Environment Agency

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Addressing environmental inequalities: waste management

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Steve Killeen

Head of Science

Executive Summary

Background

Addressing environmental inequalities is a major theme of the UK Sustainable Development Strategy and one of the three principles of the Environment Agency's social policy**.** Understanding more about the inequalities which may arise in waste management, and developing ways of addressing these inequalities, are particularly relevant to the Environment Agency as a regulator of waste facilities and to other organisations involved in waste management.

Aims of the project

The main aims of this Environment Agency science project were to:

- help the Environment Agency understand the social impacts of waste management and the policy context for addressing them;
- examine the social distribution of waste sites in relation to deprivation and the methodological issues involved in undertaking this analysis;
- make recommendations for the most effective ways of addressing inequalities in relation to waste management.

Methodology

A review of the literature on the social impacts of waste management and policy measures relevant to waste management and environmental inequalities was undertaken. This was supported by a two-day interactive workshop held with stakeholders from within and outside the Environment Agency to inform the review work and to explore perspectives on the future development of policy. Finally, a GIS-based data analysis using Environment Agency datasets on licensed waste sites for England was carried out to examine the deprivation characteristics of populations near to waste sites in North West Government Office region of England.

Environmental justice and waste management facilities

The environmental justice agenda was pioneered in the USA where a number of studies of the association between waste facility locations and patterns of ethnicity and income provided evidence for campaigners to claim widespread distributional injustice. The methodological soundness of these studies has, however, been challenged and there are unresolved debates about how and why such patterns might exist. In the UK, the evidence base is less substantial, with a few studies suggesting that there may be an association between deprivation and the locations of landfill sites and incinerators.

The social impacts of waste management facilities

There is an extremely comprehensive literature on the potential social and environmental impacts of waste management facilities, including both UK-based

studies and international research. The potential health impacts have been particularly widely debated and documented, not least regarding landfill sites and incinerators. In addition to health impacts, the potential social impacts of waste facilities include:

- nuisance impacts (e.g. odour, visual intrusion, noise, vermin, etc.);
- economic impacts (e.g. the potential reduction in housing value for housing stock in close proximity to waste sites, employment);
- geographical or community impacts such as blight and stigmatisation;
- political impacts in terms of the ability of communities to mobilise against future siting decisions or engage in recycling

The potential benefits of waste facilities have to be considered alongside any adverse impacts. Not least, facilities are essential for dealing with waste arisings which, if insufficiently managed, could have serious negative environmental and social impacts.

Waste facilities vary significantly by type, size and capacity. While it is possible to characterise generic impacts associated with particular types of facility (composting, landfill, materials recycling facility, civic amenity site, etc.), social impacts are location dependent and ultimately may only be determined through a detailed site-by-site analysis.

The extent to which impacts may affect particular social groups is uncertain, with little specific evidence about the social differentiation of impacts from waste management. Some potential impacts that could vary amongst different social groups can be suggested. In deprived communities with elevated rates of bronchial illness, for example, individuals may be more vulnerable to some health impacts from living close to facilities with emissions to air than individuals with better health but the same level of exposure. However, this example highlights the important issue that waste facilities may not be the only contributor to adverse impacts locally and it is essential to understand the relative impacts of different sources.

Waste management and deprivation: data analysis

Because of the difficulty involved in assessing the social impacts of waste management sites at a national level, a preliminary and exploratory quantitative GIS-based analysis was undertaken to:

- examine the distribution of waste facilities in England;
- examine the relationship between waste facility location and multiple social deprivation in an English Government Office region – the North West.

The analysis did not seek to provide definitive results, but to further understand the methodological problems involved and to test some ways of using available data.

The analysis attempted to differentiate between sites in terms of site type, date of licence and the environmental risk score allocated to sites by the Environment Agency under its Operator Pollution Risk Appraisal (OPRA) system as a means of determining

inspection priorities. Undertaking this work has highlighted the complexities of the waste sector, the diversity of licensed waste sites and the need to develop a sophisticated approach to equity analysis.

Methodological problems associated with the analysis include:

- the use of circular buffers around sites to measure population characteristics;
- the use of grid reference points to locate sites which vary enormously in their size and shape;
- issues with aspects of the waste site data related, for example, to what the data do and do not measure, the consistency of data collection and the time periods for which data are available.

For these reasons, it would be wrong to use the results to indicate numbers of people who are suffering harm or who are at risk from a nearby waste site, or even to imply any form of adverse social impact due to proximity.

With these important and fundamental caveats in mind, the methodology developed to analyse the relationship between the location of waste facilities and multiple deprivation suggests that in the North West region:

- more deprived populations are more likely to be living nearer to waste sites than the less deprived, except in the case of landfill sites where it is the **least** deprived populations who are more likely to live nearby;

- this pattern is consistent over the last 25 years of licence approval, but there are issues with the licence data which make this analysis particularly problematic;

- sites with the highest potential environmental impact (as indicated by their OPRA scores) are **not** found near to the most deprived populations;

- deprived populations are more likely to be living near to facilities which have not complied with the conditions of their permit (licence) at least once. This bias is over and above the general pattern of concentration of sites towards deprived populations. However, the analysis was based on only one year of compliance data.

Policy implications and recommendations
Exploring the relationships between waste management facilities, social impacts and environmental inequality raises important policy issues. There is the possibility that:

- deprived communities are both more vulnerable to the potential negative effects of proximity to waste facilities, and
- waste facilities may be disproportionately situated close to deprived communities (our initial exploratory and limited regional analysis indicates that

the latter might be the case, except for landfills, but by no means provides definitive evidence).

If vulnerability and location are linked to deprivation in this way, there is a need to understand how and why this has happened – including the political, planning and social pressures that generate this situation. However, it also suggests a need to ensure that the current assessment approaches to land-use planning as well as the process and site licensing decisions for which the Environment Agency has responsibility consider social impacts and equity issues adequately and openly.

New policy approaches which bring sustainability into the heart of government policy and which aim to explicitly consider issues of inequality and community at local and regional scales are important steps in overcoming some of the shortcomings of established assessment tools and appraisal instruments. In particular, changes to the planning framework, the advent of Regional Spatial Strategies and the increasing formalisation of tools such as sustainability appraisal are welcome improvements – provided they are implemented properly and enhance integration.

Policy pressures aside it is self-evident that facilities are more likely to be required and located in urban areas close to the point of waste generation, in proximity to other facilities that provide related services, close to good transport networks and to industrial as well as domestic waste sources. New facilities are likely to be attracted to sites previously used for waste management to optimise the potential of gaining planning consent. Therefore, there will continue to be an inevitable spatial co-location between waste sites and deprived communities. This clearly has significant implications for our ability to pursue ideals of environmental justice in the context of waste management.

In addition, the operation of the waste hierarchy and the recommendation that waste should be reduced, reused, recycled or recovered in preference to disposal may privilege certain types of waste stream response over others. For example, the increased reliance on recycling as a means of managing waste in the future has its own potential consequences with regard to site location and operation, with potentially a greater spatial dispersal of smaller sites.

This report makes the following recommendations.

- Further research is needed to improve our understanding of the social impacts and risks relating to geographical proximity to environmental impacts/hazards. This research should build on the exploratory analysis undertaken in this and other projects. It should include detailed longitudinal case studies to understand how and why waste facilities have come to be located closer to deprived communities, and how this situation might change in the future.

- A continuing programme of research based on cumulative impacts and particularly the extent to which they can be (a) identified, (b) assessed and (c) incorporated into meaningful policy is urgently needed.

- There is a need to better understand how environmental equity is taken into account in waste planning, siting and licensing decisions (particularly through existing assessment approaches) and to identify how decisions in this context could be enhanced. Such a research project could explore a number of recent case examples of different decisions with the aim of identifying limitations, and barriers to, the integration of equity considerations in decision-making, including important decision process considerations such as public participation.

- A better understanding is needed of public attitudes and behaviours towards different waste management options such as recycling, rates of which tend to be lowest in deprived and low-income areas.

- The development of future waste management scenarios should take account of the implications of different waste management options, their social impacts and implications for environmental equity under different resource use and waste generation conditions.

- Consideration should be given to the needs of excluded groups and deprived communities who will require access to additional resources (including information) and support if they are to make effective use of opportunities for participation in waste management decisions.

- There is a need for further research to explore whether living close to different types of industrial, including waste, facilities causes actual adverse outcomes.

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1. Introduction

This is one of five reports produced as part of a research project commissioned by the Environment Agency on environmental inequalities in relation to flood risk, waste management, water quality and cumulative impacts. This report deals with environmental inequalities and waste management.

There is, therefore, a general context for the project in addition to particular aspects of the policy and research context for environmental inequalities in relation to waste management. This section outlines both the general and specific context for the project, sets out its overall objectives and indicates the methods used to achieve those objectives related to waste management.

1.1 Context for the research project

The Environment Agency has a wide-ranging role in protecting and improving the environment in the context of achieving sustainable development. It is developing a strong social dimension to its work, recognising that social exclusion can have important environmental dimensions and that all people should have a right of access to a decent environment and to essential environmental resources.

The Environment Agency's social policy is defined through three principles:

- understanding and communicating the social impacts of its work, including opportunities to delivery combined environmental and social benefits;
- addressing environmental Inequalities;
- transparency, participation and access to information.

It has also developed a social appraisal framework (Warburton *et al.* 2005), which subdivides its social policy into six themes:

- promoting health, safety and well-being;
- improving local communities;
- promoting social justice and social inclusion;
- demonstrating the Environment Agency's corporate social responsibility;
- increasing access to information and participation;
- capacity building and learning.

This project focuses on addressing environmental inequalities. This is one of the Environment Agency's three social policy principles and figures centrally in the promoting 'social justice and social inclusion' theme of its appraisal framework.
In a recent position statement, the Environment Agency makes it clear that tackling environmental inequalities and ensuring access for all people to a good quality environment is critical to sustainable development (Environment Agency 2004a). The position statement sets out the role for the Environment Agency in this respect and calls for a series of policy solutions which include 'developing a better understanding of environmental inequalities and the most effective ways of addressing them'. This position statement builds on a programme of sustained attention given to questions of environmental inequality and social justice within the Environment Agency over the past five years. This has involved working with and responding to the allied agendas of other organisations within and outside government.

Examples of the ways in which the wider political and policy context has evolved over this period include:

- the work of non-governmental organisations (NGOs) such as Friends of the Earth (FoE), which has identified environmental justice as campaigning and research theme, with FoE Scotland in particular making environmental justice a key part of its advocacy work (Dunion 2003);

- a series of pamphlets and publications produced by NGOs, consultancies and political groups highlighting the linkages between the current Labour Government's priorities on social exclusion and the social dimensions of environmental concerns (e.g. Boardman *et al*. 1999, Jacobs 1999, Foley 2004);

- speeches by major political figures such as Jack McConnell, Scotland's First Minister, who in 2002 stated 'For quality of life, closing the gap demands environmental justice too. That is why I said … that environment and social justice would be the themes driving our policies and priorities...' (McConnell 2002) and Tony Blair who argued in 2003 that 'by raising the standards of our local environments overall, we have the greatest impact on the poorest areas' (Blair 2003);

- programmes of work and reports by government departments and agencies exploring the connections between economic, social and environmental policy areas, e.g.
  - the Social Exclusion Unit work on transport and social exclusion (ODPM, 2003);
  - the Sustainable Development Commission (2002) vision focusing on the connections between regeneration, poverty and environment;
  - the Neighbourhood Renewal Unit (NRU) reports on environmental exclusion (Brook Lyndhurst 2004) and achieving environmental equity through neighbourhood renewal (ODPM/NRU 2003);

- the 1998 Aarhus Convention (UNECE 1999), a pan-European treaty that aims to give substantive rights to all EU citizens on public access to environmental

information, public participation in environmental decision-making and access to justice in environmental matters;

- the new national sustainable development strategy, *Securing the Future*, (Defra 2005a), which aims to 'ensure a decent environmental for all', has clear commitments to address and research environmental inequalities and to 'fairness' in the development of sustainable communities.

Within the Environment Agency, important indicators of policy evolution have included the debate on environmental equality at the 2000 Annual General Meeting, and the reports *Our Urban Future*, (Environment Agency 2002a), and *The Urban Environment* (Environment Agency 2002b) which provided some initial analysis of relationships between environmental quality and social deprivation.

A research project undertaken by Staffordshire and Leeds Universities for the Environment Agency (Walker *et al.* 2003) explored evidence of inequalities and acted as a stimulus for debate (Chalmers and Colvin 2005) in three major areas of the Environment Agency's work – flooding, industrial pollution and air quality. The research provided a literature review, scoping and gap analysis of potential topics for investigation, drawing on the expertise of a range of stakeholders. It provided an empirical analysis of environmental data sets against the Index of Multiple Deprivation (IMD) at ward level (separately for England and Wales) (NAW 2000, ODPM 2004) identifying varied patterns of inequality. In developing policy and research recommendations for this work, the research team emphasised:

- the need for careful consideration of methodological issues;
- the limits on what the analysis could reasonably conclude;
- the need for further research, including in the area of cumulative impacts.

There is now a growing body of related UK-based research examining questions of social distribution and environmental inequality. This has recently been reviewed in a Sustainable Development Research Network (SDRN) rapid research and evidence review for the Department for Environment, Food and Rural Affairs (Defra) (Lucas *et al.* 2004). This review found that the research base is interdisciplinary in nature, drawing on a diverse range of quantitative and qualitative research methods and approaches. The available evidence suggests that patterns of environmental injustice are varied and complex and that there is, therefore, a need for some caution in making claims of inequality and to be wary of over-generalisation.

However, there is mounting evidence that:

- environmental injustice is a real and substantive problem within the UK;

- problems of environmental injustice afflict many of our most deprived communities and socially excluded groups;

- both poor local environmental quality and differential access to environmental goods and services have a detrimental effect on the quality of life experienced by members of those communities and groups;

- in some cases not only are deprived and excluded communities disproportionately exposed to an environmental risk, they are also disproportionately vulnerable to its effects;

- though more needs to be known about both the causes and impacts of environmental injustice, research is also needed to support the development and effective implementation of policy measures to address and ameliorate the impacts of environmental injustice.

This project will add to the research and evidence base that already exists in important areas of responsibility for the Environment Agency. It will build directly on previous research and contribute to the commitment to further research made in the Government's sustainable development strategy.

1.2 Overall objectives of the research project

The project aims to gain a better understanding of environmental inequalities and the most effective ways of addressing them. The project is divided into two parts:

Part 1 will:

- help the Environment Agency to understand the social impacts of waste management, flooding and water quality on deprived communities, and the policy context for addressing these;

- examine the social distribution of waste sites, areas at risk from flooding and river water quality, undertaking where possible analysis for both England as a whole and for each of the English regions;[1]

- make recommendations for the most effective ways of addressing inequalities in relation to waste management, flooding and water quality, e.g. by identifying the policy interventions designed to address them with a range of stakeholders and evaluating their relative costs and benefits.

Part 2 will:

- help the Environment Agency to develop an initial understanding of the cumulative impacts of environmental issues in combination on deprived communities;

[1] Wales is excluded from the analysis in this report as the deprivation data currently available is structured differently. A separate report on environmental inequalities in Wales has been produced (Walker et al 2006b)

- identify ways of assessing the cumulative impacts of environmental inequalities, comparing their effectiveness;

- scope and propose an approach to undertaking local case studies that will bring together understanding of cumulative environmental inequalities and ways of addressing them.

1.3 Context and objectives of waste management component

This report focuses on waste management, specifically facilities, and is one dimension of Part 1 of the overall research project.

The licensing and regulation of waste facilities is an important part of the Environment Agency's remit and operational function. Understanding more about the inequalities which may arise in waste management, within and beyond those aspects for which the Environment Agency is responsible, is relevant to its evolving social policy.

As discussed in detail in Section 6, the policy context for waste management has undergone significant change. A major driver has been *Waste Strategy 2000 for England and Wales* (DETR 2000a) (currently under revision). This set out a vision for future waste management in England and Wales, and formalised the waste hierarchy for determining the approach to managing particular waste streams.

In addition, several important European Union waste-related directives have come into force and changes to the UK planning system will have significant impacts on waste management policy. In various ways, these changes are having explicit and implicit implications for social impacts and the extent to which these impacts are considered within the planning and appraisal framework.

The specific objectives of the waste management work within the project are to:

- help the Environment Agency to understand the social impacts of waste management and the policy context for addressing these;

- examine the social distribution of waste sites in relation to deprivation and the methodological issues involved in undertaking this analysis;

- make recommendations for the most effective ways of addressing inequalities in relation to waste management, e.g. by identifying the policy interventions designed to address them with a range of stakeholders and evaluating their relative costs and benefits.

It is important to stress that the work did not attempt to address issues of the social impacts and inequalities of waste management in general (for example differential

uptake of household recycling, differential levels of service provision and mechanisms for charging for waste) but limited its analysis to the issue of distributional inequalities in terms of facility siting. This is not to suggest that broader inequalities of management policy decisions are unimportant nor that further work in this context is not necessary.

1.4 Summary of methods

Three research methods have been applied to achieve the objectives related to waste management. Each has produced different types of evidence and data of both a quantitative and qualitative form.

Review of the academic and policy literature
The review of the literature focused on the social impacts of waste management, and existing and potential future policy measures relevant to shaping and addressing environmental inequalities. Evidence from the literature is used throughout the report, which also highlights gaps in research. In particular, conceptual and methodological issues for the investigation of potential environmental inequalities around waste facilities are discussed.

Stakeholder workshop
A two-day interactive workshop was held in February 2005 with two sessions focusing on waste management issues.[2] The session outcomes are summarised along with presentation materials in Appendix 1.

Twenty-two participants contributed to the discussion including members of the project team, the project board, and other academics interested in issues of environmental justice and also waste management and stakeholders from within and outside of the Environment Agency at national and regional levels. External stakeholders included representatives from:

- Defra
- Welsh Assembly Government
- FoE
- Black Environment Network (BEN).
- Local authorities in London

The workshop took place at an early stage in the project in order to shape and inform subsequent work, before the empirical data analysis had been carried out (see below). The participants did not therefore have an opportunity to review or respond to the empirical results. The workshop was particularly important in informing the work reported in section 4 on how social impacts could be conceptualised and assessed

[2] The workshop was facilitated and documented by Malcolm Eames of the Policy Studies Institute and Karen Lucas of the University of Westminster.

across the diversity of waste facilities licensed by the Environment Agency. It also contributed to ensuring that section 6 on policy interventions captured the various ways in which policy related to inequalities and social factors, and to shaping aspects of the recommendations in section 7. The main themes and outcomes of the sessions were noted during the workshop and checked against recordings of discussion.

Data analysis
An exploratory geographical information system (GIS) based analysis was undertaken using Environment Agency data on licensed waste facilities. The analysis examined the deprivation characteristics of populations living near these facilities.

Some analysis of data was undertaken for England as a whole in terms of the profile of site types, changing licensing patterns over time, and non-compliance with licence conditions.

Patterns of distribution in relation to deprivation data were analysed for one region in order to provide a preliminary exploration of how different data on waste sites might be utilised and the methodological issues raised. To provide some differentiation between sites, Environment Agency Operator and Pollution Risk Appraisal (OPRA for Waste) data were utilised.

A detailed discussion of the methodology used in the data analysis is provided in Section 5.2.

2. Definitions and concepts

This section defines and discusses a number of terms and concepts central to the research undertaken in this project. The need to be explicit about meanings and to distinguish between different but related concepts is particularly important in this relatively new and undeveloped area of policy and research.

2.1 Environmental justice

Like many others, environmental justice is a term open to varying definition and interpretation. Agyeman *et al.* (2003) described it as a 'vocabulary for political opportunity' providing a means of highlighting questions of distribution and procedural fairness across a wide range of environmental policy domains (Stephens *et al.* 2001, Lucas *et al.* 2004).

Environmental justice has evolved over a 20-year period. It originated in protests against the siting of toxic facilities in minority communities in the USA, becoming part of the 'vocabulary' of environmental debate in the UK only over the past four or five years.

Environmental justice is generally defined in normative terms, specifying a set of conditions or expectations which should be aspired to, sought after or demanded. Two definitions provide examples.

The US Environmental Protection Agency (USEPA 1998) defines environmental justice as:

> '… the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including a racial, ethnic, or a socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Meaningful involvement means that: (1) potentially affected community residents have an appropriate opportunity to participate in decisions about a proposed activity that will affect their environment and/or health; (2) the public's contribution can influence the regulatory agency's decision; (3) the concerns of all participants involved will be considered in the decision making process; and (4) the decision makers seek out and facilitate the involvement of those potentially affected.'

The Scottish Executive (2005) defines environmental justice through two statements:

> ‘The first is that deprived communities, which may be more vulnerable to the pressures of poor environmental conditions, should not bear a disproportionate burden of negative environmental impacts.
>
> The second is that all communities should have access to the information and to the means to participate in decisions which affect the quality of their local environment.’

Environmental justice has also been conceived in terms of rights and responsibilities. For example, Stephens *et al.* (2001) identify two key assertions of environmental justice as:

> ‘that everyone should have the right and be able to live in a healthy environment, with access to enough environmental resources for a healthy life’
>
> ‘that responsibilities are on this current generation to ensure a healthy environment exists for future generations, and on countries, organisations and individuals in this generation to ensure that development does not create environmental problems or distribute environmental resources in ways which damage other peoples health’.

A number of different elements or interrelated component parts of environmental justice can be identified from the range of definitions that exist.

- **Distributive justice** is concerned with how environmental ‘goods’ (e.g. access to green space) and environmental ‘bads’ (e.g. pollution and risk) are distributed amongst different groups and the fairness or equity of this distribution (see discussion below).
- **Procedural justice** is concerned with the fairness or equity of access to environmental decision-making processes and to rights and recourse in environmental law.
- **Policy justice** is concerned with the principles and outcomes of environmental policy decisions and how these have impacts on different social groups.
- **Intranational justice** is concerned with how these distributions and processes are experienced and operate within a country.
- **International justice** extends the breadth of concerns out to include international and global issues such as climate change.
- **Intergenerational justice** encompasses issues of fairness and responsibility between generations, such as emerge in debates over the protection of biodiversity.

Though some people may recognise all of these component parts within their working definition or framing of environmental justice, others may take a more restricted or

focused view. For example, much of the US literature on environmental justice has been concerned primarily with intranational distributive justice; while a recently formed NGO, the Coalition on Access to Justice for the Environment (CAJE) in the UK is focusing primarily on issues of procedural justice (CAJE 2005).

There are also differences in the extent to which environmental justice is seen as only encompassing core environmental issues or extends – within a broader sustainability perspective – to include quality of life and social issues which have environmental dimensions to them (e.g. fuel poverty or access to transport) (Lucas *et al.* 2004).

While this project focuses on three core environmental topics (waste, water quality and flooding), the case for taking a broader perspective is also considered within the work on cumulative environmental impacts. Although the report primarily examines questions of intranational distribution (within the review work on social impacts and the data analysis), questions of procedure are also raised at various points and connections with wider international issues are identified.

2.2 Environmental inequality

Environmental inequality – the key term used in this project – is in effect a step back from, or component part of, environmental justice.

Inequality is a descriptive term. To observe or claim an environmental inequality is to point out that an aspect of the environment is distributed unevenly amongst different social groups (differentiated by social class, ethnicity, gender, age, location etc.).

There can be different degrees of inequality depending upon how skewed an environmental parameter is towards or away from the social groups of concern. In addition, this can encompass:

- negative aspects of the environment such as exposure to pollution;
- positive aspects such as access to green space;
- procedural aspects such as access to information or decision-making processes.

However, the crucial point is that an inequality is different to an injustice or inequity. It does not necessarily follow that, because a distribution of an environmental good or bad is unequal, it is also unjust or inequitable. An evaluation or judgement has to be made to progress from inequality to injustice and, as theories of justice make clear, substantially different perspectives can be taken (Young 1994, Liu 2001).

Factors which may be relevant in considering the case for an environmental injustice include:

- the degree of inequality that exists;

- the degree to which individuals have been able to exercise choice in their exposure to an environmental good or bad;
- whether or not an inequality has been created through the exercising of power by a public or private body (e.g. in taking facility siting or flood protection decisions);
- whether or not a pattern of inequality is combined with other patterns of inequality (an accumulation of unequal impacts), or with a greater degree of vulnerability or need amongst a social group, when compared to others;
- the degree to which those exposed to an impact or risk also have a role (direct or indirect) in, or benefit from, its creation.

2.3 Social impact

This project uses the term 'social impact' to consider the nature of the relationship between particular aspects of the environment and associated environmental management activities and the impacts these have on humans.

Current definitions of social impact suggest that the concept should be understood in the broadest terms. For example, the International Association for Impact Assessment (IAIA) takes the term to cover:

> 'all impacts on humans and on all the ways in which people and communities interact with their socio-cultural, economic and biophysical surroundings' (IAIA 2003, p.2).

US guidelines for social impact assessment provide a similarly broad definition:

> 'By social impacts we mean the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values and beliefs that guide and rationalize their cognition of themselves and their society' ((The Interorganisational Committee on Principles and Guidelines for Social Impact Assessment 2003, p.231).

These definitions highlight the need to go beyond narrow understandings of social impacts as measurable effects upon individuals. Data about social impacts may not be available in a quantifiable form (e.g. information about changes to patterns of social interaction or culture) and consideration should be given to effects upon households and communities as well as individuals. Social impacts may also be direct or indirect, immediate or long term, and both positive and negative in character.

The Environment Agency's policy appraisal framework (Warburton *et al.* 2005) adopts a broad view of the types of social impacts which need to be included in policy appraisal and is in line with the approach we have taken in this report.

3. Environmental justice and waste management: review of literature

The review of the literature in this report is divided into three parts. This section provides the context for waste and social impacts research by giving a brief overview of the environmental justice literature in relation to waste facilities. Section 4 considers the nature of potential social impacts and the methodological issues inherent to the study objectives, while Section 6 reviews the development of waste policy.

3.1 US literature

The environmental justice approach was pioneered in the USA by civil rights activists concerned that landfills and polluting industries were invariably sited within predominantly black communities (Bullard 1990). Policy-makers and community activists began investigating the link between race and exposure to environmental hazards during the 1980s (Taylor 2000).

US literature on environmental justice during the 1980s and 1990s drew on research findings regarding the co-existence of deprived and minority communities and undesirable land uses (particularly waste sites) to assert that racial factors influenced outcomes in the following ways (Taylor 2000):

- the increased likelihood of being exposed to environmental hazards;
- the disproportionate negative impacts of environmental processes;
- the disproportionate impacts of environmental policies, e.g.
  - the differential rate of clean-up of pollutants in communities composed of different racial groups (Margai 2001);
  - lower civil penalties for violating environmental laws in poor neighbourhoods than in wealthy neighbourhoods (Lavelle and Coyle 1992);
- the deliberate targeting and siting of noxious facilities in particular communities;
- inequality in the delivery of environmental services such as rubbish removal.

Several national studies made an explicit connection between race and the increased likelihood of being exposed to toxic waste and other hazardous environmental conditions, and the term environmental racism was coined to describe the variety of situations in which racial factors influenced outcomes.

One of the first of these studies to gain widespread publicity was that conducted by Bullard (1983), who examined the solid waste disposal system in Houston, Texas. He argued that comparisons of the percentage of black and non-black residents in the neighbourhoods in the vicinity of waste sites indicated that, although blacks made up

only 28 per cent of the Houston population in 1980, six of the eight waste incinerators and 15 of the 17 landfills were located in predominantly black neighbourhoods.

Subsequently, the United Church of Christ Commission for Racial Justice (UCC-CRJ 1987) conducted the first national analysis of environmental racism in the USA, undertaking a cross-sectional analysis of 415 commercial waste facilities operating under the US Environmental Protection Agency (USEPA) hazardous waste management system. The study related the locations of sites using various statistical methods at zip code level and socio-economic data from the 1980 Census. The research concluded that:

- race was a more significant predictor of where commercial toxic waste facilities were located in the USA than a variety of measures of income, property values and proximity to markets;
- areas with communities hosting the greatest number of hazardous facilities also had the highest composition of minority residents.

Another frequently cited US-based study is one carried out at the University of Michigan (Mohai and Bryant 1992) which focused on the relationship between hazardous waste facilities and race in and around the Detroit metropolitan area. This study found that minorities living in the Detroit area were four times more likely to live near a commercial hazardous waste facility than whites.

In 1994, a revision of the United Church of Christ study by Goldman and Fitton (1994) asserted that the situation for minorities had become even worse during the intervening seven years, such that the percentage of minorities sharing zip codes with hazardous waste facilities rose from 25 per cent in 1987 to 31 per cent in 1993. As a result of this and other studies, an Executive Order was issued in the USA in 1994 requiring federal regulatory agencies to make environmental justice part of all that they do and to consider the impact of policy on minority communities.

3.2 Critiques of the US environmental justice approach

Despite the seemingly compelling findings of numerous studies purporting to have found evidence that poor and minority communities are more likely to bear the burden of the siting of waste facilities, this research has not gone unchallenged.

- Bowen (2002) argued that the empirical foundations of environmental justice research were so underdeveloped that little could be said with scientific authority regarding the existence of geographical patterns of disproportionate distributions and minority or poor communities.

- Anderton *et al.* (1994) found no nationally consistent and statistically significant differences between the racial or ethnic composition of Census tracts containing waste facilities and those that did not.

- Oakes *et al.* (1996) found no evidence of environmental inequity or disparate impact.

- In a recreation of Bullard's (1983) study of Houston, Been (1994) was unable to replicate the results that Bullard had reportedly uncovered.

One of the reasons for the lack of convincing evidence in many US studies has been argued to be their reliance on **outcome** (in)equity as the main focus of study, i.e. analysis of the current distribution of waste facilities and their geographical relationship to deprived communities. In recent years, research has turned to an analysis of **process** equity in attempt to uncover the mechanisms behind observed outcomes, i.e. the manner in which environmental inequalities may be produced. Pellow (2000) argues that environmental inequality should be redefined as a socio-historical process rather than simply a discrete event.

Ringquist (1997) identifies two main explanations that are generally given in the environmental justice literature for the distribution of polluting facilities and thus for the distribution of environmental risk. The first argues that poor and deprived communities are deliberately targeted as prime location sites for polluting facilities either because of explicit discrimination, or because of their lack of political power and ability to mobilise opposition to siting decisions. The second argues that the reasons for observed correlations are more likely to be explained by reference to market rationality and neighbourhood transition such that the higher percentages of minority and disadvantaged people living near industrialised areas might reflect a pattern of inequity that is inherent in the structure and pattern of the growth of urban areas.

Proponents of the argument that deprived communities may have developed after facilities were sited in an area have become more prevalent in recent years. There is now a recognition that detailed socio-historical and longitudinal studies need to be conducted in order to uncover the complex issues and chains of decision-making that might underlie any geographical correlations between deprived communities and undesirable facilities. In this way, Krieg (1995) argued that a treadmill effect based on pre-existing industries, falling land values and low-income housing was primarily responsible for bringing toxic facilities and poor and/or minority communities together. Similarly, Been (1994) argued that facilities now located in minority or low-income areas may not have been sited in such areas originally and that, in some instances, poor or minority residents came to an area after the decision to site a facility there had already been made – a conclusion echoed by Callewaert (2002).

The US research community remains mired in 'chicken and egg' debates over whether facilities were located in deprived communities or the deprived communities developed after siting took place. Despite over 20 years of research (albeit often driven by particular interests and motives) and significant development in methodology, there is no emerging evidence or consensus about real impacts on deprived or vulnerable communities. Importantly, virtually no US literature has examined land use and siting practices (i.e. the process issues) in this context. This is an important omission in that:

- the planning process in the USA is not so well developed nationally as in the UK;
- environmental impact assessment (EIA) has not been applied to private projects;
- land-use zoning practices have rarely been analysed in the waste context.

3.3 UK literature

As discussed earlier, UK work on environmental justice has had a broader focus, positioned not in a civil rights agenda but on issues of environmental quality, social deprivation and equity, and the sustainable development agenda (Petts 2005). Although it has been argued that environmental justice is not just about deprived communities and that inequity is where any form of environmental hazard burdens any particular social group (Pellow 2000), the issue of environmental justice in relation to deprived communities is increasingly being made a focus of policy concern in the UK.

Although there has been a general recognition that deprived communities are likely to experience disproportionate levels of pollution and other forms of environmental degradation (Mitchell and Dorling 2003, Wheeler 2004), the evidence base for policy development has been lacking (Walker *et al.* 2003).

A study carried out by FoE (1999) was the first in the UK to examine the environmental equity dimensions of polluting site locations. It found that 662 of the Integrated Pollution Control (IPC) sites (which include some larger waste facilities) in England and Wales were located in areas with household incomes of less than £15,000, whereas only five were in areas with an average income of £30,000 or more.

A follow-up study (FoE 2001) correlated Environment Agency factory emissions data with the Index of Multiple Deprivation. This found that 66 per cent of the total carcinogenic emissions in England in 1999 took place in the 10 per cent most deprived electoral wards, with only 8 per cent in the least deprived 50 per cent of wards.

