Department for Levelling Up,
Housing & Communities

Valuing the External Impacts of Developing on Previously Developed Land

Research Report

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Contents

Section 1 – Introduction

This section presents:

- the background to the research included in the report
- the research objectives and methodologies
- the structure of the rest of the report.

Background

Previously developed land (PDL) is land which is or was occupied by a permanent structure and any associated infrastructure, including the curtilage of the development, but is now vacant' (DCLG, 2006). The UK government is actively looking for ways to unlock more property developments across the country and also for other redevelopment uses. Utilising PDL, commonly referred to as 'brownfield sites', is one area being explored. The redevelopment of brownfield, or previously developed land has been a major policy objective in England since the late 1990s, aimed at reducing urban sprawl and greenfield development, as well as contributing to a more compact form of urban development.

Redevelopment of PDL could provide a number of benefits to the public, such as improvements in landscape, opportunities for recreational use, increased accessibility and sense of community. Whilst the use of land value uplift[1] provides estimates of the private benefits (accruing to the landowner) of different land use policies, it is also important within government appraisal guidance to take into account wider societal benefits (for which value accrues to the wider population). Using economic valuation approaches it is possible to understand the value that the public place on benefits that can result from redeveloping PDL. It is important to include these wider societal benefits in economic appraisal as they may be significant in determining the value for money of a government intervention to enable redevelopment of PDL. While non-monetised impacts can be taken into account using techniques such as multi-criteria decision analysis, these require subjective judgements. Further, these assessments need to be combined in some way with monetary benefit-cost ratios (BCR) to determine value for money. Developing monetised estimates for external benefits means that these can be incorporated directly into BCR assessments.

The objective of this study is to estimate the external wider societal benefits of developing on PDL. The research seeks to understand the extent to which the benefits from an improved landscape, better accessibility, increased recreational opportunities and changes in the sense of community are valued by the wider population. The set of values developed are:

- defined using methodologies that are compliant with the Green Book,[2,3]
- consistent with existing values used in appraisal for the external costs of developing on undeveloped land (UDL),

[1] Increased land value as a result of redevelopment
[2] HM Government. 2018. The Green Book: General Government guidance on appraisal and evaluation. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf
[3] Please note that the study design was conceptualised prior to the publication of the 2018 revision of the Green Book.

- and additional to private impacts measured by Land Value Uplift.

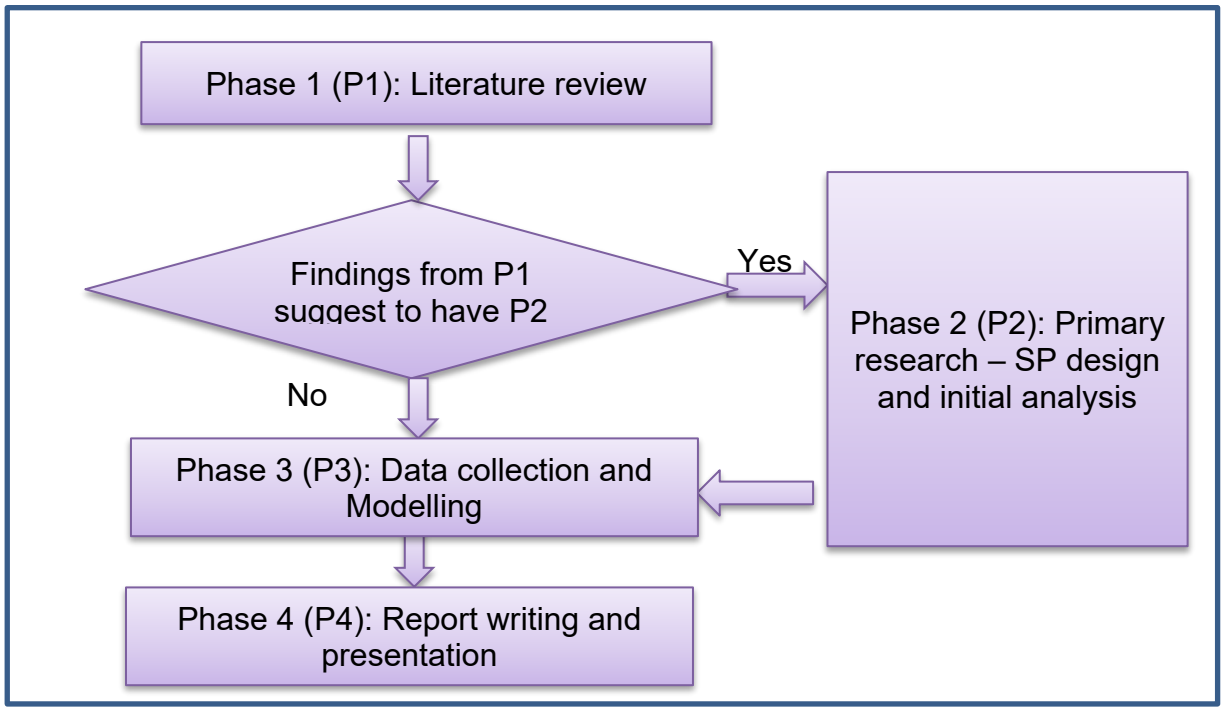
Research methodology

The ultimate output from the work will be the values of changing PDL to new development. One of the challenges of the work is to ensure that the values from this study are consistent with, and complementary to, those currently being used for the valuation of changing from Undeveloped Land (UDL) to new development (DCLG, 2006).

To ensure consistency, we have adopted a two-stage process. First, we obtain valuations for the first stage, which will reflect the gain of utility (i.e. satisfaction or benefits) from restoring PDL to the equivalent of UDL i.e. green space available for recreational use. In a second stage the existing values for the development of UDL are then used to calculate the utility associated with changing to Developed Land (DL). This approach ensures consistency with the existing values of UDL.

To fulfil the research objectives, a systematic research method was undertaken. The approach is outlined in the following figure.

Figure 1: Research method



The **first phase** of the study was a rapid evidence assessment (REA) of existing evidence on the values for the external benefits associated with redevelopment of different PDL types in order to identify readily available, valid and transferable estimates. An REA review aims to be a comprehensive, systematic and critical assessment of the scope and quality

of available evidence from literature. Alongside this literature review, a typology of PDL types was developed. In addition, the REA identified relevant gaps in the existing evidence base and provided suggestions on the method to estimate these values.

On the basis of the literature review it was judged that there was insufficient evidence to support the development of robust appraisal values from published evidence. Therefore, primary research (Phase 2) was undertaken to develop new valuations. Stated choice (SC) experiments were identified at the proposal stage as the prefered research method for this work because of a number of methodological and practical advantages compared to other valuation methods (such as the contingent valuation method or hedonic pricing) for valuing non-market goods in this context. In particular, SC experiments can be used to obtain estimates for all the required external impacts across a range of PDL types, in a consistent way.[4] The detailed design of the SC experiments was further informed byfindings from the REA in Phase 1 and refined through a small-scale pilot study.

Phase 3 of the study includes the main survey data analysis. The main survey was carried out in March – April 2019. 2,400 completed surveys were obtained which formed a sufficient database for the modelling analysis. Descriptive analysis of the sample was carried out to understand the characteristics of the research sample. Discrete choice models were developed to quantify the public's preferences in terms of restoring of PDL sites. Finally values for appraisal were calculated using the discrete choice model findings.

Phase 4 of the study concludes by summarising the research findings.

Structure of the report

The study report is structured as follows:

- Section 2 presents the literature review findings on existing evidence of the valuation of PDL and the development of a PDL type typology.
- Section 3 presents the design of the discrete choice experiment and the survey questionnaire to explore the public's preference as well as the main survey data collection work.
- Section 4 presents the findings from the data analysis. The calculation of the consumer surplus values for appraisal values is also included in this section.
- Section 5 concludes by summarising what the research reveals about the public's preferences and the estimates of the external benefits that can follow from redeveloping PDL sites.

Technical appendices are included at the end of the report:

- Appendix A details the search protocol of the REA
- Appendix B presents the main survey questionnaire
- Appendix C presents the technical details of the choice modelling analysis

[4] Additional details are provided in Section 3.

Section 2 – Rapid evidence review and development of a land use typology

This section presents:

- The literature review research method
- Summary of the evidence from the literature review
- Development of the land use typology
- Summary and recommendations for the rest of the study

The first phase of this study was to undertake an in-depth review of published literature on valuing the external impacts of development on previously developed land (PDL). The objective of the review was to understand what existing evidence was available as well as to inform the detailed implementation of the stated preference choice methodology for the subsequent phases of the study. As part of this review a typology of previous uses of developed land was also developed, based on the outcomes of the literature review and analysis of the National Land Use Database (NLUD).

Literature review methodology

A two-pronged approach was used to identify relevant literature to ensure that a broad range of relevant literature was identified and included in the evidence review.

First we conducted a systematic search of databases for literature published in peer-reviewed journals, conference papers and work undertaken by universities and other institutions.

The methodology of a REA was used for the literature search. This type of review aims to be a comprehensive, systematic and critical assessment of the scope and quality of available published evidence. REAs follow a similar structure to systematic literature reviews, as outlined in the Government Social Research Network Guidance, in that they aim to be replicable and transparent, yet they have the advantage of being less resource intensive. This is achieved by formally constraining the types of research to be reviewed, for example, in terms of location, language and publication date.

While this search methodology can also pick up grey literature (broadly defined as unpublished or non-peer-reviewed studies), particularly reports published by large agencies, it does depend on the search strategies employed. The systematic search was therefore complemented by contacting key individuals in academia to identify additional relevant literature and by searching for grey literature directly.

Systematic search

In the context of this study an REA was particularly appropriate as it allowed the literature search to focus on evidence published in the UK, while capturing the most relevant data from other developed countries. In addition, a restriction on publication date allowed a balance to be struck between the need for evidence on trends and avoiding duplication of previous work.

The main criteria used for inclusion of published evidence were:

- English language studies from OECD/EU countries to minimise issues of transferability.
- Studies published in or after 2000. Material published after this date is unlikely to have been reviewed as part of the previous valuation study on undeveloped land (that included PDL within the scope of its literature review) (DCLG, 2006).

The scope of the review was determined by the two objectives of (i) understanding the existing evidence on valuing external impacts of PDL and (ii) providing information to inform the development of a land typology and other aspects of the methodology for the rest of the study. The following types of studies were therefore included in the review scope:

- Studies that contain monetised estimates for the external impacts of developing on PDL which are sought in the scope of this review. As such, the review focused on studies that provided values for the development of PDL to UDL, rather than the disamenity value of existing PDL.
- Studies that provide more general information on impacts that could inform the detailed implementation of the SC methodology in subsequent phases of the study, for example, in terms of how the impacts are defined, the size of the PDL site or the area to be sampled. [5]

Search terms were developed to capture evidence on the four main external impacts of developing on PDL that were identified in the scope of work:

- Landscape
- Accessibility
- Recreation
- Sense of community.

Three of these are consistent with external impacts determined for UDL (DCLG, 2006): landscape, recreation and accessibility[6]. When considering undeveloped land, accessibility typically refers to the provision of green corridors that weave their way through the urban fabric, providing pedestrian and cycle routes. However, when considering PDL it is noted that a wider definition than that used for undeveloped land may be applicable, as some redevelopment uses could also potentially generate benefits in terms of accessibility to recreation, community facilities and infrastructure that are not linked to green spaces.

A search protocol was developed to capture relevant evidence on these external impacts (see Appendix A for the detailed search protocol). The search protocol consisted of search terms, combined into search strategies and inclusion criteria. A number of separate, but not mutually exclusive, search strategies were implemented to identify as much relevant

[5] The approach for primary data collection was identified at the proposal stage and a comparison of methodologies was not part of the scope of the commissioned literature review.

[6] The definitions provided in DCLG (2006) are as follows:
Recreation: refers to activities such as sport (both formal and informal), leisure and tourism;
Landscape: refers to the fabric of the land into which development is placed, along with a constantly evolving entity fashioned by that development;
Accessibility: refers to the provision of green corridors that weave their way through the urban fabric, providing pedestrian and cycle routes;

literature as possible without generating an unmanageable number of results. The search protocol was developed in conjunction with a trained librarian with expertise in implementing targeted searches in appropriate databases.

The searches were conducted in two literature databases that covered the range of publications considered most relevant for the study, Scopus and Econlit.[7]

In parallel, 15 experts were contacted directly by email, and responses received from eight, who provided paper recommendations that were screened as part of the review. Websites for organisations such as Defra were also searched directly for relevant publications.

Assembling the literature

The database searches were first screened using titles and abstracts of studies identified from the literature search (a 'first pass'). The first screening phase was conducted using Endnote – specialist reference management software – and was based on the inclusion criteria from the search protocol detailed in Appendix A. A similar approach was used to screen literature obtained from experts. In total over 2000 citations from databases, experts and direct searches were screened. The resulting longlist of 45 studies was then screened a second time, in conjunction with senior project team members to determine the list of final papers for inclusion in the review subject to approval by MHCLG.

The final short-list of papers to be reviewed consisted of 30 papers. Three papers from the original shortlist could not be obtained. Two additional studies from the longlist were therefore substituted. One further paper was dropped as it did not add relevant material to that reported in a second paper by the same authors. In total, 28 papers were reviewed; these are listed in the references.

Review of the literature and data extraction

A data extraction template was set up in Excel to collate the data collected from each study. The information recorded from each study reviewed consisted of:

- study identification information – number, authors, publication date
- publication type (journal, report, conference proceedings,…)
- study location/country
- land uses involved – previous and proposed
- methodological approach (stated preference (SP), hedonic pricing, case study,…)
- sample size
- time period of data collection
- spatial characteristics (urban/rural, site size, area of impact)
- evidence on external impacts of interest.

Specifying the evidence to be extracted specifically ensured studies were reviewed in a consistent way. Information on previous and proposed land use and on spatial characteristics was used to inform the development of the land use typology, which is

[7] Scopus is a large abstract and citation based database of peer reviewed literature with over 53 million records in the fields of science, technology, medicine, social sciences, arts and humanities. EconLit includes the most sought-after economics publications including peer-reviewed journal articles, working papers from leading universities, PhD dissertations, books, collective volume articles, conference proceedings, and book reviews.

discussed in more detail in a separate section below. Spatial characteristics were also important for interpreting the evidence on external impacts.

The categorisation has also been designed to be consistent, as far as possible, with the approach used for undeveloped land (DCLG, 2006).

An assessment of the quality of the reviewed papers was made based mainly on methodological criteria, data quality considerations and relevance, although publication type was also taken into account. The data extraction criteria are used to provide a framework for assessing the evidence in the next section.

Evidence from the literature review

This section provides an overview of the papers reviewed for this project across the main dimensions of interest. It identifies the land use types commonly analysed, the location and nature of these sites, the external impacts investigated by researchers and the methodologies used. While useful to identify gaps in the evidence, and potential areas for new research to be directed, many of the external impacts covered in the reviewed literature were only treated in a qualitative manner and do not lead to usable monetised values. There were, however, a number of studies that did have monetised values, and these are discussed in the next section.

Overview of papers selected for review

Most of the studies reviewed were from peer-reviewed journals (24) with three published reports and one working paper. The main characteristics of the papers reviewed are summarised in the table below.

Table 1 Summary of main characteristics of papers reviewed

Dimension	Number of studies					
Previous use	Unknown/ Uncategorised	Industrial/ Business	Vacant/ derelict	Mineral working/ refuse	Transport	Other (residential, retail)
	11	6	4	5	6	3
Redevelopment use	Unknown/ Uncategorised	Greenspace	Residential	Recreational	Other (commercial, industrial, mixed)	Unchanged
	8	11	4	5	7	2
External Impacts	Landscape	Accessibility	Recreation	Community	Environment / health	Other/unknown
	10	4	9	6	7	9
Methodology	Hedonic pricing	Stated Preference/Contingent Valuation Method	Survey	Other*		
	9	8	5	6		
Geography	UK	Europe	US	Other	International	
	8	11	7	1	2	
Spatial type	Urban (core and fringe)	Rural	All (urban/rural)			
	24	1	3			

Note: Some studies are included in multiple categories. For example, industrial land and transport infrastructure that is derelict. *Please see subsequent sections for details of other methodologies

Previous use

PDL or brownfield sites encompass a broad range of land types that are mostly categorised according to their previous use. The National Land Use Database (NLUD, 2016) lists 224 different land types. Based upon preliminary analysis of the NLUD data, considering both the number and total area of the PDL sites listed in the database, seven previous land use categories were initially defined: industrial/business, manufacturing, vacant/derelict, mineral workings/refuse (including quarries, mines, landfill), transport infrastructure, defence and other (predominantly residential, retail, recreation). These were mapped to the previous uses reported in the literature. A more detailed discussion of the analysis of the NLUD data is presented in the section Development of land use typology.

None of the studies reported defence and manufacturing as previous use types. These have therefore been omitted from Table 1. Two studies covered undeveloped land on brownfield sites (Defra, 2011, Chiabai et al., 2013). Some sites were also classified across two dimensions – for example, vacant or derelict residential properties. In two further studies, land was also classified as contaminated. A number of studies reviewed used the general terms brownfield or PDL and did not report a previous use. These were studies that mainly included a large number of sites in their analysis, rather than specific case studies. The previous use for these studies has been classified as 'unknown/uncategorised' in Table 1.

The final set of previous use categories covered by the literature and included in Table 1 are unknown/uncategorised, industrial/business, vacant/derelict, mineral workings/refuse, transport infrastructure, and other.

Redevelopment use

For the purposes of this analysis, the 'proposed use' is the change in use compared with the previous land use. The proposed use may depend on the methodology – the proposed use would be greenspace for example for a hedonic pricing method comparing greenfield and brownfield sites. In some cases the proposed use is a known actual end use but in others it was either anticipated or hypothetical. A range of proposed uses are covered in the literature, as summarised in Table 1.

Greenspace was the proposed land use reported most frequently in the studies reviewed. This includes natural landscape and reforestation as well as parks. There is also a grouping of studies that have examined future recreational use. For some studies the redevelopment use is not categorised. In this case a large number of sites were included in the analysis with the nature of the redevelopment specified as either not known or not considered (e.g. Bambra et al., 2014, Carozzi, 2017). This category was also used for surveys that ranked a large number of potential redevelopment uses (e.g. Greenberg & Lewis, 2000).

External impacts

Four main external impacts were specified as being in scope for this study. The impacts reported in the literature were mapped to these are far as possible. 'Landscape' and 'recreation' were quite widely covered in the literature.

The mapping of reported impacts of PDL development to 'sense of community' and 'accessibility' was less clear. As discussed earlier, accessibility is clearly defined for greenspaces but potentially has a wider definition for PDL redevelopment. One of the objectives of the redevelopment alternatives considered by Rodenberg et al. (2011), for example, was to eliminate the barrier effect of the ring road around Amsterdam. The impact on sense of community was not defined in DCLG (2006). A number of impacts

reported in the literature could be considered to be related to sense of community; these include improved public areas and community facilities, for example (Lanz & Provins, 2013, Greenberg & Lewis, 2000).

Although a mapping was possible, quantitative valuations were not available for many impacts. These are discussed in the section 'Evidence on the values of external impacts' below.

Methodology

A number of approaches have been used in the literature for valuing the external impacts of redeveloping PDL. The two main quantitative methods are: hedonic pricing and stated preference. Hedonic pricing is a revealed preference approach and is used to estimate the external impacts of an actual development by analysing surrounding property prices. Stated preference techniques use responses to hypothetical scenarios, usually collected in a survey environment, to estimate the willingness-to-pay for (or to avoid) a development. The responses reflect the preferences of the respondents. Stated preference techniques can be further categorised into stated choice experiments and contingent valuation. In stated choice experiments a good is described in terms of attributes and respondents are asked to choose between options in which these attributes are given different values (levels). In contingent valuation, the respondent is directly asked a question to quantify their willingness to pay (WTP) for the good or service or their willingness to accept (WTA) compensation for lower quality goods or services.

Both stated preference and hedonic pricing approaches can be used to infer people's willingness to pay for non-market or social goods. Stated preference techniques can be used to obtain valuations for specific aspect or attributes of a good, e.g. the value people place on improving the frequency of bus services as well as the bus service, while hedonic pricing methods usually provide values for the overall services. Definitions of these methodologies can be found in DCLG (2006).

Other quantitative approaches used in the studies reviewed include the fuzzy Delphi method (FDM)[8], which is based on the consensus expert judgement approach developed by RAND (Dalkey, 1969), as well as linear and econometric models. Survey approaches have also been used within the literature to provide information on the qualitative preferences of consumers.

Details of the methodology used by each study are presented in Table 3.

Geography

The literature covers the United Kingdom, Europe and North America. The numbers of papers for the United Kingdom reflect the literature identified from the search of published literature, paper recommendations from experts as well as direct searches for grey literature.

Within these geographical locations most studies are concerned with PDL in urban locations. The classification used in DCLG (2006) identifies two types of urban location:

[8] FDM combines the traditional Delphi Method with Fuzzy Set Theory in order to address some of the ambiguity of the Delphi panel consensus (Ishikawa et al., 1993). The Fuzzy Delphi utilizes triangulation statistics to determine the distance between the levels of consensus within the expert panel.

- urban core: those central urban areas which are characterised by a dense urban fabric and a diverse mix of urban uses including business, commercial and residential functions (5% of land in Britain); and
- urban fringe: those areas of transition where urban areas meet the countryside (10% of land in Britain).

This nomenclature is only used in UK-based reports and it is therefore difficult to categorise the sites used in the studies as more than urban, rural or all spatial types. Only one study provided information on rural PDL sites.

Evidence on values of external impacts

Hedonic pricing studies

An uplift on property prices was reported by all studies that estimated the impact on residential property prices of redevelopment of PDL. Three case studies in the UK (AMEC, 2012) found an increase on average property prices of 10.4% for the remediation of chemical works (use unchanged), 23.12% for a residential redevelopment (use unchanged) and 8.3% for the conversion of a colliery to parkland.[9] Rivas Casados et al (2017) compared property price changes when three PDL sites were redeveloped with Energy from Waste (EfW) incinerators in England. They found mainly non-significant effects on property prices up to 8km from the sites. However, property prices were negatively impacted by between 0.3% and 1.3% for different incinerators and at different distances from the redevelopments. The authors suggest that the inconsistent impacts were specific to the sites used in the analysis.

