaged, the valuer's judgement will also be influenced by the proposed use of the site, the method, or methods, by which the contamination is to be treated and the anticipated degree of risk which will exist following treatment.

The studies described in this chapter have been designed and undertaken for the purpose of constructing the theoretical model and to gain an understanding of the extent to which a valuer's perception of contaminated land may differ from that of other professionals involved in the redevelopment of such sites, and also from the perception of the population at large.

9.2 ISSUES AND METHODS

Referred to in Chapter Five, the two remediation methods generally used in the United Kingdom involve a) the excavation and removal of contaminated material and b) the removal of 'hot-spots' with the containment of residual contaminants on the site. The possible adverse effect on investment values attributable to selection of the second option, which might be perceived as being 'less than perfect', was also demonstrated in Chapter Eight. A number of other treatment methods were described in Chapter Five and many of these are now available for use, or are in advanced stages of pilot studies. In engineering terms many of these alternative methods are capable of producing a perfectly satisfactory standard of remediation for even the most sensitive of end uses and would certainly comply with the British government's view that sites should be reclaimed on a 'suitable for use' basis, as described in Chapters Three and Seven.

If, however, the containment method of treatment is regarded (in valuation terms) as producing a less acceptable standard than the excavation and removal method, how will the newer alternatives be regarded? Is there likely to be a greater or lesser impact on value and to what extent should a theoretical model be adjusted in order to take account of alternative treatment methods, relative to proposed end uses?

At the commencement of this part of the research a list of 'experts' was compiled, from the different professions involved with property development and valuation, who might be expected to hold informed opinions concerning the redevelopment and value of land affected by contamination. The initial list contained a total of 200 names, with just under 50 per cent being valuers, general practice surveyors and developers with valuation or surveying qualifications. The remaining experts were drawn from a wide range of professions including architects, engineers, environmental scientists, bankers and lawyers.

The perceptions study comprised three phases, the first being a questionnaire survey sent to the entire list of experts, whilst the second phase was an interview survey, with leading valuers and surveyors practising in Greater Manchester, selected from the experts list. The individuals concerned were selected on the basis of their experience in the valuation of industrial land and buildings. The final phase of the study was a questionnaire survey of the entire experts list and an interview/questionnaire survey of individuals not having any connection with development, valuation or the other professions in the experts list, the general population.

At the final phase, the experts list had been reduced to 165 persons, as a result of retirement, individuals changing employment or the removal of those persons who had declined to take part in either of the first two phases. The final list of those individuals who took part in the study, their occupations and the phases in which they participated, is contained in Appendix One. In total some 126 named experts assisted the research, 63 per cent of the original experts list, and 32 of these (16 per cent of the original list) participated in at least two phases. A further four anonymous responses were received in phase one of the study and five in phase three.

The first phase of the perceptions study examined the attitudes of property market actors concerning methods of treating soil contamination and the possible effects which different treatment methods may have on the value or desirability of a site according to its proposed future use. Respondents were also asked to assess the extent of their own knowledge of contamination and the valuation issues.

The second phase of the study assesses the experience and attitudes of market makers, in the form of valuers and surveyors, in respect of contaminated land and the ways in which they approached the task of valuation. Attitudes to government policies and professional guidance were also considered.

Phase three of the study was a questionnaire survey, which places the subject of contaminated land into context when compared to a number of other environmental factors. The particular factors of concern regarding land contamination were also considered and attitudes towards the perceived risks associated with different types of industry were assessed. Views concerning government policies were reviewed. The valuers and development surveyors in the sample were also asked to indicate their opinions as to the likely duration of any effect on value remaining after treatment, and the extent to which values may be affected. The general population sample was asked to address only the extent to which contaminated land was a matter of concern when compared with other general environmental issues.

The first phase of the study was conducted in January and February 1994 and phase two between July and September of the same year. The timing of these two phases of the study was considered to be important, as the proposed registers of potentially contaminated land uses had been formally abandoned and the consultation process set up by the Department of the Environment (DoE, 1994a) had not been completed. The Environment Act 1995 had not been published even in Bill form and therefore the first two phases of the study were conducted at a time when there was a great deal of uncertainty surrounding potential government policies.

The third phase of the perceptions study was undertaken in January and February 1996, after the Environment Act 1995 received Royal Assent but before any of its provisions in respect of contaminated land had been implemented. This phase of the study included an assessment of the attitudes of surveyors and valuers towards part of the new legislation. It was, however, primarily intended to assess the importance of different factors contributing to the overall perception of contaminated land, the perceived risk associated with different types of industrial use and to provide an indication of the valuers' perception of impact on value in terms of quantum and duration.

9.3 PHASE ONE - QUESTIONNAIRE SURVEY

In seeking to develop a basis for the model, a survey was undertaken of 58 property professionals, including valuers, quantity surveyors, property managers, bankers, lawyers and developers. All respondents were asked to indicate their perception as to how different property market actors may consider four alternative forms of remediation in terms of valuation and/or desirability. Desirability was used as a surrogate for those professionals who were not versed in valuation techniques. The selected methods of site remediation were as set out in Box 9.1.

BOX 9.1

SITE REMEDIATION METHODS

Scenario 1

Excavation of all contaminated material, so far as this can be determined, removal to landfill and backfilling with clean material, consolidated in layers. As appropriate, the provision of an impermeable membrane to prevent ingress of further contamination. The method was intended to represent a 'low technology' approach to site remediation.

Scenario 2

The removal of contaminated hotspots and the regrading of remaining contaminants to an agreed sub-base level, diluting contaminants if necessary, and the import of clean fill to formation level. This method represented 'medium technology', requiring a more scientific approach than Scenario 1.

Scenario 3

The on-site screening of contaminated material and subsequent treatment in a soils wash so as to reduce residual contamination levels below ICRCL trigger levels. This was also intended to represent a 'medium technology' approach.

Scenario 4

The on-site treatment of contaminants, using bio-remediation or chemical methods as appropriate, so as to reduce residual contamination below ICRCL trigger levels. This scenario represented 'high technology' methods.

This part of the study took the form of a postal survey, mailed to all 200 individuals on the 'experts' list. A total of 72 responses were received (36 per cent) but 14 individuals felt that they had insufficient knowledge of either valuation or contamination to provide a detailed response, instead they offered generalised comments as to how they perceived property markets reacting to the issue of contamination. Details of the composition of the respondent group by professional occupation and extent of knowledge, in respect of valuation and contamination issues is set out in Table 9.1.

TABLE 9.1
RESPONDENTS BY OCCUPATION AND KNOWLEDGE

OCCUPATION/ PROFESSION	NUMBER IN GROUP	CONTAMINATION ISSUES - PERSONAL ASSESSMENT OF KNOWLEDGE				
		Good	Fair	Reasonable	Poor	Very poor
Developer / development surveyor	6		1	3	2	
Valuer/ general practice surveyor	17			8	8	1
Lawyer	7	1	1	1	4	
Architect / Urban designer	9	1	1	4	2	1
Engineer / environmental scientist	7	5	1	1		
Quantity surveyor	5	1	3		1	
Other	7		2	2	2	1
Totals	58	8	9	19	19	3

OCCUPATION/ PROFESSION	NUMBER IN GROUP	VALUATION ISSUES - PERSONAL ASSESSMENT OF KNOWLEDGE				
		Good	Fair	Reasonable	Poor	Very poor
Developer / development surveyor	6		2	4		
Valuer/ general practice surveyor	17	9	5	3		
Lawyer	7		1	1	5	
Architect / Urban designer	9		2	3	3	1
Engineer / environmental scientist	7			3	3	1
Quantity surveyor	5			1	3	1
Other	7			3	1	3
Totals	58	9	10	18	15	6

Note: The 'Other' group included three town planners, two bankers, one economist and one minerals surveyor.

From the analysis of the results in Table 9.1 it is seen that the level of knowledge of at least 60 per cent of the respondents, in respect of the contamination and valuation issues, was reasonable to good.

The respondents were asked to consider the redevelopment of a 2.02 hectare (five acre) site with a 100 year history of past industrial uses. As a result of these uses the site was contaminated with metalliferous wastes, hydrocarbons and organics, a situation which may be regarded as not untypical of a site which has been used for a number of different purposes. The site was stated as being located in an inner city area but in a good location on an arterial road. Although zoned for industrial use, the planning officers have indicated that alternative uses will be considered, provided that they comply with good town planning and highways practice.

Consideration was to be given to five alternative uses for the site, as follows:

- the development of a residential estate;
- the development of a business park;
- the development of an industrial estate;
- the development of a retail park and,
- leisure use of an unspecified nature.

Respondents were asked to consider all of the land uses under examination in the research and to compare the remediated site against one of similar size, in a similar location, but not previously developed, in other words to compare the treated site against a greenfield. They were asked to indicate their assessment as to how land values may be affected, according to the remediation method used, by reference to one of five levels of impact as shown in Box 9.2. For those respondents not versed in valuation techniques, the term 'desirability' was used as a surrogate for value.

BOX 9.2 CLASSIFICATION OF PERCEIVED IMPACT ON VALUES

1	Increase in value	> than 5% change
2	No real effect on value	< than 5% increase /decrease
3	Slight decrease in value	6 to 10% change
4	Moderate decrease in value	11 to 25% change
5	Significant decrease in value	> than 25% change

In order to avoid the use of repetitious questions for each of the development alternatives under consideration, respondents were asked to provide their responses in a matrix format on a printed form similar to that contained in Appendix One. The expected reactions (as perceived by the respondents) of developers, building societies, housing associations and occupiers were used to represent the different stages of development from bare site through investment and occupation. Similarly, for the other land uses, the likely reactions of other property market actors, including investors, tenants, workers and shoppers, were used to assess the likely impact on value of the different treatment methods for the proposed uses under consideration.

The method used for this phase of the study does have its limitations, in that non-valuers were asked to indicate their opinions as to desirability, to compensate for the fact that they were not versed in the 'art of valuation'. All of the respondents were also asked to envisage how people in other disciplines would perceive the issues under consideration. Nevertheless, all respondents were experienced in property development techniques and with the working of multi-disciplinary teams. Analysis of the survey results produced reasonably conclusive results in respect of how the property market might react to the remediation options under consideration and their likely impact on value, and the results are set out in the following section.

9.4 RESULTS OF THE QUESTIONNAIRE SURVEY

The results for each of the types of development under consideration for the treated site are considered below and an analysis of the results is contained in Appendix Two:

9.4.1 Development of a residential estate

The results for Scenario 1 confirmed that, throughout all stages of development, investment and occupation, the total removal of contaminated material, and its replacement with clean fill, was seen as producing a resultant land value no different to a previously undeveloped site. Indeed, slightly more than one third of the responses indicated that this method of treatment might result in a land value in excess of that obtainable for the alternative 'greenfield' site. Several of the respondents were questioned on this point and indicated that they had decided upon this outcome on the basis that a great deal of information would be known about the reclaimed site, supported by contractor's and professional warranties, whereas the previously undeveloped site may contain unknown ground problems. Removal of the contaminated soil, and its replacement with clean fill, would probably also have the effect of overcoming any geotechnical problems.

Conclusive results were obtained in respect of Scenarios 2 and 3 with 46 per cent of the responses indicating that developers would be prepared to accept that the clean cover option (scenario 2) would have no different impact on value to total removal (scenario 1). Considered overall, however, these remediation options were perceived, at all stages of the development process, as resulting in a slight (6 to 10 per cent) decrease in value when compared to the previously undeveloped site.

When the Scenario 4 results were analysed, a wide variation of opinions was found. Very few (6.9 per cent) of the respondents considered that bio-remediation or chemical treatment methods would result in an increase in value, whereas 26 per cent to 39 per cent of respondents were of the opinion that there would be a significant decrease in values according to the perceived reactions of the different property market actors. Taken overall, developers were perceived as being prepared to accept that these 'higher technology' treatment methods resulted in only a slight decrease in value but all of the other actors could be expected to require a moderate decrease in value (11 to 25 per cent). This could be seen as confirmation of Patchin's view that stigma may, in part, be due to a fear of the unknown. The results for the residential development part of the survey are in Table 9.2.

TABLE 9.2

RESIDENTIAL DEVELOPMENT
MEANS OF RESPONSES TO QUESTIONNAIRE SURVEY

ALTERNATIVE METHODS OF PREPARATION OF A CONTAMINATED FORMER INDUSTRIAL SITE				
Residential Estate	**Scenario One**	**Scenario Two**	**Scenario Three**	**Scenario Four**
Developers	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%	Slight decrease 6-10%
Building Societies	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%	Moderate decrease 11-25%
Housing Associations	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%	Moderate decrease 11-25%
Occupiers	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%	Moderate decrease 11-25%

(Source: Syms, 1995a)

9.4.2 Development of a business park

As with the residential development, the results for Scenario 1 confirmed that, throughout all stages of development, investment and occupation, the total removal of contaminated material and its replacement with clean fill was seen as producing a resultant land value no different to a previously undeveloped site. Once again, more than one third of the responses indicated that this method of treatment might result in a land value in excess of that obtainable for the alternative 'greenfield' site.

More consistent results were obtained in respect of Scenario 2, for the business park development, with 51 per cent of the responses indicating that the various actors would be prepared to accept that the clean cover option (scenario 2) would have no different impact on value to total removal (scenario 1). Potential business park investors were seen as the most risk averse of the actors, expecting a 6-10 per cent reduction in value for sites remediated with clean cover and containment. For all other actors, however, this remediation option was perceived as producing a change of less than 5 per cent in value.

So far as physical processes such as soils washing were concerned (scenario 3), the outcome was perceived, at all stages of the development process, as resulting in a slight (6 to 10 per cent) decrease in value when compared to the greenfield site.

When the Scenario 4 results were analysed, 83 per cent of the responses over the range of actors were fairly evenly distributed between a less than 5 per cent change in value and a moderate decrease. Once again, the investors were regarded as the most conservative of the actors with 57 per cent of the responses indicating a moderate to high reduction in value, compared to the workers (33 per cent), developers (34 per cent) and the tenants (38 per cent). Very few (4.7 per cent) of the respondents considered that bio-remediation or chemical treatment methods would result in an increase in value. The results for the business park part of the survey are in Table 9.3.

TABLE 9.3
BUSINESS PARK DEVELOPMENT
MEANS OF RESPONSES TO QUESTIONNAIRE SURVEY

ALTERNATIVE METHODS OF PREPARATION OF A CONTAMINATED FORMER INDUSTRIAL SITE				
Business Park	**Scenario One**	**Scenario Two**	**Scenario Three**	**Scenario Four**
Developers	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%
Investors	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%	Moderate decrease 11-25%
Tenants	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%
Workers	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%

9.4.3 Development of an industrial estate

Once again, the results for Scenario 1 confirmed that, throughout all stages of development, investment and occupation, the total removal of contaminated material and its replacement with clean fill was seen as producing a resultant land value no different to a previously undeveloped site. Almost 90 per cent of the responses indicated that this method of treatment would result in a land value either in excess of that obtainable for the alternative 'greenfield' site or affected by less than 5 per cent change in value or desirability.

The containment and clean cover option in Scenario 2 was perceived to be almost as acceptable as the removal and replacement option, with 71 per cent of the responses indicating that the various actors would be prepared to accept that this would have no different impact on value to total removal. Even 59 per cent of potential industrial estate investors were perceived as expecting a less than 5 per cent change in value.

Soils washing (scenario 3) was also considered to be acceptable for industrial developments with 51 per cent of responses indicating a perceived impact on value of less than 5 per cent, at all stages of the development process. So far as potential investors were concerned, 72 per cent of the respondents were of the opinion that this method would result in no more than a 'slight' (6-10 per cent) reduction in value.

The 'high technology' methods (Scenario 4) appeared to be somewhat less acceptable to potential industrial estate investors, with only 52 per cent anticipating an impact of less than 10 per cent on the post treatment value, compared to 71 per cent of developers and 62 per cent of tenants. The results for the industrial estate part of the survey are in Table 9.4.

TABLE 9.4
INDUSTRIAL ESTATE DEVELOPMENT
MEANS OF RESPONSES TO QUESTIONNAIRE SURVEY

ALTERNATIVE METHODS OF PREPARATION OF A CONTAMINATED FORMER INDUSTRIAL SITE				
Industrial Estate	**Scenario One**	**Scenario Two**	**Scenario Three**	**Scenario Four**
Developers	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%
Investors	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%
Tenants	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%
Workers	<5% change in value/desirability	<5% change in value/desirability	<5% change in value/desirability	<5% change in value/desirability

9.4.4 Development of a retail park

Over all four scenarios the results for retail park development displayed close similarities to the perceptions of how the actors would perform in respect of the industrial estate development. The results for Scenario 1 confirmed that, throughout all stages of development, investment and occupation, the total removal of contaminated material and its replacement with clean fill was seen as producing a resultant land value no different to a previously undeveloped site. A total of 87 per cent of the responses indicated that this method of treatment would result in a land value either in excess of that obtainable for the alternative 'greenfield' site or affected by less than 5 per cent change in value or desirability.

Sixty-six per cent of the responses indicated that the various actors would be prepared to accept the containment and clean cover option (Scenario 2) as having less than 5 per cent impact on the value of the treated site. For 52 per cent of potential retail park investors the perceived outcome was a less than 5 per cent change in value.

As was found in respect of industrial developments, soils washing (scenario 3) was considered to be acceptable for use in the preparation of retail park sites with 48 per cent of responses indicating a perceived impact on value, at all stages of the development process, of less than 5 per cent. So far as potential investors were concerned, the acceptability of this method fell slightly when compared to its use for industrial developments, with 69 per cent of the respondents believing that this method would result in no more than a slight (6-10 per cent) reduction in value, compared to 72 per cent of respondents for industrial development.

The acceptability of 'high technology' methods (Scenario 4) to retail park investors fell by five percentage points, when compared with industrial development, with 47 per cent anticipating an impact of less than 10 per cent on the post treatment value. This method was also seen as being slightly less acceptable to developers and tenants. The results for the retail park part of the survey are in Table 9.5.

TABLE 9.5
RETAIL PARK DEVELOPMENT
MEANS OF RESPONSES TO QUESTIONNAIRE SURVEY

ALTERNATIVE METHODS OF PREPARATION OF A CONTAMINATED FORMER INDUSTRIAL SITE

Retail Park	Scenario One	Scenario Two	Scenario Three	Scenario Four
Developers	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%
Investors	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%	Slight decrease 6-10%
Tenants	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%
Shoppers	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%

9.4.5 Development for leisure use

The specific type of leisure use envisaged for the hypothetical site was not specified in the survey. It could vary from the site being totally covered in hard surfaces such as buildings and car parking, to being almost totally open and grassed over.

The results for Scenario 1 confirmed that, for all three classes of actors under consideration, the total removal of contaminated material and its replacement with clean fill was regarded by 86 per cent of the responses as resulting in a land value either in excess of that obtainable for the alternative 'greenfield' site or affected by less than 5 per cent change in value or desirability.

Sixty-three per cent of the responses indicated that the various actors would be prepared to accept the containment and clean cover option (Scenario 2) as having less than 5 per cent impact on the value of the treated site. For 55 per cent of potential leisure investors the perceived outcome was a less than 5 per cent change in value.

Soils washing (scenario 3) was considered to be less acceptable for use in the preparation of leisure sites with 41 per cent of responses indicating a perceived impact on value, at all stages of the development process, of less than 5 per cent, compared to 48 per cent for retail use and 51 per cent for industrial use. This method was also seen as being acceptable to investors with 67 per cent of the respondents believing that this method would result in no more than a slight (6-10 per cent) reduction in value, compared to 72 per cent of respondents for industrial development and 69 per cent for retail development.

The acceptability of 'high technology' methods (Scenario 4) to leisure investors was regarded as being the same as for retail parks with 47 per cent of respondents anticipating an impact of less than 10 per cent on the post treatment value. The results for the leisure use part of the survey are in Table 9.6.

TABLE 9.6
LEISURE DEVELOPMENT
MEANS OF RESPONSES TO QUESTIONNAIRE SURVEY

ALTERNATIVE METHODS OF PREPARATION OF A CONTAMINATED FORMER INDUSTRIAL SITE

Leisure Use	Scenario One	Scenario Two	Scenario Three	Scenario Four
Developers	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%
Investors	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%	Moderate decrease 11-25%
Workers	<5% change in value/desirability	<5% change in value/desirability	Slight decrease 6-10%	Slight decrease 6-10%

9.5 PHASE TWO - VALUES BEFORE AND AFTER TREATMENT AND/OR REDEVELOPMENT - INTERVIEW SURVEY

This stage of the research comprised an interview survey of valuers and surveyors, carried out between July and September 1994. Twenty-one interviews were undertaken with partners and directors[1] of most of the leading firms of valuation surveyors in the North West, many being regional offices of national firms. All of the interviewees had extensive property market knowledge, all but one having worked in the North West for at least ten years and most for a considerably longer period. The interviewees were selected for the strength of their knowledge in respect of the property markets in the region and it was considered that the individuals concerned could speak knowledgeably about those markets. All but two of the interviewees were departmental heads, or sole principals, and were therefore in a position to determine, or at least strongly influence, their firm's policies and attitudes in respect of the valuation of contaminated land. The purpose of the interview survey was to ascertain the

1 All but one of the interviewees were partners or directors and heads of their respective departments. The one exception was a senior surveyor, number two in his department, who deputised for his director at short notice.

extent of knowledge within the valuation profession, regarding land contamination and its treatment and the way in which the issues were reflected in valuations and the advice given to clients in respect of property acquisition or development decisions.

A copy of the form used as the basis for the interviews is in Appendix Two. The purpose of questions 1 and 2 was to identify the areas of the property markets with which the interviewees and their firms were actively involved. Questions 3 to 5 attempted to ascertain the extent of knowledge held by the individuals and within the firms, in respect of contaminated land. The assessment of attitudes towards government policies and the desirability of involvement by the professional bodies in the contaminated land debate was the purpose of questions 6 to 11. Treatment methods and the extent to which they might affect values were considered in questions 12 to 15, whilst question 16 attempted to obtain views as to how values might be affected before and after treatment according to differing levels of hazard. At the end of the interview all interviewees were asked if they would be prepared to answer supplementary questions at a later date and also if they would be prepared to provide information on property transactions for a possible database. All interviewees agreed to both requests.

9.6 **RESULTS OF THE INTERVIEW SURVEY**

9.6.1 Question 1 *Please state the nature of your position within the organisation.*

All but one of the interviewees was a partner or director.

9.6.2 Question 2a *Please describe the main activities of your company by the nature of the services provided to clients and the types of properties covered.*

The responses to this question are set out in Table 9.7:

TABLE 9.7

MAIN ACTIVITIES OF THE FIRMS

BY TYPE OF SERVICES	NUMBER OF FIRMS OFFERING SERVICE	
Estate Agency, general and investment	13	62%
Professional, valuations etc.	17	81%
Development consultancy	9	43%
Property management	9	43%
Town planning consultancy	6	29%
Building surveying	1	5%
Minerals surveying	1	5%
BY TYPE OF PROPERTIES		
Industrial	15	71%
Commercial, offices	14	76%
Commercial, retail	10	48%
Residential	5	24%
Investment	6	29%
Leisure	3	14%
Motor	1	5%

Question 2b *Please indicate your personal areas of specialism, by services and types of properties.*

The responses to this question are set out in Table 9.8.

TABLE 9.8

MAIN ACTIVITIES OF THE INTERVIEWEES

BY TYPE OF SERVICES	NUMBER OF INDIVIDUALS OFFERING SERVICE	
Estate Agency, general and investment	9	43%
Professional, valuations etc.	9	43%
Development consultancy	8	38%
Property management	1	5%
Town planning consultancy	2	10%
BY TYPE OF PROPERTIES		
Industrial	14	67%
Commercial, offices	11	52%
Commercial, retail	1	5%
Residential	3	14%
Investment	1	5%
Leisure	1	5%
Motor	1	5%

9.6.3 Question 3a *Does your firm regularly become involved with the valuation or redevelopment of contaminated land?*

The responses to this question were equally divided with 11 of the interviewees indicating a regular involvement, either personally or within the firm, and with the other 10 interviewees indicating no regular involvement.

Question 3b *If the answer to question 3a is yes, approximately how much of the firm's work (by number of cases - not fees) is concerned with the implications of contamination on valuation and development?*

Five of the responses indicated an involvement of less than 5 per cent of the firm's case load, four firms were between 5 per cent and 50 per cent, whilst the remaining two firms indicated that contaminated land implications affected between 50 and 74 per cent of their work. Of the two firms indicating the greatest involvement with contamination, King Sturge, is one of the country's leading industrial property consultants and the other is a small specialist firm dealing primarily with the motor industry. Of the firms which indicated a lack of involvement with contaminated land, one stated the reason as being a lack of professional indemnity insurance cover for this type of work.

9.6.4 Question 4a *Have you personally been involved with the valuation, acquisition, redevelopment or disposal of a contaminated site within the last five years?*

Seventeen of the interviewees indicated that they had been involved with a contaminated site, or sites, within the previous five years.

Question 4b *If the answer to question 4a is yes, then on approximately how many occasions have you had such an involvement?*

Nine of the interviewees indicated involvement on fewer than five occasions, two on five to nine occasions, two on 10 to 14 occasions and one on 15 to 20 occasions. Only three of the interviewees had personal experience of contaminated land issues on more than 20 occasions. Of these, two were the interviewees who had indicated the highest levels of firm involvement in response to question 3, whilst the third acted for two Urban Development Corporations in inner city areas.

9.6.5 Question 5 *To what extent do you consider yourself to be familiar with the causes of contamination in land, the ways in which such contamination may travel and the manner in which it might affect its targets, such as humans, animals, plants and buildings?*

Forty-eight per cent of the interviewees were at least reasonably familiar with the causes of contamination but only 28 per cent and 24 per cent respectively had the same level of knowledge concerning pathways and targets. The responses to this question are set out in Table 9.9:

TABLE 9.9

PERCEIVED FAMILIARITY WITH CONTAMINATION, ITS CAUSES, PATHWAYS AND TARGETS

Extent of familiarity	Causes	Pathways	Targets
Very familiar	1	0	0
Reasonably familiar	9	6	5
Some knowledge	4	6	5
Little knowledge	4	5	6
No knowledge	3	4	5

9.6.6 Question 6. *To what extent do you consider that the professional bodies (RICS and ISVA) should set down guidelines for dealing with the valuation of contaminated land?.*

The majority, 81 per cent, of those interviewed considered it to be essential or very important for the professional bodies to lead in producing guidelines. One of the interviewees was of the opinion that the valuation of contaminated land should be left to specialists and that it was not a matter of concern for general practice surveyors. Opinions were expressed by two people that the profession should 'leave it alone' and take its lead from government.

9.6.7 Question 7. *Do you believe that government should take the lead in setting standards/guidelines for the valuation of contaminated land?*

Opinion was very firmly against government involvement, with only four interviewees (19 per cent) being in favour. The reasons for opposing government involvement were diverse, including fears that political influences could work against the public interest and that any government measures would be too draconian, possibly involving the creation of yet more 'quangos'[2]. Generally, the interviewees believed that market influences should determine value and that the surveying profession should determine guidelines for valuation methods, with government possibly setting some standards to be achieved. There was, however, some objection to any government involvement on the grounds that there is already enough interference and regulation, and that prescriptive requirements could reduce flexibility and may mean that each case is not treated on its merits.

9.6.8 Question 8. *Were you in favour of the proposals to set up registers under Section 143 of the Environmental Protection Act 1990?*

2 Quasi-autonomous non-governmental organisations.

Sixteen of the interviewees (76 per cent) had been opposed to the registers, with four in favour and one undecided. Nine individuals, including two of those in favour of the registers, expressed views that the proposals were ill conceived, the potential impact not properly considered and the consultation process was badly handled. Other views included objections to the additional bureaucracy and that the government seemed intent on "wrapping people up in cotton wool". The fact that there was only a limited right of appeal and no means of removing register entries, even after treatment or a satisfactory site investigation, were highlighted by two of those interviewed. Somewhat surprisingly, only three of the interviewees expressed concern over the possible blighting effect on values, whilst a fourth was of the opinion that any blight might be considered justified. One individual was of the view that valuers should only produce valuations on the basis that properties are uncontaminated and that the registers would have produced a further complication.

9.6.9 <u>Question 9.</u> *Would you have been in favour of setting up registers giving details of all land uses, past and present, instead of concentrating on a few which were deemed to be 'potentially contaminative'?*

Responses to this question were equally divided between those in favour and those opposed, with one 'don't know'. Those in favour of comprehensive land use registers considered them to be preferable to the Section 143 registers covering only a limited number of activities, however the costs and time involved, relative to the benefits, were questioned. The comprehensive registers were also seen as being less likely to result in blighted values, or in any stigma remaining after treatment. Of those opposed to comprehensive land use registers, most cited 'unnecessary bureaucracy' as their main objection.

9.6.10 Question 10. *Are you in favour of positive action being taken by government to encourage the redevelopment of contaminated sites in preference to greenfield development?*

Eighty-six per cent of those questioned were in favour of contaminated sites being redeveloped in preference to greenfield sites. Several interviewees were in favour of positive government action being taken through the use of grant aid and tax incentives, such as enterprise zones, whilst others stressed a need to ensure that those responsible for causing pollution are made to bear the cost of treatment. The opponents viewed any pressures, or incentives, to tackle contaminated sites first as being interference with market forces.

9.6.11 Question 11a *Are you aware of the government's intention to set up an Environmental Agency?*

Almost half (10 interviewees) were not aware of the proposed agency. When the functions of the agency had been explained, together with the fact that the new organisation was likely to take over the existing powers of Her Majesty's Inspectorate of Pollution, the National Rivers Authority, the Waste Regulation Authorities and possibly some local authority responsibilities, the interviewees were asked:

Question 11b *Are you in favour of responsibility for a wide range of environmental issues being controlled by a single agency?*

Two thirds of those interviewed were in favour of the responsibility being vested in a single body, although several qualified their approval by saying that the agency must have adequate powers and not simply be another tier of bureaucracy. The bureaucratic implications were also the main objections of those opposed to the agency. The majority of people did, however, recognise the benefit of having a single point of reference for environmental matters.

9.6.12 Question 12. *Notwithstanding the fact that the total removal of contamination from affected sites can not be guaranteed, do you consider that after treatment by this method there is likely to be any difference in value between a treated site and a greenfield site of similar size and in a similar location, and if so, to what extent will values be affected?*

Twelve interviewees (57 per cent) were of the opinion that even after treatment in this way a difference in values would exist. Of those who considered that there would be no difference in value, three admitted that they would still expect the greenfield site to sell more readily and one individual was of the opinion that values would only be affected if made into an issue by the government. Only seven of the interviewees were prepared to estimate the extent to which values might be affected and their views indicated a fall in value of between 5 and 25 per cent.

9.6.13 Question 13. *Do you consider that 'higher technology' forms of treatment, such as chemical, biological or thermal treatments will a) improve, b) reduce, or c) not alter the value or development potential of a site when compared to removal of the contamination?*

Only two of those interviewed considered that these forms of treatment would improve values when compared to the alternative of removing contaminants from the site, ten believed that reductions in values would arise, whilst eight were of the opinion that values would not alter and one did not know. Eight interviewees were concerned about the long term effectiveness of new technologies and the extent to which satisfactory warranties would be available. One individual indicated that much would depend on the attitudes of fund managers, who are responsible for the majority of property investment decisions in the United Kingdom.

9.6.14 Question 14. *In your opinion is there likely to be a long lasting effect on property values even after site remediation has been completed?*

A small majority (57 per cent) was of the opinion that there was not likely to be a long lasting effect on values, especially in the absence of any registers. Comments were made that treatment works and site histories would need to be well documented. Those interviewees who believed that there would be a long lasting effect on values were of the opinion that the stigma of past contamination would remain and that the property markets would be influenced by the views of investors and by lawyers through the use of searches and pre-contract enquiries. Several people expressed the view that any effect on value would erode over time and indicated a period of between five and ten years, although much would depend upon the use of the site and the nature of the former contamination.

9.6.15 Question 15. *When valuing or acquiring premises for either occupation or redevelopment, have you made allowances in your valuation or offer to deal with known or possible contamination?*

Two thirds of the interviewees indicated that they had made allowances in valuations and/or offers. For the most part, the allowances had been arrived at by estimation and guesswork, resulting in contingency provisions of up to 25 per cent of the value of the property in an uncontaminated state. Four of those who indicated that they had not made any allowances stated that their approach was to only issue valuations which did not take account of contamination and then to include a suitable caveat to the effect that contamination might be present.

9.6.16 Question 16. *To what extent do you consider property values may be affected, before and after treatment, according to differing levels of hazard, when compared to a similar, but uncontaminated property?.*

This question sought to identify the extent to which valuers would reflect different levels of contamination hazard in their valuations before and after treatment and remediation. Five levels of hazard were described to the interviewees, as set out in Box 9.3.

BOX 9.3
HAZARD CLASSIFICATION

VERY LOW HAZARD
Contamination below ICRCL Trigger levels, unlikely to be harmful to humans, animals, plants, structures or the environment.

LOW HAZARD
Some contamination, possibly phytotoxic but unlikely to be harmful if contained below a cover layer.

MEDIUM HAZARD
Contamination well in excess of Trigger levels, possibly harmful to structures or services but unlikely to cause harm to humans or animals, except through prolonged exposure. Treatment necessary.

HIGH HAZARD
Contamination levels likely to cause harm to persons and/or property, with high levels of toxicity or other harmful substances. Comprehensive remediation required.

VERY HIGH HAZARD
Sites requiring decontamination under stringent controls, contaminants likely to cause harm even from short term exposure. Must be removed or treated before development or occupation.

(Source: Syms, 1994c)

Given these five levels of hazard, the interviewees were asked to indicate the approximate percentage adjustment they would apply in valuing such a property when compared to an uncontaminated property. It was to be assumed that valuations were to be provided before treatment and redevelopment had taken place and again, in respect of the land element only, following completion of any site treatment considered appropriate in order to reduce the risk level to one suitable for the proposed end use. In other words, the hypothetical valuations were to be the same as a bank would require when considering whether or not to provide finance for a proposed development and the extent of treatment was to be in accordance with recommendations made by government and the RICS. All of the interviewees considered this to be the most difficult question in the interview and, as a general rule, between 30 and 45 minutes of the interview time was spent in discussing the issues involved.

So far as the Low Hazard, before development, situation was concerned, twelve interviewees indicated that they would apply reductions ranging from two per cent to ten per cent, whilst eight were of the opinion that no allowance should be made in the valuation. One interviewee considered that a reduction of 21 - 25 per cent should be applied. After redevelopment, thirteen were of the opinion that no valuation adjustment should be applied, with the rest suggesting reductions of up to 10 per cent.

The amount of reduction which the interviewees would expect to apply increased with the severity of the hazard. However, there were wide differences between the valuers as to the amount of reduction which should be applied with the increasing levels of hazard. Tables 9.10 and 9.11 show the results of this question.

TABLE 9.10
IMPACT ON VALUES BEFORE DEVELOPMENT

HAZARD RANKING	RESPONDENTS BY IMPACT ON VALUE/PERCENTAGE OF SAMPLE SAMPLE SIZE 21								
	NONE	<10%	11-25%	26-40%	41-60%	61-80%	81-100%	>100%	Means
VERY LOW HAZARD	8 38.1%	12 57.14%	1 4.76%						3.71%
LOW HAZARD	4 19.05%	12 57.14%	3 14.29%	2 9.52%					8.51%
MEDIUM HAZARD	1 4.76%	3 14.29%	7 33.33%	10 47.62%					22.43%
HIGH HAZARD			3 14.29%		9 42.86%	6 28.57%	2 9.52%	1 4.76%	58.19%
VERY HIGH HAZARD			1 4.76%			3 14.29%	5 23.81%	12 57.14%	90.38%

It will be noted that even at the medium hazard level quite significant numbers of professionals indicated value discounts of around 40 to 50 per cent and that for sites in the very high hazard category the majority were of the opinion that negative values would apply. Many interviewees indicated that they would most probably advise their clients not to become involved with the very high hazard sites.

TABLE 9.11
IMPACT ON VALUES AFTER DEVELOPMENT

HAZARD RANKING	RESPONDENTS BY IMPACT ON VALUE/PERCENTAGE OF SAMPLE SAMPLE SIZE 21								
	NONE	<10%	11-25%	26-40%	41-60%	61-80%	81-100%	>100%	Means
VERY LOW HAZARD	13 61.90%	8 38.10%							1.90%
LOW HAZARD	5 23.81%	14 66.67%	1 4.76%	1 4.76%					5.75%
MEDIUM HAZARD	2 9.52%	14 66.67%	3 14.29%	1 4.76%	1 4.76%				9.90%
HIGH HAZARD	2 9.52%	7 33.33%	10 47.62%		2 9.52%				15.10%
VERY HIGH HAZARD		3 14.29%	5 23.81%	2 9.52%	3 14.29%			8 38.10%	53.90%

Even after treatment and redevelopment, there was a wide range of views as to the perceived impact on land values, with just over one third of the sample still holding the view that a site which had previously been classified as 'Very High Hazard' would still have a negative value. The acceptability of such sites for redevelopment and long term investment was seen as depending almost entirely upon the warranties being given by those responsible for the design and execution of the remediation work.

Several of the interviewees questioned the wisdom of treating a Very High Hazard site if, after treatment, the Very High Hazard classification still remained.

Such occurrences may indeed be very rare but may apply on radioactive materials processing sites and chemical works where wastes previously disposed of in an unsatisfactory manner in the ground are subsequently recovered, treated, say by solidification, and then re-interred. The hazardous wastes would remain on site and would not prevent continued use for industrial purposes, but could present a Very High Hazard if the containment was breached.

Almost all of the interviewees experienced problems in providing an assessment of the post-treatment reductions in value. In some cases these were expressed in contingencies to be applied as a percentage of the cost of treatment, whilst in others the adjustments indicated were expressed in terms of value. In view of the difficulties experienced, it was felt that the results contained in Table 9.11 may not be representative of the views held by members of the valuation profession. Therefore, the decision was taken to re-phrase the question and repeat it in the final phase of the study.

9.7 PHASE THREE - CONTAMINATED LAND IN CONTEXT - A QUESTIONNAIRE SURVEY

The final phase of the perceptions study took the form of a questionnaire survey mailed to the 165 remaining members of the original 'experts' list, together with a survey, in respect of question one only, of 50 members of the general public. Seventy-seven useable responses were received from the experts (a 47 per cent response), with a further three letters offering views on environmental issues but without completed survey forms.

The useable responses were divided into two groups, with the first being made up entirely of valuers and development surveyors, whilst the second contained all the other professions associated with property development, including architects, engineers, lawyers, quantity surveyors and engineers. There were 43 members in the first group, referred to as the 'valuers' and 34 members in the second group, referred to as the 'non-valuers'. As with the two earlier phases of the study, almost all of the respondents were in senior positions in their organisations and most had at least ten years post-qualification experience.

A copy of the questionnaire form is contained in Appendix One. The overall objective of the form design was to take the respondent from the general to the specific in terms of environmental awareness. Question 1 was therefore intended to place contaminated land into context with other environmental issues and to facilitate a comparison between the perceptions of the two expert groups and a non-expert population. Question 2 then focused upon contaminated land as an environmental issue and sought to compare the views of the expert groups in terms of a number of harmful effects which might be associated with land contamination.

Question 3 enabled the 26 industrial uses identified in Chapter Two as having the greatest potential to cause serious contamination, to be ranked according to the level of hazard perceived by the experts. The intention was to compare and contrast the perceptions of the two expert groups. This question also asked respondents to identify any other industrial activities which they considered should be included on a list of potentially contaminative uses.

Questions 4 and 5 revisited two of the issues, concerned with government policy, which had been considered in the phase two interview survey. These were included in order to test whether or not there had been any significant shift in attitudes during the eighteen month intervening period.