With regard to links between waste incinerator location and deprivation, FoE (2004) presented evidence suggesting that half of the sixteen currently operating municipal waste incinerators in England were located in the most deprived 10 per cent of wards. FoE argued that the siting of unwanted developments concentrates in more deprived areas went against a core requirement for the long-term goal of the Neighbourhood Renewal Unit (NRU) that ‘in 20 years, no-one should be disadvantaged because of where they live’. However, it must be borne in mind that waste incinerators sited near deprived communities can provide benefits – particularly the provision of heat to low-income housing in combined heat and power (CHP) schemes (Petts 2005).

More recently, Walker *et al.* (2003) analysed the distribution of waste sites coming within the IPC regime in England and Wales. They found evidence that these sites

were disproportionately located in more socially deprived areas, though the patterns were more pronounced in the more densely populated England than in Wales. Across the different industry sectors represented within the IPC regime at the time, the waste sector showed the most marked propensity for sites to be located near to deprived populations.

A number of studies have directly or indirectly provided some evidence of the locations of landfill sites in relation to patterns of social deprivation (Petts 2005):

- As part of an epidemiological study, Elliott *et al*. (2001) noted in passing that the area within 2 km of landfill sites in England tended to be more deprived than the reference area used for comparisons, but the relationship is not that strong (only 23 per cent are in the most deprived third of wards).

- In a much less comprehensive study of 21 hazardous waste sites in five European countries, Dolk *et al*. (1998) briefly observed that there is no overall evidence that more deprived communities live near to landfill sites.

- A basic analysis for England by the Environment Agency used landfill site 'density' to examine the relationship between deprivation and proximity to a landfill site. This study concluded that there is a greater area of landfill sites in the most deprived wards compared with less deprived ones (Environment Agency 2002b, Appendix 4).

- Wheeler (2004) examined landfill sites for England and Wales together, differentiating between urban and rural areas. He found that the relationship between a 'landfill index' and deprivation varied between urban and rural wards, with 'complex associations' between deprivation components also identified. In wholly urban wards, a weak trend towards landfills being found in less deprived wards was observed, whereas the reserve relationship was identified in predominantly urban, urban–rural and wholly rural wards.

This evidence base is not substantial or at all conclusive and exhibits many of the difficulties identified in the research literature in the USA – though these have been far more explicitly recognised and acknowledged in UK work. The difficulties and gaps in analysis recognised, for example, by Walker *et al*. (2003) include:

- the extent to which proximity equates with actual adverse impacts;
- the extent and nature of the social distribution of benefits that may compensate for potential adverse effects;
- the relationship between facility locations and continuing and inherent patterns of residential segregation;
- the extent to which informed choice has been exercised by people in choosing residential areas close to waste facilities;
- the extent to which discriminatory decision processes can be identified.

Environmental inequity is therefore a key area in which continued research is needed, particularly regarding:

- the cumulative impacts of environmental risks on deprived communities;
- the differentiation of impacts within certain social groups.

Lucas *et al.* (2004) argue that, where a neighbourhood experiences one environmental problem, this is rarely in isolation. They also argue that some sectors of the population are consistently more adversely affected than others and that these are frequently those that are already recognised as the most vulnerable within society.

4. The social impacts of waste management

There is an extremely comprehensive literature (academic and official) on the potential social and environmental impacts of waste management facilities, including both UK-based studies and international research. The potential health impacts have been most widely debated and documented, particularly regarding landfill sites and incinerators. In addition to health impacts, potential social impacts of waste facilities relate to:

- nuisance impacts (e.g. odour, visual intrusion, noise, vermin etc.);
- economic impacts (e.g. the potential reduction in value for housing stock in close proximity to waste sites);
- political impacts (e.g. the ability of communities to mobilise against future siting decisions and/or to engage in recycling activities)

The impacts of community perceptions must not be ignored, not least because public perception has been accepted in UK case law to be a relevant material consideration in land-use planning. Much work in the UK, Spain, Germany, France, USA and Canada has been carried out over at least a decade into perceptions of waste facilities – focusing primarily on landfills and incineration. A complex multi-dimensional picture is evident in relation to perceptions pre-siting where the following are all evident, albeit to varying degrees:

- concern about physical and social impacts;
- trust in the operators and regulators;
- concern about the strategic need for new plant;
- concerns based on experience of old facilities and nuisance effects.

There are fewer studies with respect to perceptions post-siting but, in general, these show declining concerns and increasing ‘acceptance’. However, this does not mean that where local problems arise (litter, dust, odour, etc.) that communities do not seek regulatory action. An increasing number of major operators in the UK have liaison groups linked to facilities; for example, Onyx (now Veolia) has 15 community liaison groups around energy-from-waste (EfW) facilities and landfills which act as ongoing, formal and informal, community monitoring networks.

The benefits of proximity to waste facilities must be included in any analysis as these may go some way to offsetting some of the perceived and potential negative social impacts associated with waste management facility siting in particular communities. Each of these impacts will be considered in turn, using information gathered from the UK and international literature on waste management.

4.1 Waste facility data

An understanding of the context for the social impacts associated with proximity to waste facilities requires a clear indication of the types of waste facility data available for incorporation into analyses of social deprivation and waste sites. The numbers of licensed waste sites on which the Environment Agency holds data can be grouped as shown in Table 4.1.

Of the waste types outlined in Table 4.1, those coming under the 'other' category can be omitted from statistical analysis due to the small contribution they make to the overall number of sites in England and Wales. Of the rest, landfills are clearly important to the analysis – particularly as Elliott *et al.* (2001) found that 80 per cent of the population of England lives within 2 km of some kind of landfill site. Sites at which recycling is carried out, household waste amenity sites and waste transfer stations are similarly important to any analysis of social impacts and waste management, and will become increasingly so with the future growth in recycling rates.

The incineration numbers (87 sites; 0.81 per cent) 'hide' significant differences in types of activity as they cover clinical waste, sewage sludge, 'in-house' industrial plant linked to chemical processes, and municipal EfW plant. Although the most recent municipal waste management statistics for England (2003/04; Defra 2005b) note that EfW plant account for 9 per cent of household waste, these represent only 16 currently operating municipal waste incineration plants. However, the potential social impacts, benefits and concerns about waste incinerators (particularly municipal waste plant) are well documented within the waste management literature (e.g. Petts 1992, Petts 1994, Petts 1995, Petts 2000, Snary 2002). The impact of the EU Landfill Directive on diversion of waste from landfill is expected to see an increase in number of EfW plants (as at least a further nine have already been granted planning permission). Thus, the percentage of waste handled by this route will increase, although it is not yet clear how many more plants will be required in addition to the 23 operating and planned.

Table 4.1 Waste sites licensed by the Environment Agency, 2004

Classification	Site type	No.	Percentage
LANDFILL	• Other landfill site taking special waste	86	0.80
	• Household, commercial and industrial waste landfill	654	6.06
	• Landfill taking non-biodegradable wastes	1,161	10.76
	• Landfill taking other wastes	742	6.88
	• Co-disposal landfill site	263	2.44
		2906	**26.94**
RECYCLING	• Material recycling treatment facility	197	1.83
	• Metal recycling site (vehicle dismantler)	857	7.94
	• End-of-life (ELV) facility	341	3.16
	• Metal recycling site	1,088	10.08
		2483	**23.01**
WASTE TRANSFER	• Special waste transfer station	622	5.76
	• In-house storage facility	106	0.98
	• Clinical waste transfer station	193	1.79
	• Household, commercial and industrial waste transfer station	2,549	23.62
		3470	**32.15**
CHEMICAL	• Physical treatment facility	273	2.53
	• Physico-chemical treatment facility	120	1.11
	• Incinerator	87	0.81
	• Chemical treatment facility	43	0.40
		523	**4.85**
BIOLOGICAL	• Composting facility	121	1.12
	• Biological treatment facility	108	1.00
		229	**2.12**
AMENITY SITES	• Household waste amenity site	210	1.95
	• Transfer station taking non-biodegradable wastes	291	2.70
		501	**4.65**
OTHER	• Borehole	8	0.07
	• Industrial waste landfill (factory curtilage)	241	2.23
	• Lagoon	70	0.65
	• Mobile plant	173	1.60
	• No data	186	1.72
		678	**6.27**
	TOTAL	**10,790**	**100**

4.2 Waste facility impacts

This section examines each of the main types of social impact of waste facilities evident from the literature on waste management and environmental inequity.

As noted previously, much of the UK and international literature focuses on the potential health impacts for exposed populations and communities of living or working in close proximity to different types of waste facility. Much of the evidence comes from US-based studies and it is important to remember that social context within which such waste and health studies have been conducted is very different to that of the UK. A major difference is the lack of nationally available health care provision in the USA, which provides a strong driver for a litigious society to blame environmental hazards for their problems and thus acts as a catalyst towards further research in the area. Nevertheless, the US studies are still valuable in an assessment of the potential health impacts of living or working near to waste facilities, and the findings can still prove significant within the UK context.

In addition to the potential health impacts of waste facilities, this section also considers the current literature base regarding:

- nuisance impacts of waste facilities;
- economic, geographical and community impacts;
- demographic and political impacts;
- the influence of community perceptions on the extent to which proximity to waste facilities can be seen negatively.

It is also important to discuss the benefits of waste facilities for the communities living and working nearby. The fact that there may be identifiable positive impacts associated with waste management facilities has often been overlooked in the academic and policy literatures. The positive aspects of waste facilities are therefore presented in their own section (Section 4.2.9) rather than being subsumed into those on negative impacts.

4.2.1 Health impacts and evidence

Studies of the potential health impacts of waste facilities started in the USA in the early 1980s. By the early 1990s, over 100 studies had been recorded. In the UK, early studies (e.g. Openshaw *et al*. 1987) were prompted by health complaints around the Bonnybridge and Pontypool hazardous waste incinerators (Scottish Office 1985, Welsh Office 1985). More recently, landfills have become a focus; for example, the study of Nant-y-Gwyddon landfill in Wales in relation to birth defects (Fielder *et al*. 2000).

Numerous studies have shown that the public has real concerns about the health risks posed by waste incinerator emissions. Reams and Templet (1996) argue that much of the public's concern about incineration centres on the problem of environmental risks to humans and ecosystems. Although incineration reduces the volume of solid wastes,

stack emissions and the flyash generated from the gas cleaning process may be hazardous. However, it is important to note that:

- all incinerators in the UK are licensed and controlled to meet EU-defined emission limits for major pollutants;
- EU emission limits are set to protect human health.

No assessments linked to the planning and licensing of new incineration plant have identified any potential for significant increase in health risk at any location.

Dioxins have tended to attract the most attention. This human carcinogen was first identified in municipal waste incineration emissions in the mid-1970s – around the time of the major chemical accident at Seveso involving dioxins. However, a focus on incineration as a source of dioxins significantly misrepresents their contribution to the UK burden. The most recent UK health effects study for Defra (Enviros Consulting *et al.* 2004) concluded that dealing with municipal solid waste accounts for only about 1 per cent of total UK emissions of dioxins – shared approximately equally between incineration emissions and burning landfill gas. Domestic sources such as cooking and burning coal for heating are one of the UK's largest single source of dioxins, accounting for about 18 per cent of emissions. Transport accounts for about 3 per cent and electricity generation about 4 per cent.

The widespread attention received by dioxins has resulted in less recognition of the potential adverse health effects posed by other pollutants. Other chemicals present in incinerator emissions that have the potential to result in carcinogenic effects include arsenic, cadmium, nickel, and chromium. Acidic gases (sulphur dioxide, nitrogen oxides, hydrogen fluoride and hydrogen chloride), which can cause respiratory irritation, are also emitted. More recently, attention has focused on the chronic effects of very small particulates, which can penetrate deep into the lungs. Materials such as mercury may enter the food chain through ingestion of aquatic organisms in which the material has bioaccumulated. This bioaccumulation makes it extremely difficult to set specific thresholds and standards to guarantee that emissions are safe for different people. Crematoria are the most significant source of environmental mercury.

However, the recent study for Defra on the environmental and health effects of waste management concluded that pollutant emissions from waste management (including incineration) are small contributors to the UK total, e.g. carbon dioxide (CO_2) 2.4 per cent; benzene 0.02 per cent; nitrogen oxides (NOx) <1 per cent (Enviros Consulting *et al.* 2004).

Waste disposal by landfill has also been cited as a cause for environmental concern, but relatively little is known about the impact of emissions from landfill both in the short and longer term (Enviros Consulting *et al*. 2004). Landfill gas generation rates are likely to be greatest during and immediately following the operational lifetime of a site (typically 20–30 years from the time it was opened) and it is known that landfill gas created by the decomposition of wastes in a site can continue to be emitted to air for 25–30 years after site closure. Additionally, emissions to soil and water in non-contained sites could continue for several hundred years and typically contain high

concentrations of organic compounds and heavy metals potentially detrimental to human health. Since 1989, landfill site operators have been required to undertake risk assessments to ensure that emissions do not pose an unacceptable risk to groundwater. The very small spatial extent of dispersion means that the risks to health from landfill gas are most focused on those affecting operators working on-site. Studies in the UK and USA have focused on this element with a view to ensuring that appropriate controls and working methods are in place.

During the period of site operation, landfill sites must be managed and regulated to ensure that emissions are controlled to acceptable levels. People who live near landfill sites may be exposed to chemicals released into the air, water or soil. Atmospheric contamination includes the off-site migration of gases, dust and chemicals bound to dust – especially during the operational period. Local surface water and groundwater can become contaminated and these may in turn contaminate potable water supplies or water for recreational use. Chemical contamination of air, water or soil may also affect locally grown and consumed food produce.

In relation to waste facilities, environmental justice arguments that contend that environmental 'bads' are more often located in areas of deprived and ethnic minority communities have been enhanced by separate, unrelated epidemiological studies of apparent disease clusters in the vicinity of waste facilities (Petts 2005). Evidence suggests that over a hundred waste sites in the USA and Canada (the dominant grouping) and Europe have been singled out for examination following local reporting of health complaints.

Health studies in the USA began in the early 1980s (e.g. Marsh and Caplan 1987), with facilities examined ranging from storage depots to landfills and incinerators (although mostly inactive). In the UK, early studies were prompted by health complaints around the Bonnybridge and Pontypool hazardous waste incinerators (Scottish Office 1985, Welsh Office 1985), and cancer clusters linked speculatively to local incinerators (e.g. Openshaw *et al.* 1987). More recently, landfills have become a focus, e.g. a study of Nant-y-Gwyddon landfill in Wales in relation to birth defects (Fielder *et al.* 2000, Redfearn *et al.* 2000a, Redfearn *et al.* 2000b).

The second type of health studies are primarily policy-driven examinations of the generic risks presented from waste facilities, e.g.

- early work in the USA looked at congenital malformations around 590 hazardous waste sites (Geschwind *et al.* 1992);

- in Europe, a multi-country study (Dolk *et al.* 1998, Vrijheid *et al.* 2002) examined the increased incidence of congenital malformations around 21 hazardous waste landfills;

- Elliott *et al.* (2001) identified small excess risks of congenital anomalies and very low birth weight in populations within 2 km of all (9565) landfills in the UK operational between 1982 and 1997;

- following earlier work relating to cancer of the larynx in populations around 10 oil and waste solvent plants in Lancashire (Elliott *et al.* 1992), Elliott *et al.* (1997, 2001) studied the incidence of cancer in populations within 7.5 km of municipal waste incinerators operating between 1974 and 1986;

- Drummer *et al*. (2003) looked at risks of stillbirth, neonatal death and lethal congenital anomalies in babies of mothers living close to incinerators and crematoria in Cumbria.

Although studies have found some significant statistical differences in recorded and reported illness in populations close to waste facilities, there is no conclusive evidence of a direct causal link. In relation to municipal waste, Enviros Consulting *et al*. (2004) found no consistent evidence of significantly elevated levels of ill health in populations potentially affected by incinerator emissions. The same study also found that people living close to landfill sites suffered no worse health than those at a distance.

This extensive study concurs with earlier work.

- In 1996, Her Majesty's Inspectorate of Pollution (HMIP) published a generic risk assessment of dioxin releases from municipal waste incinerators, which concluded that a plant complying with the latest pollution control standards would pose an insignificant health risk to the local population irrespective of the many site-specific factors (HMIP, 1996).

- In its report on incineration, the Royal Commission on Environmental Pollution (RCEP) concluded that there was no evidence of adverse health effects (RCEP 1993).

4.2.2 Confounders and other health impact study critiques

However, there are many confounding issues which may make the evidence for health impacts of waste sites – particularly landfills – less significant. In terms of social deprivation, even studies which have identified some increased disease incidence and health outcomes in communities in the vicinity of waste sites have reported little correlation of these with social deprivation.

Stakeholder workshop discussion relating to environmental risk

'There is a difference between association and risk. Associating problems with certain social groups is clearly not the same as assessing the degree of risk or exposure that they actually experience.'

Redfearn *et al.* (2000a) argue that the Dolk (1998) study could be criticised as it does not demonstrate an association with all landfills or all hazardous waste landfills. Despite identifying areas of land with a higher incidence of congenital anomalies, many of the results obtained may not have their causality in proximity to landfill at all. Similarly, the research by Fielder *et al.* (2000) has been criticised for finding

correlations but lacking any statistically proven causality for the observed relationships.

Research evidence that does pertain specifically to landfills generally relates to old landfills that were active before the introduction of the current regulations and landfill best practice, which have resulted in much lower emissions in recent years. In the case of incinerators, Petts (2005) notes that emissions of dioxins from incinerators have fallen by 99.8 per cent in the UK over the past 20 years due to the tightening of limits on stack emissions. Moreover, many of the health outcomes that have been linked to landfill operations are extremely rare and, in general, the studies that purport links between adverse health effects and landfill operations report only slight increases in risk.

A significant weakness associated with research into the potential health impacts of living in proximity to waste facilities is the almost complete absence of any measures relating to exposure. Exposure is nearly always a broad measure, based on distance from facility, with no real evidence base for the conclusions drawn. In addition, these studies tend to be post hoc, single site studies and the extent to which the findings of one study can be generalised in terms of relations to other sites and other populations is very low indeed.

Petts (2005) notes that there are significant problems of confounding in epidemiological studies on the health effects of living near to waste facilities. These include:

- individual lifestyle characteristics such as diet, smoking, alcohol, drug use etc.;
- other health problems which are not identifiable;
- genetic effects;
- the presence of alternative real pollution sources;
- higher likelihood of unemployment in industrial sites among studied populations;
- greater reporting of ill-health and diseases close to waste facilities, potentially linked to the desire to cast blame, as well as problems with symptom recall;
- length of residence, particularly where risks relate to chemicals that accumulate in the body over time but may not manifest as an adverse health outcome for decades;
- lack of actual pollution data over long time periods;
- reliance on distance function as a surrogate for potential exposure.

In addition to these confounders, Redfearn *et al.* (2000a) cite the following as specifically associated with determining health effects from landfill sites:

- small sample sizes in terms of the resident population or numbers of landfills studied;

- lack of robust *a priori* hypotheses that link specific diseases to exposures from specific chemicals or mixtures via specific exposure routes;
- lack of consideration of the nature of landfill sites studied including waste contents, size, engineering controls, operational practices, geology, hydrogeology, and regulatory regime;
- lack of studies of modern, highly regulated landfills;
- failure to account for other possible confounding factors such as migration into or out of the study area, socio-economic or behavioural factors.

Socio-economic status is recognised to be the most obvious confounder in any spatial analysis of health outcomes. There has been little research on the strength of the relation between socio-economic status and the risks of congenital anomalies. Landfill sites cannot be easily classified according to the chemicals they contain because:

- each site contains a range of chemicals;
- information on the chemicals deposited can be incomplete as record-keeping prior to the current licensing regime was not always robust (Vrijheid *et al.* 2002).

As such, landfill environmental hazards may be more a result of geology, engineering and management practices than the type or amounts of deposited materials.

4.2.3 Nuisance impacts

Nuisance impacts arising from waste facilities are well-documented in the literature, but again much of the evidence for impacts and the extent to which they might be experienced differentially by different social groups within a community is largely anecdotal – as is any assessment of impact magnitude.

Nuisance impacts have mostly been linked to landfill sites and may include issues such as landfill odour, which has been estimated to account for 10–25 per cent of all odour complaints to local authorities (Enviros Consulting *et al.* 2004). Odour from landfill is mainly caused by emissions to air of landfill gas containing hydrogen sulphide and compounds containing organic sulphur. Residents may identify smells from landfill sites to be of concern in their own right, as unpleasant and as leading to stress and stress-related symptoms or negative health effects. Alternatively, they may perceive smells as indicators of the degree of contamination of the air by gases, some of which may be toxic.

Noise, particularly from waste delivery vehicles and on-site operations such as compacting, is another nuisance impact. For example, residents have complained about the noise of bottles being deposited into recycling banks and resisted the siting of new banks.

Visual impacts of waste sites (not least from large-scale operations) may also have an impact on the surrounding communities, particularly in the case of landfill and incinerators.

Other assorted nuisance impacts include (Petts 2000):

- vermin and rodents at landfill sites;
- soiling from airborne dust particles;
- litter blown from landfill sites into gardens or escaped from the rear of vehicles.

Table 4.2 lists the complaint frequencies found by Redfearn *et al*. (2000b) in a study of complaints about a sample of 50 landfill sites in England, Scotland and Wales.:

Table 4.2 Frequency of complaints about landfill sites

Type	Percentage of total
Odour	59
Flies	24
Litter	8
No Specific Reason	4.5
Traffic, Rodents, Birds, etc.)	1.5
Hours of operation of site	1
Dust	1
Mud	1

Source: Redfearn *et al.* 2000b

4.2.4 Economic impacts

Most studies relating to the economic impacts of waste facilities have been concerned with the possible negative impact on property values, although little robust evidence exists of any direct negative effects.

Harvey (1996) argues that property values are lower closer to hazardous waste facilities and that economic imperatives often drive the siting of facilities in low-income areas. This, he argues, is because the insertion of such a facility causes less disturbance to property values in low-income areas. Thus, an ‘optimal’ lower cost strategy for facility siting points to areas where poorer members of society live.

In the US context, Ihlanfeldt and Taylor (2004) found that:

- severely contaminated sites such as those on the USEPA National Priority List (NPL) reduced the value of nearby single-family homes;
- in a case study of Atlanta, Georgia, hazardous waste sites were found to negatively affect the market value of nearby properties (though exact figures or estimates were not given).

In another US-based study on housing appreciation rates, McCluskey and Rausser (2003) found that residential property owners living in close proximity to closed hazardous waste sites experienced lower housing appreciation rates after the time period when sites were identified by the USEPA.

Few studies have been conducted in the UK, but the most recent research, carried out by Defra (2003) into the disamenity costs of landfills examined over half a million sales of houses situated near 11,300 landfill sites. This study found that those properties situated within half a mile of a landfill site suffer statistically significant disadvantages; there was an average reduction of about £5,500 in the value of houses located less than 0.25 miles from operational landfill sites and about £1,600 for those between 0.25 and 0.5 miles from such sites. However, the work was unable to differentiate the relative impact of the landfill from the many other sources of adverse impacts on house prices – proximity to other industries, to major roads, age and condition of property, etc. As with health studies, the spatial variations observed cannot be understood in detail.

4.2.5 Geographical or community impacts

The potential geographical or community impacts borne by those living in close proximity to waste facilities are also largely anecdotal and poorly delineated within the waste management literature.

Such proposed impacts may include community stigmatisation once an area becomes negatively associated with a waste site. Stigmatisation may, in turn, lead to changes in the availability of neighbourhood services and business infrastructure, and changes in land use – particularly if the presence of polluting and undesirable facilities encourages the location of other such sites within the locality.

Kunreuther (1995) observed that the psychological and external costs of a noxious facility are borne locally by the neighbourhood immediately surrounding the facility, while the benefits of a noxious facility are distributed globally throughout the economy.

In the same way, there is some evidence that those employed to work at waste management sites often do not live near to the site. Thus, those experiencing the negative impacts of proximity to waste facilities are not necessarily compensated for by being employed at the facility.

Additionally, there may be the development of social divides and tensions. Studies in the USA and Canada have examined losses of community cohesion resulting from clean-up activities and compensation awarded to members of communities in which hazardous waste sites were located. This was found particularly among those who felt they were entitled to compensation for nuisance impacts, etc., but were deemed to live slightly too far away from the facility to gain this entitlement.

It is important to note that much of the stigmatisation literature comes from the USA and is focused on hazardous or toxic waste (facilities and contaminated sites).

4.2.6 Demographic impacts

Demographic impacts relate to the possibility that, once a facility has been sited within a particular locality, those who are able to sell up and leave the community may do so because of perceived or actual negative impacts of their proximity to the site. This leaves those who are unable to improve their situation, and who are more likely to be poor and/or minority communities. However, there is no definitive evidence of such demographic impacts on 'in' and 'out' migration.

4.2.7 Political impacts

Political disempowerment is often cited as a reason for the siting of waste and other facilities in deprived communities (Harvey 1996). It is argued that deprived communities are likely to be unable to mobilise the resources to overturn siting decisions and may be more likely to be selected as the location for unpopular waste management facilities.

In addition, once a waste facility has been sited in a particular location, future facilities may also be granted in that location. Part of the reason for this may be the operation of the proximity principle, which states that waste should be treated as close as possible to the site of the waste arising.

In urban areas, where many deprived communities are located, this may mean the same community being host to a number of polluting or undesirable sites. The same process has also been documented in rural 'peripheral' communities. Blowers and Leroy (1994) argue that such communities may be dominated by politically disempowered homogeneous working class and low-income groups that may be unable to mobilise against a siting decision within their locality and might depend on such a facility for employment.

4.2.8 Perceptions

There is a relatively large perceptions literature identifying the multi-dimensional elements which drive perceptions – but often not directly related to potentially adverse health or environmental impacts.

Burningham and Thrush (2004) examine accounts of the risks associated with living close to potential sources of pollution and emphasise the way in which discussion of the risk of pollution is informed by wider assessments of local life. In particular, they highlight the ways in which residents' accounts of local pollution often diverge from the way in which the problem is conceptualised by 'outsiders'. They suggest that descriptions of problems in terms of environmental injustice may have little resonance with those affected and, as a consequence, may not provide the most profitable way of linking the environmental and social exclusion agendas.

In one of several Canadian case studies, Baxter and Lee (2004) analyse residents' concerns about risk and safety near a hazardous waste facility at Swan Hills, Alberta. The majority of the residents approached outwardly expressed a low concern about the facility. However, despite 31 (out of 38) residents insisting they had no or low concern about facility risks when first prompted, 11 showed latent concerns when probed further. These were expressed as uncertainty, reservations and doubt. A

heightened sense of pride and positive community identity manifested itself as a defensive reaction by insider residents to outsiders, who were perceived to hold negative, stigmatising views of the waste facility, as well as the town.

In another Canadian study, Wakefield and Elliott (2000) interviewed residents in Ontario to explore the effects of siting processes on individuals and communities, and to look at the coping strategies employed by individuals in response to the impacts experienced. Overall, substantial impacts on individual and community well-being were uncovered by the study including stress, disempowerment, hostility and divisions within the community.

As a counter-point to these negative findings, Elliott *et al*. (1997) found that positive perceptions of the landfill increased over time in a community affected by a landfill site in Ontario. Many participants in the study cited the fact that one would never know the landfill was there due to the state-of-the-art technology it employed. Non-realisation of negative effects anticipated in the 1990 survey was apparent in many people's responses in 1995, as the problems that had been expected to arise such as noise, odour and traffic increases, failed to materialise. Many residents had undertaken a cognitive reappraisal of the site in the form of resignation and acceptance, e.g. 'you get used to it and you can't do anything about it'. In general, appraisal of the landfill changed from that of a threat to one of annoyance, e.g. having to pay the $5 fee to tip on the site, picking up litter blown away from the site, noise from trucks, etc.

Regardless of whether they are founded on an understanding of the 'real' risks of, for example, environmental contamination from a landfill (however accurately these can be assessed), factors such as stress, distress, dysfunction and disability may be manifest in a wide range of psychological, social and behavioural outcomes. Barnes *et al.* (2002) found that anxieties about the potential problems associated with living near to landfill sites were often intensified by national media attention and sensational headlines in the press.

4.2.9 Benefits of waste facilities

Any analysis of the social impacts of waste facilities must recognise that there are certain well-defined positive effects associated with living close to certain facilities. These beneficial aspects may go some way to off-setting some of the more negative and nuisance effects that have been detailed above, although the extent to which such benefits are actually felt 'on the ground' may be highly location specific.

Enviros Consulting *et al*. (2004) make the fundamentally important point that waste collection and disposal is itself inherently beneficial as waste left on the street would be a significant source of disease, odours, pests and litter. Speirs and Tucker (2001) argue that proximity to waste sites – in particular those offering recycling facilities – and civic amenity sites can benefit the surrounding population in that they offer accessible locations for residents to dispose of their household wastes. In a profiling study of recyclers at several recycling centres and civic amenity sites in south-west Scotland, over 50 per cent of recyclers questioned cited nearness as their prime reason for choosing a particular recycling site.

Crucially, some positive impacts of waste facilities can benefit the very communities that environmental justice arguments emphasise are suffering disproportionate risk (Petts 2005).

Incineration has been particularly well-documented in this regard, since all EfW incinerators in the UK burning municipal waste generate power for the national grid (though it could be argued that those who gain the benefits are not those who live in close proximity to the site). One clear area in which those located close to incinerators gain directly is in the case of EfW plants that include district heating. For example, the incinerators in Sheffield and Nottingham provide heat to primarily public sector housing within a 2-km radius of the plant. Such plants are common in Scandinavia, where small EfW plants are frequently located in the heart of urban areas to provide heat and energy to the local populations and to local commerce and industry

Rushton (2003) argues that waste sites can generate employment, although Petts (2005) notes that such facilities rarely bring the same scale of employment opportunities which might arise from major industry. Nonetheless, composting facilities, landfill sites and recycling, civic amenity sites and waste incinerators employ people – often from the areas immediately surrounding the sites.

Indeed, Murray (1999) argues that recycling facilities are the key to major levels of 'green collar' job creation in the UK. An increased emphasis on recycling as a means of managing the UK's waste would, according to Murray, create a new tier of high quality employment and up to 55,000 jobs. Many of these jobs would be locally rooted. This may be particularly significant when considering environmental inequity, as the most deprived areas are often those that have suffered disproportionately in recent decades with decreases in industrial and manufacturing employment. However, with increasing mechanisation in recycling, associated not least with concerns about poor working environments when activities such as hand sorting and picking have been involved, we could also see declining employment opportunities associated with some types of processes.

It can also be said that there are significant potential gains in terms of community cohesion when residents of a locality work together to oppose a waste facility. A particular example of this is the cohesion of community protest groups in the four villages of Greengairs, Wattston, Glenmavis and Plains in North Lanarkshire, Scotland. These villages are already home to Europe's largest landfill and Scotland's largest opencast mine. An additional 8-hectare landfill site proposed in 2004 would have brought the number of landfills and opencast mines in the area to nine had the application been upheld, but strong community protest led to the application being refused (FoE Scotland, 2004).

4.2.10 Interactions between impacts

Research (e.g. Walker *et al.* 2003, Lucas *et al.* 2004) has asserted that people at the highest risk from environmental hazards include not only those who experience the highest exposures, but also those who are more susceptible to the effects of environmental pollution, particularly in terms of health effects. Concerns about susceptibility are frequently vocalised in local siting disputes (Petts 1992, Petts 2000).

Significant social and economic factors affect the vulnerability of communities and individuals to environmental problems such as existing poor health, poor levels of nutrition and low incomes, which 'trap' families in blighted communities. Lucas *et al.* (2004) also argue that factors such as age, lifestyle, genetic background, gender and ethnicity play an important role in enhancing the susceptibility of persons to environmentally related disease. Alcohol, tobacco and drug use are more frequent in minority populations and may impair respiratory, cardiovascular and metabolic processes. They may also reduce a person's ability to metabolise or eliminate toxic substances. Inadequate diets due to poverty and high-risk diets due to cultural or historical reasons also may be more prevalent in minority communities and increase susceptibility.

There is a need for a broader and more fundamental analysis of the social impacts of waste facilities and particularly an examination of cumulative impacts.[3]

4.3 Waste facility impacts matrix

The complexity of the waste issue renders it virtually impossible to represent it in the form of a matrix as has, for example, been produced for the flooding element of this project (Walker *et al.* 2006a). Not only is there a wide range of potential social impacts from living near to waste facilities (including health, economic, political, nuisance impacts, demographic impacts and community issues), the extent to which these impacts may affect different social groups with variables such as age, gender and ethnicity differs greatly.

In general terms, it may be possible to detail some associations. For example, if there are negative health effects associated with living near to landfill sites, these may be particularly harmful to babies (birth defects, low birth weights). In deprived communities, residents are more likely to have poor diets and health, etc., which may make them more sensitive to some of the negative health effects of living close to landfills or incinerators.

Workshop discussion on the value of international research comparisons

'The planning system in the UK is highly regulated. If US environmental justice studies have failed to find statistically convincing evidence that deprived communities are exposed to greater impacts from waste sites than less deprived communities given the comparatively unregulated planning system there, it could be argued that we in the UK stand to find even less convincing evidence of any association.'

There are many different types of waste facility and even facilities within the same category (e.g. recycling centres) may vary hugely in terms of size, capacity and impacts in different locations. Thus, while it is possible to characterise generic impacts

[3] See the report on Cumulative Impacts (Stephens *et* al. 2006) for further discussion.

that may be associated with particular types of facility, the real social impacts of those facilities can only be determined if a detailed site-by-site analysis is undertaken.