Several studies have also been undertaken in urban settings in the USA. Kaufman et al. (2006) used data on a comparator greenfield site to estimate an increase in value of between $2694 and $7693 (3% and 10% on the mean house price) as a result of converting two brownfield sites to greenspace.[10] Greenspace is also one of the new development (redevelopment) uses studied by De Sousa et al (2009). Using data for a number of sites in two US cities, these authors found different percentage increases for the same type of redevelopment in the two cities. However, for both cities redevelopment of brownfield sites as commercial developments and parks was associated with higher property prices than residential or industrial developments. Further, property prices were estimated to increase by between 4.4% and 11.7%, depending on the city, when brownfield sites were converted to parks. Ki and Jayantha (2010) analysed the impact of a mixed use urban redevelopment in Hong Kong and estimated an 0.9-0.5 HK$million increase relative to the mean price of 1.8 HK$million (roughly 30%), decreasing with distance from redeveloped site.

Two studies from the USA focused on the impact of brownfield sites on property prices relative to areas without such sites. Both found a negative effect on residential property prices of a similar order of magnitude that decreased with distance from the site, although the studies were based on very different numbers of and types of sites ($7.64/ft, Mihaescu & Vom Hofe 2013 and up to $5.54/ft, Braden et al 2004).

Two further studies looked at the impact of remediation of industrial sites on industrial property prices (and not on neighbourhood residential property prices). These studies are more related to impacts on the land price, which are included in the private benefits of the

[9] In all cases the property price increases were the uplift compared to the area average.
[10] 2000 prices.

redevelopment, than the external impacts of the site redevelopment and therefore not directly relevant for this review.

Several of the above studies include distance effects but few include properties at distances greater than 1-2km from the redeveloped brownfield sites. While it would be possible to calculate a valuation of the external impacts implicit in the property price changes, this would require information on the impacts that followed the redevelopment, the average house prices, the site area or number of households and a time period over which the benefits are enjoyed. Moreover, with the exception of Rivas Casados (2017), the changes in property prices are only measured close to the site and may not therefore reflect valuations of the wider population.

Overall the hedonic pricing studies are based upon a wide range of geographical locations, sizes of brownfield sites and redevelopment uses as well as different sample sizes (see Table 3). It is therefore difficult to draw any conclusions on the size of the external impacts and make the link between the price changes and the different impacts.

Stated preference studies

Two studies report WTP values for the development of PDL in the UK. A study for a coastal town (Lanz & Provins, 2013), formerly supported by the mining industry, employed a choice experiment incorporating six environmental amenity attributes. The attributes included open spaces (parks), community facilities for more formalised recreation actives (e.g. sports pitches), public areas, such as town squares that could also feature cultural amenities (e.g. sculptures) and green routes, which are infrastructure to provide access links for the population, enhance recreation and promote healthier lifestyles. These attributes can reasonably be mapped to the landscape, recreation and accessibility impacts of interest for this review. The study by Cambridge Economic Associates et al (2010) also consider landscape impacts linked to residential redevelopment, open spaces and public realm improvements. These authors apply a combination of choice modelling and contingent valuation techniques. However, the focus of that study is regeneration rather than brownfield redevelopment and a number of additional impacts that are related to other regeneration activities are also reported.

A third study from the UK (Defra, 2011), also using a choice experiment, estimates values for maintaining Sites of Special Scientific Interest (SSSIs), which may also occur on PDL. However, the resulting impacts are not directly relevant to this review as they focus specifically on the public's willingness to pay for SSSI policy scenarios. The exercise was designed to examine the value to the public of changes in biodiversity and ecosystem services resulting from changes in the overall level of funding provided to SSSIs.

Damigos & Kaliampakos (2003) use a contingent valuation approach to estimate landscape and recreation impacts of the redevelopment of a quarry in Athens. They analyse three alternatives with different levels of reforestation and recreational facilities.

Three further studies estimate WTP/WTA for redevelopment projects. Rodenberg et al. (2011) use a contingent valuation method and estimate values using two extreme (Dock and Dike) scenarios. Both include a future development with houses and offices but one puts all transport infrastructure underground (Dock), while the other raises it above ground level (Dike). They report the average minimum compensation that respondents would be willing to accept, irrespective of their most-preferred or least-preferred scenario is €53,000 (based on 94 respondents). This one-off payment for redevelopment of the 20 hectare site is equivalent to approximately €28 per household per hectare. The redevelopment of a 4 hectare port site in Castellon, Spain, into a recreational area with green space (Del Saz-

Salazar et al., 2003) is valued at between 7,475 and 10,411 pesetas per year using a contingent valuation approach, equivalent to €45-62 per year.[11] Latinopoulos et al. (2016) also use this method to estimate a mean WTP of €3.98-€7.85 per/hh/yr for residents within 10km of a greenspace redevelopment of PDL in Thessaloniki.

The overall values can be compared to the values estimated for separate impacts from the studies discussed above. These are summarised in Table 2 below.

While not completely comparable due to differences in the stated preference approach used, the units of measurement and the price base year, the values presented in Table 2 are reasonably consistent with each other in magnitude and also with the overall WTP estimated by Del Saz-Salazar et al.(2003). The values in Table 2 all relate to open space or public space development. It is therefore perhaps unsurprising that the WTA values for the Dock and Dike scenarios are larger as they represent extreme redevelopment of commercial, residential and transport infrastructure. In addition, Rodenberg et al. (2011) discuss possible biases that could occur in using the contingent valuation method, such as starting point bias and strategic bias, which could explain the larger WTA values from the study.

Table 2 Summary of values for external impacts estimated by stated preference techniques

Study	landscape	recreation	accessibility	other
Lanz & Provins (2013) £/hh/unit/yr	0.38-1.75 per ha (open space) 1.94-4.51 per derelict property	4.46-18.33 per facility (community facility)	3.32-4.09 per km (green routes)	4.58 – 23.95 per discrete change (public space)
Cambridge Economic Associates et al. (2010) £/hh/unit/yr	3.39 per restored property, 1.80 per hectare (open space)			24.15 per 2 hectare (public realm)
Damigos & Kaliamakos (2003) €/hh/unit	1.34-1.73 per ha[1] (partial reforestation) 2.17-2.77 per ha (full reforestation)			
	2.62-3.20 per ha			

1 Own calculation based on reported WTP and site area

Stated preference studies provide valuations of specific impacts and also cover a wider population than hedonic pricing methods but these depend on the attribute definitions used in the study and the sampling area. The papers reviewed mainly focus on greenspace, recreational use and public space developments of PDL. It should also be noted that the sample sizes were in general relatively small (see Table 3).

Other quantitative methods

One study used the Fuzzy Delphi Method (FDM) to estimate the impact of redevelopment of an airport outside Athens into a park (Damigos and Kaliampakos, 2012). Using a panel of 10 experts, this expert elicitation method estimated €1080 per m2 of added value to property values within 3km of the site.

A consensus approach was also used by Miccoli et al. (2015) to estimate the WTP for the conversion of a derelict road overpass to a linear park. This Deliberative Esteem Valuation Technology (DEVT) uses stated preference as its basis but seeks consensus in a group

[11] The study estimated WTP using spike, logit and probit models.

setting and involves stakeholder consultation by the group. Sampling across the Rome population, they estimated a WTP of €6/year over 10 years. This would correspond to €51.18 per Rome household.

Finally, Bambra et al. (2014) examined the association between health and PDL. They found that wards in England with larger proportions of PDL had higher levels of morbidity and mortality. This was not explicitly monetised, but such a translation could be made using Quality Adjusted Life Years (QALYs).

Surveys not directly collecting monetary values

A number of papers reviewed in this report cover surveys that do not provide monetised valuations of external impacts. However, they can still provide useful contextual information on external impacts.

Greenberg and Lewis (2000) report the percentage of respondents who prefer or strongly prefer different redevelopment options for brownfield in New Jersey, USA and find that 90% have a preference for play areas and parks, with community facilities also generally ranked highly. Similarly, preferences for different hypothetical redevelopment uses for five sites in a Czech Republic municipality seem to depend on previous use, but overall development for sport, parks and culture rank highest (Martinet et al.,2015).

In a study of brownfield sites worldwide, Loures (2015) finds differences in the perceptions of benefits from redevelopment between experts and the general public. Both groups rated benefits related to recreation and accessibility highly but landscape aspects were ranked more highly by the general public and affordable housing and reducing urban sprawl by experts.

In a survey of the utilisation and quality of life impacts of restoring three brownfield sites to greenspace in the USA (De Sousa, 2006), respondents ranked scenic beauty and walking trails highest. Accees to recreational areas was ranked 5th out of 18 and social interaction with other residents was ranked 11th. There were differences in rankings between sites.

Summary of values of external impacts

The reviewed literature provides a limited number of valuations of specific external impacts, namely landscape, recreation and accessibility estimated using stated preference methods. These valuations are reasonably consistent, but are few in number and no single study covers all of the aspects of interest so direct comparisons are difficult.

There is larger number of valuations, if we consider both stated preference and hedonic pricing techniques. However, it is difficult to directly compare these valuations because hedonic pricing studies do not generally report a valuation per household per unit area as this is not necessarily the main focus of the analysis. The studies are also based on a diverse range of previous land uses, spatial areas and geographical locations. Moreover, most of these valuations are for the redevelopment of PDL to greenspace or other recreational uses. Hedonic pricing methods have been used to analyse a wider range of redevelopment uses for PDL but values for the impacts of interest to this study are not available from these.

The data on external impacts found in the literature are a valuable resource. However, there is no single high quality study providing the full range of values for the different impacts being sought, and there are insufficient quantitative values reported in the literature to undertake a rigorous meta-analysis. We therefore conclude that the present literature is insufficient to generate the values required for use in appraisal.

We therefore recommended that a new survey be undertaken to obtain values for restoring PDL to UDL. The approaches used in the studies reviewed informed the design of the survey, including providing useful methodological insights (i.e.selection of the research method). Qualitative survey rankings also provide some useful information as to which impacts are expected to be valued most highly by consumers, informing the survey design. The existing values and the studies from which they are taken also provide useful figures for validation.

Table 3 Summary information from studies reviewed

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
AMEC	Mirvale - industrial Ince - residential Thurscoe - mine	Mirvale - remediation of chemical works (unchanged use) Ince - improvement of residential area (unchanged) Thurscoe - parkland uncategorised (housing, park case studies)	Hedonic Price Model	3 case studies Mirvale Chemical Works: (N=125 for for paired sample approach) Ince Central Estate: (N=11 for paired sample) Phoenix Park (Thurnscoe):	1999-2011 (Mirvale), 2003-2006 (Ince Estate), 1999-2001 (Thurnscoe)	West Yorkshire (Mirvale Chemical Works), South Yorkshire (Phoenix Park), Wigan (Ince Central Estate)		within 1.2km of site (Mirvale) within 1km of site (Ince) within 2km of site (Thurnscoe)	Mirvale uplift of 10.4% on house price relative to average, Ince 23.12% uplift relative to Wigan average. Thurscoe 8.3% (see Table 5.6 5.13, and 5.21 for house type breakdown)
Bambra, C., S. Robertson, A. Kasim, J. Smith, J. M. Cairns-Nagi, A. Copeland, N. Finlay and K. Johnson	Uncategorised (brownfield)	uncategorised	Linear mixed modelling - association between % of PDL and morbidity + mortality at the ward level	Total (n=7941) wards with no PDL (n=2842) w/ small amounts (n=2146) w/ med. amounts (n=2084) w/ large amounts (n=869) as % area of PDL in ward	1998-2003 health data, 2009 PDL data, 2001 Townsend Index of Deprivation	England (every ward)	all	varying site size effects at ward level (average of 2570 households)	higher % of PDL positively correlates with higher levels of morbidity and mortality
Beekmans, J., P. Beckers, E. van der Krabben and K. Martens	industrial	unchanged (industrial)	hedonic price model	27,141 industrial sites	1997-2008	Netherlands - separated into Randstad (megalopolis), intermediate zone, periphery	urban core (mostly)	megalopolis/regional - separated into Randstad, intermediate zone, and periphery	See table 2 for coefficients Accessibility - road, PT, water, along motorway all +ve landscape - housing and open space both +ve

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Braden, J. B., A. A. Patunru, S. Chattopadhyay and N. Mays	transport (Harbor)	uncategorised (housing, park case studies) - remediation only	-hedonic price model -random utility model (stated choice survey of residents to assess impacts of proximity of environmental contaminaton)	14,893 properties (8,017 in Waukegan, 6,879 elsewhere), 1 of 8 groups of 16 choice sets sent to each hh	1999-2001	Waukegan Harbor, Illinois, USA	urban core	N/A, Waukegan municipality and surrounding county impact zone	WTP/WTA per household per mile distance away from harbor $24,400-$29,500, $54,300-$89,900 for households outside Waukegan Remediation - WTP per hh per year for fullcleanup: $1,016-$7,715 partial cleanup: $418-$3.676 WTA compensation: $1,251-$8,536
Cambridge Economic Associates, EFTEC and Cambridge Econometrics	Unspecified	uncategorized/housing	Develop a conceptual framework one could use to value the benefits of regeneration Pilot study of a stated preference survey to value environment improvements and another hedonic pricing study to value land reclamation	N/A	2007-2011	United Kingdom	all	sub-region level	landscape: £3.39 per hh/yr per restored property, £1.80 per hh/yr per hectare of open space, £24.15 per hh/yr per 2 hectare public realm improvement
Carozzi,F	uncategorised(brownfield)	uncategorised	Boundary discontinuity design (BDD) to find probability of private re-development as a function of house prices increases	356,369 transactions	2007 PDL data, 2002-2006 transaction price and housing char. Data	United Kingdom (LSOA level of aggregation)	urban core, urban fringe, rural	2.7m hectares total (1.4% PDL), area of impact any site within 2km of county boundaries	property value increase of 21.5% could lead to private redevelopment of most brownfield sites

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Chiabai, A., I. Galarraga, A. Markandya and U. Pascual	undeveloped (interesting because of equivalence methodology used)	natural landscape	Determine the discount rate for projects to maintain or restore undeveloped land to its natural state 'equivalency principle' e.g. long term value of preserving undeveloped land is at least equivalent to the value of simlilar land with permission to build up.	5 case studies	2004-2011 (2006 normalized prices)	Basque Country: Jaizkibel mountain, Beaches and shore in Bizkaia and Gipuzkoa UK: Birkham woodland in North Yorkshire, Mar Lodge Estate in scottish highlands, Wekenwae Moss and red moss in South Lanarkashire Scotland	urban fringe, rural	various, forest/mountain/coastline 'sized'	environmental, landscape Basque sites: $93,008-$232,300 TEV per hectare per year for undeveloped land, $8.85m-$9.65m price for developed land per hectare UK sites: $4,599-$17,631 TEV per hectare per year for undeveloped land, $763,557-$1,35m price for developed land per hectare
Damigos, D.	Mineral workings/ quarries/refuse disposal - quarry	parkland/recreation facilities	Fuzzy Delphi Method (expert judgment) to examine issues involved in remediation of derelict mined land into green and recreational spaces	1 case study (Leventakis quarry) of 3 alternatives: Alternative 1 backfilling and full reforestation (n=86) Alternative 2 partial backfilling and installation of footpahts/stands (n=104) Alternative 3 partial backfilling, reforestation and recreation/sport facilities (n=96)	2006	Athens city center	urban core	2 hectares size of site impact area between 2-6 blocks (4 most plausible), 3-9 (6 most plausible), 6-12 (8 most plausible) for alternatives 1-3 respectively	Overall - property value premium between 9-38% (21% most likely), 12-48%(27% most likely), 12-50%(28% most likely) for impact area of alternatives 1-3 respectively. 25-60% for properties with view of redeveloped area (for any alternative). €460 per m^2 premium for alternative 1, €615 per m^2 premium for alternative 2-3

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Damigos, D. and D. Kaliampakos	Mineral workings/ quarries/refuse disposal - quarry	parkland/recreation facilities	Contingent Valuation Method (CVM) with stated WTP for preserving environmental asset or WTA (willingness to accept) for loss of the asset	1 case study of 3 alternatives: Alternative 1 partial reforestation (n=86) Alternative 2 total reforestation (n=104) Alternative 3 reforestation plus recreation facilities (n=96)	1998-1999	Athens city center	urban core	20 hectares size of site impact area between 3-7 blocks from the site in the surrounding municipality of Galatsi	landscape: €26.85-€34.65 per hh for partial reforestation €43.47-€55.47 per hh for complete reforestation landscape+recreation: €52.38-€64.02 per hh for reforestation plus recreational facilities table 10 details socio-economic variables that are significant (income, sufficient access to green areas, education level and family size)
Damigos, D. and D. Kaliampakos	Mineral workings/ quarries/refuse disposal - Mine Other - (airport)	tech and culture park; park	Fuzzy Delphi Method (FDM) for airport case Economic valuation for metallurgical site	10 panel experts 2 case studies: metallurgical site to tech and culture park; airport to park.	2009 values	55km outside Athens; 11.5km outside of Athens, Greece	urban fringe; urban core	25 hectares;530 hectares (26 hectares built up) 3km impact area for Airport case	€11m in tax revenues, €21.1m in job creation, €24.8m in soil remediation (case study 1) €1080 per m^2 added value to property values (case study 2)
De Sousa, C. A.	industrial, transport (railroad)	green space	Survey on utilization and quality of life impacts of brownfield to green space projects	479 individuals from 3 sites: 139 Ping Tom Park, 151 Senka Park, 186 Mill Ruins Park)	2000	Midwest USA (Chicago x2 and Minneapolis)	urban core	site 1 (Ping Tom Memorial Park): 4.8 hectares site 2 (Senka Park): 3.6 hectares site 3 (Mill Ruins Park): N/A	See Table 3, no monetary values just rated out of 5 various attributes that can be mapped to landscape, accessibility, landscape and sense of community

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
De Sousa, C. A., Wu C and L Westphal	unknown/ uncategorised	green space and industrial, commercial, residential	hedonic pricing model (pre/post development models) +stakeholder interviews	1254 (pre-model), 1097 (post-model),23 interviews	1997-2003	compares 2 US cities, Milwaukee + Minneapolis	urban core	various, mean 5.1ha, max 112 ha distance bands 500ft intervals up to 3500ft	All land uses positive effect on house prices Milwaukee: Commercial and park projects had the highest net benefit (15.8% and 11.7%, respectively). Residential projects had slightly lower net benefits (8.6%), and industrial projects had the lowest net benefit (4.7%). Minneapolis: commercial and park projects having the highest net benefit (4.6% and 4.4%,respectively) and industrial and residential projects havingslightly less of an effect (about 3.2% and 3.1%, respectively WTP in Table 7 by income, distance to transport access.

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Defra	Other - Sites of Special Scientific Interest for biodiversity	unchanged (maintaining or improving condition of site)	Scenarios: a) funding at levels sufficient to maintain current condition b) increased funding to achieve 'favourable' condition on all SSSI sites, c) no funding, decline in SSSI condition literature review, 20 case studies of benefits of SSSIs, 4 expert workshops including weighting matrix, 10 focus groups including choice experiment, economic analysis to derive public WTP	5000 SSSIs 49 experts, 153 choice experiment participants	2010 (when focus groups w/ choice experiment conducted)	England and Wales	urban core, urban fringe, rural	77% smaller than 100 hectares, 2.3-20,938ha range for case studies (Table 4.3)	***WTP maintain funding scenario:*** £/hh/yr:nature's gifts (£6.50), climate regulation(£89), water regulation (£66.30), sense of experience (£29.92), charismatic species (£136.95), research and education (£68) ***WTP increase funding scenario:*** £/hh/yr:nature's gifts (£3.25), climate regulation(£89), water regulation (£66.30), sense of experience (£24.68), charismatic species (£49.80), research and education (£56.10)
Del Saz-Salazar, S. and L. Garcia-Menendez	transport (port)	recreation/leisure /green area	Contingent Valuation Method (CVM) to obtain nonmarket benefits of redevolping port-related area for recreation and leisure use spike model, probit, logit and nonparametric models for WTP values	n=700 (350 in Castellon, 210 in port area, 140 in metro area)	1999	Castellon, Spain	urban core	4 hectares, area of impact metropolitan area-wide	WTP 7,475-11,186 pesetas per year

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Greenberg, M. and M. J. Lewis	unknown/ uncategorised	recreation, cultural, community facilities, or new housing	survey on preferences for brownfield redevelopement types	n=176 (out of 204 surveyees)	1999	census tract 46, Perth Amboy, New Jersey, USA (across river from NYC)	urban core	n/a, census tract 46 area of impact	% of respondents who 'prefer' or 'strongly prefer' the following uses: Play areas and parks 90 Community cultural and arts centre, theatre 84 Health care facilities 80 Sports arena 76 Other land use 66 Child care centres 6090% Schools 56 Single-family houses 48 Small businesses 47 Restaurants and dancing 45 Apartments 41 Stores 31 Factories 31 Warehouses 24
Kaufman, D. A. and N. R. Cloutier	industrial	green space	hedonic pricing model assessing impact of proximity to brownfield and green space on property values	890 residential properties in one neighborhood with 2 brownfields and 1 park	2000, 1999 or 2000 tax assessment value in lieu of sales data	Lincoln neighborhood, Kenosha, Wisconsin	urban core	1.9 hectare brownfield;11.5 hectare brownfield; 17.8 hectare park 160 hectare (5/8m x 1m) size of neighborhood. Distances to sites range from 12.5ft-3587.5ft depending on site (see pg. 23 for differences and averages)	$78,540 > $81,234 if brownfield converted to green space $78,540 > $79,881 if brownfield was remediated only

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Ki, C. O. and W. M. Jayantha	vacant/derelict	other - mixed use residential/hotel/commercial	hedonic pricing model to assess how redevelopment affects housing values in the surrounding area (price gradient approach)	1066 residential unit transactions across 47 buildings (378 before; 438 during; 250 after development) case study of Hanoi Road Project (The Masterpiece), formerly 345 residential flats.	2010	Hong Kong	urban core	10.26 hectares, within 750m of site	~0.9-0.5 HK$million change after development cf mean price of 1.8 HK$million, decreasing with distance from redeveloped site.
Kim, E. J. and P. Miller	unknown/uncategorised	uncategorised	stated preference survey to gauge residents' perceptions on different types of brownfield sites	200 residents	2013	Roanoke, Virginia	urban core	60 brownfield sites.	landscape - brownfield type preference: - historical landmarks - maintained landscape with scattered structures - scruffy vegetation - plain modest rundown structures - industrial remnants - crumbling industrial remnants
Lanz, B. and A. Provins	unknown (includes restoration of derelict properties in list of projects) But are was previousoy focused on colliery work	green space, recreation facilities, public areas, restored buildings	Discrete choice experiment to establish WTP values for various preferences	n=106 residents	2010	Seaham, England	urban core, urban fringe	see Table 1 for matrix of each of 6 improvements X area level 3 impact areas: L1(28000ha), L2 (3000ha), L3 (6ha) open area improvement of 5ha (level 1);15ha (level2), 5 properties restored (L1);10 properties restored (L2), 1 extra facility (L1);2 extra facilities (L2), 'improved' public spaces (L1), 2km more green routes (L1,);4km more green routes (L2);2.5km baseline	See table 4 for WTP in £/hh/unit/year per impact area <u>landscape:</u> areas of open space: 0.09-0.10 per ha derelict property improvement: 0.16-0.31 per unit street cleanliness: 0.90-1.78 per 'grade' <u>recreation:</u> community facilities: 0.99-1.51 per facility green routes: 0.61-1.00 per km <u>sense of community:</u> public areas: 1.42-2.32 per new area created

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Latinopoulos, D., Z. Mallios and P. Latinopoulos	Other - fairground (development of new park in city area)	green space	contingent valuation method to estimate WTP of local residents for a proposed new park both dichotomous choice model and a mixed model including protest responses estimated	600 inhabitants (3 zones, city center, west, east. Representative sample by age and sex)	2013	Thessaloniki, Greece	urban core	18.4 hectares, 10km radius from site impact area	Table 5-7 for WTP breakdowns per model €2.13-€7.68 median, €3.98-€7.85 per/hh/yr mean.
Loures, L.	unknown/ uncategorised (post industrial)	not known	Literature review, case studies, survey of public and experts/stakeholders	117 case studies anaylsed from 346 possible. 67 members of public (from sample of 100) and 47 experts (from sample of 100)	Not stated	Intenational - case study sites worldwide	not stated	various, not stated	landscape aspects rated highly by general public (>10%) but not experts. Recreation/accessiblity rated highly by both (>10%) Reducing urban sprawl and increasing affordable housing rated highly by experts (>10%) but not public.
Martinat, S., J. Kunc, P. Klusacek, T. Krejci, J. Navratil, J. Vnenkova and J. Cernik	industrial/ business - 5 sites of various types (transport, retail, distillery, mine), now derelict or partly used for other purposes	various hypothetical options (shopping mall, sport, culture, housing park)	survey questionnaire with prior pilot interviews with 10	5 brownfield sites, 163 survey respondents	2014 survey	Ostrava, Czech Republic	urban core, urban fringe	87 hectares out of 1162 ha city	Outcomes are based on perceptions of possible proposed options. Prefences for outcomes seem to depend on previous use but overall sprot, parks and culture rank highest.