The final question dealt with the specific issue of the post remediation impact of contamination on land value and the likely duration of any impact. This question was addressed only to the 'valuers' group and was similar in nature to part of question 16 in the interview survey. This question was included to test whether there had been any change in the perceptions of valuers since the time of the interview survey.

9.8 RESULTS OF THE SECOND QUESTIONNAIRE SURVEY

The results of the second interview survey are discussed below and analyses of the results are contained in Appendix Two.

9.8.1 Question 1 *Please indicate your perception of hazard for the* ***Known Risks and Uncertainties*** *for each of 20 environmental issues.*

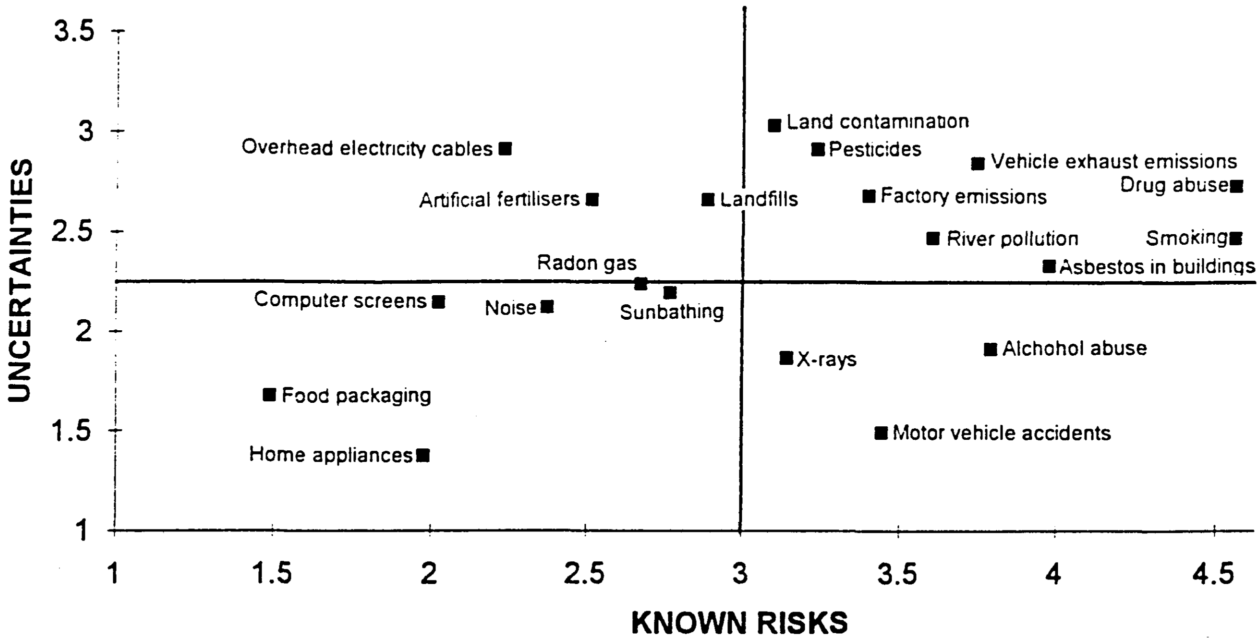
This question adopted a psychometric approach to environmental perceptions. The intention was to place contaminated land in context with other environmental issues and to facilitate a comparison between the perceptions of the two expert groups and a non-expert population. A total of 127 individuals were involved in this part of the study, divided into three groups, 43 valuers and development surveyors (the 'valuers' group), 34 non-valuation experts (including engineers, environmental scientists, architects and property lawyers - the 'non-valuers' group) and a 'general population' group of 50 individuals not having any professional connection with valuation or development.

Twenty environmental issues were selected for this study, comprising a mix of property and non-property related issues. These were carefully chosen to represent ordinary, every day, concerns and avoided 'catastrophic' type concerns, such as earthquakes and nuclear accidents. Some of the issues were selected because they had also been used in the studies illustrated in earlier work (Slovic, 1992 and Petts and Eduljee, 1994), and may provide a comparison to that work.

The respondents were asked to indicate their perception of risk in respect of the Known Risks, those that are well researched or publicised, in respect of each of the issues, together with their perceptions of the unknown risks, or Uncertainties, using the five levels of hazard classification, Very Low to Very High, as used in the interview survey described previously.

The research methodology was similar the earlier work by Paul Slovic (see for example Slovic, 1992), described in Chapter Three, except for the fact that Slovic's presentation of findings derived directly from factor analysis, which was not the case with the present study. It also differed from Slovic's work in that the intention was to compare the perceptions of populations with potentially different levels of knowledge in respect of environmental issues. It may therefore be expected that the results from the three sample populations, valuers, non-valuers and general, presented spatially in Figures 9.1 to 9.3, whilst being in the same style as Slovic's work, will produce some different outcomes. The highest perceptions of risk are located in the top right quadrant and the lowest perceived risks are in the bottom left quadrant. The detailed results are contained in Appendix Two.

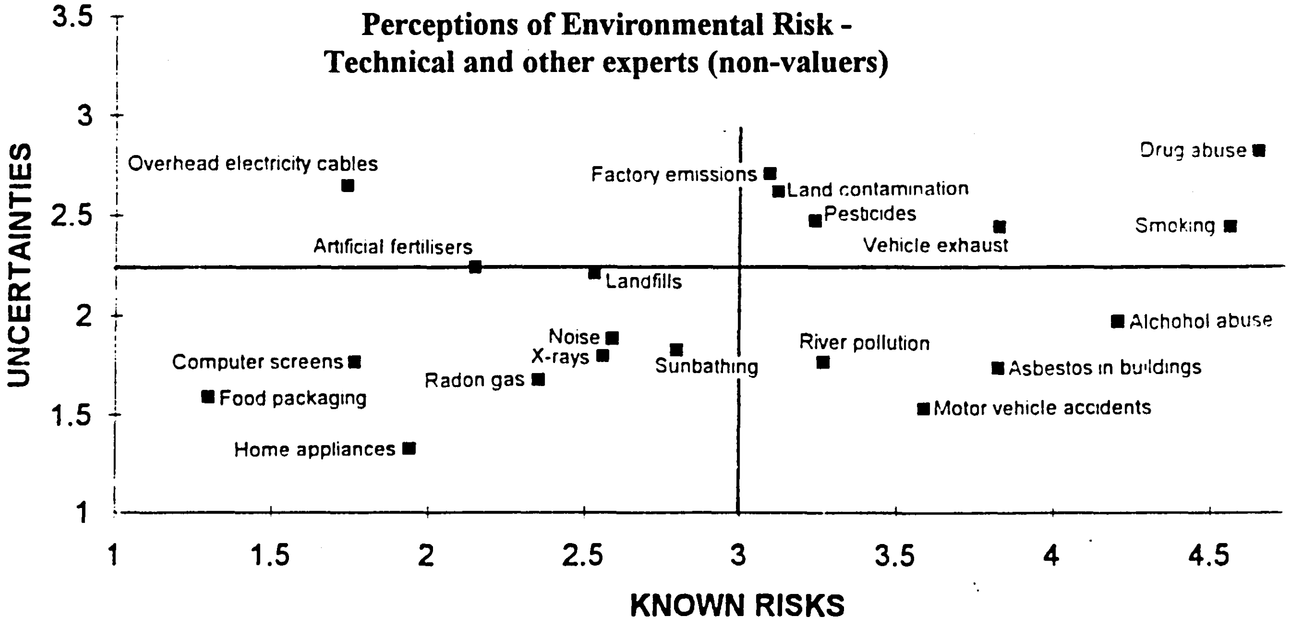
FIGURE 9.1
Perceptions of Environmental Risk - Valuers and Development Surveyors



Of the non-property related risks Drug Abuse and Smoking are seen as being of most concern to all three groups, with very similar levels of concern in respect of the Uncertainties, but with the 'general population' seeing a higher level of Known Risk. The 'general population' considered three of the property related issues, River Pollution, Land Contamination and Landfills to have very similar levels of perceived risk, all just within the top right quadrant.

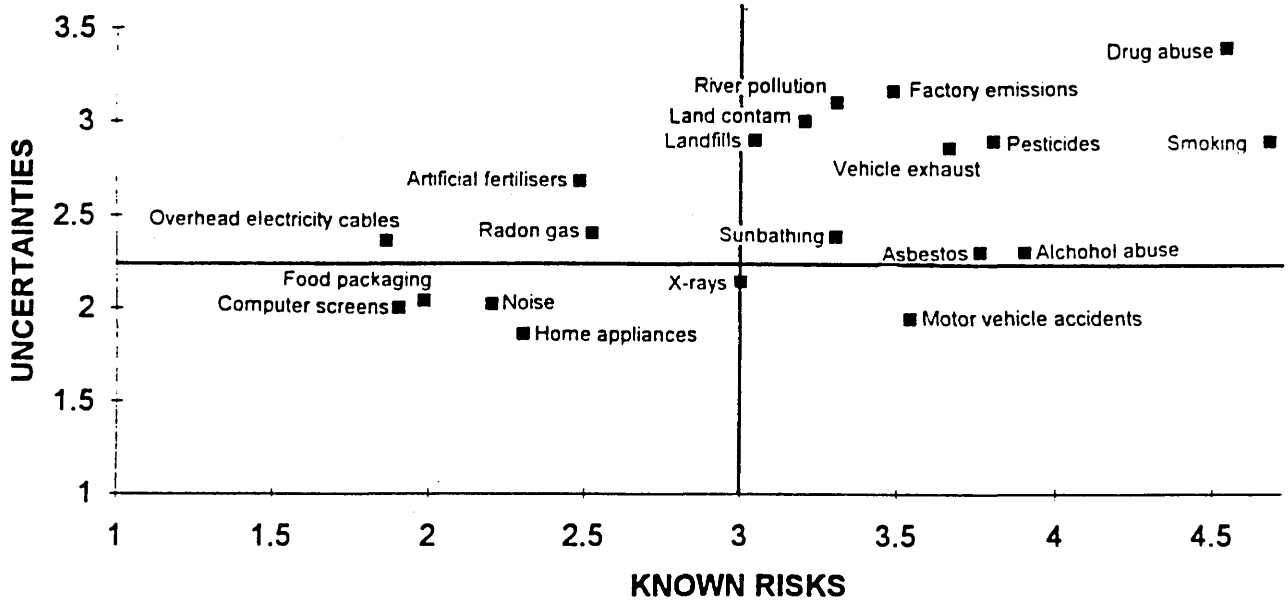
Both the 'valuers' group and the 'general population' group had similar perceptions in respect of the Known Risks attaching to Land Contamination but the 'none valuers' perception of risk was somewhat lower. All three groups indicated similar degrees of Uncertainty perception for Land Contamination. The 'none valuers' perception of risk for Landfills and Radon Gas was noticeably lower than for either of the other two groups, possibly due to the technical background of many members in this group.

FIGURE 9.2
Perceptions of Environmental Risk -
Technical and other experts (non-valuers)



For all three groups the issues of least concern were Home Appliances, Food Packaging and Computer Screens. Rather surprisingly, all three groups indicated a low level of risk perception in respect of Overhead Electricity Cables, especially in terms of Known Risks. This was a different outcome to Slovic's 1987 study, which indicated a greater perception of risk in respect of this issue. Co-incidentally, however, a few weeks after the survey was conducted, this issue received considerable exposure in the press and a different result may be produced if the study was to be repeated.

FIGURE 9.3
Perceptions of Environmental Risk - General Population



In order to test the significance of the responses in respect of the environmental issues a Chi-square technique was used as an indicator for each of the environmental issues under consideration. Separate tests were carried out for the 'Known Risks' and the 'Uncertainties'. The results for the 'general' population were used as the expected hypotheses, instead of a normal distribution, with each of the 'expert' groups being tested against these results.

For all but one of the non-property related environmental issues there was a close correlation between the perceptions of the general population and the two expert groups, at the 95% confidence level with four degrees of freedom. The one exception was for the 'none valuers' group tested against the general population in respect of the Uncertainties relating to Smoking, which produced a result of 14.9766. From the detailed results in Appendix Five it can clearly be seen the none valuers have a significantly lower perception of the uncertainties relating to smoking than the general population.

For most of the property related issues the statistical tests produced a similarly strong correlation between the expert groups and the general population. There were, however, three exceptions. The general population's perception of uncertainty in respect of River Pollution and Landfills was significantly greater the that of the non-valuers group, with results of 13.6697 and 13.5632 respectively. For Radon Gas the valuers' perception of Known Risk was significantly higher than that of the general population, with a result of 11.6965.

A comparison between the present study and the two earlier studies, referred to above, in terms of spatial representation, is shown in Table 9.12.

TABLE 9.12
Comparisons of the spatial location of environmental issues common to three studies

Environmental Factor	Slovic 1987	Slovic 1980	Syms, 1996 General	Valuers	Non-Valuers
Smoking	LL	LR	UR	UR	UR
Alcohol abuse	LL(1)	LL(1)	UR	LR	LR
Vehicle exhaust emissions			UR	UR	UR
Radon gas			UL	CL	LL
Noise			LL	LL	LL
Land contamination			UR	UR	UR
Drug abuse			UR	UR	UR
Factory emissions			UR	UR	UR
Overhead electricity cables	UR(2)		UL	UL	UL
Computer screens			LL	LL	LL
Asbestos in buildings	UR(3)		UR	UR	LR
River pollution			UR	UR	LR
X-rays	UL		LC	LR	LL
Pesticides and insecticides	UR	UR	UR	UR	UR
Food packaging			LL	LL	LL
Artificial fertilisers	UR(4)		UL	UL	CL
Motor vehicle accidents	LR	LL	LR	LR	LR
Home appliances		LL	LL	LL	LL
Sunbathing		UL	UR	CL	LL
Landfills			UR	UL	CL

Key:
UL=Upper left
LL=Lower left
LR=Lower right
UR=Upper right
C=on or touching centre line of respective axis

Notes:
(1)Described only as alcohol in Slovic 1987 and alcoholic beverage in Slovic 1980
(2)Referred to as electric fields in Slovic, 1980
(3)Referred to as asbestos insulation in Slovic, 1980
(4)Referred to as nitrogen fertilizers in Slovic, 1980

The differences observed between the three studies may be attributable to different research methods, sample sizes and timing of the studies, especially the latter as the studies extend over a period of more than 15 years. During this period, perceptions of risk are likely to have undergone significant changes and there is no means of scaling the results of the latest study against the earlier studies. Nevertheless, there would seem to be sufficient similarity between the results of the three studies to confirm the validity of the approach.

9.8.2 Question 2 *Please indicate your perception of hazard for the* ***Known Risks*** *and* ***Uncertainties*** *for each of 16 environmental issues, relating directly to contaminated land.*

This part of the study focused upon Contaminated Land as an environmental issue and sought to compare the views of the expert groups in terms of a number of harmful effects which might be associated with land contamination. It was not considered appropriate to involve the 'general public' group in this part of the study as the responses required a degree of 'expert' knowledge. The results from this part of the study are presented spatially in Figures 9.4 and 9.5, from which it will be noted that the perception of land contamination associated risks held by the valuers and development surveyors was considerably higher, for both Known Risks and Uncertainties, than for the non-valuer group of experts.

A Chi square technique was also used as an indicator in respect of these results, with the results from the non-valuer group being used as the expected hypotheses. The correlation from these tests was much weaker than those from the environmental issues tests, as might be expected from the spatial representation. In particular, the valuers' perception of Known Risks was significantly higher than that of the non-valuers in respect of Damage to

Invertebrates, Acid Burns and Risk of Explosion, with results of 12.1249, 12.1788 and 10.1867 respectively. The valuers' perception of Uncertainties in respect of Contaminated Drinking Water was also higher than that of the non-valuers, with a result of 10.139. All tests were based on 95% confidence level with four degrees of freedom.

FIGURE 9.4

Perceptions of Contaminated Land Risks -
Valuers and Development Surveyors

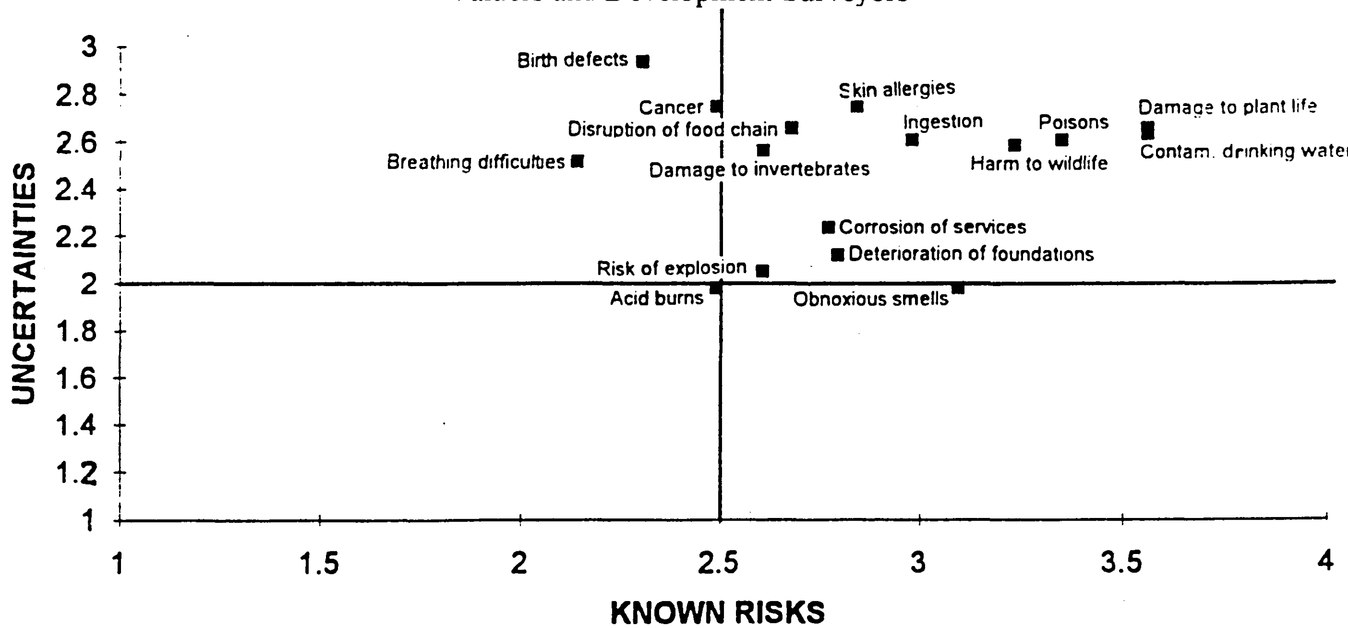
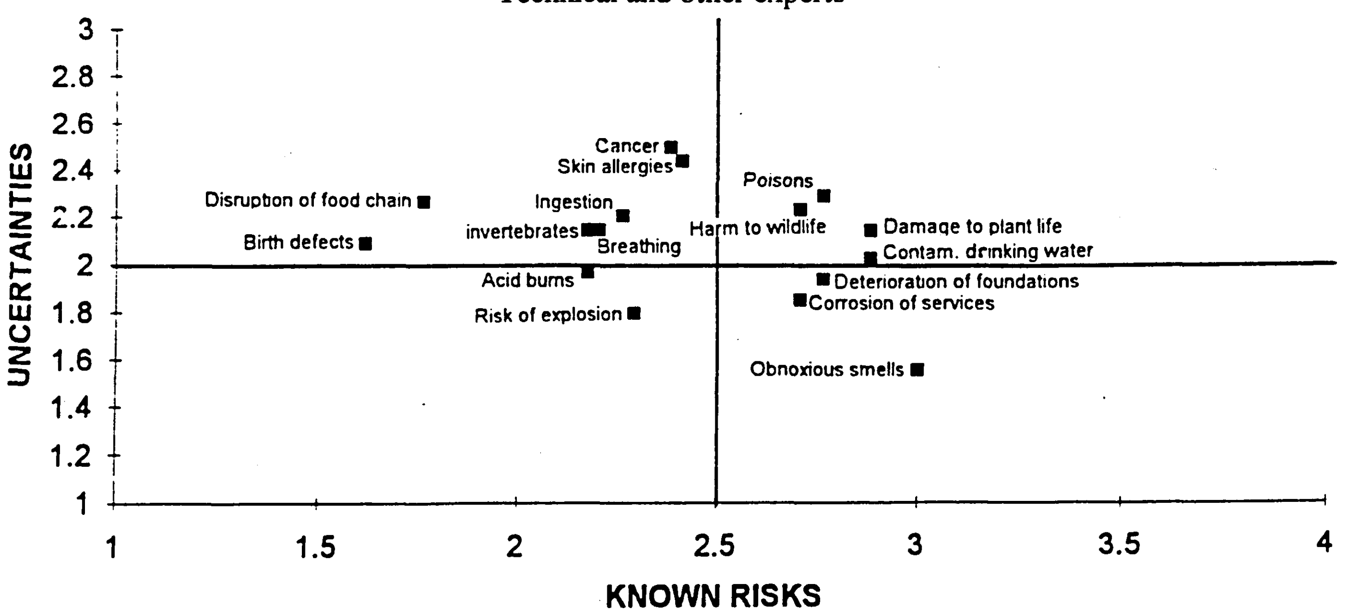


FIGURE 9.5

Perceptions of Contaminated Land Risks -
Technical and other experts



9.8.3 Question 3 *Please indicate your perception of risk in respect of each of the following 26 industrial activities.*

The objective of this part of the study was to compile a ranking, in respect of the perceived environmental risk attaching to a number of 'potentially contaminative' industrial uses. The 26 industrial uses were those identified in Chapter Two as having 'the greatest potential to cause serious contamination'. The two 'expert' groups were, once again, asked to indicate their perception of risk for each industry, using the five degrees of hazard from Very High to Very Low. Once again, the intention was to compare and contrast the perceptions of the two expert groups. The result of this part of the study is in Table 9.13.

TABLE 9.13

Rank order of perceived industrial risks

INDUSTRY TYPE	COMBINED TOTAL	MEAN	VALUERS SAMPLE	NON-VALUERS SAMPLE	COMBINED Rank
Asbestos manu. and use	349	4.53247	1	1	1
Chemicals manu. and store	327	4.24675	3	2	2
Radioactive mats. process	306	3.97403	2	7	3
Gas works	297	3.85714	7	3	4
Waste disposal sites	297	3.85714	4	4	4
Oil refining and storage	292	3.79221	5	6	6
Dyestuffs manufacturing	286	3.71429	8	4	7
Paint manufacture	277	3.5974	6	10	8
Tanning and leather works	268	3.48052	10	8	9
Metal treatment and finishing	265	3.44156	9	11	10
Metal smelting and refining	259	3.36364	12	9	11
Explosives industry	254	3.2987	13	12	12
Iron and steelworks	250	3.24675	11	13	13
Scrapyards	238	3.09091	14	16	14
Heavy engineering	230	2.98701	15	17	15
Mining and extractive inds.	228	2.96104	17	15	16
Electricity generating	224	2.90909	16	19	17
Pharmacuetical industries	215	2.79221	19	14	18
Paper and printing works	208	2.7013	18	20	19
Glass manufacture	202	2.62338	21	18	20
Timber treatment works	201	2.61039	20	21	21
Sewage treatment works	190	2.46753	22	22	22
Railway land	185	2.4026	23	23	23
Semi-conductor man. plants	169	2.19481	24	26	24
Textiles manufacture	168	2.18182	26	24	25
Dockyards and wharves	166	2.15584	25	25	26

The respondents were also asked to list any other industries which they considered to have the potential to cause contamination and only small numbers of respondents in each group identified additional industries of concern, as set out in Table 9.14.

TABLE 9.14

Other industrial activities of concern

Type of Industrial Activity	Valuers Group	Non-Valuers
Abattoirs and meat processing	1	1
Agriculture and food processing	2	2
Battery manufacture		1
Brewing industry		1
Car maintenance	2	
Cement manufacture		1
Coking plants	1	
Dry-cleaners	1	
Electricity sub-stations	1	
Hospitals (especially isolation hospitals)		1
Photographic works	1	
Use of x-ray machines	1	
Warehousing and distribution		1

9.8.4 Question 4a *Are you in favour of the establishment of the environmental agencies?*

The purpose of this question was to obtain a larger sample of opinions in respect of the proposed environment agencies and to compare the results to those obtained in the Phase 2 interview survey. The result of this question revealed that overall 92.2% of the combined sample was in favour of the new agencies but that non-valuers tended to be more in favour than the valuers group, at 95.35% compared to 88.24%. This would appear to indicate a marked increase in acceptability when compared to the interview survey result, conducted 18 months earlier, which showed that only two thirds of the interviewees were in favour of the agencies.

Question 4b The respondents were asked to add any comments which they wished to make so as to qualify or expand upon their answers and those comments are summarised in Table 9.15.

TABLE 9.15

Comments made regarding the proposed environment agencies

Type of comment	Valuers group	Non-valuers
The agencies should ensure a comprehensive and co-ordinated response to contaminated land problems and the setting of appropriate guidelines.	4	4
They should enable 'clean-up' to take place, with the proviso that there must be adequate powers, controls and enforcement procedures, recognising that there must be a public cost to improving the environment.	6	5
The agencies must have adequate funding and be free from political interference.	2	3
It would be better to retain the existing 'specialist' bodies, such as the NRA, but possibly with the agencies having a co-ordinating role.	2	1
The agencies represent an unnecessary increase in bureaucracy.	1	2

9.8.5 Question 5a *Are you in favour of the redevelopment of contaminated or 'brownfield' sites in preference to greenfield development?*

The purpose of this question was also to obtain the views of a larger sample and to compare the result to the interview survey. Almost all of the respondents responded in the affirmative to this question, compared to 86 per cent of those questioned in the interview survey. Two members of the non-valuers group indicated 'don't know' in respect of this part of the question.

Question 5b The respondents were asked to indicate the extent to which they considered that government should take positive action to support the objective of brownfield redevelopment. Eighty-one per cent of the valuers group and eighty-five per cent of the non-valuers group indicated that they were strongly or very strongly in favour of positive action being taken.

Question 5c   The respondents were asked to indicate the type of actions which they considered should be taken by government and the responses are summarised in Table 9.16.

TABLE 9.16
Suggested actions to encourage the redevelopment of contaminated and 'brownfield' sites

Suggested action	Valuers group	Non-valuers
Availability of grant aid.	17	6
Combination of grants with planning and transport policies.	8	8
Financial assistance and a more flexible approach to contaminated land.	10	7
Tax relief or Business Rate relief.	11	7
Tax on the owners of contaminated land.	1	
Assistance for site assessments.	1	
Public support for sites capable of commercial development.	1	
Enforcement of the polluter pays principle.	1	
Clear guidelines and cash incentives.		2
Free trade areas.		1

9.8.6 Question 6   *To what extent do you consider that contamination would have an impact, in terms of a) timescale and b) land value, when compared to a similar but 'greenfield' site, on the assumption that site remediation work had been completed on the 'suitable for us' basis?*

This question was only directed to the valuers group and was intended to provide a larger sample than that obtained from the interview survey, as well as addressing the concerns in respect of the post-treatment part of question 16 in that survey. The detailed results from this question are contained in Appendix Two and the means of the results are set out in Table 9.17.

TABLE 9.17

Perceived impacts on value and duration of effect, immediately following site 'suitable for use' remediation - means of results

<u>Severity of previous hazard</u>	<u>Timescale</u> - duration of impact on value	<u>Impact on value</u> percentage reduction in value
Very Low Hazard	1.85 years	4.47%
Low Hazard	3.63 years	7.05%
Medium Hazard	6.80 years	19.07%
High Hazard	12.79 years	25.77%
Very High Hazard	14.53 years	39.53%

As with the interview survey, a number of the respondents were of the opinion that, even after treatment, those sites regarded as having had Very High Hazard would suffer a valuation impact in excess of 100 per cent of the value of a comparable greenfield site. The respondents holding this opinion, however, only represented seven per cent of the valuers group sample, compared to 38 per cent of the interview sample. One member of the valuers group indicated that even after treatment the impact on the value of a site previously classified as High Hazard would also exceed 100 per cent of greenfield site value, whereas none of the interview sample expected values of these sites to be affected by more than 60 per cent of value.

9.9 CONCLUSION

The interview and questionnaire surveys confirmed that valuers, in general, have a poorly developed perception of the problems associated with contaminated land. Many would prefer not to become involved with its valuation and would only consider offering advice to clients on its redevelopment if the assessment and remediation aspects are dealt with by other professionals. Approaches to valuation are ill-formed and valuers tend to adopt those methods which they, as individuals, consider to be appropriate. Guidance is expected from the professional institutions but government should not intervene in valuation issues.

Government should, however, take the lead in encouraging the redevelopment of contaminated land, through the use of grants and other incentives. There would also appear to be general concern for the establishment of environment agencies, although concern was expressed regarding their ability to undertake the task and the bureaucracy involved.

The valuation profession appears to have a fairly poor understanding in respect of site remediation methods and a distrust of innovative technologies. In spite of this, the valuers tended to place a relatively low valuation impact on the selection of remediation methods, when compared to pre and post-treatment risk assessments. This may be the result of valuers placing reliance on other professions to select the 'right treatment' and thus ensure that the site is made 'suitable for use'.

CHAPTER TEN

A RISK ASSESSMENT APPROACH TO THE VALUE OF CONTAMINATED LAND[1]

10.1 INTRODUCTION

Valuers of industrial land and buildings are faced with a dilemma when preparing valuations, or when advising on redevelopment, in respect of properties used for potentially contaminative purposes. Statements to the effect that valuations be issued, or revised, in the light of adequate environmental data concerning a property may be acceptable in circumstances where the site is vacant, or redevelopment is proposed and there is no competition from other potential purchasers. But, in almost all other circumstances, it is suggested that such an approach is unlikely to be acceptable to clients and does not provide the standard of service which should be expected of a responsible profession.

A report which relies upon caveats to avoid any liability may be of little use to a client interested in acquiring a manufacturing business and wishing to satisfy himself as to the value of the premises. The same argument may also apply in situations where the valuation is required for accounts purposes, or for bank security purposes where lending is to be secured against the business as a whole, rather than simply against the property assets. A recommendation that a Land Quality Statement be produced (see RICS, 1995a) is not very helpful in circumstances where continued operational use of the premises rules out the possibility of an invasive site investigation and a report which reserves the right of the valuer to reconsider the valuation may be totally unacceptable to the bank.

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1 Parts of this chapter have previously been published in Syms, 1995a, 1996b, c and d.

The valuation of contaminated land may be distinguished from the valuation of other classes of property, including those damaged by fire, flood or decay, by virtue of its 'newness' in terms of being recognised as a valuation problem. The perceptions studies, described in Chapter Nine, have confirmed that valuers have a fairly poor understanding of contamination and environmental issues in general. Contamination problems are also often hidden from sight, under floor-slabs, concrete yards or hardstandings and are therefore less likely to be obvious to valuers than other types of property damage. The enquiries and observations described in Chapter Four, in relation to preliminary site investigations, are little different from those which a prudent valuer should make as part of the valuation process.

Valuers may be concerned that if they produce valuations which attempt to take account of the existence of land contamination, or other environmental impairment, without full knowledge of the potential liabilities, they may leave themselves open to allegations of professional negligence. This is a most important issue as "any professional indemnity insurance cover for giving advice about the effects of contamination [for a valuer], is unlikely to be available as part of the normal PII policy or is likely to be strictly limited in scope." (Wilbourn, 1995) It can be argued, however, that if valuers follow a common practice in respect of such properties, thoroughly researching available data and ensuring that clients are made fully aware of the limitations in respect of information concerning the property to be valued, then negligence should not be an issue.

The 'sales comparison' method of assessing stigma, first described by Patchin (1994a) and discussed in the United Kingdom context in Chapter Six, has been criticised by other researchers. For example, Dixon (1995) expressed the view that such an approach is possible only when unimpaired and impaired transaction data are available, and that "using contaminated comparables is fraught with difficulty: every contaminated case is different and often has circumstances which are unique". (Dixon and Richards, 1995) Comments such as these are not fully substantiated. Certainly it is not necessary to have access to unimpaired transaction data in order to use the sales comparison method, as the uncontaminated value is arrived at using whatever valuation method is appropriate to the property and its current circumstances, disregarding contamination.

Whilst it is accepted that every contaminated case is different, the sales comparison approach requires transaction data to be carefully analysed, so that comparisons can be made between sites, even when they are affected by different contaminants. In other words, the 'sales comparisons' should be used as a means to compare the level of risk associated with each site.

In the opinion of Richards, T. (1996), use of the sales comparison approach "in the case of income-producing properties, could produce absurd results" and this is correct if, as Richards suggests, the method is used to assess the post-treatment value of investment properties. This he demonstrated by applying the same percentage 'stigma' effect to the post-treatment investment value to produce a far greater discount in value. Such an application would be a totally inappropriate use of the sales comparison method and has not been suggested in this research.

The sales comparison method is most suited for use in respect of properties, such as those listed in Box 2.1 and the (slightly different) list in paragraph 2.2.3, of Guidance Note 2 (RICS, 1995c). As stated in Chapter Six, these types of property are rarely found in investment portfolios and are infrequently sold in the open market. The method may also be suitable for use in respect of investment properties, which are to remain in industrial use, provided that due regard is paid to any impact which the covenant strength of the tenant may have on the value.

Research by Turner *et al* (1994) has considered the effect of tenants' environmental policies on investment portfolios and concluded that assessing the risk "associated with the tenant's wider commercial activities .... involves a number of different stages utilizing new sources of information which the property investment market is unfamiliar with." It would seem likely however that the environmental record of an individual tenant, or even a whole industry, may have an impact on property investment values.

The impact of contamination on the value of investment properties was considered by Lizieri *et al* (1995) who stated that "there are a number of technical difficulties associated with using an all risks yield approach to deal with potential environmental hazard." The research included a survey of 52 property investors and advisors, from which it was concluded that the "standard approach ... takes the local initial yield for the type of property under consideration then adjusts the value either by deducting estimated clean up costs or by adding a risk premium for the additional risk of environmental liability." (Lizieri *et al*, 1995) In some cases, the researchers found that costs were being deducted and yields adjusted upwards, with a potential risk of double counting the impact of contamination on value.

The research undertaken at the College of Estate Management, by Dixon and Richards, has focused primarily on investment properties and, in the example scenarios, reflected the impact of stigma by way of adjustments to the All Risks Yield (Richards, T. 1995). The amount of adjustment was derived from the result of an interview/questionnaire survey of valuation professionals but was based on a very small sample of 12 valuation scenario responses. The general nature of contamination was reflected in the scenarios, for example 'non-migratory heavy metals' and 'groundwater contamination' but no attempt was made to reflect the degree of hazard associated with the contaminants. The survey responses produced ranges of suggested adjustments to the All Risks Yield which, in some cases, were quite wide, for example an upwards yield adjustment in respect of non-migratory metals varied between 0.5% and 5.0%. It is suggested, therefore, that adjusting the All Risks Yield in order to reflect stigma is at best arbitrary and may result in a misleading result, unless the yield adjustment is made with the benefit of a thorough understanding of the degree of risk associated with the property.

Recognising the problems associated with both the 'sales comparison' and yield adjustment' methods of valuing contaminated properties, the present research has examined the impact of contamination on the value of the land itself, rather than the investment value of land and buildings. One objective has been to develop a model which takes account of a wider range of factors, is less reliant upon comparable evidence or arbitrary yield adjustments, and more accurately reflects the true level of risk associated with the property to be valued. The development of this model is considered in the following section.

10.2 A MODEL FOR THE ASSESSMENT OF STIGMA

The model has a theoretical basis and is empirically tested. The purpose of the model is to assist in the valuation of properties, affected by industrial contamination, where the industrial use is to continue for the foreseeable future, or the site is to be redeveloped. It is intended that the model should be used to deduce land values only and it is not therefore intended for use in respect of investment valuations, although it may be used to assess the value of the land element in those valuations. Also the model is not intended for use in respect of 'post-remediation' valuations.

To be of benefit the model needs to reflect practical considerations and to withstand testing against case study scenarios of actual transactions. Any proposed model needs to conform, so far as is possible, to the procedures recommended by the surveying profession, otherwise it is unlikely to be accepted by practitioners.

Commentators such as Simm (1992) and Laing (1992) have expressed opinions that the normal capital approach to valuation is not appropriate for the purpose of valuing contaminated land and, instead, have advocated use of the residual valuation method. This method is capable of being used in order to make allowance for the quantifiable costs of treating contamination but it fails when stigma has to be assessed. Patchin (1994a) proposed the use of the 'sales comparison' approach but, unless good comparables are available, this too has limitations. The basis for the proposed model is therefore the three step valuation process, as described in Chapter Six, with the final 'sales comparison' step being replaced by a 'risk assessment' technique. This change overcomes the problems associated with obtaining reliable comparable evidence.

The three steps of the suggested valuation process are therefore as follows:

- <u>Step 1</u> - the preparation of a valuation of the property on the assumption that contamination does not exist, in order to deduce a base or Unimpaired Value;
- <u>Step 2</u> - calculation of the expenditure required to treat the contaminated site, together with any associated costs, deferred as appropriate in order to arrive at Impaired Value 1;
- <u>Step 3</u> - the assessment of any stigma attaching to the past or present industrial use(s) of the site, using a risk assessment based model, in order to arrive at Impaired Value 2.

The first two steps of the valuation process have been described in Chapter Six and it is not intended that these should be altered in any respect, except that the value to be included in Step 1 is that applicable to the land devoid of any buildings. The third step in the valuation process, as set out in Figures 6.2, relied upon the use of comparables so as to adjust the valuation in order to reflect the stigma effect and this is replaced by the risk assessment part of the model.