It is also essential to remember that waste facilities are inherently highly controlled and regulated activities. Planning permissions and licences are not granted unless there is expert judgement that there is insignificant environmental and health risk. Waste facilities are subject to monitoring by the regulator and ongoing monitoring of critical parameters by the operator (often on a daily basis for major facilities). The regulator has the power to impose more stringent emission controls than are required to meet emission guidelines and limits if this is considered important in a particular location. Table 4.3 summarises the potential social impacts of waste facilities as discussed so far in this report.

Table 4.3 Summary of potential social impacts of waste facilities

Category of impact	Type of potential impact	Potential outcome
HEALTH – incinerators	*Stack emissions* • Flyash • Dioxins • Emission of arsenic, cadmium, nickel, chromium • Emission of sulphur dioxide, nitrogen oxides, hydrogen fluoride, hydrogen chloride • Particulate emissions	• Respiratory complaints • Carcinogenic effects • Bioaccumulation in the food chain
HEALTH – landfills	*Emissions* • Landfill gas emissions to air, dust and chemicals bound to dust • Landfill leachate to soil • Leachate to groundwater, potable water, recreational waters	• Respiratory complaints • Impact on agricultural produce • Contamination of drinking water supplies • Reduction in recreational water quality, groundwater quality • Carcinogenic effects • Bioaccumulation

Category of impact	Type of potential impact	Potential outcome
NUISANCE	*Odours* • Hydrogen sulphide compounds from landfills • By-products of biological breakdown from composting *Noise* • Operation of landfills, waste transfer sites, recycling centres • Transport to and from sites *Visual impacts* *Other* • Vermin, rodents, airborne dust, litter	• Stress-related symptoms and negative health effects
ECONOMIC	• Reduction in housing values • Lowering of house value appreciation rates *Positive impacts* • EfW plants provide heat • Electricity for national grid • Employment creation • Provision of recycling facilities • Waste disposal close to point of arising reduces cost to industry and increases competitiveness	• Increased economic marginality for deprived communities • Particular benefit for deprived communities and social housing
GEOGRAPHICAL / COMMUNITY	• Stigmatisation • Community divisions, e.g. compensation payouts *Positive impacts* • Creation of 'green collar' jobs • Community cohesion in protesting successfully • Convenience of waste disposal method nearby	• Reduction in availability of neighbourhood services • Lack of business infrastructure • Attraction of other polluting land uses
POLITICAL	• Political disempowerment • Peripheralisation Positive impacts • Recycling engagement • Improved service provision	• Vicious cycle: disempowered communities may be more likely to have sites – those who can move away do so, leaving the most marginal and least empowered.

4.4 Methodological issues

The literature on which the analysis of the potential social impacts of waste facilities above is based raises many methodological issues, both in general terms and, more specifically, in terms of the capacity to uncover meaningful results in the present project. Many of these issues relate to the use of statistical analyses used to assess environmental inequalities. A range of these issues is outlined below:

4.4.1 Proximity versus risk

The extent to which population proximity to waste sites and emission sources can be reasonably assumed to produce undesirable impacts of various forms can be contested. Most environmental equity studies rely on proximity to site as a proxy for exposure. However, Walker *et al*. (2003) argue that proximity can only be a surrogate for exposure to hazard, risk or uncertainty – an important limitation of site-based equity analyses. Being exposed to a hazard does not directly translate into being at risk from that hazard and the significance of exposure relates to sensitivity as well as likelihood of exposure.

4.4.2 Boundary delineation

There has been a tendency to define boundaries in relation to the possible effects of a facility without clear notions of the diverse nature of these effects. Factors such as employment opportunities, traffic nuisance, air pollution, water pollution, visual impacts, and beneficial and economical waste management, etc. each have potentially variable areas of influence that are:

- site-specific;
- not replicable across multiple sites and facilities of different natures or scales of activity.

Part of this issue is the choice of geographical boundary. The most frequent approach – at least in relation to site-specific studies and particularly in waste management ones – has been to delineate a circular buffer zone around a specific site and to assume that people within the zone will be affected equally by any potential impacts and that those outside the zone will be (relatively) unaffected. However, in relation to incineration, for example, stack emissions do not affect all residents who may live within a certain distance from a plant equally – exposure is likely to be greater down-wind than up-wind.

Some recent research has tried to overcome these problems. For example, Chakraborty and Armstrong (1997) demonstrated the benefits of using geographical plume analysis compared with circular buffers for estimating exposure from a hazardous site. Risk assessments in relation to new sites use such analysis, drawing upon hazard assessment methodologies that understand pathways of exposure in relation to local geological and meteorological variations. Risk assessments generate isopleths of maximum concentrations around sites.

Jacobson *et al*. (2005) point out that previous environmental justice studies have generally used one of several approaches to compute exposure. The most common characterises exposure as the count of hazardous facilities in a Census area or as a dichotomous indicator of the presence of a facility. A problem with this is that pollutants do not disperse within Census boundaries, making edge effects a real concern. A second approach defines the outcome measure as the distance from the Census area to the nearest site. However, this ignores the possibility of exposure from multiple nearby sources, which is particularly significant when considering the impact of cumulative effects.

4.4.3 Model and method choice

The validity of an environmental distributional equity analysis depends strongly on the right choice of statistical method or model, and the correct interpretation of the results (Liu 1997, Talih and Fricker 2002). Since the landmark study by UCC-CRJ (1987), investigations of environmental equity have employed a broad range of statistical methods and GIS approaches to examine proximity or exposure to sites, e.g.

- landfills and incinerators (Been 1994);
- toxic storage and disposal facilities (Been and Gupta 1997);
- accidental hazardous releases (Margai 2001).

Statistical methods have included:

- bivariate tests (Been 1994);
- more sophisticated cross-sectional multivariate regressions (Fricker and Hengartner 2001, Margai 2001);
- longitudinal comparisons (Been and Gupta 1997).

McMaster *et al*. (1997) present an important summary of the methodological problems with environmental equity assessments. This is based on considerable evidence that findings are sensitive to the scale, resolution and choice of outcome measure. Crucially, it points to the importance of reaching a consensus on the most appropriate methodologies given the often dramatic shifts in findings when methods are altered slightly.

4.4.4 Equity definitions

To date, no consensus regarding standardised analysis or operational definition of equity is evident in either GIS or statistics literature. The most common approach is to estimate a multivariate regression of a Census tract-level indicator of exposure on a measure of the racial/demographic composition of the tract. However, this approach does not assess whether the burden of hazardous exposure is shared equally among subpopulations of interest, but rather whether largely minority Census tracts are more likely to be exposed than others (Jacobson *et al.* 2005).

Workshop discussion about the importance of changing policy contexts

'A consideration of future change is crucial. Future waste facility location may influence future housing provision decisions, and future siting decisions are based on legislation in place now. Current planning regulations and potential future impacts of current legislation on the need for alternative waste facilities are key elements of a focus on social impacts.'

A major concern is that simply establishing a spatial correlation between deprived communities and waste sites says little about the reasons for this correlation and, in particular, how such unequal distributions of waste sites can be avoided in the future.

Broadening the focus away from simple notions of outcome (in)equity (or distributive justice) to a more useful process equity (or procedural justice) consideration may represent the way forward. This is not just in terms of providing a comprehensive examination of social and economic factors and how these interact temporally and spatially, but also in terms of examining the decision-making procedures and regulatory and legislative issues that may contribute to observed patterns of inequity. For example, environmental impact assessments in the UK have been shown to take a narrow view of what represents a social impact, whereas assessments in other countries, most notably Australia, have often defined social impacts in a vastly different and more comprehensive manner (e.g. Petts and Eduljee 1994).

In addition, relying on mapping and data analysis – particularly in the context of waste sites – may not show anything new or significant. The historical legacy of industrial development and waste facility siting, combined with government planning policies encouraging siting as close as possible to the point of waste arisings (proximity principle) and the reuse of brownfield sites, means that many waste facilities are located in urban areas. Mapping where waste facilities are located in relation to where deprived communities live may do little more than produce a map of industrial areas, which is where many deprived communities are already known to live.

4.5 Other issues

In addition to the issues outlined above, there are:

- significant scale issues related to the choice of waste facilities for analysis, both in terms of the size of individual facilities and their capacity;

- thousands of waste facilities (reportedly 10,000 in the West Midlands alone) at the lower end of the risk spectrum are exempt from licensing and operate under general rules. But there are still potential negative social impacts from exempted waste facilities and activities which it is neither feasible nor possible to map and potential negative impacts from activities such as fly-tipping and waste transport;

- dangers in assuming the importance of largely anecdotal evidence not based on rigorous statistical evidence and attempting to translate such concerns into concrete efficient, robust and equitable policy measures.

5. Waste facilities and deprivation: exploratory data analysis

5.1 Introduction

This section discusses the methodology and results of:

- a quantitative GIS-based analysis of the distribution of waste facilities in England;
- the relationship between waste facility location and multiple social deprivation in the North West Government Office region of England.

The analysis is preliminary and exploratory. It does not seek to provide definitive results, but to further understand the problems of any analysis of waste facility siting and deprivation and to test some ways of using available data. The focus is on distributional (proximity) impacts not an analysis of the other (potentially important) social impacts of waste facilities or broader waste management impacts.

As discussed in Sections 3 and 4, there are many methodological issues for environmental justice studies focused on waste facility locations. This means that a simplistic analysis is likely to be insufficient and potentially misleading in the results it produces. A more sophisticated approach needs to be developed (e.g. one that seeks to differentiate between different types and scales of waste facility), but this would then have to address the limitations of the datasets available.

The analysis below makes use of:

- the Environment Agency database on licensed waste facilities;
- the scores given to these facilities within the OPRA system (OPRA for Waste) (Environment Agency 2004);
- the Common Classification Scheme (CCS) database which records instances of non-compliances with license conditions.[4]

Each of these datasets proved challenging to use and provided different choices as to how particular items of information on each site might be utilised. The conclusions and related recommendations drawn in Section 7 therefore emphasise the need to consider carefully the results produced and their implications for future analytical research.

[4] Details of the licensing and permitting regime are given in Section 6.3.4.

5.2 Methodology

5.2.1 Datasets

Super Output Area population and deprivation data
The spatial unit of analysis used for population and deprivation is the Super Output Area (SOA) (Lower Level), of which there are 32,482 in England. SOAs are aggregations of 2001 Census Output Areas and are designed to be the core geography for small area statistics. Because SOAs are designed to contain roughly equal populations (approximately 1,500 people), their physical size is density dependent – with small SOAs in urban centres and large SOAs in rural areas.

Deprivation was represented using the English Index of Multiple Deprivation 2004 (IMD 2004), (ODPM 2004). The IMD is based on seven separate domains:

- income deprivation
- employment deprivation
- health deprivation and disability
- education, skills and training deprivation
- barriers to housing and services
- living environment deprivation
- crime.

Each domain score is produced from a total of 37 indicators, with the majority recorded in 2001. For each SOA, a score is produced for each indicator and then each domain. Individual domain scores are then weighted and summed to create the overall IMD score for the SOA. This IMD score forms the basis for a final ranking of SOAs.

The living environment domain of the IMD required further investigation because there could be potential for auto-correlation in the environmental equity analysis. This domain is made up of two sub domains – the ‘indoors’ living environment and the ‘outdoors’ living environment. The outdoors living environment sub-domain accounts for one-third of the overall domain score and is made up of an air quality score and a road traffic accidents score.

For the purpose of this study, there is the potential for a link between air quality and proximity to those types of waste site that produce pollutants which may contribute to poor air quality. Thus, there is a danger of auto-correlation in the analysis that has been undertaken. However, auto-correlation was not deemed a significant problem as the effect on results will be small because:

- this link is not expected for all types of waste site;
- in most parts of the country, the majority of air pollution is generated by traffic;

- the contribution of air quality to the overall IMD score is less than 3 per cent (3 per cent is the combined contribution of air quality and road traffic accidents to the overall IMD score).

Given the nature of the IMD, deprivation data in this project are consistently presented in the form of deprivation deciles, which maintain the ranked ordinal form of the data. A detailed explanation of the construction of these deciles is given in Section 5.2.2.

Address location data
To improve the spatial resolution of the analysis, the study used Ordnance Survey's Address-Point®, a spatial dataset which records every residence (postal delivery address) in England (http://www.ordnancesurvey.co.uk/oswebsite/products/addresspoint/). This point dataset gives approximately 98 per cent of locations to 1-metre accuracy (based on an interrogation of the dataset's positional quality indicator). These data were used to locate residential address locations within a SOA that contained population. Locations were deemed residential if they were 'non PO Box and did not have an organisation name' and, in addition, they were not classified as demolished.

The use of Address-Point data enabled SOA populations to be combined with residential address location to ensure that only the population within SOAs within a set distance of a waste site was counted within the analysis. Many SOAs (particularly rural ones) will contain waste site locations but no people resident within a particular distance.

The reported results show the percentage of population for each deprivation decile living within defined distances of waste sites. This method is described in detail in Section 5.2.7.

Waste data
This study used three Environment Agency datasets to locate and classify waste management sites.

- National REGIS (Regulation Information System) database of licensed sites for waste management – a full listing of waste management licences from the latest national REGIS dataset. Data extracted on 31 December 2004 were used to:
  - determine the date of issue of the licence;
  - classify sites as 1 of 24 types (see Section 5.3);
  - locate each site using National Grid reference co-ordinates.

- Operator and Pollution Risk Appraisal (OPRA) waste database for 2003. These data were used to:
  - determine whether a site was currently operational;
  - classify each site based on OPRA score environment categories.

- Compliance Classification Scheme (CCS) data for waste management sites for the year 1 April 2004 to 31 March 2005. The CCS allocates a classification for every non-compliance with a permit condition. These data were was used to:
  - determine whether a site had an incidence of non-compliance within the last year;
  - determine the number of non-compliances per site in the last year.

Although the national REGIS database covers many waste facilities and activities, many are exempt from licensing and only have to be registered with the local authority. Such sites may still, however, cause local nuisance and negative impacts but were not included in the analysis because of a lack of robust data concerning their operation.

5.2.2 Creation of SOA deprivation deciles

For the purpose of this study, the population of England was divided into ten groups containing equal populations; these are known as deciles. This allowed differences between them according to the level of deprivation indicated by the IMD to be determined.

In order to create SOA deciles, the overall IMD 2004 rank was used to place each SOA into a decile of equal population (see Table 5.1). Deciles of equal population are preferred to those of equal SOA count as the analysis then gives a population-based distribution, which is more meaningful for equity-based studies.

In all cases, decile 1 is the most deprived and decile 10 is the least deprived. Essentially, decile 1 has the largest concentration of deprived people and decile 10 the smallest concentration.

Shorthand terminology is often used to refer to population-weighted deprivation deciles of this form, but it is important to remember their precise definition. This definition means that decile 1 is not ‘the poorest 10 per cent of the population’, as some of the poorest people will live in pockets within less deprived SOAs. Nor is it ‘the 10 per cent most deprived SOAs’, as a population weighting has been applied.

The population within a SOA and within a decile will vary in their characteristics. The IMD provides a statistical measure for a group of people rather than a precise measure for every individual. This is a well-known limitation of area-based studies. It is referred to as the ‘ecological fallacy’ and requires a caveat to be placed on any area-based analysis. However, the smaller population of SOAs help to lessen this problem compared with a ward level analysis.

Table 5.1 Population weighted deprivation deciles for SOAs in England

Decile	Population	SOA count	Rank	
			From	To
1	4,934,430	3,247	1	3,247
2	4,934,780	3,253	3,248	6,500
3	4,934,250	3,261	6,501	9,761
4	4,934,910	3,262	9,762	13,023
5	4,935,060	3,259	13,024	16,282
6	4,933,820	3,255	16,283	19,537
7	4,935,180	3,237	19,538	22,774
8	4,933,430	3,234	22,775	26,008
9	4,935,160	3,229	26,009	29,237
10	4,934,500	3,245	29,238	32,482
England	**49,345,520**	**32,482**		

5.2.3 Combining sources of data on waste sites

Sites included in the analysis
The waste site datasets listed above were combined using the Environment Agency's licence number. The datasets included sites for England and Wales, and accounted for closed sites as well as those currently operational. This study focussed on sites:

- in England;
- covered by OPRA assessment;
- recorded as operational within the combined database.

The first step was to select sites from the OPRA database that were in England. The next step was to find the site type, the date of issue of the licence and the grid co-ordinates from the data extracted from REGIS (the grid references were of inconsistent format and variable quality, and needed considerable work to be useable). This provided a set of 7,005 sites.

Only operational sites were considered for the analysis relating to deprivation. Any site that is pre- or post-operational is classified as having a 'waste input' score in OPRA of 0 (see below for information on OPRA data fields). Thus, any site with a waste component score of 0 was removed, leaving a subset of 5,435 operational sites. This included 796 in the North West.

Sites with a type classified as 'other' (as defined in Table 5.3[5]) were not included in results that looked at OPRA score bandings or in any analysis relating to deprivation. Removing sites classified as 'other' provided a subset of 5,276 sites; this included 771 sites in the North West.

Date that a site licence was issued
The sites selected for analysis were differentiated by 'date licence issued' taken from the REGIS data. The licence dates were grouped into five-year bandings to explore the scope for tracking changes in site locations related to deprivation over time. However, the study was only able to address current deprivation characteristics around 'currently operational sites'. A fully developed historical analysis that tracked changes in both site location and social deprivation over time was not feasible.

There are also a number of potential difficulties associated with assuming that the 'date licence issued' provides a reliable indicator of the first time that licensed waste management activities began at a given site location.

- The waste management licensing regime has evolved over time and, particularly at points where major changes have been made (e.g. the first introduction of licensing in 1976 and the Environmental Protection Act 1990), sites could take some time to apply for and receive approved licences.

- Some new licences may in fact be at locations where waste management activities have already existed for some time but, for one of several reasons, a new licence has been issued. Licence modifications, revocations, surrenders, transfers and expiry are recorded separately in the database, but not always consistently.

- The REGIS database was constructed from information held by more than 80 separate Waste Regulation Authorities (WRAs) before they came together under the Environment Agency in 1995. Each WRA had its own way both of interpreting and implementing legislation and of recording data. This is likely to have produce inconsistencies in the database – particularly for the more historic site records.

The licence date analysis results reported in Section 5.4.2 therefore need to be treated with caution.

Site type
Sites were categorised according to their site type using the descriptions and corresponding categories given in Table 5.3. Sites classified as 'other' were not included in analyses relating to deprivation because they were not deemed suitable for this study.

OPRA score components
The OPRA for Waste scoring system is used by the Environment Agency to set site inspection protocols (Environment Agency 2004b). It has two parts, an 'environmental

[5] The first landscape table at the end of Section 5.3.

appraisal' and an 'operator performance appraisal', each of which have sub-component scores. Only certain components of the 'environmental appraisal' data were used in the analysis to enable the derivation of a method of distinguishing between waste facilities in terms of their inherent scale of potential environmental impact.

The use of operator performance appraisal data was considered. However, these data were not recorded for all sites in the database and there were concerns over the consistency of appraisals that had been undertaken.

Three elements of the OPRA environmental appraisal related to the characteristics of the facility were selected for use (see Table 5.2). These combine to form a score out of 100 – the higher the score, the higher the potential impact.

Table 5.2 Elements of OPRA environmental appraisal used in the analysis

OPRA element	Description	Number of points
Facility Score	Based on the type of facility.	60
Input of Waste Score	Based on the volume of waste that the facility receives.	20
Control and Containment	Based on the control mechanisms that a site has or requires.	20

Other components of the OPRA environmental appraisal (relating to humans, groundwater and surface water) were not included in the analysis as they relate to the characteristics of the waste facility location rather than the characteristics of the facility itself. Although the 'human' score may appear to be relevant to the project, it provides an indicator of the proximity of nearby population which the study's analysis derives using a more sophisticated methodology. To include this would therefore have produced a significant degree of double-counting or 'auto-correlation'.

Non-compliance with permit condition
The CCS provides data on incidents of non-compliance with permit conditions at waste sites. It therefore identifies those sites where environmental impacts of various forms and severity could potentially have been experienced. However, the CCS records where the observation of the potential for a environmental impact and the need for some form of responsive action. In some cases, an actual environmental impact may also have taken place but, in others, the action needed may be preventative to avoid future impacts. Licence conditions can only link indirectly to environmental impact; for example, conditions relating to permitted opening hours, fencing, signage, etc. have direct implications for site management but only indirect environmental and social impacts.

CCS data were used to differentiate those sites selected for analysis by whether or not they had had an incidence of non-compliance with a permit condition in the last year (April 1 2004 to 31 March 2005). Because only one year of data was used, however, this inevitably provides a very partial view of non-compliance incidents, which may

have taken place at any one site over a longer time period. As with other parts of the analysis, the aim was to demonstrate how the dataset could be used rather than to provide definitive results.

Each record of non-compliance within the CCS has a classification code of 1 to 4, with 1 being a non-compliance that could result in an incident that has the largest environmental impact and 4 being a non-compliance that is believed to have no potential environmental impact. Class 4 non-compliances were therefore excluded from the analysis. Where multiple permit breaches of class 1–3 had taken place, the classification of the 'worst' record of non-compliance observed in the last year was attached to the site.

5.2.4 National analysis

The analysis undertaken at a national level does not look at population or at deprivation patterns, but provides a summary of the characteristics of waste sites in England.

The point locations of the combined waste database were mapped along with the boundaries of Government Office regions. This allowed summary tables to be produced for England differentiated by:

- operational/non-operational by site type (and category);
- operational sites in each Government Office region by:
  - site type (and category);
  - date of licence;
  - combined OPRA environment score bandings;
  - non-compliance with permit conditions (class 1–3).

This provided an overview of the geography and characteristics of waste sites in England.

5.2.5 North West regional analysis

The analysis undertaken for the North West Government Office region takes into account the population and associated deprivation around waste sites. Results are reported by deprivation decile as discussed in Section 5.2.2. Because deprivation deciles were created to have equal populations throughout England as a whole, however, the region does not have an equal population within each deprivation decile. A summary of the population within each deprivation decile in the North West is given in Table 5.16, which shows that some 21 per cent are in deprivation decile 1.

5.2.6 Spatial proximity measures

The analyses in this report make use of proximity analysis, i.e. what type of population lives within a set distance of a site. The distance used is a Euclidean or 'as the crow flies' distance.

In this report, distances of 500 m and 1 km are the preferred distances used to create buffer zones around the grid references for waste sites. Distances of 300 m and 2 km were also used to test for sensitivity.

The choice of 500 m and 1 km as buffer distances is to an extent arbitrary. Ideally and as discussed in Section 4.4, it would have been preferable to use a more precise and tailored distance or even the 'footprint' of impact for each individual site. However, the site-specific information required to do this is not readily available. Alternatively, it might have been possible to use a different distance for each type of site (e.g. a small distance for a recycling site, a larger distance for an incinerator). In this case, the uncertainties in parameters for making this distinction were felt to be too problematic, particularly given that sites within each of these categories vary significantly in their size and potential impact.

However, for all but the larger sites producing emissions to air (e.g. incinerators), the distance of any impact is unlikely to extend beyond 1 km and to be less than 500 m. In addition, significant problems may arise with imprecision of site grid references (see below). For these reasons, 500 m and 1 km were chosen to provide two simple indicators of the deprivation characteristics of the populations surrounding each waste facility. It is important that they are to be treated only as **indicators** of deprivation characteristics and not, in any way, as a 'good' measure of the population experiencing significant impacts or risks.

The contrast with the flooding data analysis (Walker *et al.* 2006a) that has been undertaken within the broader project is interesting. For flooding, a risk contour delineates with some sophistication which areas of land could be affected by a flood of a given likelihood. This allows the analysis of potentially at 'risk' population patterns within it. For waste sites, the line drawn around each site has no such status. It is not a risk contour or a delineation of an area of land potentially affected by impacts from the waste site. It can, therefore, only be used to define an area within which proximate population deprivation profiles can be characterised.

Site grid references
Users of the REGIS database are asked to provide a grid reference for the 'site entrance'. For large waste facilities such as landfills, this may be some distance (tens of metres) from where the significant waste management activities actually take place. A small buffer distance drawn around this point may also capture largely the site itself rather than the surrounding area (hence the problem with using smaller buffer distances referred to above). There were also inconsistencies within the database in the spatial accuracy of the grid references specified. These problems provide further reasons why the results of the analysis should be treated with some caution.

5.2.7 Estimating the population around a waste site

To provide a good estimate of the population falling within each buffer distance around a waste facility, each residential address location was assigned to the SOA that it fell within. Each SOA population was then divided evenly across all of the addresses within it. This is important because the total population of the addresses must match the population reported in the IMD.

By assigning a SOA to each address, the deprivation decile of each address is also known. The waste site buffers can be used to determine which residential addresses

within a SOA are located inside a waste site buffer (see Figure 5.1). Using the populations assigned to the addresses, the population of the SOA within a waste site buffer can be estimated and resulting summary data produced.

Figure 5.1 Residential address locations within and outside a waste management (WM) site buffer

This method is a better alternative to other methods often used in equity studies such as calculating the proportion of the SOA area occupied by the waste site buffer and using this to estimate the proportion of the population.

Using Address-Point data does not provide a perfect distribution of the population in each SOA because, in reality, each address location population will vary slightly (though average household size does not tend to vary by a large amount within the same locality). In addition, some addresses may be wrongly classified as residential or commercial. For the purposes of this study, however, it provides a very good estimation of the proportion of the population within a SOA (and therefore each deprivation decile) that is within a set distance of a waste site.

With this method, large sites such as blocks of flats or apartments will be represented by single points sitting on top of each other. The limitation of these locations is that they will experience edge effects in any analysis because they are representing a large site with a large population as a single point location. Thus, a point could fall outside a buffer zone resulting in the population being missed out while in reality part of the site and associated population is actually within the zone. In contrast, a point could fall within a buffer zone resulting in all of the population being included while in reality part of the site is outside the zone. It is important to be aware of these limitations when looking at the results, even though the population involved is only a very small percentage of the total population.

Although the use of Address-Point data improves the spatial distribution of population, it **cannot** provide a more detailed picture of the deprivation characteristics of that

population. All addresses within a SOA are still considered to have the same deprivation characteristics, a feature which could over-estimate actual deprivation.

5.2.8 Comparative Environmental Risk Index (CERI)

The Comparative Environmental Risk Index (CERI) was used to help compare results (deprivation patterns) between various differentiations in the analysis. This measure involves the calculation of a ratio of the population 'at-risk' as a proportion of the total population for any particular group over the ratio of the rest of the population 'at-risk' as a proportion of the total rest of the population.

The index produced is a quotient (a ratio of ratios) (Harner *et al*. 2002In terms of the deciles used in this study, the index can be represented by the following equation, where X is any particular decile:

$$\frac{DecileX^{at-risk} \big/ DecileX}{Not-in-DecileX^{at-risk} \big/ Not-in-DecileX}$$

When looking at the results of this study, the group of people in question (decile X) can refer to a group of deciles.

For example, if the group reported in the results is 'decile 1 and 2' and the CERI value is '1.696' (this is the case for the population within 1 km of all waste sites), then this means that people living in decile 1 and 2 (as a group) are 69.6 per cent more likely to be living within 1 km of a waste site compared with people living in deciles 3–10 (as a group). In presenting the results of analysis, three CERI values are provided:

- deciles 1 and 2 compared with all others;
- deciles 1–5 compared with all others;
- deciles 6–10 compared with all others.

5.3 Waste facilities in England

This section presents the results of analysis according to a series of questions. The tables and figures referred to in the text are grouped together at the end of the section.

How many operational waste sites of what type are there in England?

The Environment Agency's waste facility licence database (REGIS) listed a total of 10,790 licences for England broken down by type of site as in Table 4.1. Approximately a third of these licences are no longer current for various reasons.

The OPRA database lists 7,005 sites in England for which scores have been assigned and thus some ongoing form of regulatory attention is being applied. Table 5.3 shows the breakdown of these sites across the 24 Environment Agency site types (A1–A24)

and across seven grouped categories of types of site. The ‘waste transfer’ category (A9–A12) has the largest number of sites – with household, commercial and industrial sites dominant – followed by ‘recycling’ and ‘landfill’. The remaining categories (‘chemical’, ‘biological’, ‘amenity sites’ and ‘other’) contain relatively small numbers of sites, with none containing more than 5 per cent of the total number of licensed sites. Note that the licensed facilities in the ‘other’ category are excluded from any subsequent analysis.

Of the sites listed in the OPRA database, 5,435 are recorded as operational (see Section 5.2.3 for an explanation of how this was determined). The remainder are non-operational for various reasons (pre-operational, post operational or with operations suspended) and have no current input of waste.

Thus, only about half the 10,790 waste licences in the overall waste facility licence database relate to currently operational waste facilities. The proportions of operational and non-operational sites differ significantly between the waste facility categories (Table 5.3). Only about half the total number of landfill sites are operational, reflecting:

- the changes that have taken place in waste disposal away from landfill;
- declining landfill void space availability in many areas;
- the need for longer term regulatory attention in the non-operational phase than for other waste site types.

For all other categories (apart from ‘other’), the proportions of operational sites are over 85 per cent.

How are operational waste sites distributed across the English regions?

The regional distribution of operational sites within the broad waste categories is shown in Tables 5.4–5.6.

The total number of sites varies across the regions reflecting to some degree the size of each region, population levels, and profiles of land uses and economic activity. Hence it is, for example, not surprising to find that London has the lowest proportion of landfills and highest proportion of waste transfer stations. However, other marked differences are harder to immediately explain, e.g. the low proportion of amenity sites in the North West compared with the Government Office regions of Yorkshire and Humberside, and the North East.

When were site licences for currently operational facilities issued?

As noted in Section 5.2.3, data for the date at which a site licence was issued can be problematic for a number of reasons and may not provide a reliable indicator of the year in which waste management activities at a given location were initiated.

With this important proviso, however, some overall patterns in the number and type of licences issued were observed. There was a marked increase in the total number of

licences issued in the early 1990s (Tables 5.7–5.9); 48 per cent of all sites obtained their licence between 1991 and 1995. However, this reflects the introduction of a new licensing regime under the Environmental Protection Act 1990 rather than a significant growth in number of waste facilities.

In terms of the types of sites obtaining licences, landfill was dominant until 1986, after which waste transfer stations consistently became the largest category of sites for each time period. The declining trend in the proportion of new landfill licences over the last 20 years is counterbalanced by a rising trend in the proportions of recycling, chemical and biological facility licences over the same period.

How are non-compliances with permit conditions distributed across different types of waste sites and regions?

Data on non-compliances are drawn from only one year of records (2004/05) and all breaches in severity classes 1– 3 are combined in the summary results shown in Tables 5.10–5.12.

Tables 5.10 shows that the highest absolute numbers of non-compliances are at waste transfer and recycling sites (reflecting the large total numbers of these sites). In relative terms, however, landfill sites have the highest average number of breaches per site (Table 5.12).

The proportion of all sites with at least one non-compliance shows some variation across the regions – the North East having the highest proportion and the East of England the lowest (Table 5.11). A similar pattern is evident for average number of non-compliances per site (Table 5.12).

Larger and more significant sites are inspected more frequently (some every working day). Therefore, the chances of non-compliance being identified could be increased at such sites even though they may be inherently better managed. Sites subject to infrequent inspection could become more complacent and hence more likely to non-compliant at any point in time.