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Miccoli, S., F. Finucci and R. Murro	case study - derelict elevated roadway (replaced by road tunnel)	linear park on existing structure (alternative is demolition)	deliberative esteem value technology (DEVT). Uses Valuation Groups (VG) to determine consensus view. VGs form intial view, consults experts and stakeholders and then form final view - contingent valuation approach as hypothetical scenarios used for valuation	Valuation groups formed as sample from total Rome population (2 million) with quotas for socio-economic groups. VG size 30. Consult stakeholders and experts.		Rome, Italy	urban core	site: 2200m stretch of elevated roadway. Zone affected: all residents of Rome, based on VG sample	50% of VG did not have WTP for conservation of elevated roadway as park intially. WTP 50 Euro cents monthly for 10 years. Converts to euro 51.18 per person (in Rome municipality)
Mihaescu, O. and R. Vom Hofe	unknown (brownfield)	n/a	Hedonic Pricing Model	87 Brownfield sites, 6863 properties with 2000ft of brownfield sites. 3 zones 0-1000ft, 1-1.5k ft, 1.5-2k ft	Not stated	US - Cincinatti, Ohio	urban? Not directly speicfied	87 sites.	Two models - spatial durbin (SDEM) and spatial lag (SLX) SDEM:1% increase in distance from site leads to $92 increase in price. ($7.64 per ft).SLX $11/ft.
Rivas Casado, M., J. Serafini, J. Glen and A. Angus	unspecified	actual use - waste (incinerator) EfW (Energy from Waste) incinerators only built on PDL	Hedonic Pricing Model	3 incinerators, 55000 transactions over 20 yr period	1983-2014	UK	urban (only incinerators within 0.8km of urban areas)	houses within 8km	Operational: negative impact on house prices between 0.4 and 1.3% (within range reported in literature). For 2 out of 3 incinerators no sig, -ve effect on house prices within 2km of site. But distance from site at which effects are seen also differ between incinerators. Results show a number of sig, +ve coeffs that cannot be explained

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Rodenburg, C. A., P. Nijkamp, H. L. F. de Groot and E. T. Verhoef	unknown (urban redevelopment - so could be a mix of previous uses) mainly consists of offices (not clear if it is still in use)	multi-function (compact) development. Different scenarios: Dock/Dike: consists of transport infrastructure, buidling/office spaces, houses and facilities	Stated preference - WTA contingent valuation surveys for current residents in the area to understand their WTA for compensating the externalities occurred under different development alternatives	195 respondents (response rate = 28%), and the analysis is based on a restricted sample of 94 responses	around 2004 - the details of the survey was in a different paper which can't be accessed	Irenebuurt - Amsterdam Zuidas	urban core	1km * 100metres (on both sides of the orbital motorway (A10)	Unweighted average minimum compensation €53000 (based on 94 respondents) More detailed analysis in Tabels 2-4.
Tonin, S & M Turvani	industrial (contaminated)	not known (could be anything as looking at effect of environmental condtion)	Hedonic pricing model But looks at industrial property values and focus is on remediation costs	1 main site, 187 industrial and commercial transactions	1997-2008	Porto Marghera (Italy)	urban?	2100 ha site but sales used in model cover approx 17% of this	Model I 10% increase in distance to contaminated site increases sales price by 6.2% (ceteris parabus). Remediated site has postivie, significant effect on price. Model II Site size important determinant of price. Estimate that competely remediated land increases sale price by 160%

Authors	Previous land use	Redevelopment-use	Methodology	Sample size (and unit)	Time period	Location (geographical)	Spatial type	Size of site area and zone of impact	External Impacts
Zhang, L. and D. B. Klenosky	landfill/waste treatment facilities	green space/recreation	Literature review. Two strands of research. 1) Attitudes to proposed or existing landfill/waste treatment facilities - pyschological and social impacts 2) Attitudes to redevelopment of former landfill sites for economic redevelopment or recreation use	Strand 1)=> 18 studies, interview or surveys Strand 2)=> 9 papers. All US/Canada. Mostly survey or interviews. One uses primary data.	n/a	International - reviews stuides from US, Canada, Europe, Asia	not specified		Attitudes only. No useful quantitative values. 1) existing or proposed landfill Different studies place different emphasis on importance of outcomes. 2) Landfill as brownfield redevelopment Categorisation of impacts: Environmental includes landscape. Social includes recreation but also sense of community (public collaboration and involvement, connecting places and spaces)

Development of land use typology

A land use typology is useful in the context of this study as it will be used as a framework around which the values for redevelopment of different forms of PDL can be based.

An initial typology was developed to inform the literature review, specifically regarding the specification of search terms. We reviewed the National Land Use Database (NLUD) data, published by the Home and Communities Agency (2014), alongside the data from Scottish Vacant and Derelict Survey (SVDS), published by the Scottish Government (2017). The initial typology considered land type, location of sites, the previous use and potential use characteristics.

Findings from the literature review have then been used to refine the recommended typology. We have aimed for the typology to be as exhaustive as possible, whilst trying to limit the number of common themes.

In the sections that follow we set out a series of descriptive analysis of the characteristics of the known PDL sites based on the NLUD and SVDS data.[12]

Evidence from the NLUD

Although with caveats, the NLUD data contains detailed information on individual PDL sites provided by local authorities in England. The NLUD (2012 base year) data consists of 8,844 PDL sites and covers 23,627ha. The information includes previous use characteristics, location, as well as suitability of sites for different activities.

The NLUD currently classifies PDL into four different categories as shown in Table 4.

Table 4: PDL by land type

	Land Type	Proportion of the total PDL area
A	PDL now vacant	34.5%
B	Vacant buildings	13.6%
C	Derelict lands and buildings	16.2%
D	PDL or buildings currently in use and allocated in local plan or with planning permission	35.8%

Source: produced by research team based on NLUD data (2012)

PREVIOUS USE ANALYSIS

It is likely that people may place different value on restoring different types of previously developed land. It is therefore useful to understand the composition of the land available and how it can be characterised.

The NLUD database has recorded 224 different types of previous use of the PDL sites, whilst the SVDS (2016 base year) summary file contains 21 types of previous use. Based on the information, we have further aggregated these to 10 types in the initial analysis, as shown in Table 5 below. In England, 19% of PDL sites were previously used for industrial and business purposes, followed by unknown / uncategorised at 17% and manufacturing at 16%. In Scotland, 31% of PDL sites were used for mineral workings, quarries and refuse disposal, followed by defence at 17% and other (including retail and recreation purposes) at 16%. The variation of the previous uses of PDL sites in England and Scotland might to be linked to the different geographic area types in these two countries and historic differences in land use.

[12] For the SVDS data, only the summary information is available but not the detailed individual PDL site information (such as area, LA etc). Therefore the disaggregate analysis is based on the NLUD data (for England only).

Table 5: PDL by previous use for England and Scotland

Previous use summary	England		Scotland	
	Area (ha)	%	Area (ha)	%
Community (education/medical/police etc.)	1,237	5%	1,050	5%
Defence	1,548	7%	1,939	17%
Industry/Business	4,453	19%	629	5%
Manufacturing	3,775	16%	2,119	1%
Mineral workings/quarries/refuse disposal	3,179	13%	3,796	31%
Residential	886	4%	487	10%
Transport	1,434	6%	330	3%
Vacant/derelict	1,436	6%	148	4%
Other (retail/recreation etc.)	1,550	7%	1,300	16%
Unknown/uncategorised	4,129	17%	636	8%
Total	23,627	100%	10,898	100%

Note: the highest proportion of each region is highlighted. 'Transport' includes unused railway land and other associated infrastructure

Table 6 summarises the previous use by PDL type from based NLUD data[13]. We find some clusters of the previous use by the type of land:

- 65% of the Defence, 52% of the Vacant and derelict land and 49% of the Resident land are categorised as 'now vacant' land.
- 54% of the mineral workings, quarries and refuse disposal and 46% of the manufacturing PDL sites are in the 'derelict land and buildings' category.
- Apart from these above, the rest previous use land types are mostly under the category D – 'currently in use and allocated in local plan or with planning permission'.

Table 6: PDL by previous use for England for each land type (England)

	Total Area (ha)	A - PDL now vacant	B - Vacant Buildings	C - Derelict land and buildings	D - PDL or buildings currently in use and allocated in local plan or with planning permission
Community (education/medical/police etc)	1,237	23%	22%	11%	44%
Defence	1,548	65%	8%	17%	10%
Industry/Business	4,453	28%	7%	12%	52%
Manufacturing	3,775	25%	11%	46%	17%
Mineral workings/quarries/refuse disposal	3,179	30%	3%	54%	13%
Residential	886	49%	9%	5%	36%
Transport	1,434	36%	2%	23%	39%
Vacant/derelict	1,436	52%	3%	37%	8%
Other (retail/recreation etc.)	1,550	25%	10%	17%	49%
Unknown/uncategorised	4,129	13%	2%	2%	83%
Total	23,627	30%	7%	24%	39%

Note: the highest proportion of each previous use category (row) is highlighted

AREA TYPE ANALYSIS - RURAL AND URBAN CLASSIFICATION ANALYSIS

We also aimed to include within the typology a consideration of area types, drawing upon the previous work undertaken on valuing undeveloped land.

In the existing typology for undeveloped land valuation (DCLG, 2006), undeveloped land is categorised into seven area types: Urban core (public place, city park), Urban Fringe

[13] For the SVDS data, only the summary information is available but not the detailed individual PDL site information (such as area, LA etc). Therefore the following analysis is based on the NLUD data (for England only).

('greenbelt'), Urban Fringe (forest land), Rural forest land (amenity), Agricultural land (extensive), Agricultural land (intensive) and Natural and semi-natural land (Wetlands). It is desirable for any new typology for PDL to work in a way that is consistent and allows some read-across to the UDL typology. In our context (valuation of PDL), the last three area types (agricultural and natural land) are less relevant. For the Urban Fringe category, again, we judge that the 'greenbelt' category is less pertinent. We would therefore propose at a minimum to classify the area types as urban core, urban fringe, and rural; however, we also look to the literature to see whether a more disaggregate classification could be supported.

The NLUD data contains the detailed geo-reference and the Local Authority (LA) information for each individual site, but no information on the rural and urban classification. Therefore we match the NLUD site data to 2011 Census rural and urban classification at the LA level, using Defra (2016) data on the 2011 rural-urban classification of Local Authorities and other geographies. This is shown in Table 7.

For the 2011 Census, England was divided into 171,372 Output Areas (OAs) which on average have a resident population of 309 people. Each OA is assigned as urban or rural based on whether its (population-weighted) centre is within or outside a built up area of greater than 10,000 people. OA-level information is then aggregated to suit data at larger spatial scales, including Local Authority Districts (LADs). LADs are classified based on the share of their population that live in rural or 'rural-related' areas (i.e. hub towns), as shown in the table below. Hub towns are built-up areas (defined by Ordnance Survey) with a population of 10,000 to 30,000 that meet specific criteria relating to dwelling and business densities, suggesting the potential to serve the wider rural hinterland.

Table 7: Rural and urban classification description

Category	Description	Broader category
Urban with Major Conurbation	Less than 26% living in rural settlements and hub towns	Predominantly Urban
Urban with Minor Conurbation	Less than 26% living in rural settlements and hub towns	
Urban with City and Town	Less than 26% living in rural settlements and hub towns	
Urban with Significant Rural	At least 26% but less than 50% living in rural settlements and hub towns	Urban with Significant Rural
Largely Rural	At least 50% but less than 80% living in rural settlements and hub towns	Predominantly Rural
Mainly Rural	At least 80% living in rural settlements and hub towns	

Using the 2011 Rural-Urban Classification guidance, we have derived the rural and urban classification for each PDL site based on the LA information available in the database. Table 8 shows the PDL type by area type. 56% of the PDL sites are located in the Predominantly Urban area. For PDL sites within 'Predominantly Urban' areas, 45% of them are currently in use and allocated in local plan or with planning permission. However, the PDL sites in 'Urban with Significant Rural' and 'Predominantly Rural' areas are mainly PDL which is vacant or derelict land and buildings or PDL currently in use and allocated in local plan or with planning permission.

Table 8: PDL by area type (column percentage)

	Predominantly Urban		Urban with Significant Rural		Predominantly Rural	
	Area (ha)	%	Area (ha)	%	Area (ha)	%
A - PDL now vacant	4,082	31%	1,570	24%	1,418	38%
B - Vacant Buildings	736	6%	548	8%	327	9%
C - Derelict land and buildings	2,527	19%	2,414	36%	724	19%
D - PDL or buildings currently in use and allocated in local plan or with planning permission	5,907	45%	2,119	32%	1,254	34%
Total	13,252	100%	6,651	100%	3,723	100%

Note: the highest proportion of area type is highlighted.

We identified a few clusters of previous use of PDL sites by different area types. For example, 45% of the Manufacturing, 46% of the vacant /derelict PDL and 52% of the Transport PDL sites are in the 'Urban with Significant Rural' area, 72% of the Defence PDL is in the 'Predominantly Rural' area. For the rest of the PDL sites, most of them are currently located in the urban area ('Predominantly Urban').

Table 9: PDL previous use by different area types (row percentage)

Previously use	Total area (ha)	%	Predominantly Urban		Urban with Significant Rural		Predominantly Rural	
Community (education/medical/police etc.)	1,237	5%	791	64%	290	23%	156	13%
Defence	1,548	7%	124	8%	317	20%	1,107	72%
Industry/Business	4,453	19%	3,043	68%	774	17%	636	14%
Manufacturing	3,775	16%	1,690	45%	1,707	45%	378	10%
Mineral workings/quarries/refuse disposal	3,179	13%	1,814	57%	1,007	32%	359	11%
Residential	886	4%	682	77%	130	15%	74	8%
Transport	1,434	6%	529	37%	752	52%	154	11%
Vacant/derelict	1,436	6%	653	45%	660	46%	123	9%
Other (retail/recreation etc.)	1,550	7%	826	53%	506	33%	217	14%
Unknown/uncategorised	4,129	17%	3,101	75%	509	12%	520	13%
Total	23627	100%	13,252	56%	6,651	28%	3,723	16%

Note: the highest proportion of each previous use category is highlighted

PREVIOUS USE BY PROPOSED REDEVELOPMENT USE ANALYSIS

Lastly, we explored the proposed redevelopment use of the PDL as shown in Table 10 and Table 11. Based on the NLUD data, PDL sites are proposed to be developed for a range of future uses. Most of the PDL sites are proposed to be developed for Employment purpose (30%), Mixed with housing (22%) or for Housing (14%).

In Table 11, we observe that the stated proposed use of PDL is often linked to its previous use. For instance, the PDL sites previously used for Manufacturing, Industry/Business and Transport are more likely to be used for employment in future (at 52%, 53% and 48% respectively). 50% of the PDL that were used for residential and 33% of the PDL that were for Community are proposed to be developed for housing purpose. This aligns with a policy presumption in favour of seeking to reuse sites for the same purpose, and demonstrating efforts to market sites in this way, before considering change of use.

48% of the PDL that were previously used for Defence are proposed to be used for mixed with housing purpose. For the PDL sites with a previously use listed as unknown/uncategorised, vacant/derelict and mineral workings/quarries/refuse disposal, their proposed use is rather unclear or not proposed.

Table 10: PDL previous use by proposed use (England data)

	Proposed Use (Area ha)								
Previously use	**Employment**	**Housing**	**Mixed with housing**	**Mixed without housing**	**None**	**Open Space**	**Other**	**Retail**	**Total**
Community (education /medical/police etc.)	35	404	328	26	201	17	206	19	1,237
Defence	359	62	744	66	271	0	45	0	1,548
Industry/Business	2,347	476	1,048	75	371	0	104	32	4,453
Manufacturing	1,952	358	765	111	451	9	109	20	3,775
Mineral workings /quarries/refuse disposal	462	301	687	231	1,107	178	209	4	3,179
Residential	21	443	154	2	226	8	32	2	886
Transport	684	65	116	58	368	26	114	3	1,434
Vacant/derelict	400	181	133	36	492	24	150	20	1,436
Other (retail/recreation etc.)	208	348	413	55	201	79	152	94	1,550
Unknown/uncategorised	640	653	890	139	339	1	1,433	34	4,129
Total	7,108	3,291	5,279	799	4,026	341	2,554	229	23,627

Table 11: PDL previous use by proposed use row percentage

	Proposed Use								
Previously use	**Employment**	**Housing**	**Mixed with housing**	**Mixed without housing**	**None**	**Open Space**	**Other**	**Retail**	**Total**
Community (education /medical/police etc.)	3%	33%	27%	2%	16%	1%	17%	2%	100%
Defence	23%	4%	48%	4%	18%	0%	3%	0%	100%
Industry/Business	53%	11%	24%	2%	8%	0%	2%	1%	100%
Manufacturing	52%	9%	20%	3%	12%	0%	3%	1%	100%
Mineral workings /quarries/refuse disposal	15%	9%	22%	7%	35%	6%	7%	0%	100%
Residential	2%	50%	17%	0%	25%	1%	4%	0%	100%
Transport	48%	5%	8%	4%	26%	2%	8%	0%	100%
Vacant/derelict	28%	13%	9%	3%	34%	2%	10%	1%	100%
Other (retail/recreation etc.)	13%	22%	27%	4%	13%	5%	10%	6%	100%
Unknown/uncategorised	15%	16%	22%	3%	8%	0%	35%	1%	100%
Total	30%	14%	22%	3%	17%	1%	11%	1%	100%

Note: the highest proportion of each previous use category is highlighted

SUMMARY OF THE NLUD ANALYSIS

Based on the analysis of the NLUD and SVDS databases:

- We have categorised the previous use of PDL as 8 types. Most of the PDL sites are previously used for manufacturing, industry/business, other (including residential, retail etc.), mineral working /quarries/refuse disposal and defence for both England and Scotland.
- Some variation is found for the proportions of PDL available according to previous use in England and Scotland. This might link to the different geographic features of the two countries. However, the lack of details in PDL site information of the Scottish data prevents us from doing more thorough analysis. Therefore the further

analysis of area type and the proposed use of PDL sites are based on the NLUD data only (England) which consists of 8,844 PDL sites and covers 23,627ha PDL.

- Using the 2011 Census rural-urban classification guidance, we matched the PDL sites in the NLUD to three different broader area types. Over half of the area available from PDL sites (56%) recorded in the NLUD data is located in the 'Predominantly Urban area', followed by 'Urban with significant rural' (at 28%). Only 16% of the currently registered PDL is in the 'Predominantly Rural' area.
- Some clusters are identified for the previous use of PDL sites for each geographic area.
- The proposed use of the PDL is often linked to their previous use for some of the categories.

Evidence from the literature review

The evidence from the literature is mainly from urban PDL sites. Urban core and urban fringe are only distinguished in a few studies but distance to residential housing and the size of the impact on households with distance from the site are important considerations, as is the number of households affected.

Although a number of previous land use types are covered by the literature, the evidence base is insufficient to indicate whether the value placed on external impacts would depend on previous land use type. Similarly, while a number of redevelopment uses are contained in the literature, values of external impacts are mostly estimated for green space and recreational redevelopments. Although other redevelopments are considered in the hedonic pricing literature, the evidence is not sufficient to indicate whether redevelopment use influence the external impact values.

Comparison with the approach used for undeveloped land

The typology adopted for undeveloped land combines spatial and previous land use types. This is sensible as undeveloped land in the urban core is most likely to be parks and, on the urban fringe, greenbelt. There are additionally a number of different rural undeveloped land types. For all area and land type combinations, the valuations of external impacts used in appraisal are independent of redevelopment use.

This typology cannot be as easily mapped to PDL as there is a much larger variety of previous uses with different characteristics. Many of these may occur in urban, urban fringe and rural areas, although the NLUD analysis indicates some correlation between previous use and spatial type.

Proposed typology

Based on the evidence from the literature review and the national land use data analysis, we propose a typology of PDL as shown in Table 12. This typology takes into account the previous use of the PDL site and the geographic location of the site.

Table 12: Proposed PDL typology

Proposed PDL type (by previous use)	Previous use from the NLUD analysis	Predominantly Urban	Urban with Significant Rural	Predominantly Rural
Residential and Community	Community (education /medical/police etc.)			
	Residential			
Defence	Defence			
Industrial use	Industry/Business			
	Manufacturing			
	Transport			
Mineral workings/ quarries/refuse disposal	Mineral workings /quarries/refuse disposal			
Other (retail / recreation etc.)	Other (retail / recreation etc.)			
Vacant / derelict/ Unknown/ uncategorised	Vacant/derelict			
	Unknown/uncategorised			

The previous use dimension has been further aggregated to six types in the typology which comprise of Residential & Community, Defence, Industrial use, Mineral workings/quarries/refuse disposal, Other (retail/recreation act) and Vacant / derelict/ Unknown / Uncategorised. The rationale behind the aggregation is:

- Categories are grouped where they are likely to be perceived by the public as being similar in nature,
- The literature reviewed does not identify significant variation in valuations around the categories that are combined.
- Based on the land use data, the grouped categories showed similar patterns around their spatial area type, and their proposed redevelopment use.