Stigma is part of the diminution in the value of a property brought about by the fact that the land has been contaminated by past or present industrial activities. It is made up of an observer's perception of individual factors affecting value and it is therefore likely to vary from one observer to another. As stated in Chapter Six, the definition of stigma adopted for the purpose of this research is:

> ***That part of any diminution in value attributable to the existence of land contamination, whether treated or not, which exceeds the costs attributable to a) the remediation of the subject property, b) the prevention of future contamination, c) any known penalties or civil liabilities, d) insurance and e) future monitoring.***

The model now proposed draws upon the earlier work, in accepting both the residual approach and the sales comparison method. It also applies the 'professional perceptions' which influence the judgements the valuer will have to make in order to arrive at his or her opinion of value. In order to construct the model, five sets of data are required, as follows:

i) observed stigma effects as reported in the literature;

ii) perceptions as to the relative levels of risk associated with different industrial activities, using the list of 26 uses in Box 2.1;

iii) the assessed risk, in respect of the site to be valued, before any remediation work is undertaken, using the levels of risk as set out in Box 9.10;

iv) the perceived impact on value attributable to alternative methods of remediation and the expected end use of the site following treatment, Boxes 9.2 to 9.6;

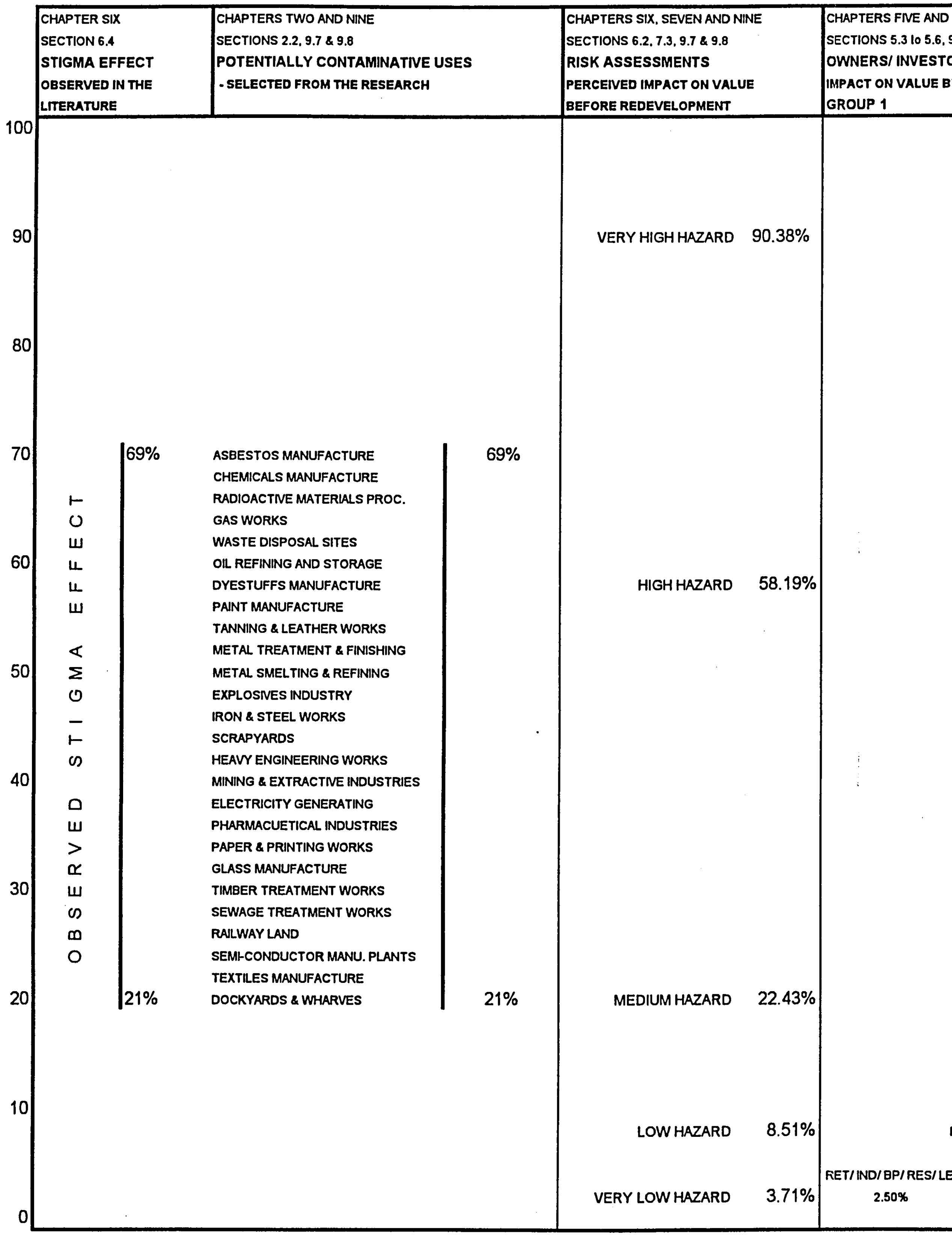
v) the estimated assessment of risk, following treatment and redevelopment of the site, using the levels of risk as set out in Box 9.17.

The relationship between the five sets of data is shown in Figure 10.1, together with references to the relevant Chapters and Sections in the thesis.

For the initial model development, the extent of stigma impact has been taken from the results of Patchin's 1994 study, as amended in Chapter Six, which indicated a range of reduction in value of 21 to 69 per cent. There are problems in adopting these results for the purpose of the model, not least of which is the fact that they are based on United States transactions but, to date, the United Kingdom literature does not provide a theoretical basis for determining a range of stigma effect. As an alternative to using an observed range of stigma effect obtained from the literature, valuers could produce a range based on their own experience but one valuer of contaminated properties has stated that, in his experience "it is not possible to define a level of stigma discount allied to the level of contamination" (Wilbourn, 1996). It may be necessary for valuers to pool information in order to obtain data on a sufficiently large number of transactions so as to construct a base range of stigma impact. A proposal for a national databank is discussed in the final section of this chapter.

FIGURE 10.1

A MODEL FOR THE ASSESSMENT OF



The third phase of the perceptions studies, described in the previous chapter, enabled the 26 industrial activities used for the research to be ranked according to the risk perceptions of professionals involved in the valuation and redevelopment of contaminated properties. This produced the second set of data for the model and the ranking used is that obtained from the combined sample of valuation and non-valuation experts. The combined sample was selected for this purpose in order to reflect the full range of professional opinions which may be available to an intending purchaser or developer but, as noted in Section 9.8, there was in fact very little difference of opinion between the two expert groups. For use in the model, the perceived highest risk use 'Asbestos manufacture and use' was given the value of the highest observed stigma effect, 69 per cent, whilst the perceived lowest risk use 'Dockyards and wharves' was ascribed the value of the lowest observed stigma effect, 21 per cent. The other industrial uses were given intermediate values according to the scoring from the study, as in Table 10.1:

TABLE 10.1

Range of stigma effect and ranking of industrial activities

INDUSTRY PERCEPTIONS				
INDUSTRY TYPE				STIGMA
	Column1	*Rank*	*Percent*	*%age*
Asbestos manu. and use	4.53247	1	100.00%	69.00%
Chemicals manu. and store	4.24675	2	96.00%	63.23%
Radioactive mats. process	3.97403	3	92.00%	57.72%
Gas works	3.85714	4	84.00%	55.36%
Waste disposal sites	3.85714	4	84.00%	55.36%
Oil refining and storage	3.79221	6	80.00%	54.05%
Dyestuffs manufacturing	3.71429	7	76.00%	52.48%
Paint manufacture	3.5974	8	72.00%	50.11%
Tanning and leather works	3.48052	9	68.00%	47.75%
Metal treatment and finishing	3.44156	10	64.00%	46.97%
Metal smelting and refining	3.36364	11	60.00%	45.39%
Explosives industry	3.2987	12	56.00%	44.08%
Iron and steelworks	3.24675	13	52.00%	43.03%
Scrapyards	3.09091	14	48.00%	39.89%
Heavy engineering	2.98701	15	44.00%	37.79%
Mining and extractive inds.	2.96104	16	40.00%	37.26%
Electricity generating	2.90909	17	36.00%	36.21%
Pharmacuetical industries	2.79221	18	32.00%	33.85%
Paper and printing works	2.7013	19	28.00%	32.02%
Glass manufacture	2.62338	20	24.00%	30.44%
Timber treatment works	2.61039	21	20.00%	30.18%
Sewage treatment works	2.46753	22	16.00%	27.30%
Railway land	2.4026	23	12.00%	25.98%
Semi-conductor man. plants	2.19481	24	8.00%	21.79%
Textiles manufacture	2.18182	25	4.00%	21.52%
Dockyards and wharves	2.15584	26	0.00%	21.00%

The purpose of the first two sets of data is to provide a framework to be applied to the valuation of specific properties. Information regarding the property to be valued is not required for either of the two data sets. The remaining three sets of data all require the input of property related information.

The third set of data is the perceived impact on value, from phase two of the perceptions study, according to a risk assessment for the site in its untreated state. A formal risk assessment, prepared by an environmental consultant, may be available, alternatively, it is suggested, a valuer with appropriate experience should be able to allocate the site into one of the five hazard categories used for the research. Whether or not the valuer is able to make such an allocation will depend upon the answers received in response to the questions set out in Box 6.1, together with any further enquiries which may be considered necessary.

The fourth set of data is intended to reflect the site treatment and future use aspects of the valuation. This uses the results from the first phase of the perceptions study and, as with the industrial activities in set two, reflects the views of both valuation and non-valuation professionals. In situations where immediate redevelopment of the site is not anticipated, and the site is to remain in its present use for the foreseeable future, the valuer will have to make assumptions as to the method of treatment and the future use(s) which might be considered appropriate, at the date of valuation, and set out the basis of those assumptions in his or her report. The same assumptions will also be required to assess the costs of possible treatment to complete step 2 of the valuation method.

The final set of data comprises the impact on value attributable to the degree of hazard which is expected to exist on the site following redevelopment. This issue was addressed in both phases two and three of the perceptions study but, for the reasons set out in the previous chapter, the results from the phase two study have been disregarded for the purpose of this model. A value has been included in the model for the possibility of severe contamination, VERY HIGH HAZARD, remaining on site after treatment, although it would appear, at first sight, to be pointless to undertake any form of treatment if the resultant hazard classification is not reduced. This category has, however, been retained in respect of the post-treatment state of the site, to deal with situations such as the excavation of radioactive material or toxic chemicals and their re-interment in a secure containment within the curtilage of the building. Other situations where the VERY HIGH HAZARD classification would apply after treatment might include industrial properties where the contaminants are covered by existing buildings or impervious yard areas and the treatment works are undertaken to prevent migration of the contamination to adjoining properties or groundwater. In such cases the sites would be suitable for continued industrial use but would present a very high degree of risk if the containments were to fail or be breached.

10.3 **APPLICATION OF THE MODEL**

The first set of data referred to in the previous section sets a baseline for the impact of stigma on property values and the second set enables stigma values to be determined for a range of industrial activities, based upon the research. Data sets three to five link the empirical research to actual properties which are to be valued, using risk related data for the present and expected conditions of the land.

In this way values are obtainable in respect of strands two to five and, in order to apply the model, these values should be aggregated then divided by four to give a mean value. The mean value thus arrived at is the stigma effect to be applied as a percentage reduction against 'Impaired Value 1' to give 'Impaired Value 2'. Use of this method enables the valuer to take account of the present and/or past uses of the site, the present level of risk attaching to the contaminants in the ground, the valuation impact of the selected method of treatment and the expected 'post-treatment' level of risk. The method brings together actual site conditions and the perceptions of professional valuers.

The case studies described in Chapter Eight are used to test the validity of the valuation model. Formal risk assessments were not prepared for any of the case study sites and the 'risk assessments' used for the purpose of testing the model have been allocated on the basis of the site investigations and consultants' reports. The model is also tested against four additional case study development sites, three of which were proposed to be redeveloped for residential purposes. The total model testing sample therefore comprises ten redevelopment situations, with five of the sites intended to be retained in industrial use and five changed to residential use. One of the enlarged sample properties was the subject of a formal risk assessment undertaken by a firm of environmental consultants and, in another case, the agreed sale was aborted as the vendor was not prepared to accept the reduced offer made by the proposed developer; that site remains unsold.

10.3.1 Case study 1 - PICCADILLY VILLAGE, MANCHESTER

As described in Chapter Eight, a large number of uses had existed on this site. The use with the highest risk, as identified by the results of the professional perceptions study, was that of 'scrap yard' and this determined the base value for the model. The site investigation did not produce evidence of any highly toxic contaminants and the most serious hazard was found to exist in relation to the sub-structures and services for the new buildings, therefore the pre-treatment risk level was assessed as 'Medium hazard'. A Group 1, excavation and disposal, method was used to treat the site and the post-treatment risk assessment was 'Low hazard'. A 'Very low hazard' risk assessment was not applied to this site because the soil was left with a high sulphate level. Although appropriate measures were taken to protect the sub-structures and services a residual risk of failure remains. The model as applied to this site is set out in Table 10.2.

TABLE 10.2
THE MODEL APPLIED TO CASE STUDY SITE 1

COMPARABLE CASE STUDY:	Piccadilly Village, Manchester	
		MODEL VALUE
PRESENT OR PAST INDUSTRIAL USE(S):	Warehousing, timber yard, scrap yard, textiles manufacture.	
HIGHEST RISK PRESENT OR PAST USE:	Scrap yard	39.89
PRE-TREATMENT RISK ASSESSMENT:	Medium hazard	22.43
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 1 Excavate and remove contamination	2.5
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Low hazard	7.05
AGGREGATE MODEL VALUE:		71.87
EXPECTED STIGMA EFFECT:		17.97%
OBSERVED STIGMA EFFECT:		21.21%

10.3.2 Case study 2 - LOUISA STREET, MANCHESTER

Only one previous use was recorded for this site and, due to the nature of the waste materials buried in the ground, the pre-treatment hazard level was judged to be High. The site treatment method involved the removal of contaminated 'hot-spots' and disposal off site of the most highly contaminated material. The remaining contaminated material was then regraded and the site covered with clean fill, a Group 2 method. The post treatment risk assessment for the site was considered to be Low, but some residual risk remains from the covered material. The model as applied to this site is set out in Table 10.3.

TABLE 10.3
THE MODEL APPLIED TO CASE STUDY SITE 2

COMPARABLE CASE STUDY:	Louisa Street, Manchester	
		MODEL VALUE
PRESENT OR PAST INDUSTRIAL USE(S):	Metal treatment and finishing	
HIGHEST RISK PRESENT OR PAST USE:	Metal treatment and finishing	46.97
PRE-TREATMENT RISK ASSESSMENT:	High hazard	58.19
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 2 Partial excavation, cover and contain remaining contaminated material	8.00
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Low hazard	7.05
AGGREGATE MODEL VALUE:		120.21
EXPECTED STIGMA EFFECT:		30.05%
OBSERVED STIGMA EFFECT:		35.00%

10.3.3 Case study 3 - Gresford Industrial Estate, Wrexham

Several different industrial uses had existed on this site, all related to the coal mining industry. The highest risk uses were considered to be the use of part of the site for coal products and as a depository for highly combustible coal wastes. Therefore, a Very High hazard assessment was applied to this site. The treatment method used for the site was the excavation of contaminated material and its replacement with clean fill, a Group 1 method, but the excavated material was to be retained in a depository constructed within the curtilage of the site, therefore a Group 2 value has been used for the model. Because of the existence of the depository a Medium hazard post-treatment risk assessment has been used, although it should be stressed that responsibility for the deposited material has not been passed to the tenant or subsequent investor. The model as applied to this site is set out in Table 10.4.

TABLE 10.4
THE MODEL APPLIED TO CASE STUDY SITE 3

		MODEL VALUE
COMPARABLE CASE STUDY:	Gresford Industrial Estate, Wrexham.	
PRESENT OR PAST INDUSTRIAL USE(S):	Coal tar and gasification plant, coal mining, colliery spoil heap	
HIGHEST RISK PRESENT OR PAST USE:	Gas works and waste disposal site	55.36
PRE-TREATMENT RISK ASSESSMENT:	Very high hazard	90.38
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 2 Excavate from development area, contain within site.	2.50
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Medium hazard	19.10
AGGREGATE MODEL VALUE:		167.34
EXPECTED STIGMA EFFECT:		41.84%
OBSERVED STIGMA EFFECT:		67.00%

10.3.4 Case study 4 - BROMBOROUGH BUSINESS PARK, WIRRAL

This site had a long history of use for chemicals and dyestuffs manufacture, with the former being considered the highest risk use for the purpose of the model. The pre-treatment hazard level was considered to be Medium. The selected treatment method was in Group 2, cover and containment, and the post-treatment risk level was estimated as Low hazard. The model as applied to this site is set out in Table 10.5.

TABLE 10.5
THE MODEL APPLIED TO CASE STUDY SITE 4

COMPARABLE CASE STUDY:	Bromborough Business Park, Bromborough, Wirral	
		MODEL VALUE
PRESENT OR PAST INDUSTRIAL USE(S):	Chemicals manufacture, dyestuffs manufacture	
HIGHEST RISK PRESENT OR PAST USE:	Chemicals manufacture	63.23
PRE-TREATMENT RISK ASSESSMENT:	Medium hazard	22.43
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 2 Excavate most severe contamination, cover and contain remainder	2.50
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Low hazard	7.05
AGGREGATE MODEL VALUE:		95.21
EXPECTED STIGMA EFFECT:		23.80%
OBSERVED STIGMA EFFECT:		25.91%

0.3.5 Case study 5 - CENTREPOINT, TRAFFORD PARK

The historic uses in respect of this site were in the same general classifications as case study 4 but the nature of the chemicals involved was very different. Many of the materials known to be buried within this site were carcinogenic or toxic and the pre-treatment risk assessment was therefore considered to be Very High hazard. A Group 1 treatment method was used to remediate the site with all identifiable contaminants being removed to an average depth of two metres. Following treatment the risk level was considered to be Very Low. The model as applied to this site is set out in Table 10.6.

TABLE 10.6
THE MODEL APPLIED TO CASE STUDY SITE 5

COMPARABLE CASE STUDY:	Centrepoint, Trafford Park	**MODEL VALUE**
PRESENT OR PAST INDUSTRIAL USE(S):	Chemicals manufacture, dyestuffs manufacture	
HIGHEST RISK PRESENT OR PAST USE:	Chemicals manufacture	63.23
PRE-TREATMENT RISK ASSESSMENT:	Very high hazard	90.38
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 1 Excavate and remove all contaminants	2.50
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Very low hazard	4.47
AGGREGATE MODEL VALUE:		160.58
EXPECTED STIGMA EFFECT:		40.15%
OBSERVED STIGMA EFFECT:		42.34%

10.3.6 Case study 6 - THE ALBION, SALFORD

A number of different uses had previously existed on this site and the nature of goods stored in the rail yard was unknown. The site had also been extensively fly tipped and a substantial area, the former railway cutting, had been filled to a depth of several metres. The site was also adjacent to a former gas works. The most appropriate highest risk use was therefore considered to be 'waste disposal site' and a Very High hazard assessment was ascribed to the site. The treatment method used was the excavation and removal of contaminated material. The fill material also included a substantial amount of inert material, in the form of concrete and brickwork, which was crushed and used to re-fill the railway cutting. A Low hazard post-treatment assessment was used to allow for the remote possibility of any contaminated material remaining within the filled areas. The model as applied to this site is set out in Table 10.7.

TABLE 10.7
THE MODEL APPLIED TO CASE STUDY SITE 6

COMPARABLE CASE STUDY:	The Albion, Salford	
		MODEL VALUE
PRESENT OR PAST INDUSTRIAL USE(S):	Uncontrolled waste disposal site, railway land	
HIGHEST RISK PRESENT OR PAST USE:	Waste disposal site	55.36
PRE-TREATMENT RISK ASSESSMENT:	Very high hazard	90.38
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 1 and Group 2 Excavate and remove contaminated material from site, re-use inert material as fill	2.50
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Low hazard	7.05
AGGREGATE MODEL VALUE:		155.29
EXPECTED STIGMA EFFECT:		38.82%
OBSERVED STIGMA EFFECT:		55.00%

10.3.7 Case study 7 - FORMER TRAM AND BUS DEPOT, SALFORD

This site has an area of approximately 1.80 hectares (4.37 acres) and was originally developed as a tram depot. Around seventy per cent of the site area was covered by buildings, which were primarily used as maintenance workshops. Within the buildings were maintenance pits, extending over almost half of the total floor area, above which the trams were driven on rails supported by cast iron columns. The average depth of the pits was 1.5 metres.

When trams ceased to operate in the streets of Manchester and Salford the depot was converted for use by motor buses. The conversion involved filling the pits and constructing at least four groups of 'finger pits'. The origin of the fill material is unknown but is assumed to have comprised industrial wastes, mainly in ash or slag form, from nearby metal treatment and finishing works. Following closure of the bus depot, all buildings on the site were demolished down to floor slab level and some of the demolition material appears to have been used to fill the 'finger pits'.

The site was subsequently sold to a developer for the construction of a new housing scheme of 119 units. A site investigation was commissioned and, based on the information then available, a City Grant was awarded by the Department of the Environment. The development was not started and the developer eventually went into receivership.

Four years later a second developer agreed to purchase the site, provided that grant aid was still available, and to carry out the original scheme. At this stage it was found that the original site investigation had not included any chemical testing of the fill materials and a second investigation was commissioned in order to identify the nature and extent of any contamination. This revealed that the fill material in the maintenance pits was heavily contaminated with heavy metals, including, arsenic, boron, chromium, mercury, nickel, lead, selenium and zinc, and with poly-aromatic hydrocarbons (PAH's). A formal, quantified, risk assessment subsequently classified the site as High Risk.

The site was adjacent to a river and was at risk from flooding on the basis of a one hundred year flood. The National Rivers Authority had therefore recommended that the finished floor level of the ground floors of the dwellings be raised by at least one metre above the existing datum. A remediation strategy was therefore evolved which required the removal of contaminated hotspots and the sealing of residual contamination within the original maintenance pits, with the entire site then being covered with at least one metre of clean material. On completion of the work the risk assessment would be reduced to Low Risk.

The entire cost of the site remediation and abnormal foundations work was covered by an offer of investment funding from English Partnerships and the developer agreed to purchase the site for a price which represented a discount of 21.42% against the price paid by the original developer. Reductions in the end value of the development, attributable to a fall in house prices, had been fully offset by a reduction in construction costs and therefore the whole of the reduction in site value is considered to be due to the stigma effect. The model as applied to this site is set out in Table 10.8.

TABLE 10.8
THE MODEL APPLIED TO CASE STUDY SITE 7

COMPARABLE CASE STUDY:	Tram and bus depot, Salford	
		MODEL VALUE
PRESENT OR PAST INDUSTRIAL USE(S):	Tram depot converted to bus garage all buildings demolished, extensively filled	
HIGHEST RISK PRESENT OR PAST USE:	Fill materials of unknown origin, probably metal treatment and finishing.	46.97
PRE-TREATMENT RISK ASSESSMENT:	High hazard	58.19
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 1 and Group 2 Excavate and remove most highly contaminated material from site, re-use less contaminated and inert material as fill, clean cover	8.0
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Low hazard	7.05
AGGREGATE MODEL VALUE:		120.21
EXPECTED STIGMA EFFECT:		30.05%
OBSERVED STIGMA EFFECT:		21.42%

10.3.8 Case study 8 - DERELICT SITE, WIGAN

A site of 0.37 hectare (0.91 acre), surrounded on all sides by local authority housing, originally intended as informal open space but in reality a communal 'rubbish tip'. A site investigation revealed that the entire area of the site had been raised above its natural level by up to two metres and that the fill material was contaminated with arsenic, copper and nickel at concentrations which exceeded the guidance in ICRCL 59/83 for domestic gardens, allotments and areas in which plants are to be grown. The origin of the fill material was unknown but glass and paint industries had formerly operated in the area.

The site was owned by the local authority and, prior to the site investigation, a local house builder had agreed to purchase it in order to construct 18 low cost houses. It was agreed that the most suitable form of remediation was to remove the most severely contaminated fill material from the site, in order to enable a clean cover layer to be introduced. The total cost of treatment was covered by grant aid and a 25% reduction in the purchase price was agreed, so as to allow for stigma. The model as applied to this site is set out in Table 10.9.

TABLE 10.9
THE MODEL APPLIED TO CASE STUDY SITE 8

COMPARABLE CASE STUDY:	Derelict site, Wigan	
		MODEL VALUE
PRESENT OR PAST INDUSTRIAL USE(S):	open space within residential area	
HIGHEST RISK PRESENT OR PAST USE:	Industrial wastes from paint manufacture	50.11
PRE-TREATMENT RISK ASSESSMENT:	Medium hazard	19.07
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 1 and Group 2 Excavate and remove contaminated material from site, import clean material as fill	8.0
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Low hazard	7.05
AGGREGATE MODEL VALUE:		84.23
EXPECTED STIGMA EFFECT:		21.06%
OBSERVED STIGMA EFFECT:		25.00%

10.3.9 Case study 9 - CLOSED LANDFILL, TAMESIDE

This development site, with an area of 7.8 hectares (19.27 acres) forms part of a larger site which was acquired by a property developer at the height of the property market for the development of an industrial estate. The larger site included a former quarry which had subsequently been used as a hazardous wastes landfill but the developer did not undertake any site investigation work until some time after the acquisition had been completed. The landfill site had been closed and 'restored' and, at the time of purchase, was being used for grazing cattle and horses.

A site investigation identified a wide range of contaminants from many different industries, including those listed in Box 10.1.

BOX 10.1

CONTAMINANTS IN CLOSED LANDFILL, TAMESIDE

Hydrochloric, chromic, phosphoric and sulphuric acids. Arsenic, cadmium, lead, mercury, zinc, copper, silver and iron compounds. Ferro and ferri cyanides, other cyanides. Alphatic and aromatic hydrocarbons.	Fuel oil, hydrocarbons and halogenated hydrocarbons. Printing and paint industry wastes. Mixed organic and inorganic wastes, phenols, esters, alcohols. Medical wastes and general industrial wastes, including cheese.

Landfill gas was migrating from the landfill site and the sand lenses in the surrounding ground were probably providing pathways for leachate. The development site itself had been partly tipped but any contamination was considered to be insignificant.

The remediation proposed for the site was to isolate the development area from the landfill with a 'cut-off' wall using an impermeable barrier, with provision for venting on the landfill side through seven metre high vent stacks. Contaminated fill from within the development area would be removed as part of a re-grading process, required in order to prepare the site for development. All buildings constructed as part of the development would need to have vent pipes and an impermeable membrane incorporated in the floorslabs, as a safety precaution against methane and carbon dioxide migration.

The price paid by the developer exceeded the valuation subsequently placed on the site for industrial use as serviced plots, disregarding both the site remediation cost and the provision of infrastructure. A grant was subsequently awarded by English Partnerships in respect of the site remediation work and the base value used for grant application purposes, after allowing for all infrastructure work, selling costs, finance and developer's profit, represented a stigma discount of 41.66%. The model as applied to this site is set out in Table 10.10.

TABLE 10.10
THE MODEL APPLIED TO CASE STUDY SITE 9

COMPARABLE CASE STUDY:	Closed landfill, Tameside	
		MODEL VALUE
PRESENT OR PAST INDUSTRIAL USE(S):	Former quarry then privately operated chemical wastes landfill	
HIGHEST RISK PRESENT OR PAST USE:	Waste disposal site	55.36
PRE-TREATMENT RISK ASSESSMENT:	Very high hazard	90.38
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 2 Remove or regrade contaminated material within development area, protect with barrier	2.50
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Low hazard	7.05
AGGREGATE MODEL VALUE:		155.29
EXPECTED STIGMA EFFECT:		38.82%
OBSERVED STIGMA EFFECT:		41.66%

10.3.10 Case study 10 - CLOSED LANDFILL, SALFORD

This is a site of approximately 4.05 hectares (10 acres) partly comprising a former quarry, with the rest of the site having been used as a builders yard. The quarry had been filled with a variety of material, mostly inert building materials, to a depth of 24 metres. At, or near, the base of the fill material was an unknown quantity of putrescible material, believed to consist largely of railway sleepers. This fill material was generating methane, with readings from the monitoring wells as high as 17% by volume, well in excess of the level which would normally be allowed for residential development.

Excavation of the fill material, in order to remove the organic matter was considered to be prohibitively expensive but a barrier wall could be constructed, between the two parts of the site, at a reasonable cost. This would allow the unaffected part of the site to be developed with private houses for sale. It was also agreed with the Greater Manchester Geological Unit that, if the houses were provided with suitably designed venting systems, the filled part of the site could be developed as a managed housing scheme.

The intending developer then offered the landowner a reduced price for the site, which reflected the cost of carrying out the methane protection work and a 25 per cent discount for stigma. This was refused and the site remains unsold. The model as applied to this site is set out in Table 10.11

TABLE 10.11
THE MODEL APPLIED TO CASE STUDY SITE 10

		MODEL VALUE
COMPARABLE CASE STUDY:	Closed landfill, Salford	
PRESENT OR PAST INDUSTRIAL USE(S):	Quarry, then waste disposal site, builders yard.	
HIGHEST RISK PRESENT OR PAST USE:	Waste disposal site	55.36
PRE-TREATMENT RISK ASSESSMENT:	Medium hazard	22.43
PROPOSED OR PROBABLE TREATMENT METHOD:	Group 1 and Group 2 Excavate and remove contaminated material from site, install methane barrier.	8.0
POST-TREATMENT EXPECTED RISK ASSESSMENT:	Low hazard	7.05
AGGREGATE MODEL VALUE:		92.84
EXPECTED STIGMA EFFECT:		23.21%
OBSERVED STIGMA EFFECT:		25.00%

In seven out of the ten case studies the difference between the expected and observed stigma impacts was less than five per cent of the value or previous price paid for the land. So far as the Gresford site is concerned, the two landowners were both prepared to dispose of the additional land required for the development for a nominal sum in order to secure employment for the town. The difference between the expected and observed stigma effects on the Albion site is more difficult to explain, as the reduction in purchase price was only achieved following lengthy negotiations. Perhaps the difference should be attributed to the negotiating skills of the developer.

Unlike Gresford and the Albion, the price paid for the tram depot site in Salford represented an 'observed stigma effect' which was significantly lower than the 'expected stigma effect' produced by the model. This was due to the length of time taken to negotiate the grant aid, following transfer of the responsibility of the grant schemes from the Department of the Environment to English Partnerships. The period involved was in excess of one year, during which time the receiver threatened to re-market the site unless the developer was prepared to exchange contracts without further delay. The value eventually ascribed to the site, for grant purposes, was significantly below the price paid.

A Chi Square technique was used as an indicator to test the correlation between the results obtained in applying the model to the case studies and the actual price reductions derived from the property transactions. The model test value impact results were used as the expected hypothesis and the actual impacts on value as the observed results. The outcome was a good correlation, with a result of 19.18, at the 95% confidence level with nine degrees of freedom. The results from seventy per cent of the case study tests, admittedly based on a small sample, were so close as to provide proof of the suitability of the model for providing a 'risk assessment' approach to the valuation of contaminated land.

Application of the model in practice, for the calculation of stigma effect, leaves very little potential for error on the part of the valuer. The first action required by the valuer is to identify the past use or uses of the site and to select the relevant highest ranking "industrial activity" factor from the list of uses in Tables 10.1. If the precise use of the site is not listed, then the valuer will need to select that use which approximates most closely to the actual site history. This, it is argued, should be well within the capability of any valuer experienced in the valuation of industrial property. Expansion of the range of industrial activities is one of the areas for future research identified in Chapter Eleven.

The second action required from the valuer is to identify an appropriate 'risk assessment' for the site in its 'pre-remediation' state. In the absence of a formal risk assessment, it is suggested that a competent valuer should be able to 'narrow down' the degree of risk associated with a site to within two of the five classes of risk, Very High Hazard to Very Low Hazard, used for the purpose of this research. This would produce a range of effects attributable to the existing risks.

The third action is for the valuer to allocate the treatment method proposed for the site to the correct group of treatments considered in the research. The model also provides the opportunity for the valuer to perform 'what if' calculations in situations where two or more treatment methods are under consideration.

The fourth action required from the valuer is to determine the expected, or desired 'post-treatment' hazard level for the site. As with the 'pre-treatment' risk assessment, it may be appropriate for the valuer to select two of the five categories in order to determine a range of effect, this can also be used to perform 'what if' calculations by selecting different 'post-treatment' risk levels according to the type of treatment method under consideration.

10.4 **TESTING THE MODEL**

If a valuation model, such as that described in this chapter, is to be of use in practice it must be capable of withstanding testing by valuers and development surveyors who may only have a limited knowledge of contamination issues. For the purpose of this research two alternative methods of testing have been considered:

i) field trials with a number of valuation practices using the model in practice as a means of confirming, or otherwise, their existing methods of valuing contaminated land and,

ii) the preparation of valuations of the case study sites, using the model, by independent valuers.

The first option may be regarded as the ideal test but is likely to involve a large number of people, so as to obtain a sample which includes valuations prepared by firms which regularly value contaminated land and those which infrequently undertake such work. It would also have the effect of extending the research period by one, or possibly two, years. This form of testing has been identified for further research.

Testing of the case studies by independent valuers also presents problems, in terms of confidentiality, as it is unlikely that the developers concerned would be prepared to make the files available for the valuers to form their individual assessments of pre and post-treatment risk levels. Therefore any testing of the model by valuers not directly connected with the research would have to be undertaken by professionals connected with the case study developments in capacities such as letting agent or development surveyor.

Only one of the case study sites, number 7, had been the subject of a formal risk assessment, thus removing from the valuer the need to assess the pre and post-treatment risk levels. Independent valuers or development surveyors had not been involved with case studies 1 and 3, and no transaction had taken place in respect of case study 10. Therefore this left six case studies available for independent testing of the model and in all cases the valuer or development surveyor involved agreed to provide their opinion as to the pre and post-treatment risk levels. In all cases the previous uses and remediation methods were a matter of fact, as described in the case studies. Table 10.12 shows the independent assessments compared to the expected assessments from the research and the resultant stigma effects compared to the observed stigma effects.

TABLE 10.12

COMPARISON OF RISK ASSESSMENTS AND STIGMA EFFECTS

Case study	2	4	5	6	7*	8	9
independent pre-	HH	MH	VHH	MH	HH	LH	VHH
post-treatment	LH	VLH	LH	VLH	LH	VLH	LH
research pre-	HH	MH	VHH	VHH	HH	MH	VHH
post-treatment	LH	LH	LH	LH	LH	LH	LH
STIGMA							
Observed	35.00%	25.91%	42.34%	55.00%	21.42%	25.00%	41.66%
Independent	30.05%	23.16%	40.15%	21.19%		17.77%	38.82%
Research	30.05%	23.80%	40.15%	38.82%	30.05%	21.06%	38.82%

* Formal risk assessment, no independent testing

As may be seen from the results in Table 10.12, three of the independently tested case studies (numbers 2, 5 and 9) produced identical pre and post-treatment perceptions of risk. In one instance (case study 4) the independent valuer was of the opinion that the post-treatment risk level was below that derived from the research and, in the remaining two cases (case studies 6 and 8) the independent valuers believed that both the pre and post-treatment risk levels were below those indicated by the research.

In other words, fifty per cent of the independent tests confirmed the research results, whilst in the other cases the independent valuers perceived a lower degree of risk from the contaminated site. In one case (number 4) the difference between the research result and the independent result was less than one per cent of value and only 2.25 per cent below the observed stigma impact. The difference between the independently tested result and the research result in case study number 8 was only 3.29 per cent and 7.29 per cent below the observed stigma effect.

Where the independent test results differed from the research results, they all indicated a lower perception of risk than that obtained from the research. This may be due to the fact that, although the valuers and development surveyors asked to test the model were independent of the research, they all acted for, or were employed by, the developer concerned. This may, therefore, have produced a bias in favour of the development, which resulted in a reduced perception of risk. A similar result may not have been obtained if the 'independent' valuers had been preparing valuations for a bank or potential investor. If flexibility in determining the 'pre' and 'post' treatment risk assessments is applied to the case studies, adopting a more cautious approach than that set out in Tables 10.2 to 10.11 by using a range of two classes of risk for the pre and post-treatment factors, then the range of stigma effects applicable to the studies would be as set out in Table 10.13.

TABLE 10.13

RANGE OF STIGMA EFFECTS APPLICABLE TO CASE STUDIES

Case study number	'Pre-treatment' factor range	'Post-treatment' factor range	Range of expected stigma effect	Observed stigma effect
1	MH-HH	LH-MH	17.97-29.91%	21.21%
2	HH-VHH	LH-MH	30.05-41.10%	35.00%
3	VHH	MH-HH	41.84-43.50%	67.00%
4	MH-HH	LH-MH	23.80-35.50%	25.91%
5	VHH	LH-MH	40.79-43.80%	42.34%
6	VHH	LH-MH	38.82-41.83%	55.00%
7*	HH	LH	30.05%	21.42%
8	MH-HH	LH-MH	21.06-33.84%	25.00%
9	VHH	LH-MH	38.82-41.83%	41.66%
10	MH-HH	LH-MH	23.21-35.16%	25.00%

* Case study 7 was the subject of a formal risk assessment.

For all but two of the case studies, the more cautious approach shown in Table 10.13 resulted in a maximum difference in stigma impact of less than 10 per cent of value, with one case (number 9) showing a difference of less than one per cent of value. The two case studies producing wider variations were numbers 3 and 6, for which the possible explanations have been discussed in the previous section.

10.5 AN ENVIRONMENTAL IMPAIRMENT DATABANK

Given the difficulties involved in obtaining appropriate comparables each time a contaminated property is to be valued, and the need to identify the applicable determinants, it has been proposed that a national databank of comparables be established (Syms, 1995a). Initially this would contain data relating to the sales and values of contaminated properties but, in future, it could be expanded so as to include other forms of environmental impairment. It was suggested that the databank would include the information set out in Box 10.2.

The databank would be available to valuers for use in preparing valuations or development appraisals of properties affected by contamination; information concerning the property to be valued, including its past and/or present uses and the nature of the contamination, would be used to identify the most appropriate comparables. The valuer would be provided with a computer printout detailing the comparables suggested for use, but probably not their precise addresses because of confidentiality restrictions, and a recommended "value adjuster" to be applied to the impaired value arrived at after deduction of the quantifiable costs. Regional variations would be taken into account if applicable.

BOX 10.2
ENVIRONMENTAL IMPAIRMENT DATABANK
(Suggested information to be included in respect of case study properties)

i) **General Information**
- Address of the property
- Tenure
- Site area
- Floor area of buildings
- Age of buildings
- Present or immediate past use
- Previous use(s)

ii) **Contamination information**
- Nature of the primary contaminant
- Nature of the secondary contaminant(s)
- Whether site investigation and/or risk assessment undertaken
- Date of site investigation/risk assessment
- Hazard level of primary contaminant
- Hazard level of secondary contaminant(s)

iii) **Treatment information**
- Whether a programme of treatment has been undertaken or is proposed
- Main method of treatment undertaken or proposed
- Secondary treatment method(s)
- Post-treatment hazard level

iv) **Valuation information**
- Unimpaired value
- Disposal price
- Uncompleted sales price(s)
- Treatment cost, actual or estimated.
- The availability of grants or other incentives

Ideally the primary search field for the identification of comparables should be properties which have been used for similar purposes but, given the problems in obtaining information in respect of an adequate number of similar properties, it is anticipated that, at least in the short term, comparisons will be made on the basis of risk levels and types of contamination. As the number of records in the databank increases, the procedures used in identifying suitable comparables would be subject to revision, so as to improve the accuracy of the valuation method. In addition to being used for the assessment of stigma, the databank would be of considerable benefit in recording information as to the costs of dealing with the physical aspects of land contamination. Once fully tested and operational the databank could be expanded so as to assist research into other aspects of environmental impairment.

An approach was made, in mid 1995, to 25 of the leading firms of valuation surveyors practising in England and to English Partnerships, the government funded organisation responsible for promoting urban regeneration, in order to assess the level of support for the proposed databank. Replies were received from twelve of the surveying firms, expressing support for the idea, but six of these respondents envisaged problems in being able to analyse transaction data, including client confidentiality. The proposed databank was initially welcomed by English Partnerships but the organisation subsequently declined to take part in a pilot study on the grounds of "commercial confidentiality". The databank proposal has been welcomed by Wilbourn (1996) and Richards, T. (1996) both of whom have noted the problems involved in obtaining access to the required information. The possibility of undertaking a pilot study is identified as an area for further research, as part of a larger research project designed to facilitate further testing of the valuation model.

CHAPTER ELEVEN

CONCLUSIONS AND RECOMMENDATIONS

11.1 INTRODUCTION

The primary objective of this research project has been to prove that contaminated land is an important resource, even if the land is regarded, at least in the short term, as a liability. The findings of the research support the hypothesis that a risk assessment approach will assist in identifying the future potential of such land, informing the decision making process in respect of its redevelopment and value.

The research has demonstrated that land which has been used once can be used again, for a wide range of uses. With care, future contamination of land can be minimised, through the use of town planning and environmental controls, but it would be naive to believe that all future contamination can be prevented. Accidents do occur, from the stranding of supertankers on rocky shores to the leakage of an underground tank in a petrol filling station. Some industrial activities have the potential to create contamination, in spite of the most stringent controls, the disposal of domestic and industrial wastes is a fact of life and, for the foreseeable future, the use of landfill for a significant proportion of these wastes can be expected to continue.

The excavation of contaminated sites and deposition of the excavated material in landfills is also likely to continue for some time to come. Alternative methods are available to tackle the problems associated with land contamination but their adoption will depend upon many factors including economics, time scale and the personal perceptions of the individuals charged with the task of finding solutions. Site specific factors and the possible future uses of contaminated land are also important factors in the selection of treatment methods.