Table 5.3 All waste sites with OPRA scores (operational/non-operational) in England by type of site and site category

Classification		Type of site	All sites				Operational sites				Not operational			
			Number		Percentage of total		Number		Percentage of total		Number		Percentage of total	
Landfill	A1	Co-disposal landfill site	261		3.7		181		69.3		80		30.7	
	A2	Other landfill site taking special waste	64		0.9		42		65.6		22		34.4	
	A4	Household, commercial and industrial waste landfill	346		4.9		167		48.3		179		51.7	
	A5	Landfill taking non-biodegradable wastes	698		10.0		295		42.3		403		57.7	
	A6	Landfill taking other wastes	469	1,838	6.7	26.2	204	889	43.5	48.4	265	949	56.5	51.6
Recycling	A15	Material recycling treatment facility	139		2.0		125		89.9		14		10.1	
	A19	Metal recycling site (vehicle dismantler)	622		8.9		532		85.5		90		14.5	
	A20	Metal recycling site (mixed MRSs)	807	1,568	11.5	22.4	696	1,353	86.2	86.3	111	215	13.8	13.7
Waste transfer	A9	Special waste transfer station	410		5.9		370		90.2		40		9.8	
	A10	In-house storage facility	56		0.8		49		87.5		7		12.5	
	A12	Clinical waste transfer station	120		1.7		111		92.5		9		7.5	
	A11	Household, commercial and industrial waste transfer site	1,921	2,507	27.4	35.8	1,767	2,297	92.0	91.6	154	210	8.0	8.4
Chemical	A16	Physical treatment facility	181		2.6		166		91.7		15		8.3	
	A17	Physico-chemical treatment facility	74		1.1		66		89.2		8		10.8	
	A18	Incinerator	58		0.8		50		86.2		8		13.8	
	A21	Chemical treatment facility	31	344	0.4	4.9	28	310	90.3	90.1	3	34	9.7	9.9
Biological	A22	Composting facility	80		1.1		71		88.8		9		11.3	
	A23	Biological treatment facility	95	175	1.4	2.5	84	155	88.4	88.6	11	20	11.6	11.4
Amenity sites	A13	Household waste amenity site	135		1.9		131		97.0		4		3.0	
	A14	Transfer station taking non-biodegradable wastes	168	303	2.4	4.3	141	272	83.9	89.8	27	31	16.1	10.2
Other	A3	Borehole	8		0.1		7		87.5		1		12.5	
	A7	Industrial waste landfill (factory curtilage)	180		2.6		98		54.4		82		45.6	
	A8	Lagoon	65		0.9		44		67.7		21		32.3	
	A24	Mobile plant	17	270	0.2	3.9	10	159	58.8	58.9	7	111	41.2	41.1
		Total	**7,005**	**7,005**	**100**	**100**	**5,435**	**5,435**	**78**	**78**	**1,570**	**1,570**	**22**	**22**

Table 5.4 Operational OPRA waste sites in England by site category for each region (number of sites)

Site category	All sites	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
Landfill	889	44	98	159	97	70	114	19	159	129
Recycling	1,353	66	194	278	112	171	181	49	156	146
Waste transfer	2,297	106	400	284	210	266	291	153	308	279
Chemical	310	10	47	35	40	27	34	12	74	31
Biological	155	6	21	4	11	8	20	3	40	42
Amenity	272	49	11	66	26	15	16	29	20	40
Other	159	7	25	31	34	10	15		11	26
Total	5,435	288	796	857	530	567	671	265	768	693

Table 5.5 Operational OPRA waste sites in England by site category for each region (regional percentages)

Site category	All sites	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
Landfill	16.4	15.3	12.3	18.6	18.3	12.3	17.0	7.2	20.7	18.6
Recycling	24.9	22.9	24.4	32.4	21.1	30.2	27.0	18.5	20.3	21.1
Waste transfer	42.3	36.8	50.3	33.1	39.6	46.9	43.4	57.7	40.1	40.3
Chemical	5.7	3.5	5.9	4.1	7.5	4.8	5.1	4.5	9.6	4.5
Biological	2.9	2.1	2.6	0.5	2.1	1.4	3.0	1.1	5.2	6.1
Amenity	5.0	17.0	1.4	7.7	4.9	2.6	2.4	10.9	2.6	5.8
Other	2.9	2.4	3.1	3.6	6.4	1.8	2.2	0.0	1.4	3.8
Total	100	100	100	100	100	100	100	100	100	100

Table 5.6 Operational OPRA waste sites in England by site category for each region (site category percentages)

Site category	All sites	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
Landfill	100	4.9	11.0	17.9	10.9	7.9	12.8	2.1	17.9	14.5
Recycling	100	4.9	14.3	20.5	8.3	12.6	13.4	3.6	11.5	10.8
Waste transfer	100	4.6	17.4	12.4	9.1	11.6	12.7	6.7	13.4	12.1
Chemical	100	3.2	15.2	11.3	12.9	8.7	11.0	3.9	23.9	10.0
Biological	100	3.9	13.5	2.6	7.1	5.2	12.9	1.9	25.8	27.1
Amenity	100	18.0	4.0	24.3	9.6	5.5	5.9	10.7	7.4	14.7
Other	100	4.4	15.7	19.5	21.4	6.3	9.4	0.0	6.9	16.4
Total	100	5	15	16	10	10	12	5	14	13

Table 5.7 Operational OPRA waste sites in England for each site category by licence issue date

Site category	All sites	Pre-1980	1981–1985	1986–1990	1991–1995	1996–2000	Post-2001	Date unknown
Landfill	889	106	77	146	326	182	50	2
Recycling	1,353	11	2	91	820	307	119	3
Waste transfer	2,297	38	54	164	1,158	537	343	3
Chemical	310	8	12	10	97	103	79	1
Biological	155		3	1	51	69	31	
Amenity	272	5	1	10	115	100	39	2
Other	159	43	14	19	42	22	17	2
Total	5,435	205	163	441	2,609	1,320	678	13

Table 5.8 Operational OPRA waste sites in England for each site category by licence issue date (year percentages)

Site category	All sites	Pre-1980	1981–1985	1986–1990	1991–1995	1996–2000	Post-2001	Date unknown
Landfill	16.4	51.7	47.2	33.1	12.5	13.8	7.4	15.4
Recycling	24.9	5.3	1.2	20.6	31.4	23.3	17.6	23.1
Waste transfer	42.3	18.5	33.1	37.2	44.4	40.7	50.6	23.1
Chemical	5.7	3.9	7.4	2.3	3.7	7.8	11.7	7.7
Biological	2.9		1.8	0.2	2.0	5.2	4.6	
Amenity	5.0	2.4	0.6	2.3	4.4	7.6	5.8	15.4
Other	2.9	20.9	8.6	4.3	1.6	1.7	2.5	15.4
Total	100	100	100	100	100	100	100	100

Table 5.9 Operational OPRA Waste sites in England for each site category by licence issue date (site type percentages)

Site category	All sites	Pre-1980	1981–1985	1986–1990	1991–1995	1996–2000	Post-2001	Date unknown
Landfill	100	11.9	8.7	16.4	36.7	20.5	5.6	0.2
Recycling	100	0.8	0.1	6.7	60.6	22.7	8.8	0.2
Waste transfer	100	1.7	2.4	7.1	50.4	23.4	14.9	0.1
Chemical	100	2.6	3.9	3.2	31.3	33.2	25.5	0.3
Biological	100		1.9	0.6	32.9	44.5	20.0	
Amenity	100	1.8	0.4	3.7	42.3	36.8	14.3	0.7
Other	100	27.0	8.8	11.9	26.4	13.8	10.7	1.3
Total	100	3.9	3.0	8.1	48.0	24.3	12.5	0.2

Figure 5.2 Operational OPRA waste sites in England for each site category by licence issue date (year percentages)

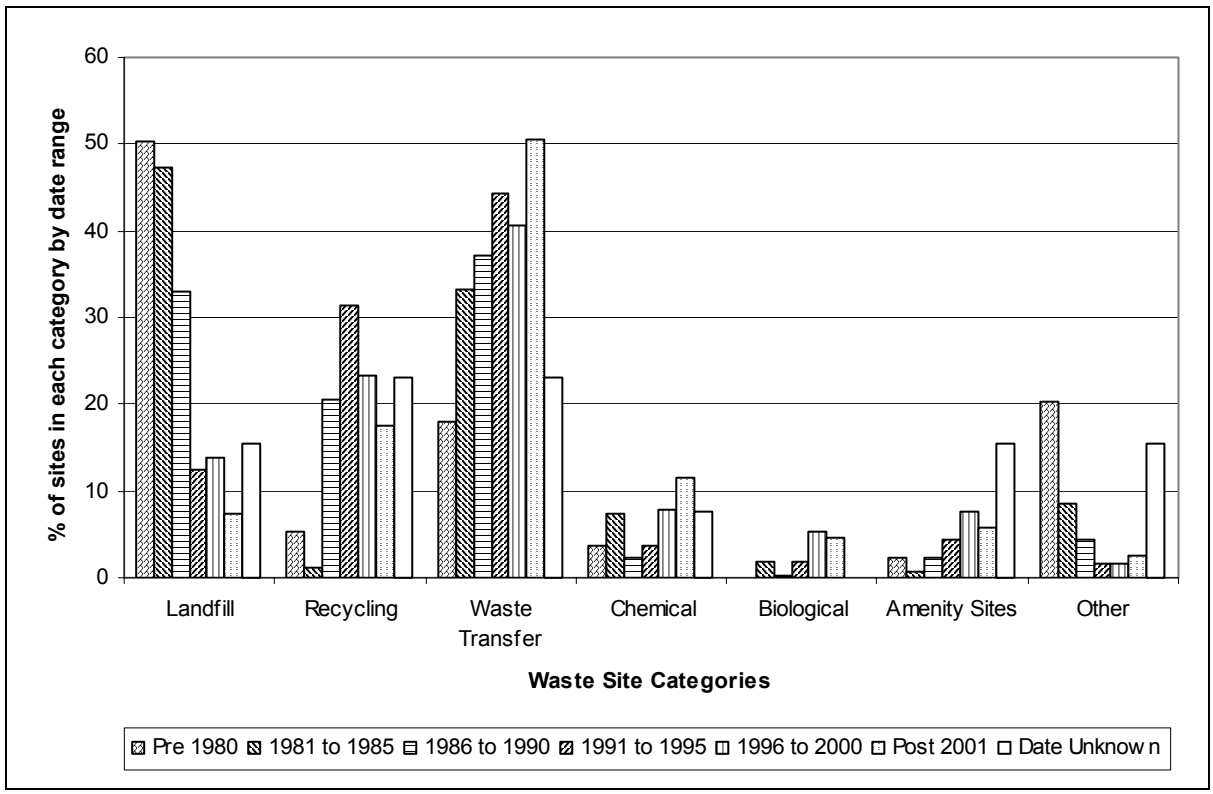


Table 5.10 Total number of permit non-compliances at waste sites by region and site category

Site category	All sites	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
Landfill	4,550	522	378	1,133	588	258	450	139	502	580
Recycling	5,578	855	935	1,191	478	766	376	180	426	371
Waste transfer	6,583	355	1,332	683	768	1,009	399	548	681	808
Chemical	885	17	249	87	109	40	18	99	198	68
Biological	298	15	46	10	111	26	30	5	40	15
Amenity	395	142	7	70	50	3	15	49	24	35
Other	129	3	33	42	29	3	9		6	4
Total	18,418	1,909	2,980	3,216	2,133	2,105	1,297	1,020	1,877	1,881

Table 5.11 Total numbers of sites with non-compliances and total numbers of non-compliances by region (2004/05 data)

Classification	All sites	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
Operational sites	5,435	288	796	857	530	567	671	265	768	693
Number of sites with a class 1–3 non-compliance	2,482	180	369	412	278	306	234	126	317	260
Percentage of operational sites with a class 1–3 non-compliance	45.7	62.5	46.4	48.1	52.5	54.0	34.9	47.5	41.3	37.5
Number of reported non-compliances with a classification of 1–3	18,418	1,909	2,980	3,216	2,133	2,105	1,297	1,020	1,877	1,881
Percentage of sites with a non-compliance classification 1–3 within each Government Office region	100	7.3	14.9	16.6	11.2	12.3	9.4	5.1	12.8	10.5
Percentage of reported non-compliances with a classification of 1–3 within each Government Office region	100	10.4	16.2	17.5	11.6	11.4	7.0	5.5	10.2	10.2
Average number of non-compliances per site	7.4	10.6	8.1	7.8	7.7	6.9	5.5	8.1	5.9	7.2

Table 5.12 Average number of non-compliances per site by site category and region (2004/05 data)

Site category	All sites	North East	North West	Yorkshire and Humberside	East Midlands	West Midlands	East of England	London	South East	South West
Landfill	10.5	18.0	8.6	13.5	10.9	6.5	9.0	23.2	6.7	10.9
Recycling	7.9	18.6	9.3	7.3	7.2	7.8	5.4	8.2	6.4	5.3
Waste transfer	6.4	5.1	7.6	5.4	7.0	6.6	4.4	7.2	5.5	7.3
Chemical	7.1	4.3	9.2	8.7	5.7	4.4	2.0	12.4	7.1	6.8
Biological	5.2	5.0	4.2	3.3	15.9	8.7	3.3	2.5	3.1	2.5
Amenity	4.0	5.3	2.3	3.5	3.8	1.5	3.0	4.1	3.0	4.4
Other	3.9	1.5	4.7	8.4	3.2	1.5	4.5	0.0	2.0	1.3
Total:	7.4	10.6	8.1	7.8	7.7	6.9	5.5	8.1	5.9	7.2

5.4 Waste facilities and deprivation in North West England

5.4.1 Site and population data

The North West Government Office region was chosen for more detailed analysis against deprivation data as it contained a substantial number of operational licensed sites and a good cross-section of site types (see Table 5.13). For the purposes of analysis, those sites in the 'other category' (borehole, industrial waste landfill within the factory curtilage, lagoon, mobile plant) were excluded because an analysis of population proximity was considered to be conceptually problematic in these cases. The analysis therefore included 771 sites.

Table 5.13 Number of operational waste sites in the North West by site type

Type of site	Number of sites	Percentage of sites
Landfill	98	13
Recycling	194	25
Waste transfer	400	52
Chemical	47	6
Biological	21	3
Amenity	11	1
North West	771	100
'Other' sites (not included in analysis)	25	

The profile of site types in the North West reflects to some degree the industrial geography of the region, which has historic clusters of heavy industry, particularly the chemical industry, which generates complex and hazardous wastes. This industry has, however, also produced significant employment and income for the region. The relatively large number of industrial waste transfer stations facilities in the region reflects this industrial geography. A merchant hazardous waste incinerator – an important treatment route particularly for chemical waste – is located towards the south of the region.

One of the objectives of the exploratory analysis was to find ways of differentiating between different types of waste facility and their potential scales of social impact, rather than simplistically treating all sites as somehow equal. Whilst this is provided by a breakdown by site type, OPRA scores can provide a further degree of differentiation. Three sub-components of the OPRA environment score for each site were chosen, which were felt to provide an indicator of the scale of environmental impact that could be potentially presented (see Table 5.2). Table 5.14 shows the range of scores obtained when these three sub-component scores are added together. A few sites obtained very high scores extending up to a 100, while the majority (nearly 60 per cent of all sites) fall between 21 and 40. Table 5.15 also shows that the sites with the highest scores – those having characteristics associated with a high potential environmental impact – are all landfill facilities. Other site types have a smaller range of scores concentrated in the lower groupings.

Table 5.14 Number of operational waste sites in the North West grouped by OPRA combined environment scores band

Combined OPRA score	Number of sites	Percentage of sites
0–20*	16	2.1
21–30	228	29.6
31–40	307	39.8
41–50	136	17.6
51–60	38	4.9
61–70	10	1.3
71–80	5	0.6
81–90	28	3.6
91–100**	3	0.4
Total	**771**	**100**

* Low potential impact
** High potential impact

Table 5.15 Number of operational waste sites in the North West grouped by OPRA combined environment scores band and site category

Combined OPRA score	All sites	Amenity	Biological	Chemical	Landfill	Recycling	Waste transfer
0–20	16	4		1	5		6
21–30	228	4	7	14	14	82	107
31–40	307	3	13	21	15	71	184
41–50	136		1	9	11	40	75
51–60	38			2	8	1	27
61–70	10				9		1
71–80	5				5		
81–90	28				28		
91–100	3				3		
Total	**771**	**11**	**21**	**47**	**98**	**194**	**400**

In terms of population data, the analysis needs to take account of the distribution of population in the North West across nationally derived deprivation deciles. As explained in Section 5.2.2, although deprivation deciles were constructed for England as a whole to contain equal numbers of people, the population of the North West region is not equally represented in each of these deciles (which would be 10 per cent in each decile).

As shown in Table 5.16, there are higher proportions of people in the more deprived deciles (just over 20 per cent in decile 1) and lower proportions in the less deprived

(nearly 5 per cent in decile 10). It is important that this distribution of population by deprivation is taken into account in the following analysis and interpretation.

Higher absolute numbers of people live near to waste facilities in the most deprived deciles compared with the least deprived just because of the underlying geography of deprivation. However, in relative terms, there may still be a disproportionate concentration of deprived populations near to waste sites over and above what would be expected from the overall social profile of the region.

Table 5.16 Population in the North West within deprivation deciles derived for England as a whole

Population weighted deprivation decile for England	Population in North West	Percentage of population in North West
1	1,401,540	20.73
2	822,230	12.16
3	780,730	11.55
4	652,710	9.65
5	620,170	9.17
6	613,250	9.07
7	580,880	8.59
8	492,710	7.29
9	479,220	7.09
10	316,920	4.69
Total	**6,760,360**	**100**

5.4.2 Analysis against deprivation

What is the profile of deprivation of populations living within 300 m, 500 m, 1 km and 2 km of all waste sites?

An initial basic analysis involved testing out the impact of changing buffer distances on the deprivation profiles of populations living near to all types of waste sites (without any differentiation between them). There is no satisfactory way of determining precise distances that represent the impact that any one waste site, or type of waste site, will have on the nearby area.

As discussed in Section 4.4, many inter-related variables influence local impacts. These can only be assessed properly by specific site-by-site analyses. A proximity analysis that uses a standard distance drawn around each site can only seek to derive a profile or characterisation of the deprivation characteristics of the population within that distance. Using a number of different distances provides a way of testing out the sensitivity of the deprivation profile to the chosen distance. Table 5.17 and Figures 5.3–5.6 show that, for each of the distances, there is a higher absolute number and a higher proportion of people living within the distance in the more deprived deciles compared with the less deprived.

The overall nature of the association is therefore not sensitive to distance. However, the proportional strength of the association does vary with differences between the deciles becoming less acute as distance increases – to the point where the distribution for 2 km

is beginning to become relatively flat across the deciles. The declining CERI deciles 1–2 and 1–5 values also indicate this; at 300 m, people in deciles 1 and 2 are 101 per cent more likely to be living near to a waste site than others whereas, for 2 km, they are only 23 per cent more likely.

For simplicity, the distance of 500 m and, in a few cases, 1 km have been used in the following analyses. Although this choice is arbitrary to some degree, 300 m was felt to be too sensitive to potential inaccuracies in grid referencing, while 2 km was considered too large to sensibly characterise populations living near many of the smaller facilities.

Table 5.17 Population within 300 m, 500 m, 1 km and 2 km of all waste sites in North West and percentage of each decile's population within each distance

Decile	Decile population	300 m		500 m		1 km		2 km	
		Number	%	Number	%	Number	%	Number	%
1	1,401,540	77,649	5.54	230,196	16.42	673,789	48.07	1,201,232	85.71
2	822,230	39,337	4.78	118,787	14.45	394,957	48.03	708,322	86.15
3	780,730	31,954	4.09	88,327	11.31	326,744	41.85	651,894	83.50
4	652,710	20,518	3.14	64,017	9.81	230,486	35.31	520,361	79.72
5	620,170	18,906	3.05	58,391	9.42	201,374	32.47	464,897	74.96
6	613,250	14,113	2.30	41,401	6.75	154,785	25.24	405,080	66.05
7	580,880	8,810	1.52	27,520	4.74	114,063	19.64	352,113	60.62
8	492,710	9,665	1.96	26,940	5.47	98,175	19.93	306,535	62.21
9	479,220	5,612	1.17	19,923	4.16	93,086	19.42	272,695	56.90
10	316,920	3,761	1.19	15,483	4.89	67,101	21.17	195,810	61.79
North West	**6,760,360**	**230,324**	**3.41**	**690,985**	**10.22**	**2,354,559**	**34.83**	**5,078,938**	**75.13**
CERI deciles 1 and 2			2.106		2.082		1.696		1.229
CERI deciles 1–5			2.606		2.475		2.012		1.344
CERI deciles 6–10			0.384		0.404		0.497		0.744

Figure 5.3 Percentage of total population in the North West within 300 m of all types of waste site by deprivation decile

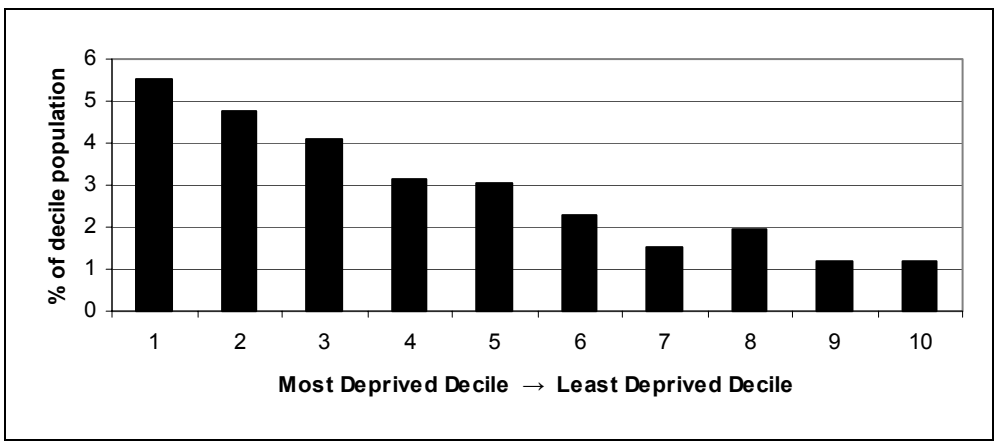


Figure 5.4 Percentage of total decile population in the North West within 500 m of all types of waste site by deprivation decile

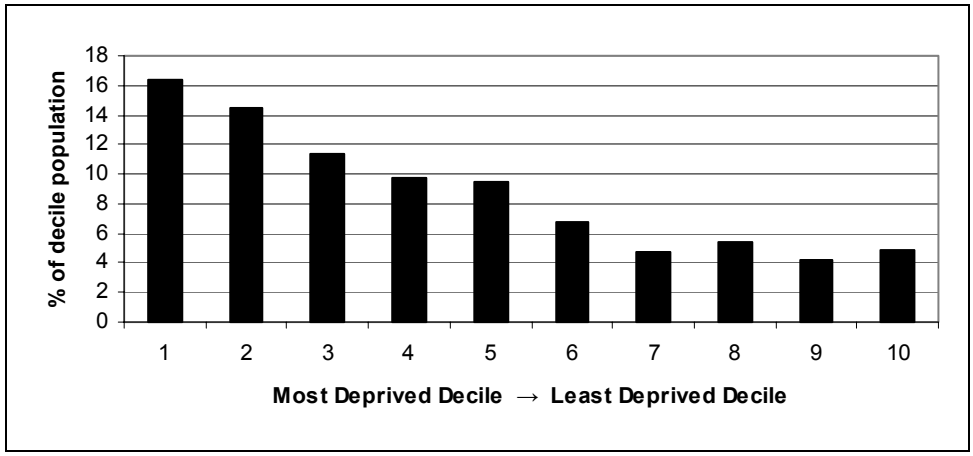


Figure 5.5 Percentage of total decile population in the North West within 1 km of all types of waste site by deprivation decile

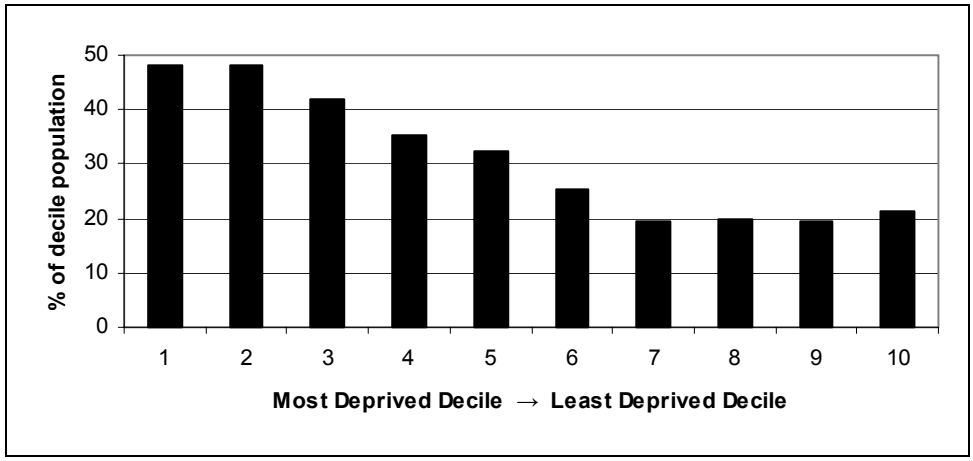
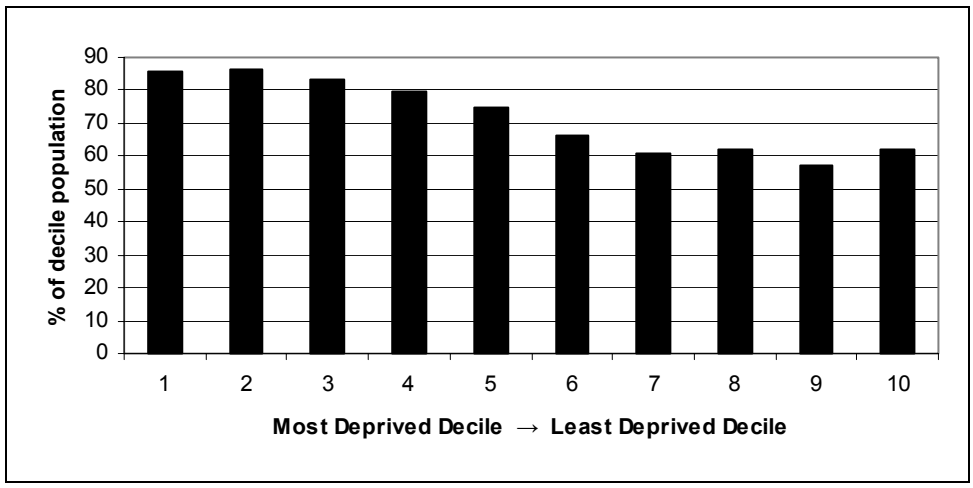


Figure 5.6 Percentage of total population in the North West within 2 km of all types of waste site by deprivation decile



What is the profile of deprivation of populations living within 500 m of different site categories?

Differentiating the waste sites by type begins to show some marked differences and confirms the significant limitations of treating all sites as the same. Table 5.18 shows the total population within 500 m of each site type and derives an average number of people per site for each site type category. This highlights the low numbers of people living near landfill and biological treatment facilities compared with all other types of facility – reflecting their typical locations away from major urban settlements. Amenity and recycling sites, in contrast, have high average population figures reflecting their need to be close to where people live and where waste is generated and collected. In this respect, the proximity of local people may be considered a 'good' rather than a 'bad'. Note that there will be double-counting here due to some sites being very close to each other. For example, some amenity and recycling facilities are on landfill sites but have separate operating licences.

Table 5.18 Numbers of people living within 500 m of waste sites by site category

	Region	All sites	Landfill	Recycling	Waste transfer	Chemical	Biological	Amenity
Total population	6,760,360	690,985	19,560	269,600	440,341	44,492	5,547	16,696
Percentage of total population	100	10.22	0.29	3.99	6.51	0.66	0.08	0.25
Number of sites		771	98	194	400	47	21	11
Mean population per site		896.2	199.6	1389.7	1100.8	946.6	264.1	1517.8

Deprivation profiles show some related variation between site types (Table 5.19 and Figures 5.7 and 5.8). In absolute terms, decile 1 dominates for recycling, waste transfer and chemical treatment facilities because of the underlying deprivation profile for the North West. For all site types apart from landfill, however, populations in the more deprived deciles are more likely to be living within 500 m of waste sites than others.

This is over and above the higher number of people in the more deprived deciles within the region, as indicated by the CERI values, which provide a relative ratio measure. The CERI values for deciles 1 and 2 are all significantly above 1 (apart from landfill). The strongest bias towards deprived populations is found in the recycling category, where people in deciles 1 and 2 are 266 per cent more likely than others to be living within 500 m of a facility (which could bring benefits to these communities).

For chemical treatment facilities, the bias is more acutely towards just the most deprived decile 1. The CERI 1–5 value is very high (9.14), reflecting the very low populations in the least deprived deciles. Amenity sites have a high CERI value for deciles 1–5, but the highest proportions of population are found in deciles 5 and 3.

Landfills stand out with a markedly different deprivation profile, exhibiting a bias towards the least rather than most deprived. The highest proportions of population are found in deciles 10 and 8, and the CERI values for deciles 1–2 and 1–5 are below rather than

over 1. The populations living with a below median level of deprivation (deciles 6–10) are 125 per cent more likely to be living near to a landfill site than those living at above median deprivation.

The locations of the different types of waste site in relation to deprived areas are shown in a series of maps in Appendix 2. These, in particular, highlight the concentration of many waste sites in the main urban settlements forming a band across the south of the region and in the deprived areas within these. The contrasting locations of landfills and amenity sites outside the most deprived areas are also apparent.

Are there differences in deprivation profiles of population that live within 500 m of waste sites which relate to the date at which licences were issued?

In considering the data on the date of issue of site licences, it is important to bear in mind the problems (see Section 5.2.3) that exist for the robustness of these data (though within a region the recording of data should at least be more consistent than across different regions).

The ideal situation would be to relate the date at which a waste facility was established to the deprivation geography that existed at the time, e.g. to track if site locations have in relative terms moved towards or away from deprived communities over time, perhaps reflecting political influences on siting decisions. However, it is difficult to be sure when a waste facility first came into operation (because of complications with the available dataset) and to provide an analysis using historic deprivation data within the scope of the project. It was thus only possible to consider sites that are still operational, though the REGIS dataset could be manipulated in a larger study to identify sites that have closed in the past. The analysis that has been undertaken therefore needs to be approached carefully and as a starting point for further work.

Table 5.20 and Figure 5.9 show that, apart for the earliest period pre-1980, a broadly similar current population deprivation profile exists for long-standing and more recently issued licences for sites that are still in operation. In each time period from 1986 onwards, the most deprived decile has the highest proportion of population living within 500 m of a waste site – and the lowest proportion is in decile 9 or 10. CERI values do change between the four-year periods, but clear trends in relative concentration towards or away from deprived populations cannot be immediately identified.

These results emphasise the need for a longitudinal analysis to be approached in a sophisticated and careful manner – developing a robust methodology where data makes this possible. In many respects, land-use planning polices combined with a tendency to reuse waste sites for new/replacement/upgraded facilities means that land designated for waste uses at a particular point in time is likely to continue in such use over time regardless of operator changes – though type of use could vary. In many urban areas, waste facilities (not least waste combustion processes) can be identified on particular sites over 100 years ago. A longitudinal analysis of site use and development would therefore be highly valuable.