The geographic area type categories are drawn mostly from the national land use database analysis as there was very limited evidence from the literature review around how valuations may vary by different area types. Three categories are proposed: Predominantly Urban, Urban with Significant Rural, and Significantly Rural. The categories are derived based on the 2011 Census classification scheme for rural and urban – calculated from population density of the Local Authority in which the PDL site is located. Below in Table 13 we show how these area types can map across to those in the typology used for UDL valuation (DCLG, 2016).

Table 13: Proposed typology – spatial matching to the existing evidence (DCLG, 2006)

Land type (PDL ->UDL)	Land type (UDL ->DL) (DCLG, 2006)
Predominantly Urban	Urban core
	Public space (city park)
Urban with Significant Rural	Urban Fringe ('green belt')
	Urban Fringe (forested land)
Significantly Rural	Rural forested land (amenity)
	Agricultural land (extensive)
	Agricultural land (intensive)
	Natural and semi-natural land (Wetlands)

It should be noted that the decision has been taken not to include the proposed redevelopment use in this typology. In the current framework, we focus on the valuation of the development of PDL to UDL. The future use of the developed land (if required) should be taken into account in the second stage of moving from UDL to DL.

Summary and conclusions

To understand the existing evidence and to inform the methodology for the subsequent phases of the study, an in-depth review of the literature was undertaken focussing on recent literature on valuing the external impacts of development on PDL. Below we summarise the findings from the literature review and identify a few gaps on the valuation of redevelopment of PDLs:

- **Different types of PDLs**: The studies reviewed covered a diverse range of previous land uses, spatial areas and geographical locations. However not all of the previous uses of PDL were covered in the literature. For example, none of the studies reviewed reported defence and manufacturing as previous use types. Based on the NLUD data analysis, 7% of the England and 17% of the Scotland PDLs (area) were used for defence purposes. In additional, the PDLs covered by most of the existing literatures were in the urban core or urban fringe. Only one study (Defra, 2011) discussed the valuation of redevelopment of PDLs in rural areas.
- **Overall valuation**: A number of studies estimated overall valuations, using hedonic pricing and/or SP (both stated choice and contingent valuation) techniques. It is difficult to directly compare these valuations due to the different research focus of each study. Some of the literature caveats the contingent valuation method on the basis that the approach is subjected to responses biases (although it is noted that these apply to a greater or lesser extent for all self-reported valuation approaches). The evidence is not sufficient for a robust analysis / comparison of the valuations for different types of PDLs. Transferring these values to new appraisal or valuations would be challenging as there is insufficient evidence to justify the validity of such a transfer.
- **Valuations of the external impacts**: There is limited literature focusing on the quantitative valuation of specific external impacts. There is some literature around the valuation of landscape and recreation; however, there is very little available evidence on the value associated with changes in the sense of community and accessibility. The valuations that have been obtained for external impacts using stated preference methods seem reasonably consistent. However, it is difficult to conduct direct comparisons as no single study covers all of the aspects of interest.
- **Research methods**: Moreover, most of these valuations are for the redevelopment of PDL to greenspace or other recreational uses. Hedonic pricing methods have been used to analyse a wider range of redevelopment uses for PDL but values for the disaggregate impacts of interest to this study are not available from these.
- **Variation of the valuations of PDL by different sub-group of the population**: From the literature reviewed, there is not much evidence on the valuation of the PDLs by different sub-groups of the population. For instance, only one study by Damigos & Kaliampakos (2003) identified socio-economic factors (such as income and education level etc.) that had a significant impact on the overall valuation of the landscape and recreation impacts of the redevelopment of a quarry in Athens.

In summary, the values on external impacts derived from the literature are a valuable resource. However, no single high quality study is identified providing the full range of values for the different impacts being sought. Insufficient quantitative values are reported in the literature that could allow a rigorous meta-analysis. We therefore conclude that the present literature is insufficient to generate the values required for use in appraisal.

Proposed PDL typology

As part of this review a typology of previous uses of developed land was also developed, based on the outcomes of the literature review and analysis of the National Land Use Database (NLUD). The typology has considered the previous use and location characteristics of PDL sites.

Table 14: Proposed typology by PDL type and area type

PDL type (by previous use)	Predominantly Urban (Urban)	Urban with Significant Rural	Predominantly Rural (Rural)
Residential and Community			
Defence			
Industrial use			
Mineral workings/ quarries/refuse disposal			
Other (retail / recreation etc.)			
Vacant / derelict/ Unknown/ uncategorised			

This typology has been developed on the basis of our analysis of the available PDL stock; however, it is also recognised that it is important to ensure that the typology is capable of supporting analysis into key policy issues. We solicited input on proposed changes and none was forthcoming.

We also emphasise that this typology will need to be reviewed periodically to ensure that the typology covers the land use types and area types that could be needed in the future.

Recommendations for the quantitative research stage

On the basis of the literature and data review, we recommended that:

- A bespoke survey be developed to obtain the required values for restoring PDL to UDL.
- The typology developed could be used as a framework around which the values for the redevelopment on different forms of PDL can be based (subject to any revisions in light of additional requirements for policy analysis).
- The existing values and information derived from the literature review would provide essential inputs for the design of the new survey. The quantitative and qualitative findings from the literature review could also provide reference points for validation checks on any future values developed from new primary data collection.

Recommendations for the stated preference study

Any new survey should be designed to fill in the research gaps identified from the phase 1 of this study, more specifically:

- to measure the values of restoring PDL to UDL for different previous use and area types (set out in our proposed typology)
- to measure the external impacts of redevelopment of PDL: landscape, recreation, sense of community and accessibility.

Research method – Stated choice experiments survey

As part of our proposal, we recommended stated choice experiments as the method for the primary data collection. There are a few methodological and practical advantages of stated choice experiments compared to other valuation methods for valuing the external

impacts of redeveloping PDL. The UDL valuation report[14] suggested that in the literature of valuation of land type, both revealed preference (RP) and stated preference (SP) methods (including stated choice SC and contingent valuation CV approach) were found to be widely used.

The most commonly used revealed preference (RP) approach used for land valuation is hedonic pricing. This entails building a database of past property and land sales and regressing these against a range of explanatory variables to determine the impact that specific area characteristics may have in explaining differences in market values. For the purposes of this study it would be necessary to compare the value of properties in areas that have PDL sites present with those that do not. Whilst producing valuations that are clearly anchored to real market transactions, the approach is dependent upon identifying all characteristics which differ between properties in the two areas. If there are other systematic differences between properties, which are correlated to some extent with the presence of PDL, then the estimates being obtained will be biased. This is commonly referred to as omitted variable bias. Further, these data often lack socio-economic information on consumers (DCLG, 2010)[15], which may be vital for understanding and valuing the development of PDLs.

SP methods are not reliant on the availability of suitable revealed preference data as they derive valuations by eliciting consumer preferences in a hypothetical survey setting. This means that valuations both for different PDL types and sizes, as well as different external impacts can be developed in a consistent framework, in which socio-economic characteristics can also be collected. SP valuations of external impacts may be overestimates due to the hypothetical nature of the approach. However this can be mitigated to a certain extent by careful experimental design and comparison with existing valuations using RP methods from the literature.

While both SP methods (SC and CV) are recommended by The HM Treasury Green Book as methods appropriate to the valuation of non-market goods, Choice experiments are considered better suited to the research topic. Firstly, as required by the study brief, they allow valuations to be broken down into a range of component parts; in this case the separate external impacts (landscape, recreation, accessibility and sense of community), which are taken into account through the inclusion of a range of different attributes. In contrast, contingent valuation questions would tend not to allow the same level of disaggregation of the valuation into different dimensions of the benefits from development. Secondly, it is also evident from the findings of the literature review and our experience that contingent valuation approaches are more open to policy response biases (as the task which they are being asked to consider is simplified to such an extent that it is easy to provide responses that seek to influence policy in a particular direction).

[14] Valuing the external benefits of undeveloped land: main document, available at: http://webarchive.nationalarchives.gov.uk/20120919132719/http:/www.communities.gov.uk/documents/planningandbuilding/pdf/158136.pdf

[15] Valuing the benefits of regeneration, 2010, DCLG

Section 3 – Development of the stated choice experiment survey for data collection

This section presents:

- Development of the stated choice experiments and survey questionnaire
- Pilot survey and lessons learned from the pilot survey

Introduction

Phase 1 of this study has shown a lack of sufficient evidence for deriving values for restoring PDL and recommended a bespoke survey be undertaken to obtain the required values for the public benefits following from restoring PDL. A new survey has therefore been designed to:

- measure the values of restoring PDL to UDL for different previous use and area types
- ensure the description of the PDL characteristics in the choice experiment are consistent with the existing land use data (such as NLUD) so that the values from this study can be directly applied to the appraisal values calculation
- measure the external impacts of redevelopment of PDL: landscape, recreation, accessibility and sense of community
- ensure that the values obtained from this survey can be used in conjunction with the existing UDL values.

Below we set out our thinking around the survey design. The phase 1 findings (from both the literature review and the analysis of the NLUD data) informed both the methodological approach we adopt for the survey and provided important information for the survey design and analysis.

The existing evidence for UDL benefits is presented below in Table 15 (source: Eftec and Entec report[16]) and the land values recommended for policy appraisal. [17]

[16] Valuing the external benefits of undeveloped land: main document, available at: http://webarchive.nationalarchives.gov.uk/20120919132719/http:/www.communities.gov.uk/documents/planningandbuilding/pdf/158136.pdf

[17] Land value estimates for policy appraisal, available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/488041/Land_values_2015.pdf

Table 15: UDL land type and external benefits

Land type	Coverage of benefits (shaded cells)									£ /ha /yr (2001)	Present value r = 3.5% p=3 %
Urban Core Public space (City park)	R	L	E	C	H	A	T	A	S	£54,000	£10,800,000
Urban Fringe ('greenbelt')	R	L	E	C	H	A	T	A	S	£889	£177,800
Urban Fringe forested land	R	L	E	C	H	A	T	A	S	£2,700	£540,000
Rural forested land (amenity)	R	L	E	C	H	A	T	A	S	£6,626	£1,325,200
Agricultural land (extensive)	R	L	E	C	H	A	T	A	S	£3,150	£630,000
Agricultural land (intensive)	R	L	E	C	H	A	T	A	S	£103	£20,600
Natural and semi-natural land (Wetlands)	R	L	E	C	H	A	T	A	S	£6,616	£1,323,200

R= Recreation; L= Landscape; E= Ecology; C= Cultural Heritage; H= Hydrology; A= Air quality and climate; T= Tranquillity; A= Accessibility; S= Soil.

To ensure the values from this study be consistent with values of the UDL with the external benefits in the existing evidence, the design of the SC experiments has considered:

Land type: the land type of UDL can be mapped to three main categories: Urban, Urban Fringe (greenbelt and forested land) and Rural (rural, agriculture land and natural and semi-nature land). The PDL area type in the study (Urban, Urban with significantly rural and Rural) can be broadly matched to the UDL land type, although for urban with significant rural, and rural, there are different types of UDL which can be reflected by the different benefits in the land type.

Benefits: in this study, the external benefits (recreation, accessibility, landscape and sense of community) were incorporated in and measured using the SC experiment. The definition of these benefits was generally in line with the existing evidence of UDL values to ensure consistency.

Development of stated choice experiment

Revised PDL typology

The typology developed in Phase 1 was used to frame the design of the choice experiment. We revised the PDL typology slightly by splitting the residential and community previous use category and dropping the vacant/derelict category. The residential and community previous use types were separated as these could be viewed quite differently. We also dropped the vacant/derelict category and overlay that as an additional attribute in the experiment. The table below presents the revised PDL typology that was used to define the framework for the SC experiment design.

Table 16: Revised PDL typology

PDL type (by previous use)	Area type		
	Predominantly Urban	Urban with Significant Rural	Predominantly Rural
Housing			
Office, shop or business site			
Factory or industrial use			
Local authority site (school, hospital, council buildings)			
MOD barracks or airfield			
Quarry or landfill			

Selection of the PDL sites

The findings from the literature supported an approach in which the SC experiment was based around a series of described hypothetical PDL developments, rather than a real site in a specific location. This would allow differences in the nature of different PDL sites to be described and systematically explored between respondents, using attribute descriptions and images. In addition, the experiment can also explicitly describe the differences between the PDL types of interest (such as the size of the site, distance to home etc.).

Selection of the attributes and levels

In the SC experiments, we included attributes that described the characteristics of hypothetical PDL sites, including specific features of the PDL site, benefits of development and the cost associated with the restoring the PDL to UDL. Below Table 17 summarises the proposed list of the attributes.

Table 17: Proposed attributes to be included in the choice experiment

PDL features	External benefits of development	Cost
Previous use of PDL	Accessibility	Cost associated with development of PDLs
Size of the site	Landscape	
Distance away	Recreation	
Level of contamination	Sense of community	
Whether vacant or derelict		

The geographic area type was not included as an attribute in the choice experiment. The reason is that from the analysis of NLUD, the PDL site characteristics (such as area size, PDL types) did not vary significantly by different geographic area type. Although we found some clusters of previous use in different area types (for example, sites used for defence are mainly in rural areas), these types of PDL also exist in the other two geographic area types. Instead we used the area type information to define the survey sample composition by asking respondents to consider the PDL options in the area where they live. The survey data collection ensured that the sample adequately covers each of the area types (see section 4 on the data collection). In the modelling stage, the area type information was used as a segmentation variable to explore variation in PDL valuation by different geographic area type.

Attributes that describe the PDL features

It is likely that the public may place different values on restoring different types of previously developed land. We therefore included the attributes for PDL characteristics as shown in Table 18. Note that the attribute levels presented below reflected the final set of

the levels in the main survey data collection work. Some minor wording changes were made after the pilot survey which is summarised in the pilot survey analysis presented later in this section.

Six types of previous use were included in the experiment (as informed by the revised typology shown in Table 4) which were drawn from the literature review and NLUD data analysis. One advantage of using this approach was that the values estimated can then later be applied back to different sites in the database as part of the process of translating the values from the choice experiment to those appropriate for appraisal.

We derived the area size levels from our analysis of the NLUD data. This analysis showed that nearly half of the PDL sites have an area size below 0.5 ha. 18% of the PDL sites have an area size of 0.5 – 1ha, 25% of the sites have an area size of 1 – 5 ha. And the remaining 9% of the sites have an area size above 5 ha.

The literature review indicated that distance from the redevelopment site has a significant impact on the nearby property prices. For instance, Tonin and Turvani (2017) found that a 10% increase in the distance to contaminated site increases the nearby property sales price by 6.2% (ceteris parabus). Therefore, we suggested including a range of distances (up to 10 miles) to explore the impact of distance from the respondent's home location on their valuation. We used both travel time and distance measures to ensure that the distance terms were clear to respondents.

The literature review also suggested that the level of contamination is a significant consideration for the public for restoring PDL sites (Braden et al. 2004, Tonin and Turvani 2017). AMEC (2012) found that average property prices increased by 10.4% as a result of remediation of chemical works (land use unchanged). Tonin and Turvani (2017) found that completely remediated land increased nearby property sale price by 160%. The proposed attribute levels (shown in Table 3) reflected different levels of clean up required to remediate the PDL site: no contamination; needs contaminated materials to be removed from site; and land needs treating to remove contamination from soil. After the pilot survey, the attribute levels for the two levels that required treatment were modified slightly to emphasise that the treatments follow safe procedures and would not cause any other environmental concerns.

Table 18: Proposed PDL characteristics attributes

Levels	Attributes
	Previously developed land types
1	Buildings currently in use, but with permission to redevelop it
2	Buildings currently vacant, but usable
3	Buildings currently vacant, and derelict
4	Previous site with buildings demolished
	Previous Use
1	Housing
2	Office, shop or business site
3	Factory or industrial use
4	Local authority site (school, hospital, council buildings)
5	MOD barracks or airfield
6	Quarry or landfill
	Size of the land
1	0.25 ha

2	0.5 ha
3	1 ha
4	3 ha
4	5 ha
	distance from your house
1	next to where you live
2	around 1/4 mile away (0.4 kms, 5 minutes walk)
3	around 1/2 mile away (0.8 kms, 10 minutes walk)
4	around 1 mile away (1.6 kms, around 20 minutes walk, 2-3 minutes drive)
5	around 5 miles away (8 kms, 10 minutes drive)
6	around 10 miles away (16k ms, 20 minutes drive)
	Level of contamination
1	No contamination
2	Site currently contaminated. Restoring will include safely removing these materials from the site
3	Site currently contaminated. Restoring will include safely treating the soil to clean up the site

Attributes that describe the benefits of restoring PDL

We included attributes to describe the external benefits of the PDL developments, including those relating to improving landscape, accessibility, recreation and sense of community as shown in Table 19.

Overall, consideration has been given to ensure that the attribute levels:

- do not double count external benefits, for instance, separating or accounting for any correlation between the accessibility and recreation benefits.
- measure the value independently of any private benefits of developing on PDL (that will be measured separately by the Land Value Uplift). Specifically, we are interested in public's perceived benefits of restoring the PDL but not the potential land price change.

Landscape: Previous work on valuing undeveloped land[18] defined "landscape" as the fabric of the land into which development is placed, along with a constantly evolving entity fashioned by the development. In the literature review, landscape was depicted generally by two main categories: aesthetics improvement (Kim and Miller, 2017, Damigos 2003, 2011, EFTEC) and presence of greenspace or natural areas (De Souza 2006, Loure 2015). Aesthetics is defined as scenic beauty, increased tourism and visual amenity enhancement including the removal of the negative impact of blight and uncleanness in the previous literature. However we judged that the extent of the aesthetics benefit depends on the type of developed land (DL). Also the literature indicated that aesthetics features can be subjective (Carlson, 1977) and "should be assessed by experts" with knowledge on aesthetics qualities and landscape processes.

[18] <*Valuing the external benefits of undeveloped land: main document*>, as of 18 Jan 2019: http://webarchive.nationalarchives.gov.uk/20120919132719/http:/www.communities.gov.uk/documents/planningandbuilding/pdf/158136.pdf

The focus of this study was on the valuation of restoring PDL to UDL. Therefore, we determined the impact of landscape improvement by looking at the value that respondents would place on restoring different landscapes of PDL sites to UDL. The four levels of landscape attributes are proposed to be the PDL current status which were drawn from the NLUD definition: previously developed land and now vacant; vacant buildings; derelict land and buildings and previously developed land currently in use. For the UDL landscape, two levels were proposed to reflect the different types of the UDL: with landscaping features or trees (such as a city park) and no landscaping features (such as greenspace).

Recreation: referred to activities such as sport, leisure and tourism. [19] Future recreational use of the redevelopment of PDLs was widely covered in the existing literature. For instance, De Souse (2006) evaluated impacts of developing brownfields to green space and investigated public's preferences towards different recreational activities as part of the benefits. Using a contingent valuation approach, Damigos & Kaliampakos (2003) estimate landscape and recreation impacts of the redevelopment of a quarry in Athens. They analysed three alternatives with different levels of reforestation and recreational facilities. In the current study, we used different levels of recreational activities that the different types of UDL could provide, including: can't be used as recreational purpose (such as agriculture land), can walk, run, cycle around defined routes within the site (such as forested land, natural and semi-natural land etc.) and can fully access all of the site for sports or recreation (such as city park, greenspace etc.).

Accessibility: referred to the provision of green corridors that weave their way through the urban fabric, providing pedestrian and cycle routes. [20] Accessibility was clearly defined for greenspaces but potentially has a wider definition for PDL redevelopment. For example, Rodenberg et al. (2011) considered one of the objectives of the redevelopment alternatives was to eliminate the barrier effect of the ring road around Amsterdam. Zhang and Klenosky (2016) considered accessibility as connecting places and spaces such as access to recreational areas, playgrounds etc. In De Souze et al (2006) accessibility was measured as travelling through to get to another destination. To avoid double counting the impact of accessibility and recreation, we used the De Souze et al (2006) definition, which was travelling through to get to another destination.

Sense of community: this was not explicitly discussed in the previous work on valuing development on undeveloped land. In the literature on the sense of community (SoC), a four-dimension model[21] was used to define SoC (McMillian and Chavis, 1986, Perkins,

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[19] <*Valuing the external benefits of undeveloped land: main document*>, as of 18 Jan 2019: http://webarchive.nationalarchives.gov.uk/20120919132719/http:/www.communities.gov.uk/documents/planningandbuilding/pdf/158136.pdf

[20] <*Valuing the external benefits of undeveloped land: main document*>, as of 18 Jan 2019: http://webarchive.nationalarchives.gov.uk/20120919132719/http:/www.communities.gov.uk/documents/planningandbuilding/pdf/158136.pdf

[21] ***Membership*** corresponds to the feeling of being part of a community; this aspect embraces the perception of shared boundaries, common history, symbols, sense of emotional safety, and personal investment in community life. ***Influence*** encompasses the individual perception of mutual influence, not only providing opportunities for individuals to participate in community life, make their own contributions, and perceive their impacts on the collective decisions and actions of the community but also heightening individual awareness that personal choices and decisions are affected by the community itself. ***Fulfillment of needs*** represents the benefits that people derive from their community membership and refers to the positive relationship between individuals and their communities to the extent that the community helps its members meet their personal and group needs. Finally, ***shared emotional connection*** unveils the sharing of common repertoires, such as history and significant events, and strengthens the quality of social ties

1990): membership, influence, fulfilment of needs and shared emotional connection. A number of impacts reported in the literature could be considered to be related to sense of community, for instance, improved public areas and community facilities (Lanz & Provins, 2013, Greenberg & Lewis, 2000). However many of the aspects could be correlated with recreational use and /or accessibility and were heavily dependent upon the type of final development on the land.

It also appeared difficult to describe the sense of community in the way of (dis)benefits that respondents placed on the existing PDL sites referenced to the UDL (such as greenspace). We have thought about using crime or anti-social behaviour as a way to measure the (dis)benefits of the sense of community aspect of the PDL, as suggested at a project steering group meeting. However we judged that it might not be a direct measure for sense of community in the current research context.