For all but the simplest forms of contamination, presenting relatively low levels of risk, it is certain that the cost of remediating contaminated sites will be of major importance in the consideration of redevelopment proposals. In many cases it is likely that the costs involved will exceed any future economic value which may be derived from the land, thus throwing into doubt the entire redevelopment project. When this occurs a number of questions will have to be asked:

- does the present or previous owner, or the original polluter, have any legal liability in respect of the "clean-up" of the site?
- is the contamination of immediate risk to surrounding properties, ground and surface water and/or the wider environment?
- is the proposed development essential, requiring short term treatment of the contamination, or can longer term treatments be considered?
- if longer term treatments are suitable, is there a cost saving associated with them and can the delay to the project be justified in economic terms?

The research has considered these and other related questions as part of the development process. A model has been developed to assess the value of land affected by contamination. The true extent of land affected by contamination in the United Kingdom is impossible to verify and there are differences of opinion between government estimates and independent research. The government has attempted to limit the extent of contaminated land, through the use of definitions which are more narrowly worded than the definition adopted for this research.

Whether or not the definition of 'significant harm' presently under discussion between the Department of the Environment and its advisors, as described in Chapter Three, will eventually be adopted, remains to be seen. It may, however, be appropriate for the legal definition of contaminated land to contain a form of limitation, so as to focus attention on the most severely affected sites. To do otherwise would undoubtedly stretch the human resources of the regulatory authorities to such a point as to be self defeating unless, of course, unlimited financial resources were made available to tackle the problem.

Other European countries have found that land contamination is far more widespread than had initially been envisaged and, as in the case of the Netherlands, the principle of 'multifunctionality' is being reconsidered. The economic burden of remediating contaminated land to a uniformly 'clean' state is one which can not be contemplated by most industrialised countries and manufacturing companies. The research has shown that in many instances such actions are unnecessary. Occupiers, investors, local authorities and financial institutions have all accepted soil remediation treatments which leave some residual contamination in the redeveloped site. This acceptance has been achieved through the adoption of a policy of 'full disclosure' by the developers concerned, the use of good working practices in the site treatments and the maintenance of detailed records.

11.2. THE REDEVELOPMENT AND VALUE OF CONTAMINATED LAND

Personal fears on the risks from contamination, and prejudices against former industrial areas, may prevent many property developers from using their skills in the redevelopment of contaminated land. Perceptions of the problems involved are also influenced by the views and attitudes of their professional advisors and the lending or investment policies of funding institutions.

The results of the first questionnaire survey demonstrated clearly that investors and housing associations were perceived as being the most cautious actors in the development process, although for all actors a tendency to avoid innovative treatment methods was indicated. As investors play a major part in the financing of redevelopment projects, their attitudes must be taken into account in the preparation of valuations and development appraisals. This is reflected in the valuation model. Workers on industrial and commercial developments, and shoppers using retail developments, were perceived as being the least sensitive to a history of land contamination.

There are many problems associated with the redevelopment of land contaminated by former industrial activities. No two sites are identical and the severity of contamination will differ according to the nature of the contaminants and their concentrations. Sites which have been used for the same industrial activity can present totally different degrees of risk, as was demonstrated by the Bromborough Business Park and Centrepoint case studies reported in Chapter Eight. The severity of contamination will have been influenced by the working practices, both within the firms themselves and entire industries, in respect of the storage of raw materials and disposal of waste products. Several of the case studies in Chapters Seven and Eight illustrate the problems brought about by commencing redevelopment without sufficient knowledge of the extent and nature of soil contamination and the consequences of inadequately designed treatments.

The period 1991 to 1996 has been very difficult in terms of the redevelopment and valuation of contaminated land due to changes in government policies and the inadequacies of professional guidance. Nevertheless, sites have been redeveloped and valuations prepared, with developers and valuers dealing with problems on a site specific basis. In general, developers and their advisors have adopted a cautious approach to redevelopment. To some extent this approach has been influenced by the funding institutions, which have tended to request increasing amounts of information on environmental issues.

11.3 <u>CONSOLIDATING THE RESULTS</u>

The case studies have confirmed that, consciously or otherwise, prospective developers expect to receive a price reduction against the development value of the land which is in excess of the cost of remediating the land and preparing for development. For most of the case study developments tested in Chapter Ten there was a close correlation between the actual discount received by the developer and the expected discount produced by the valuation model.

Stigma has been proved to exist and to be capable of quantification. Pre-development 'stigma' impacts on value were observed for all of the case studies considered in Chapters Eight and Ten, ranging from 21.21 per cent to 67 per cent. The 'risk assessment' model developed has proved to be a useful tool in confirming an expected stigma range of 17.97 per cent to 41.84 per cent. The stigma effect observed in the ten case studies was similar to the range of 21 per cent to 69 per cent observed by Patchin (1994a) in respect of his seven case studies in the United States.

In all but one of the six studies in Chapter Eight, it was not possible to identify any post-development price reduction which represents the stigma effect. In the one exception the observed price discount may in fact reflect other factors such as 'run-down' appearance of the surrounding area and the developer's desire to stimulate market awareness of a location which had not previously been considered for residential development. Redevelopment of the four additional case study sites, described in Chapter Ten, is not sufficiently well advanced to determine whether or not any stigma effect will be observable after redevelopment.

The research indicates that, whilst house builders and developers expect to see a substantial discount in the price paid for remediated former industrial land, only a small part of the reduction trickles down to the eventual home owners through a reduction of less than 10 per cent in the price paid for new homes. It would, therefore, seem that the purchasers of new homes in the lower price ranges of the market are relatively insensitive to the former industrial, and possibly contaminated, nature of the sites upon which homes may be constructed. Also, the history of such sites may be overcome by the use of quality landscaping and the creation by the developer of a 'self-contained environment'.

So far as the non-residential case studies are concerned, once potential tenants and investors were satisfied in respect of the treatment methods there was no adverse impact on the rental or investment values of the completed development. In one of the case studies, the contaminated material was removed from site and replaced with clean fill and in another only the contaminated content of the fill material was removed from site, with the remaining, inert, material being re-used. The other industrial use case studies utilised cover and containment methods.

11.3.1 <u>The Implications For Valuers And Developers</u>

It is essential for valuers of industrial land to have an understanding of the causes and effects of contamination arising from industrial activities. This applies whether the land is to remain in the existing industrial use or is to be redeveloped for industrial or other purposes. Valuers also need to be able to exercise their professional judgement in determining whether or not the contamination is potentially harmful. In some cases this may result in the valuer having to obtain specialist advice in respect of the contamination issues but, it is argued, in many instances a valuer should be capable of making a preliminary assessment of the risks involved with a site.

The information and observations needed to arrive at an assessment of risk in respect of an industrial property are similar to those which would be required by a prudent valuer for normal valuation purposes. A valuer's assessment of risk is likely to be qualitative in nature and may fall short of the requirements of a formal 'quantitative' risk assessment but Cairney (1995) has suggested the use of a semi-quantified risk assessment procedure. This approach would seem to be compatible with the functions of the valuer and should enable assessments to be made which adhere to the proposed definition of 'significant harm'. Petts (1996) has, however, cautioned that the chapter "on risks to human health is contentious in suggesting that occupational health criteria in terms of allowable exposure limits can be used directly to consider exposure risks amongst residents and sensitive members of the population (e.g. the pica child)." She also expresses doubts as to whether [the semi-quantitative method] will " be used robustly by some members of the property and consultancy professions." (Petts, 1996)

That there are differences in terms of perceptions of risk between valuers and other 'consultancy' professions was quite apparent from the results of the third phase of the perceptions studies. The responses to the question relating to the harmful factors of contaminated land (in the second questionnaire survey) confirmed a very significant difference, in terms of both Known Risks and uncertainties, between valuers and their colleagues in other professions. Less significant, but nevertheless noticeable, was the difference between the perceptions of the 'valuers' and 'non-valuers' in respect of the property related environmental issues. Although the 'valuers' and 'non-valuers' demonstrated very similar perceptions in terms of the Known Risks, the 'valuers' perception of risk associated with uncertainties was noticeably higher and more aligned to the perception of the 'general population'. So far as landfills were concerned, the 'valuers' perception of risk, for both Known Risks and Uncertainties, was higher than that of the 'non-valuers' and closer to the perceptions of the general population.

The results from the psychometric tests might be regarded as an indication that the 'valuers' group has a better perception of environmental risk than the 'non-valuers', in view of the closer association with the 'general population' results. Such an outcome is unlikely in view of the range of expertise in the 'non-valuers' group. A more logical explanation is that the 'valuers' are less well informed about the risks associated with property related environmental issues, such as contaminated land, than their counterparts in other professions. As a result of this lesser informed state, the 'valuers' may tend to over compensate for their lack of knowledge in dealing with the issues.

Most of the professions in the 'non-valuers' group, especially the engineers and environmental consultants, have been dealing with the issues of land contamination for a longer period of time than the valuers and developers. Many members of these professions have been involved with the problems of soil contamination for a period of more than ten years and as a consequence of this longer period of involvement it is likely that the risk perceptions of the 'technical professions' peaked several years ago. Those professions will therefore have learned to deal with land contamination as a management issue and are able to provide clients with relevant advice.

Valuers, on the other hand, will inevitably experience problems in providing clients with advice on the subject of contaminated land, a situation which will exist until such time as the appropriate guidance is provided by both government and professional organisations. In the absence of such guidance, valuers will adopt a cautious attitude to the valuation of contaminated land, both before and after treatment, which will be reflected in the advice provided to their developer clients.

The valuer's view of contamination issues is likely to be closely associated with the general public's perception, because education and training in the profession tends to deal with environmental issues in a fairly superficial manner and valuers do not come from an engineering background. The research would seem to suggest that there is scope for a greater emphasis to be placed on environmental training for valuers and general practice surveyors. Whether or not this should occur at undergraduate level is debatable, given the diversity of subjects with which new entrants to the profession are expected to be conversant, including marketing, business management, and professional ethics, in addition to the traditional subjects of valuation, law, construction and economics.

It may, therefore, be more appropriate for valuers to develop skills in relation to the valuation and redevelopment of contaminated land through post-graduate courses. Such a course may, for example, include the following topics:

- an introduction to environmental issues and concerns;
- contaminated land, pollution and waste management;
- environmental legislation in the UK and Europe;
- environmental management systems, risk assessment, management and auditing.

Valuers and developers need to be able to distinguish soil contamination which is directly attributable to present or past industrial uses and the 'background' levels of contamination which may be found in industrial areas. The case study in section 8.2 described the problems associated with the redevelopment of a site owned by a chemical company in east Manchester. In addition to the contamination, which had clearly arisen from the industrial activities carried out on the site, the soil was also affected by very high sulphate levels. The high sulphate concentrations would have been extremely aggressive if allowed into contact with foundations or services but there was no apparent source for the sulphates from within the site. Following further investigations by environmental consultants, including testing soil samples from adjoining properties, it was decided that the probable cause of the sulphate contamination was the former town gas works, situated approximately half a mile from the site, and that all surrounding properties were similarly affected. Research by Douglas *et al* (1993), in the same Manchester inner urban area, also found elevated levels of lead in surface soil samples and established a relationship between the sampling location and proximity to major roads.

The example described above illustrates the need for valuers to look beyond the boundaries of the site being valued, when considering the likelihood of contamination, and to adequately research the industrial history of the area.

11.3.2 The Implications for Government Policies

Government policy proposals in respect of 'registers of potentially contaminated sites', the subsequent debate and withdrawal of the proposals, have undoubtedly contributed to a state of uncertainty among valuers concerning contaminated land. Most of the valuers interviewed in the second phase of the perceptions study were opposed to the registers, with almost half of the interviewees believing them to have been ill conceived. Opinions were evenly divided as to whether or not registers of all land uses, past and present would have been preferable to identifying certain uses as 'potentially contaminative'.

Concerns over the effect the registers might have on an already weakened property market provoked some of the opposition to the proposal, although only 14 per cent of the interviewees expressed concern over the potential blighting effect which the registers may have on property values. Most of the opposition to a system of registers centred on the bureaucracy involved and similar concerns were expressed in respect of the role of the environment agencies. Addressing the problems of contaminated land is only one of the many functions of the new environment agencies, whose responsibilities range from fishing licences to the control of pollution, and the priority level to be applied to contaminated land remains to be seen.

In mid-1994, in the interview phase of the perceptions study, almost 50 per cent of the valuers questioned were unaware of the government's intentions to establish 'environment agencies' and, of those who had some knowledge of the proposal, opinions were equally divided between those in favour and those opposed to the new agencies. Eighteen months later almost 90 per cent of valuers were in favour of the new agencies, provided that they were equipped with the necessary powers to tackle the problems and were not over-burdened by bureaucracy.

In both the interview survey and the second questionnaire survey there was clear support for government policies which encourage the redevelopment of contaminated and 'brownfield' sites in preference to 'greenfield' development. For the most part, opinions were in favour of the use of public sector funds to tackle the problems remaining from industrial activities but there was also a widely held view that the polluter should pay.

11.4 THE RESEARCH METHODOLOGY AND FURTHER RESEARCH

This study has attempted to synergise the technical and economic aspects of contaminated land. More than 130 professionals involved in the valuation, redevelopment, funding or transfer of contaminated land contributed to the research. The three phases of the perceptions study enabled the research methodology to be adapted to changing circumstances in respect of policy issues. A matrix technique was employed for the first questionnaire survey, in order to avoid asking repetitious questions in respect of the five types of development under consideration. The intention was to make the issues easier for the respondents to consider but, in practice, a number of people on the original 'experts list' found the matrix format too difficult and declined to provide a response. This part of the survey would probably have been better conducted through interviews or group sessions.

The research considers the technical aspects of site investigations and soil treatment methods from the perspective of the valuer, the development surveyor and the developer. This is an extremely large subject area, which was expanding, in terms of both technologies and literature, during the research period. The research has not attempted to provide a critique in respect of treatment technologies but has instead endeavoured to consider those issues which are of concern to valuers, and their clients, when it comes to the selection of appropriate treatment methods for the remediation of contaminated soils.

Whether or not valuers and surveyors become involved in site investigations and the design of soil treatments will depend on individual practitioners. However, industrial property valuers in particular need to take account of contamination issues and much of the information required for a preliminary site investigation will be relevant in enabling the valuer to provide his or her client with meaningful advice.

Three principal contributions to knowledge are produced by the research. Firstly, the development of a model by which the value of contaminated land might be assessed. The 'risk assessment' approach adopted in the model accords with the Department of the Environment's approach and that of the 'technical professions'. Secondly, in respect of the psychometric part of the perceptions study, it proved that the perceptions of valuers were markedly different to those of a mixed professional group of 'non-valuers'. Finally, the research confirmed that investors are the most risk averse of all actors when it comes to consideration of the treatment and re-use of contaminated land.

Solutions to the redevelopment of contaminated land require a multi-disciplinary approach and the research has attempted to provide a link between the technical and economic aspects of the problem. Further quantitative testing is required in order to test the valuation model and a computer program is being developed for this purpose. Testing would also benefit from a 'comparables databank' and the problems associated with the establishment of a databank are recognised, not least in terms of commercial confidentiality. An application is to be made for research council funding to facilitate further research and it is hoped that this will have the support of the professional institutions, as well as the major firms of valuers.

Further research has already commenced, in conjunction with the University of Connecticut, to examine the perceptions of funding institutions and equity investors with regard to contaminated land. This research will compare the attitudes of actors in both the United States and the United Kingdom. Valuers, developers and investors all need to be better informed about innovative soil treatment methods. This is largely an educative process but further research is probably required in order to convince those people that are being expected to invest large sums of money, often for a period of many years, that they will not be faced with environmental problems at some future date.

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APPENDIX ONE

Questionnaires Interview Form and
List of Study Participants

THE POST-REMEDIATION VALUES OF CONTAMINATED LAND

SURVEY OF THE PERCEIVED IMPACTS OF ALTERNATIVE REMEDIATION METHODS

It is almost certain that, in an age of increasing environmental awareness, the intending developers and ultimate investors or users of property developments will demand to be better informed as to the past uses of the site upon which the buildings are to be constructed. Where sites have previously been used for potentially contaminative purposes the demand will be for information of the highest quality. The aim of this survey is to assess the extent to which different methods of remediation are likely to impact upon the values and desirabilities of sites to be redeveloped for a variety of end uses.

Respondents are therefore asked to visualise a site of 5 acres (2.02 Ha) located close to the centre of an industrial city, with good access from a main arterial road. The site has a 100 year history of past industrial use and is contaminated with metalliferous wastes, hydrocarbons and organic substances originating from a variety of former uses. The site is zoned for industrial use but, in view of its present derelict and contaminated state, the planning authority has indicated a willingness to consider any proposals which comply with good planning and highways principles. All buildings have been demolished, with some demolition material remaining on site and four site remediation alternatives are under consideration.

Scenario 1 The removal of all contaminated material and its replacement with clean granular fill, consolidated in layers.

Scenario 2 The removal, and off site disposal, of contaminated hot spots and the dilution of remaining contamination with clean fill, the site then to be covered with clean material to form a base for construction.

Scenario 3 Dry screening of soil, together with soils washing so as to reduce the level of contamination below ICRCL trigger levels. Disposal of the heavily contaminated residues off site.

Scenario 4 On site biological or chemical treatment as appropriate so as to reduce contamination, or render it relatively harmless.

With all scenarios and development options respondents are asked to consider the completed value and/or desirability of the development when compared to a similar project carried out on a nearby greenfield site.

Respondents should also have regard to the following arguments:-
1. Fully documented remediation work should provide a site ready for development and render a formerly contaminated site more desirable than a greenfield site with unknown problems.
2. Even after remediation a formerly contaminated site will still bear the stigma of its former use.

NAME .... OCCUPATION ....

FIRM OR ORGANISATION ....

In which of the following categories would you place your knowledge of contamination and valuation.

	GOOD	FAIRLY GOOD	REASONABLE	POOR	VERY POOR
CONTAMINATION					
VALUATION					

REMEDIATION METHODS

PROPOSED END USE / END USER REACTION	SCENARIO 1 Excavate and backfill	SCENARIO 2 Excavate hotspots and clean cover	SCENARIO 3 On-site screening and soils washing	SCENARIO 4 On-site bio or chemical treatment
Residential development				
- Developers				
- Building Societies				
- Housing Associations				
- Occupiers				
Business Parks				
- Developers				
- Investors				
- Tenants				
- Workers				
Industrial Estates				
- Developers				
- Investors				
- Tenants				
- Workers				
Retail Parks				
- Developers				
- Investors				
- Tenants				
- Shoppers				
Leisure uses				
- Developers				
- Investors				
- Users				

For EACH category of development and for EACH remediation scenario would you please indicate your opinion as to how the various players in development, investment and use might perceive the alternative approaches to the treatment of contaminated sites. Please use the numbering system set out below. Thank you for your assistance.

1	Increase in value/desirability.	- greater than 5% change
2	No real effect on value/desirability	- less than 5% increase/ decrease in value
3	Slight decrease in value/desirability	- 6 to 10% change
4	Moderate decrease in value/desirability	- 11 to 25% change
5	Significant decrease in value/desirability	- greater than 25% change

PLEASE RETURN THE FORM TO:- Paul Syms, 95 Park Lane Poynton, Cheshire, SK12 1RB

SHEFFIELD HALLAM UNIVERSITY
CENTRE FOR PROPERTY AND PLANNING RESEARCH
CONTAMINATED LAND - VALUATION AND DEVELOPMENT SURVEY

1. Name of Interviewee..

   Name of Company ....

   Position ....

   Questions about the Company

2. Nature of Company's Business ....
   Main Areas of Specialism ....

   Company

   Agency Professional Development Management Planning
   Industrial Commercial Residential Leisure

   Personal

   Agency Professional Development Management Planning
   Industrial Commercial Residential Leisure

3. Does your firm regularly become involved with the valuation or redevelopment of contaminated land? **Yes/No**

   If yes, approximately how much of the firm's work (by number of cases - not fees) is concerned with the implications of contamination on valuation and development

   90-100% 75-89% 50-74% 25-49%
   15-24% 5-14% less than 5%

Questions about Individual Experience

4. Have you personally been involved with the valuation, acquisition, redevelopment or disposal of a contaminated site within the last five years? **Yes/No**

If yes, on approximately how many occasions?
>20, 15-20, 10-14, 5-9, <5

5. To what extent are you familiar with the causes of contamination in land, the ways in which such contamination may travel and the manner in which it may affect its targets, such as humans, animals, plants and buildings?

	Causes	Pathways	Targets
Very familiar			
Reasonably familiar			
Some knowledge			
Understand that there is a problem but know little about it			
No real knowledge or understanding			

Questions about the Surveying Profession and Government

6. To what extent do you consider that the professional bodies (RICS and ISVA) should set down guidelines for dealing with the valuation of contaminated land?

Essential ....
Very important ....
Unimportant ....
Leave it alone ....

7. Do you believe that government should take the lead in setting standards/guidelines for valuation of contaminated land? **Yes/No**
Please give reasons for your answer.

8. Were you in favour of the proposals to set up registers under Section 143 of the Environmental Protection Act 1990? **Yes/No/Don't Know**
Please give reasons for your answer

9. Would you have been in favour of setting up registers giving details of all land uses, past and present, instead of concentrating on a few which were deemed to be "potentially contaminative" **Yes/No**
Please give reasons for your answer

10. Are you in favour of positive action being taken by government to encourage the redevelopment of contaminated sites in preference to greenfield development? **Yes/No**
Please give reasons for your answer and describe actions you consider may be appropriate

11. Are you aware of the government's intention to set up an Environmental Agency? **Yes/No**
This agency is expected to take over responsibility for a wide range of environmental matters from HMIP, NRA, WRA's and local authorities.
Are you in favour of responsibility for a wide range of environmental issues being controlled by a single agency? **Yes/No**

<u>Questions about Contaminated Land and Valuation</u>

12. Removal of contamination from affected sites cannot be guaranteed to be absolute but is the method by which most contaminated sites in the UK have hitherto been reclaimed. Do you consider that after treatment by this method there is likely to be any difference in value between a treated site and a greenfield site of a similar size and in a similar location? **Yes/No**
If yes, please indicate extent to which you consider values may be affected

13. Besides the removal of contamination from affected sites other forms of remediation may be used. Do you consider that higher technology forms of treatment, such as chemical, biological or thermal treatments will -

a) **improve**
b) **reduce**
c) **not alter**

the value or development potential of a site when compared to removal of the contamination?

14. In your opinion is there likely to be a long lasting adverse effect on property values even after site remediation has been completed?

Yes/No

Please give reasons for your answers

15. When valuing or acquiring premises for either occupation or redevelopment, have you made allowances in your valuation or offer to deal with known or possible contamination? **Yes/No**

If yes, has this been by -

a) deducting cost of site remediation **Yes/No**
b) by percentage reduction **Yes/No**
(what sort of percentage ....%)
c) by other methods, please describe

16. Forms of contamination and their impacts on human and animal life, plants and structures are extremely diverse and difficult to categorise. For the purpose of this study therefore we have attempted to classify contaminants by their impact on the environment. Would you please indicate how you consider property values would be affected in each of these groups when compared to a similar, but uncontaminated, property. Please indicate the percentages by which you consider values of both land and buildings would be affected both before and after remediation.

	Before	After
<u>Very low hazard</u> Contamination below ICRCL trigger levels, unlikely to be harmful		
<u>Low hazard</u> Some contamination, possibly phytotoxic (ie harmful to plant life) but unlikely to cause problems if contained below a cover layer		
<u>Medium hazard</u> Contamination well in excess of trigger levels, possibly harmful to structures or services but unlikely to cause harm to humans or animals except through prolonged exposure		
<u>High hazard</u> Contamination levels likely to cause harm to persons and/or property with high levels of toxicity or other harmful substances. Extensive remediation required.		
<u>Very high hazard</u> Sites requiring decontamination under stringent controls, contaminants likely to cause harm even from short term exposure. Must be removed or treated before development or occupation.		

Questions about Future Research

17. It is likely that the ongoing nature of this research and the establishment of the Environmental Agency will raise other issues in due course. Would you therefore be prepared to answer supplementary questions at a later date? **Yes/No**

18. As part of the research it is hoped to establish a database of information relating to the impact of contamination on property values. In this context it is important to be able to compare valuations made before the contamination, or extent of the problem, was known about with actual prices achieved. In this context, information relating to negotiations, and prices agreed, which failed to come to completed sales is as important as information on actual transactions. Are you prepared to supply information, on the basis of strict confidentiality, which will only be used for the purpose of this study? **Yes/No**

Sheffield Hallam University

11 January 1996

Tel: 01625 827220
Fax: 01625 829957

Dear

ENVIRONMENTAL IMPAIRMENT RESEARCH PROJECT

In 1994 you kindly assisted this research project by completing a questionnaire. The research is progressing well and I would like to ask for a little more of your time in completing a further questionnaire. There are only six questions (five for none valuers) and I am seeking your initial thoughts, not lengthy consideration of the various issues, it should not take longer than 15-20 minutes.

We are intending to conduct a 12 month pilot study for the establishment of an ENVIRONMENTAL IMPAIRMENT DATABANK and the information obtained on professional and public perceptions will greatly assist the work of the project.

It would be appreciated if you could return the questionnaire to me as soon as possible.

Thank you for your help.

Yours sincerely

P M SYMS
VISITING RESEARCH FELLOW

School of Urban and Regional Studies
City Campus Pond Street Sheffield S1 1WB UK
Telephone +44 0114 253 3525 Fax +44 0114 253 3553
Director of School Professor Peter M Townroe BA(Econ) MA DLitt

Divisions
Housing Planning and Urban Policy Surveying

ENVIRONMENTAL AWARENESS QUESTONNAIRE

Many aspects of everyday life may cause harm to the environment. The effects may be perceived on the personal scale, community wide and world wide. They may also be classified into different categories, for example, **Known risks** which are well researched and publicised and **Uncertainties**, which are less well researched or understood. In respect of vehicle emissions, the **Known risks** might include health hazards such as a higher incidence of asthma and physical hazards such as acid attacks on buildings, **Uncertainties** might include wider environmental impacts such as damage to the ozone layer. For smoking, **Known risks** might include cancer and heart problems, whilst an **Uncertainty** may be the effect of passive smoking.

Questions 1 and 2 seek to differentiate between **Known risks** and **Uncertainties** using a numbering system in which the number 5 represents the highest level of perceived hazard, number 4 the next highest level and so on down to number 1 as being the lowest level of perceived risk, with 0 being used if no risk is perceived.

QUESTION 1 Please indicate your perception of hazard for the **Known risks** and **Uncertainties** for each of the following;

DEGREE OF PERCEIVED HAZARD | **DEGREE OF PERCEIVED HAZARD**

5=HIGHEST RISK , 1=LOWEST RISK, 0=NO RISK

	KNOWN RISKS	*UNCERT-AINTIES*		*KNOWN RISKS*	*UNCERT-AINTIES*
Smoking			Asbestos in buildings		
Alcohol abuse			River pollution		
Vehicle exhaust emissions			X-rays		
Radon gas			Pesticides and insecticides		
Noise			Food packaging		
Land contamination			Artificial fertilisers		
Drug abuse			Motor vehicle accidents		
Factory emissions			Home appliances		
Overhead electricity cables			Sunbathing		
Computer screens			Landfills		

QUESTION 2 For **Land contamination** only, Please indicate your perception of hazard for the **Known risks** and **Uncertainties** in respect of the following possible harmful effects,

DEGREE OF PERCEIVED HAZARD | **DEGREE OF PERCEIVED HAZARD**

5=HIGHEST RISK , 1=LOWEST RISK, 0=NO RISK

	KNOWN RISKS	*UNCERT-AINTIES*		*KNOWN RISKS*	*UNCERT-AINTIES*
Breathing difficulties			Acid burns		
Cancer			Poisons		
Skin allergies			Disruption of the food chain		
Contaminated drinking water			Ingestion by small children		
Damage to invertebrates			Deterioration of foundations		
Corrosion of service pipes/ducts			Damage to plant life		
Birth defects			Risk of explosion		
Obnoxious smells			Harm to wildlife		

QUESTION 3.

The following land uses have been identified as having the potential to contaminate the sites which they occupy but this does not mean that those sites are actually contaminated. Please indicate with the number 5 those activities which you would perceive as being most likely to result in contamination - the highest risk category. Use the number 4 to indicate the activities which you regard as the next highest risk and so on down to number 1 to indicate your perception of the lowest risk to human health or the wider environment.

5=HIGHEST RISK 1=LOWEST RISK

Asbestos manufacture and use		Oil refining and storage	
Chemicals manufacture and storage		Paint manufacture	
Dockyards and wharves		Paper and printing works	
Dye-stuffs manufacturing works		Pharmaceutical industries	
Electricity generating stations		Radioactive materials processing	
Explosive industry		Railway land	
Gas works and similar sites		Scrapyards	
Glass manufacturing		Semi-conductor manufacturing plants	
Heavy engineering works		Sewage treatment works	
Iron and steelworks		Tanning and leather works	
Metal smelting and refining		Textiles manufacture	
Metal treatment and finishing		Timber treatment works	
Mining and extractive industries		Waste disposal sites	

The above list of industrial categories is not exhaustive but has been prepared after careful study. If you consider that there are other industries which should be included, please list these below:

i)...

ii)..

QUESTION 4

In an interview survey carried out in 1994, two thirds of the interviewees indicated that they were in favour of the establishment of an Environment Agency which will assume responsibility for a wide range of environmental matters currently the responsibility of the National Rivers Authority, Her Majesty's Inspectorate of Pollution and the Waste Regulation Authorities. The Environment Act 1995 has now received the Royal Assent and the Agency is scheduled to become operational in 1996.

a) Are you now in favour of the establishment of an Agency with such wide ranging powers?

YES/NO PLEASE DELETE AS APPROPRIATE

b) Please add any comments you wish to make so as to qualify or expand upon your answer.

....

....

QUESTION 5

In the same survey 86% of the interviewees indicated that they were in favour of contaminated sites being developed in preference to greenfield sites and several were of the opinion that positive action should be taken by government in support of this objective.

a) Are you in favour of the redevelopment of contaminated or "brownfield" sites in preference to greenfield development? **YES/NO** PLEASE DELETE AS APPROPRIATE

b) If your answer to Question 5a) was YES please indicate the extent to which you believe government should take positive action in support of this objective.

NOT IN FAVOUR	
INDIFFERENT	
MILDLY IN FAVOUR	
STRONGLY IN FAVOUR	
VERY STRONGLY IN FAVOUR	

c) What type of action would you suggest? ....

QUESTION 6 - *FOR VALUATION AND DEVELOPMENT SURVEYORS ONLY*

Fifty-seven per cent of the interviewees were of the opinion that contamination was likely to have a long lasting effect on value even after site remediation works have been completed.

To what extent do you consider that contamination would have an impact, in terms of a) timescale and b) impact on land value, when compared to a similar but "greenfield" site, on the assumption that site remediation work had been completed on the "suitable for use" basis?

a) Timescale - duration of effect on value

Severity of previous hazard	None	1-2 years	2-5 years	5-10 years	10-15 years	>15 years
Very low hazard						
Low hazard						
Medium hazard						
High hazard						
Very High hazard						

b) Impact on value - percentage reduction in value immediately after remediation

Severity of previous hazard	None	<10%	11-25%	26-40%	41-60%	61-80%	81-100%	>100%
Very low hazard								
Low hazard								
Medium hazard								
High hazard								
Very High hazard								

Thank you for your help,
Paul Syms
Visiting Research Fellow

Would you like to receive a copy of the survey results?
YES/NO PLEASE DELETE AS APPROPRIATE

Name of the person completing the questionnaire ....

Occupation .... **Name of firm or organisation** ....

FOLDING INSTRUCTIONS:
Fold along line A to A and line B to B. Tuck one flap into the other, with the address on the outside. Postage is already paid - No stamp is required

FOLD HERE

A..A

Do not affix postage stamp if posted in Gt. Britain, Channel Islands or N. Ireland

2

PAUL SYMS
FREEPOST (SK 2017)
P.O. BOX 156
MACCLESFIELD
CHESHIRE
SK10 4YE

B..B

FOLD HERE

HAZARD CLASSIFICATIONS USED IN THE RESEARCH

VERY LOW HAZARD Contamination below ICRCL Trigger levels, unlikely to be harmful to humans, animals, plants, structure or the environment.

LOW HAZARD Some contamination, possibly harmful to plant life but unlikely to cause harm if contained below a cover layer.

MEDIUM HAZARD Contamination well in excess of Trigger levels, possibly harmful to structures or services but unlikely to cause harm to humans or animals, except through prolonged exposure. Treatment necessary.

HIGH HAZARD Contamination levels likely to cause harm to persons and/or property, with high levels of toxicity or other harmful substances. Extensive remediation required.

VERY HIGH HAZARD Sites requiring decontamination under stringent controls, contaminants likely to cause harm even from short term exposure. Must be removed or treated before development or occupation.

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VERY HIGH HAZARD Sites requiring decontamination under stringent controls, contaminants likely to cause harm even from short term exposure. Must be removed or treated before development or occupation.

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND

EXPERTS PARTICIPATING IN THE THE PHASES OF THE STUDY

NAME	COMPANY	PHASE 1	PHASE 2	PHASE 3	VALUER	DEVELOPER	ARCHITECT	ENGINEER	QUAN. SURV.	ENV. SCIENT.	LAWYER	PLANNER	BANKER	OTHER
Albutt, J.W.	AEW Architects	1		1			1							
Ashley, C.A.	Shepherd Gilmour Traffic			1				1						
Askham, P.	Sheffield Hallam	1			1									
Auld, E.	Shell UK			1				1						
Baddeley, R.	Richard Baddeley & Co.			1	1									
Balderston, T.A.	Thos. Balderston & Co.			1	1									
Banks, J.W.	Chesterton	1		1	1									
Beard, R.D.	Berkeleys		1		1									
Bithell, T.	Macclesfield B.C.	1		1								1		
Blick, R.A.	Alfred McAlpine Holdings*	1				1								
Braithwaite, M.A.	Fletcher King		1	1	1									
Breakell, J.C.	Raab Kaarcher	1		1	1									
Brooks, D.J.	King Sturge & Co.	1			1									
Burgess, K.	Andrews & Boyd	1		1					1					
Byrom, R.	Byrom Clark Roberts			1	1		1							
Cairney, T.	W.A. Fairhurst & Partners			1				1		1				
Caldwell, J.S.	Foden Investments	1		1		1								
Carden, S.	John Brunton Partnership	1					1							
Carter, J.F.	Maple Grove	1		1	1	1								
Chambers, R.	DTZ Debenham Thorpe	1		1	1									
Chivers, C.	DTZ Debenham Thorpe*		1		1									
Clark, A.	British Rail			1	1									
Clark, P.	Macclesfield B.C.	1									1			
Clarkson, A.P.	Macclesfield B.C.	1									1			
Cooper, E.	Sir Wm. Halcrow & Partners	1						1		1				
Costello, A.	Banks Wood & Partners			1					1					
Council, B.	Liverpool John Moores Univ.	1									1			
Cramer, R.	Macclesfield B.C.	1						1						
Croft, P.	Sheffield Hallam	1		1	1									
Crosby, D.E.	Sheffield Hallam	1					1							
Cumming, R.	Sheffield Hallam	1										1		
Cummings, M.	CEP Architects	1					1							
Cunliffe, M.J.	Peter Cunliffe & Co.			1	1									
Cunliffe, P.F.	Peter Cunliffe & Co.	1			1									
Davies, C.	Dunlop Heywood			1	1									
Dent, J.R.	Lambert Smith Hampton			1	1									
Dewhurst, A.	Maple Grove	1		1	1	1								
Dunston, R.	Dunlop Heywood		1		1									
Edwards, J.S.	John Edwards FRICS	1							1					
Egan, D.	Sheffield Hallam	1												1
Fitz-Gerald, J.E.	Maunders Urban Renewal			1		1								
Fletcher, A.J.	Rust Environmental			1						1				

Forbes, L.M.	British Linen Bank*	1											1	
Ford, R.	Manhester College			1							1			
Frank, G.	Grahame Frank & Co.		1		1									
Galley, M.	Sheffield Hallam	1												1
Garner, M.	Garner & Sons		1	1	1									
Gleave, S.	Taylor Young Urban Design	1		1								1		
Grainger, N.	Sheffield Hallam	1									1			
Greenham, A.	Anthony Greenham & Co.		1		1									
Griggs, P.	N.M. Rothschilds & Sons	1											1	
Guest, M.	Guest Garsden			1	1									
Hake, S.	Wardell Armstrong	1						1						
Hardman, I.	Knight Frank			1	1									
Healey, V.	Skelhorn, Walker		1		1									
Hickman, A.P.	Suttons Commercial Partnership	1			1									
Higginbottom, P.	Fairbank Properties	1			1	1								
Higson, M.	Chesters Commercial		1		1									
Hill, P.R.	English Partnerships			1	1									
Hillier, C.	Ladbroke Group			1	1	1								
Hinxman, L.	Sheffield Hallam	1		1	1									
Hiscocks, J	SWH Partnership	1		1			1							
Hughes, G.	Richard Ellis			1	1									
Isherwood, S.	AMEC Developments			1	1	1								
Jackson, A.	Building Design Partnership	1					1							
Jeffries, R.	Dames & Moore			1				1		1				
Johnson, S.	CIRIA*	1						1		1				
Jones, H.	Howard Jones & Co.		1		1									
Jones, I.	Sheffield Hallam	1		1	1									
Kendall, P.D.	John Maunders Group			1							1			
Lamb, M.	Collingwood Housing Assoc.	1		1		1								
Lathwood, D.	King Sturge & Co.		1		1									
Lawton, A.R.	Donaldsons			1	1									
Leehane, N.	Sir Wm. Halcrow & Partners	1		1				1		1				
Leggett, K.	Keith Leggett Consultancy			1	1									
Lockwood, R.	Macclesfield B.C.	1			1									
Lydon, I.	Lydon Reece Partnership	1						1						
Mackmin, D.	Sheffield Hallam	1		1	1									
Martin, D.	Warrington Martin	1		1					1					
Martin, J.L.	Banks Wood & Partners	1							1					
Millington, D.	Dunlop Heywood			1	1									
Morris, R.	Impey & Co.		1		1									
Murdoch, A.	Stevens Scanlan	1	1	1	1									
Parry, M.	Fuller Peiser			1	1									
Peggs S.	Arrowcroft Northwest			1	1	1								
Penson, C.	Dobson, Chapman*	1					1							
Pentith, N.	Pentith Ltd.			1		1								
Pinchbeck, J.	Bacons			1	1									
Pye, S.J.	Edward Roscoe Associates	1						1		1				
Quick, P.	Gorna & Co.	1		1							1			
Rathbone, P.J.	P.R.A.Ltd.	1					1							
Ravenhill, S.	W.T. Gunson*		1		1									
Ravenscroft, N.S.	Brady		1	1	1									
Rawsthorn, M.	Cobbett Leak Almond	1		1							1			

Richards, C.	Willan Investments	1		1	1									
Richards, T.	Sheffield Hallam	1		1	1									
Roberts, J.M.	Allott & Lomax			1				1						
Roberts, L.A.	Donaldsons	1			1									
Rooney, M.	Lambert Smith Hampton		1		1									
Russell, C.	Templar Housing Association	1				1								
Salisbury, S.N.	Swimer Lee Blasdale	1			1									
Sharp, J.	Jonathan Sharp Partnership			1	1									
Shaw, J.	Dunlop Heywood			1	1									
Shone, M.	AMEC Developments	1								1				
Shufflebottom, R.H.	The Elliot Partnership*		1		1									
Skelton, P.J.	Lambert Smith Hampton			1	1									
Smart, I.	AGP Architects	1		1			1							
Stephenson, M.J.	Howard, Fairbairn & Partners			1			1							
Steward, M.	Sedgwick Risk Services			1						1				
Stringer, M.	Swimer Lee Blasdale*		1		1									
Sykes, S.	Booth & Co.	1									1			
Taylor, E.J.F.	Dobson, Chapman	1		1			1							
Thomas, M.D.	Arrowcroft Northwest			1	1	1								
Townsend, N.	Macclesfield B.C.			1	1									
Warrington, J.	Warrington Martin	1		1					1					
Welsby, J.	Joshua Bury Earle		1		1									
Wewer, C.	AEW Architects	1		1			1							
White, P.	English Partnerships			1								1		
Whitmore, J.	Shaw Whitmore Fyffe Partnership	1						1						
Wilkinson, J.	Grimley		1	1	1									
Williams, T.	Grundy Kershaw	1									1			
Williamson, N.	Williamson Homes			1		1								
Winter, P.	Eversheds	1									1			
Wood, L.	Sheffield Hallam	1										1		
Wood, P.	AEA Technology			1						1				
Worthington, D.	Barker & Co.		1	1	1									
	TOTALS	66	21	72	64	14	13	13	6	10	11	5	2	2

Notes: Four anonymous returns were received in Phase 1and five in Phase 3.
Entries marked *, person is no longer with the firm stated.