Table 5.19 Population in the North West within 500 m of categories of waste site type by deprivation decile

Decile	Population	Total within 500 m	Population within 500 m of a waste site of type:					
			Landfill	Recycling	Waste transfer	Chemical	Biological	Amenity
1	1,401,540	230,196	1,635	116,460	143,534	18,461	2,173	3,979
2	822,230	118,787	1,721	56,604	70,831	6,566	802	2,177
3	780,730	88,327	2,510	29,145	57,867	7,101	377	2,708
4	652,710	64,017	1,690	20,971	38,259	5,754	253	1,746
5	620,170	58,391	935	16,327	41,685	3,954	61	3,619
6	613,250	41,401	1,370	15,200	23,096	1,230	503	1,040
7	580,880	27,520	1,356	4,525	20,418	825	684	264
8	492,710	26,940	3,784	3,118	19,491	356	444	799
9	479,220	19,923	1,417	4,610	15,003	51	189	364
10	316,920	15,483	3,141	2,639	10,157	195	62	
North West	**6,760,360**	**690,985**	**19,560**	**269,600**	**440,341**	**44,492**	**5,547**	**16,696**

Decile	Population	Total within 500 m (%)	Percentage of each decile's population within 500 m					
			Landfill	Recycling	Waste transfer	Chemical	Biological	Amenity
1	1,401,540	16.42	0.12	8.31	10.24	1.32	0.16	0.28
2	822,230	14.45	0.21	6.88	8.61	0.80	0.10	0.26
3	780,730	11.31	0.32	3.73	7.41	0.91	0.05	0.35
4	652,710	9.81	0.26	3.21	5.86	0.88	0.04	0.27
5	620,170	9.42	0.15	2.63	6.72	0.64	0.01	0.58
6	613,250	6.75	0.22	2.48	3.77	0.20	0.08	0.17
7	580,880	4.74	0.23	0.78	3.52	0.14	0.12	0.05
8	492,710	5.47	0.77	0.63	3.96	0.07	0.09	0.16
9	479,220	4.16	0.30	0.96	3.13	0.01	0.04	0.08
10	316,920	4.89	0.99	0.83	3.20	0.06	0.02	0.00
North West	**6,760,360**	**10.22**	**0.29**	**3.99**	**6.51**	**0.66**	**0.08**	**0.25**
CERI deciles 1 and 2		2.082	0.422	3.657	1.935	2.623	2.359	1.191
CERI deciles 1–5		2.475	0.445	4.620	2.319	9.141	1.131	3.349
CERI deciles 6–10		0.404	2.246	0.216	0.431	0.109	0.884	0.299

Figure 5.7 Percentage of total population in the North West within 500 m of recycling and waste transfer sites by deprivation decile

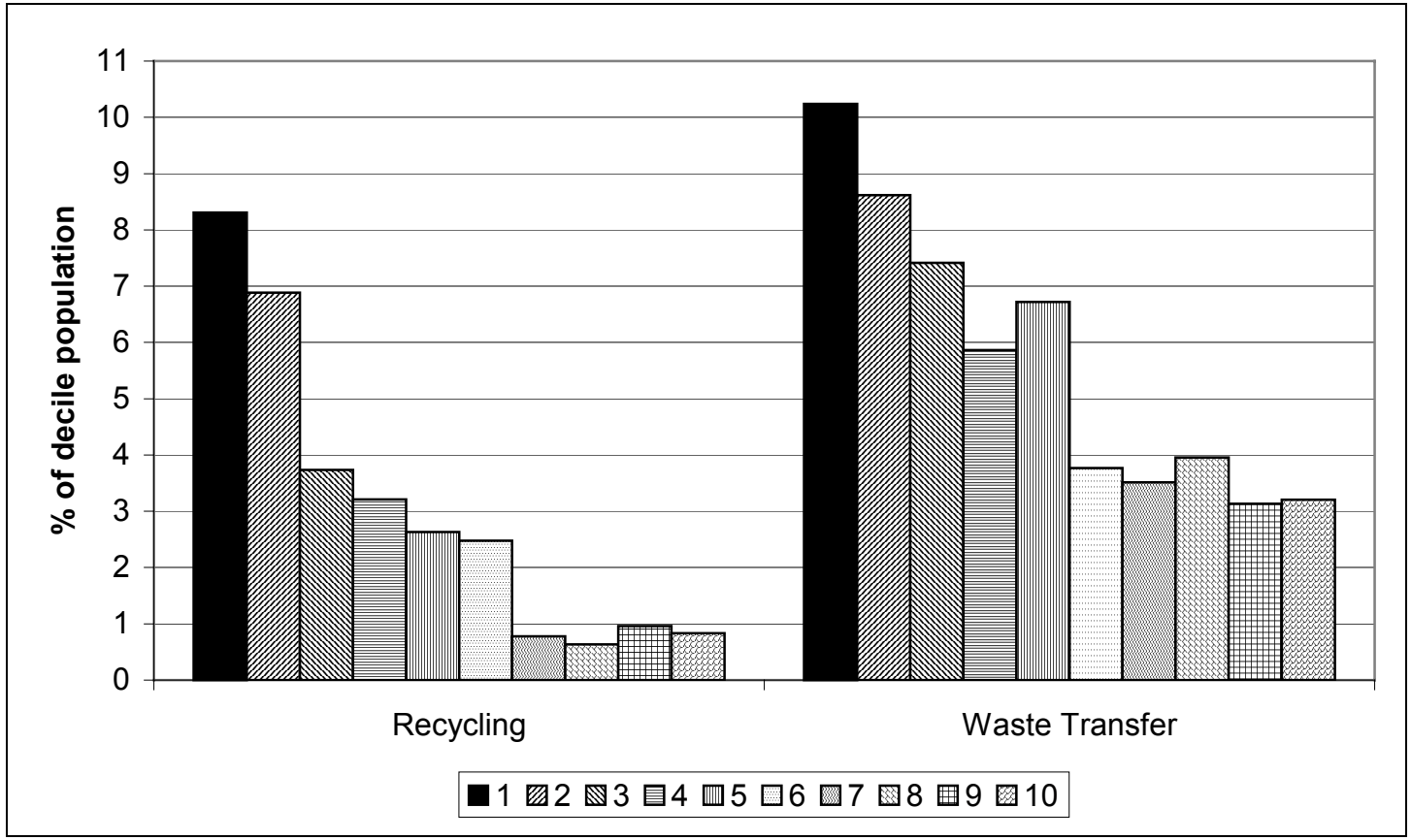


Figure 5.8 Percentage of total population in the North West within 500 m of landfill, chemical, biological and amenity sites by deprivation decile (1–10)

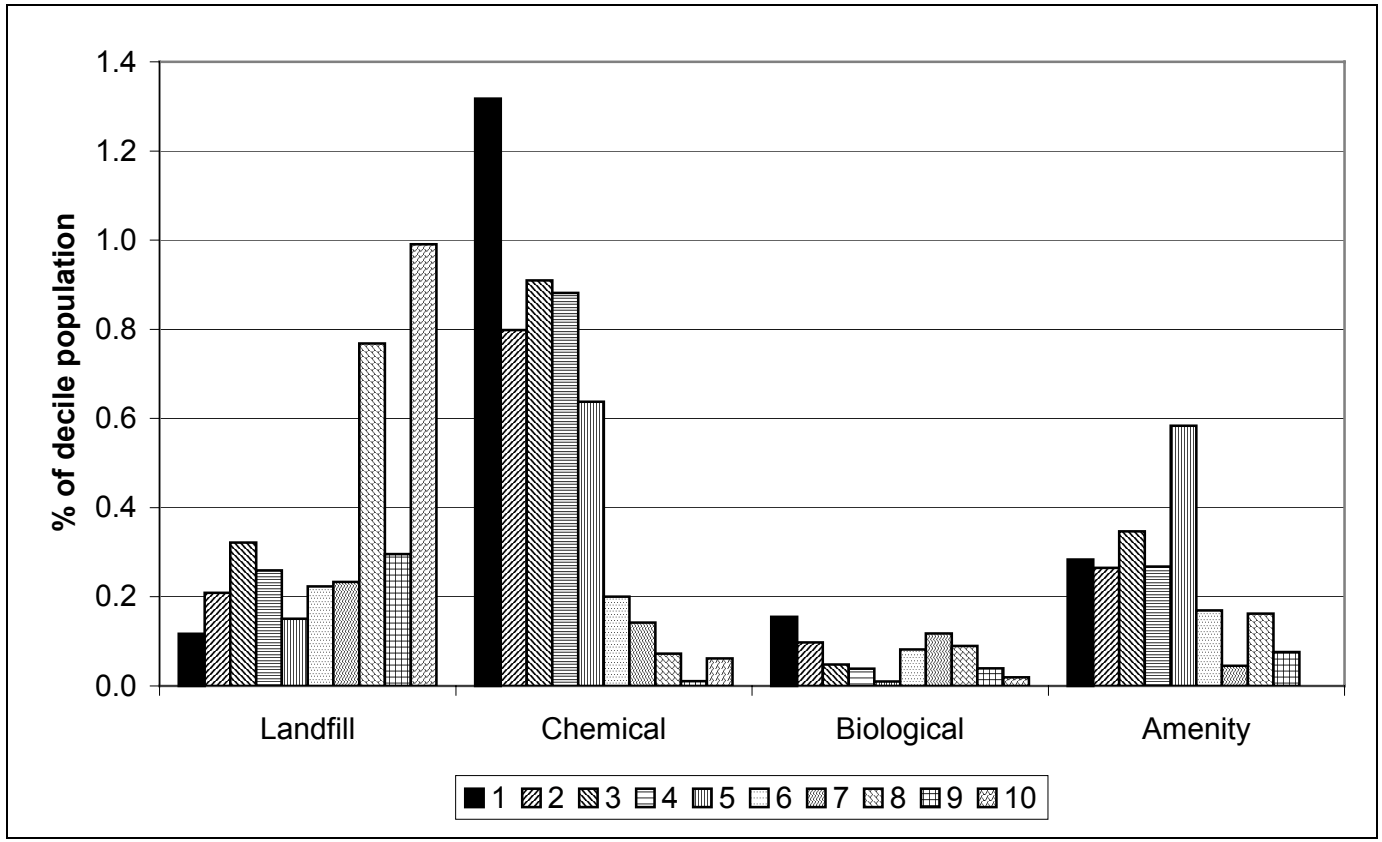
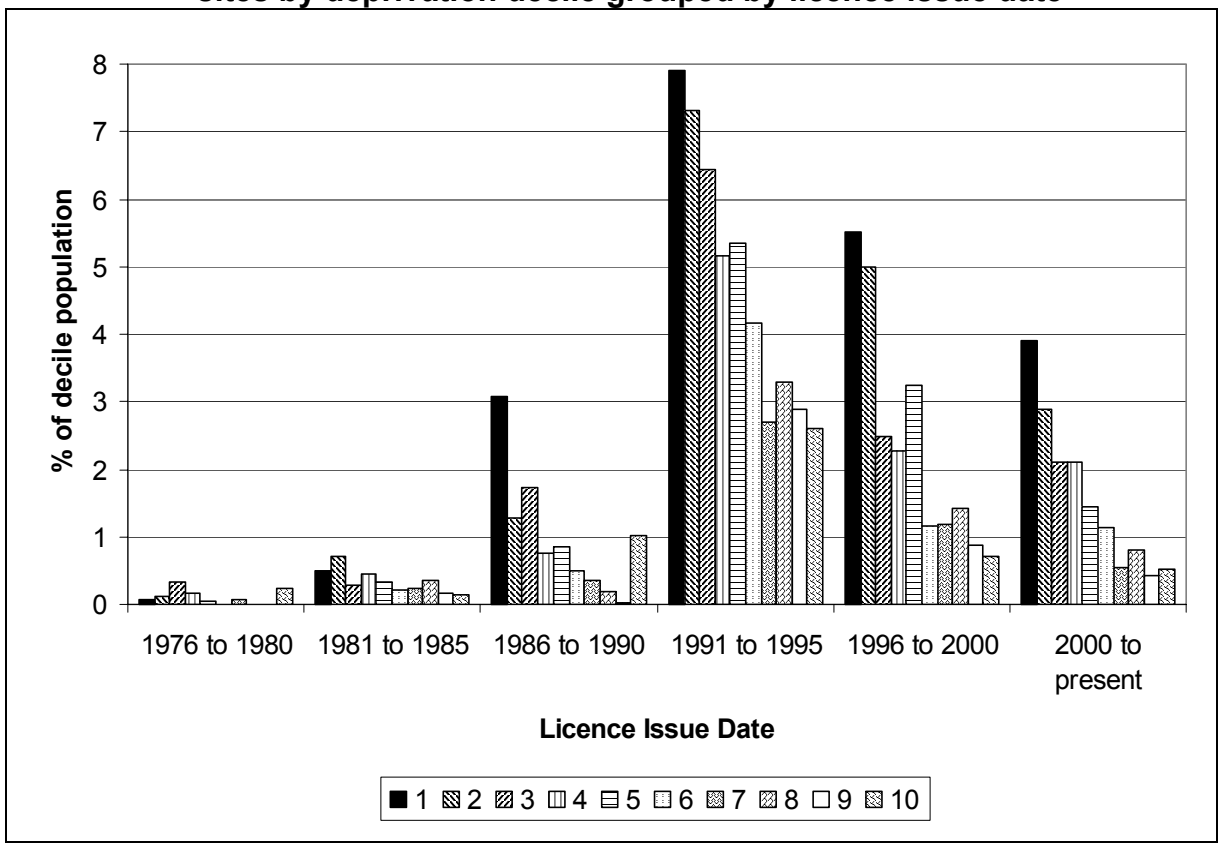


Table 5.20 Population in the North West within 500 m of waste sites by deprivation decile grouped by licence issue date

Decile	Population	Total within 500 m	Population within 500 m of a waste site by licence issue date:					
			Pre-1980	1981–1985	1986–1990	1991–1995	1996–2000	Post-2001
1	1,401,540	230,196	873	6,942	43,181	110,726	77,189	54,706
2	822,230	118,787	1,014	5,861	10,540	60,195	40,966	23,830
3	780,730	88,327	2,547	2,303	13,511	50,229	19,408	16,477
4	652,710	64,017	1,148	2,961	4,898	33,656	14,842	13,789
5	620,170	58,391	300	2,021	5,314	33,246	20,078	8,928
6	613,250	41,401	21	1,243	3,004	25,536	7,164	6,911
7	580,880	27,520	460	1,332	2,116	15,621	6,827	3,154
8	492,710	26,940	8	1,721	904	16,168	7,020	3,989
9	479,220	19,923	2	848	165	13,798	4,181	2,052
10	316,920	15,483	732	487	3,229	8,259	2,272	1,631
North West	**6,760,360**	**690,985**	**7,106**	**25,717**	**86,862**	**367,435**	**199,947**	**135,466**

Decile	Population	Total within 500 m (%)	Percentage of each decile's population within 500 m by licence issue date					
			Pre-1980	1981–1985	1986–1990	1991–1995	1996–2000	Post-2001
1	1,401,540	16.42	0.06	0.50	3.08	7.90	5.51	3.90
2	822,230	14.45	0.12	0.71	1.28	7.32	4.98	2.90
3	780,730	11.31	0.33	0.29	1.73	6.43	2.49	2.11
4	652,710	9.81	0.18	0.45	0.75	5.16	2.27	2.11
5	620,170	9.42	0.05	0.33	0.86	5.36	3.24	1.44
6	613,250	6.75	0.00	0.20	0.49	4.16	1.17	1.13
7	580,880	4.74	0.08	0.23	0.36	2.69	1.18	0.54
8	492,710	5.47	0.00	0.35	0.18	3.28	1.42	0.81
9	479,220	4.16	0.00	0.18	0.03	2.88	0.87	0.43
10	316,920	4.89	0.23	0.15	1.02	2.61	0.72	0.51
North West	**6,760,360**	**10.22**	**0.11**	**0.38**	**1.28**	**5.44**	**2.96**	**2.00**
CERI deciles 1 and 2			0.738	2.023	3.307	1.774	2.947	2.814
CERI deciles 1–5			2.790	2.071	4.774	2.106	3.646	3.853
CERI deciles 6–10			0.358	0.483	0.209	0.475	0.274	0.260

Figure 5.9 Percentage of total population in the North West within 500 m of waste sites by deprivation decile grouped by licence issue date



Do sites with high combined OPRA environment scores have different population deprivation profiles than other sites?

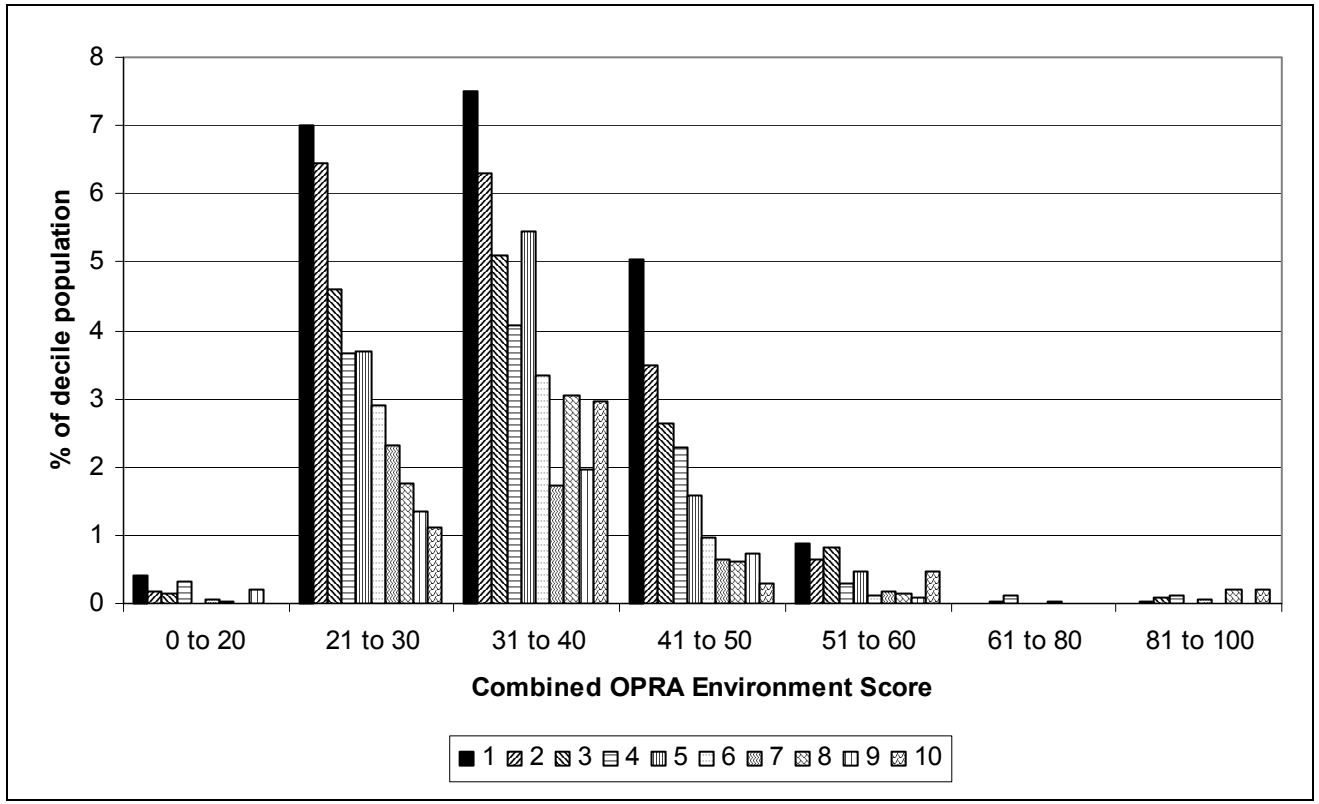
A further way of differentiating between sites is to use the three combined sub-components of the OPRA environment score. As discussed in Section 5.4.1, the majority of site OPRA scores in the North West fall within the ranges 21–30 and 30–40. Not surprisingly, these two bands have the highest populations within 500 m (Table 5.21 and Figure 5.10). In both cases, these populations are also skewed towards the most deprived deciles, as are populations for OPRA scores 41–50 and 51–60. However, the relatively few sites with the highest scores (31 in the range 81–100; see Table 5.14) have a low total population in their vicinity and these people are predominantly in the less deprived deciles (indicated by the CERI value for deciles 6–10 of 2.12). This does not suggest that the sites with the highest potential environmental impact are located in the most deprived areas – in fact the opposite.

Table 5.21 Population in the North West within 500 m of waste sites by deprivation decile grouped by OPRA environment score band

Decile	Population	Total within 500 m	Population within 500 m of a waste site by combined OPRA score:						
			0–20	21–30	31–40	41–50	51–60	61–80	81–100
1	1,401,540	230,196	5,886	98,171	105,332	70,798	12,333		17
2	822,230	118,787	1,385	53,071	51,748	28,758	5,344		191
3	780,730	88,327	1,075	35,995	39,845	20,607	6,372	141	586
4	652,710	64,017	2,119	23,823	26,620	15,002	1,929	703	739
5	620,170	58,391	43	22,844	33,840	9,815	2,891	23	55
6	613,250	41,401	438	17,879	20,571	5,879	659	81	345
7	580,880	27,520	167	13,478	10,025	3,677	1,088	189	21
8	492,710	26,940	8	8,713	15,046	3,055	660	3	944
9	479,220	19,923	990	6,498	9,412	3,445	356		43
10	316,920	15,483		3,568	9,405	972	1,492	2	606
North West	**6,760,360**	**690,985**	**12,109**	**284,040**	**321,844**	**162,008**	**33,123**	**1,143**	**3,548**

			Percentage of each decile's population within 500 m by combined OPRA score						
Decile	Population	Total within 500 m (%)	0–20	21–30	31–40	41–50	51–60	61–80	81–100
1	1,401,540	16.42	0.42	7.00	7.52	5.05	0.88		0.00
2	822,230	14.45	0.17	6.45	6.29	3.50	0.65		0.02
3	780,730	11.31	0.14	4.61	5.10	2.64	0.82	0.02	0.08
4	652,710	9.81	0.32	3.65	4.08	2.30	0.30	0.11	0.11
5	620,170	9.42	0.01	3.68	5.46	1.58	0.47	0.00	0.01
6	613,250	6.75	0.07	2.92	3.35	0.96	0.11	0.01	0.06
7	580,880	4.74	0.03	2.32	1.73	0.63	0.19	0.03	0.00
8	492,710	5.47	0.00	1.77	3.05	0.62	0.13	0.00	0.19
9	479,220	4.16	0.21	1.36	1.96	0.72	0.07		0.01
10	316,920	4.89	0.00	1.13	2.97	0.31	0.47	0.00	0.19
North West	**6,760,360**	**10.22**	**0.18**	**4.20**	**4.76**	**2.40**	**0.49**	**0.02**	**0.05**
CERI deciles 1 and 2		2.082	3.066	2.323	1.945	3.252	2.335	0.000	0.127
CERI deciles 1–5		2.475	3.809	2.708	2.318	4.942	3.938	1.826	0.471
CERI deciles 6–10		0.404	0.263	0.369	0.431	0.202	0.254	0.548	2.124

Figure 5.10 Percentage of total population in the North West within 500 m of waste sites by deprivation decile grouped by OPRA environment score band



Do sites with non-compliances with permit conditions have different population deprivation profiles than other sites?

In the North West, 362 of the 771 sites (47 per cent) had at least one non-compliance classified as 1–3. But as noted earlier, a non-compliance does not necessarily imply that an environmental impact has taken place and some non-compliances may not relate to potential for impact.

The total number of such non-compliances was 2,947, giving an average number of non-compliances per site of 8.1. The deprivation profile of the populations living within 500 m of the 362 sites is given in Table 5.22. This shows that populations in the more deprived deciles are more likely to be living near to a site with at least one non-compliance than those in the least deprived.

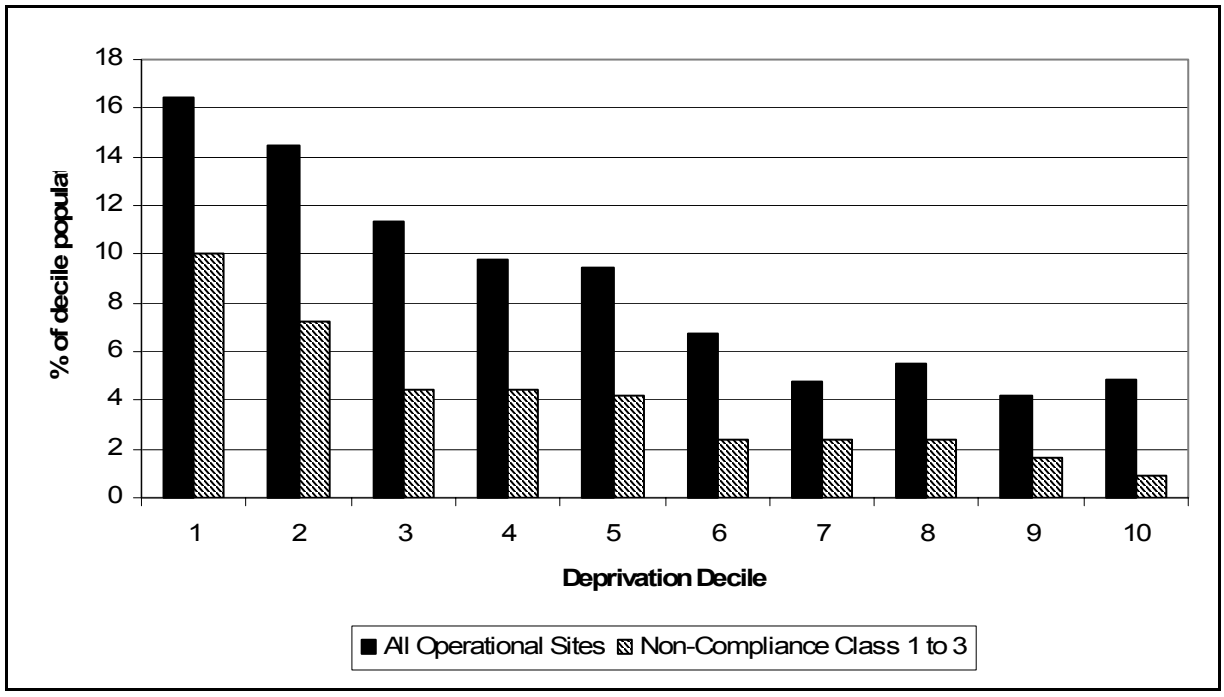
This bias towards deprived populations is more acute than for the general pattern of site locations – the decile 1–2 CERI value for all sites in the North West is 2.08, but for those with a non-compliance, it is 2.91 indicating a greater degree of inequality. For the least deprived decile, only a fifth of the total population within 500 m of a waste site are within 500 m of a site with a non-compliance; for the most deprived decile, the equivalent proportion is over two-thirds.

This suggests that, for the year 2004/05, sites near to less deprived populations in the North West are more likely to have been operated on an entirely satisfactory basis than those in more deprived areas. However, such a conclusion needs to be treated with considerable caution as, for example, the extent to which non-compliance is picked up will reflect the frequency with which sites are inspected – which in turn relates to various factors measured within OPRA scores. In addition, apart from excluding the minor non-compliances in class 4, the analysis did not distinguish between the severity of non-compliance or the degree to which any actual environmental impact resulted.

Table 5.22 Population within 500 m of waste sites with non-compliances of class 1–3 in 2004/05 by deprivation decile

Decile	Population	Total within 500 m of all operational sites	Percentage	Total within 500 m of all waste sites with a non-compliance of class 1–3	Percentage
1	1,401,540	230,196	16.42	140,592	10.03
2	822,230	118,787	14.45	59,661	7.26
3	780,730	88,327	11.31	34,598	4.43
4	652,710	64,017	9.81	28,957	4.44
5	620,170	58,391	9.42	25,753	4.15
6	613,250	41,401	6.75	14,681	2.39
7	580,880	27,520	4.74	13,869	2.39
8	492,710	26,940	5.47	11,694	2.37
9	479,220	19,923	4.16	7,991	1.67
10	316,920	15,483	4.89	2,836	0.89
North West	**6,760,360**	**690,985**	**10.22**	**340,632**	**5.04**
CERI deciles 1 and 2			2.082		2.910
CERI deciles 1–5			2.475		3.291
CERI deciles 6–10			0.404		0.304

Figure 5.11 Population within 500 m of waste sites with at least one non-compliance of class 1–3 in 2004/05 by deprivation decile



5.5 Conclusions

The available data on licensed waste sites in England has been explored for use in an analysis of environmental inequality at a regional level. The analysis undertaken attempted to differentiate between sites in terms of site type, date of licence and selected elements of the OPRA environment score. This work has highlighted:

- the complexities of the waste sector;
- the diversity of licensed waste sites;
- the consequent need to develop a more sophisticated approach to distributional equity analysis.

The approaches to analysis tried as part of this project partially address the methodological problems discussed in Section 4, but many remain.

- There is the fundamental problem that proximity as indicated by the drawing of a circle around a grid reference can only be a very crude and inadequate surrogate for 'social impact'. It would therefore be entirely wrong to use the results that have been produced in this way to indicate numbers of people who are suffering environmental harm or who are at risk in some way from a nearby waste site.

- Grid reference points are poor representations of waste sites, which in reality vary enormously in their size and shape.

- Waste sites are highly diverse in other operational respects with major implications for their potential social impact and with some such impacts being beneficial rather than negative. The analysis undertaken during this study has only partially represented this diversity.

- Issues have been identified for each of the datasets used for dates of licences, OPRA scores and non-compliances. These issues relate, for example:
  - to what the data does and does not measure;
  - the consistency of data collection;
  - the time periods for which data are available.

  It was only possible within this study to briefly demonstrate the use of these datasets, rather than explore fully both their potential and problems in a more complete manner.

- The IMD data are generalised across Super Output Areas which may, in some locations, hide smaller pockets of deprivation or affluence.

With these important caveats in mind, the methodology developed for the analysis for the North West region (where 21 per cent of the population is in deprivation decile 1) found the following.

- When all waste site are considered together, more deprived populations are more likely to be living nearer to waste sites (particularly recycling, waste transfer and chemical treatment sites) for a range of proximity distances than less deprived. Smaller proximity distances – identifying areas closer to the sites – accentuate the bias towards deprived populations compared with larger distances.

- The total numbers of people living near landfill and biological treatment facilities are much lower than for other types of site. The **least** deprived populations are more likely to live near landfills.

- No marked trends were observed in the deprivation profiles of people surrounding sites first issued with licences at different times over the last 25 years. However, there have been significant changes in the types of sites given licences over this period.

- Using a combination of OPRA environment scores to provide an indicator of potential environmental impact for each site suggested that those facilities with the highest scores are not found near the most deprived populations.

- Using one year of data on non-compliances with permit conditions indicated that deprived populations are more likely to be living near sites with at least one non-compliance than less deprived populations. This bias is over and above the general pattern of concentration of waste sites towards deprived populations.

The results of this exploratory analysis identify many different directions for further interrelation between variables and more detailed examination and mapping of the data. The data are certainly not conclusive.

6. Policy interventions

This section introduces the current and developing policy context for waste management and approaches to addressing environmental inequalities in the UK. This context has undergone significant change in recent years under the influence of several driving factors.

A major driver has been *Waste Strategy 2000* (DETR 2000a). This set out a vision for future waste management in England and Wales,[6] and formalised the waste hierarchy for determining the approach to managing particular waste streams. The Waste Strategy is currently being reviewed, with several key changes to waste management policy in England being proposed. In addition, several important EU directives have come into force in recent years, which have influenced the UK approach to waste management.

The wider Government move towards advocating the principles of sustainable development as a central focus for social, economic and environmental policy has had:

- major impacts on understandings and assessments of social exclusion and inequity, neighbourhood renewal and community regeneration (Cabinet Office 2001, ODPM/NRU 2003, ODPM 2003, ODPM 2004b, ODPM 2004c);
- far-reaching consequences for the way in which UK waste management policy progresses.

Significant changes to the UK planning system include the formalisation of a system of Regional Spatial Strategies (RSS) replacing the former Regional Planning Guidance (RPG) will undoubtedly have significant impacts on:

- waste management policy within the UK;
- the extent to which the social impacts of waste facilities are considered within the planning and appraisal framework, particularly with regard to facility siting issues.

This section examines:

- the changing context for addressing environmental inequalities;
- the waste policy context – focusing particularly on the Waste Strategy for England and Wales (including recently proposed revisions), and the implications for addressing environmental inequality;
- current and potential tools for assessing social impacts, particularly in terms of the role of different appraisal techniques and the impact of changes to the planning system.

[6] *National Waste Strategy: Scotland* was published by the Scottish Environment Protection Agency in 1999. *National Waste Management Strategy for Northern Ireland* was published by the Department of the Environment (NI) in 2000.

Finally, some recommendations for future changes to waste management policy in the context of environmental inequality are made.

6.1 UK context for addressing environmental inequalities

6.1.1 UK Sustainable Development Strategy

The cornerstone of the sustainable development focus in UK policy has been the UK Sustainable Development Strategy, *A Better Quality of Life* (DETR 1999). This states that '[E]veryone should share the benefits of increased prosperity and a clean and safe environment. We have to improve access to services, tackle social exclusion, and reduce the harm to health caused by poverty, poor housing, unemployment and pollution' (DETR 1999. p.2). The strategy set out four sustainable development aims:

- social progress which recognises the needs of everyone;
- effective protection of the environment;
- prudent use of natural resources;
- maintenance of high and stable levels of economic growth and employment.

Waste management has a high profile within the UK Sustainable Development Strategy. It is one of the headline indicators – on the basis that tackling waste is important if we are to achieve the improved resource efficiency deemed essential for sustainable development.

The UK Sustainable Development Strategy has recently been updated and re-focussed with the publication in March 2005 of *Securing the Future* (Defra 2005a). The new strategy builds on the 1999 strategy, providing an integrated vision which incorporates stronger societal dimensions, with particular emphasis on sustainable consumption and production, i.e. not just focusing on how things are produced, but also assessing the impacts of products and materials over their whole life cycle. The strategy now stresses as a key goal the need to live within environmental limits; the second primary goal being to ensure a strong, healthy, and just society. The responsible use of sound science, good governance and achieving a sustainable economy are the three main means to achieve these goals.

Equality and diversity considerations in planning

The focus on sustainable development has brought about a crucial change in Government policy with an emphasis on equality and diversity (e.g. ODPM 2005a). This requires equality and diversity to become part of the planning mainstream and not to be treated as 'fringe' issues.

- Equality and diversity can now be material considerations in planning policies and decisions.
- They should be an integral part of everyday service delivery and not an added extra.

- Planners should take positive action to ensure that their practice and policies are inclusive and do not result in the systematic disadvantaging of some communities or individuals.

In preparing Development Plans, local planning authorities are required to consider the relationship of planning policies and proposals to social needs and problems including their likely impact on different groups in the population such as women, the disabled, ethnic minorities, and disadvantaged people living in deprived areas. An integral part of this is to consider the extent to which issues of social exclusion can be addressed through land-use planning policies. Key Government areas for action in planning are the regeneration of deprived communities and neighbourhood renewal. The aim is to explicitly address environmental and social inequality, with a strong emphasis on social inclusion and combating disadvantage (ODPM 2005a).

The *National Strategy for Neighbourhood Renewal* (Cabinet Office 2001) emphasises the important part that local residents and community groups can have in regenerating their neighbourhoods. Community empowerment networks serve as communication channels between local authorities and the community sector, and the Neighbourhood Renewal Unit (NRU) works across government with a range of partners. Local Strategic Partnerships are extensively engaged in community outreach, particularly to excluded or deprived communities.

Sustainable communities
The creation of sustainable communities is established as a policy aim in Planning Policy Statement 1 (PPS1) *Delivering Sustainable Development* (ODPM 2005b). Sustainable communities are envisaged as embodying the principles of sustainable development and which meet 'the diverse needs of existing and future residents, are sensitive to their environment, and contribute to a high quality of life, are safe and inclusive, and offer equality of opportunity and good services to all.'

One of the main elements of creating such sustainable communities is both integrating and achieving a balance between the social, economic and environmental components of the community. This entails:

- environmental protection by minimising pollution on land, in water and in the air;
- waste minimisation and waste disposal in accordance with current good practice.

6.2 Changing context of UK waste policy

Recent developments in UK waste management policy have been influenced significantly by EU directives – particularly the Landfill Directive but also the end-of-life vehicle (ELV) and waste electrical and electronic equipment (WEEE) directives managed by the DTI in terms of producer responsibility in England. Defra, the devolved administrations, regional and local planning authorities, local authorities, the Environment Agency, the Scottish Environment Protection Agency (SEPA) and the Northern Ireland Environment and Heritage Service also play major roles in waste regulation and assessment in the UK.

The EC Waste Framework Directive (75/442/EEC) and its subsequent amendment (91/156/EEC) set the overall policy context for waste management and disposal in EU Member States. However, it does not prescribe the processes that should be adopted within each Member State. The principles of the Waste Framework Directive are incorporated in *Waste Strategy 2000* (DETR 2000a). This aims to seek to curb the growth in the quantity of waste produced and, where waste is produced, to encourage the recovery of value from it through increased recycling, composting and energy recovery (see Section 6.2.1).