Based on the national crime statistics[22] and previous literature, crime type and rates vary by different land types but more importantly by the socio-economic features of the neighbourhood (see the review by Greenberg et al. 1982[23]). For instance, in an early research paper, Brantingham (1971) observed that the most frequently burgled land uses were sports clubs, youth clubs, and restaurants. Phillips and Sandler (2015)[24] showed that public transit influences the spatial distribution of crime by affecting the transportation costs facing potential offenders. Han et al. (2013) found that the average income, unemployment rate and number of young people in the neighbourhood have a statistically significant role in explaining the crime rates for different types of crime in England and Wales. Therefore, PDL sites are likely to have similar challenges in terms of crime type or rates, as with the other types of land (UDL or DL).

In addition, the relationship between crime or anti-social behaviour and the land type is a broad research topic which involves the socio-economic characteristics of the neighbourhood as well as the geographic land type. We were slightly concerned that introducing this aspect into the choice experiment would introduce more complexity to the choice experiment and be out of the scope of the current research. We also suspect that introducing crime and anti-social behaviour into the choice experiment would make it an overly dominant attribute as we anticipated that the public would place a higher value on safety and security factors, which could detract from the other benefits brought by the redevelopment of the PDLs.

The valuation of sense of community largely depends on the final developed use and the nature of the development that is planned (and that falls outside the scope of our values and sits in those from the last study). However, we can see that there is some scope for sense of community gains in moving from PDL to an undeveloped site – and this seems to mainly come down to previously inaccessible sites becoming points for social interaction and their perceived utility to the wider community. The extent to which this materialises will obviously depend to some extent on the site's location, its size, and the perception that

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[22] As of 18 Jan 2019:
https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/datasets/crimeinenglandandwalesannualtrendanddemographictables

[23] Greenberg, Stephanie W., William M. Rohe, and Jay R. Williams. 1982. *Safe and secure neighborhoods: Physical characteristics and informal territorial control in high and low crime neighborhoods*. Washington, DC. National Institute of Justice.

[24] Phillips, D.C. , Sandler, D. , 2015. Does public transit spread crime? Evidence from temporary rail station closures. Reg. Sci. Urban Econ. 52, 13–26 .

people have of its quality and safety (and those in themselves will differ between types of undeveloped land).

Given that the experiment included aspects such as level of access through the site, and level of recreational availability of the site, we decided to add an additional attribute about its likely level of use by others, as shown in Table 19, to reflect the potential value of sense of community.

A constraint was put in the design such that this attribute was only presented if recreational use of the converted site was present.

None of these attribute levels implied anything beyond it being a form of undeveloped location (e.g. accessible private land, public park, forest, etc) but allowed us to capture positive gains that follow from opportunities for interaction and associated aspects of common value. These will help us to form the different UDL baseline types before then moving from these land types to final developed use.

Table 19: Proposed PDL attributes to reflect external benefits

Levels	Attributes
L	***Landscape***[25]
L1	Buildings currently in use, but with permission to redevelop it
L 2	Buildings currently vacant, but usable
L 3	Buildings currently vacant, and derelict
L 4	Previous site with buildings demolished
L 5	Restored to greenspace – no landscaping features or trees
L 6	Restored to greenspace – with landscaping
R	***Recreational use after development***
R1	No public access within the site
R2	Can walk, run, cycle around defined routes within the site
R3	Can fully access all of the site for sport or recreation
C	***Likely use by other people (Sense of Community)***
C1	Would be infrequently used by other people
C2	Would be frequently used by those from your area
C3	Would be frequently used by those from your area and attracts people from elsewhere
A	***Accessibility after the development***
A1	Can't pass through the site to other destinations
A2	Can walk, run or cycle through the site to other destinations

Attributes that describe the monetary cost

Lastly, we included the **monetary cost** of improving any of the described scenarios to undeveloped land. It was essential to include a monetary cost attribute in the experiments to be able to calculate valuations. An important consideration here was the payment vehicle to use for the task. The costs should be presented in a way that is credible to respondents and applies equally to all in the sample.

Lanz and Provins (2013) used an increase in council tax (£ per year) to measure the preference for spatial provision of local environment improvements in the context of

[25] Note that the levels 1 to 4 are the landscape of the PDL in the second choice option, whilst the levels 5 and 6 are for the landscape after restoring the PDL to UDL.

regeneration policies. The payment ranged from £0 to £30 per year for measuring the PDL redevelopment. In a pilot study by Cambridge Economic Associates et al (2010), additional council tax (on top of the current council tax) was used to account for the improvements to the local environment to be maintained and to be continually provided each year. The cost ranged from £0 to £50 per year (in addition to current tax levels). Damigos & Kaliampakos (2003) used a contingent valuation (CV) approach to estimate landscape and recreation impacts of the redevelopment of a quarry in Athens. The payment method included was the maximum one-off payment respondents would be willing to pay for reclaiming the site.

Based on the review of previous literature, we suggested that the most appropriate vehicle to use for the experiment was council tax. In the choice scenarios, respondents were asked to consider paying different amounts of additional council tax in order to return different types of PDL to undeveloped land. Initially we presented monthly payments within a range of £0.00 to £5.00 per month (£0 - £60 per year if council tax is paid in 12 instalments). After the pilot survey, we reviewed and refined the level of the cost attributes and increase the highest band to £10 per month per household. .

Table 20: Proposed PDL attributes – monetary cost

	Cost for restoring and maintaining the (on top of council tax)
1	£0.00 per month (£0.00 per year)
2	£1.00 per month (£12.00 per year)
3	£2.00 per month (£24.00 per year)
4	£5.00 per month (£60.00 per year)
5	£10.00 per month (£120.00 per year)

Choice examples

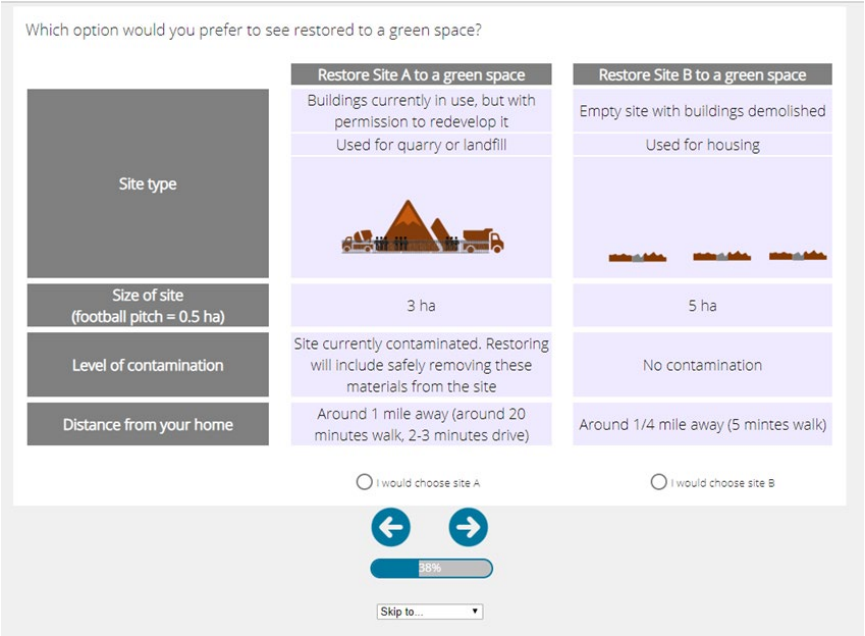
The survey incorporated two stated choice (SC) experiments. The first was designed to establish the relative weight placed on different PDL characteristics to restore PDL to UDL. The second was designed to examine, contingent on other information being provided, the valuation of the development of different types of PDL considering other external benefits.

SC 1: Binary SC – to measure the weight placed on different characteristics of PDL for decisions to convert PDL to UDL

In the first SC experiment respondents were asked to choose between two different PDL areas and indicate which they would prefer to see returned to undeveloped land. The options for the PDL areas were derived from combinations of the attribute levels shown in Table 18 and Table 19. This experiment was designed to measure the relative preferences for different attribute levels of PDLs. An example of choice scenario is shown in Figure 2. After the pilot survey, we updated the introduction of the SC1 experiment to emphasise that the PDL will be redeveloped to a greenspace to ensure that the values obtained from this experiment reflect the benefits/dis- benefits of redevelopment of PDL to UDL. Each respondent was asked to consider five different scenarios in which the characteristics of the PDLs that they are asked to compare are varied. The first SC experiment allowed us to provide estimates for coefficients for:

- all the key PDL characteristics for different type of PDLs,
- allowing testing how the attribute weights vary across different land type of PDLs of interest,
- as well as allowing testing how the attribute weights vary across socio-demographic groups.

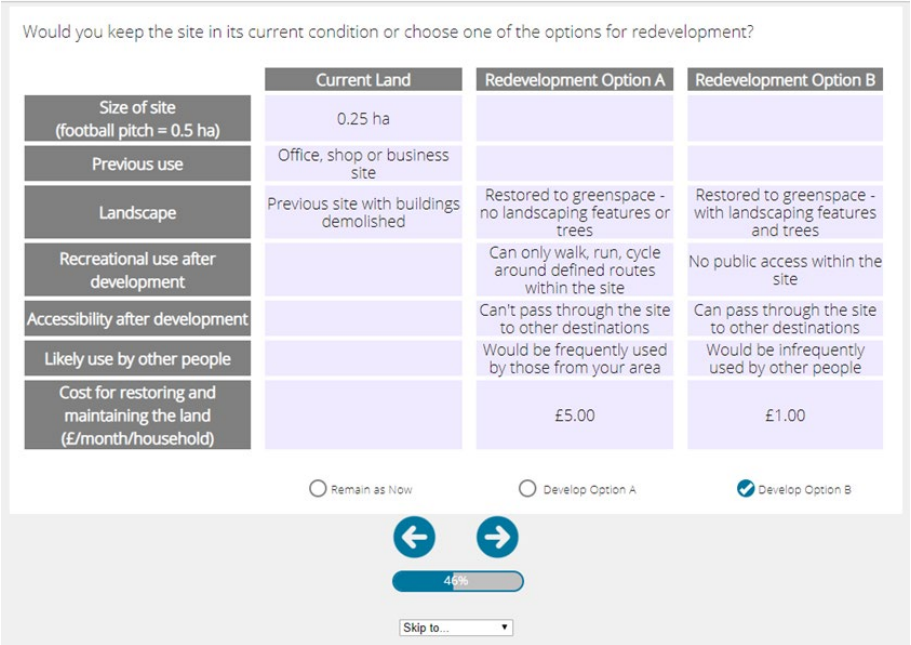
Figure 2: Example of the first choice experiment



SC 2: Multiple option choices - to measure the value associated with developing a PDL, and assign monetary cost to the PDL attributes

A second experiment was used to examine the willingness to pay (value of overall external benefits) for restoring different types of PDL by respondents. This experiment allowed us to calculate monetary valuations for the coefficient weights. This experiment consisted of a choice between keeping the current PDL site and two restoring options, each with an associated cost to the individual. As respondents were familiarised with the different type of PDLs through the first SC, they were able to compare the different PDL development plans and make their choice around the PDL development. Each respondent is asked to complete five choices in this experiment. Figure 3 shows an example of the layout of the second SC experiment.

Figure 3: Example of the second choice experiment



Size of site, previous use and landscape/PDL type were retained in both of the SC experiments, which were used to link these two experiments in the combined model estimation.

In addition, in the introduction of the second experiment, we included a description of the distance and level of contamination of the PDL to avoid respondents making different assumptions on these aspects that may lead to the different valuations of the land. For the pilot, the description was *"Please imaging that the site would be around 0.5 miles from your home (0.8km and around 10 minutes walk) and would need contaminated materials to be removed from the site as part of the redevelopment*." In the main survey, the description of the contamination was modified to be "No contamination" to exclude any issues with contamination.

The choices obtained from the second experiment were used to calculate the value of external benefits and provide insights into the impact of socio-demographic characteristics on the valuation of the PDL development, for instance, whether older people or people were more likely to have higher WTP for the PDL developments.

A statistical experimental design determined the combinations of attribute levels to present to each respondent in each choice experiment. The design was specified to allow the main effects of each attribute to be estimated independently, and constraints were imposed to ensure that combinations of attribute levels that are logically inconsistent are not presented together. We used the Ngene[26] experimental design software to develop these designs.

Design of the questionnaire

In addition to the SC experiments, the survey included questions to collect information on respondents' current experience of PDL and PDL development. More specifically, if respondents live or lived close to a PDL site, what is/was the distance between the PDL site and their home, the size of the PDL site, their experience with the PDL etc.

After the choice experiments, the survey collected respondents attitudes towards PDL development related issues as well as questions on the demographic and socio economic characteristics of respondents and their households. The main survey questionnaire is included in Appendix B.

Pilot Survey

The survey questionnaire and the choice experiments were tested through a pilot survey in December 2018. The detailed pilot survey analysis is presented in the earlier separate note.

The pilot survey was undertaken (with the sample provided by an online panel company) across England during December 2018. The initial sample size for the pilot was to be split by different area types, more specifically, 35 in predominantly urban, 35 in urban with rural and 30 in predominantly rural. However we found it challenging to capture in-scope

[26] ChoiceMetrics. *Ngene 1.2 User Manual and Reference Guide*. ChoiceMetrics; 2018. Available at: http://www.choice-metrics.com/NgeneManual120.pdf

respondents in the urban with rural area in the pilot stage. This was mainly because of the low incidence in the population (13%) living in an urban fringe area.[27]

Table 21: Pilot survey sample size

	Number of interviews (target)	Number of interviews (achieved)
Predominantly urban [Urban core]	35	51
Urban with significant rural [Urban fringe]	35	17
Predominantly rural [Rural area]	30	33
Total	**100**	**101**

The questionnaire took an average of 14 minutes to complete which was in line with expectations.

Lessons learnt from pilot survey

The pilot survey analysis indicated that the survey design and questionnaire were generally working as intended, but the recruitment of the respondents in the "urban with significantly rural" areas was challenging. Most of the respondents (93 per cent) could understand and answer the choice experiment questions.

As a result of the pilot survey, a few changes were made to the main survey:

- Survey recruitment: During the pilot survey we experienced challenges to achieve sufficient sample for the area type of "urban with significantly rural".[28] For the main survey, we therefore set out to use our best endeavours to achieve to the original targets as close as possible, but anticipated that it could be necessary to relax the targets slightly in the course of the data collection.
- For the SC experiments design, the following changes were made:
    - In the SP1 introduction, we emphasised that the PDL will be redeveloped to a greenspace to ensure that the values obtained from this experiment reflect the benefits/dis- benefits of redevelopment of PDL to UDL.
    - In the SP2 introduction, the introduction of the PDL site was changed to be "*Please imagine this is an uncontaminated site which would be around 0.5 miles from your home (0.8km and around 10 minutes walk)"* to exclude any issues around contamination.
    - On the levels for the contamination attribute, the wording was updated to emphases that the clean-up of the site will be in a safe way to minimise any concerns respondents may have on this issue.
    - On the cost levels, the highest cost level was increased to £10/month to allow exploration of a wider range of willingness to pay.

[27] See: https://www.gov.uk/government/statistics/2011-rural-urban-classification-of-local-authority-and-other-higher-level-geographies-for-statistical-purposes

[28] This is partly due to the smaller population in these areas. In the 2011 Census, the population split for urban with significant rural area is 13% (available at: https://www.gov.uk/government/statistics/2011-rural-urban-classification-of-local-authority-and-other-higher-level-geographies-for-statistical-purposes).

Section 4 – Main survey data analysis

This section presents:

- The main survey data collection work
- Main survey sample description and background questions analysis
- The findings of the choice experiment and the comparison with the previous evidence
- The consumer surplus values calculated from the model analysis.

Introduction

This section sets out the main survey data collection and the data analysis. We first report the main survey data collection and a description of the sample. We then present the findings from the discrete choice modelling analysis, and what they tell us about the preferences of the general public in England on the restoring of PDL sites. Finally, we present consumer surplus values which can be used in future appraisals.

Main Survey field work and descriptive analysis

An online survey approach was adopted as it allowed us to reach a geographically dispersed population, which was done by collecting postcodes and using ONS definitions for different area types by means of a look-up table. At the beginning of the survey, respondents were asked to provide their postcode. Based on the ONS rurality classification, respondents were classified by area type and region. Quotas were set on area type. Minimum quotas were also set on age and gender to ensure that the sample was broadly representative of the adult population in England. We emphasise that the quotas were specified at the national level, not the area level.

Table 22: Main survey quotas (n=2400)

Category	Band	Quotas (%)
Gender	Male	45-55%
	Female	45-55%
Age	18 – 24 years	10-20%
	25 – 44 years	29-39%
	45 – 64 years	26-36%
	65 and older	15-25%

Table 23 sets out the distribution of interviews obtained across area types.

Table 23: Main survey sample size and distribution across area types

Area type	Number of interviews (main – phase 3)
Predominantly urban [Urban core]	1,254
Urban with significant rural [Urban fringe]	545
Predominantly rural [Rural area]	601
Total	**2,400**

Similarly to the pilot survey, we experienced challenges in achieving sufficient sample for the area type “urban with significant rural”. This was mainly due to the small proportion of

population living in this area type (13 per cent, as shown in Table 24). Consequently, the quotas were relaxed during the main stage.

Table 24: Main survey quotas

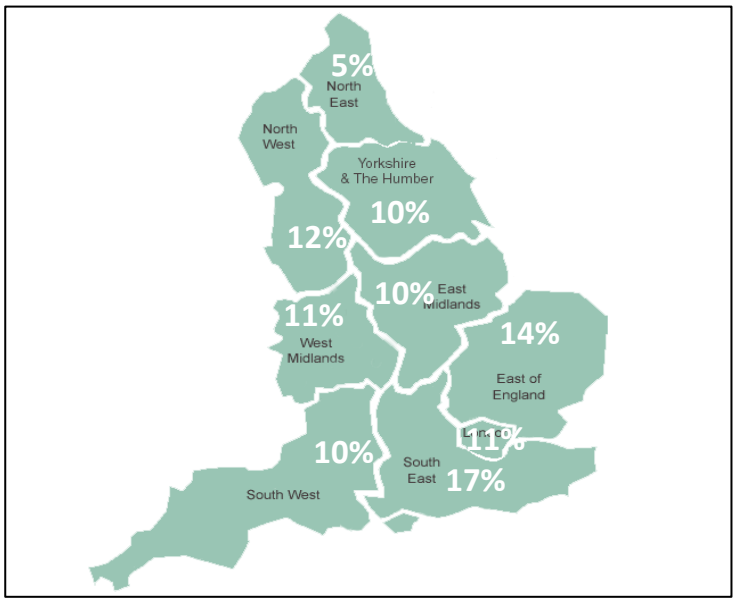
	Initial target proportion of interviews	Proportion of PDL sites (NLUD data)	Population (2011 census)	Final sample
Predominantly urban [Urban core]	42%	56%	66%	52%
Urban with significant rural [Urban fringe]	33%	16%	13%	21%
Predominantly rural [Rural area]	25%	28%	21%	27%
Total	**2,400**	**100%**	**100%**	**2,400**

Sample composition and socio - economic characteristics

We analysed the sample composition and characteristics at the overall level and the split between the three area types (urban, urban with significant rural and rural). Table 25 summarises the sample socio-economic characteristics split by area types.

The sample covered all regions of England. Figures 1 shows the geographical distribution of surveys.

Figure 4: Geographic locations of the overall sample (n = 2400)



The sample achieved a fairly even split between males and females, and a spread of different age groups with variations in areas. The unweighted sample showed the following splits across the 2,400 participants:

- Just over half of the participants (53%) were female[29]
- Despite the overall sample being fairly evenly split by gender (47 per cent male and 53 per cent female) 60 per cent of our urban sample are female and 58 per cent of our rural sample are male,

[29] ONS mid-year population estimates indicate female population is 51% nationally (available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland)

- Approximately half (49%) of the respondents were aged 35 to 64.
- We observed higher proportion of the younger people in the urban area (44 per cent in urban vs 16 per cent in urban with significant rural and 15 per cent in rural areas). Conversely, we observed fewer respondents aged 65 and above (7 percent) in urban areas compared to urban with significant rural (over 30 percent) and rural areas (around 40 percent).

Table 25: Distribution of key variables by area type in the main survey sample (n = 2,400)

Age	Total (%)	Urban (%) n=1,254	Urban with significant rural (%) n=545	Rural (%) n=601
1 18 - 24 years	11.8	16.6	7.2	6.2
2 25 - 34 years	18.5	27.1	9.2	8.8
3 35 - 44 years	17.9	23.1	13.6	11.0
4 45 - 54 years	16.8	16.7	19.5	14.8
5 55 - 64 years	14.5	9.4	20.6	19.5
6 65 - 74 years	15.8	6.0	23.7	29.1
7 75 years or older	4.8	1.2	6.4	10.7
Gender				
1 Male	47.2	39.6	52.7	58.1
2 Female	52.8	60.29	47.3	41.9
Region				
1 North East	4.9	4.8	2.2	7.5
2 North West	12.1	14	16.7	4.2
3 Yorkshire and The Humber	10	13	8.1	5.7
4 East Midlands	9.5	8.1	5.1	16.5
5 West Midlands	10.7	13.2	9	7
6 East of England	13.8	6.5	22.2	21.3
7 London	11.3	21.7	0	0
8 South East	17.2	13	29.7	14.6
9 South West	10.5	5.8	7	23.3

For **employment status and education level**:

- Over half were working either full-time (42%) or part-time (15%) however, when analysed for those of working age we see that the employment proportion for those aged 18 – 64 in the sample is 69.2 per cent[30], whilst the 2019 UK employment rate is 76.1 per cent for those aged 16-64[31],
- 31 per cent of rural respondents and 41 per cent of urban with significant rural respondents are retired, but just 8.5 per cent of urban respondents are. This coincides with the age split by the area type as shown above.
- Over one third of respondents hold a degree or above.

Other demographic questions answered by the participants included household annual income, whether participants hold a degree or above, their marital status and ethnicity.

[30] Our sample covered respondents aged from 18 to 75 and plus. For a like-for-like comparison, we only calculated the proportion of employed respondents over those aged 18 to 64.
[31] 2019 UK employment rate for those aged 16-64 years is estimated at 76.1% (available at https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/bulletins/uklabourmarket/may2019).