THE IMPACT OF CONTAMINATED LAND ON PROPERTY VALUES
RESPONSES TO QUESTIONNAIRE SURVEY **NUMBER IN SAMPLE** 58

						Stand Dev						Stand Dev						Stand Dev						Stand Dev
	SCENARIO ONE					**Wt. Mean**	SCENARIO TWO					**Wt. Mean**	SCENARIO THREE					**Wt. Mean**	SCENARIO FOUR					**Wt. Mean**
RESIDENTIAL ESTATE	1	2	3	4	5	58.00	1	2	3	4	5	58.00	1	2	3	4	5	58.00	1	2	3	4	5	58.00
-Developers	27	21	3	4	3	11.52	14	18	11	9	6	4.62	5	14	17	12	10	4.51	3	11	16	14	14	5.13
	1					**1.88**		**1**				**2.57**			**1**			**3.14**			**1**			**3.43**
-Building Societies	20	23	7	5	3	9.21	6	20	15	7	10	5.86	3	14	12	17	12	5.22	3	11	6	18	20	7.37
		1				**2.10**		**1**				**2.91**				**1**		**3.36**					**1**	**3.71**
-Housing Associations	22	23	7	4	2	10.11	7	20	16	9	6	6.11	2	18	13	16	9	6.35	3	13	10	17	15	5.46
		1				**1.98**		**1**				**2.78**		**1**				**3.21**				**1**		**3.48**
-Occupiers	16	23	14	4	1	9.02	4	24	14	9	7	7.83	3	21	6	14	14	7.16	3	17	8	8	22	7.70
		1				**2.16**		**1**				**2.84**		**1**				**3.26**					**1**	**3.50**
TOTALS	**85**	**90**	**31**	**17**	**9**		**31**	**82**	**56**	**34**	**29**		**13**	**67**	**48**	**59**	**45**		**12**	**52**	**40**	**57**	**71**	
BUSINESS PARKS						58.00						58.00						58.00						58.00
-Developers	26	25	2	3.	2	12.70	14	25	10	9		9.07	5	18	22	12	1	8.73	4	12	22	15	5	7.44
	1					**1.79**		**1**				**2.24**			**1**			**2.76**			**1**			**3.09**
-Investors	21	24	8	5		10.41	4	22	21	9	2	9.40	2	16	20	17	3	8.44	2	11	12	24	9	7.96
		1				**1.95**		**1**				**2.71**			**1**			**3.05**				**1**		**3.47**
-Tenants	20	31	6	1		13.46	6	30	14	7	1	11.28	4	24	16	12	2	8.99	2	17	17	16	6	7.09
		1				**1.79**		**1**				**2.43**		**1**				**2.72**		**1**	**1**			**3.12**
-Workers	15	38	3	2		15.88	7	38	7	5	1	14.96	4	30	11	11	2	11.06	3	26	10	11	8	8.62
		1				**1.86**		**1**				**2.22**		**1**				**2.60**		**1**				**2.91**
TOTALS	**82**	**118**	**19**	**11**	**2**		**31**	**115**	**52**	**30**	**4**		**15**	**88**	**69**	**52**	**8**		**11**	**66**	**61**	**66**	**28**	
INDUSTRIAL ESTATES						58.00						58.00						58.00						58.00
-Developers	28	23	3	1	3	12.84	16	26	9	7		9.86	7	18	24	8	1	9.24	6	12	23	14	3	7.77
	1					**1.76**		**1**				**2.12**			**1**			**2.62**			**1**			**2.93**
-Investors	24	25	4	4	1	11.84	8	26	14	8	2	9.10	4	19	19	14	2	8.14	4	9	17	22	6	7.64
		1				**1.84**		**1**				**2.48**		**1**	**1**			**2.84**				**1**		**3.29**
-Tenants	19	34	3	1	1	14.62	7	35	12	4		13.79	4	27	19	7	1	10.99	3	21	14	17	3	8.23
		1				**1.81**		**1**				**2.22**		**1**				**2.55**		**1**				**2.93**
-Workers	15	39	3		1	16.46	5	42	9	2		17.33	3	37	10	7	1	14.62	2	32	8	12	4	12.03
		1				**1.84**		**1**				**2.14**		**1**				**2.41**		**1**				**2.72**
TOTALS	**86**	**121**	**13**	**6**	**6**		**36**	**129**	**44**	**21**	**2**		**18**	**101**	**72**	**36**	**5**		**15**	**74**	**62**	**65**	**16**	
RETAIL PARKS						58.00						58.00						58.00						58.00
-Developers	26	24	4	2	2	12.28	12	24	13	9		8.62	4	17	24	11	2	9.13	5	10	21	18	4	7.64
	1					**1.79**		**1**				**2.33**			**1**			**2.83**			**1**			**3.10**
-Investors	25	23	7	3		11.61	6	24	17	9	2	8.85	2	20	18	13	5	7.89	3	10	14	23	8	7.50
	1					**1.79**		**1**				**2.60**		**1**				**2.98**				**1**		**3.40**
-Tenants	22	28	6	2		12.60	5	33	14	6		12.97	2	26	13	16	1	10.41	2	21	9	21	5	8.93
		1				**1.79**		**1**				**2.36**		**1**				**2.79**		**1**		**1**		**3.10**
-Shoppers	17	38	2	1		16.32	6	43	6	3		17.73	3	38	8	6	3	14.91	3	35	4	11	5	13.45
		1				**1.78**		**1**				**2.10**		**1**				**2.45**		**1**				**2.66**
TOTALS	**90**	**113**	**19**	**8**	**2**		**29**	**124**	**50**	**27**	**2**		**11**	**101**	**63**	**46**	**11**		**13**	**76**	**48**	**73**	**22**	
LEISURE USES						58.00						58.00						58.00						58.00
-Developers	25	24	3	3	3	11.78	11	27	8	12		9.81	3	17	22	14	2	8.79	3	10	18	20	7	7.23
	1					**1.88**		**1**				**2.36**			**1**			**2.91**				**1**		**3.31**
-Investors	24	25	5	2	2	11.84	4	28	13	10	3	10.06	1	18	20	15	4	8.56	2	8	17	20	11	7.16
		1				**1.84**		**1**				**2.66**			**1**			**3.05**				**1**		**3.52**
-Users	16	35	3	2	2	14.36	4	36	9	7	2	13.90	2	30	12	10	4	11.08	2	26	5	14	11	9.34
		1				**1.95**		**1**				**2.43**		**1**				**2.72**		**1**				**3.10**
TOTALS	**65**	**84**	**11**	**7**	**7**		**19**	**91**	**30**	**29**	**5**		**6**	**65**	**54**	**39**	**10**		**7**	**44**	**40**	**54**	**29**	

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND

PHASE THREE QUESTIONNAIRE ANALYSIS

QUESTION NUMBER	1
POPULATION:	Experts - valuers
SAMPLE SIZE:	43

Environmental	KNOWN RISKS					TOTAL	MEAN		STD.	UNCERTAINTIES					TOTAL	MEAN		STD.
Factor	1	2	3	4	5			*Rank*	DEV	1	2	3	4	5			*Rank*	DEV.
Smoking		2	5	8	29	196	4.55814	1	12.247	3	15	11	5	4	106	2.4651	9	5.1769
Alchohol abuse		2	10	11	17	163	3.790698	4	6.1644	11	10	13	3		82	1.907	16	4.3493
Vehicle exhaust emissions	1	3	9	18	11	161	3.744186	5	6.7676	4	8	14	10	4	122	2.8372	4	4.2426
Radon gas	2	19	9	7	4	115	2.674419	14	6.6106	11	12	9	6	2	96	2.2326	12	4.062
Noise	10	11	11	3	5	102	2.372093	16	3.7417	9	18	10	4		91	2.1163	15	5.7951
Land contamination	2	9	12	13	5	133	3.093023	11	4.6583	2	10	12	13	4	130	3.0233	1	4.9193
Drug abuse		1	4	8	30	196	4.55814	1	13.15	7	6	10	7	8	117	2.7209	5	1.5166
Factory emissions		8	13	14	7	146	3.395349	8	3.5119	5	9	14	10	2	115	2.6744	6	4.6368
Overhead electricity cables	8	16	7	5	3	96	2.232558	17	4.9699	8	6	11	13	4	125	2.907	2	3.6469
Computer screens	15	12	9	4	1	87	2.023256	18	5.7184	13	11	8	7	1	92	2.1395	14	4.5826
Asbestos in buildings		4	12	8	19	171	3.976744	3	6.3966	6	11	12	4	4	100	2.3256	11	3.8471
River pollution	2	3	13	12	12	155	3.604651	6	5.4129	3	13	14	5	3	106	2.4651	9	5.4589
X-rays	5	8	13	10	7	135	3.139535	10	3.0496	14	9	12	3		80	1.8605	17	4.7958
Pesticides and insecticides	2	6	12	16	5	139	3.232558	9	5.6745	4	12	9	10	6	125	2.907	2	3.1937
Food packaging	17	8	9	1		64	1.488372	20	6.5511	12	10	9	2	1	72	1.6744	18	4.9699
Artificial fertilisers	6	16	8	9	2	108	2.511628	15	5.1186	7	13	7	10	4	114	2.6512	7	3.4205
Motor vehicle accidents	3	9	8	12	11	148	3.44186	7	3.5071	11	10	7	3		64	1.4884	19	3.594
Home appliances	11	17	9	2	1	85	1.976744	19	6.6332	14	9	1	6		59	1.3721	20	5.4467
Sunbathing	1	17	13	5	5	119	2.767442	13	6.5727	10	6	12	4	4	94	2.186	13	3.6332
Landfills	3	10	15	9	4	124	2.883721	12	4.8683	5	9	12	10	3	114	2.6512	7	3.7014

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND																		
PHASE THREE QUESTIONNAIRE ANALYSIS																		
QUESTION NUMBER	1																	
POPULATION:	Experts - none valuers																	
SAMPLE SIZE:	34																	
Environmental	**KNOWN RISKS**					TOTAL	MEAN		STD.	**UNCERTAINTIES**					TOTAL	MEAN		STD.
Factor	**1**	**2**	**3**	**4**	**5**			*Rank*	DEV.	**1**	**2**	**3**	**4**	**5**			*Rank*	DEV.
Smoking		1	2	8	23	155	4.559	2	0.931	5	5	10	2	6	83	2.441	6	0.436095744
Alchohol abuse		1	8	8	17	143	4.206	3		7	9	4	5	2	67	1.971	10	
Vehicle exhaust emissions		3	10	11	10	130	3.824	4		6	5	11	6	2	83	2.441	6	
Radon gas	7	11	3	8	2	80	2.353	15		11	9	5	2	1	57	1.676	17	
Noise	7	8	12	6	1	88	2.588	12		8	7	11	1	1	64	1.882	11	
Land contamination		9	14	9	2	106	3.118	9		4	11	8	6	3	89	2.618	4	
Drug abuse			2	8	24	158	4.647	1		2	7	7	6	7	96	2.824	1	
Factory emissions		7	15	9	2	105	3.088	10		2	10	11	8	1	92	2.706	2	
Overhead electricity cables	14	8	4	3	1	59	1.735	19		7	2	10	6	5	90	2.647	3	
Computer screens	14	7	5	3	1	60	1.765	18		9	12	5	3		60	1.765	14	
Asbestos in buildings	1	5	5	11	12	130	3.824	4		12	8	6	2	1	59	1.735	16	
River pollution	3	5	11	10	5	111	3.265	7		5	13	8		1	60	1.765	14	
X-rays	5	9	4	8	4	87	2.559	13		11	7	6	2	2	61	1.794	13	
Pesticides and insecticides	1	9	7	10	6	110	3.235	8		5	8	8	6	3	84	2.471	5	
Food packaging	19	5	5			44	1.294	20		13	10	3	3		54	1.588	18	
Artificial fertilisers	10	5	11	5		73	2.147	16		7	9	11	2	2	76	2.235	8	
Motor vehicle accidents	2	4	7	4	15	122	3.588	6		11	9	3	1	2	52	1.529	19	
Home appliances	9	7	7	3	2	66	1.941	17		15	9	1	1	1	45	1.324	20	
Sunbathing	5	5	11	8	3	95	2.794	11		12	11	5	2	1	62	1.824	12	
Landfills	5	7	14	5	1	86	2.529	14		6	12	6	3	3	75	2.206	9	

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND																			
PHASE THREE QUESTIONNAIRE ANALYSIS																			
QUESTION NUMBER																			
POPULATION:	General population																		
SAMPLE SIZE:	50																		
Environmental	KNOWN RISKS					TOTAL	MEAN		STD.	UNCERTAINTIES					TOTAL	MEAN		STD.
Factor	1	2	3	4	5			*Rank*	DEV.	1	2	3	4	5			*Rank*	DEV.
Smoking			3	10	37	234	4.68	1	17.95	4	11	14	8	9	145	2.9	5	3.701
Alcohol abuse		4	12	19	15	195	3.9	3	6.351	15	14	4	5	8	115	2.3	13	5.07
Vehicle exhaust emissions	0	6	15	14	14	183	3.66	6	6.573	5	13	9	10	9	143	2.86	8	2.864
Radon gas	12	10	17	7	3	126	2.52	14	5.263	12	9	14	7	4	120	2.4	10	3.962
Noise	17	10	11	5	4	110	2.2	17	5.225	17	14	8	3	4	101	2.02	17	6.14
Land contamination	6	9	10	14	10	160	3.2	11	2.864	4	9	10	12	10	150	3	4	3
Drug abuse	0	2	3	11	34	227	4.54	2	14.05	3	3	13	8	18	170	3.4	1	6.519
Factory emissions	3	5	17	15	10	174	3.48	8	6.083	4	7	15	10	11	158	3.16	2	4.159
Overhead electricity cables	18	19	9		2	93	1.86	20	8.042	14	12	6	8	6	118	2.36	12	3.633
Computer screens	16	13	11	5		95	1.9	19	4.646	12	15	8	6	2	100	2	18	5.079
Asbestos in buildings	4	6	9	10	21	188	3.76	5	6.595	11	12	8	4	8	115	2.3	13	3.13
River pollution	2	13	13	12	10	165	3.3	9	4.637	6	9	10	9	13	155	3.1	3	2.51
X-rays	8	12	9	9	11	150	3	13	1.643	12	15	11	3	4	107	2.14	15	5.244
Pesticides and insecticides	2	14	14	12	14	190	3.8	4	5.215	4	12	12	9	9	145	2.9	5	3.271
Food packaging	18	15	10	4	1	99	1.98	18	7.162	18	9	7	5	5	102	2.04	16	5.404
Artificial fertilisers	12	15	8	7	6	124	2.48	15	3.782	7	10	11	11	6	134	2.68	9	2.345
Motor vehicle accidents	4	7	14	8	17	177	3.54	7	5.339	17	12	6	7	2	97	1.94	19	5.805
Home appliances	17	11	10	4	6	115	2.3	16	5.03	19	8	8	6	2	93	1.86	20	6.309
Sunbathing	2	9	12	11	13	165	3.3	9	4.393	6	14	8	9	5	119	2.38	11	3.507
Landfills	6	12	12	9	10	152	3.04	12	2.49	6	4	17	10	8	145	2.9	5	5

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND

PHASE THREE QUESTIONNAIRE ANALYSIS

QUESTION NUMBER: 2

POPULATION: Experts - valuers

SAMPLE SIZE: 43

CONTAMINATED LAND FACTORS

Environmental	**KNOWN RISKS**					TOTAL	MEAN		STD.	**UNCERTAINTIES**					TOTAL	MEAN		STD.
Factor	**1**	**2**	**3**	**4**	**5**			*Rank*	DEV.	**1**	**2**	**3**	**4**	**5**			*Rank*	DEV.
Breathing difficulties	9	9	12	6	1	92	2.139535	16	4.1593	7	12	15	3	4	108	2.5116	11	5.1672
Cancer	8	10	10	6	5	107	2.488372	13	2.2804	7	11	8	10	5	118	2.7442	2	2.3875
Skin allergies	7	6	16	10	3	122	2.837209	7	4.9295	5	16	10	9	3	118	2.7442	2	5.0299
Contam. dinking water	3	5	8	14	12	153	3.55814	1	4.6152	6	12	10	7	5	113	2.6279	6	2.9155
Damage to invertebrates	11	7	8	12	3	112	2.604651	11	3.5637	7	12	10	6	5	110	2.5581	10	2.9155
Corrosion of services	5	10	12	12	2	119	2.767442	9	4.4944	13	10	11	5	2	96	2.2326	12	4.5497
Birth defects	12	8	8	8	3	99	2.302326	15	3.1937	7	8	12	8	7	126	2.9302	1	2.0736
Obnoxious smells	4	8	12	13	5	133	3.093023	5	4.0373	9	12	10	3	2	85	1.9767	15	4.4385
Acid burns	11	9	9	9	3	107	2.488372	13	3.0332	12	13	9	5		85	1.9767	15	3.594
Poisons	3	6	12	12	9	144	3.348837	3	3.9115	8	7	13	9	3	112	2.6047	7	3.6056
Disruption of food chain	6	10	12	7	5	115	2.674419	10	2.9155	6	7	14	8	4	114	2.6512	4	3.7683
Ingestion by small children	7	9	11	10	6	128	2.976744	6	2.0736	10	3	15	9	3	112	2.6047	7	5.099
Deterioration of foundations	2	13	12	9	4	120	2.790698	8	4.8477	13	12	7	7	1	91	2.1163	13	4.7958
Damage to plant life	2	5	9	11	14	153	3.55814	1	4.7645	5	12	11	8	4	114	2.6512	4	3.5355
Risk of explosion	7	13	14	3	5	112	2.604651	11	4.8785	12	13	9	2	3	88	2.0465	14	5.0695
Harm to wildlife	4	7	12	10	9	139	3.232558	4	3.0496	8	9	9	12	2	111	2.5814	9	3.6742

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND

PHASE THREE QUESTIONNAIRE ANALYSIS

QUESTION NUMBER: 2

POPULATION: Experts - none valuers

SAMPLE SIZE: 34

CONTAMINATED LAND FACTORS

Environmental	**KNOWN RISKS**					TOTAL	MEAN		STD.	**UNCERTAINTIES**					TOTAL	MEAN		STD.
Factor	**1**	**2**	**3**	**4**	**5**			*Rank*	DEV.	**1**	**2**	**3**	**4**	**5**			*Rank*	DEV.
Breathing difficulties	7	9	11	3	1	75	2.206	12	0.39	6	10	13	2		73	2.147	7	0.233441408
Cancer	4	13	11	2	2	81	2.382	9		6	8	11	5	2	85	2.5	1	
Skin allergies	3	11	9	5	2	82	2.412	8		4	7	13	4	2	83	2.441	2	
Contam. dinking water	5	3	7	9	6	98	2.882	2		4	18	4	3	1	69	2.029	11	
Damage to invertebrates	6	9	12	1	2	74	2.176	13		6	12	6	5	1	73	2.147	7	
Corrosion of services	3	6	11	11		92	2.706	6		10	10	8	1	1	63	1.853	14	
Birth defects	12	10	6		1	55	1.618	16		10	6	4	8	1	71	2.088	10	
Obnoxious smells	3	5	10	6	7	102	3	1		13	7	3	3	1	53	1.559	16	
Acid burns	3	16	6	4	1	74	2.176	13		9	12	4	3	2	67	1.971	12	
Poisons	1	12	7	7	4	94	2.765	4		10	2	11	4	3	78	2.294	3	
Disruption of food chain	7	10	8	1	1	60	1.765	15		10	5	9	5	2	77	2.265	4	
Ingestion by small children	5	11	12	1	2	77	2.265	11		7	10	10	2	2	75	2.206	6	
Deterioration of foundations	3	7	10	8	3	94	2.765	4		11	10	6	3	1	66	1.941	13	
Damage to plant life		6	10	9	4	98	2.882	2		7	9	5	7	1	73	2.147	7	
Risk of explosion	9	9	2	5	5	78	2.294	10		13	10	5	2	1	61	1.794	15	
Harm to wildlife		11	9	7	3	92	2.706	6		7	10	8	5	1	76	2.235	5	

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND									
PHASE THREE QUESTIONNAIRE ANALYSIS									
QUESTION NUMBER	3								
POPULATION:	Experts - valuers								
SAMPLE SIZE:	43								
INDUSTRY PERCEPTIONS									
INDUSTRY TYPE						TOTALS	MEANS		STD.
	1	**2**	**3**	**4**	**5**			*Rank*	DEV.
Asbestos manu. and use			5	7	30	193	4.488372	1	11.343
Chemicals manu. and store		3	3	11	23	174	4.046512	3	8.1854
Dockyards and wharves	9	17	12	4		95	2.209302	25	4.717
Dyestuffs manufacturing		9	11	15	8	151	3.511628	8	2.681
Electricity generating	4	12	11	11	5	130	3.023256	16	3.3823
Explosives industry	4	5	14	12	7	139	3.232558	13	3.9294
Gas works	2	4	9	16	11	156	3.627907	7	5.004
Glass manufacture	7	15	12	7	1	106	2.465116	21	4.8
Heavy engineering		12	16	9	5	133	3.093023	15	4.0311
Iron and steelworks		7	18	8	9	145	3.372093	11	4.3875
Metal smelting and refining		4	14	15	6	140	3.255814	12	4.8153
Metal treatment and finishing	2	2	15	17	6	149	3.465116	9	6.4062
Mining and extractive inds.	4	7	19	8	4	127	2.953488	17	5.5353
Oil refining and storage		1	6	19	13	161	3.744186	5	6.8328
Paint manufacture		1	11	16	12	159	3.697674	6	5.5227
Paper and printing works	5	8	15	10	2	116	2.697674	18	4.4272
Pharmacuetical industries	5	13	11	6	5	113	2.627907	19	3.3466
Radioactive mats. process	1	3	1	8	27	177	4.116279	2	9.8387
Railway land	9	7	17	6	1	103	2.395349	23	5.2154
Scrapyards		7	14	13	6	138	3.209302	14	3.5355
Semi-conductor man. plants	4	13	14	7		100	2.325581	24	4.1533
Sewage treatment works	7	14	10	5	4	105	2.44186	22	3.6332
Tanning and leather works	4	3	10	9	14	146	3.395349	10	4.0497
Textiles manufacture	7	14	12	4	1	92	2.139535	26	4.8415
Timber treatment works	6	11	11	10	2	111	2.581395	20	3.5214
Waste disposal sites		3	7	15	15	162	3.767442	4	5.1962

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND									
PHASE THREE QUESTIONNAIRE ANALYSIS									
QUESTION NUMBER	3								
POPULATION:	Experts - none valuers								
SAMPLE SIZE:	34								
INDUSTRY PERCEPTIONS									
INDUSTRY TYPE						TOTAL	MEAN		STD.
	1	**2**	**3**	**4**	**5**			*Rank*	DEV.
Asbestos manu. and use		1	4	8	22	156	4.5882	1	0.2366
Chemicals manu. and store		1	2	10	21	153	4.5	2	0.2358
Dockyards and wharves	10	10	11	2		71	2.0882	25	0.1068
Dyestuffs manufacturing	1	2	7	11	13	135	3.9706	4	0.1397
Electricity generating	6	8	10	8	2	94	2.7647	19	0.0798
Explosives industry	5	5	5	10	9	115	3.3824	12	0.0655
Gas works	2		4	13	15	141	4.1471	3	0.1644
Glass manufacture	2	10	15	6	1	96	2.8235	18	0.1527
Heavy engineering	2	10	15	5	2	97	2.8529	17	0.1481
Iron and steelworks		8	18	5	3	105	3.0882	13	0.1696
Metal smelting and refining	1	2	16	9	6	119	3.5	9	0.1594
Metal treatment and finishing	2	2	15	10	5	116	3.4118	11	0.1481
Mining and extractive inds.	2	10	13	5	4	101	2.9706	15	0.1197
Oil refining and storage	1	3	7	12	11	131	3.8529	6	0.1267
Paint manufacture	2	5	13	8	7	118	3.4706	10	0.1069
Paper and printing works	6	7	14	5	2	92	2.7059	20	0.1168
Pharmacuetical industries	7	8	7	7	6	102	3	14	0.0186
Radioactive mats. process	2	5	7	4	16	129	3.7941	7	0.1434
Railway land	10	7	11	5	1	82	2.4118	23	0.1059
Scrapyards	5	7	13	3	6	100	2.9412	16	0.0991
Semi-conductor man. plants	10	15	7	2		69	2.0294	26	0.1387
Sewage treatment works	6	15	7	2	4	85	2.5	22	0.1307
Tanning and leather works	3	1	12	9	9	122	3.5882	8	0.1211
Textiles manufacture	9	8	14	1	1	76	2.2353	24	0.1472
Timber treatment works	6	10	10	6	2	90	2.6471	21	0.088
Waste disposal sites	1	2	6	13	12	135	3.9706	4	0.1458

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND

PHASE THREE QUESTIONNAIRE ANALYSIS

QUESTION NUMBER	3				
POPULATION:	CONSOLIDATED SAMPLE				
SAMPLE SIZE:	77				
INDUSTRY PERCEPTIONS					
INDUSTRY TYPE	COMBINED		VALUERS	NON-VALUERS	COMBINED
	TOTAL	MEAN	SAMPLE	SAMPLE	*Rank*
Asbestos manu. and use	349	4.53247	1	1	1
Chemicals manu. and store	327	4.24675	3	2	2
Radioactive mats. process	306	3.97403	2	7	3
Gas works	297	3.85714	7	3	4
Waste disposal sites	297	3.85714	4	4	4
Oil refining and storage	292	3.79221	5	6	6
Dyestuffs manufacturing	286	3.71429	8	4	7
Paint manufacture	277	3.5974	6	10	8
Tanning and leather works	268	3.48052	10	8	9
Metal treatment and finishing	265	3.44156	9	11	10
Metal smelting and refining	259	3.36364	12	9	11
Explosives industry	254	3.2987	13	12	12
Iron and steelworks	250	3.24675	11	13	13
Scrapyards	238	3.09091	14	16	14
Heavy engineering	230	2.98701	15	17	15
Mining and extractive inds.	228	2.96104	17	15	16
Electricity generating	224	2.90909	16	19	17
Pharmacuetical industries	215	2.79221	19	14	18
Paper and printing works	208	2.7013	18	20	19
Glass manufacture	202	2.62338	21	18	20
Timber treatment works	201	2.61039	20	21	21
Sewage treatment works	190	2.46753	22	22	22
Railway land	185	2.4026	23	23	23
Semi-conductor man. plants	169	2.19481	24	26	24
Textiles manufacture	168	2.18182	26	24	25
Dockyards and wharves	166	2.15584	25	25	26

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND				
PHASE THREE QUESTIONNAIRE ANALYSIS				
QUESTION NUMBER	4			
POPULATION:	Experts - none valuers			
SAMPLE SIZE:	34			
		YES	NO	
In favour of Environment				
Agency with wide ranging		30	4	
powers		88.24%	11.76%	
POPULATION:	Experts - valuers			
SAMPLE SIZE:	43			
		YES	NO	
In favour of Environment				
Agency with wide ranging		41	2	
powers		95.35%	4.65%	
PHASE THREE QUESTIONNAIRE ANALYSIS				
QUESTION NUMBER	5			
POPULATION:	Experts - none valuers			
SAMPLE SIZE:	34			
		YES	NO	Don't know
In favour of "BROWNFIELD"				
sites being developed		32	0	2
in preference to greenfield		94.12%	0.00%	5.88%
POPULATION:	Experts - valuers			
SAMPLE SIZE:	43			
		YES	NO	
In favour of "BROWNFIELD"				
sites being developed		43	0	
in preference to greenfield		100.00%	0.00%	

PERCEPTIONS OF RISK IN THE VALUATION OF CONTAMINATED LAND												
PHASE THREE QUESTIONNAIRE ANALYSIS												
QUESTION NUMBER	6											
POPULATION:	Experts - valuers											
SAMPLE SIZE:	43											
								WT.				
a) Timescale - duration of effect on value							TOTALS	TOTALS	MEANS			
	None	1-2 years	2-5 years	5-10 years	10-15 year	>15 years						
Very low hazard	21	13	5	2	1	1	43	79.50	1.85			
	48.84%	30.23%	11.63%	4.65%	2.33%	2.33%	100.00%					
Low hazard	13	9	10	7	2	2	43	156.00	3.63			
	30.23%	20.93%	23.26%	16.28%	4.65%	4.65%	100.00%					
Medium hazard	3	11	11	6	5	7	43	292.50	6.80			
	6.98%	25.58%	25.58%	13.95%	11.63%	16.28%	100.00%					
High hazard	2	4	4	12	5	16	43	550.00	12.79			
	4.65%	9.30%	9.30%	27.91%	11.63%	37.21%	100.00%					
Very high hazard	1	3	3	8	8	20	43	625.00	14.53			
	2.33%	6.98%	6.98%	18.60%	18.60%	46.51%	100.00%					
											WT.	
b) Impact on value - percentage reduction in value immediately after remediation										TOTALS	TOTALS	MEANS
	None	<10%	11-25%	26-40%	41-60%	61-80%	81-100%	>100%				
Very low hazard	21	18	2	2	0	0	0	0		43	192.00	4.47%
	48.84%	41.86%	4.65%	4.65%	0.00%	0.00%	0.00%	0.00%		100.00%		
Low hazard	12	18	10	1	2	0	0	0		43	303.00	7.05%
	27.91%	41.86%	23.26%	2.33%	4.65%	0.00%	0.00%	0.00%		100.00%		
Medium hazard	2	14	16	4	4	2	1	0		43	820.00	19.07%
	4.65%	32.56%	37.21%	9.30%	9.30%	4.65%	2.33%	0.00%		100.00%		
High hazard	0	6	10	16	7	0	3	1		43	1,108.00	25.77%
	0.00%	13.95%	23.26%	37.21%	16.28%	0.00%	6.98%	2.33%		100.00%		
Very high hazard	0	4	10	10	8	5	3	3		43	1,700.00	39.53%
	0.00%	9.30%	23.26%	23.26%	18.60%	11.63%	6.98%	6.98%		100.00%		

Urban Regeneration - Property Investment and development
E & FN Spon 1993

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Piccadilly Village, Manchester: a case study in waterside urban renewal

P. Syms

Any urban renewal project will, almost certainly, bring with it a multiplicity of problems. It should always go without saying that, when contemplating the redevelopment of a site which has previously been used for some other purpose, great care should be taken so as to overcome any problems which may remain hidden from sight. Fleming (1991) observed that in an industrialized community such as Europe, much of the land used for redevelopment has a history of previous uses and went on to point out that the state of such land is often so poor as to be unsuitable for continued use or re-use without major land engineering works. The cost of such works will, in many instances, have a significant effect on the viability of a redevelopment project. Such costs may well be far in excess of the reclaimed value of the land in question and, in such circumstances, the balance of a potentially successful urban regeneration project may well be tipped from profit into substantial loss.

It follows, therefore, that it is of benefit to gain as much knowledge as possible about a redevelopment site before any commitment is made to the project. McEntee (1991) describes four basic stages to be followed in undertaking an investigation of a derelict or potentially contaminated site: a desk study; identification of materials underlying the site; measurement of the geotechnical and chemical properties of these materials; and recommendations for development of the site.

In the pre-acquisition stage of a property development it is often not possible to undertake a full site investigation and the prospective developer has to base the investment decision on limited information. This should include, at the very least, a desk study of both the available geological data and records (e.g. town planning, building regulations, waste regulations, health and safety) relating to past uses of the land. Even a study of old Ordnance Survey maps will indicate where site levels have been changed, indicating the possible presence of fill materials. All too often, however, these fundamental first steps are completely overlooked, or are given only cursory attention.

Where sites have been occupied by structures which are no longer required, whether they be old factories, houses, gasworks or chemical works, these are usually demolished down only to ground level. Often the rubble left behind from the demolition process is either spread over the surface of the site or left around the perimeter, in a continuous mound, to deter vehicular access. Alternatively, it may be used to fill voids, such as basements and old mineral workings, with any surplus material simply being mounded on the site. Whatever method is used in disposing of demolition rubble the end result, with the introduction of topsoil, grass seed and a few shrubs, may be the creation of a green and pleasant visual environment. Even if the former industrial site is left to vegetate naturally in the post-demolition period, the end result may not be unattractive. In reality, however, many of the problems associated with the former use may be hidden from sight beneath the green sward and will present major problems for the future redevelopment of the area.

Add to the problem of adverse ground conditions the inadequacy of an outdated infrastructure and a multiplicity of ownerships, then an understanding may be gained of the wide range of problems likely to face the prospective developers of inner city sites. Other issues, such as the unneighbourliness of remaining industrial users and the demographics of the area, will also have to be addressed in considering redevelopment proposals. Land adjacent to commercial waterways, docks, canals and rivers in industrialized locations, introduce a further set of problems which must be taken into account. Such problems have been considered in some detail by Hoyle *et al.* (1988).

Considerable as they may seem, the physical problems attaching to an urban renewal site may become relatively unimportant when compared with the problem of perception and this is especially true of urban watersides, which are frequently regarded as 'no-go' areas and often with good reason. Typically urban waterside sites are in the most run-down, and very often crime-ridden, parts of inner cities, the areas from which industry has departed and in which no-one wishes to live. High technology firms and service industry companies are reluctant to relocate into such areas and therefore they become abandoned. Law (1988) refers to a process of cumulative

decline with a lack of investment producing further obsolescence, which has in turn discouraged investment. An important part of a waterside urban renewal project must therefore be the changing of perceptions to encourage new investment.

The location of what is now Piccadilly Village, close to the centre of Manchester, contained all of these problems and more besides. It was also bisected by a run-down canal and suffered from major changes in level across the site as well as containing a number of old cobbled streets. Although close to Manchester centre, the site was in a highly depressed area of the city, regarded in a poor light by property professionals and potential occupiers alike. This chapter examines the development of Piccadilly Village from its inception through to completion of the development process.

20.1 INNER CITY ENVIRONMENT

Lying immediately north of Piccadilly Station, Manchester's mainline railway terminus, there used to exist an area of industrial dereliction. The area in general is bisected by the Manchester and Ashton Canal, including its junction with the Rochdale Canal. In years gone by, this was an important traffic hub, both in connection with the canal system and later with the introduction of the railway. As a transport interface, development of the area predated by about 100 years the better known and larger Manchester Docks, the redevelopment of which to form Salford Quays has been described by Law (1988). In the post-war era the area fell into a typical state of industrial decline; the canal had lost its commercial traffic by 1957 and fell derelict in 1961, when the last pleasure boat made a passage with the greatest difficulty (McKnight, 1975). The former cotton mills became disused or passed into alternative uses, many of which were unneighbourly; most of the other manufacturing concerns either went out of existence or managed to subsist at the economic margin. Such residential accommodation that had existed in the area, mostly in the form of back-to-back housing, has been demolished as a result of slum clearance programmes.

Situated within the defined inner area of Manchester (Manchester and Salford Inner City Partnership, 1979), the locality suffered from physical, economic and social dereliction. According to the Manchester and Salford Inner Area Study (published in September 1978) the area encompassed by the partnership had the largest concentration of employment in the Greater Manchester Conurbation, and yet contained the largest concentration of poor and disadvantaged people. A lack of investment had also resulted in the inner area containing the bulk of the vacant industrial buildings and derelict land in the two cities.

Poorest housing stock conditions were perceived as being in the private sector but some physical problems, for example, associated with walk-up and deck access flats, were to be found among council dwellings, often housing the poorest and most disadvantaged people. Of all the problems found in the inner city the public considered vandalism to be the most serious.

Such was the situation which existed before 1985 and the formation of the Manchester Phoenix Initiative. The Phoenix Initiative was promoted by the 'Group of Eight', industry, manufacturing, professional and trade union organizations representing the building industry. Originally it was intended that the area north of Piccadilly Station would be excluded from the Phoenix Initiative area. Not only was it a 'forgotten area' in terms of economic activity, it was also overlooked as far as urban renewal proposals were concerned. On further reflection, however, the area was included within the Phoenix Initiative as it was seen to present an opportunity for early redevelopment, owing to the fact that many of the older buildings had already been demolished and those which remained were grossly underutilized. The Phoenix Initiative, together with two of the major landowners in the area, sponsored a land use study, encompassing an area of about 13 ha. From this initial study the Piccadilly Village concept emerged as one of a mix of uses providing an environment in which people would wish to 'live, work and play'.

The general environment of the area was not conducive to any form of new development and it was recognized that any project would have to produce an end product which was in itself a total contrast to the run-down aura of the inner city location. A genuine exercise in urban renewal was called for, not simply some new buildings on a former industrial site. The development would also have to be capable of existing in isolation from the surrounding area, although it was the hope of the study team that the example provided by the Piccadilly Village concept would encourage other landowners to redevelop, or at least upgrade, their properties. The objective of trying to create an environment which transformed the site from a scene of total dereliction into something modern and refreshing was later condemned by some as the creation of a 'yuppie village'. Such an intention was far from the minds of the promoters and, as will be shown later, has proved not to be the case in reality.

The concept produced by the study team called for a high density urban development, preferably one which would be vibrant, with a mix of uses ensuring activity throughout the day and evening. Although intended as a high density development it was considered most important to retain the human scale, therefore the height of the development was to be limited to four storeys. Public access and security for the occupiers of properties were to be given prominence, especially bearing in mind the poor public and professional perceptions of this run-down part of the inner city.

20.2 SITE ASSEMBLY

The initial land use study identified a site of approximately 1.62 ha, bis by the Ashton Canal which, due to the lack of existing buildings, cou developed at an early date. The canal itself was in use as part of the Ch Ring of the leisure waterways, although it was in need of dredging canal structure, in the form of its walls and adjacent footpaths, was unsound condition and totally unsuitable for the new development two parts of this first site had, during the commercial lifetime of the c contained a total of three canal basins but these had been filled in at point during the past.

The southern part of the site had previously been occupied by a building and timber yard as well as stabling used by British Rail. Wit exception of a small beerhouse, which was by then occupied by sorter, all of the existing buildings had been demolished. Some prol had been encountered with the unauthorized use of the site by itin travellers and extensive fly-tipping had also taken place. On the north of the canal the former wharves had long since fallen into disuse; again all buildings had been demolished. During the 1960s and 1970s (F 20.1) the site had been in use as a car breaker's yard but more recently been used by British Waterways for the tipping of canal dredgings. S environmental improvement work had taken place under the auspic the Manpower Services Commission along the north bank, creating a path with landscaping and seating. Unfortunately this had not been well maintained and was becoming overgrown.