Workshop discussion on factors contributing to waste production rates

'Demographic change within UK society towards more single person households has significant impacts on waste production. Single people use an average of 120 kg of packaging per year, whereas a family of four uses only 70 kg per year.'

One of the driving forces for the approach taken in the Waste Strategy was the year-on-year increase in waste production (particularly household waste) in England and Wales. However, the most recent statistics on municipal waste arisings (Defra 2005b) show a marked improvement for the year 2003/04. In particular, the total amount of municipal waste in England fell by one per cent between 2002/03 and 2003/04. In addition, recycling rates increased significantly; the amount of household waste collected for recycling increased in absolute terms by 20.5 per cent in 2003/04 compared with 2002/03. However, there are still significant differences in recycling rates at a regional level. The North West recycled/composted 18 per cent of its municipal waste in 2003/04 compared with 13 per cent in 2002/03 (Defra 2005b, Annex A: Table 3). Its household waste recycling rate of 14.2 per cent also increased, but was still one of the lower regional rates (the East of England was highest with 23.4 per cent and the North East with 12.3 per cent) (Defra 2005b, Annex A: Table 5B).
The Waste Strategy emphasises that waste management decisions should be taken with three considerations in mind – the waste hierarchy, the proximity principle and the notion of self-sufficiency. These are examined below.

6.2.1 The waste hierarchy

The waste hierarchy offers a sustainable approach to waste management, viewing waste as a potential resource and the production of waste as a waste of resources. The waste hierarchy was first introduced to European waste policy in 1975 as part of the Waste Framework Directive. It was formalised into a hierarchy of management options in the 1989 EC Strategy for Waste Management (SEC(89) 934 Final 1989) and further endorsed in the EC review of the strategy, which was adopted in July 1996.

The waste hierarchy takes the following form:

- prevent and reduce the amount of waste produced;
- reuse products wherever possible;
- recycle what cannot be reused;
- recover energy from waste that cannot be reused or recycled;

- disposal to landfill as a last resort and only if it represents the Best Practicable Environmental Option (BPEO) for the particular material involved.

The waste hierarchy has been fundamental in designing UK waste management policies and plans, particularly through:

- the introduction in 1996 of the Landfill Tax, which will escalate steeply to a target level of £35 per tonne;
- the setting of national recycling and recovery targets.

Landfill Directive (1999/31/EC)
Regulations to implement the Landfill Directive in England and Wales came into force in 2002, and in Scotland and Northern Ireland in 2003. Their overall objective is 'to provide for measures, procedures and guidance to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, and on the global environment, including the greenhouse effect, as well as any resulting risk to human health, from landfilling of waste during the whole life cycle of the landfill.'

The Directive's main requirements are:

- targets for reduction of biodegradable municipal waste to landfill (introduced in 2003);
- banning as of July 2004 of the co-disposal of hazardous and non-hazardous wastes, and the requirement of separate landfills for hazardous, non-hazardous and inert wastes;
- banning the landfilling of tyres;
- banning the landfilling of liquid wastes, infectious clinical waste and certain types of hazardous waste;
- provisions on the control, monitoring, reporting and closure of landfill sites.

These requirements will have the effect of significantly reducing the use of landfill in the UK. By 2020, the amount of biodegradable waste sent to landfill in the UK has to be reduced to 35 per cent of that produced in 1995. Additionally, the Government has a target to reduce the amount of industrial and commercial waste landfilled by 2005 to 85 per cent of 1998/99 levels. The Waste and Emissions Trading Act 2003 introduced the Landfill Allowance Trading Scheme, whereby each waste authority will be permitted to landfill only a certain tonnage of municipal waste each year. Allowances can be traded between authorities, with penalties applied if an authority exceeds its allowance.

In tandem with these measures to reduce the reliance on landfilling as a waste management option, the Government has set requirements for constituent parts of the UK to achieve increased household waste recycling and recovery rates and, in 2001, placed statutory household waste recycling performance targets on local authorities, audited through Best Value Performance Indicators.

Recycling and recovery

The Household Waste Recycling Act 2003 recognised that separation of materials at source is the key to sustainable management of the municipal waste stream. It placed an obligation on waste collection authorities to provide for separate collection of at least two recyclables from domestic premises by 2010.

Government targets for recycling in England were set at 17 per cent for 2003/04, rising to 25 per cent by 2005/06, and 33 per cent by 2015.[7] However, meeting these targets will require a significant change in recycling activity. Recycling rates vary considerably between local authorities, and while these have increased significantly since 1996/97 (Defra 2005b), with provisional figures for 2004/5 suggesting that authorities in England achieved 23% just short of the 25% target (Defra 2005c), they are still significantly short of those achieved elsewhere in Europe.

As a means of addressing environmental inequalities in the waste field, a move away from landfilling up the waste hierarchy towards an increased emphasis on reuse and recycling is potentially beneficial. However, major challenges have to be met if high national and regional rates of recycling are to be attained and sustained.

Workshop discussion on recycling

'There is a key need for work on understanding participation rates in recycling schemes, particularly amongst deprived communities. What makes some communities more keen to participate in doorstep recycling or bring schemes? And what makes other communities less interested?'

Participation rates in recycling schemes are highly variable. Recycling rates in metropolitan authorities have been on average about half those of non-metropolitan authorities (Defra 2005b). Latest data (Anon 2006) suggest that some high rates in predominantly rural authorities of 48-50% compare with very low rates of 6-8% in some London Boroughs. Recycling rates are particularly low among those living in deprived areas. There is a clear need to examine evidence about changing attitudes and behaviour towards recycling where uptake is currently low. McDonald and Oates (2003) argue that one of the most commonly cited barriers to participation in recycling schemes is the perceived amount of effort it entails. The context of recycling activity is important in accounting for low participation rates as, in a weak social context where recycling is not a 'visible' activity, there is little community expectation of behaviour and recycling is not perceived as the 'norm'. These views are echoed by Williams and Taylor (2004who argue that the role of the local authority and the actions of individual householders are paramount to the success of sustainable waste policies and, crucially, that it is not just about how many people participate in a scheme, but also how effectively they do so.

6.2.2 The proximity principle

This principle, which was established in the Waste Framework Directive, states that waste should generally be disposed of as near to its place of origin as possible. This is partly so that waste problems are not merely transferred to other regions/areas and partly because the transportation of waste is in itself detrimental to the environment. The

[7] There are similar targets for Scotland and Northern Ireland.

principle is also driven by the belief that those who produce the waste should also bear the responsibility for, and the impacts of, its management (Petts 2003).

6.2.3 Self-sufficiency

The notion of self-sufficiency, in a similar way to the proximity principle, requires that most waste is treated or disposed of in the region within which it is produced. Each region should provide for facilities with sufficient capacity to manage the expected quantity of waste requiring management in that particular area for at least 10 years. The principle again embodies the belief that the communities that produce the waste should be responsible for its management and that the problem should not be exported to other areas and other communities.

6.2.4 Policy issues arising from the Waste Strategy 2000

The Waste Strategy's requirements raised a number of issues with potential impacts on environmental inequality, and particularly on deprived communities.

The embodiment of the waste hierarchy in the Waste Strategy has undoubted potential positive impacts in reducing the burden of waste facilities sited in deprived communities. The reduced reliance on landfill as a result of the Landfill Directive and the associated drive towards significant increases in recycling and recovery rates are theoretically excellent propositions. However, both will require the development of infrastructure to support high-intensity recycling and composting schemes. New municipal energy-from-waste incinerators will be required (a further 10 have already received planning permission or are under construction), though there is strong evidence that smaller-scale 'community focussed facilities' are likely to be more attractive to local communities (Petts, 1995; 2000). If CHP can be included alongside modern technologies (e.g. gasification, etc.), then small capacity plant (less than 100,000 tonnes per annum capacity and potentially less than 50,000 tonnes per annum) could be highly beneficial to local communities through the provision of direct heating as well as electricity generation and inherently dealing with local waste. This is common practice in Scandinavia for example. In England there is evidence that where strong public engagement in local strategy development has been possible (e.g. Hampshire) there has been a public focus on smaller scale facilities with consequent impact on final decisions (Petts 2000)

In theory, the landfill tax and other policy drivers away from landfill should in due course reduce any spatial inequalities associated with landfill waste disposal and deprived communities (Lucas *et al.* 2004). However, there are no specific UK policies to address inequalities in landfill site locations. The Landfill Tax Credit Scheme provides compensation to nearby communities through spending on local community projects, but these projects have been widely criticised for being poorly targeted and inadequate (Lucas *et al.* 2004).

In addition, the waste hierarchy has been interpreted differently. Some planners and regulators have regarded it as representing a strict order of preference in which recycling is always preferable to incineration and incineration is always preferable to landfilling, regardless of factors such as environmental outcomes. This sense is reinforced by Waste Strategy 2000's emphasis on the use of landfilling only if it can be demonstrated to be the BPEO in a particular circumstance. However, there may be significant tensions between local BPEOs and regional or national policy priorities in waste management, as

a preferred solution at the local scale may not offer optimum environmental or cost benefits at other scales.

BPEO was first outlined in the UK in the Fifth Report of the Royal Commission on Environmental Pollution (RCEP) on air pollution. This defined the concept as 'the optimum combination of available methods so as to limit damage to the environment to the greatest extent achievable for a reasonable and acceptable total combined cost to industry and the public purse' (RCEP 1976). BPEO was first applied to waste planning in 1995, and encapsulates several key principles:

- in taking decisions there should be consideration of alternative options in a systematic way;
- engagement with the community and key stakeholders should be an important and integral part of the decision making process;
- the environmental impacts for possible options should be assessed looking at both the long and short term, and
- decisions should seek the best environmental outcomes taking account of what is feasible and what is an acceptable cost.

However, there is rarely a single option that represents the 'best' option and various combinations of options may produce similar social, environmental and economic outcomes. Integrated waste management is accepted as a key policy strategy combining facilities in the optimum way to minimise waste impacts while at the same time optimising recovery and recycling. Due to the origin of BPEO in the field of environmental protection, BPEO estimates have tended to focus on environmental emissions and resource depletion rather than local environmental issues. In addition, they omit the socio-economic aspects of waste management.

With regard to environmental inequalities, these tensions within the concept of the BPEO and its application to waste management may have increased inequality in the past rather than avoiding it. For example, recycling would usually be preferred to landfilling under the BPEO. But in remote areas with dispersed and small populations, the collection and transport of recyclate to processing centres presents potentially significant environmental and cost disincentives. In such circumstances, it might be that direct landfilling of waste with minimal recycling is the BPEO. Reliance on the BPEO has been dropped from new planning guidance related to waste management in Planning Policy Statement 10 (PPS10) *Planning for Sustainable Waste Management* (ODPM 2005c). BPEO should thus have minimal influence on future site location/decisions.

Similarly, the practical operation of the proximity principle and notions of self-sufficiency may be problematic for those living in deprived communities. For example, most facilities require proximity to people and waste arisings, and good transport access. These locations are inevitably found in predominantly urban areas, where the majority of deprived communities are also found. New plant tends to be attracted to existing waste sites because of these transport links, so the operation of the proximity principle may contribute to a clustering of waste facilities in urban areas. As well as this facility clustering, the principle of self-sufficiency could promote arguments in favour of large-scale facilities to support a region and which achieve the economies of scale preferred by the waste industry. Such facilities might therefore be drawn to locate in deprived communities, thus enhancing environmental inequity. However, evidence suggests a

tendency for public pressures for smaller-scale facilities, which are community rather than regionally focussed.

6.2.5 Proposed changes to Waste Strategy (2000)

The Waste Strategy 2000 as published in May 2000 was a 20-year strategy for the management of waste in England and Wales and for the provision of the appropriate infrastructure to facilitate this. Periodic, five-yearly reviews of the Waste Strategy were planned and the 2005 review recently took place. The Waste Strategy review process provides an opportunity to reflect on existing policies and the mechanisms for policy delivery, and the 2005 review allowed issues arising from the government response to the recommendations made in the Prime Minister's Strategy Unit (formerly Strategy Unit) report *Waste Not, Want Not* (Strategy Unit, 2002) to be addressed. The formal consultation on the Waste Strategy was launched on 6th December 2004, and closed on 31st March 2005 (Defra 2004b, 2005c). The resulting proposed changes are out for public consultation until 9th May 2006.

In the time since the original Waste Strategy 2000, there has been a growing awareness of the economic and environmental dividends that can be delivered through a more sustainable approach to managing waste (Defra 2005c). Since 2000, the amount of waste generated in England and Wales has continued to rise, and much of this goes to landfill. Compared with many other European countries, more municipal waste is produced per head in England and Wales, and less is recycled, although as noted earlier some significant successes are being recorded in terms of improved recycling rates within some authorities (particularly rural). There is evidence of links between arisings increases and socio-demographic changes not least a growth in single person households with a consequent increase in per capita household waste arisings.

The initial formal consultation on proposed revisions to the Waste Strategy 2000 suggested that a stronger emphasis is necessary on:

- managing waste as part of a wider resource economy. This includes looking across the whole life-cycle of products and services to identify opportunities for improving resource efficiency across the production and consumption chain;
- reducing the growth in the amount of waste produced and decoupling its environmental impacts from economic growth;
- the reduction, re-use and recycling of non-municipal waste, from commerce, industry, construction and other areas, which together represent the sources of most waste produced in England and Wales, and
- stimulating a step-change in investment to achieve substantial development in the infrastructure needed to treat, recover or dispose of waste in each part of the chain.

This means moving away from a waste policy framework designed as an end-of-pipe solution, towards a framework that seeks to better manage the flow of resources through the economy. This could certainly have social impacts in terms of environmental equity related for example to service delivery, potential charging mechanisms for waste management, etc.

Thus, the overall objective of a revised waste strategy is to further reduce the impacts of waste management on the environment, while developing the economic benefit of using waste as a resource and meeting European obligations (Defra 2004b). Action on waste continues to contribute to meeting the government's strategic priority of sustainable consumption and production within a broad framework of sustainable development. In revising the guidance for waste planning and waste management authorities, Defra also reviewed the decision making principles set out in the Waste Strategy 2000 underpinning Planning Policy Guidance on waste (PPG10) and guidance on Municipal Waste Management Strategies.

The principal changes outlined in the proposed revisions to Waste Strategy 2000 concern the processes for determining the BPEO for waste management facilities. It was argued that the way that BPEO was set out in the 2000 Waste Strategy hindered its effective delivery in practice, with a poorly elaborated scope and interpretation of the term. This was argued to cause confusion as to how the principle should be applied, the most appropriate geographical scale for this, the costs involved and to lead to significant delays in the planning process for waste management facilities, holding up the provision of the appropriate mix and capacity of waste infrastructure (Defra, 2004b).

The revised waste strategy argues that the underlying principles of BPEO (as outlined in section 6.2.4 of this report) remain valid, but that these principles must be applied in ways that are relevant to the decisions being taken about waste and the provision of management infrastructure. To this end, the revised waste strategy proposes that the process for determining the BPEO in waste management planning should be superseded by Sustainability Appraisal (see section 6.3.3).

The proposed revisions to the Waste Strategy 2000 retain the use of the waste hierarchy to inform decision making. The proximity principle is also retained, defined as 'disposing of waste at the nearest appropriate installation, by means of the most appropriate methods and technologies', as is the principle of regional self-sufficiency, defined as 'individuals and communities and organisations [taking] responsibility for their own waste'. Although the proximity and self-sufficiency principles have been retained in the waste management strategy in order that they should be included in decision making processes, they are not seen as standalone principles that must be explicitly met, instead they are key elements that contribute towards the achievement of an integrated and holistic waste management policy in England and Wales.

The proposed revised Strategy therefore states that the objectives of waste management decisions should be:

- reducing the environmental impact of waste by moving waste management up the waste hierarchy;
- managing waste in ways that protect human health and the environment;
    - without risk to water, air, soil and plants and animals;
    - without causing a nuisance through noise or odours;
    - without adversely affecting the countryside or places of special interest, and
    - disposing of waste at the nearest appropriate installation, by means of the most appropriate methods and technologies.

However, despite the proposed changes there continue to be criticisms of the principles embodied in the Strategy for England and Wales, and particularly the application of the waste hierarchy, the proximity principle, and the notion of self-sufficiency. For example, it has been argued (e.g. SITA, 2005) that the notion of reducing the environmental (and potential health) impacts of waste by moving waste management up the waste hierarchy is problematic, in that the reduction in impacts brought about by recycling or recovery is not necessarily due to these activities *per se*, but because of the avoided impacts associated with savings in the use of raw materials, energy usage and fossil fuels further up the resource chain. A further argument against proximity and self sufficiency is that the more 'proximate' each individual waste management service is to the generating community, the smaller the scale of each activity, hosted on a potentially far larger number of small sites with potentially increased environmental inequalities and costs of waste management. However, the counter argument is that localising waste management at the community level serves to increase waste minimisation and recycling and acceptance of required facilities. Certainly it is generally accepted that the costs of waste management impacting on individual households have to rise to reflect the true environmental disbenefits. Arguments in favour of direct charging for waste collection at the individual household attract concerns about possible social inequity depending on the mechanism selected.

6.3 Tools, assessments and appraisals

A number of assessment and appraisal tools exist to assess social impacts and to aid the implementation of waste management policy.

One of the main elements of any research into environmental inequalities and the potential impact on deprived communities is a consideration of:

- the decision-making processes through which waste sites and facilities are sited;
- the assessment and appraisal tools which govern their monitoring and control over time.

Fundamental to this is the permitting and licensing regime, and the system of project appraisals undertaken to ascertain whether a proposed waste facility is likely to meet accepted standards of safety and therefore cause minimal risk to human and environmental health.

This section considers waste facility siting issues, the licensing regime, social appraisal and sustainability appraisal tools. It also examines the land-use planning process, which has recently undergone significant changes. These tools and appraisals are then evaluated in terms of their role in mitigating or contributing to environmental inequality.

6.3.1 Waste facility siting

Site selection in the UK context involves the identification of a potential site followed by a detailed assessment of the likely impact of the proposed facility at the preferred location. The identification of potential sites has to be undertaken with regard to planning criteria which recognise various siting constraints, e.g. physical, environmental, safety, social, economic, political and technical. Site selection is not just about the siting of particular

facilities, but also strategic selection processes at the waste plan stage using a range of inclusionary and exclusionary criteria. Many waste plans identify potential sites, which specific developers must select and provide a justification for. If a site is identified for potential use in a waste plan, this provides a strong basis for the granting of planning permission, as the waste plan is a material consideration in the determination of waste facility planning applications.

Countries with less complex and widespread urban development (e.g. Canada and Australia) have favoured the adoption of siting criteria and buffer zones between waste facilities and residential populations. The UK planning system has historically favoured case-by-case consideration against generic planning objectives to minimise the potential for blighting of land near waste facilities (Petts 2004). Where planning permission is clearly linked to the land, however, there has historically been a presumption in the UK planning system in favour of continuation of permitted use. This means that waste plans have nearly always identified sites based on previous waste or industrial use, and site access. Therefore, if a site has been used historically as an incinerator, the planning system is likely to start from an assumption of the site being used again for incineration subject to detailed consideration of the impacts of the specific proposal (and assuming that the waste plan confirms the continued validity of this use).

6.3.2 Planning regime

The operation of the land-use planning system has a central, indeed crucial, role with respect to environmental justice issues in determining what type of, and where, waste facilities are to be sited. Positive planning has a key role in delivering sustainable waste management:

- through the development of appropriate strategies for growth, regeneration and the prudent use of resources, and
- by providing sufficient opportunities for new waste management facilities of the right type, in the right place, at the right time (ODPM, 2005c).

The waste strategic planning framework identifies what types of facilities are required in an area (county or unitary authority in England) for forward management of waste (typically over 20–30 year periods). These plans consider issues relating to;

- the proximity principle;
- the types of waste arising in an area;
- appropriate technologies for managing them.

The plans also define appropriate criteria for making site-specific decisions and often identify appropriate sites for different types of facility. The site-specific impacts of a single proposed facility are addressed at the planning application stage.

The planning system is currently undergoing significant change, with the replacement of advisory Planning Policy Guidance (PPG) with the statutory Planning Policy Statements (PPS). PPS10 *Planning for Sustainable Waste Management* published in July 2005 (ODPM 2005c), which has replaced PPG10 *Planning for Waste Management* published in 1999, aims to provide a clear statement of government planning policy on waste-

related issues. PPS10 responds to specific recommendations made by the Strategy Unit in their 2002 report *Waste Not Want Not* to:

- improve the performance of the planning system;
- speed up plan-making procedures;
- secure more effective community engagement in the planning process.

As part of the Government emphasis on sustainable development as the driving force behind policy implementation, PPS10 advocates integration and indicates that waste management should be considered alongside other spatial planning concerns such as transport, housing, economic growth and regeneration. It also emphasises recognition of the positive contribution that waste management can make to the development of sustainable communities through integration with other important strategies at the appropriate level (regional, local, etc.).

The self-sufficiency principle is reflected in PPS10 through the requirement for:

- regional planning bodies and local authorities to plan for the management of waste generated by their communities;
- planning authorities to prepare Regional Spatial Strategies that aim to provide sufficient opportunities to meet the needs of their area for waste management of all relevant waste streams. In turn, planning authorities should prepare local development documents that reflect their contribution to delivering the Regional Spatial Strategy.

Regional Spatial Strategies
The concept of spatial planning gained impetus from the European Spatial Development Perspective (ESDP) agreed at Potsdam in 1999, which set a framework for spatial planning at national and regional levels within the EU (EC 1999).

In the UK, RSS replace existing RPG and county structure plans. They are intended to provide, for the first time in the UK, a planning system with the overall objective of sustainable development. The procedural policy on RSS is set out in PPS11 *Regional Spatial Strategies* (ODPM 2004d). All English regions will have to produce RSSs, drawing together plans for housing, planning, environmental protection, economic development, agriculture, transport and waste in the region. Each RSS should cover a 15–20 year period and it is hoped that all of the English regions will have one by the end of 2006.

Regional Spatial Strategies have good potential to deliver sustainable development and thus help address and avoid environmental inequalities. They require integration in terms of balancing the options for spatial strategy – embracing core sustainability principles and, fundamentally, notions of societal equity, i.e.

- environmental limits and not exceeding carrying capacities;
- demand management, rather than planning simply to meet demands;
- environmental efficiency through reducing reliance on natural resources;

- welfare efficiency through obtaining the most human benefit from economic activity;
- equity through social cohesion and an equitable distribution of wealth.

It remains to be seen whether RSSs will function as well in reality as they have the potential to do in theory. They have the potential to overcome some of the current problems with waste management – not least the fact that, despite the focus since *Waste Strategy 2000* on disposal of waste as close as possible to the point of arising, significant political and economic drivers still promote the regional rather than the community context. RSS legislation should overcome this by integrating the 'local' more tightly into spatial waste management strategies and by having quality of life and sustainability issues at its heart, i.e.

- regional and local planning authorities should assess how their decisions and development plans will affect environmental inequality;
- planning authorities should assess the cumulative impacts of new development and locations of sites such as waste management facilities on environmental equity;
- local strategic partnerships and community planning should work to address environmental inequalities through the development of community strategies in deprived areas.

Further to this, regional planning bodies should consider the need for additional waste management capacity of regional or sub-regional significance, and reflect any requirement for waste management facilities identified nationally. The strategy for waste management should provide a strategic framework for the preparation of local development documents by identifying the waste management facilities to satisfy any identified need and their distribution across the reqion in question. To facilitate this, and to ensure that all key stakeholders have an input into the process, the regional planning body should convene a broadly based Regional Technical Advisory Body (RTAB) to provide advice on the preparation of the strategy for waste management in the RSS and its implementation. The membership of the RTAB should be drawn from those with a direct interest in, and knowledge of, sustainable waste management, including Regional Development Agencies, the Environment Agency, waste planning authorities, waste collection and disposal authorities, representatives from regional government offices, industry and commerce, the waste management industry and key non-governmental organisations (NGOs) (ODPM, 2005c). RTAB's are neither democratically elected nor directly accountable and largely focus on data and information collection. It is for the local authorities within the context of Regional Spatial Strategies and Local Development Plans to assess and understand potential social and environmental impacts of different waste management strategies.

6.3.3 Risk assessment and appraisal tools

In recent decades, the location and potential impact of waste disposal sites have been assessed using a number of tools, largely based on risk and environmental assessments. An evolution in the degree of sophistication of such tools over the years has been coupled more stringent government requirements for assessments and appraisals to be conducted rigorously and their results taken fully into account as part of waste management and planning policy. However, numerous problems remain with their

implementation – not least, the continuing gap between what should be done in theory and what is actually done in practice.

The extent to which cumulative impacts are taken into account is at present rather low. For example, a consideration of cumulative environmental impacts should form a key element of Environmental Impact Assessment (EIA). However, such assessments have been hampered by a series of procedural and legal issues, which make cumulative impacts extremely difficult to establish/predict. Such issues could be said to lie at the heart of inadequacies in Strategic Environmental Assessment (SEA) and EIA in relation to the assessment of cumulative environmental impacts. The cumulative impacts report (Stephens *et al.* 2006) produced as part of this project contains a further discussion of these issues.

Risk assessment
In the UK, risk assessment has its roots in the assessment of technological and major accident hazards where the effects are generally acute and immediate. Since the late 1980s, however, health risk assessments have particularly informed land-use planning decisions about the siting of chemical waste treatment facilities, landfills and incinerators (Petts and Eduljee 1994, Petts 2000, Petts 2004).

Risk assessment usually addresses the risks posed by one emission source, and regulatory decisions about what is an acceptable risk usually focus on the risk posed by that single source. This is difficult when considering cumulative or synergistic risks faced by individuals and communities. The total risk that a person faces is an aggregate of many smaller risks, each of which may individually be deemed acceptable but which, together, may be substantial. In addition, risk assessment has often not addressed adequately background or prevailing exposure and other risks occurring in a particular area. This failure often enhances concern about environmental equity in communities with, for example, existing poor background health.

Concerns about poor background air quality in an area surrounding the site of a proposed large Thameside EfW plant in Bexley, south east London, resulted in a cumulative impact assessment being undertaken relating to the multiple combustion sources along the Thames corridor. Nevertheless, cumulative risk assessments are still rare and there remain significant difficulties in fully characterising the cause and effect chain in relation to multiple, low-level chemical exposures (Petts 2000).

Environmental Impact Assessment
EIA was developed as a tool using different techniques with which to provide decision-makers with technical information on environmental impacts. UK regulations on EIA were introduced in 1988.

EIA aims to integrate environmental assessment tools with the wider dimensions of the decision-making process (Petts 2000), including:

- engagement with the public;
- local authority inputs;
- the gathering and incorporation of new information;

- the amendment of proposals in the light of emerging legislative, social, economic and technical priorities.

The planning process for specific waste sites is supported by EIA, which focuses on understanding significant adverse impacts that might result from siting in a particular location. Such negative impacts may be exacerbated in particular communities, e.g. those of existing poor environmental quality. The information provided by an EIA takes the form of an Environmental Statement (ES), which is intended for use by the competent authority following a process of review and consultation to help decide whether planning permission should be granted.

However, it has been argued that the use of EIA as a tool to take account of the risks (and particularly cumulative risks) faced by those living in particular communities is limited. Social impacts in EIA have often focused on easily identifiable impacts such as increases in employment, benefits to the local economy, etc. without considering how people's lives, culture, mental and physical well-being, and community are affected (Petts 2005). Where EIAs have included a Health Impact Assessment (HIA) and health risk assessments, they have been found to (Petts 2000, Snary 2002):

- poorly justify the choice of exposure pathways;
- neglect a discussion of the uncertainties linked to the various stages of the assessment process;
- fail to characterise the risks in terms of their wider psychological contexts.

Life Cycle Analysis
Life Cycle Analysis (LCA) is an established method for identifying, analysing and evaluating environmental flows of burdens associated with a product or service from 'cradle-to-grave' and across its entire lifespan in order to compare alternatives.

In the field of waste management, the Environment Agency has used a LCA software tool called WISARD (Waste: Integrated Systems Analysis for Recovery and Disposal), which forecasts the potential environmental impacts associated with integrated waste management systems. Developed in 1994, the software assesses the potential impacts stemming from all stages in the management and processing of waste, including waste collection, transport, treatment and disposal activities. Impacts considered include:

- the direct emissions from management activities themselves, e.g. transport, composting, landfill, incineration, etc.;
- the emissions associated with the provision of infrastructure, e.g. bins, vehicles, facility construction;
- the avoided impacts associated with material and energy recovery.

However, LCA is limited in its application to indicating real, local impacts because the impacts it quantifies are global and potential.

- Global impacts. The method aggregates all flows that are the same, irrespective of where they arise. For example, carbon dioxide emissions from waste transport, landfills and energy production are aggregated and reported together for their

place of origin. Unless the results are disaggregated, it is therefore not possible to use a LCA model to determine accurately local impacts such as the emissions to air from an incinerator stack.

- Potential impacts. Because the flows are aggregated from all sources, no account can be taken of the receiving environment and its characteristics such as background contamination levels of environmental buffering capacity.

For this reason, LCA has largely been used by the Environment Agency as set out in its Strategic Waste Management Assessments (SWMAs), which investigate the environmental impacts associated with future waste management scenarios for England and Wales (Environment Agency 2000).

Strategic Environmental Assessment
SEA describes a systematic process for evaluating and anticipating the consequences of decision-making in relation to policies, plans and programmes to ensure that environmental considerations and alternatives are addressed as early as possible in the process and providing an input at every process stage.

SEA came into operation through the EC Directive on Strategic Environmental Assessment (2001/42/EC). The Directive aims to overcome many of the shortcomings of alternative environmental assessment tools by increasing the integration of environmental considerations with other issues '… to achieve greater integration of the environmental in sectoral policies … whilst exacting a minimum assessment of the plans and programmes that are likely to have an environmental impact before they are adopted' (Queralt *et al*. 2001, p.5).

SEA was introduced formally in the UK in 2002. But despite being incorporated into UK law in 2004, it has yet to be extensively applied to waste strategy development at a national or local level (Short *et al*. 2004) – partly because many current waste plans pre-date its implementation.

Sustainability appraisal
Sustainability appraisal evolved as a tool in the 1990s from the environmental appraisal of Development Plans. In the past, it has been principally applied in the fields of local and regional planning, but is becoming increasingly widely used to assess the environmental and social impacts of particular proposals.

Sustainability appraisal is a method of appraisal that aims to ensure that consideration of sustainable development objectives is embedded in all stages of the decision-making process. In many ways, it is an extension of environmental assessment in that social and economic factors are given parity with environmental factors in assessing potential alternatives and impacts. In a study into the use of sustainability appraisal in minerals and waste local plans, James (2001) argued that it had proved more worthwhile than environmental assessment because '… it enhances the [position of decision-makers] by providing more information, thereby making it easier to identify where trade-offs occur, and how they can be minimised' (James 2001, p.160). Furthermore, James argues that this is virtually impossible in environmental assessment because of the lack of integrated information it incorporates on social and economic effects.

But despite the potential benefits of sustainability appraisal (and its application to the waste management field), Short *et al*. (2004) argue that:

- there is still a significant gap between the current application of the process and its impact on effective, environmentally beneficial decision-making;
- questions remain about the ability of the planning system to respond to the complex challenges of sustainable development, despite the increased government emphasis on sustainability as the guiding policy principle in recent years.

It is unlikely that sustainability appraisal will have a substantial impact on decision-making without real political commitment to the appraisal process and the issues it seeks to address, although the current proposals for revisions to the Waste Strategy 2000 in England and Wales are likely to improve the means by which sustainability considerations are a key, integrated element of waste management policy. The revised Waste Strategy 2000 states that Sustainability Appraisal is required for both new and revised Regional Spatial Strategies, development plan documents and supplementary planning documents (which identify waste management infrastructure requirements). Sustainability Appraisal is supposed to represent a systematic and iterative process which identifies and reports on the extent to which implementation of plans will achieve the economic, environmental and social objectives of sustainable development. A Consultation Paper on guidance on Sustainability Appraisal was issued by ODPM in February 2006.

6.3.4 The licensing and permitting regime

The primary role of the Environment Agency in relation to waste in England and Wales is to ensure that waste management activities at a particular location do not cause environmental pollution, harm to human health, or serious detriment to the amenities of a locality. This is achieved through the waste management licensing regulations and other regulations related to Pollution Prevention and Control (PPC), which must be implemented in a fair, consistent and transparent way. Current waste management controls originate from the Control of Pollution Act 1974, which evolved into the Environmental Protection Act 1990 and tightened up the licensing system by ensuring that sites are run by competent people and do not harm the environment.

Waste management licences are issued under sections 35 and 36 of the Environmental Protection Act 1990 and have two parts. The first sets standards and operational criteria, while the second describes how these criteria will be realised by operational practices. Monitoring requirements are included in all licences. These relate both to operational controls and environmental monitoring, with emphasis placed on a continuous monitoring regime throughout the lifetime of a site until the point of licence surrender and 'sign-off'. Licences control environmental impacts and **not** necessarily social impacts.