Table 26: Distribution of socio-economic characteristics by area type (n = 2,400)

Current employment status	Total (%)	Urban (%) n=1,254	Urban with significant rural (%) n=545	Rural (%) n=601
1 In full-time paid work (or away temporarily)	42	51.4	32.7	30.8
2 In part-time paid work (or away temporarily)	15	16	15.6	12.5
3 In education, (not paid for by employer) even if on vacation	4.1	6	2.9	1.3
4 Unemployed and actively looking for a job	3.7	4.4	3.3	2.7
5 Unemployed, wanting a job but not actively looking	1.4	1.3	1.7	1.3
6 Permanently sick or disabled	4.2	3.7	5	4.7
7 Retired	21.9	8.5	31.4	41.1
8 Doing housework, looking after children or other persons	6.7	7.7	6.8	4.7
9 Other, please describe	0.8	0.6	0.7	1
10 Don't know	0.3	0.5	0	0
Education level				
1 No formal qualifications	4.7	3.4	7.5	4.7
2 GCSE (or CSE) / O level / School Certificate	23.8	22.9	22.4	26.8
3 'A' levels or equivalent	23.5	24.6	23.7	21
4 Professional qualification below degree level	13.2	10.1	16.9	16.3
5 Bachelor's degree level qualification or equivalent	26.6	29.8	22	24.1
6 Higher degree	7.3	8.3	6.8	5.7
7 Other, please describe	1	1	0.7	1.5
Marital status				
1 Married or in a civil partnership	55.4	50.9	58	62.4
2 Separated (still legally married or still in a civil partnership)	2	1.9	2	2
3 Divorced / Formerly in a civil partnership, now legally dissolved	8.5	6.9	9.2	11.3
4 Widowed / Formerly in a civil partnership, partner died	2.7	1.4	4.8	3.5
5 Single, that is, never married AND never in a civil partnership	30.1	37.6	24.4	19.8
6 Prefer not to say	1.3	1.4	1.7	1
Household income				
1 Up to £9,499	7.7	9.1	7.3	5.2
2 £9,500 - £15,499	11.5	10.1	12.8	13.1
3 £15,500 - £24,999	20.6	18.9	20.4	24.3
4 £25,000 - £34,999	19.8	21.1	16.7	20
5 £35,000 - £49,999	18.5	18.5	19.1	17.8
6 £50,000 - £74,999	12	13.2	11	10.5
7 £75,000+	4.7	4.8	5.3	3.8
8 Prefer not to say	5.3	4.3	7.3	5.3
Ethnicity				
1 White	90.2	83.8	96.9	97.3
2 Black or Black British	2.9	5.3	0	0.3
3 Asian or Asian British	3.7	6.5	0.6	0.5
4 Chinese	0.7	1.1	0	0.5
5 Mixed	1.8	2.5	1.7	0.3
6 Other	0.8	0.7	0.9	1

For **tenure:**

- More than half (56%) of the sample own their property outright or with a mortgage. This is slightly lower than measured in government home ownership statistics[32] (63% in England in home ownership).
- A lower proportion of urban residents own their own home outright (20 per cent) and a much higher proportion privately rent (27 per cent), compared to other area types.
- Nearly 60 per cent have lived at their current accommodation for over 5 years. At least two thirds of rural and urban with significant rural respondents report being in their home for at least five years, compared to under half for urban residents.

Table 27: Distribution of tenure characteristics by area type (n = 2,400)

Tenure	Total (%)	Urban (%) n=1,254	Urban with significant rural (%) n=545	Rural (%) n=601
1 Own it outright	31.5	19.5	43.5	45.9
2 Own it with a mortgage/loan	24.4	26.8	21.1	22.3
3 Part own and part rent (shared ownership)	1.5	2.2	1.1	0.5
4 Rent it (private renting)	20.7	27	14.9	13
5 Rent it (social renting including those who are on House Benefits or Local Housing Allowance)	15.9	17.4	15.1	13.5
6 Live here rent-free (including rent-free in relative's/friend's property but excluding squatters)	5	6	3.7	4.3
7 Other, please describe	0.5	0.7	0.4	0.3
8 Don't know	0.4	0.6	0.4	0.2
Length of stay in the current accommodation				
1 Less than 1 year	9.1	12.6	5.9	4.7
2 1 - 3 years	18.6	23.2	15.8	11.5
3 3 - 5 years	13.7	15.8	10.6	12
4 Longer than 5 years	58.7	48.4	67.7	71.9

Just under a third (30%) of participants reported having a physical or mental impairment, which limits daily activities or work they can do. This is higher than measured in Census data[33] (18 per cent of the UK population reported having a limiting long-term health problem or disability in 2011 census).

[32] Home ownership statistics (2018). Available at: https://www.ethnicity-facts-figures.service.gov.uk/housing/owning-and-renting/home-ownership/latest

[33] 2011 Census: Key statistics and quick statistics for local authorities in the United Kingdom, Defining characteristics of the UK population on the topics of population, ethnic group, country of birth, health and housing and accommodation, published by Office for National Statistics, available at: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/keystatisticsandquickstatisticsforlocalauthoritiesintheunitedkingdom/2013-10-11

Table 28: Distribution reported impairment and membership by area type (n = 2,400)

Physical or mental impairment (including those age-related)	Total (%)	Urban (%) n=1,254	Urban with significant rural (%) n=545	Rural (%) n=601
1 No, none	69.9	73.4	66.8	65.6
2 Mobility impairment	11.6	8.3	14.5	15.8
3 Visual impairment	3.1	2.8	3.5	3.3
4 Hearing impairment	3.7	2.5	3.9	6.2
5 Learning disability	1.9	2.5	1.3	1.2
6 Mental health condition	10.4	10.9	11.2	8.5
7 Serious long term illness	5.8	4.3	6.6	8.3
8 Other	1.4	1	1.7	1.8
9 Prefer not to say	2.4	2.3	2.4	2.5
Membership of environmental groups				
1 The National Trust	19	17.8	17.3	23.3
2 English Heritage	7.8	8.5	6.8	7
3 The Wildlife Trusts	8.2	10	5.9	6.5
4 Friends of the Earth	4.5	5.3	2.9	4.2
5 Keep Britain Tidy	4.7	6.1	2.2	4
6 Campaign to Protect Rural England (CPRE)	1.9	2.2	1.3	1.7
7 Energy Saving Trust	1.8	2.8	0.9	0.3
8 Others	2.4	1.3	2.9	4.2
9 None	68.8	68.1	73.4	66.1

Sample current experience with PDL and redevelopment of PDL

Table 29 presents respondents' current experiences of PDL. Only 1,346 respondents have experience of PDL (although all subsequent analysis is based on the 2,400 completed responses). Of these respondents, 733 were from predominantly urban areas (59 per cent of the total respondents in urban area), 296 were from urban with significant rural (54 per cent of the respondents in urban with rural area) and 317 were from predominantly rural areas (53 per cent of the respondents in rural area). To summarise the findings:

- 56 per cent of the respondents that completed the survey currently live or have previously lived near a brownfield site.
- Among those with experience of living near PDL (n = 1,346), the previous use of the sites were mainly for business and industrial, residential and community purposes.
- Just under 30 per cent of the sites either were redeveloped or were currently being redeveloped.
- Two thirds of the sites were 5 ha (hectares) or less in area size.
- Nearly 90 per cent of the sites were 1 mile or less to the respondents' home.
- Nearly 80 per cent of them were visible to the respondents either from their home or travelling to or from their home.
- In urban areas, the previous use of PDL sites is more frequently reported to be residential but less frequently reported to be business and industrial.
- A greater proportion of PDL land was either currently being redeveloped or had previously been redeveloped in rural and urban with significant rural areas, compared to urban areas.
- In rural areas, 19 per cent of PDL sites were over 5 ha in size, but just 11 per cent were in urban areas.

Table 29: Current experience of PDL by area type

Lived or live near a brownfield site	Total (%) n=1,346	Urban (%) n=733	Urban with significant rural (%) n=296	Rural (%) n=317
1 Yes, I currently live near a brownfield site / a few brownfield sites	34.1	34.1	33.6	34.6
2 Yes, I have previously lived near a brownfield site / a few brownfield sites	22	24.3	20.7	18.1
3 No, I have not ever lived near a brownfield site	43.9	41.6	45.7	47.3
Previous use (n= 1,346)				
1 Residential	24.5	31.8	13.9	17.7
2 Community (e.g. old schools or hospitals)	14	15.4	13.5	11.4
3 Defence	4.4	3.6	4.7	6
4 Business and industrial sites	37.2	31	43.9	45.1
5 Quarries and landfill	5.1	4.8	4.7	6.3
6 Retail and recreation	8	7.6	10.8	6
7 Don't know	6.8	5.9	8.5	7.6
Previously developed land type (n= 1,346)				
1 Still in use	13.2	16.8	8.2	9.8
2 Vacant, but usable	18.9	21.2	17.4	14.9
3 Vacant and derelict	22.9	21.8	25.6	22.6
4 Previous site with buildings demolished	10.9	10.8	10.7	11.5
5 Redeveloped or currently being redeveloped	29.6	23.7	34.7	38.5
6 Don't know	4.5	5.7	3.5	2.7
Size of the site (n= 1,346)				
1 0 - 0.5 ha	11.4	12.1	10.8	10.4
2 0.5 - 1 ha	24.5	29.1	17.9	20.2
3 1 - 5 ha	31.1	30.6	33.5	30.3
4 Over 5 ha	13.9	11.2	15.2	18.9
5 Don't know	19	17.1	22.6	20.2
Distance to your home (n= 1,346)				
1 Next to our home	10.3	10.5	12.2	8.2
2 Around ¼ mile away (0.4 kms, 5 minutes walk)	31	33.2	27.4	29.3
3 Around ½ mile away (0.8 kms, 10 minutes walk)	27.3	27.8	26.7	26.5
4 Around 1 mile away (1.6 kms, 20 minutes walk, 2-3 minutes driving)	20.6	18.6	21	24.9
5 Around 5 miles away (8 kms, 10 minutes driving)	7.1	5.7	9.8	7.9
6 Longer than 5 miles away (8 kms)	1.6	1.6	1.4	1.6
7 Don’t know	2.2	2.6	1.7	1.6
If the site is/was visible from your home or travelling to / from your home (n= 1,346)				
1 Yes, it is/was visible from your home	25.4	28.9	21	21.5
2 It is/was not visible from your home, but it is/was visible travelling to / from your home	54.2	52	57.4	56.2
3 No, it is/was neither visible from your home, nor travelling to / from your home	19.4	18	21	21.1
4 Don't know	1	1.1	0.7	1.3

We observed variation in sense of community by area type

In order to create an indicator of respondents' sense of community, we calculated the sense of community index.[34] This measure is created using the responses to a series of 12 statements about aspects of the local community.

1. I think my neighbourhood is a good place for me to live
2. People in this neighbourhood do not share the same values as me
3. My neighbours and I want the same thing from this neighbourhood
4. I can recognize most of the people who live in my neighbourhood
5. I feel at home in this neighbourhood
6. Very few of my neighbours know me
7. I care about what my neighbours think about my actions
8. I have almost no influence over what this neighbourhood is like
9. If there is a problem in this neighbourhood people who live here can get it solved
10. It is important to me to live in this particular neighbourhood
11. The people who live in this neighbourhood get along well.
12. I expect to live in this neighbourhood for a long time

Respondents were asked to rate to what extent they agree with statements according to the following scale: completely disagree, disagree, neutral, agree or completely agree. The theory behind the sense of community index stems from the work of Mcmillan and Chavis.[35] The method itself, using the 12-item scale, was developed by Community Science.[36] The method is:

- If respondents answered either "agree" or "completely agree" to positively phrased statements then we coded this as a 1
- and 0 if they answered otherwise.

For negatively phrased statements, we coded a 1 if they answered "completely disagree" or "disagree" and 0 if they answered otherwise. The scores are then added together across all 12 statements, with a higher score (the maximum score is 12) indicating a greater sense of community. The statements can also be categorised into four subgroups, each measuring different aspects of community:

- Membership: Emotional safety and sense of belonging to the larger collective
- Influence: The ability of an individual and the community to affect change in one another
- Fulfilment of needs: Individuals get their needs met through cooperative community support
- Emotional Connection: Emotional support received from community living.

Not a single respondent scored a 12. The average score was 5.65. Rural respondents have the highest average score at 6.5, followed by urban with significant rural at 5.88. Urban respondents appear to have the lowest sense of community, with an average score of just 5.12.

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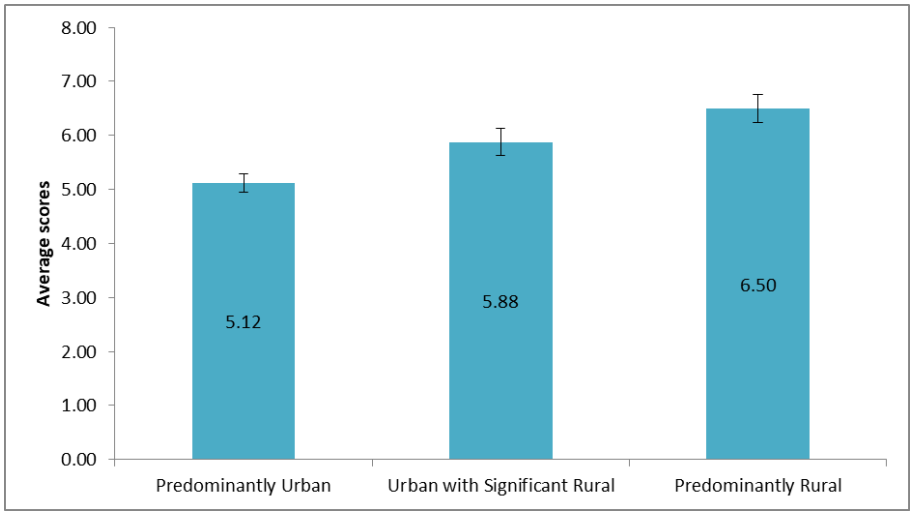
[34] Sense of Community Index (homepage). 2019. As of 21 May 2019: https://www.senseofcommunity.com/soc-index/

[35] McMillan, David & David Chavis. 1986. 'Sense of community: A definition and theory.' *Journal of community psychology* 14(1):6-23.

[36] Community Science. 2019. 'Measuring Sense of Community.' As of 21 May 2019: http://www.communityscience.com/news-detail.php?news=114

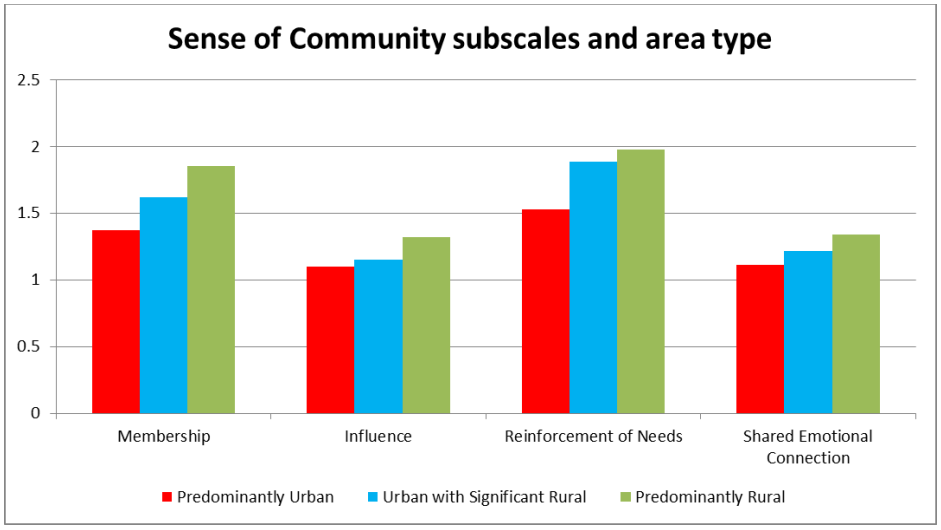
Figure 5: Average Sense of Community Index score by area type



Note: Error bars reflect 95 per cent confidence intervals

Similar patterns were shown when we break down the index into its subgroups. Rural residents score the highest for each of the four subgroups, followed by urban with significant rural, with urban residents scoring the lowest. Interestingly, we also found that for all area types the "Membership" and "Reinforcement of needs" subgroups had a higher average score than the "Influence" and "Shared emotional connection" subgroups. We cannot find any available evidence for comparison.

Figure 6: Sense of Community Index breakdown by area-types

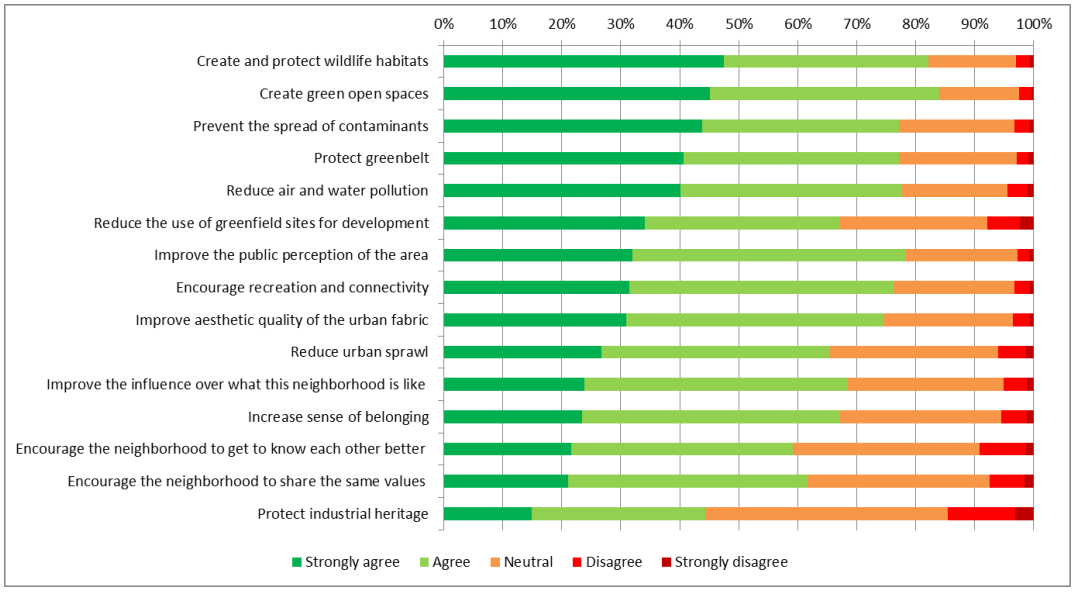


Respondents tend to agree that benefits accrue from restoring PDL

We examined respondents' attitudes towards the benefits of redeveloping PDL. Figure 7 shows that most of the respondents (over 70 per cent) agree with the statements on the environmental, landscape and recreational benefits. 82 per cent selected "agree" or "strongly agree" to statements about creating green open spaces and creating and protecting wildlife habitats.

Respondents also thought there were benefits to the community, although the percent for “agree” and “strongly agree” is slightly lower than other benefits. The only statement that most people do not “agree” or “strongly agree” with (only 44 per cent) is about protecting industrial heritage.

Figure 7: Respondents’ perceived benefits of redevelopment of PDL



The reported frequency of use of greenspace is relatively low, although most people use it at some time

In the survey people were also asked how frequently they participate in various activities using public green spaces. Figure 8 shows the reported frequency of using greenspace for recreational activities. Overall, the frequency is relatively low, although most use it at some time.

We then further categorised the activities to five groups: walking, relaxing, using children playground, exercises and other activity type and undertake the analysis by different area types. Also we grouped the frequency by regularly (at least once a week and a few times a week), less regularly and never to better shown the comparison.

People living in urban areas used greenspace more regularly for exercise and use children’s playgrounds compared to rural and urban with significant rural residents, as shown in Figure 9.

We analysed other activities and found a similar, but weaker pattern. On average, urban residents were more likely to engage in an activity regularly and less likely to never engage. Examples of ‘other’ activities include walking, relaxing and fishing.

Figure 8: Respondents' reported frequency of using the greenspace for recreational activity

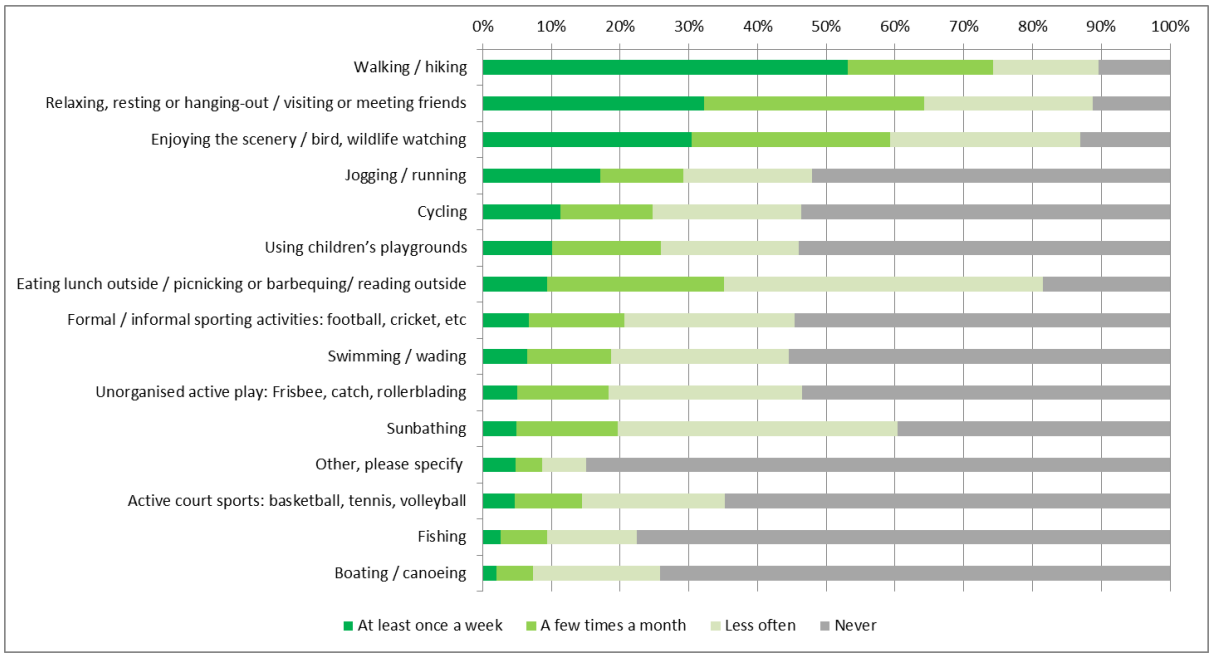
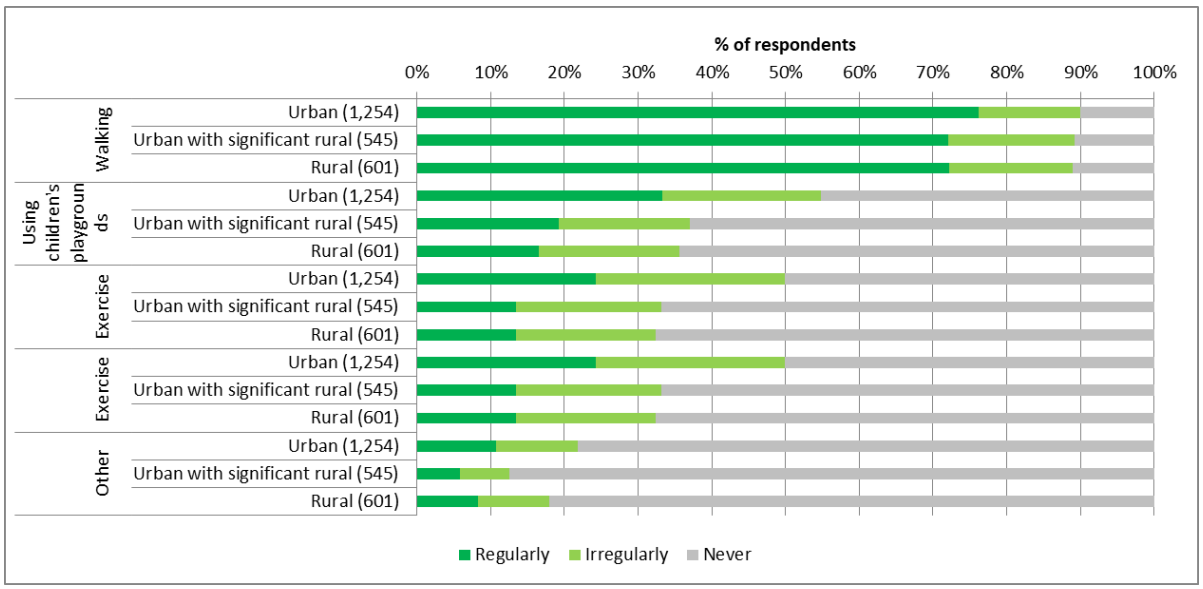


Figure 9: Respondents' reported frequency of using the greenspace for recreational activity, by area type



Respondents' engagement with the survey and understanding of the choice experiment

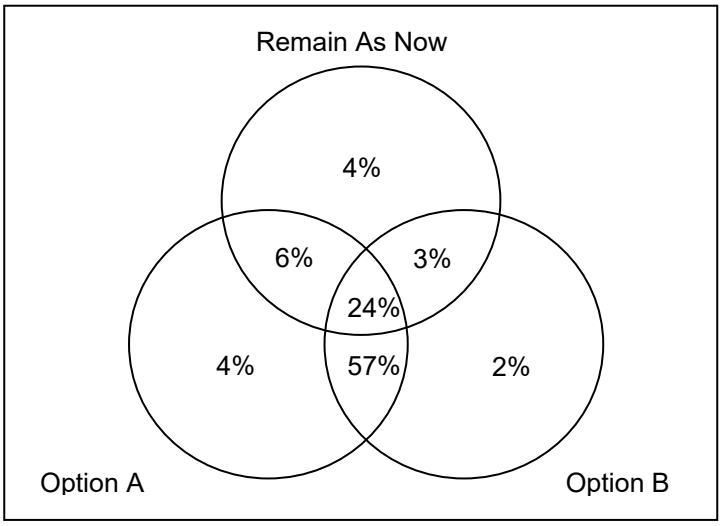
TRADING ANALYSIS

One way of measuring how engaged respondents were in the survey is to look at whether they chose different options in the choice experiment, which indicated that their choices were sensitive to the attribute levels being presented to them. We called this 'trading behaviour'.