At the time of the land use study the initial site (Figure 20.2) wa approximately 18 or 19 different ownerships, which included bodies as British Waterways, Manchester City Council and British Rail. Fortuna the first two of these bodies agreed to include their land in a comprehe redevelopment scheme and the City Council also made a compul purchase order in respect of a number of the ownerships along the C Ancoats Street frontage for the purpose of widening the street so th could form part of the city's inner relief road. British Rail, on the other h decided that it could not wait for a comprehensive regeneration schen be put together and made the decision to sell, by auction, its totally de portion of the site. At the auction this small piece of land, crucial to comprehensive scheme, was bought by National Car Parks, which alr owned land in the area, used as surface car parking. Eventually the car company agreed to sell the site for the purpose of redevelopment, but price approximately twice that received by British Rail, the additional being eventually met by the Department of the Environment.

During this early stage of the project no developer was committe carrying out the urban regeneration of the area, but one of the landowr Moran Holdings plc of London, had indicated a willingness to proceed

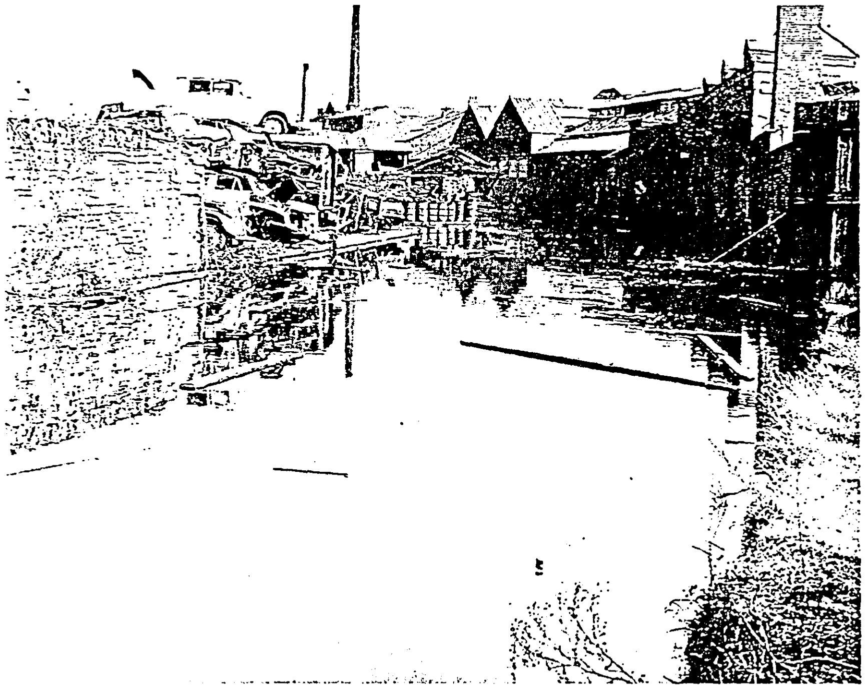

Figure 20.1 Photograph of site taken in the 1960s showing previous usage

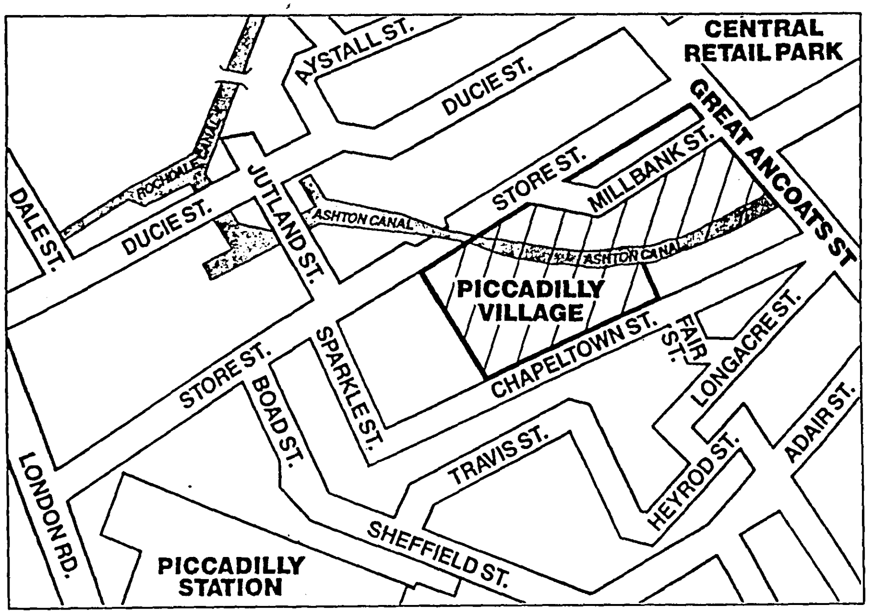

Figure 20.2 Street map showing location of Piccadilly Village in Manchester city centre. Initial phases are shown as hatched

a project subject to it being financially viable. British Waterways h
held discussions with a north-west based developer, Trafford Park
plc, regarding the possible development of the land owned by the
way. It was therefore decided that these two companies would form
development company, Piccadilly Village Limited, to carry out the
renewal project.

Following the formation of the development partnership, negot
started to acquire the other land ownerships, all of which were eve
obtained by agreement. The total cost of the site was just in exc
£187 800/ha. This relatively low price for land close to the city cent
attributable to the fact that major changes in level existed between the
and the adjoining streets, the configuration of the plots themselves
redevelopment extremely difficult and ground problems were antici

The site acquisition stage extended over a period in excess of on
and indeed work started on some areas of the site before legal form
had been completed. In addition to site assembly, the first phase
project involved two street closures, as well as the diversion of ex
services and the installation of new services for the development its

20.3 PROFESSIONAL TEAM

Other than the development consultants no other professionals were
ployed by the joint development company in the early stages of the p
and it was therefore necessary to assemble a full team, capable of u
taking a project of this size and nature. A development brief was prep
setting out the requirements for a mixed commercial and residentia
velopment which would encourage visitors to this part of the city, wh
the same time preserving the privacy and security of the residents.
architectural practices were invited to submit their proposals and, follo
interview, Halliday Meecham Architects of Alderley Edge, Cheshire
selected.

This firm had already designed several very successful urban wate
residential projects, in Bristol and Swansea, and this was an important f
in the decision-making process. The development which eventually eme
closely followed the architects' original competition entry (Figure 2
subject to some elevational changes requested by the city's planning
partment. A number of modifications were, however, made to the mi
uses, both in the early design stages and as the project proceeded.

In addition to the architects, it was necessary to appoint quantity surve
and consulting engineers. These were appointed from firms with which
joint venture partners had worked on previous occasions. So far as
water related engineering aspects were concerned, it was decided to app
British Waterways' own civil engineering department for their expe

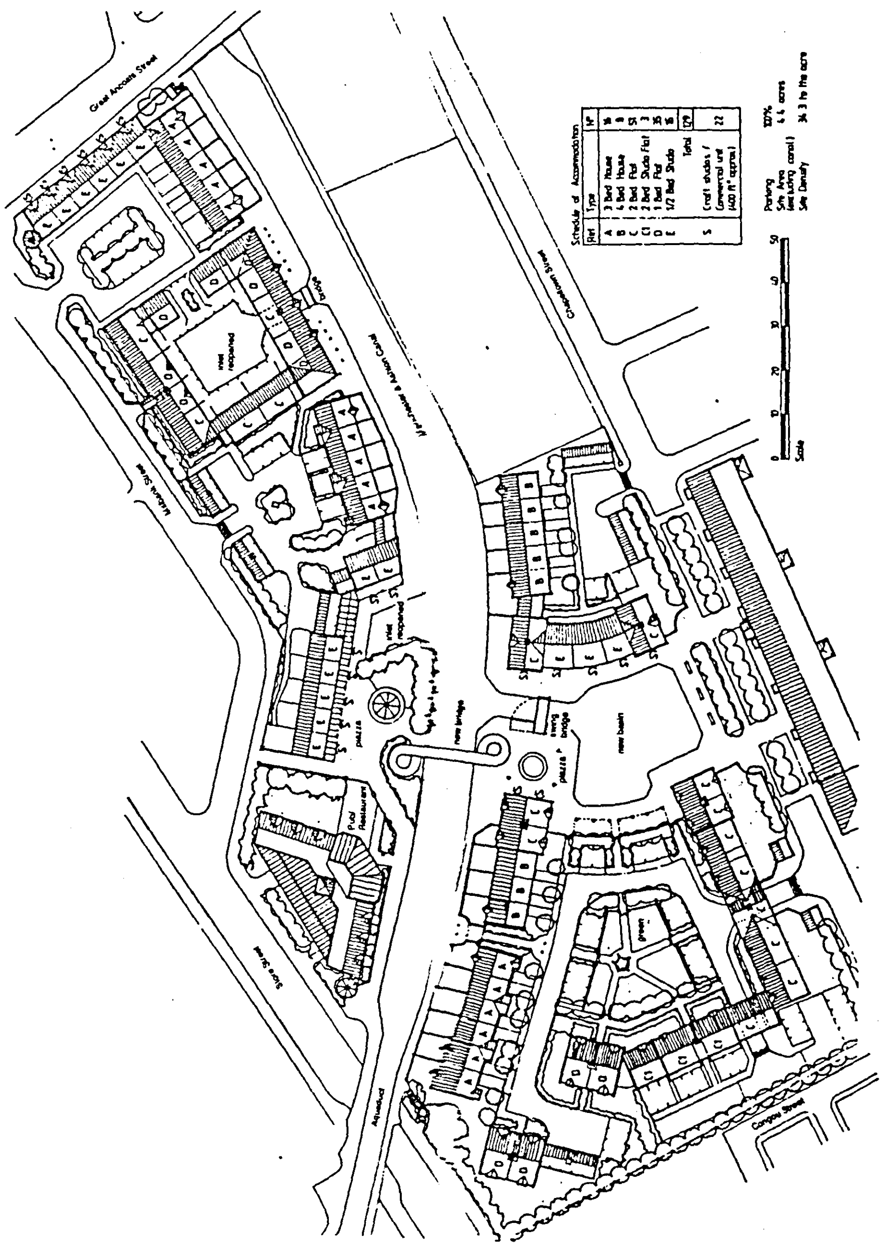

Figure 20.3 Layout of Piccadilly Village from winning entry in architectural competition

in the design of canals and bridges. In return for this, and a share in development profits, British Waterways agreed to accept future responsibi for the repair and maintenance of engineering structures within three met of the water.

20.4 SITE CONTAMINATION AND RECLAMATION

A major consideration in planning the redevelopment of an inner city dustrial site, such as that to be occupied by Piccadilly Village, is the po sibility of ground contamination. This is of particular importance whe residential occupation is the proposed end use, especially when the site h been in a multiplicity of uses. So far as this site was concerned past us were known to have included a timber yard, coal yard, engineering factor car breakers, stables, car sales, dredgings tip and a rag sorter. In additic much of the site had been the subject of fly-tipping and so the diversity potential contaminants was considerable.

Currently (1992) no set standard exists in the United Kingdom for th reclamation of contaminated sites, although some guidance is available. Th Interdepartmental Committee on the Redevelopment of Contaminated Lan (ICRCL) was established in 1976 with representatives from the Departmer of the Environment, Department of Health, the Welsh Office, the Healt and Safety Executive and the Ministry of Agriculture, Fisheries and Food Subsequently, the Scottish Development Agency was also represented or the committee. Since its formation the ICRCL has produced guidelines fo the redevelopment of contaminated sites to a number of different end uses Guideline information is presented in the form of 'trigger concentrations which, together with an appreciation of local background levels, are in tended to be of assistance during the interpretation of data derived from site investigation (Harris, 1987).

The ICRCL guidelines do not cover all circumstances and, although of assistance, are not mandatory: nor should they be regarded as minimum standards to be achieved. Valuation implications are disregarded so far as the ICRCL guidelines are concerned; consequently there are arguments in favour of seeking a clean site solution, in which all contaminants are removed from the land so that it may be redeveloped for any purpose.

Reclamation of the site was carried out in 1988–9, before the introduction of the Environmental Protection Act 1990. Nevertheless the site was reclaimed in a controlled manner, with the contaminated material being removed to a licensed tip. Thus the clean site option was chosen to render the site suitable for any end use. Where contaminated material was contained in voids, such as old canal basins, these were excavated and either refilled with clean material or re-opened to the canal. Following reclamation the ground was left with a high sulphate level, probably no different to that found in the surrounding area, and therefore special precautions were taken in the construction of foundations and ground floor slabs.

The two re-opened canal basins were found to be in surprisingly good condition and, except for some alterations to fit in with the proposed development, required very little in the way of restoration. The canal walls themselves, on the other hand, were a totally different proposition.

On the south side of the canal the wall was in a very poor state of repair, necessitating total removal and rebuilding. Instead of replacing this wall in masonry, as the original, it was decided to use sheet steel piling, capped with concrete and finished above water level with stone copings. The problems on the north side were less severe and thus was possible to retain much of the existing wall, pressure cleaned and grouted where necessary, with a new mass concrete wall poured in behind the existing structure.

The new basin was constructed with sheet piling at the same time as the rebuilding of the south wall of the canal and finished in a similar manner. Traditional puddle clay was used to waterproof the bed of the basin and behind the rebuilt and refurbished canal walls. All of the canal restoration works were undertaken during the winter season, with the canal closed and drained between November and March (1988–9).

The new canal bridges were constructed: one across the canal itself and the other two crossing the mouths of basins. The main canal bridge, with spiral ramps, was based on the design of a traditional Macclesfield Canal roving bridge, to provide disabled access between the two halves of the development. The canal was narrowed at this point to reduce the span of the bridge and to provide a lay-by for the mooring of boats.

20.5 PROJECT FINANCE

When the Piccadilly Village project was conceived in 1987 the property development industry was fairly buoyant and, in particular, urban renewal was receiving a great deal of attention from both government and media. As a result the banks were prepared to bid against each other for the privilege of providing competitive finance rates for what they perceived to be prestige projects. Thus it was possible for the development partnership to obtain a very attractive package of lending.

Private sector funding on its own, however, was not sufficient to ensure the commercial success of the project. Public sector support was necessary to provide the right environment for urban renewal by overcoming the ground and water engineering problems. Initial discussions with the Department of the Environment centred around two possible sources of public sector support, the Urban Development Grant and private sector Derelict Land Grant. During the course of these discussions two important events occurred.

In May 1988 City Grant was introduced to replace the Urban Development Grant and the Urban Regeneration Grant, as well as subsuming (in the 57 invited authority areas to which City Grant was applicable) the private sector Derelict Land Grant scheme. The rationale for introducing City Grant was described by the then Minister in the Department of the Environment as 'firstly, to simplify the existing grant structure (UDG, URG and DLG) which many people found confusing; and secondly to speed up delivery of assistance.' The Minister went on to say that 'City Grant is available . . . for private sector projects which benefit our inner cities. It attracts private investment by supporting projects which would not go ahead without grant and which provide jobs or private housing and help rebuild investors' confidence' (Bruinvels and Rodrigues, 1989).

The second event occurred in July 1988 with the setting up of the Central Manchester Development Corporation and the inclusion of the Piccadilly Village site in the urban development area. The Department of the Environment's appraiser thereafter acted as agent for the fledgling development corporation and, within six weeks of submission of the formal application, a City Grant of £1.13 million was agreed. This equated approximately to the estimated costs of reclaiming the site and the restoration works to the canal. The new development itself did not receive any commercial subsidy.

20.6 NEW HOMES AND COMMERCIAL ACCOMMODATION

Initially the project was to provide 125 residential units, 15 craft studios, six shops and 1486 m^2 of office accommodation. During the course of construction a number of changes were made which increased the number of residential units to 150 and omitted the craft units. These changes were made in response to market conditions; although tenants could be found for the craft units the rents which most were able to afford were uneconomic and none appeared able to purchase units. At the same time there was found to be a demand for bedsitting room units; the only one originally provided by the design had sold very quickly. Hence the craft units were converted, very successfully, into residential use. The ground floor units in Figure 20.5 are therefore bedsitting rooms, with two storey apartments above.

Originally the development company intended to let the construction contract for the development by competitive tender, in the same way that the site reclamation work had been procured. However, following problems with the successful tenderer, the decision was taken by the two partners for Piccadilly Village Limited to act as its own contractor.

Moran Holdings plc, through its subsidiary company Moran Homes Limited,

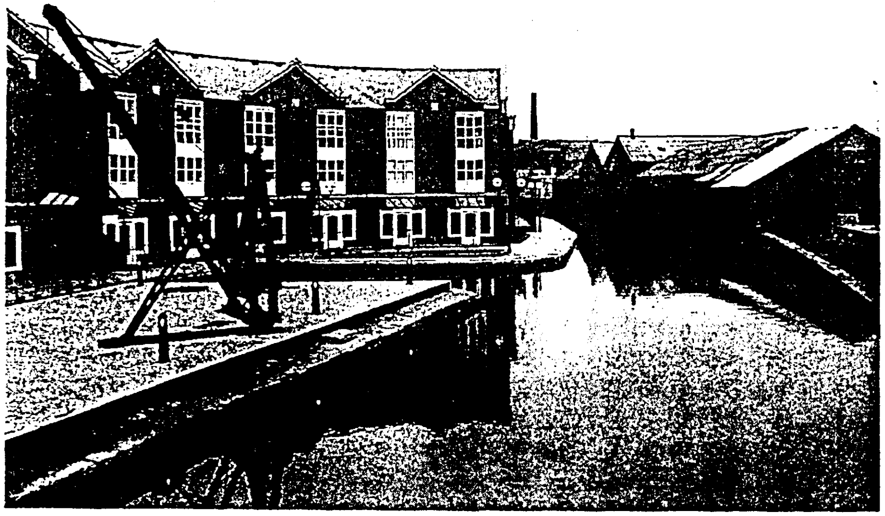

Figure 20.4 Photograph of part of Piccadilly Village (same view as Figure 20.1) showing residential accommodation

was already actively involved in house-building projects in south-east England. Therefore the expertise was available within the partnership for the control and supervision of the construction programme using consultants to assist on the cost control and purchasing aspects. Trafford Park Estates plc provided local management and accounting facilities.

20.7 MARKETING AND FUTURE MANAGEMENT

The acquisition of additional land subsequently increased the potential size of the development to around 200 residential units, with a site for a public house and the possibility of increasing the office content to as much as 9290 m^2, subject to there being sufficient demand. Although intended to provide a mix of differing uses, the new development was to be essentially driven by residential occupation and it was in this respect that the greatest problems of perception lay.

The intention was that new housing would be for sale to owner occupiers, yet the site lay close to a fairly notorious local authority housing estate and, unlike many other cities, Manchester did not have a history of people living in the city centre. At the time that the Central Manchester Development Corporation was designated, a survey revealed that less than 200 people lived in the central area of the city. Virtually no new residential deve ment had taken place in recent years, the last new building scheme ha been St John's Gardens, developed by Wimpey in the 1970s. One fo warehouse building had also been converted into residential use to pro low cost housing accommodation, but neither of these schemes comp in any way with the type of development envisaged for Piccadilly Vill

A view of the market, which had arisen out of the original study, was need for good quality accommodation in a pleasant environment, yet wi a few minutes' walk of the city centre. Potential purchasers were see people working in the centre of the city, often during unsocial hour hospitals, media industry, restaurants and entertainment businesses addition, due to the close proximity of the universities and Manche Polytechnic, another potential market was academic staff and student

One of the most important aspects to be considered in respect o urban renewal project of this nature is the methods used in selling letting the accommodation produced by the project. In one respect comes down to a decision of whether real estate agents should be emplo and, if they are, which firm should be appointed. So far as central Manche is concerned, there are very many well known and competent estate ag located in the city centre. For the most part, however, these firms are involved with the marketing of commercial and industrial properties the sale of development sites. Thus such firms had little feel for ur renewal and their perceptions of the Piccadilly area of the city were extrer poor.

So far as residential estate agents were concerned, these were fev number, mostly located in the run-down areas of east Manchester where bulk of their business was in older terraced housing. These practices were considered to be unsuitable for the marketing of this type of product addition, most of the prospective purchasers envisaged for the developm were also considered unlikely to make enquiries of east Manchester age

Therefore the decision was taken to establish a direct selling opera from the site, initially with a staff of one, later increased to two. A tempo sales office was established, to be followed later as construction procee by a more permanent sales suite and show units. During the first 18 mon from release of the first units onto the market, sales averaged approxima one and a half units per week, running contrary to the local and, especi national house sales trends which were in deep depression for most of period. The general malaise of the housing market did eventually ca up with the development, with a resultant slowdown of sales in the l stages.

An early sale of half the phase one office buildings to a housing associa gave a good boost to the commercial side of the project, followed by sale of a second building to a firm of quantity surveyors. An over-suppl offices in the Manchester market, the 'off pitch' location of the developm and the poor state of the economy resulted in some resistance from prospective purchasers. The development company, having been set up specifically for this one project, also had a firm desire to sell buildings, rather than to enter into leases and retain the investment on a long term basis. To assist sales, therefore, one of the city centre firms of commercial estate agents was subsequently engaged to assist in the marketing.

The future maintenance of the completed development is of greatest concern to all who live and work in an urban renewal project such as Piccadilly Village. A dedicated management company was therefore set up, Piccadilly Village Management Limited, administered on a day to day basis by Trafford Park Estates plc. The full-time manager is responsible for ensuring the cleanliness and security of the village; for example, keypad control vehicle entry gates have now been installed for additional security, and for ensuring that maintenance and repair works are undertaken. All of the properties are occupied on leases for 125 years, at peppercorn rents, and all occupiers contribute to the ongoing costs by way of management charges.

20.8 CONCLUSIONS

In terms of transforming a run-down former industrial area of the inner city, Piccadilly Village has undoubtedly proved to be successful. The same can also be said of the architectural appearance of the project although, with the benefit of hindsight, occupiers, developers and architects alike would probably wish to make a number of changes to the internal layout of the buildings.

Having once been accused of creating a 'yuppie village', the developers can now point to the very broad mix of people who have taken up residence, from students to semi-retired, manual workers to professionals, people working in medicine and entertainment, and from a mix of ethnic backgrounds. Many of the purchasers have been attracted by the presence of the restored waterway; although few residents are boat owners several are fishermen and the quality of the water means that the canal is well stocked with fish.

Even in one of the worst markets for residential property, a good level of sales was achieved. During the 18 month period following the release of the first phase, a selling programme was maintained three to four months ahead of completions, averaging 1.5 units sold each week. Although the residential properties had to be priced at full market value, a requirement of the City Grant, they were fixed at a realistic level to attract purchasers into this previously untested part of the inner city. Prices ranged from £39 950 for a bedsitter and £50 000 for a one-bedroomed apartment up to £140 000 for a four-bedroomed house, all on 125 year leases. At these prices it is not difficult to understand why people are willing to consider moving back to the centre (Hanson, 1989). Sales of the commercial properties were slow than the residential units, much more in line with the prevailing mark conditions of that period, although half of the first phase office building w sold during construction to a housing association as its head office.

Problems have certainly occurred, not least of all concerning securi The existence of a major new development has not, in itself, succeeded entirely reversing the high incidence of crime in the neighbourhood. number of car thefts have taken place from the village, which has result in the fitting of keypad controlled vehicular gates. There have been a numb of attempted burglaries and several fairly minor crimes against the perso Nevertheless the police have reported that there has been an overall redu tion in the incidence of crime and that, compared with other areas of th inner city, a serious crime problem does not exist.

Considered as an entirety the development has so far been a success. Th presence of water has played an important, but perhaps not, an essenti part; good design and proximity to the facilities of the city centre have bee of equal importance. As an exercise in urban renewal the project has tran formed a run-down area of the city and is having a catalytic effect in e couraging adjoining landowners to embark on other development project

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4 The funding of developments on derelict and contaminated sites

Paul M. Syms

INTRODUCTION

An important aspect of industrial development, particularly in periods of decline or renewal, is the derelict industrial site (see Kivell 1993). This chapter highlights the fact that reclaiming and recovering such land for new uses is a particularly thorny problem. As such, it emphasises the broader environmental questions related to the redevelopment of industrial sites: many of which are polluted as the result of present or former manufacturing activities. Questions of finance are often the most important factors in such cases and a key focus of the chapter is the problem of persuading investors to fund the development of these sites.

Within the United Kingdom there is an increasing pressure for derelict or 'brownfield' sites to be redeveloped in preference to rural or greenfield sites. In the context of this chapter we regard 'brownfield' sites as any areas of land which have previously been the subject of a man-made or non-agricultural use of any type. This would include industrial uses such as chemical works, heavy engineering, shipbuilding and textile processing, together with unfit housing clearance sites and docklands, both inland and coastal, as well as mineral extraction sites and those used for landfill purposes.

The pressure to re-use such sites is at its greatest when it is advocated as the alternative to the development of sites situated in the greenbelts around major cities, as the residents of those cities, both individuals and businesses, seek to escape from the urban environment. For a highly populated island nation, with a very limited land resource, the arguments in favour of re-using previously used sites would seem to make good sense. Yet there are many constraints which seriously limit the potential for such redevelopments, of which one of the foremost is the question of funding.

This chapter seeks to examine the constraints affecting the redevelopment of derelict and contaminated sites, with particular reference to the funding issues. The reclamation of sites to 'soft' after uses, such as landscaping and public open space, is not the concern of this chapter. Rather, it is intended to concentrate on the provision of 'hard' after uses, providing homes and employment.

THE DERELICT LAND PROBLEM

There is comparatively little literature on the subject of reclaiming and redeveloping derelict and contaminated sites. For the most part, published works address the technical issues, for example Cairney (1987) and Fleming (1991), and pay little attention to the financial issues involved. Even where such issues are considered (Haines 1987; Ironside 1989), the authors appear to confine themselves to a discussion of the availability of public sector finance to go towards the cost of site reclamation. It is of course very true that without public sector support in one form or another many site reclamation projects would fail to come to fruition. However, in many cases, the private sector input is of equal or greater importance.

Derelict or contaminated sites have previously been used for a wide range of purposes, often over a period of many centuries, during which time the use may well have changed and quite often buildings may have been constructed over the remains of earlier developments. Fleming (1991) has commented that the state of such land is often so poor as to be unsuitable for continued use or re-use without major land engineering works. The Department of the Environment adopts a similar view in its definition of derelict land as 'land which has been so damaged by industrial and other development that it is incapable of beneficial use without treatment' (Department of the Environment 1986).

Taking the country as a whole, dereliction is not widespread, although the problem of derelict land is by no means insignificant. Kivell (1987) noted that, according to a survey by the Department of the Environment carried out in 1982, the total area of dereliction (in England) had increased from 43,300 hectares (1974 survey) to 45,700 hectares, despite major programmes of reclamation which dealt with 17,000 hectares during the same time period. By 1988, however, the equivalent study indicated a reduction to 41,456 hectares (Department of the Environment, 1991a). Table 4.1 sets out the changes in the amount of derelict land in England between 1974 and 1988, under the different categories used in preparing the study.

Looked at another way, taken as a percentage of the total area of England, this is equal to only 0.32 per cent, but it is still 160 times the area of the City of London, where so many property investment decisions are made. It should also be borne in mind that not all derelict land can justify reclamation. For example, in the 1988 study only 32,010 hectares (77 per cent) were considered to justify reclamation. From Table 4.1 it can be seen

Table 4.1 The composition of derelict land in England

Type of dereliction	*Stock (ha)*	*1974 (%)*	*Stock (ha)*	*1982 (%)*	*Stock (ha)*	*1988 (%)*
Spoil heaps	13,118	30.3	13,340	29.2	12,015	29.0
Excavation and pits	8,717	20.1	8,578	18.8	6,186	14.9
Military	3,777	8.7	3,016	6.6	2,624	6.3
Railway	9,107	21.0	8,210	18.0	6,650	16.0
Other	8,554	19.8	12,539	27.4	13,981	33.7
Total	43,273	100.0	45,685	100.0	41,456	100.0

Source: Kivell 1987; Department of the Environment 1991a
Note: Kivell's 1987 figures transposed two digits in the 'other' category. This has been corrected.

that spoil heaps, arising from mineral extraction and other industrial processes, account for the largest area of dereliction. Many of these sites, especially those of a metalliferous nature, are considered to be so badly contaminated, or in such remote locations, as to not justify reclamation.

The survey of derelict land provides only a small part of the overall picture. There are many other sites which are still in use, or may be semi-derelict, which suffer from the same instability or contamination problems as those sites which are officially classed as derelict. Kivell cites as an example Stoke-on-Trent which, in 1984, identified 332 hectares of derelict land, but added 291 hectares of potential dereliction (where existing industrial activity is (sic) expected to cease shortly, leaving behind land which is unsuitable for use without treatment) and a further 538 hectares of neglected land (at present uncared for, untidy and in a condition detrimental to the environment).

Of the 32,010 hectares of derelict land justifying reclamation, and the industrial land still in use, an unknown but believed to be very significant percentage is undoubtedly contaminated. This contamination, lying in or on the ground, takes many forms: heavy metals, PCBs and coal tars to name but a few. The most recent estimates suggest that 50,000–100,000 sites may be considered to be contaminated, affecting perhaps 50,000 hectares. Only a small proportion of these, however, are likely to pose an immediate threat to public health or the environment (Hobson 1991).

The 1988 survey provides details of the post-reclamation use of almost 12,000 hectares of derelict land which was reclaimed between 1982 and 1988 (see Table 4.2). As can readily be seen, local authorities play a major role in the reclamation of derelict land, accounting for the reclamation of 45

Table 4.2 Derelict land reclaimed and brought back into use, 1982–8: the use of land after reclamation (hectares)

Land use	*By local authority with grant*	*By local authority without grant*	*By other agencies*	*Total*
Industry	901	44	622	1,567
Commerce	118	11	460	589
Residential	294	79	675	1,048
Sub total (hard end use)	1,313	134	1,757	3,204
Sport and recreation	793	96	251	1,140
Public open space	3,078	251	475	3,804
Agriculture/forestry	1,282	199	1,212	2,693
Sub total (soft end use)	5,153	546	1,938	7,637
Other	289	103	736	1,128
Total	6,755	783	4,431	11,969

Source: Department of the Environment 1991a

per cent of land reclaimed for hard end uses and 75 per cent of land reclaimed for soft end uses. Nevertheless, the area of land reclaimed and brought back into use by other agencies, which includes private sector developers and investors, is of considerable importance, representing many millions of pounds worth of development projects.

THE REDEVELOPMENT OF DERELICT AND CONTAMINATED SITES

The Environmental Protection Act, 1990

Potentially, one of the most important factors affecting the redevelopment of derelict or contaminated sites is the impact of the Environmental Protection Act, 1990. A well intentioned piece of legislation, reaching far beyond land and development issues, it does, however, have the effect of highlighting the environmental responsibilities attaching to the redevelopment of such sites. Section 143 of the Act provides for the setting up of registers

of sites which are currently, or have previously been, used for a potentially contaminative purpose. The immediate 'knee jerk' reaction to the setting up of these registers in all local authority areas was the fear that all land listed on the register would be deemed to be contaminated, whether or not any such contamination was in fact present, and therefore land values would be blighted. This view was heightened by the fact that the government did not intend to provide for any appeal procedure against register listing. It was also the intention that once on the register sites could not be removed, even if it was subsequently proved that no contamination was present or that the site had been reclaimed to an acceptable standard.

The reasons given for not making provision for an appeal procedure, and the subsequent removal of sites from the register, were twofold. First, that the register was one of 'potentially contaminative uses', a matter of fact, rather than an absolute register of contaminated land. To have undertaken site investigations so as to identify sites of actual contamination would have taken years and an expenditure running into millions of pounds. Even then there would have been no guarantee that all contaminated sites would have been identified in such a process.

The second reason lay in the fact that there is no single agreed definition of what constitutes contamination and also no single standard of reclamation. All contaminated sites need to be investigated and remedial processes designed on a discrete basis, as no two sites are alike. Consideration also needs to be given to the proposed after use of the site as different standards of reclamation may be applied to different uses, such as industrial or residential, although there are strong arguments in favour of reclaiming contaminated sites to a standard which makes them suitable for any future use. The counter argument to this asks whether it is worth reclaiming a site to a higher standard than that which will exist, post-reclamation, in the general locality of the site. For example, there would seem to be little point in reclaiming a site to the highest possible standard while the adjoining factory continues to emit toxic fumes and other contaminative waste products. Standards need to evolve as uses cease to exist, or new techniques are introduced to control the pollution from manufacturing processes, so as to ensure a continual improvement in environmental quality.

Recognizing the problems involved, therefore, the registers were seen as an attempt to identify sites where problems might exist and the Department of the Environment's consultation paper (Department of the Environment 1991b) noted that the registers could not be expected to contain details of all contaminated sites. It was, however, considered that registers would provide a record of a large proportion of land which may be contaminated (Denner 1991).

The consultation paper also recognized the possibility of blighted land values, but Denner made the point that, of the information proposed to be included on the registers, much 'is likely to be required in any case by planners and/or purchasers, whenever a site is sold or a new use proposed' (Denner 1991: 4.1). A great deal of the information is already available through diligent research and all the registers were intended to do was to bring this information together. In view of this, the Department of the Environment considered that any blighting effect was likely to be short-lived and would reduce once the registers were accepted in daily use.

Nevertheless, it must be said that many of the objections to the setting up of the registers contained a great deal of validity. Implementation of the legislation was to have commenced at a time when the property markets in the UK were in the depths of depression. Initially, it was intended that local authorities would commence work on preparing the register for their administrative area on 1 April 1992, with the register to be completed and available for public inspection from 1 April 1993. Central government envisaged that the average cost to each local authority, for the initial register compilation, would be around £35,000 to £40,000, with the annual cost of maintenance thereafter being around £8,000, although the estimated ongoing cost of maintaining the registers has subsequently been revised in an upwards direction.

The methods used for the register compilation were to be based on desk studies of current and historic information, mainly map based. The sources to be used and the methodology for compiling the registers are all discussed in the consultation paper (Department of the Environment 1991b) and additional guidance was to have been made available to local authorities by the Department of the Environment.

One criticism of the method of register compilation made by landowners and developers was that there appeared to be no standard format for compilation, let alone a standardized computer software and hardware package. Each local authority was to be left to set up and run the register in its own way, an approach which, it was felt, would lead to disparity between authority areas. It was, however, the potentially blighting effect of the registers which attracted the greatest criticism. In March 1992, the government took the decision to postpone, for an indefinite period, the introduction of the register. However, in view of the fact that the measure had been supported by all major Parliamentary parties, abandonment of the proposal was not envisaged. The delay was to be for the purpose of allowing further discussions to take place.

Following these discussions, the draft regulations for the implementation of the Section 143 register provisions were published on 31 July 1992 and contained a number of significant changes to the original proposals. Most important of all was the reduction in specified contamination uses (originally a list of sixteen main categories, divided into forty-two sub-categories, covering a wide range of activities, see Department of the Environment 1991b) to a list of eight land uses, as set out in Table 4.3. The government did, however, reserve the right to extend the list in the light of experience and this, in itself, caused widespread concern in the property development industry. It was estimated by the Department of the Environment that, on the basis of the reduced list, the area of land covered by the registers would be reduced to some 10–15 per cent of the area previously envisaged.

Table 4.3 Specified contaminative uses

1	Manufacture of gas, coke or bituminous material from coal.
2	Manufacture or refining of lead or steel or an alloy of lead or steel.
3	Manufacture of asbestos or asbestos products.
4	Manufacture, refining or recovery of petroleum or its derivatives, other than extraction from petroleum-bearing ground.
5	Manufacture, refining or recovery of other chemicals, excluding minerals.
6	Final deposit in or on land of household, commercial or industrial waste (within the meaning of section 75 of the Act) other than waste consisting of ash, slag, clinker, rock, wood, gypsum, railway ballast, peat, bricks, tiles, concrete, glass, other minerals or dredging spoil; or where the waste is used as a fertilizer or in order to condition the land in some other beneficial manner.
7	Treatment at a fixed installation of household, commercial or industrial waste (within the meaning of section 75 of the Act) by chemical or thermal means.
8	Use as a scrap metal store, within the meaning of section 9(2) of the Scrap Metal Dealers Act 1964(a).

Source: The Environmental Protection Act, 1990 (Section 143 Registers), Schedule 1, Regulations 1992 (Draft)

Provision was to have been made for owners and others to be notified of the intention to include properties on the registers and for them to be able to challenge authorities on the facts of a site's history of contaminative use or other particulars, both of these being changes to the original proposals. Local authorities were to be expected to respond promptly to any such challenge and to make available their documentary evidence. The register was to have been split into two parts, to be called Parts A and B. Part A would record land which has been subjected to a potentially contaminative use but has not been either investigated or treated. Part B would record land which has been investigated and/or treated for any contamination found. Caveat emptor would still apply and local authorities could not be held liable if, for example, a treatment was later found to have been unsuccessful.

The original intention that sites would not be removed from the register, even after decontamination or site investigation, was retained in the draft regulations. Two reasons were given for this. First, the history of the previous uses on the site is a matter of fact and, second, contamination from the site may have migrated to adjacent sites. Subsequently, the timescale given under the draft regulation to local authorities for the compilation of the Section 143 registers was increased from twelve to fifteen months.

Reaction to the Section 143 registers

In spite of the postponement, in March 1992, in the implementation of the Section 143 registers, there were a number of immediate impacts affecting the funding of development on brownfield sites. These impacts were attributable in whole or in part to the Environmental Protection Act proposals and the revised proposals contained in the draft regulations did nothing to diffuse the situation. On the contrary, the author understands that the number of objections to the revised proposals received by the Department of the Environment was even greater than those received in response to the original consultative document.

The nature of these objections was no doubt widespread, but the main thrust is believed to have centred around two issues. First, reduction in the list of specified uses, from more than forty to only eight, focused attention on those few categories. This, by implication, would appear to have indicated that all sites used for those specified purposes would be undoubtedly contaminated. Thus sites used for those purposes may be regarded as having only minimal or even negative value. Second, reserving the right for the Secretary of State to add in other uses in the future left behind an air of uncertainty. At the very least those uses specified in the original consultative document could be seen as targets and therefore very difficult to value without taking some account of the fact that they may be added to the specified categories under Section 143.

In the face of increasing opposition to the proposed registers, the Secretary of State for the Environment announced, on 24 March 1993, that the registers were to be abandoned, stating that:

> There has been substantial criticism of the proposals. The proposed registers would have reduced confidence in the value of sites placed on the register, thereby exacerbating blight without giving any clear indication on how such sites could be brought back into good condition and confidence restored.
>
> (*Estates Gazette* 1993)

At the same time the Secretary of State announced plans for a wide-ranging review into land contamination, to be chaired by the Department of the Environment but seeking views and recommendations from many sources.

One alternative to the Section 143 registers, proposed by this author, is the setting up of a comprehensive register of land use so as to provide full information on land usage throughout the UK. Such a register could not be produced within the timescale of fifteen months envisaged by the Department of the Environment, but could be prepared 'in several phases and a comprehensive register compiled by the year 2000' (Syms 1993: 6).

In spite of the abandonment of the Section 143 registers the government's proposals are likely to have a long-lasting effect on the property industry. Prospective developers are making play upon the fact that even if contaminated sites are adequately reclaimed a stigma may be attached to the site by virtue of its previous use. This is being done so as to drive down land prices even further in what, at the time of writing, is already a depressed market. The author is aware of at least one case where a prospective purchaser has demanded a discount of 40 per cent from open market value for a decontaminated site because the site will be blighted by the fact that it was formerly contaminated.

Solicitors, conscious of their professional responsibilities, are also advising clients to think very carefully before entering into contracts to purchase sites which may be contaminated. Many legal firms are also increasing the scope of their environmentally based pre-contract enquiries and are organizing training seminars so as to ensure that their property lawyers are adequately briefed on environmental matters.