In practice, the licensing system is regarded as lacking in flexibility. A Waste Permitting Review was set up by Defra in 2003 to consult on the current waste management licensing arrangements and to address the disproportionality of the system. Following this, work has now commenced on the Environmental Permitting Programme (www.defra.gov.uk/environment/epp), which takes forward the findings and recommendations of the Waste Permitting Review. This review extends to the PPC

regime (formerly Integrated Pollution Control – IPC), which covers many higher risk waste recovery and disposal operations.

An important point related to waste management licensing – and particularly environmental inequalities – is that, if waste sites have been granted a licence, they are 'officially' considered to present insignificant environmental risks as long as they comply with the licence conditions. Furthermore, a waste facility with a licence cannot operate without planning permission. Therefore, the proactive opportunity for environmental impacts to be considered in land-use terms still lies at the planning stage.

Negative impacts could arise from unplanned accidental discharges or, crucially, from cumulative aggregations of impacts each deemed safe on its own but which, in aggregate, may have significant social impacts on those living near one or more waste facilities. The planning, licensing and monitoring regimes lack the ability to reflect these cumulative social and environmental impacts effectively.

Importantly, licences relate to the current operator of a site whereas a planning permission for a designated waste use runs with the land regardless of owner or operator. Therefore, it is vital that the full social impacts are addressed at the planning stage. A licence can only control the operation of a site, not the broader context of facility siting.

6.3.5 Monitoring and control

Since July 2000, the Environment Agency has used its Operator and Pollution Risk Appraisal (OPRA) system to assess the risk associated with waste management activities. Each site is scored according to the risk it poses to the environment, how that risk is controlled by the management systems in place, and the operator performance. The sum of these gives the OPRA rating for overall risk to the environment. A score of less than 20 is deemed by the Environment Agency to reflect sites with good and safe operational practice.

7. Recommendations

7.1 Policy issues

The discussion relating to UK waste management and environmental inequality raises a number of important policy issues. Environmental equity issues should receive further attention as a means of:

- improving the evidence base for causation between risk and geographical proximity of deprived communities, which is still weak. The analysis undertaken in this project has demonstrated and re-emphasised the complexities involved, and indicated possible approaches for developing a more involved analysis. However, vital questions relating to the geography of risk and impact are not resolvable within a simple proximity analysis.

- improving the level of community engagement with the issues which concern them, particularly given drivers like the Aarhus Convention (UNECE, 1999) and considerations of environmental justice embodied within it;

- advancing the sustainability agenda. The increased Government emphasis on sustainable development in recent years shows the importance of sustainability to all aspects of society, the economy and the environment.

Recommendation 1
Further research is needed to improve our understanding of the social impacts and risks relating to geographical proximity to environmental impacts/hazards. This research should build on the exploratory analysis undertaken in this and other projects. It should include detailed longitudinal case studies to understand how and why waste facilities have been more likely to be located closer to deprived communities over time and how this situation might change in the future. A number of organisations could be involved in funding such research, including the Environment Agency.

7.1.1 Cumulative impacts

A key issue relates to cumulative impacts and the extent to which these are considered adequately in current waste management policy, siting and licensing decisions. An individual site may be deemed to have insignificant impacts under the planning and licensing regimes, but problems could still arise with the synergistic or cumulative effects of the aggregation of many ‘safe’ emission doses from multiple sources. This is not least because it is recognised that individuals in more deprived communities may be more vulnerable due to poorer health profiles. The data analysis at a simplistic level showed evidence of waste site clustering and the related potential for accumulation and synergism.

Recommendation 2
A continuing programme of research based on cumulative impacts and particularly the extent to which they can be (a) identified, (b) assessed, and (c) incorporated into

meaningful policy is urgently needed. This would be particularly appropriate for joint funding involving government agencies, charities and research councils.

7.1.2 The appraisal and assessment process

This project has not been able to produce definitive evidence that waste facilities are disproportionately situated close to deprived communities. However, our initial exploratory for the North West Government Office region suggests might this is the case in relation to some types of waste facilities.

It is clear that we do not understand the full reasons why or how such circumstances may have arisen over time (many decades) (and hence the reason for Recommendation 1). However, it is important that existing environmental assessment tools and approaches used at both planning and licensing stages consider adequately the existing environmental and social characteristics of areas where waste facilities are to be located. It is not apparent that existing tools fulfil this requirement in practice.

New policy approaches which bring sustainability into the heart of government policy and which aim to explicitly consider issues of inequality and community at local and regional scales are an important step forward in overcoming some of the shortcomings of established assessment tools and appraisal instruments. In particular, changes to the planning framework, the advent of Regional Spatial Strategies and the increasing formalisation of tools such as sustainability appraisal are welcome improvements. However, these will only prove truly successful if (a) they are implemented properly and (b) they enhance integration between government departments, regulatory authorities, and across different spatial scales of governance.

Recommendation 3

There is a need to better understand how environmental equity is taken into account in waste planning, siting and licensing decisions – particularly through existing assessment approaches – and to identify how decisions in this context could be enhanced. Such a research project could explore a number of recent case examples of different decisions with the aim of identifying limitations, and barriers to, the integration of equity considerations in decision-making including important decision process considerations such as public participation. ODPM, Defra and the Environment Agency would be relevant funding bodies.

7.1.3 The waste strategy

Alongside policy imperatives and developments, it is self-evident that waste facilities are more likely to be required and located in urban areas close to the point of waste generation, in proximity to other facilities that provide related services, close to good transport networks and to industrial as well as domestic waste sources. New facilities are likely to be attracted to sites previously used for waste management to optimise the potential of gaining planning consent. Therefore, there will continue to be an inevitable spatial co-location between waste sites and deprived communities. This clearly has significant implications for our ability to pursue ideals of environmental justice in the context of waste management.

In addition, the operation of the waste hierarchy and the recommendation that waste should be reduced, reused, recycled or recovered in preference to disposal may privilege certain types of waste stream response over others. For example, the increased reliance

on recycling as a means of managing waste has its own potential consequences with regard to site location and operation. Not only will there potentially be a greater spatial dispersal of smaller sites, it is important to remember that recycling is of benefit only if the environmental impacts and resources needed are lower than those associated with providing equivalent virgin material (Lave *et al*. 1999). Despite recent improvements, UK household recycling rates are still relatively low, especially in metropolitan areas where most household waste is produced.

Recommendation 4
There is a need for better understanding of public attitudes and behaviours towards different waste management options such as recycling, rates of which tend to be lowest in deprived and low-income areas.

Recommendation 5
Future waste management scenarios should be developed that take account of the implications of different waste management options, their social impacts and implications for environmental equity under different resource use and waste generation conditions. Defra should take the lead in setting up such a scenario generation process.

7.1.4 Public participation

The principles and practice of public participation can serve to promote environmental equity for disadvantaged social groups and, crucially, can help us to gain a better understanding of where existing mechanisms are reinforcing environmental inequality.

Public participation and community involvement in waste management strategy and siting decisions is essential to enhance the effectiveness of waste management policy and to deal explicitly with community impacts. The formation of neighbourhood strategic partnerships is one means of enhancing policy effectively.

Workshop discussion on attitudes to waste production

'We need to break the mould of the culture of consumption which we live in at the moment. This is part of our modern lifestyle cultures where we are told to replace household goods often. Waste is still thought of as someone else's problem and there is little sense of social responsibility.'

The effectiveness of such practice in preventing or reducing environmental inequality depends on the use of participation methodologies that cater to the cultural and social needs of the groups involved. These methods need to provide appropriate forms of information, suitable venues for participation, and access to expertise and education to enable members of the public to understand policy issues and formulate preferences.

The extent to which public preferences are incorporated in policy decisions determines the worth of public participation programmes in promoting environmental equity (Hampton 1999). Petts (2005) argues that, despite recent government policy that reaffirms its desirability, there are barriers to promoting public participation. The principle of at the heart of public participation (i.e. the nature of risks and the assessments required need to be determined through discussion with the public at the earliest stage,

rather than in advance of it) faces institutional challenges from decision-making cultures in authorities which incorporate ingrained technical–cultural perspectives.

In addition, one of the barriers to public engagement with issues of waste management and with options such as recycling is the 'culture of consumption', which determines attitudes towards waste production and disposal. It is clear that social responsibility needs to be fostered and people need to see themselves as the starting point for the creation of a stream of waste that has to be dealt with somehow. The policy of self-sufficiency and its emphasis on public and community involvement in waste-related matters is a step in the right direction, but such ingrained attitudes are likely to persist for a long time, with increases in waste production placing more pressure on waste management infrastructure as time progresses.

An associated issue is that of access to information and opportunities to participate in environmental decision-making as pre-requisites to environmental justice. The Aarhus Convention (UNECE 1999) stresses environmental justice as a right for every citizen. Yet, it should also be recognised that the poorest and most excluded communities are usually also those who are the least able to make use of existing participation mechanisms and can be difficult to involve in more deliberative engagement processes (Petts 2005).

Recommendation 6
Marginal groups and communities will require access to additional resources and support if they are to make effective use of public participation mechanisms. Such support mechanisms rarely exist at present. Consideration therefore needs to be given to the nature of support mechanisms required and the means to bring these into operation. This recommendation is relevant for many governmental and NGOs involved in the waste field.

7.1.5 Equity and justice

A key problem with environmental equity or justice studies, including the analysis undertaken in this project, is that finding an association between the location of, for example, waste facilities and the location of potentially vulnerable communities does not necessarily prove that there is a risk or adverse impact associated with that proximity.

Despite the recent increase in concern and research interest in issues of environmental equity, the evidence for causation in the UK remains weak. This is a particularly important point when considering potential policy changes to address environmental inequalities. Previous research (e.g. Walker *et al.* 2003) has suggested, for example, directing new IPC sites away from deprived areas to ensure that distributional inequality does not worsen further, or perhaps applying higher emission standards in deprived areas, particularly those which are host to multiple sites. Further work is needed to understand the different impacts of environmental exposure on different social groups so that this can be taken into account in the development of environmental standards and in planning and licensing processes.

Additionally, nearly all evidence for causation that does exist relates only to levels of deprivation as measured by the Index of Multiple Deprivation. There is little attempt (or possibility given the available data sources) to disaggregate this index to allow consideration of aspects such as gender, ethnicity, disability, etc.

Recommendation 7
Research is needed to enhance achievement of disaggregation of existing data sources and identification of ways in which new datasets can be created to help us to develop a more nuanced understanding of environmental inequity.

7.2 Data and methodological issues

7.2.1 The need for longitudinal case studies

There are many reasons why waste sites are clustered in certain geographical areas. They include:

- the result of the operation of land and housing markets;
- the legacy of industrial location;
- the result of planning policy;
- transport advantages;
- proximity to waste arisings

Some argue that there has been deliberate targeting of deprived communities as host communities for waste facilities.

If environmental problems can be seen to accumulate in particular localities and communities, uncovering the reasons for this is the first step towards making any required changes for the better.

Recommendation 8
Processes of causation and their relationship to social and environmental distributional inequality could be better understood and contextualised through the employment of comprehensive and detailed longitudinal case studies. Such case studies may need to extend over 50–100 years to capture the history of waste facility developments adequately.

Traditionally there has been a lack of scenario building in the waste field, partly because the responsibility for waste management issues is split across regulatory levels and organisations. Recent policy changes have taken the first steps towards overcoming those problems and looking ahead as a means of avoiding a worsening of existing inequalities and the avoidance of inequality in the future.

Crucially, current vulnerable groups are future generations. Future waste facility siting decisions will be based on legislation in force today, with strategic waste planning decisions having at least 20–30 year future impacts. A longitudinal **and** scenario building approach could facilitate ‘joined-up’ thinking in the waste field, and thereby enhance future policy integration.

Recommendation 9
Case study approaches should look at the **future** as well as the past and present situations.

References

Agyeman J, Bullard R D and Evans B, 2003 *Just Sustainabilities: Development in an Unequal World.* London: Earthscan.

Anderton D L, Anderson A B, Oakes J M and Fraser M R, 1994 *Environmental equity: the demographics of dumping*. Demography, **31**, No. 2, 229–248.

Anon, 2006, St Edmundsbury first to recycle 50% waste. *ENDS Report*, **373**, 12

Barnes G, Baxter J, Litva A and Staples B, 2002 *The social and psychological impact of the chemical contamination incident in Weston village, UK: a qualitative analysis*. Social Science & Medicine, **55**, 2227–2241.

Baxter J and Lee D, 2004 *Understanding expressed low concern and latent concern near a hazardous waste treatment facility*. Journal of Risk Research, **7**, No. 7–8, 705–729.

Been V, 1994 *Locally undesirable land uses in minority neighborhoods: disproportionate siting or market dynamics*. Yale Law Journal, **10**, 1383–1422.

Been V and Gupta F, 1997 *Coming to the nuisance, or going to the barrios? A longitudinal analysis of environmental justice claims*. Ecological Law Quarterly, **24**, 1–56.

Blair T, 2003 Prime Minister's speech on sustainable development, 24 February 2003. Available from: http://www.number10.gov.uk/output/Page3073.asp [Accessed 1 September 2005]

Blowers A and Leroy P, 1994 *Power, politics and environmental inequality: a theoretical and empirical analysis of the process of 'peripheralisation'*. Environmental Politics, **3**, No. 2, 197–228.

Boardman B, Bullock S and McLaren D, 1999 *Equity and the Environment: Guidelines for Green and Socially Just Government*. London: Catalyst Trust and Friends of the Earth (FoE).

Bowen W, 2002 *An analytical review of environmental justice research: what do we really know?* Environmental Management, **29**, No. 1, 3–15.

Brook Lyndhurst, 2004 *Environmental exclusion review*. London: Neighbourhood Renewal Unit, Office of the Deputy Prime Minister. Available from: http://www.brooklyndhurst.co.uk/publications.php?smid=151 [Accessed 1 September 2005]

Bullard R, 1983 *Solid waste sites and the Houston black community*. Sociological Enquiry, **53**, 273–288.

Bullard R, 1990 *Dumping on Dixie: Race, Class and Environmental Quality.* Boulder, Colorado: Westview Press.

Burningham K and Thrush D, 2004 *Pollution concerns in context: a comparison of local perceptions of the risks associated with living close to a road and a chemical factory*. Journal of Risk Research, **7**, No. 2, 213–232.

Cabinet Office, Social Exclusion Unit, 2001 *A new commitment to neighbourhood renewal. National Strategy Action Plan*. London: Social Exclusion Unit, Cabinet Office. Available from: http://www.neighbourhood.gov.uk/publications.asp?did=85 [Accessed 6 September 2005]

Callewaert J, 2002 *The importance of local history for understanding and addressing environmental justice*. Local Environment, **7**, No. 3, 257–267.

Chalmers H and Colvin J, 2005 *Addressing environmental inequalities in UK policy: an action research perspective*. Local Environment, **10**, No. 4, 333–360.

Chakraborty J and Armstrong M P, 1997 *Exploring the use of buffer analysis for the identification of impacted areas in environmental equity assessment.* Cartography and Geographic Information Systems, **24**, 145–157.

Coalition on Access to Justice for the Environment, 2004 *Access to Environmental Justice: Making it Affordable.* Available from: http://www.elflaw.org/files/CAJE%20Briefing.pdf [Accessed 1 September 2005]

Department for Environment, Food and Rural Affairs (Defra), 2003 *The disamenity costs of landfill*. London: Defra. Available from: http://www.defra.gov.uk/environment/waste/landfill/disamenity.htm [Accessed 1 September 2005]

Department for Environment, Food and Rural Affairs (Defra), 2004a *Municipal waste management survey 2002/03*. London: Defra. Available from: http://www.defra.gov.uk/environment/statistics/wastats/archive.htm [Accessed 1 September 2005]

Department for Environment, Food and Rural Affairs (Defra), 2004b *Consultation Paper 1 Document A – Changes to Waste Management Decision Making Principles in Waste Strategy 2000,* London: Defra.

Department for Environment, Food and Rural Affairs (Defra), 2005a *Securing the Future: Delivering the UK Sustainable Development Strategy*. London: The Stationery Office. Available from: http://www.sustainable-development.gov.uk/publications/uk-strategy/uk-strategy-2005.htm [Accessed 1 September 2005]

Department for Environment, Food and Rural Affairs (Defra), 2005b *Municipal waste management survey 2003/04* [online]. Available from: http://www.defra.gov.uk/environment/statistics/wastats/mwb0304/index.htm [Accessed 6 September 2005]

Department for Environment, Food and Rural Affairs (Defra), 2005c *Consultation on Changes to Waste Strategy 2000, Guidance on Municipal Waste Management Strategies*

and Proposals for Providing Central Data and Forecasting Advice: Summary of Responses, London: Defra.

Department of the Environment, Transport and the Regions (DETR), 1999 *A better quality of life: a strategy for sustainable development for the United Kingdom*. London: The Stationery Office. Available from: http://www.sustainable-development.gov.uk/publications/uk-strategy99/index.htm [Accessed 6 September 2005]

Department of the Environment, Transport and the Regions (DETR), 2000a Waste Strategy 2000 for England and Wales. London: DETR. Available from: http://www.defra.gov.uk/environment/waste/strategy/cm4693/ [Accessed 1 September 2005]

Department of the Environment, Transport and the Regions (DETR), 2000b *Sustainability appraisal of regional planning guidance: a good practice guide*. London: DETR. Available from: http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_606126.hcsp [Accessed 1 September 2005]

Dolk H, Vrijheid M, Armstrong B, Abramsky L, Bianchi F, Game F, Nelen V, Robert E, Scott J E S, Stone D and Tenconi R, 1998 *Risk of congenital abnormalities near hazardous waste landfill sites in Europe: the EUROHAZCON study*. The Lancet, **352**, 423–427.

Drummer T J, Dickinson H O and Parker L, 2003 *Prevalence of adverse pregnancy outcomes around hazardous individual sites in Cumbria, north-west England, 1950–1993*. Paediatric Perinatal Epidemiology, **17**, No. 3, 250–252.

Dunion K, 2003 *Trouble Makers. The Struggle for Environmental Justice in Scotland*. Edinburgh: Edinburgh University Press.

Elliott S J, Hills M and Beresford J, 1992 *Incidence of cancer of the larynx and lung near incinerators of waste solvents and oils in Great Britain*. The Lancet, **339**, 854–858.

Elliott S J, Taylor S M, Hampson C, Dunn J, Eyles J, Walkter S and Streiner D, 1997 *It's not because you like it any better: residents' reappraisal of a landfill site.* Journal of Environmental Psychology*,* **17**, No. 3, 229–241.

Elliott P, Briggs D, Morris S, de Hoogh C, Hurt C, Jensen T K, Maitland I, Richardson S, Wakefield J and Jarup L, 2001 *Risk of adverse birth outcomes in populations living near landfill sites*. British Medical Journal, **323**, 363–368.

Environment Agency, 2000 *Strategic Waste Management Assessments* [online]. Bristol: Environment Agency. Available from: http://www.environment-agency.gov.uk/subjects/waste/1031954/315439/147529/?version=1&lang=_e [Accessed 6 September 2005]

Environment Agency, 2002a *Our urban future: putting the environment at the heart of urban renewal*. Bristol: Environment Agency. Available from: http://www.environment-agency.gov.uk/yourenv/857406/353880/364533/?lang=_e [Accessed 1 September 2005]

Environment Agency, 2002b *The urban environment in England and Wales: a detailed assessment.* Bristol: Environment Agency. Available from: http://www.environment-agency.gov.uk/yourenv/857406/353880/363999/?lang=_e [Accessed 1 September 2005]

Environment Agency, 2004a *Addressing environmental inequalities*. Position Statement, October 2004, Bristol: Environment Agency. Available from: http://www.environment-agency.gov.uk/aboutus/512398/289428/888451/?version=1&lang=_e [Accessed 1 September 2005]

Environment Agency, 2004b *Waste management licensing risk assessment inspection frequencies.* Operator and Pollution Risk Appraisal (OPRA for Waste). Version 3, January 2004. Bristol: Environment Agency. Available from: http://www.environment-agency.gov.uk/commondata/acrobat/wasteriskinspectv3_133720.pdf [Accessed 1 September 2005]

Enviros Consulting Ltd, University of Birmingham, Risk and Policy Analysts Ltd, Open University and Thurgood M, 2004 *Review of environmental and health effects of waste management: municipal solid waste and similar wastes.* Report commissioned by the Department for Environment, Food and Rural Affairs (Defra). London: Defra. Available from: http://www.defra.gov.uk/environment/waste/research/health/ [Accessed 1 September 2005]

European Commission, 1999 *European Spatial Development Perspective. Towards balanced and sustainable development of the territory of the European Union*. Brussels: European Commission. Available from: http://europa.eu.int/comm/regional_policy/sources/docoffic/official/reports/som_en.htm [Accessed 6 September 2005]

Fielder H M P, Poon-King C M, Palmer S R, Moss N and Coleman G, 2000 *Assessment of impact on health of residents living near the Nant-y-Gwyddon landfill site: retrospective analysis*. British Medical Journal, **320**, 19–22.

Foley J, 2004 Editor *Sustainability and Social Justice*. London: Institute of Public Policy Research.

Fricker R D and Hengartner N W, 2001 *Environmental equity and the distribution of toxic release inventory and other environmentally undesirable sites in metropolitan New York City*. Environmental and Ecological Statistics, **8**, 33–52.

Friends of the Earth (FoE), 1999 *Pollution Injustice and the Geographic Relation Between Household Income and Polluting Factories*. London: FoE. Available from: http://www.foe.co.uk/resource/reports/income_pollution.html [Accessed 1 September 2005]

Friends of the Earth (FoE), 2001 *Pollution and Poverty: Breaking the Link*. London: FoE. Available from: http://www.foe.co.uk/resource/briefings/pollution_and_poverty.pdf [Accessed 1 September 2005]

Friends of the Earth (FoE), 2004 *Incinerators and Deprivation*. Briefing. London: FoE. Available from: http://www.foe.co.uk/resource/briefings/incineration_deprivation.pdf [Accessed 1 September 2005]

Friends of the Earth (FoE) Scotland, 2004 *Greengairs – Enough is Enough: Friends of the Earth Scotland Support Struggle for Environmental Justice*. FoE Scotland Press Release. Available from: http://www.foe-scotland.org.uk/press/pr20040501.html [Accessed 10 October 2005]

Geschwind S A, Stolwijk J A, Bracken M, Fitzgerald E, Stark A, Olsen C and Melius J, 1992 *Risk of congenital malformations associated with proximity to hazardous waste sites*. American Journal of Epidemiology, **135**, No. 11, 1197–1207.

Goldman B and Fitton L, 1994 *Toxic wastes and race revisited: an update of the 1987 report on the racial and socioeconomic characteristics of communities with hazardous waste sites*. Washington, DC: Center for Policy Alternatives.

Hampton G 1999 *Environmental equity and public participation*, Policy Sciences, **32**, No. 2, 163-174.

Harner J, Warner K, Huber T and Pierce J, 2002 *Environmental justice indices*. The Professional Geographer, **54**, No. 3, 318–331.

Harvey D, 1996 *The environment of justice*. In Justice, Nature and the Geography of Difference (ed. D Harvey), pp.366–402. Cambridge, MA: Blackwell.

Her Majesty's Inspectorate of Pollution (HMIP), 1996 *Risk assessment of dioxin releases from municipal waste incineration processes*. HMIP/CPR2/41/1/181. London, HMIP.

International Association for Impact Assessment (IAIA), 2003 *Social impact assessment: international principles*. Special Publication Series No. 2. Fargo, North Dakota: ISIA. Available from: http://www.iaia.org/Members/Publications/Guidelines_Principles/SP2.pdf [Accessed 1 September 2005]

Ihlanfeldt K R and Taylor L O, 2004 *Externality effects of small-scale hazardous waste sites: evidence from urban commercial property markets*. Journal of Environmental Economics and Management, **47**, No. 1, 117–139.

Jacobs M, 1999 *Environmental Modernisation: the New Labour Agenda*. Pamphlet 591. London: Fabian Society.

Jacobson J O, Hengartner N W and Louis T A, 2005 *Inequity measures for evaluations of environmental justice: A case study of close proximity to highways in New York City*. Environment and Planning A, **37**, 21–43.

James E, 2001 *Assessing the sustainability of minerals development in Devon, UK: evolution of appraisal methods*. Impact Assessment and Project Appraisal, **18**, 191–200.

Krieg E J, 1995 *A sociohistorical interpretation of toxic waste sites: the case of greater Boston*. The American Journal of Economics and Soociology, **54**, No. 1, 1–13.

Kunreuther M, 1995 *Hazard Compensation and Incentive Systems: an Economic Perspective*. Philadelphia, PA: Center for Risk and Decision Processes, University of Pennsylvania.

Lave L B, Hendrickson C T, Conway-Schempf N M and McMichael F C *1999 Municipal solid waste recycling issues*, Journal of Environmental Engineering, **125**, No. 10, 944-949.

Lavelle M and Coyle M, 1992 Unequal protection: the racial divide in environmental law, *National Law Journal*, 21 September 1992, 2–12.

Liu F, 1997 *Dynamics and causation of environmental equity, locally unwanted land uses, and neighbourhood changes*. Environmental Management, **21**, No. 5, 643–656.

Liu F, 2001 *Environmental Justice Analysis: Theories, Methods and Practice*. Boca Raton, Florida: Lewis Publishers.

Lucas K, Walker G, Eames M, Fay H and Poustie M, 2004 *Environment and Social Justice: Rapid Research and Evidence Review*. London: Policy Studies Institute.

Margai F L, 2001 *Health risks and environmental inequity: A geographical analysis of accidental releases of hazardous materials.* The Professional Geographer, **53**, No. 3, 422–434.

Marsh G and Caplan R, 1987 *Evaluating health effects of exposure at hazardous waste sites: A review of the state-of-the-art, with recommendations for future research*. In Health Effects from Hazardous Waste Sites (ed. J B Andelman and D W Underhill), pp.3–80. Chelsea, MI: Lewis.

McCluskey J J and Rausser G C, 2003 *Hazardous waste sites and housing appreciation rates*. Journal of Environmental Economics and Management, **45**, No. 2, 166–176.

McConnell J, 2002 First Minister's speech on the Scottish Executive policy on environment and sustainable development to the Dynamic Earth Conference, Edinburgh, 18 February 2002. Available from: http://www.scotland.gov.uk/News/News-Extras/57 [Accessed 1 September 2005]

McDonald S and Oates C, 2003 *Reasons for non-participation in a kerbside recycling scheme*. Resources Conservation and Recycling, **39**, No. 4, 369-385.

McMaster R B, Leitner H and Sheppard E, 1997 *GIS based environmental equity and risk assessment: methodological problems and prospects*. Cartography and Geographical Information Systems, **24**, 172–189.

Mitchell G and Dorling D, 2003 *An environmental justice analysis of British air quality*. Environment and Planning A*,* **35**, 909–929.

Mohai P and Bryant B, 1992 *Environmental Racism: Reviewing the Evidence*. Ann Arbor, MI: School of Natural Resources, University of Michigan.

Murray R, 1999 *Creating Wealth from Waste*. London: Demos.

National Assembly for Wales (NAW), 2000 *Welsh Index of Multiple Deprivation* [online] Available from: http://www.wales.gov.uk/keypubstatisticsforwalesheadline/content/social/2000/hdw20000904a_e.htm [Accessed 1 September 2005]

Oakes J M, Anderton D L and Anderson A B, 1996. *A longitudinal analysis of environmental equity in communities with hazardous waste facilities*. Social Science Research, **25**, No. 2, 125–148

Office of the Deputy Prime Minister/Neighbourhood Renewal Unit (ODPM/NRU), 2003 *Achieving environmental equity through neighbourhood renewal: policy and practice guide*. London: Neighbourhood Renewal Unit, ODPM. Available from: http://www.renewal.net/Documents/RNET/PolicyGuidance/Achievingenvironmentalequity.pdf [Accessed 1 September 2005]

Office of the Deputy Prime Minister, Social Exclusion Unit, 2003 *Making the connections: final report on transport and social exclusion*. London: Social Exclusion Unit, ODPM. Available from: http://www.socialexclusionunit.gov.uk/publications.asp?did=229 [Accessed 1 September 2005]

Office of the Deputy Prime Minister (ODPM), 2004a *Indices of deprivation 2004* [online]. London: ODPM. Available from: http://www.odpm.gov.uk/stellent/groups/odpm_control/documents/contentservertemplate/odpm_index.hcst?n=4610&l=3 [Accessed 1 September 2005]

Office of the Deputy Prime Minister (ODPM), 2004b *Skills for sustainable communities (The Egan Review)*. London: ODPM. Available from: http://www.odpm.gov.uk/eganreview [Accessed 1 September 2005

Office of the Deputy Prime Minister (ODPM), 2004c *Community involvement in planning: the Government's objectives*. London: ODPM.

Office of the Deputy Prime Minister (ODPM), 2004d *Planning Policy Statement 11: Regional Spatial Strategies*. London: ODPM. Available from: http://www.odpm.gov.uk/stellent/groups/odpm_control/documents/contentservertemplate/odpm_index.hcst?n=5379&l=3 [Accessed 6 September 2005]

Office of the Deputy Prime Minister (ODPM) 2005a. *Diversity and equality in planning: a good practice guide.* London: ODPM. Available from: http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_035786.pdf [Accessed 1 September 2005]

Office of the Deputy Prime Minister (ODPM), 2005b *Planning Policy Statement 1: Delivering Sustainable Development*. London: ODPM. Available from: http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/page/odpm_plan_035506.hcsp [Accessed 1 September 2005]

Office of the Deputy Prime Minister (ODPM), 2005c *Planning Policy Statement 10: Planning for Sustainable Waste Management*. London: ODPM. Available from: http://www.odpm.gov.uk/stellent/groups/odpm_planning/documents/divisionhomepage/039993.hcsp [Accessed 6 September 2005]

Openshaw S, Charlton M A, Wymer C and Craft A, 1987 *A Mark I geographical analysis machine for the automated analysis of point data sets*. International Journal of Geographic Information Systems, **1**, No. 4, 335–358.

Pellow D N, 2000 *Environmental inequality formation: toward a theory of environmental injustice*. The American Behavioral Scientist, **43**, No. 4, 581–601.

Petts J, 1992 *Incineration risk perceptions and public concern - improving risk communication: experience in the UK*. Waste Management & Research, **10**, 169–182.

Petts J, 1994 *Incineration as a waste management option*. Issues in Environmental Science and Technology, **2**, 1–27.

Petts J, 1995 *Waste management strategy development: a case study of community involvement and consensus-building in Hampshire*. Journal of Environmental Planning & Management, **38**, No. 4, 519–536.

Petts J, 2000 *Municipal waste management: inequities and the role of deliberation*. Risk Analysis, **20**, No. 6, 821–832.

Petts J, 2003 *Barriers to deliberative participation in EIA: Learning from waste policies, plans and projects*, Journal and Environmental Assessment Policy and Management, **5**, No. 3, 269-293.

Petts J, 2004 *Barriers to participation and deliberation in risk decisions: evidence from waste management*. Journal of Risk Research, **7**, No. 2, 115–133.

Petts J, 2005 *Enhancing environmental equity through decision making: learning from waste management*. Local Environment, 10, No. 4, 1–13.

Petts J and Eduljee G, 1994 *Environmental Impact Assessment for Waste Treatment and Disposal Facilities*. Chichester: Wiley.

Queralt A, Sala A and Torres S, 2001 *Challenges to the implementation by the European regions of the Directive on Strategic Environmental Assessment.* Technical Report for ENCORE. Barcelona: Ministry of the Environment, Government of Catalonia.

Reams M A and Templet P H, 1996 *Political and environmental equity issues related to municipal waste incineration siting*. Journal of Hazardous Materials, **47**, No. 1–3, 313–323.

Redfearn A, Dockerty J C and Roberts R D, 2000a Assessment of health effects associated with landfills. *IWM Scientific and Technical Review*, April 2000, 14–28.

Redfearn A, Dockerty J C and Roberts R D, 2000b Can landfills be good neighbours? *IWM Scientific and Technical Review*, April 2000, 9–13.

Ringquist E, 1997 *Environmental justice: normative concerns and empirical evidence*. In Environmental Policy in the 1990s (3rd edn.) (ed. N J Vig and M E Kraft), pp.231–254. Washington DC: Congressional Quarterly Press.

Royal Commission on Environmental Pollution (RCEP), 1993 *Incineration of waste.* 17th Report. London: RCEP.

Rushton L, 2003 *Health hazards and waste management*. British Medical Bulletin, **68**, 183–197.

Scottish Executive, 2005 *Environmental justice* [online] http://www.scotland.gov.uk/about/ERADEN/SCU/00017108/environjust.aspx [Accessed 1 September 2005]

Scottish Office, 1985 *Bonnybridge/Denny morbidity review*. Edinburgh: Scottish Office.

Short M, Jones C, Carter J, Baker M and Wood C, 2004 *Current practice in the Strategic Environmental Assessment of Development Plans in England*. Regional Studies, **38**, No. 2, 177–190.

SITA, 2005. *Review of Waste Strategy 2000: Position Paper*, SITA: London.

Snary C, 2002 *Health risk assessment for planned waste incinerators: getting the right science and the science right*. Risk Analysis, **22**, No. 6, 1095–1105.

Speirs D and Tucker P, 2001 *A profile of recyclers making special trips to recycle*. Journal of Environmental Management, **62**, No. 2, 201–220.