The trading behaviour for the second choice experiment is shown in the Venn diagram in Figure 10. Across the 5 choices offered, 4% of respondents always selected the "Remain as now" option, regardless of the choices on offer, whereas 57% of respondents always chose one of the redevelopment options across all 5 choices. In total, 33% of respondents switched between choosing "Remain as now" and the redevelopment options in their choices, contingent upon the specification of the redevelopment options.

This behaviour is encouraging as it showed that the attribute combinations being presented in the choices lead to differences in choice behaviour. This suggested that the relevant choice space was being investigated, and the data being collected allowed an understanding of how these attribute levels influenced choice behaviour.

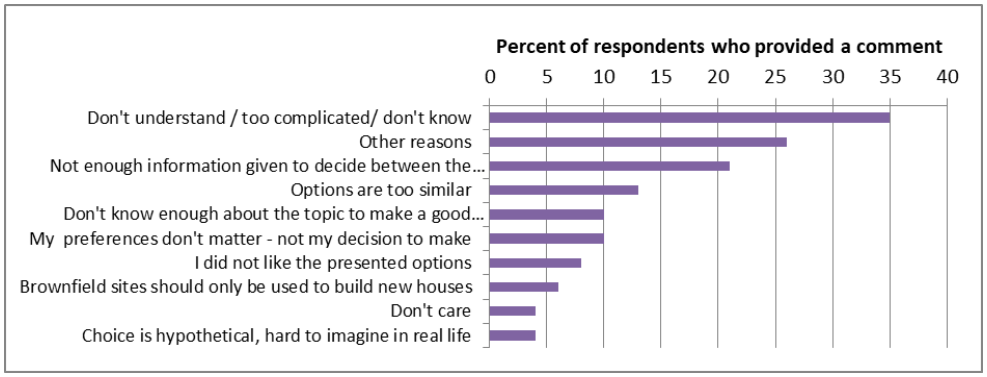
Figure 10: Choice behaviour in the second choice experiment



DIAGNOSTIC QUESTIONS AND COMMENTS FROM RESPONDENTS

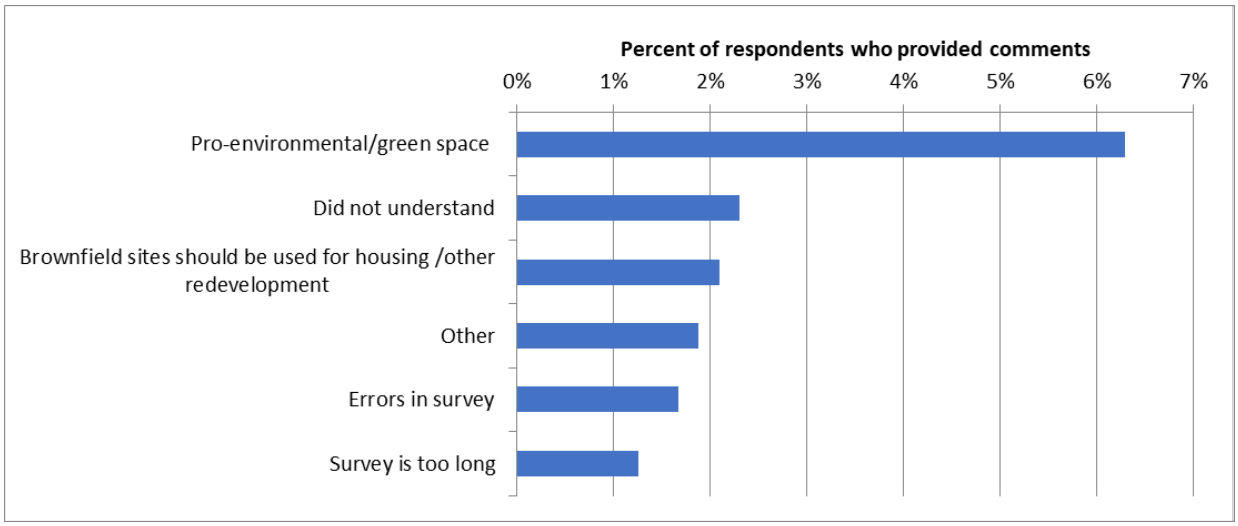
As part of the survey we also included some diagnostic questions after the choice experiments to explore respondents' perceived difficulty of making the choices. 94 per cent of respondents stated that they could answer the choices, with 6 per cent saying they could not (139 respondents). We categorised the comments for those who said they could not undertake the choices into the ten categories shown in Figure 11. 35 per cent of those who could not make the choices did not understand the choices or thought they were too complicated. Just over 20 per cent of those who said they could not make the choices thought there was not enough information given in order to make the choice. We also include a category called 'Other reasons' which includes a variety of responses that did not belong to any of the other categories. Examples of responses here include not caring, "definitions were not broad enough", "my area isn't like that" and "too many options".

Figure 11: Reasons for being unable to answer the choice question (n=139)



At the end of the survey, respondents were given the opportunity to provide any further comments. 477 people provided comments. Approximately two thirds of these comments were positive with many people saying thank you or commenting on how interesting the survey was. About 15 per cent of the comments were not directly relevant or made little sense. 30 people left pro-environment comments, with people stating that green spaces should be protected and brownfield sites should be redeveloped. 11 people said they did not understand the survey and 6 people complained it was too long. The "other" category in Figure 12 includes comments about a wide variety of issues including people not wanting to pay any money, and others claiming the survey is too hypothetical. Some commented on possible improvements that could be made to the survey. The question on marital status could be given an extra category to accommodate people in relationships/co-habiting who are not technically married. Others noted that more information could have been provided about what type of redevelopment the brownfield sites could be used for (although it should be noted that this had been deliberately omitted in order to focus specifically on the value of restoring PDL to undeveloped land).

Figure 12: General comments about the survey (n=433)



Main survey model analysis

Introduction

We have developed discrete choice models (Ben-Akiva & Lerman, 1985, Train, 2009) to explain the choice behaviour of respondents regarding a range of different aspects of PDL characteristics, disaggregate benefits of restoring the PDL to UDL (i.e. landscape, recreation, accessibility and sense of community) and how these preferences differ between groups in the population. The model is based on 24,000 choice observations, collected from 2,400 individuals from two SC experiments. Details of the modelling approach are set out in Appendix C, which presents the theoretical basis of discrete choice modelling as well as detailing the model development and final model results.

The ultimate output from the work was appraisal values for moving from PDL to UDL. The appraisal values will be consistent with, and complementary to, those currently being used for the valuation of moving from Undeveloped Land (UDL) to new development (DCLG, 2006).

The models reflected people preferences regarding PDL characteristics and the external benefits of restoring PDL: landscape, accessibility, recreation and sense of community, accounting for different area type. We explicitly explored differences in preferences across different population segments (for instance the differences by social-economic groups and their current experience of PDL redevelopment). Therefore in the model development, we developed two sets of the models (again, see Appendix C final model specification for more details):

- Model to obtain average values across the whole sample (Model 1): across overall sample but allowing variation in preferences by area type and region (we use these to calculate values for appraisal).
- Model that accounted for the preference differences in subgroup of population (Model 2)[37]: based on above Model 1 but also accounting for the impacts of respondents' socio-economic characteristics and their current experience of PDL (for policy understanding more generally).

Below we discuss the findings from the Model 2, particularly focussing on how preferences vary across population segments.

We then present values for appraisal calculated using the consumer surplus approach[38] which is based on the results from Model 1. The appraisal values obtained from this study should be in line with the existing values of developing UDL which vary only by area type and type of UDL. Hence the appraisal values reflected the average values across population but allowed variation by different area type (with weighting) and each PDL type.

[37] Model 2 is an extended version of Model 1 but with covariates to capture the differences by sub-group of population. The log likelihood ratio test shows that Model 2 has a b significantly better fit to the data than Model 1.

[38] Consumer surplus, the welfare measure, is the difference between the maximum price a consumer is willing to pay and the actual price they do pay to purchase a product. It is the monetary gain obtained by consumers because they are able to purchase a product for a price that is less than the highest price that they would be willing to pay.

In the present study, Consumer surplus (CS) values[39] were calculated to generate the values for restoring PDL to UDL to be used in appraisals (see more details in the subsequent sections).

Respondents' preferences for PDL characteristics

Below we present the findings on respondents' preferences with regard to different PDL characteristics. To interpret the results, we used the utility weights (coefficient estimates) to show the relative preference for each attribute and level. The willingness to pay (WTP: the ratio between the coefficient of the characteristics and the coefficient of cost associated with restoring PDL) could be used for the comparison of the characteristics. However, in the subsequent part of the study, consumer surplus (CS) values were calculated for use in appraisal. Compared with WTP values, the CS values take into account:

- all aspects of the site that are changing (the benefits accruing from redevelopment of PDL) and
- both the values accruing to the proportions of the population that the model predicts will choose a given redevelopment option and the proportions that would rather not pay towards it.

In the present study, due to the design of the choice experiment, the consumer surplus values were different from the WTP values. Therefore, we used utility values here to show the magnitude of the preferences to avoid confusion from presenting two set of the monetary values.

In general, when the relative preference (coefficient estimated from the model) is greater than zero, this means that the particular attribute level is preferred relative to the reference level (where the coefficient is set to zero) and it is seen as contributing to utility gain. Similarly, when coefficients are less than zero, this means that respondents were "averse" to a particular option, compared to the reference case. The absolute magnitudes of the coefficients do not have a direct interpretation but rather it is the relative magnitude of the coefficients in relation to each other that is meaningful. For example, a coefficient of 0.4 means that the preference for a particular attribute level relative to the reference level of that attribute is stronger than the preference for a different attribute level where the coefficient is 0.2, say.

Covariates were added to the model to capture the differences in preferences in subgroups within the survey sample (note that these are additive to other values). We have tested a wide range of the factors that could affect respondents' preferences for each attribute, including their socio-economic characteristics and their current experience with the PDL redevelopment as well as their life style and attitudes. A detailed discussion of the factors being examined and the test process is included in Appendix C. Only the factors that are statistically significant (above 90%), and taking account of correlation between observations from the same person (using bootstrapping methods)[40], are presented here.

RESPONDENTS PREFER TO RESTORE PDL SITES THAT ARE USED FOR HOUSING, BUSINESS, OFFICE AND LOCAL AUTHORITY SITES

[39] See G de Jong et al., (2007) for a good review of Consumer Surplus theory and application in the choice modelling settings.
[40] Efron, 1979, see appendix C for more details)

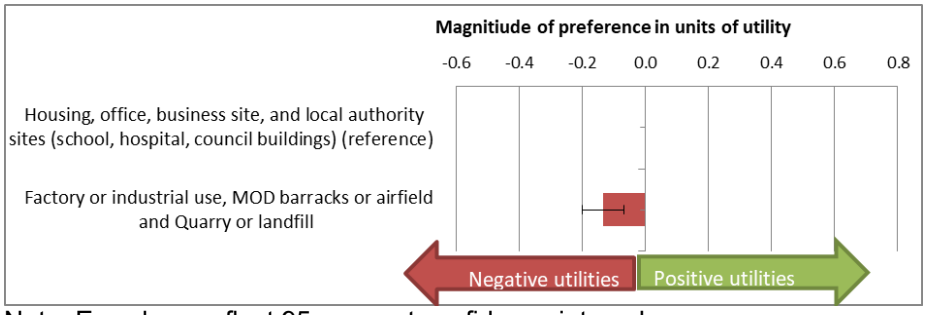
Initially, the six PDL previous uses were modelled separately with "housing" as the baseline level. However, we found the category of "office, business sites" and "local authority sites" were not statistically significantly different from the baseline level (housing) and therefore combined them in the final model. Similarly the categories of "factory or industry use", "MOD barracks or airfield" and "Quarry or landfill" were combined and jointly estimated as the separate estimates were not statistically significantly different from each other. Therefore the six categories were then combined into two categories based on initial model findings.

Figure 13 shows the relative preference for different types of PDL previous use. To interpret the results, the reference baseline is "used for housing purpose, office, business site and local authorities" (i.e. 'non-industrial uses'). The red bar in the figure then shows the value (in units of utility, utils) that is placed on a site where the PDL was "used for factory or industrial use, MOD barracks or airfield and Quarry or landfill" (i.e. 'industrial uses') relative to the reference baseline. We found this to be negative and to have a relatively small magnitude, around -0.13 utils, which means that respondents in the sample would, on average, rather PDL sites previously used for non-industrial purposes were restored over those previously used for industrial purposes, when all other things are equal.

For this attribute, we did not observe any variations in preferences across segments of the sample.

The first phase of the study found that most previous studies used the general terms brownfield or PDL and many did not report explicitly the previous use. For instance, none of the studies reviewed reported defence and manufacturing as previous use types. Two studies covered undeveloped land on brownfield sites (Defra, 2011, Chiabai et al., 2013). Some sites were also classified across two dimensions – for example, vacant or derelict residential properties. As such, we cannot find previous evidence for a like-for-like comparison for this attribute.

Figure 13: Relative preferences for PDL previous use



Note: Error bars reflect 95 per cent confidence intervals

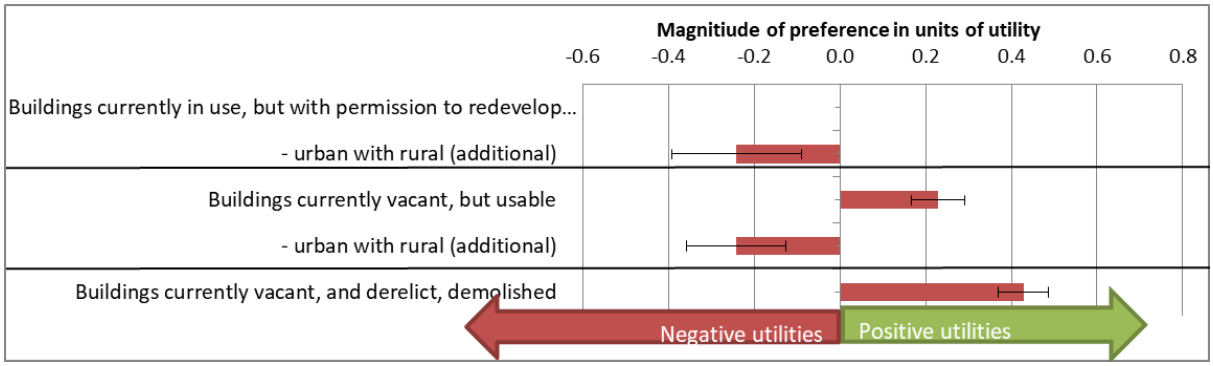
RESPONDENTS PREFER TO RESTORE MORE DERELICT PDL SITES

Figure 14 shows that respondents prefer to restore PDL sites that were more derelict compared to sites where buildings were currently in use but with permission to develop or those where buildings were currently vacant but the land was usable.[41]

[41] In earlier model development we found that the "building current vacant but derelict" level) had a slightly high magnitude compared to "buildings demolished". However the differences were not statistically significant at the 95% confidence interval (t = 0.52). Therefore these two levels are combined and the coefficient value jointly estimated.

We observed that preferences varied according to area type and employment. For instance, respondents who reside in "urban with significant rural" areas showed much lower preferences for redeveloping the sites that are currently in use but with permission and the sites currently vacant but usable compared to respondents who reside in urban and rural areas (these differences are significantly different at the 99% confidence level).

Figure 14: Relative preferences for PDL types



Note: Error bars reflect 95 per cent confidence intervals

Similarly to the preference for previous use, we could not find much previous evidence from the literature for comparison. Miccoli et al. (2015) used a consensus approach combined with stated preference techniques to estimate the WTP for the conversion of a derelict road overpass to a linear park. Sampling across the Rome population, they estimated a WTP of €6/year over 10 years. This would correspond to €51.18 per Rome household. We will compare these with the monetary valuations from our consumer surplus calculations in the next section.

RESPONDENTS PREFER TO RESTORE UNCONTAMINATED PDL SITES

Figure 15 shows that respondents strongly disliked the idea of restoring sites that they were told were currently contaminated and required treatment, even with the emphasis of the 'safely treatment/removal of the contaminated materials from the site" (compared to sites with no contamination)[42]. This indicates that respondents were more likely to select the non-contaminated PDL sites to be restored, all else being equal. We did not find statistically significant differences between the options that "sites restoring require safely removing the contaminated materials" and "sites restoring requires safely treating the soil to clean up the site" and so produced one value for these two.

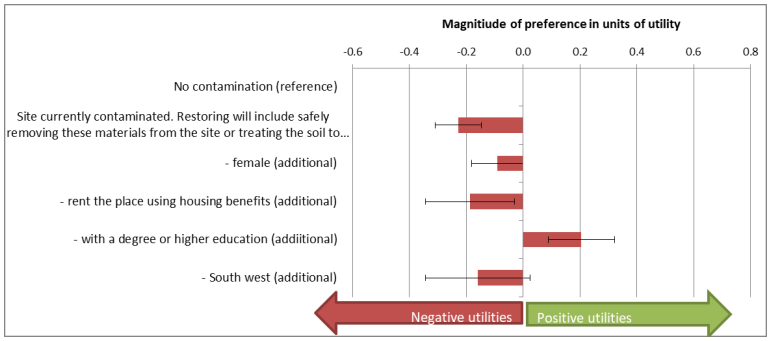
We found a few differences in the preferences on the current level of contamination across sub-groups of population:

- Female respondents placed a higher penalty (greater dislike) on the options presenting sites with contamination to be restored (additional - 0.1 utils), although the impact is only significant at the 95% confidence interval.
- Respondents who currently rent their place with housing benefits disliked the options presenting sites with contamination to be restored (additional -0.19 utils).

[42] In the pilot survey, we found respondents prefer to redevelop a site that does not require the treatment of contamination compared to the ones with pollution. Hence in the main surveys, the level descriptions were clarified to focus on the end product regarding contamination and to be clear that the process of dealing with contamination to be carried out in a safe manner.

- Similarly we found respondents that were from the South west region of the country disliked the options presenting sites requiring safe clean up, compared to average. This was only significant at 90 per cent confidence interval).
- Lastly, we observed that respondents with a degree or higher education showed a relative small preference (additional 0.20 utils) for options where the sites required safe clean up. However, overall, this group of respondents disliked the option that the sites being restored require safely treating the soil at - 0.02 utils (= -0.22 + 0.20).

Figure 15: Relative preferences for contamination



Note: Error bars reflect 95 per cent confidence intervals

The literature review in phase 1 of the study suggested that the level of contamination is a significant consideration by public for restoring PDL sites (Braden et al. 2004, Tonin and Turvani 2017). Braden et al (2004), in a study to assess the impact of environmental contamination on the residents, found the WTP per household per year for a full clean-up of the contamination is $1,016 - $7,715 and a partial clean-up at $418 - $3676. The study area was in Waukegan Harbor, USA (urban core).

However much of the previous evidence was on the impact of treatment of contamination on the property sale price. For instance, AMEC (2012) found that average property prices increased by 10.4% as a result of remediation of chemical works (land use unchanged).

RESPONDENTS PREFER TO RESTORE LARGER PDL SITES

The size of the PDL site was included in the choice models as a continuous term. A strongly positively impact was found on the size of the site (0.032 per hectare, at 99 per cent confidence level). This implies that respondents preferred to restore the sites that are larger in size, all else being equal.