A number of banks, led by National Westminster, have issued environmental guidelines to their managers to warn them of the risks involved in lending to companies which pollute the environment. The banks are being forced to carry out 'environmental audits' of companies before they decide to lend. An internal report of National Westminster Bank is reported as stating that, 'where the risk is too great, prudent financiers will stay away, and neither the national economy nor the environment will benefit' (Bennett 1992).

Within the property development industry, at least one major developer, Mountleigh, is reported to have been severely affected by the implications of the Section 143 register. The company had,

> agreed the sale of the Merry Hill Centre (a large shopping development in the West Midlands) to Hammerson, the UK property company, and the O'Connor Group, a US pension fund adviser. The deal would have brought in £125m, which although less than the property's £160m book value, would have allowed the company to meet its coming obligations. But the deal fell through . . . in part it was because of the likelihood that the shopping centre was built on contaminated land, a risk that had been heightened by the possibility that the government would bring in a register of contaminated land.
>
> (Houlder 1992: 23)

The reference to 'a register of contaminated land' in this report typifies the way in which the proposed register had been reported in the press, thus heightening the concern felt by both the property industry and the public at large.

Although Section 143 of the Environmental Protection Act 1990 is of considerable importance to the property development industry, it is probably less important, in terms of valuation implications, than Sections 61 and 79 of the Act. Under Section 61 the waste regulation authorities are given the power to enter land and carry out tests if they have reason to believe that the site in question, or an adjoining property, contains contaminated material which may be harmful to humans, animals or the environment. Similar powers already exist under the Control of Pollution Act 1974 but the Environmental Protection Act gives the waste regulation authority the power to require the owner to clean up the site or, in default, for the authority to carry out the work and to recover the reasonable cost of the work from the owner.

This action is enforceable against the current owner of the property, even if the contamination has come about as a result of actions which occurred under a previous owner, or indeed if the contamination has migrated from an adjoining site. From the valuer's point of view, therefore, the question must be asked as to the extent that provision should be made to allow for the possible cost of clean-up. It should be mentioned that the margin note for Section 61 refers to closed landfills, but sub-clause (3)(c) appears to extend the scope of the section beyond such sites by reference to '[any land] in which there are, or the [waste regulation] authority has reason to believe there may be, concentrations or accumulations of noxious gases or noxious liquids' (Environmental Protection Act 1990). Taken to its extreme, this sub-clause would appear to give the waste regulation authority power to enter any land where potentially contaminative materials may be stored, buried or otherwise contained and to compel the land owner to clean up the site.

Section 79 of the Act imposes a duty on local authorities to inspect their areas so as to detect any statutory nuisances, and to investigate complaints of such nuisances (this includes deposits on land which may be harmful to health) with a view to obtaining the abatement of the nuisance under Section 80 of the Act. In respect of this Section, it could be argued that a valuer, observing a possible nuisance during the course of a property inspection, should take account of the likely cost of compliance when preparing the valuation.

In terms of future development on such sites the problem is even more serious than that of complying with legislation. Banks are cautious institutions, as evidenced by National Westminster's requirement for environmental audits, and are likely to become even more cautious having had their fingers burnt by the downturn in property values and resultant collapse of

many property development companies in the early 1990s. It would not be unreasonable, therefore, to expect them to reject all requests for development finance in respect of contaminated sites unless it can be conclusively demonstrated that all possible contamination has been removed, even if such removal was not absolutely necessary for the proposed end use. Insurance cover may be available in respect of any remaining risks, although that aspect is beyond the scope of this chapter, but any such cover would have to meet with the approval of the banks.

The banks' fear is one of increased exposure. Take for example the proposed redevelopment of a site in a major industrial city where the former uses were railway sidings, goods yard and gas works. The land under the area previously occupied by the gas works is contaminated with coal tars and heavy metals. The railway sidings have been removed and a railway cutting, running diagonally across the site, has been filled with a mix of materials, including demolition rubble from the old gas works, surface material from the railway sidings and household refuse. Since the site was cleared and levelled, uncontrolled fly tipping has taken place, with drums and bags of unidentified contents having burst open on site. Unauthorized burning of waste materials, such as vehicle tyres and insulated cables, has also taken place.

The site therefore illustrates a not untypical local environmental situation – a mixture of contaminants, originating over a long period of time from a variety of different sources. Assuming that the site is to be redeveloped for industrial purposes, with buildings, service yards and car parks covering most of the site area, it may be perfectly acceptable in engineering terms to leave much of the contaminated material *in situ*. But is such a course of action going to be acceptable to the financial institutions?

In considering applications for development finance the banks and other financial institutions, such as insurance companies, must have regard for the possibility that the developer may fail to complete the project and go into liquidation, or indeed the bank itself may have to put in a receiver. Given such circumstances, the decision will have to be taken as to whether the project should be completed, altered or abandoned. If, in the period since agreeing to finance the development, custom and practice, and possibly also legislation, have changed in such a way as to dictate that contaminated material should not be left *in situ*, then there would seem to be little point in continuing with the project as originally intended.

Substantial alterations to the project would then have to be considered and weighed against the cost of abandonment. There is a strong possibility that the latter course of action would not only involve the financial institution in the total loss of its investment to date but may also result in additional expenditure in cleaning up the contamination.

The concern of financial institutions extends far beyond the development process itself, into the provision of long-term finance by way of mortgage or debenture. Loans secured on contaminated sites may, following the failure of the borrower, result in the institution finding itself burdened with a liability which it could not have anticipated at the time the loan was approved. Once again there are valuation implications which may well affect the asset values of many industrial companies and, in a number of cases, banks are reviewing their loan books so as to assess the extent of their possible exposure.

All of a sudden property investment and the use of property as security for loans, especially where industrial property is concerned, is becoming less attractive to financial institutions as the level of risk is seen to be greater than hitherto envisaged. The onus is clearly on the developer to fully investigate site conditions, so as to be able to supply end users, investors and funding institutions with a comprehensive report on the land upon which buildings have been developed.

PUBLIC SECTOR FUNDING FOR REDEVELOPMENT

Central government is prepared to assist in the reclamation and redevelopment of derelict or contaminated land and buildings by making a contribution towards the viability gap. Financial assistance may be obtained through three schemes administered by the Department of the Environment: Derelict Land Grant, referred to earlier in this chapter; City Grant; and the Urban Programme. Responsibility for the first two schemes is to be transferred to the newly created Urban Regeneration Agency (URA), due to commence in late 1993. The URA will have powers of compulsory purchase in order to be able to assemble sites for redevelopment and will also take over responsibility for English Estates, the government-owned industrial development organization sponsored by the Department of Trade and Industry. As an interim measure, administration of the Derelict Land Grant and City Grant schemes has been brought together in the Land Development Grants Division of the Department of the Environment.

Government policies and principles relating to the environment were set out, in 1990, in the White Paper *This Common Inheritance*. One important principle with regard to the responsibility for clearing up pollution was clearly stated: 'those causing contamination should pay for the costs of putting it right' (*This Common Inheritance* 1990: 92). The 'polluter pays' principle adopted by the British government, in common with many others, is seen as an important means of influencing potential polluters.

Nevertheless, the problem remains of what should be done about the pollution and contamination arising out of the activities of previous generations. To compel present-day owners of land to clean up after previous owners would seem to be inequitable, especially as those same owners may well be having to face up to the fact that the property, for which they paid the market price several years ago, now has a nil or even negative value. Even forcing businesses to reclaim land which has been contaminated over earlier years by the industrial processses of the firm may be counterproductive if it has the effect of forcing the company out of business. At the present time there is no provision in the UK for a 'superfund' of the type which exists in the United States, or any means of requiring industries to put into place a financial deposit or bond in respect of any potentially contaminative manufacturing processes. Therefore, financial intervention by government would appear, for the time being at least, to be an essential component in the reclamation and redevelopment of derelict land.

Returning to the former gas works and rail siding site referred to above for the purpose of considering how the public sector grant systems work, it will be seen that the public sector contribution may well be fundamental in ensuring that sites are redeveloped. The site in question is located in one of the fifty-seven local authority areas designated under the Inner Urban Areas Act 1978 as being eligible for Urban Programme money and, as the completed project value exceeds £500,000, it falls into the category which would be considered for City Grant appraisal.

The site contains an area of 3.04 hectares (7.5 acres) on which it is intended to build eighteen industrial units with a gross internal floor area of 11,148 square metres (120,000 square feet). A detailed site investigation has revealed that the site is heavily contaminated with cyanide and heavy metals, including cadmium, mercury and arsenic, as well as toluene extractable matter and high levels of sulphates. Monitoring has also revealed high levels of methane.

Technically, much of the fill material could be consolidated under impervious finishes such as concrete and the foundations piled through the fill to suitable load bearing strata. The recommendation of the structural engineer is, however, that the fill should be removed and replaced with clean granular fill, properly consolidated in layers, so as to provide a good base from which to build. This view is also shared by the investment consultants advising the developer.

The total cost of undertaking the project is estimated as being £5 million excluding professional fees, interest charges and other costs, of which £1.3 million is in respect of site reclamation works. In 1989 the site was valued, for the purpose of the owner's annual accounts, at £1 million and at the time of writing (May 1993) industrial land values in the area, for clean serviced sites, are around £240,000 per hectare (£100,000 per acre), or £750,000 for the site, which is typical of the fall in values over the three year period. If

Clearly, the site owner would be unlikely to pay this sort of money to reclaim the site, unless compelled to by a legal obligation. As the site is located in the inner urban area of the city and has the potential to create a substantial number of jobs, there is a good chance that the scheme will receive favourable consideration from the City Grant appraiser. The amount of City Grant to be allocated to the project would be calculated as shown in Table 4.4.

Table 4.4 Calculating a City Grant allocation

Paul Syms Associates – development appraisal	
Client:	Anyclient Limited
Project:	The Roundhouse Site
Scheme:	Industrial B2 units
Sheet title:	City Grant appraisal

Investment value

	Occ. rate	Lettable area	Gross rent	Yield %	Years purchase	Totals
Industrial units	100.00%	120,000	£600,000	10.50	9.52	£5,714,286
		120,000	£600.000			
Rent per square foot	£5.00					
Estimated investment value						£5,714,286
Institutional acquisition costs		2.75% of est. inv. value				£157,143
Net investment value						£5,557,143
Estimated total value of development						£5,557,143

	%	Area	Period	Rate		Totals
Existing value		7.50		£33,333		£250,000
Acq. costs	2.75%					£6,875
Buildings		120,000		£24.38		£2,925,000
Infrastructure / Abnormal and demolition / Preliminaries						£1,300,000
Prof. fees	11.09%					£468,345
Statutory fees	0.90%					£38,025
Any other costs	4.23%					£235,050
Non-rec. VAT						
Finance charges	12.50%		1.25			£485,434
Contingency	3.50%					£164,267
Total development costs						£5,872,996
Profit on value	15.00%	Profit on net cost			17.29%	£833,571
Total cost plus profit						£6,706,568
Development surplus (deficit)						(£1,149,425)
Saving on finance costs		(Net finance cost		£386,695)		£98,740
City Grant requirement						(£1,050,685)
City Grant gearing					1 TO	5.44
City Grant cost per job based on		300 jobs				£3,502

(Notes follow on next page)

o in e genera area. ere must a mar et for the completed buildings, albeit with the allowance of a suitable marketing period and grant is not awarded so as to enable one development to compete on a more favourable basis than others in the vicinity.

2 The existing site value has to be one which meets with the approval of the Department of the Environment and may bear no relationship with the price actually paid by the prospective developer. Site values included in grant applications should reflect the argument that, without the grant, the site cannot be used beneficially and cannot be developed. In many cases this value will be negligible (Department of the Environment 1992).
3 Building costs, site reclamation costs and professional fees will all be scrutinized during the appraisal process and must be seen to be reasonable.
4 Finance charges are calculated on the basis of a cash flow which assumes that the grant will be drawn down quarterly in arrears, with the receipt of grant being used to reduce the financing cost of the development.
5 The developer is expected to make a reasonable profit out of the development but not one as high as might be expected in respect of a project which does not involve a public sector partner. The developer is not expected to make a profit on the grant aided element of the expenditure and grant is therefore calculated as a percentage of end value. A profit of 15 per cent on value is usually considered acceptable in respect of a wholly speculative scheme but this may be reduced if the accommodation is partly pre-let.
6 If the value which the developer receives on completion of the project is higher than that anticipated in the agreed City Grant appraisal, then the excess amount may be subject to clawback by the Department of the Environment.

Under the City Grant method of assessing the need for grant aid, which looks at the entire development project, the amount of grant required so as to enable the industrial redevelopment project to proceed is slightly in excess of £1.050 million. This results in a public sector contribution of one pound for every £5.44 of private sector contribution, based on the end value, otherwise referred to as a gearing of 1 :5.44. Such a level of gearing would normally be acceptable to the Department of the Environment, which seeks to achieve an average gearing of at least 1:4. The public cost of job creation is also at an acceptable level, being an estimated £3,502 for each expected new job.

If the derelict site were not located in one of the fifty-seven priority areas for City Grant, then it may be suitable for reclamation under the Derelict Land Grant scheme. Its broad aim is to reclaim land which reduces the attractiveness of an area as a place in which to live, work or invest or, because of contamination or other reasons, is a threat to public health and safety or the natural environment. Such land, when reclaimed, should be capable of being used to provide for development, amenity value for the community or to contribute towards nature or historic conservation (Department of the Environment 1991c). In Assisted Areas and Derelict Land Clearance Areas (areas with high levels of dereliction, mostly in the north and Midlands), grant is payable at the rate of 100 per cent for local

Site value as existing (7.5 acres at £33,333 per acre)		£250,000
Site value post-reclamation (7.5 acres at £100,000 per acre)		£750,000
Betterment (increase in site value)		£500,000
Cost of site reclamation		
Reclamation contract	£1,300,000	
Site investigation	£25,000	
Professional fees @ 8 per cent	£106,000	
Total reclamation cost		£1,431,000
Deduct betterment		£500,000
Amount eligible for grant aid		£931,000
Rate of grant (Derelict Land Clearance Area)		80 per cent
Amount of grant		£744,000

authorities and English Estates, and 80 per cent for other applicant Outside these areas the rate is 50 per cent, except in National Parks an Areas of Outstanding Natural Beauty where local authorities can receive 7 per cent grants.

Unlike the City Grant, Derelict Land Grant does not require an apprais of the entire project to be undertaken for the purpose of assessing the grar requirement. It does, however, take into account the existing use value c the site and the anticipated post-reclamation value. A Derelict Land Grar calculation for the proposed industrial redevelopment would take the forr shown in Table 4.5.

The City Grant basis of calculating financial assistance for developmen projects therefore produces a grant requirement £306,000 greater than th Derelict Land Grant method. Even allowing for the fact that the private secto DLG scheme only contributes 80 per cent towards the excess cost of reclaim ing the site, it can be seen that the City Grant basis has the ability to provide ai additional subsidy so as to assist the commercial viability of the project.

The size of the development used as a case study in this chapter is suct as to make it ineligible for Urban Programme support but, for smalle projects, this can also assist in the reclamation and redevelopment o derelict sites. Within the areas designated under the Inner Urban Areas Ac 1978 and subsequent amendments, loans can be made available for the acquisition of land and the carrying out of works on land. Grants and/or loans can also be made available within Improvement Areas in the designated districts, for environmental improvement and also for the conversion, modification or extension of industrial and commercial buildings. As with both of the other forms of grant aid, it is necessary to demonstrate that the project will not proceed without assistance.

It should be noted that, at the time of writing in May 1993, consideration was being given to the replacement of City Grant and Derelict Land with a unified grant system. This may well come into being under the auspices of the Urban Regeneration Agency, although some observers consider that it may well be necessary to retain the two different methods of appraisal so as to be able to adequately consider the various types of projects needing public sector support.

CONCLUSION

Without doubt, the Environmental Protection Act 1990 has produced a heightened awareness in the minds of property developers and investors, of the problems of developing on contaminated and derelict sites. Initially this has had the effect of making such brownfield sites less attractive for redevelopment and may have increased the pressure for the release of greenfield sites.

It must be borne in mind, however, that the legislation was to have come into effect at a time when property markets generally were depressed and property users could afford to be very selective in deciding upon their new acquisitions. Therefore, they were likely to avoid problem sites, as the possible yield differential had yet to be proven or fully tested. In a buoyant market a different picture may well emerge, with problems tending to be overlooked in the competition to acquire development opportunities.

Banks and other financial institutions are conscious of the fact that the level of their exposure could be increased as the result of contamination of land from former industrial uses. They are therefore tending to play safe and require sites to be fully investigated and, if found, any contamination removed from the property. Such an attitude does little to assist in tackling the problem of contaminated land as it simply removes the contamination to another location, albeit under controlled conditions.

There is no real reason, in engineering terms, why many contaminants should not be safely encapsulated under industrial buildings. Such encapsulation would need to be adequately documented, so as to facilitate future changes to, or even redevelopment of, the building. Other, more esoteric, forms of site remediation, such as soils washing and thermal treatments, have yet to gain much of a foothold in the UK, although they are used quite extensively throughout Europe and North America.

The real problem lies, however, in the question of valuation and potential future liabilities in respect of the encapsulated material and treatment methods other than total removal. There may, therefore, be some need for central government to consider ways in which developers of former industrial sites may be indemnified against such liabilities in return for them making arrangements to contain or treat contaminated material on site rather than disposing of it elsewhere.

Government already plays an important part in the redevelopment of brownfield sites through the provision of grant aid. Without such assistance many sites would not be reclaimed and redeveloped, especially those which are contaminated. Existing legislation should have the effect of minimizing future contamination, although certain manufacturing processes are still bound to cause a degree of contamination. Use of the 'polluter pays' principle should eventually reduce demands on the public purse, provided of course that polluters can be held to account. In the meantime there is still a considerable area of land which is capable of being reclaimed and perhaps consideration should be given to the setting up of a fund to assist in site reclamation works.

From the research point of view there are many topics which could provide an agenda for the future. This could include studies into the impact on land values in countries which have already introduced tighter controls on the redevelopment of contaminated land, such as Germany and the Netherlands. The establishment of a fund for the reclamation of sites, where the polluter is no longer in existence or for some other reason cannot be held to account, should be considered, together with ways in which such a fund may be financed. As a newly-formed government agency, the performance of the Urban Regeneration Agency will need to be monitored. Perhaps most important of all, there is a need for research aimed at producing a set of standards for the reclamation of contaminated and derelict sites. Such standards must be acceptable to occupiers, investors, funding institutions and government alike, without simply transferring the problem from one location to another, leaving the permanent solution to a future generation.

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The Effects of Industrial Contamination on Residential Land Values in the United Kingdom

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The Environmental Protection Act 1990 introduced proposals for local governments in the United Kingdom to prepare and maintain registers of land which are, or have been, used for 'potentially contaminative' purposes. Following objections from professional organisations and other powerful lobbies with vested interests in real estate, the proposed registers were abandoned in 1993. A side effect of the proposal has, however, been to heighten public and professional awareness of land contamination issues. Other effects include a reluctance on the part of banks to lend money on sites which may be subject to contamination and a greater diligence on the part of lawyers in making pre-contract enquiries of an environmental nature. The present legal situation is described and case studies are used to illustrate the changing attitudes to methods of remediating contaminated land. Research has been undertaken in order to assess the attitudes of professionals involved with the processes of valuation and development as to alternative treatment methods and the ways in which they impact value.

INTRODUCTION

This paper is part of a programme of research into the effects of industrial contamination on the reuse of former industrial sites in the United Kingdom. It focuses on development for residential use, although the wider research project is examining redevelopment for industrial, office, retail and leisure uses. The paper builds on the findings of two earlier studies, the first being a case study of the redevelopment of a derelict and contaminated urban waterfront site for mainly residential use (Syms 1993), whilst the second examines the problems of funding developments on derelict and contaminated sites (Syms 1994). These studies identified some of the difficulties which may be experienced in returning old industrial sites to beneficial uses.

Recognition of the issue of industrial contamination and its impact on land values is a phenomenon of the 1990s, at least so far as the United Kingdom is concerned. Contaminated land has, of course, existed for many decades, even centuries, so why have valuers in the world's oldest industrialised nation only recently come to accept that values may be adversely affected by contamination left behind by previous industrial uses? This paper will attempt to answer that question and, by drawing upon a case study from one of the country's oldest industrial cities, will consider the extent to which contamination may impact residential property values. The paper concludes with a report on how the issues of contamination and valuation may be perceived, relative to alternative methods of site remediation, following a survey of property market actors.

In a small, but heavily populated, island nation such as Britain, development land is a resource in short supply and strict town planning controls are in force. As a consequence, there exists a long history of using this resource over and over again. Until the 1980s, the possibility of a need to decontaminate such land was rarely considered. At best, decaying organic matter and other visible problems were removed, but if the ground was capable of supporting the new structures then it was not usually considered necessary to take any further action. Chemical analysis of soil samples was rarely undertaken.

Consider, for example, a former naval dockyard on the south bank of the River Thames in London. The poor load bearing quality of the river silts meant that buildings had to be supported on piled foundations. When the 29-acre site was investigated in 1986 for a possible residential development, it was found that there had been at least three distinct phases of development with piles driven upon piles. The earliest piles were of timber and probably dated back to the original development of the dockyard more than three hundred years ago. Associated with each phase of development was demolition rubble and fill material, as the site was built up higher and higher so as to overcome the problems of flooding. The remediation methods proposed by the engineers consisted primarily of ground stabilisation measures, with the decaying organic matter remaining in the ground and the gases generated from that matter being vented out through basement carparks. Although technically viable, eight years later this method would probably not be acceptable to the funding institutions, thus illustrating the changes which are taking place in tackling the problem of contaminated land.

In 1976, the Government set up the Interdepartmental Committee on the Redevelopment of Contaminated Land (ICRCL) which produced its first guidelines in terms of contaminated land remediation in 1983 (ICRCL 1987). These were updated in 1987 and are still in use, but even today it is doubted that the vast majority of valuers would recognise the initials ICRCL. Until 1991, development sites which had previously been in industrial use were generally considered only with regard to their physical problems, contamination was rarely even thought of and certainly it was nothing to concern valuers. Such matters were the province of structural engineers and environmental health officers.

THE LEGAL SITUATION

The move to a greater awareness of how contamination may affect values started slowly, beginning with the publication in 1990 of a government White Paper on the environment, entitled *This Common Inheritance* (HM Government 1990). The white paper sets out government policies on all manner of environmental issues and, so far as contaminated land is concerned, restates the 'polluter pays' principle whereby, 'those causing contamination and dereliction should pay for the costs of putting it right'. The white paper was followed by the Environmental Protection Act 1990 (EPA 1990), which came into force at the beginning of 1991. A wide ranging piece of legislation, the Act covers many environmental issues, besides addressing the problems of contaminated land, and valuers did not immediately recognise the implications for their profession.

Contained within the EPA 1990, in section 143, was a clause imposing a duty upon local authorities to set up and maintain registers of land which had been, or was currently, used for potentially contaminative purposes. The full implications of this section were not apparent until, several months after the Act came into force, the Department of the Environment published a consultation paper on the proposed registers (Department of the Environment and the Welsh Office 1991). This consultation paper identified 16 categories of potentially contaminative land use, sub-divided into 42 sub-categories, potentially encompassing around 100 industries.

Immediately following publication of the consultation paper there was an outcry from a number of powerful property lobbies, expressing concern at the likelihood of values being blighted by the inclusion of the specified properties on the registers. Press and television references to 'contaminated land registers' raised public fears about the safety, and value, of homes built on former industrial sites. It should be noted that the registers were intended only to contain facts relating to past or present usage. They were not intended as registers of actual contamination and, as registers relating to historic facts regarding use, it was proposed that properties would not be removed from the registers, even if it was subsequently proved that no contamination existed, or if a full programme of remediation had been completed.

When the draft regulation, intended to implement preparation of the registers, was published in July 1992 (Department of the Environment 1992), the list of potentially contaminative uses had been reduced to eight, very narrowly defined, industries. Any reference to potential contamination from agricultural use had been removed, as too had railway lands and 'high street' uses such as dry cleaners. These deletions had arisen as the direct result of successful lobbying by the National Farmers Union, British Rail, the British Property Federation and other organisations with vested interests in real estate.

The land area to be covered by the proposed registers had thus been reduced to between 10 and 15% of the area covered by the original schedule of uses which, in some of the more heavily industrialised parts of the country, could have virtually covered entire local authority areas. Properties would still remain on the registers for all time, but if they had been subjected to a site investigation or had been 'cleaned up', they would be placed on Part B of the register, leaving only those properties in respect of which nothing was known, except for the past or present use, on Part A.[1] The Government also retained the right to add other categories to the schedule of potentially contaminative uses.

Far from calming fears about the possible blighting effect of the registers, the draft regulation produced exactly the opposite response. The eight uses remaining in the schedule were seen as being the most contaminative of all land uses and it was considered by the valuation profession that, once properties in these categories were on the registers, they would effectively be valueless. Also, the possibility that other categories of use might be added later left behind an air of uncertainty. Opposition to the registers intensified and resulted in the proposal being abandoned in March 1993 (Howard 1993), with the promise that a comprehensive review would be undertaken into the whole issue of contaminated land. As part of this review a consultation paper was issued by the Department of the Environment in March 1994 (The Department of the Environment and the Welsh Office 1994*a*).

This consultation paper set the scene in terms of policy towards contamination and the current legal and regulatory framework. A number of key issues were identified for resolution:

- A – What should the objectives be within the policy?
- B – How should the statutory framework meet the objectives?
- C – What relationship should the statutory framework have with the common law?
- D – Should there be any extension of strict liability?
- E – Who should pay for putting right environmental damage?
- F – How should markets be provided with information?
- G – What other roles should public sector bodies have?

The consultation paper invited further discussion on these key issues and set out a number of preliminary conclusions. Perhaps the most important of these, in terms of valuation impacts, was a view that contaminated sites should be improved in line with the 'suitable for use' approach as and when hazards are tackled. In other words, it was not seen as being necessary to remediate sites to a uniformly 'clean'

1. No site investigation or site remediation criteria were to be imposed as pre-conditions for the inclusion of land and buildings on Part B of the registers.

standard regardless of future use. This has now been confirmed as government policy (Department of the Environment and Welsh Office 1994*b*).

The well publicised debate has, however, had the effect of increasing awareness of contaminated land issues in the legal and real estate professions and, most importantly, in the world of property finance. Lawyers have started to make more searching enquiries, at pre-contract stage, regarding environmental issues. Recent case law also contains a judgement of significant importance in relation to contaminated land, especially where there is a risk of potable water supplies becoming polluted. In the *Cambridge Water* case[1] the House of Lords overturned the Court of Appeal decision, ruling that a polluter cannot be liable for pollution damage that was not reasonably foreseeable when the polluting incident occurred (Broughton 1994).

Valuers have reconsidered the caveats which they need to include in valuation reports and the Royal Institution of Chartered Surveyors has updated its guidance to valuers (Royal Institution of Chartered Surveyors 1993 and 1995). Many banks have simply stopped lending on properties which may possibly be affected by contamination, for fear that they may be held responsible for 'clean-up' costs in the event of default by the borrower. Therefore the potential remains for property values to be blighted, even though the registers themselves have been abandoned.

The extent to which values have been affected, and the extent to which blight will continue to exist in the future, is difficult to quantify. Little or no transactional evidence exists and, unlike in the United States and other countries where there is greater freedom of access to information, the prices paid for real estate in the England and Wales[2] remain confidential between the buyer and seller, their professional advisers, the Inland Revenue's Stamping Office and the Land Registry. Land Registry records are held centrally, rather than in each local authority area and, until fairly recently, it was not even possible to obtain details of land ownership.

It is to be hoped that the relaxation, in terms of being able to obtain details of ownerships and other interests in land, will shortly be followed by a decision to make transaction details available, even if this is only to authorised professionals. In the meantime, valuers have to rely upon their own records, asking prices and such transaction details as are published in order to obtain comparable evidence. In the residential markets published data are extremely sparse, being confined almost exclusively to auction reports. In view of the lack of available data it is extremely difficult to compile a generalisable quantitative study into the ways in which industrial contamination impacts residential property values.

THE IMPACT OF CONTAMINATION ON VALUE – A CASE STUDY APPROACH

In spite of the lack of a comprehensive database, it may be possible to make some assessments as to the likely impact of industrial contamination on values; using a case study approach for which transactional data are available. Take for example the case of a 7.2 acre site in east Manchester, located in an area which, until 1980, was totally dominated by heavy industry, especially engineering. Today, virtually all of the industrial businesses have closed, as a result of going out of business, reduction in the number of plants or relocation to greenfield sites. They have left behind a legacy of redundant buildings, mostly vandalised, or cleared but contaminated sites.

The case study site was the location of a long-running industrial dispute in the early 1980s, when the workforce was locked out by the management. After many months of bitterness, the matter was brought to an end, the factory demolished and the site eventually sold for residential development. Following the sale, site investigations revealed extensive contamination, caused by the previous industrial use but there was no recourse to the vendor. *Caveat emptor* applied and the purchaser had neglected to undertake any investigative work before entering into the contract. In time, the intending developer became the victim of financial difficulties and the bank stepped in as mortgagee, owed £750,000 in principal and rolled up interest charges.

After more than two years, and many abortive negotiations, the bank agreed to sell the site to a major house builder for £325,000 and the Department of the Environment offered a City Grant[3] of £765,000 to ensure the redevelopment of the site. As the estimated cost of dealing with the contamination was only £569,000, it can be seen that the grant included an element of commercial subsidy, supporting the provision of new housing in a depressed part of the city. This development is now on site (December 1995) and site remediation has been completed, the method adopted being one of contamination 'hot spot' removal, the reduction of remaining contaminants to concentrations below ICRCL trigger levels and covering the site with three feet of clean clay and topsoil. In other words a containment solution was adopted.

Most of the existing housing in the locality comprises two-storey terraced houses, of 600 to 750 square feet in floor area, built in the latter part of the last century. In good condition these houses sell for around £25,000 to £30,000: which is no more than the construction cost for similar sized new homes, before taking account of land, profit and finance costs. The development will comprise terraced, semi-detached or duplex homes of similar size to the existing dwellings, developed at a density of 19 units per acre. These 'starter homes' will be aimed to sell in the price range £35,000 to £42,000, excluding central heating and garage. Virtually identical homes in other

1. *Cambridge Water Co.* v *Eastern Counties Leather plc* [1993] EGCS 211
2. Transaction data is available in Scotland.

3. City Grant was a shortfall grant, funded entirely by central government, intended to bridge the gap between project end value and development cost (including a reasonable profit level), when the cost was higher than value. Any profit achieved in excess of the agreed level was normally shared equally between the developer and the Government. City Grant was the successor to Urban Development Grant and Urban Regeneration Grant, which in turn owed their origins (in 1981) to the United States Urban Development Action Grant. City Grant has now been replaced (from April 1995) by English Partnerships' Investment Fund.

..., unaffected by industrial dereliction, sell for prices up to 10% higher and the older terraced houses also achieve similarly increased prices. The generally lower selling prices in east Manchester may not be due entirely to the possibility of contamination blight but may also, to some extent, be a symptom of the depressed economy of that part of the city. It is however very difficult to separate out the effects.

The developer acquired the site for a cost of around £18,000 per acre, after taking account of the subsidy contained in the City Grant, compared to the £70–100,000 per acre which would be paid for problem-free, high density residential development land in other parts of the city. This represents a discount of at least 70% against the value of an uncontaminated site. Much of the reduction in land value is, of course, attributable to the expectation of lower selling prices in this de-industrialised locality but at least part of the discount is attributable to the developer's perception of increased risk. The developer also considered that an increased marketing budget was required to overcome the possible stigma attaching to the previous use.

Such substantial discounts are not unexpected as a result of the debate over the proposal to introduce registers of potentially contaminated land. In 1992, Lightbody warned housing associations which had bought properties on previously used land that the values may be reduced by up to 60% (Lightbody 1992). This author is aware of a major housebuilder insisting on a reduction of 40%, for a fully reclaimed site, against the general level of housing site values in the immediate vicinity, because of the 'blighting effect' of the past use.

The method of site remediation used for the east Manchester case study is based on the safe containment of a residue of contaminated material, at concentration levels which are considered to be safe, under the development itself. This is not unlike the way in which such sites were redeveloped prior to the implementation of the Environmental Protection Act 1990, except that on the case study site the work was carried out under stringently controlled conditions. The alternative of removing all of the contaminated material to landfill and backfilling with clean material, was considered but this would have cost in excess of £1.2 million. The level of grant aid required for this alternative would substantially have exceeded the Department of the Environment's aid guideline of one part of public money to four parts of private money. The money could therefore have been more effectively used elsewhere and this site would not have received grant aid. The bank would also not have received any payment as mortgagee and it would have been forced to write off its £750,000 debt.

THE STIGMA EFFECT

The issue of property values possibly being stigmatised by contamination was considered by Patchin (1988) when, in 1988, he used the term 'stigma' to represent a variety of intangible factors from possible public liability and fear of additional health hazards, to the simple fear of the unknown. Over the next two years Patchin was repeatedly questioned on the issue of stigma and it was suggested that perhaps the 'concept of stigma' was a figment of his imagination. In 1991, therefore, he revisited the issue of stigma and concluded that the market had become 'significantly more aware of the issue of toxic contamination on real estate values' (Patchin 1991). He also formed the opinion that, in attempting to determine the extent of stigma, extensive research would be necessary to disclose the relevant information. In this context, information relating to sales which did not go through could be more important than those sales that actually did occur.

In a further development of his research, Patchin described four case studies where agreed transactions had failed to be completed or had been completed at reduced sales figures, as a result of contamination (Patchin 1994). From these and four other case studies Patchin postulated that the impact on property values, attributable to the stigma of contamination, was between 21% and 94% of the unimpaired value of the properties. In all cases remediation work had been undertaken, or the site itself was not contaminated but merely suffered from the effect of being adjacent to a contaminated property. The wide variation in impacts was, he suggested, due to differences in the severity of contamination, and whether the site itself was contaminated or merely adjoining contamination.

The most severe impact, at 93.7%, was in respect of a former chemical works which was on the EPA Superfund list. The impact on value in respect of this case study property was so much greater than the next most severely affected property, a vacant site where the stigma was assessed at 69% of the unimpaired value, that it should be considered that part at least of the reduction in value may be attributable to causes other than contamination. Following closure and sale of the former chemical works, the new owner intended to sub-divide the premises for 'rental to multiple tenants'. Some of the buildings had been constructed in the 1930s, with others built in the 1950s and 1960s. It is therefore likely that the new owner would have had to deal with a degree of functional obsolescence in sub-dividing the property, and presumably would also have required a return for risk, finance and profit. In view of the questions raised in respect of the case study apparently suffering the greatest stigma it would perhaps be safer to disregard this example and rely upon the remaining seven case studies, which indicate a stigma effect of 21% to 69% of the unimpaired value.

Patchin suggested that the case study examples should be used as comparables in respect of other properties for which values have to be determined. The basis of comparison would not, however, be the usual valuer's method of comparing the similarities and dissimilarities of properties, in terms of location, site, size and specification. Instead, comparisons would be made as to the nature and extent of contamination so as to assess the percentage stigma effect to be applied in respect of the property to be valued. The percentage stigma effect could then be applied to the unimpaired value so as to arrive at a value for the property as impaired by contamination. Patchin considered that whilst this approach should only be used at present (July 1994) 'as a confirming approach to value', the development of further market data may well result in this becoming 'the primary approach to valuation of contaminated properties'.

Patchin acknowledged the problems involved in obtaining data on transactions, failed or completed, concerning contaminated property, which is an even greater problem in the United Kingdom where there is no public, or professional, access to information regarding property transactions. It should also be stressed that, in using any case study or sales comparables methods in attempting to identify the extent of stigma on real estate values, values and prices paid may be impacted by a number of factors other than contamination. Therefore it is important to identify those determinants which relate most directly to the contamination issue.

SITE REMEDIATION METHODS AND A MODELLING APPROACH

Recognising the problems involved in obtaining suitable data, both in the US and the UK, part of the present research programme includes an attempt to construct a model for use in assessing possible valuation impacts caused by past contamination. The model will be concerned with valuation impacts, post remediation, at three levels in the development process: cleared site level, tenant or occupier level, and the investor or funder level. It is anticipated that results, similar to those obtained by Patchin, will be found which show a direct correlation between the severity of contamination and the impact on value. In addition to taking account of the nature of the contamination affecting the site, the model will also take into account the remediation method, or methods, used to remove or reduce the contamination.

Up to the present time, total removal and containment are the only two forms of site remediation which have been widely used and accepted in the United Kingdom. There has been virtually no experience of soils washing, bio-remediation and chemical treatments, although these have been used in other European countries. Certainly, it is not yet possible to assess from market experience whether or not alternative forms of site remediation may have differing impacts on property values. The model will address how the traditional methods and these alternative forms of remediation may be perceived in the marketplace, and the extent to which such perceptions may impact valuation.

In seeking to develop a basis for the model, a recent survey has been undertaken of 58 property professionals, including valuers, quantity surveyors, property managers, bankers, lawyers and developers. All respondents were asked to indicate their perception as to how different property market actors may consider four alternative forms of remediation in terms of valuation and/or desirability. Desirability was used as a surrogate for those professionals who were not versed in valuation techniques. The selected methods of site remediation were as set out in Table 1.

This part of the study took the form of a postal survey, mailed to 200 individuals in different professions but all having a first hand knowledge of property development, investment, construction, valuation or environmental matters. A total of 70 responses were received (35%) but 12 individuals felt that they had insufficient knowledge of either valuation or contamination to provide a detailed response, instead they

Table 1. Site remediation methods

Scenario 1	Excavation of all contaminated material, so far as this can be determined, removal to landfill and backfilling with clean material, consolidated in layers. As appropriate, the provision of an impermeable membrane to prevent ingress of further contamination. The method was intended to represent a 'low technology' approach to site remediation.
Scenario 2	The removal of contaminated hotspots and the regrading of remaining contaminants to an agreed subbase level, diluting contaminants if necessary, and the import of clean fill to formation level. This method represented 'medium technology', requiring a more scientific approach than Scenario 1.
Scenario 3	The on-site screening of contaminated material and subsequent treatment in a soils wash so as to reduce residual contamination levels below ICRCL trigger levels. This was also intended to represent a 'medium technology' approach.
Scenario 4	The on-site treatment of contaminants. using bio-remediation or chemical methods as appropriate, so as to reduce residual contamination below ICRCL trigger levels. This scenario represented 'high technology' methods.

offered generalised comments as to how they perceived property markets reacting to the issue of contamination. Respondents were asked to consider all of the land uses under examination in the research programme and to compare the remediated site against one of similar size, in a similar location but not previously developed; in other words a greenfield. They were asked to indicate their assessment as to how land values may be affected, according to the remediation method used, by reference to one of five categories as shown in Table 2. The expected reactions (as perceived by the respondents) of developers, building societies, housing associations and occupiers were used as surrogates for the different stages of development from bare site through investment and occupation. Similarly, for the other land uses, the likely reactions of other property market actors, including investors, tenants, workers and shoppers, were used to assess the likely impact on value of the different treatment methods for the proposed uses under consideration.

Table 2. Classification of perceived impact on values

1.	Increase in value	–	> than 5 % change
2.	No real effect on value	–	< than 5% increase/decrease
3.	Slight decrease in value	–	6 to 10% change
4.	Moderate decrease in value	–	11 to 25% change
5.	Significant decrease in value	–	> than 25% change

Analysis of the survey results produced good results in respect of how the property market might react to the remediation options under consideration and their likely impact on value. The results for Scenario 1 confirmed that, throughout all stages of development, investment and occupation, the total removal of contaminated material and its replacement with clean fill was seen as producing a resultant land value no different to a previously undeveloped site. Indeed, almost one-third of the respondents indicated that this method of treatment might result in a land value in excess of that obtainable for the alternative 'greenfield' site, on the basis that a great deal of information would be known about the reclaimed site, supported by contractors and professional warranties, whereas the previously undeveloped site may contain unknown ground problems.