Stephens C, Bullock S and Scott A, (2001) *Environmental justice: rights and mean to a healthy environment for all*. Special Briefing Paper 7. Economic and Social Research Council (ESRC) Global Environmental Change Programme. Brighton: ESRC Global Environmental Change Programme, University of Sussex. Available from: http://www.foe.co.uk/resource/reports/environmental_justice.pdf [Accessed 1 September 2005]

Stephens C, Willis R and Walker G, 2006 *Addressing environmental inequalities: cumulative environmental impacts*. R&D Technical Report SC020061/SR4. Bristol: Environment Agency.

Strategy Unit, 2002. *Waste not, want not: A strategy for tackling the waste problem in England,* Strategy Unit, London.

Sustainable Development Commission, 2002 *Vision for Sustainable Regeneration. Environment and Poverty – Breaking the Link?* London: Sustainable Development Commission.

Talih M and Fricker R D, 2002 *Effects of neighbourhood demographic shifts on findings of environmental injustice: a New York City case-study*. Journal of the Royal Statistical Society A, **165**, No. 2, 375–397.

Taylor D E, 2000 *The rise of the environmental justice paradigm*. The American Behavioral Scientist**, 43**, No. 4, 508–580.

The Interorganizational Committee on Principles and Guidelines for Social Impact Assessment, 2003 *Principles and guidelines for social impact assessment in the USA*. Impact Assessment and Project Appraisal, **21,** No. 3, 231–250.

United Church of Christ Commission for Racial Justice. (UCC-CRJ), 1987 *Toxic wastes in the United States: a national report on the racial and socioeconomic characteristics of communities with hazardous waste sites*. New York: UCC-CRJ.

United Nations Economic Commission on the Environment (UNECE), 1999 *Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters*. Geneva: UNECE.

US Environmental Protection Agency (USEPA), 1998 *Final guidance for incorporating environmental justice concerns in EPA's NEPA compliance analyses*. Washington DC: USEPA. Available from: http://www.epa.gov/compliance/resources/policies/ej/ej_guidance_nepa_epa0498.pdf [Accessed 1 September 2005]

Vrijheid M, Dolk H, Armstrong B, Abramsky L, Bianchi F, Fazarinc I, Garne E, Ide R, Nelen V, Robert E, Scott J E S, Stone D and Tenconi R, 2002 *Chromosomal congenital anomalies and residence near hazardous waste landfill sites*. The Lancet, **359**, 320–322.

Wakefield S and Elliott S J, 2000 *Environmental risk perception and well-being: effects of the landfill siting process in two southern Ontario communities*. Social Science & Medicine, **50**, No. 7–8**,** 1139–1154.

Walker G, Fairburn J, Smith G and Mitchell G, 2003 *Environmental quality and social deprivation*. R&D Technical Report E2-067/1/TR. Bristol: Environment Agency.

Walker G, Burningham K, Fielding J, Smith G, Thrush D and Fay H, 2006a *Addressing environmental inequalities: flood risk*. R&D Technical Report SC020061/SR1. Bristol: Environment Agency.

Walker G, Damery S, Smith G and Petts J, 2006b, Addressing Environmental Inequalities in Wales, R&D Technical Report SC020061/SR5. Bristol, Environment Agency.

Warburton D, Christie I and Wilkinson D (2005) Developing social appraisal criteria for the Environment Agency. R&D Technical Report SC010044/SR3. Bristol: Environment Agency.

Welsh Office, 1985 *The incidence of congenital malformations in Wales, with particular reference to the dsitrict of Torfaen, Gwent.* Cardiff: Welsh Office.

Wheeler B W, 2004 *Health-related environmental indices and environmental equity in England and Wales*. Environment and Planning A, **36**, No. 5, 803–822.

Williams I D and Taylor C 2004 *Maximising household waste recycling at civic amenity sites in Lancashire*, Waste Management, **24**, No. 9, 861-874.

Young H P, 1994 *Equity in Theory and Practice*. Princeton NJ: Princeton University Press.

List of acronyms

BPEO	Best Practicable Environmental Option
Defra	Department for Environment, Food and Rural Affairs
DETR	Department of the Environment, Transport and the Regions (no longer exists; environment responsibilities moved to Defra)
CCS	Common Classification Scheme
CHP	Combined Heat and Power
EfW	Energy From Waste
EIA	Environmental Impact Assessment
ES	Environmental Statement
ELV	End-of-Life Vehicle
FoE	Friends of the Earth
GIS	Geographical Information System
HIA	Health Impact Assessment
HMIP	Her Majesty's Inspectorate of Pollution
IMD	Index of Multiple Deprivation
IPC	Integrated Pollution Control
IPCC	Integrated Pollution Prevention and Control
LCA	Life Cycle Analysis
NGO	non-governmental organisation
NPL	National Priority List
ODPM	Office of the Deputy Prime Minister
OPRA	Operational and Pollution Risk Appraisal
PPC	Pollution Prevention and Control
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
RCEP	Royal Commission on Environmental Pollution
RPG	Regional Planning Guidance
RSS	Regional Spatial Strategy
RTAB	Regional Technical Advisory Board
SEA	Strategic Environmental Assessment
SOA	Super Output Area
USEPA	US Environmental Protection Agency

Appendix 1: Workshop summary

Aims of the workshop

A project workshop was held from 2–3 February 2005 at Wast Hills House Conference Centre in Birmingham. A range of stakeholders both internal and external to the Environment Agency were invited in order to draw on a breadth of expertise and experience. Twenty two participants attended, in addition to the project team, seven of these attending both days of the workshop, nine who attended the first day only, and a further six who attended the second day only. The first day of the workshop was devoted to understanding environmental inequalities in relation to waste sites and flooding, with participants splitting into two groups of eight to discuss each issue in depth.

Participants were recruited on the basis of their experience relevant to understanding the distribution of the social impacts of waste management at both the national scale, and on a regional basis. These included senior Environment Agency staff and representatives of Defra, the National Assembly of Wales, FoE, Black Environment Network and local authorities in London.

Two sessions were held which focused on waste management with the objectives of:

- exploring understandings of waste and social impacts and what it is useful to know about their relationship in the context of inequality;

- considering policy options for the future which responded to social inequality becoming a key driver.

Waste breakout group

Facilitated by Professor Judith Petts, University of Birmingham

Initial exercise, exploring what we mean by waste and what we mean by social impacts

Main points made during the discussion:

- Waste is an interesting issue – and very different to something like flooding – because waste is a highly regulated activity whereas flooding is not regulated.

- It is not just the waste facilities that are important in terms of potential impacts, but the transport of wastes is also crucial. This is often the most important aspect that people are concerned with but one which cannot be captured through GIS and spatial distribution maps.

- Application of the proximity principle means that there may be a future move away from landfill to facilities that are smaller and located closer to the sites at which the waste is produced. The database held by the Environment Agency relates only to

facilities that are currently licensed. This may not necessarily be that useful in terms of capturing change over time, given the large number of unlicensed facilities in operation. These unlicensed facilities may be far more harmful in terms of social impacts than licensed sites.

- There are extreme gaps in the available data on licensed sites and a lack of size data for most of the sites for which licensing data exists. There is, for example, a difference in the potential impacts between a small recycling centre and a very large recycling facility. There are also recovery facilities which are not subject to normal licensing and which can be quite large. In the Midlands alone, there are nearly 10,000 exemptions from licensing and it might be argued that such sites are where the real issues regarding potential negative impacts of waste treatment sites, etc. are most important.

- The existing database only provides a snapshot, as the sites for which data are held will change over time. The data are not good enough to allow us to understand significant differences between type of plant and we cannot really map transport routes.

- Impact of potential differences in regulation at the local and national planning levels: it is possible to apply more stringent emissions standards to certain sites should this be thought to be necessary. But this has rarely been done.

- Recycling: doorstep recycling is more difficult for certain groups of people. Those who live in low-income areas and thus have greater problems to start with, have more problems when it comes to recycling. In any analysis, it is important to consider economic models and the mechanics of charging if people do not recycle enough and thus local or regional recycling targets are not met.

- Importance of work on participation rates in recycling schemes: what makes some communities more keen to participate in doorstep recycling or ‘bring’ schemes, and other communities less interested in participation?

- Incinerators: there is the perception that they are very negative types of facility, but they may not actually deal with a massive amount of our waste (0.81 per cent total, 9 per cent of household). Thus, the literature on impacts is skewed towards negative perceptions of incinerators.

- Location and siting of landfills and incinerators: landfills might be located anywhere whereas facilities like metal recycling sites are more likely in urban areas with a legacy of industrial development, etc. There may be a historical legacy of facility in a site and legislation leads to a tendency to use existing sites rather than start new ones.

- Sites in which facilities are located are not necessarily the same as the sites at which the waste is produced. Thus there is an unequal burden of the impacts in which those who produce the waste may not have to bear the burden or negative impacts associated with its disposal.

- NIMBY (not in my back yard) politics and social capital with regard to facilities siting and political issues: a consideration of affluent communities and the extent to which they are empowered to argue and can overturn problematic decisions regarding the siting of undesirable facilities in their localities.

- Crucial to consider the benefits of waste facilities: some modern facilities are clean, not noisy, and essentially no different to light industry in many ways. They create employment, provide energy for low-income housing from incineration, etc.

- Important to look at change over time in the composition of communities affected by the impacts of a particular facility. The operation of housing markets (i.e. if house prices fall, they become more affordable for those on lower incomes) may mean that the more deprived members of society are more likely to move into those disadvantaged areas after a facility is sited there.

- Public perceptions versus those of science and industry regarding the impacts. Do people perceive there to be certain impacts associated with landfills, etc. when there is little scientific evidence to back up these perceptions?

- Social responsibility: we all produce waste – people need to see that they are the starting point for the creation of a stream of waste. Reduction in waste creation is the main way to deal with waste – if we did not produce so much in the first place, many of the issues surrounding the siting of facilities would not be important because we would not need so many.

- Bring sites: the legislation on how close they can be to housing before it is deemed that they have negative impacts regarding noise of bottles dropping into the recycling bins, etc.

- The issue of vulnerable groups: congenital anomalies might affect vulnerable groups more than more affluent groups, But it is not necessarily easy to tie these anomalies down as being directly caused by proximity to an incinerator, etc. Which vulnerable groups (e.g. unborn children, mothers, breast-fed children) might we look at?. Issues of genetics, diet, existing poor health and poor housing become important in causation. If more deprived people are more likely to live near to certain sites like landfills, this becomes a confounding point in the analysis, as there are likely to be other things going on in that community that might account for any anomalies found.

- Proximity to sites, e.g. exposure to incineration is worst at about 1,500 m from the facility due to the plume of emissions. In many ways, it is most healthy to live right next door to an incinerator because of the way in which that the plumes of emissions fan out.

- Distinction between physical health impacts and psychological impacts, e.g. stress.

- Difference between historical legacy and future situations. Vulnerable groups as future generations.

- Feedback loops – future waste facility location may influence future housing decisions, etc. and, crucially, future siting decisions are based on the legislation we have in force today, planning regulations, etc.

- There are also wider social impacts in the form of communities not benefiting from the industry that produces the waste, then getting the double effect of having the facilities near them, along with the house price impacts of those facilities. There may be many different negative impacts building on each other for some communities. Other amenities will reduce as well – education and community facilities will reduce in availability and quality as well in terms of wider causation of social impacts.

- An important issue is how you begin to define deprivation. Using the IMD may not capture all the significant groups we should be focusing on. For example, are all vulnerable groups equal in terms of access and participation? In some areas, the more deprived groups are more engaged with issues and complain about issues, etc. This can give a strong community, which would seem deprived on an analysis of the data but, in many ways, is more active and engaged, self-sufficient, etc. than more affluent ones. On the other hand, many ethnic minority communities might seem self-sufficient and self-reliant, but this may be because they have historically been forced to rely on others within their own community as they have had no help from outside. White communities might have more engagement with outside. There may be initiatives in place within the community to improve awareness, political engagement, etc.

- The extent to which there are sites that are no longer operational but which have not surrendered their license so seem to still be operational in terms of the data. Some facilities are on sites that were used in the past, e.g. for incineration. Just because there has been a facility on a site for 30 years does not mean that a new facility on the same site is as polluting as the old one, e.g. landfills and incinerators.

- Differences between urban and rural communities, especially in terms of ethnic minorities. In rural areas, they have little community cohesion and are not helped by local government initiatives at all. Identification of types of community and procedural access and participation issues would be useful.

- Rural and urban differentials in health impacts, e.g. agricultural waste. This is not covered by the regulatory system at the moment. New regulations are being put in place to cover farmers who burn waste, etc.

Group discussion – what is it possible (and useful) to find out?

- The participative element is important – engaging people at all levels from recycling to cleaning up litter from front gardens, etc. The ENCAMS national survey of participation of individuals in recycling may offer clues about how to boost participation by revealing the reasons people recycle goods, and why they do not.

- Organisations that produce waste – extent to which, for example, rural industry is participating in waste management other than their legislative obligations.

- EA has emissions data, OPRA scores of different facilities etc. Some of the different datasets may be brought together through correlation with other aspects. We could identify the facilities that might be making larger emissions and do more detailed mapping around those (problems with that practically though as low OPRA scores achieved by a certain facility might have these scores because of administrative problems rather than e.g. emission standard failures).

- National incident recording system to measure nuisance of waste facilities. A complaint categorised as a waste incident, can be searched in terms of the nature of the nuisance, and given a score in terms of the action taken etc.

- The new Flycapture database (http://www.defra.gov.uk/environment/localenv/flytipping/flycapture.htm) records incidents of fly-tipping reported to the Environment Agency and local authorities.

- Some people are natural complainers who complain about anything and everything. Complaints may be lodged with a range of different organisations depending on where people registered their complaint, e.g. waste complaints may be directed to the Environment Agency, the local authority or the waste facility itself. Most complaints about licensed facilities should go to the Environment Agency but many people still report them to their local authority. Local authorities have historically dealt with smaller scale household waste problems, whereas the Environment Agency has historically dealt with the larger ones. Databases like Flycapture are a way of targeting all sizes of problem and linking them together. In addition, the 'bad things' reported might be 'things' in nicer areas where they are more noticeable.

- The influence of perceptions: house prices might not be lowered by proximity to a certain type of waste facility but people think they are. This can lead to stigmatisation of neighbourhoods whether they are based on fact or not. Some studies been carried out in Canada but not in the UK on perceptions of facilities after they have been built.

- What is going to happen in the future? It will be useful in the waste report to raise those policy issues that are important at the moment and the way that these instruments might influence the siting of facilities in the future. With regard to waste strategies, etc., what are the factors that affect decision-making about where things will go in the future? Scenarios might include what will be needed in the future and how many, but not necessarily where they should be, and any consideration of the social aspects of that. There is very little scenario building carried out in the waste field because responsibility for the issue is split across regulatory levels and organisations.

- We might not see anything useful from the GIS analyses.

- Sustainability: a community with problems with waste, etc. can still be sustainable. EIA does not define social impacts at all, whereas the move towards sustainability

assessments includes social impacts. However, these still might not be assessed in enough detail to have a useful outcome for policy.

Policy interventions – small group discussions

Scenario building exercise: how might waste policy change in 10 years' time if social inequality became the key driver of waste policy?

The discussion focussed on the following key issue areas:

- charging and economics
- licensing and siting/location of waste facilities
- waste hierarchy.

Charging and economics

- Lifestyle: We need to break the mould of the culture of consumption which we live in at the moment. This is part of our modern lifestyle culture where we are told to replace household goods often.

- Purchasing: Major elements of a policy would be to both charge and incentivise, e.g. make it cheaper to purchase items which have been recycled, deposit schemes where you get money back for every item you recycle.

- Households at the gate: Again, charging and incentives. Other countries have schemes whereby they charge for the number of bins/weight of rubbish, so that vouchers are given to those who reduce the amount of bins they take.

- Producers: Landfill Tax needs to be higher and enforcement mechanisms need to be stronger. There could be incentives for producers, such as a star-rating scheme for products.

To be equitable, we would need charging and incentive schemes to operate at the same time so as not to discriminate against poorer households. There is also a knock-on effect of laws in other areas of society, e.g. much of the drive to get rid of electrical equipment comes from health and safety legislation requiring people to replace equipment, fuse boxes, etc. To avoid this, there has to be integrated decision-making and truly joined-up thinking across government.

Facility licensing and site location

Criteria to consider:

- Will the site benefit the local economy?
- Social aspects and impacts
- Impact on future inequalities
- Level of deprivation of the existing community

- Impact of house prices and potential blight
- Compensatory measures
- Community involvement and improving procedural aspects
- Community involvement in monitoring and enforcement of sites
- Consider consequences of policies and knock-on effects.
- Lower the threshold for what constitutes a contaminating effect for deprived areas to take into account their existing poor environment and provide explicit recognition of cumulative environmental impacts.
- Improve fiscal penalties.
- Carry out comprehensive LCA and sustainability appraisal.
- Take account of non-monetary costs of land remediation.

The waste hierarchy

- There would be increased public participation at all stages of the process.
- The waste hierarchy might have to change.
- Importance of the proximity principle: people should take responsibility for their own waste. This would mean many more smaller facilities scattered equitably around in terms of geography. However, this would entail greater transport costs in moving wastes to the disparate facilities.
- Social responsibility: every producer should take responsibility for their own waste production. This would make the waste hierarchy function properly instead of being retrofitted.
- Education would be crucial: links to scientific research to enhance the information regarding effects of emissions.
- More emphasis on waste reduction as the root to a solution.
- Greater emphasis on tight policing of things like fly-tipping.

But how do such things get adopted? Researchers over the past few decades have made the same recommendations time and time again, but they have rarely been implemented into waste management policies and strategies. Therefore, perhaps the most important issue to consider is: **how does policy learning happen**? What are the barriers that have to be overcome in order for these long-standing policy recommendations to actually be adopted as part of policy?

Another important issue is the difference between policy *learning* and policy *uptake*. We may have instances of learning, but not necessarily the adoption of certain recommendations into policy frameworks**.**

Appendix 2: Maps of waste sites in North West England

Figure A2.1 Waste transfer sites and deprived areas in NW England

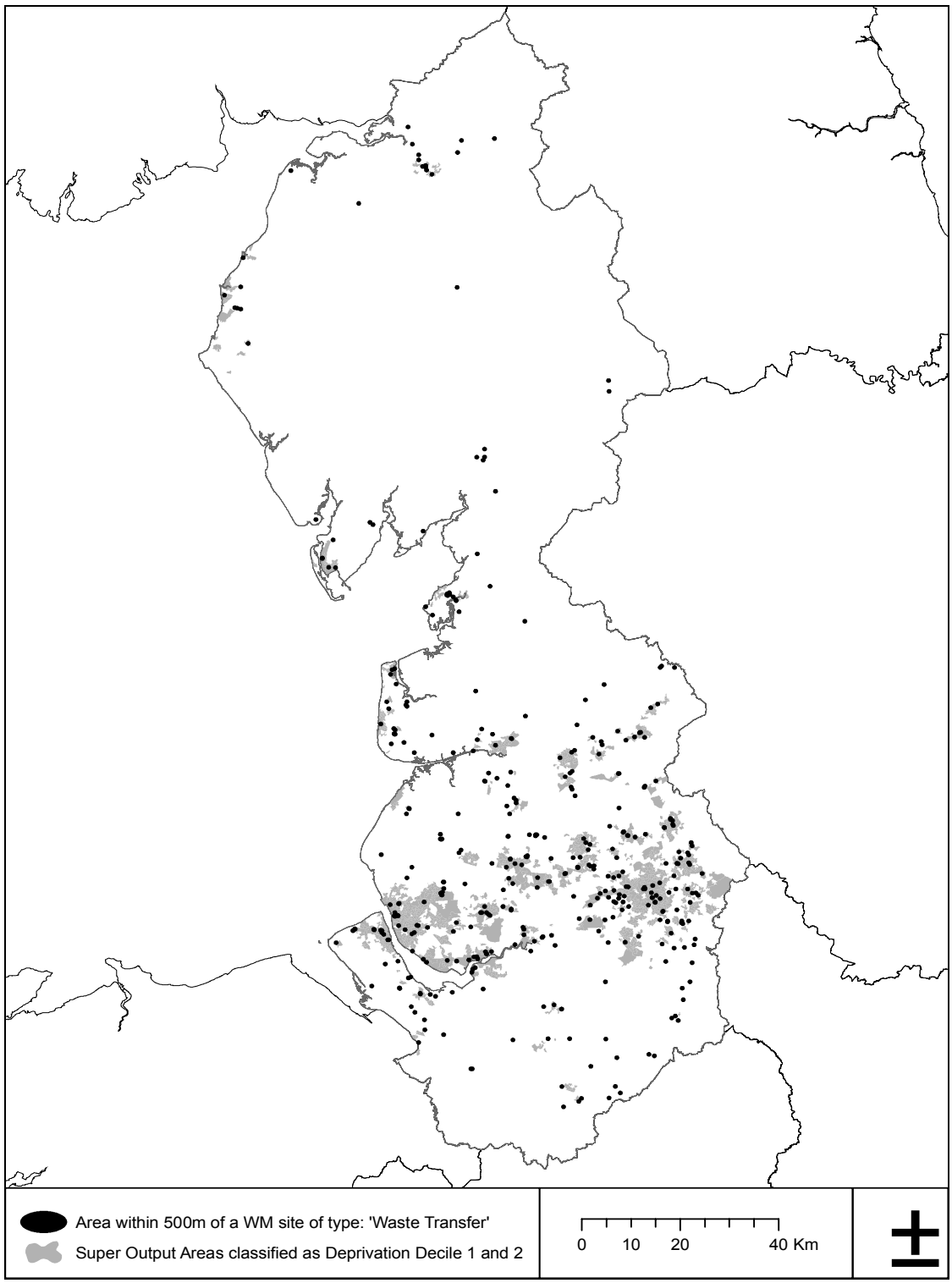


Figure A2.2 Recycling sites and deprived areas in NW England

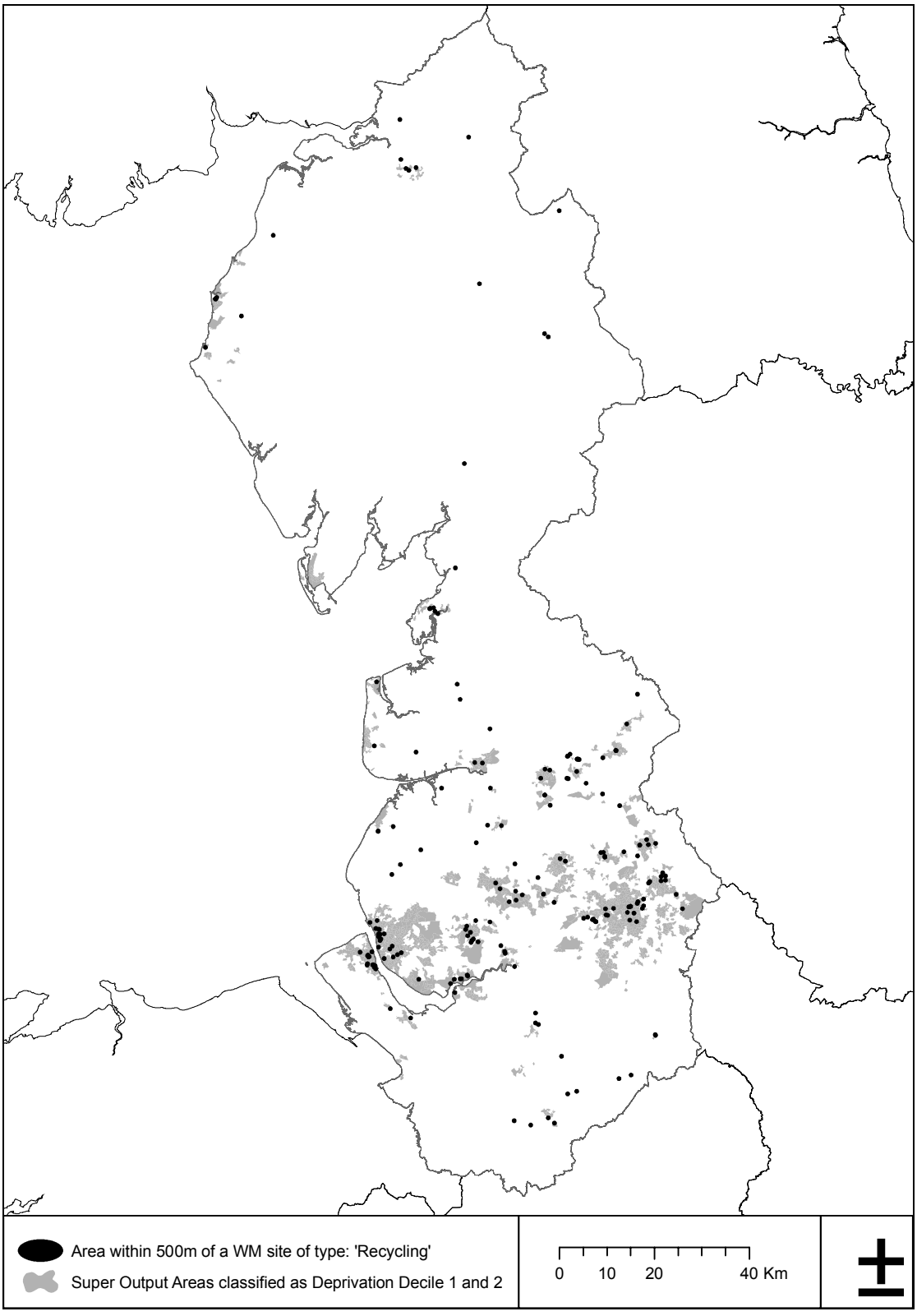


Figure A2.3 Landfill sites and deprived areas in NW England

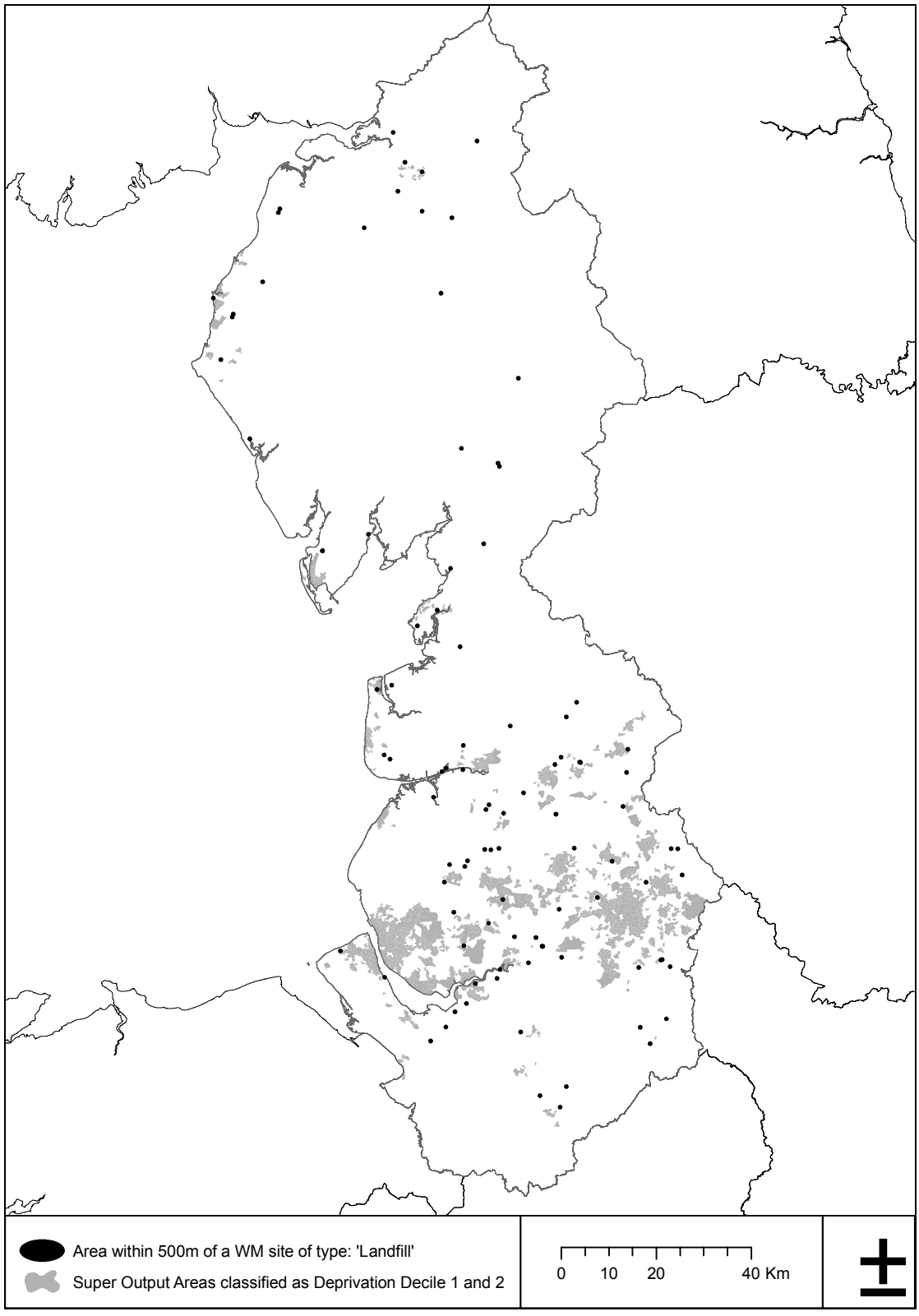


Figure A2.4 Chemical waste treatment sites and deprived areas in NW England

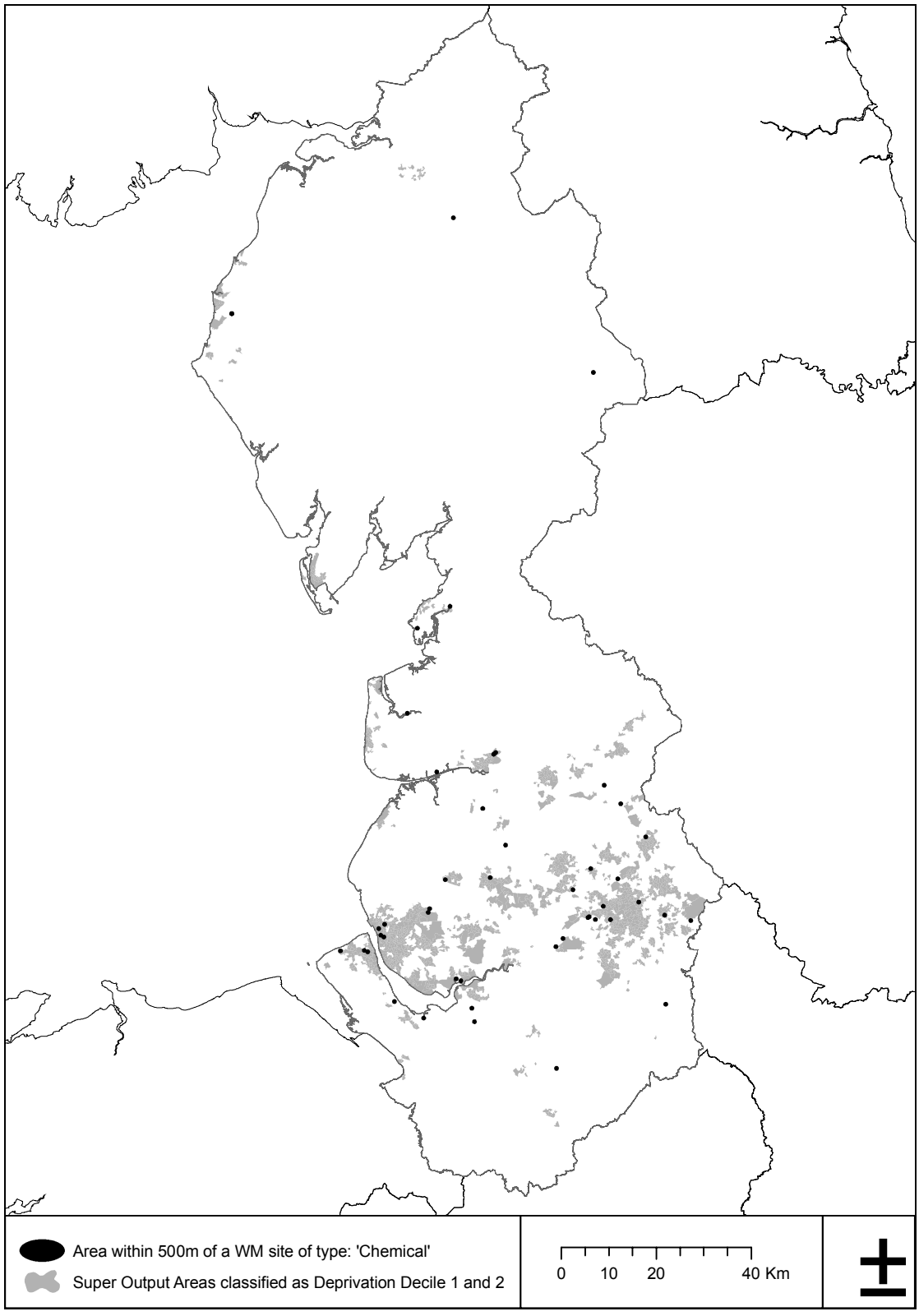


Figure A2.5 Biological waste treatment sites and deprived areas in NW England

Figure A2.6 Civic amenity sites and deprived areas in NW England

We are The Environment Agency. It's our job to look after your environment and make it **a better place** – for you, and for future generations.

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