Fairly conclusive results were obtained in respect of Scenarios 2 and 3 with developers prepared to accept that the clean cover option (Scenario 2) would have no different impact on value to total removal (Scenario 1). For all other actors, however, these remediation options were perceived, at all stages of the development process, as resulting in a slight (6 to 10%) decrease in value when compared to the previously undeveloped site.

When the Scenario 4 results were analysed, a wide variation of opinions was found. Very few of the respondents considered that bio-remediation or chemical treatment methods would result in an increase in value, whereas 26% to 39% of respondents were of the opinion that there would be a significant decrease in value, according to the perceived reactions of the different property market actors. Taken overall, developers were perceived as being prepared to accept that these 'higher technology' treatment methods resulted in only a slight decrease in value but all of the other actors could be expected to require a moderate decrease in value (11 to 25%). This could be seen as confirmation of Patchin's view that stigma may, in part, be due to a fear of the unknown. The full results for the residential development part of the survey are set out in Table 3.

The research to date would seem to indicate that, whilst house builders and developers expect to see a substantial discount in the price paid for remediated former industrial land, only a small part of that reduction trickles down to the eventual home owners through a small reduction in the price paid for new homes. It would therefore seem that the purchasers of new homes at the lower, or first time buyer, end of the market are relatively insensitive to the former industrial, and possibly contaminated, nature of the sites upon which homes may be constructed. To some extent also the past history of such sites may be overcome by the use of quality landscaping and the creation by the developer of a 'self-contained environment'. Bleich *et al* (1991) considered the impact of surrounding land uses on residential property values. They suggested that, in the case of prices of housing adjacent to a landfill, the reduction in value will erode over time and values of the affected properties will increase towards those of similar, but unaffected, properties. This was due, in part, to the gradual erosion over time of any stigma and also to the fact that, as landscaping becomes established the closed landfill has the potential to create a pleasant environment next to the housing neighbourhood.

In situations such as the east Manchester case study, the redevelopment of a derelict and contaminated site has the potential to act as a stimulus towards the redevelopment of other properties in the neighbourhood. Already in east Manchester, in the immediate vicinity of the case study site, development is under way on an adjoining site to provide low cost housing for rent and a nearby office block, vacant for many years, is being converted into 52 apartments, also for rent. One derelict factory is in the process of being refurbished and it is believed that there is serious interest from developers, wishing to demolish and redevelop two other derelict factories. The decontamination and redevelopment of one old industrial site thus has the potential to create wider environmental impacts of a positive nature. It is therefore possible for the initial reduction in selling prices to be replaced by a significant uplift in values within a relatively short period of time, at which stage it becomes difficult to differentiate between the decontamination and wider economic effects on property values.

CONCLUSIONS

The UK Government's proposals to introduce registers of potentially contaminated sites may have been ill thought out, resulting in their abandonment but they have served to

Table 3. Means of responses to questionnaire survey

Preparation for residential redevelopment of contaminated former industrial site

	% change in value/desirability			
	Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**
Developers	<5% change	<5% change	Slight decrease, 6-10%	Slight decrease, 6-10%
Building societies	<5% change	Slight decrease, 6-10%	Slight decrease, 6-10%	Slight decrease, 6-10%
Housing associations	<5% change	Slight decrease, 6-10%	Slight decrease, 6-10%	Moderate decrease, 11-25%
Occupiers	<5% change	Slight decrease, 6-10%	Slight decrease, 6-10%	Moderate decrease, 11-25%

land. Certainly, developers and funding institutions are examining with more care those development opportunities which may be on potentially contaminated sites. To some extent they may be over-reacting to the problem by the discounts which they expect to see in terms of the values attributed to former industrial sites when compared to greenfield situations.

Case law would seem to indicate that whilst 'strict liability' remains in respect of the actions of land owners, such liability is limited to the extent of any damage which might reasonably have been foreseen. Polluter pays will remain the guiding principle in terms of assessing responsibilities for the cost of clean-up but, unless damage to the wider environment can be proved, there would seem to be no intention by government to compel landowners to clean up their sites. This could have the effect of halting some comprehensive urban renewal projects, unless government is prepared to continue contributing to site remediation costs in respect of sites which would otherwise be uneconomic to develop.

The remediation and re-development of the case study site used in this paper took place against the background of a depressed property market, when few residential developers would consider building on sites that had contained contamination, which undoubtedly is a contributory factor in negotiating a substantial reduction against the unimpaired value of such sites. To what extent such discounts would apply in an improving property market, with developers competing more aggressively for available sites, remains to be seen. Whatever the outcome, it would seem that only a small percentage of any discount is received by the eventual occupier and this would seem to be very little compensation for the potential risk involved in purchasing a property on a former industrial site. Nevertheless, it may be postulated that over a period of time following completion of a development, say five to ten years, any stigma attaching to properties as a result of former use may well disappear. Values of homes on old industrial sites may rise to equal, or perhaps even exceed, those achievable in nearby 'non-industrial' areas, as the benefits of urban renewal provide a stimulus to demand.

Survey results indicate that developers may be prepared to adopt a more pragmatic approach towards the residential development of former industrial sites than the funding institutions and occupiers, provided that they receive their discount on the site value. Much of the discount is expected to compensate for the developer's perceived higher risk and increased marketing costs. The ultimate home buyer receives little of the discount but may gain from longer-term improvement in value. From this it may be concluded that the further removed the actor is from the original industrial use, in terms of both physical environment and new use, the less apparent will be the impact of contamination on value. This demonstrates the need to examine the related issues of how, in practice, valuers take account of contamination, at different levels of severity, when preparing property valuations and to compile a database so as to determine the extent to which the theoretical and practical approaches are borne out by actual market transactions. It should then be possible to produce a model which takes account of past industrial uses and the dealing with the contamination, the proposed future use (or uses) of the site and market evidence.

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Dealing with contaminated assets

Paul Syms suggests a method for valuing contaminated property where industrial use is to continue.

Eight heads of cost to be taken into account when valuing contaminated land are listed in the new Red Book. Taking account of these may be relatively straightforward when sites are to be redeveloped, especially if it has been possible to prepare a land quality statement. However, when the property is to remain in industrial use, the need to undertake site remediation may be deferred for many years. This article describes a method of valuation which may be appropriate in such circumstances, whether the valuation is required for accounts or loan security purposes.

Figure 1 suggests a method by which the costs referred to in the guidance notes may be dealt with.

No costs have been included for items (c) and (d), the costs of process redesign and penalties/civil liabilities, because these should be treated as immediate costs, not capable of deferment for the economic life of the buildings. There may also be a case for treating all or part of item (b) in the same way. All such non-deferable costs should be treated as current liabilities in the valuation and specifically reported upon. The items should also be discussed with the company's auditor, so as to determine which, if any, of the costs should be treated as general liabilities of the business rather than property specific liabilities.

No allowance has been made in the valuation in Figure 1 in respect of any grants or other incentives which may be available towards the cost of dealing with contamination, although GN 2 makes reference to the need to reflect grants, or other financial incentives, in the valuation. The government has adopted the principle of "polluter pays" (DOE 1990) and does not consider it appropriate to use public money in clearing up contamination resulting from industrial activities.

Even where the property is no longer owned by the original polluter the attitude is that land values should reflect the cost of dealing with contamination and may thus result in nil, or negligible, base values being applied to sites considered for grant aid. It is therefore unlikely that grant aid will be made available to tackle the problems of land contamination. Exceptions may occur where the cost of treatment is significantly in excess of any development value which would accrue from the site, or in circumstances where environmental, as opposed to economic, benefits are the expected outcome of the treatment.

The principal problem in adopting the method described here is in producing reasonable estimates of works to be undertaken. Valuers are right to be concerned that any figures which they use may be wildly inaccurate, but is the situation so very different from reflecting the likely cost of dilapidations when preparing a valuation of a building? In both cases the valuer will almost certainly need to consult other professionals, such as engineers and quantity surveyors, and both valuations may require a degree of subjective judgment on the part of the valuer. Accounting for land contamination differs in that:

- much of the liability may be hidden from sight; and
- there may be a lack of information in respect of site remediation costs.

These will require reasoned assumptions to be made and demonstrate the need for a readily available source of costs information.

It is suggested that adoption of the procedures and valuation method described

FIG 1: ASSET VALUATION OF CONTAMINATED PROPERTY

Unimpaired value (calculated by an appropriate method, such as open market value or depreciated replacement cost, disregarding the existence of any contamination)		£1,500,000
Remediation costs in accordance with GN 2 para GN2.9.2 (present cost estimates, applicable as if the site is to be redeveloped at the date of valuation)		
(a) clean-up of on-site contamination;	£350,000	
(b) effective contamination control and management measures;	£75,000	
(c) redesign of production facilities;	N/A	
(d) penalties and civil liabilities for non-compliance;	N/A	
(e) indemnity insurance for the future;	£10,000	
(f) the avoidance of migration of the contamination to adjacent sites;	£100,000	
(g) the control of migration from other sites; and	£15,000	
(h) the regular monitoring of the site.	£10,000	
Estimated total cost of treatment	£560,000	
Anticipated economic life of buildings — 20 years		
Present value of £1 for 20 years @ 7.5%	0.235413	
Present value of treatment costs		£131,830
Adjusted value (excluding any allowance for stigma)		£1,368,170
Percentage reduction in value attributable to anticipated future remediation		8.79%

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Who pays? — the government deems it inappropriate to use public money in clearing up contamination resulting from industrial activity

bove should be sufficient to enable valuers to eflect adequately the quantifiable costs of ackling contamination and to provide eaningful advice to their clients. There is, owever, an unquantifiable aspect to land ·ontamination — the question of stigma, eferred to in para GN2.9.7 of Guidance Note 2 d specifically omitted from consideration in e valuation method described in Figure 1.

The Guidance Note lists the various fluences which collectively may be referred) as "stigma" and, for the purpose of this icle, stigma has been defined as:

hat part of any diminution in value attributable to ıe existence of land contamination, whether treated r not, which exceeds the costs attributable to (a) the ·mediation of the subject property, (b) the revention of future contamination, (c) any known ·nalties or civil liabilities, (d) insurance and ·) future monitoring.

In other words, stigma includes all those atters likely to have an influence on value, cept those which are readily quantifiable or r which estimates can be produced.

At first sight, the effect of stigma would em difficult to assess with conventional uation techniques. However, Patchin (1994) ggested the use of a "sales comparison proach". Case studies, said Patchin, should used as comparables in respect of other perties for which values have to be ·termined. The basis of comparison would t, however, be the usual valuer's method of mparing the similarities and dis-similarities ˈproperties in terms of location, site, size and ecification. Instead, comparisons would be de as to the nature and extent of ntamination so as to assess the percentage igma effect to be applied in respect of the operty to be valued, as in Figure 2.

The total fall in value, reflecting both the ysical and non-physical effects of the ntamination, is therefore £556,000 or 37.1% the open market value of the property, disregarding the existence of the contamination. While it is appropriate to defer most of the physical costs of remediation (as in Figure 1), the stigma effect must be applied as a current liability because it reflects present-day attitudes to the former use of the premises, the type of contaminants and the associated hazard level.

Patchin acknowledged the problems of obtaining data on transactions concerning contaminated property and this is an even greater problem in the UK. It should also be stressed that, in using any case study or sales comparable methods in attempting to identify the extent of stigma on real estate values, values and prices paid may be affected by factors other than contamination. It is important, therefore, to identify those determinants which relate most directly to the contamination issue.

Most valuers are unlikely to encounter many impaired sites during the course of a year, let alone sufficient sites with problems caused by the same use or similar contaminants, to enable them to use market evidence in the normal way. Developers and their advisers are also unlikely to have sufficient information on impaired property values from which to assess the true worth of a potential development site. Nevertheless, there may be merit in further developing the method, and it would be useful to establish a databank of case studies for this purpose. ■

FIG 2: A METHOD OF ASSESSING STIGMA

Unimpaired value (a medium-hazard risk property as in the example in Figure 1) £1,500,000
Present value of remediation costs (as from Figure 1) £ 131.830
Impaired value 1 — not allowing for stigma £1,368.170

Comparable case studies

Case study number	Indicated percentage of impaired Value 1 lost to stigma	Comparison with property to be valued
1	25.9%	Treatment completed, stigma caused by fear of additional contamination, less severe than subject property.
2	29.2%	No treatment proposed at present, continued industrial use, similar risk level to subject property.
3	20.9%	Site not contaminated, but is situated adjacent to a contaminated site.
4	32.7%	Similar type of contamination to subject property, but slightly more severe.
5	45.4%	Heavily contaminated site, derelict land, more severe than the subject property.

Range of stigma effects indicated by comparables 20.9 to 45.4%
Comparables closest to subject property nos 2 and 4, 29.2% to 32.7%
Therefore, percentage stigma applicable to the subject property is 31%

Amount of stigma @31% of impaired value 1 £424,133

Impaired value 2 (taking account of treatment and associated costs and stigma) £944,037

say £944,000

Source: Adapted from Patchin 1994

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A question of evidence

Paul Syms

ENVIRONMENTAL IMPAIRMENT DATABANK

Suggested information to be included in respect of case study properties

GENERAL INFORMATION
- Address of the property
- Tenure
- Site area
- Floor area of buildings
- Age of buildings
- Present or immediate past use
- Previous use(s)

CONTAMINATION INFORMATION
- Nature of the primary contaminant
- Nature of the secondary contaminant(s)
- Whether site investigation and/or risk assessment undertaken
- Date of site investigation/ risk assessment
- Hazard level of primary contaminant
- Hazard level of secondary contaminant(s)

TREATMENT INFORMATION
- Whether a programme of treatment has been undertaken or is proposed
- Main method of treatment undertaken or proposed
- Secondary treatment method(s)
- Post-treatment hazard level

VALUATION INFORMATION
- Unimpaired value
- Disposal price
- Uncompleted sales price(s)
- Treatment cost, actual or estimated.
- The availability of grants or other incentives

Guidance Note 2 of the RICS Appraisal and Valuation Manual, which replaced VGN 11 of the old "White Book", is now mandatory, in respect of valuations undertaken by valuers and surveyors on properties which may be affected by contamination.

The Guidance Note lists a total of 28 industrial uses which are seen as having the potential to cause contamination but this list should not be seen as excluding all other land uses from the consideration of contamination. Many other land uses can result in contamination, and single instances of accidental spillage may create problems which seem out of proportion to the original polluting event.

Valuers should not assume that Guidance Note 2 does not apply to them; it not only covers premises which are currently used for industrial purposes but also development sites and properties which have been redeveloped or converted to other uses.

For most valuers, surveyors and developers the issue of contaminated land and its impact on valuation and development has only come to the forefront within the last four or five years. The problems associated with the government's proposal to establish registers of "potentially contaminated sites" are well known, with professional, industry and media pressure resulting in their abandonment.

The consultation period which followed the decision not to proceed with the registers resulted in the amendment of the Environmental Protection Act 1990 through the addition of some 32 pages of legislation, dealing specifically with contaminated land, contained in the Environment Act 1995. This Act also repealed the by now infamous Section 143 of the Environmental Protection Act and laid down the framework for the new Environment Agency and Scottish Environmental Protection Agency. The development industry and the various professions interested in this subject now await with interest the Parliamentary Guidance, expected later this year, which will further define the government's approach to land contamination.

During the last few years several researchers at British universities and colleges have turned their attention to the problems associated with the valuation of land and buildings affected by contamination. See for example the works by Turner et al (1994) on the effect of tenants' environmental policies on investment values, Lizieri et al (1995) at City University and Richards (1995) at the College of Estate Management at Reading, on valuation methodologies, and Syms (1996) on the impact of contamination on residential land values.

While the various researchers have addressed different aspects of the problem, all research projects in respect of contaminated land valuation are likely to suffer from a common difficulty, that is the lack of sufficient high quality data against which to test theories and models. The same problem also occurs for valuers when faced with the task of preparing valuations of land affected by industrial activities or by other forms of contamination.

The majority of valuers are unlikely to encounter many impaired sites during the course of a year. There is even less likelihood that they will be instructed in respect of an adequate number of sites suffering from the problems caused by the same use or similar contaminants, to enable them to use market evidence in the normal way in order to arrive at their valuations. There is no publicly available record of property transactions in England and Wales and even in the United States, where such information is widely available, researchers have found it extremely difficult to obtain details of contamination and to isolate its effect upon value.

Given the difficulties involved in obtaining appropriate comparables each time a contaminated property is to be valued, or to be redeveloped, and the need to identify the applicable determinants attributable to the valuation impairment, I have been working on the development of a theoretical model for the valuation of contaminated sites. I have also proposed that a national databank be established to record information on contaminated land transactions, treatment methods and redevelopment.

The databank would consist of a collection of case studies of property transactions where selling prices had been affected by the existence of contamination on the site or nearby. Information regarding aborted sales and independent luations would also be recorded. ˙tially the databank would only contain ta relating to the sales and values of ntaminated properties but in future it uld be expanded so as to include other rms of environmental impairment. It is ggested that the databank would include e information set out in in the box opposite.

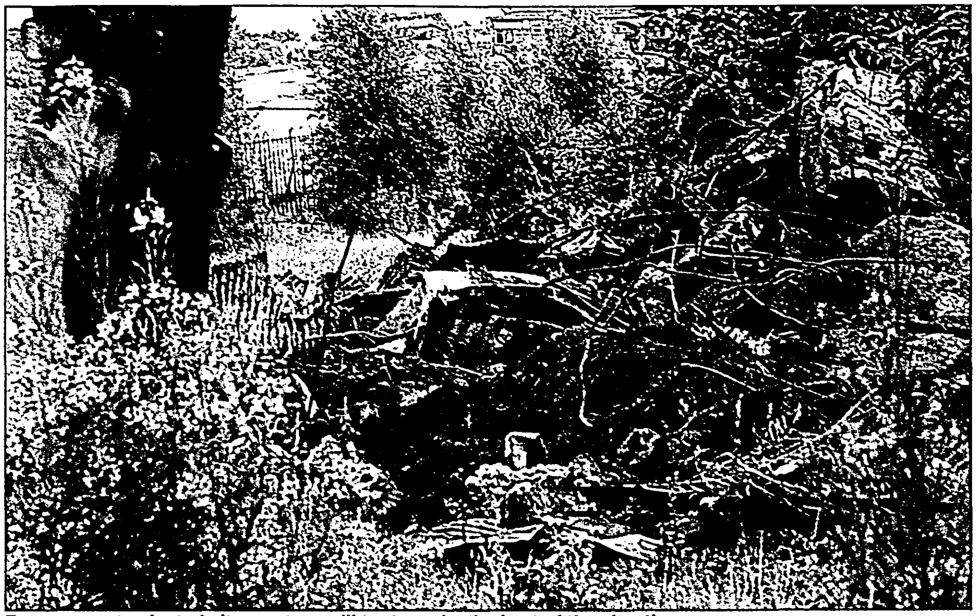
The databank would be available researchers in order to test theories and valuers for use in preparing valuations development appraisals of properties fected by contamination. The databank ould be maintained on computer and formation concerning the property to be lued or to be redeveloped, including its st and/or present uses and the nature of e contamination, would be used to entify the most appropriate case studies r using in assessing the valuation impact.

The researcher or valuer would be ovided with a computer printout ntaining information on the most suitable se studies but probably not their precise dresses because of confidentiality strictions. Regional variations would be en into account if applicable.

Ideally the primary search field for e identification of comparables should be operties which have been used for ilar purposes but, given the problems in taining information in respect of an equate number of similar properties, it is ticipated that, at least in the short term, mparisons will be made on the basis of k levels and types of contamination. As e number of records in the databank reases, the procedures used in entifying suitable comparables would be bject to revision, so as to improve the curacy of the valuation method.

In addition to being used for the velopment of valuation methods the tabank would be of considerable benefit recording information as to the costs of aling with the physical aspects of land ntamination. Information of this nature l be required by valuers in order to mply with Guidance Note 2, paragraph .2 in respect of the costs to be taken into ount, in order to arrive at the value of a maged property. This data would also able assessments to be made as to ether or not alternative methods of aiming contaminated sites produced fering impacts on end values.

There is no easy solution to the blem of valuing properties affected by tamination but valuers must use their t endeavours to arrive at realistic values. not appropriate to decline to prepare valuations unless clients first appoint other consultants to provide detailed information; nor is it appropriate to produce valuations which state that any possible impairment has been disregarded, especially when there is a strong probability that some contamination may be present.



Even on contaminated sites, nature will try to make the best of the situation

Photo: Paul Syms

Valuers must not mislead their clients and need to take care that they are not negligent in the advice which they provide, nevertheless valuers have long been accustomed to making judgements as to a wide range of factors which may impact the value of a property.

Why should environmental matters be treated any differently to other factors affecting value? The problems lie in the lack of accepted methods of preparing valuations and the lack of adequate information concerning properties affected by environmental impairment. It is also likely that the current Guidance Note 2 will have to undergo extensive revision once Parliamentary Guidance has been issued.

This article has suggested a means by which a reasonably reliable source of data may be established but this should be regarded as no more than a single stage in the development of suitable valuation methods. Whether or not it will be possible to compile a databank which is suitable for use in practice remains to be seen. It is hoped, however, that a pilot study of such a databank will be undertaken at Sheffield Hallam University.

The task of setting up a databank depends largely on the willingness of surveying firms, and other organisations, to make the data available and upon the development of suitable computer software.

If you are prepared to assist the project, through the provision of case study data and in testing theoretical models against actual valuations, then please contact me on:
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Contaminated land and other forms of environmental impairment: an approach to valuation

Paul Syms

Accepting instructions

Valuers are faced with a dilemma when preparing valuations of land and buildings used, at present or in the past, for a purpose which may result in some form of environmental impairment. The use of clauses stating that valuations will only be issued, or may be revised, in the light of subsequent environmental data concerning a property may be acceptable in circumstances where the site is vacant, or when redevelopment is proposed and there is no competition from other potential purchasers. But in almost all other circumstances, it is suggested that such an approach is unlikely to be acceptable to clients and does not provide the standard of service which should be expected of a responsible profession.

A report hedged with caveats concerning environmental risk may be of little use to a client interested in acquiring a manufacturing business and wishing to satisfy himself as to the value of the premises to be included in the purchase. The same argument may also apply in situations where the valuation is required for accounts purposes, or for bank security purposes where lending is to be secured against the business as a whole, rather than simply against the property assets. A recommendation that a land quality statement be produced (see RICS, 1995a) is not very helpful in circumstances where the nature of the operational use of the premises rules out the possibility of an invasive site investigation and a consequent report which reserves the right of the valuer to reconsider the valuation, in the light of future information regarding environmental risks, may be totally unacceptable to the bank.

Valuers are right to be concerned that if they produce valuations which attempt to take account of the existence of land contamination, or other environmental impairment, without full knowledge of the potential liabilities, they may leave themselves open to allegations of professional negligence. It can be argued, however, that if valuers follow an accepted practice in respect of such properties, thoroughly researching available data and ensuring that clients are made fully aware of the limitations in respect of information concerning the property to be valued, then negligence should not be an issue, although valuers may wish to obtain the opinion of their professional indemnity insurer. This paper considers the procedures to be followed by valuers when preparing valuations of potentially contaminated sites and describes a suggested method of valuing premises which are expected to remain in industrial use for the foreseeable future and discusses current research. While the paper deals mainly with land contamination, it is suggested that the procedures described can be applied to other forms of environmental impairment.

In its original guidance on the valuation of contaminated land (RICS, 1993), the RICS identified 14 activities as being the uses most likely to cause contamination. This is a relatively small number of uses and in marked contrast with the 16 groups, divided into 42 sub-groups, affecting between 80 and 100 industries, as contained in the Department of the Environment's original consultation paper (DoE, 1991), issued in respect of the registers which were proposed to be established under Section 143 of the *Environmental Protection Act 1990*. Admittedly, the Department subsequently reduced its list to eight uses (EPA, 1992) and eventually abandoned the proposed registers, although it must be pointed out that the Labour Party has promised to introduce similar legislation, if and when it is returned to power (Barnett, 1995). Drawing on earlier proposals and having regard to their shortcomings, a schedule of 26 uses was prepared (see Appendix 1), in an attempt to identify those activities where valuers should proceed on the assumption that contamination may exist.

This list of uses should not be regarded as exhaustive, it does not for example include any agricultural activities, although the burying of diseased animals was included in the DoE's original schedule (DoE, 1991), and other food-related industries have been excluded, although many of these have the potential to cause contamination. General warehousing (B8 use) was also excluded, although this should be regarded as a potential problem area, especially if adequate documentation cannot be obtained in respect of goods which have been stored on the premises. In spite of these omissions, however, it is considered that the list fairly represents those uses which have the greatest potential to cause serious contamination and the list of uses, with two omissions and four additions, has been adopted for use in the latest RICS guidance note (RICS, 1995b)[1].

When receiving an invitation to carry out a valuation on a property which may suffer from some form of environmental impairment, valuers must first of all decide whether they wish to accept or decline the instruction. It is essential that any instruction must be clearly defined and agreed. Similarly, before indicating acceptance to the client the valuer needs to assess whether the type of property, disregarding any potential environmental impairment, is within his

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or her sphere of competence. If the type of property, and the locality in which it is situated, is such that the valuer feels comfortable in accepting the instruction, then as much information as possible should be obtained from the client and other sources, including archives. With this in mind, a list of 16 questions has been prepared, not all of which will be relevant if contamination is not suspected (see Appendix 2). In addition to the questions, there will undoubtedly be other questions, of a site-specific nature, which need to be answered. Assuming that adequate answers are received, the valuer should be in a position to decide whether or not it is possible to prepare a valuation on the basis of the information available.

If adequate answers are not received, or if they reveal inconsistencies, or simply lead to the conclusion that insufficient information is available, then it may be appropriate to advise the client to commission a comprehensive site investigation, in accordance with the procedures set out in the British Standards Institution's *Draft for Development Code of Practice for the Identification of Potentially Contaminated Land and Its Investigation* (DD175, BSI, 1988), with a view to the preparation of a full land quality statement. On the other hand if the information obtained, albeit confirming that contamination exists, is sufficiently detailed to proceed with a valuation, how should that valuation be produced?

A valuation method

Current guidance on the valuation of contaminated land, for valuers in the UK, is contained in Guidance Note 2 (GN 2) of the RICS Appraisal and Valuation Manual (RICS, 1995b) and in the publication *Contaminated Land: Guidance for Chartered Surveyors* (RICS, 1995a). Paragraph 2.9.2 of GN 2 details eight heads of costs which should be taken into account when preparing valuations, net of grants or other financial incentives. Taking account of these costs is relatively straightforward in situations where sites are to be redeveloped in the short term, especially if it has been possible to prepare a land quality statement. However, when the property is to remain in industrial use, either for its current use or for some other use which would not require a change of use planning consent, the need to undertake site remediation may be deferred for many years. The example given in Table I example suggests a method which might be applied in such cases.

It will be noted from the example that no cost has been included for items (c) and (d), the costs of process redesign and penalties/civil liabilities. This is because these should be regarded as immediate costs, not capable of deferment to the end of the economic life of the buildings. There may also be a case, depending on site specific circumstances, for treating all or part of item (b) in the same way. All such non-deferable costs should be treated as current liabilities in the valuation and specifically reported upon.

No allowance has been made in the valuation in respect of any grants or other incentives which may be available towards the cost of dealing with contamination. This is in spite of the fact that GN 2 makes reference to the need to reflect grants, or other financial incentives, in the valuation. The government has adopted the principle of "polluter pays" (DoE, 1990) and does not consider it appropriate to use public money in clearing up contamination resulting from industrial activities. Even in situations where the property is no longer owned by the original polluter, the attitude is that land values should reflect the cost of dealing with contamination. This was confirmed by the Department of the Environment in its *City Grant Guidance Notes* (DoE, 1992), which stated that "if the site value is high it may be reasonable to assume that the land or buildings can be used or developed without grant" and that the appraiser "will ask what the site is likely to fetch if sold now, in its existing physical condition … on the assumption that grant will not be available. In many cases this value will be negligible" (DoE, 1992).

A similar approach to existing site values is being applied by English Partnerships, which assumed responsibility for the grant regimes (formerly, Derelict Land Grant and City Grant) previously administered by the

Unimpaired value (calculated by an appropriate method, such as open market value or depreciated replacement cost, disregarding the existence of any contamination)			£1,500,000
Remediation costs in accordance with GN 2, paragraph 2.9.2 (present cost estimates, applicable as if the site were to be redeveloped at the date of valuation:			
(a) clean-up of on-site contamination		£350,000	
(b) effective contamination control and management measures		£75,000	
(c) redesign of production facilities		N/A	
(d) penalties and civil liabilities for non-compliance		N/A	
(e) indemnity insurance for the future		£10,000	
(f) avoidance of migration of contamination to adjacent sites		£100,000	
(g) control of migration from other sites		£15,000	
(h) regular monitoring of the site		£10,000	
Estimated total cost of treatment		£560,000	
Anticipated economic life of buildings	20 years		
Present value of £1 for 20 years @ 7.5 per cent		0.235413	
Present value of treatment costs			£131,830
Adjusted value (excluding any allowance for stigma)			£1,368,170
Percentage reduction in value attributable to anticipated future remediation	8.79		

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Department of the Environment and now replaced by English Partnership's Investment Fund. It is therefore most unlikely that grant aid will, as a general rule, be made available to tackle the problems of land contamination. The exceptions to this may be in situations where the cost of treatment is significantly in excess of any development value which would accrue from the site, or in circumstances where environmental, as opposed to economic, benefits are the expected outcome of the treatment.

The principal problem in adopting an approach, such as that described above, where detailed costs are not available, is in producing reasonable estimates of the costs involved. Valuers are right to be concerned that any figures which they use may be wildly inaccurate, but is the situation so very different from reflecting the likely cost of dilapidations when preparing a valuation of a building? In both cases the valuer will almost certainly need to consult with other professionals, such as engineers and quantity surveyors, and both valuations may require a degree of subjective judgement on the part of the valuer. Land contamination effects on value may differ from dilapidations effects in two principal respects:

(1) that much of the liability may be hidden from sight; and

(2) the lack of information in respect of site remediation costs.

These effects will require reasoned assumptions to be made and demonstrate the need for a readily available source of costs information. The valuer may also consider it appropriate to include a caveat which describes the information upon which the valuation has been based.

Assessment of stigma

It is suggested that adoption of the procedures and valuation method described should be sufficient to enable valuers to adequately reflect the quantifiable costs of tackling contamination and to provide meaningful advice to their clients. There is, however, an unquantifiable aspect to land contamination; that is the question of stigma, referred to in paragraph 2.9.7 of GN 2 (RICS, 1995b) and specifically omitted from consideration in the valuation method described previously. The existence of stigma has been considered by a number of researchers, most notably in the United States, including Patchin (1988, 1991a, 1991b, 1994) and Mundy (1992a, 1992b and 1992c). Patchin used the term "stigma" to represent a variety of intangible factors from possible public liability and fear of additional health hazards to the simple fear of the unknown (Patchin, 1991a). In the United Kingdom context and for the purpose of this paper it is suggested that stigma be defined as:

> That part of any diminution in value attributable to the existence of land contamination, whether treated or not, which exceeds the costs attributable to a) the remediation of the subject property, b) the prevention of future contamination, c) any known penalties or civil liabilities, d) insurance and e) future monitoring.

In other words stigma should include all those matters likely to have an influence on value, other than those which are readily quantifiable or for which reasonable estimates can be produced. This is a slightly different approach from that which was contained in paragraph 7.6 of the previous guidance note VGN 11 (RICS, 1993), where stigma was listed as only one of seven influences which might affect market value. It has subsequently been accepted that these influences should all be regarded as "unquantifiable" and that it would be impossible in most cases to distinguish between them. Therefore the term "stigma" should now be used as a collective term to describe all such costs, including the following:

- inability to effect a total "cure";
- prejudice arising out of the past use(s) (referred to as stigma in VGN 11);
- risk of failure of treatment;
- compensation payable or receivable, under Section 78G of the Environmental Protection Act 1990 or otherwise;
- risk of changes to legislation or remediation standards;
- reduced range of alternative uses of the site;
- uncertainty.

The impact of stigma would, at first sight, seem difficult to assess through the use of conventional valuation techniques; however, Patchin (1994) suggested the use of a "sales comparison approach". In his paper Patchin described eight case studies where agreed transactions had failed to be completed, or had been completed at reduced sales figures, as a result of contamination. From these case studies Patchin postulated that the impact on property values, attributable to the stigma of contamination, was between 21 per cent and 94 per cent[2] of the unimpaired value of the properties. In all cases, remediation work had been undertaken, so as to render the site "fit for use", or the site itself was not contaminated, but merely suffered from the effect of being adjacent to a contaminated property. The wide variation in impacts was, he suggested, due to differences in the severity of contamination and whether the site itself was contaminated, or merely adjoining contamination.

Patchin suggested that the case study examples should be used as comparables in respect of other properties for which values have to be determined. The basis of comparison would not, however, be the usual valuer's method of comparing the similarities and dissimilarities of properties, in terms of location, site, size and specification. Instead, comparisons would be made as to the nature and extent of contamination so as to assess the percentage stigma effect to be applied in respect of the property to be valued. The case studies would be used in assessing the impact of stigma on property values using the method set out in Table II.

Table II.
A method of assessing stigma

Unimpaired value (a medium hazard risk property as used in previous example)			£1,500,000
Present value of remediation costs (as from previous example)			£ 131,830
Impaired value 1 – not allowing for stigma			£1,368,170
Comparable case studies			
Case study number	Indicated loss of impaired value 1 due to stigma	Comparison to property to be valued	
1	25.9 per cent	Treatment completed, stigma caused by fear of additional contamination, less severe than subject property	
2	29.2 per cent	No treatment proposed at present, continued industrial use, similar risk level to subject property	
3	20.9 per cent	Site not contaminated but is situated adjacent to a contaminated site	
4	32.7 per cent	Similar type of contamination to subject property but slightly more severe	
5	45.4 per cent	Heavily contaminated site, derelict land, more severe than the subject property	
Range of stigma effects indicated by comparables is 20.9-45.4 per cent			
Comparables closest to subject properties 2 and 4 are 29.2-32.7 per cent			
Therefore stigma applicable to the subject property is 31 per cent			
Amount of stigma @ 31 per cent of impaired value 1.			£424,133
Impaired value 2 (taking account of treatment and associated costs and stigma)			£944,037
			say £944,000

The total fall in value, reflecting both the physical and non-physical aspects of the contamination impact, is therefore £556,000 or 37.1 per cent of the open market value of the property disregarding the existence of the contamination. While it is appropriate, in circumstances such as the example described above, to defer most of the physical costs of remediation, the stigma effect must be applied as a current liability. This is because the calculation of stigma reflects present-day attitudes to the former use of the premises, the type of contaminants and the associated hazard level.

Patchin acknowledged, in both 1991 and 1994, the problems involved in obtaining data on transactions, failed or completed, concerning contaminated property. This is an even greater problem in the UK where there is no public, or professional, access to information regarding property transactions. It should also be stressed that, in using any case study or sales comparables methods in attempting to identify the extent of stigma on real estate values, values and prices paid may be affected by a number of factors other than contamination. Therefore it is important to identify those determinants which relate most directly to the contamination issue.

The majority of valuers are unlikely to encounter many sites during the course of a year where environmental impairment is an issue requiring specific consideration, let alone sufficient sites suffering from the problems caused by the same use or contaminants, to enable them to use market evidence in the normal way in order to arrive at their valuations. The exception may of course be in the preparation of asset valuations for major firms engaged in potentially contaminative activities but, in any event, such clients will be expecting the valuer to produce valuations which take account of data other than that contained in the company's own files. Developers and their advisers are also unlikely to have sufficient information on impaired property values, from which to assess the true worth of a potential development site.

Given the difficulties involved in obtaining appropriate comparables each time a contaminated property is to be valued, or developed, and the need to identify the applicable determinants attributable to the valuation impairment, it is proposed that a national databank of comparables be established. Initially, this would contain data relating to the sales and values of contaminated properties, but in future it could be expanded so as to include other forms of environmental impairment. It is suggested that the databank would include the information set out as follows:

- *General information*– address of the property: tenure; site area; floor area of buildings; age of buildings; present or immediate past use; previous use(s).
- *Contamination information* – nature of the primary contaminant; nature of the secondary contaminant(s); whether site investigation and/or risk assessment undertaken; date of site investigation/risk assessment; hazard level of primary contaminant; hazard level of secondary contaminant(s).
- *Treatment information* – whether a programme of treatment has been undertaken or is proposed; main method of treatment undertaken or proposed; secondary treatment method(s); post-treatment hazard level
- *Valuation information* – unimpaired value; disposal price; uncompleted sales price(s); treatment cost, actual or estimated; the availability of grants or other incentives.

The databank would be available to valuers for use in preparing valuations or development appraisals of properties affected by contamination; information concerning the property to be valued, including its past and/or present uses and the nature of the contamination, would be used to identify the most appropriate comparables. Whether or not it will be possible to compile a databank which is suitable for use in practice remains to be seen. The task of setting up a databank depends, to a very large extent, on the willingness of surveying firms, and other organizations, to make the data available and on the development of suitable computer software. Anyone interested in participating in the project, through the supply of data and in testing theoretical approaches in actual valuation situations, is asked to contact the author.

Notes

1. The uses "Mining and extractive industries" and "Textiles manufacture" were omitted from the RICS Guidance Note, with petrol storage sites, pipelines, animal products works, and defence and research establishments being added (RICS, 1995b).
2. Doubts were subsequently raised, by the present author, about the validity of Patchin's most severely affected case study and for practical purposes the outcome of Patchin's work should be a finding that contamination may result in a reduction in value of between 21 per cent and 69 per cent.

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Appendix I. List of 26 uses of land having the potential to cause serious contamination

(1) Asbestos manufacture and use.
(2) Chemicals manufacture and storage.
(3) Dockyards and wharves.
(4) Dye-stuffs manufacturing works.
(5) Electricity generating stations.
(6) Explosive industry.
(7) Gas works and similar sites.
(8) Glass manufacturing.
(9) Heavy engineering works.
(10) Iron and steelworks.
(11) Metal smelting and refining.
(12) Metal treatment and finishing.
(13) Mining and extractive industries.
(14) Oil refining and storage.
(15) Paint manufacture.
(16) Paper and printing works.
(17) Pharmaceutical industries.
(18) Radioactive materials processing.
(19) Railway land.
(20) Scrapyards.
(21) Semiconductor manufacturing plants.
(22) Sewage treatment works.
(23) Tanning and leather works.
(24) Textiles manufacture.
(25) Timber treatment works.
(26) Waste disposal sites.

Appendix II. Questions which need to be asked before accepting a land valuation instruction

(1) What is the present, or last known use of the property?
(2) Is there documentary evidence of the past uses and development of the site?
(3) Are the present or past uses likely to be potentially contaminative in nature?
(4) What is the land use history in the immediate vicinity, say, within one kilometre?
(5) What is the geographical and geological setting of the site?
(6) Are there any known, or suspected, mineshafts or landfill sites in the vicinity?
(7) Has there been asbestos product manufacture or iron and steel smelting in the area?
(8) Is there a waterway or watercourse near the property?
(9) Is the site underlain by a producing aquifer?
(10) Has any fly tipping taken place?
(11) Has there ever been a programme of asbestos removal from the property?
(12) Does documentary evidence exist of any tanks or pipeworks having been emptied or flushed?
(13) Has there been any on-site disposal of manufacturing wastes or other residues and, if so, is adequate documentation available?
(14) Do plans of past and present buildings or works exist and are they complete?
(15) Has the present, or previous, occupier complied with all statutory regulations relating to the nature of the business and, if so, is there documentary evidence of such compliance?
(16) Has a decommissioning audit been carried out and/or has any past contamination been dealt with?

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