RESPONDENTS PREFER TO RESTORE PDL SITES THAT ARE CLOSER TO THEIR HOME

Similarly, the distance between PDL sites and respondent's home was included in the choice models as a continuous term. A strongly negatively impact was found on the distance (-0.033 per mile, at the 99 per cent confidence level). Respondents residing in the "urban with significant rural" area showed a more negative preference towards the options with sites that are farther from their home to be re-developed (additional -0.03 per mile). This implies that respondents preferred to restore the sites that are closer to their home, all else being equal.

Our findings are generally in line with the previous evidence. However we need to emphasise that previous literature was mainly focused on the impact that distance from the brownfield sites had on property prices and showed a negative impact on the property price. For instance, two studies from the USA found a negative effect on residential property prices of a similar order of magnitude that decreased with distance from the site,

although the studies were based on very different numbers of and types of sites ($7.64/ft, Mihaescu & Vom Hofe 2013 and up to $5.54/ft, Braden et al 2004). This implies that the public preferred the brownfield sites closer to them to be restored, which is consistent with what we observed in our choice experiments.

Findings on respondents' perceived external benefits of restoring PDL sites

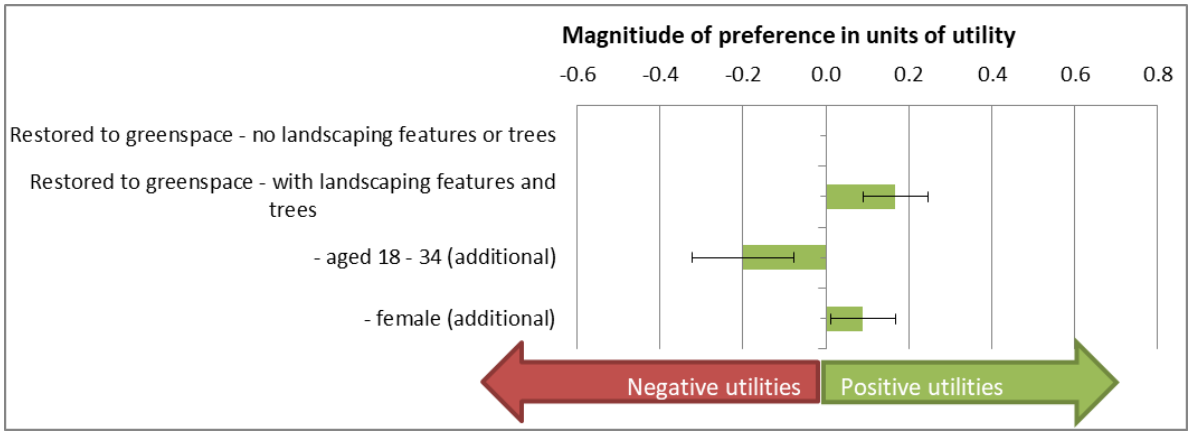
Below we summarise the findings from the choice models with regards to the external benefits of restoring PDL sites.

RESPONDENTS PREFER PDL SITES TO BE RESTORED WITH LANDSCAPING FEATURES

Figure 16 shows that compared to the option that the PDL site being restored to a greenspace without landscaping features (as the baseline), respondents strongly preferred sites that have landscaping features and trees at 0.17 utils (99 percent confidence interval). Further, we found that

- Younger people (aged 18 – 34) placed less value on these landscaping features (the overall utils -0.03 = 0.17 + (-0.20)).
- Female respondents showed a higher preference for the landscaping features at additional 0.09 utils.

Figure 16: Relative preferences for the landscape benefits of the restoring of PDL



Note: Error bars reflect 95 per cent confidence intervals

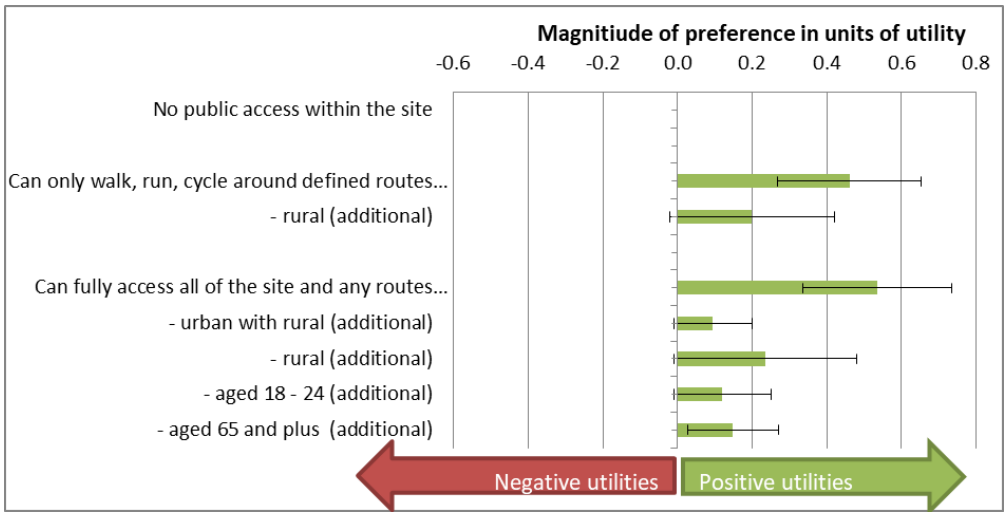
RESPONDENTS PREFER PDL SITES TO BE RESTORED WHICH LEAD TO RECREATIONAL BENEFITS

Figure 17 shows that respondents strongly prefer options where the PDL sites being restored will result in recreational benefits. Further, their value of the benefits increased with the increase in the scope of recreational activities possible within the restored sites. For instance, the average preference for options where the restored sites allow opportunities to only walk, run and cycle around defined routes within the sites was valued at 0.47 utils. The average preference for options that allow full access to the restored sites for sports and recreation increased to 0.54 utils. Differences in these preferences that can be observed from the choices include:

- Respondents that reside in rural areas showed a stronger preference for recreational benefits compared to those who reside in urban areas (for both levels of possible recreational benefits).
- Respondents that reside in "urban with significant rural" areas showed a stronger preference for having full access to the site for recreational use compared to those who reside in urban areas (only significant at 90 per cent confidence level).

- We found that for the level of “fully access all of the site for sports and recreation”, the younger (aged 18 – 24) and older (aged 65 and above) respondents showed a stronger preference compared to the other age groups.

Figure 17: Relative preferences for the recreational benefits of the restoring of PDL

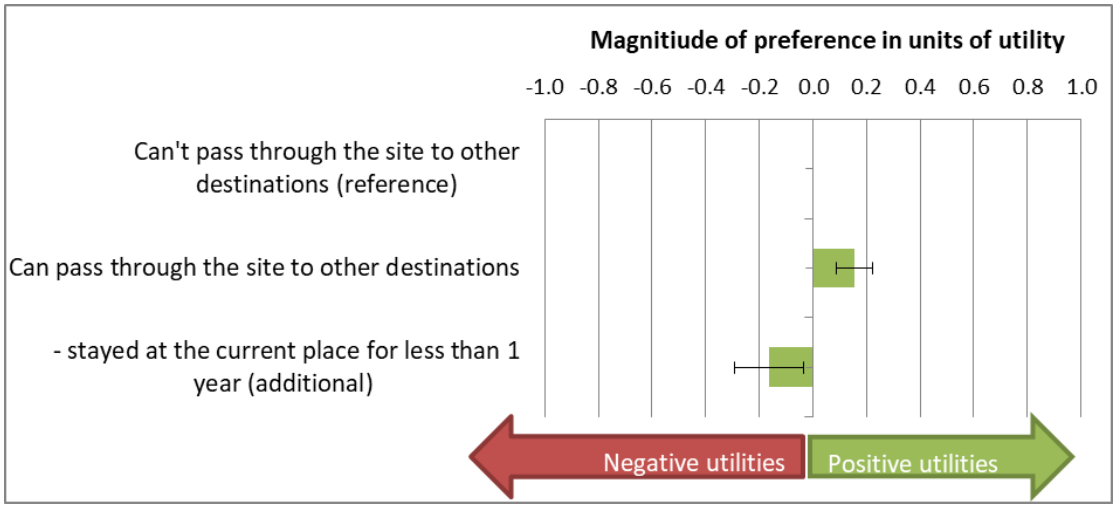


Note: Error bars reflect 95 per cent confidence intervals

RESPONDENTS PREFER PDL SITES TO BE RESTORED WHICH WILL LEAD TO IMPROVEMENTS IN ACCESSIBILITY

Figure 18 shows that compared to the option that PDL sites were restored with no accessibility benefits (baseline), respondents preferred options where they can pass through the restored site to other destinations, valuing this at 0.159 utils. Moreover, respondents who have lived at their current place for less than 1 year showed less preference for these accessibility benefits (-0.008 utils = 0.159 + (-0.166)).

Figure 18: Relative preferences for the accessibility benefits of the restoring of PDL



Note: Error bars reflect 95 per cent confidence intervals

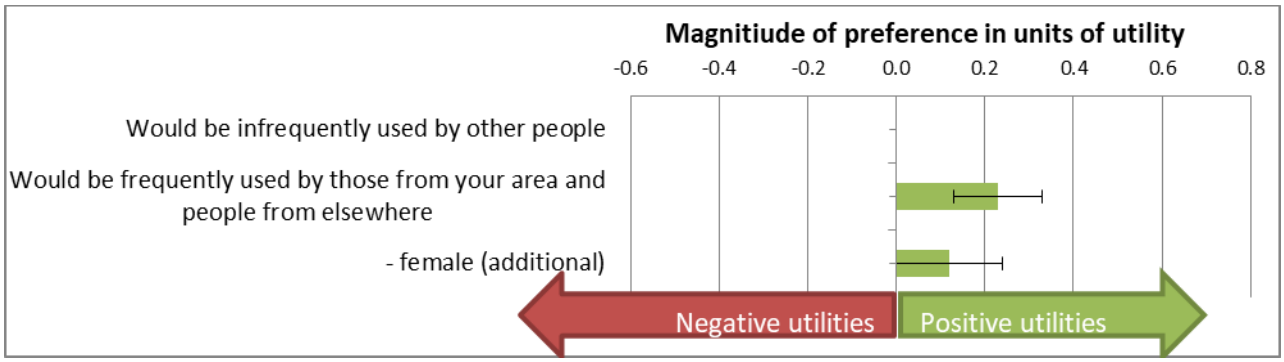
RESPONDENTS PREFER PDL SITES TO BE RESTORED TO SITES THAT WILL BE USED BY OTHERS

Figure 19 shows that respondents have a strong preference for cases where the restored PDL land would be frequently used by those from their own area and from elsewhere (0.23 utils).

Interestingly, in the earlier model we found that respondents reveal a slightly higher preference for the likely use by those from their own area compared to the use by those from their own area and those from elsewhere. The difference was -0.06 utils, but not statistically significant, so these two levels of sense of community benefits were combined.

We find female respondents showed a higher preference towards the options that the restored sites would be frequently used by other people (for both from their own area and from elsewhere) at additional 0.12 utils.

Figure 19: Relative preferences for the sense of community benefits of the restoring of PDL



Note: Error bars reflect 95 per cent confidence intervals

THERE IS VARIATION BETWEEN RESPONDENTS IN THEIR PREFERENCE TOWARDS RESTORING ANY PDL SITE OR NOT

The choice models incorporated the impacts of the main PDL characteristics, external benefits and the various impacts of respondents' socio-economic characteristics and their life styles. After we controlled for all of the above factors, we found that there was still variation in respondents' preferences as to whether a given PDL site is restored of not, as shown in Figure 20. To interpret the findings, a positive utility in the chart showed that respondents showed greater preference to "Remain as Now", whilst a negative utility showed respondents showed greater preference to "Restore the land".

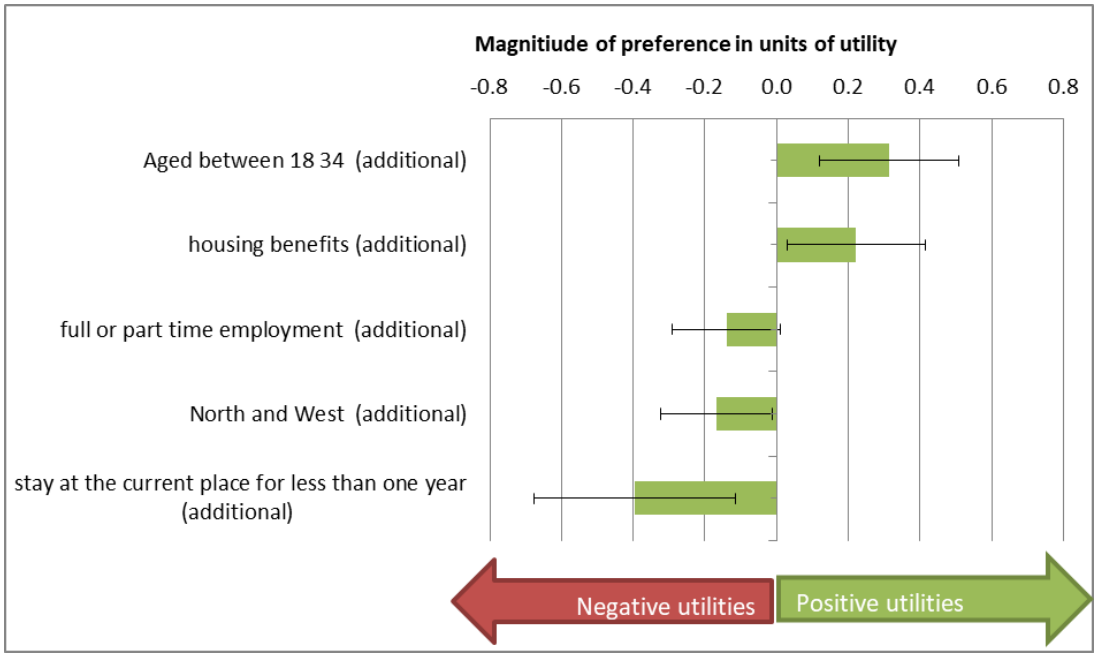
We found that respondents in the following groups showed greater preference for PDL sites to be kept as now, all else being equal:

- Younger people (aged 18 – 34): 0.31 utils
- Respondents who rent a place with housing benefits: 0.22 utils (only significant at 90 percent confidence interval)

We found that respondents in the following groups showed greater preference for PDL sites to be restored to greenspace, all else being equal:

- those who work full or part time: 0.14 utils (only significant at 90 percent confidence interval)
- those from areas in the North and West: 0.16 utils
- those who have lived at their current place for less than one year: 0.40 utils.

Figure 20: Relative preferences for the options of the restoring of PDL sites



Note: Error bars reflect 95 per cent confidence intervals

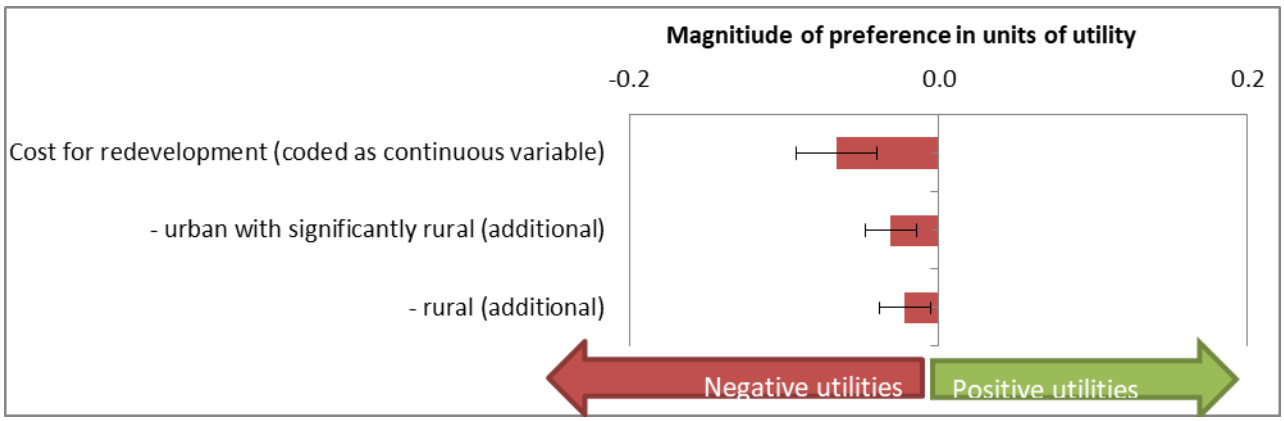
Respondents disliked options where they are asked to pay more towards restoring the PDL sites

The cost to the respondent of restoring different PDL sites has been incorporated in the model as a continuous variable. A number of different model specifications were tested to find the best formulation for interpreting the impact of cost on respondents' preference. This is documented in Appendix C. After extensive testing we found linear terms, differing by area type, provides good levels of model fit whilst providing a formulation that is well suited to the calculation of the final appraisal values (through consumer surplus).

As shown in Figure 21, respondents showed a strong negative preference towards the cost associated with the restoring of PDL which is quite intuitive. This indicates that people disliked options where restoring PDL require greater payment from themselves.

We also found that the sensitivity to cost is affected by the area types. For respondents who reside in the "urban with significant rural" and rural areas, were more sensitive to the cost changes compared to the respondents who are in the urban areas. This was after we tested for household income effects which did not show any significant impacts. This implies that respondents from urban with significant rural and rural areas were more reluctant to pay for restoring PDL sites compared to those in urban areas.

Figure 21: Relative preferences for the cost associated with restoring PDL



Note: Error bars reflect 95 per cent confidence intervals

Calculation of the values for use in appraisal

Consumer surplus (CS) values[43] were calculated to generate the values for restoring PDL to UDL to be used in appraisal.

Often studies derive willingness-to-pay estimates directly from the ratio of the coefficients within the choice models, i.e. calculate the marginal rates of substitution of changes in individual attributes with respect to money. In the case of this study, however, we are interested in the value associated with the complete package, i.e. the value associated with the option of restoring a given site.

In the case of restoring PDL, we anticipate that there may be some proportions of the population that decide for a given type of site that they would rather not return it to an undeveloped state. As such, we have deliberately designed a choice experiment that allows us to explore whether an individual would choose to restore a given PDL site or not. Indeed, from the SP2 experiment, we observed 4 per cent of respondents always selected 'remain as now' across the choices that they were offered. Moreover, 15 per cent of all the SP2 choices (1,605 out of 10,905 observations) were 'remain as now', indicating in those scenarios the respondents in question were not willing to pay to restore the PDL site presented to UDL. Using the marginal rates of substitution as a measure of WTP estimates the value that a person would obtain from the attribute, if the person chose the alternative. People who would not chose the alternative would not obtain this value and hence this would not be taken into account into the valuaton of the external impact (attribute).

In contrast, the welfare measure, consumer surplus, estimates the value attributed over an entire population, including those who would choose to leave the PDL in its current state and not redevelop it to UDL. It accounts for both parts: the value of the attribute conditional on taking up the good or product, and the share of the population that take up the good or product. In cases where the status quo outcome is often preferred, welfare calculations based upon consumer surplus calculations will be lower and more representative of the valuation across the population of interest, since it accounts for the subpopulation who would rather not take up the choice. Consumer surplus therefore provides a more

[43] See G de Jong et al., (2007) for a good review of Consumer Surplus theory and application in the choice modelling settings.

appropriate way to calculate the value placed on the development of PDL across the general population.

Consumer surplus or **consumers' surplus** is the difference between the maximum price a consumer is willing to pay and the actual price they do pay to purchase a product. It is the monetary gain obtained by consumers because they are able to purchase a product for a price that is less than the highest price that they would be willing to pay.

The consumer surplus (CS) as defined above was first proposed by Marshall and is derived using the Marshallian or uncompensated demand curve. A consumer gains benefits if his/her maximum willing to pay for a unit of a good is higher than the current asking price. Consumer surplus can be used as a measurement of social welfare, first shown by Willig (1976). For a single price change, consumer surplus can provide an approximation of changes in welfare.

In the choice experiment setting, by definition, a person's consumer surplus is the utility, after conversion to monetary terms that a person receives in the choice situation. If the unobserved component of utility is independently and identically distributed extreme value and utility is linear in income (cost in this case), then the expected utility becomes the log of the denominator of a logit choice probability, divided by the marginal utility of income, plus arbitrary constants. This is often called the ''*logsum*''. Total consumer surplus in the population can be calculated as a weighted sum of *logsums* over a sample of decision-makers, with the weights reflecting the number of people in the population who face the same representative utilities as the sampled person. The advantages that the *logsums* give to the appraisal procedure is that *logsums* can incorporate a degree of heterogeneity in the population, while also being theoretically more correct and in many cases easier to calculate.

The values for use in appraisals

In the present study, the model results were used to calculate the consumer surplus values. The method to calculate the CS values is included in Appendix C.

To ensure that we obtain values that are consistent with the existing evidence for the (dis)benefits of developing UDL to DL, we mapped the PDL area type to the UDL area type with the combination of the benefits using the attribute levels from the choice experiment in Table 19 (see Section 3 selection of attribute and levels). Below Table 30 presents the mapping of the PDL to UDL area type and the external benefits from development of PDL to UDL. Notably, the left part of the table is same as the categories in Table 14 (source: Eftec and Entec report[44]) which shows the benefits included in the values for different UDL land types in appraisal. The right part of the table (mapping external benefits of redevelopment PDL to UDL) shows how we map the external benefits for each UDL mid-point using the attribute levels from the choice experiment in Table 19.

[44] Valuing the external benefits of undeveloped land: main document, available at: http://webarchive.nationalarchives.gov.uk/20120919132719/http:/www.communities.gov.uk/documents/planningandbuilding/pdf/158136.pdf

Table 30 Mapping the PDL to UDL type and benefits

UDL (PDL) Area type	UDL Land type	Coverage of benefits (shaded cells)									mapping external benefits of redevelopment PDL to UDL			
											Recreation	Landscape	Accessibility	Sense of Community
Urban	**Urban Core Public space** (city park)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**Ac**	**S**	R3	L6	A2	C2
Urban with significant rural	**Urban Fringe** ('greenbelt')	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**Ac**	**S**	R2	L5	A1	C1
	Urban Fringe forecast land	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**Ac**	**S**	R2	L6	A1	C2
Rural	**Rural** forested land (amenity)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**Ac**	**S**	R2	L6	A1	C2
	Agricultural land (extensive)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**Ac**	**S**	R2	L5	A1	C1
	Agricultural land (intensive)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**Ac**	**S**	R1	L5	A1	C1
	Natural and semi-natural land (wetlands)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**Ac**	**S**	R2	L6	A1	C2

R = recreation; L = landscape; E = ecology; C = cultural Heritage; H = hydrology; A = air quality and climate; T = tranquillity; Ac = accessibility; S = soil

Below in Table 31 and Table 32 we present the consumer surplus values for redevelopment of PDL to UDL by each PDL type, previous use and UDL type. Slightly different values were obtained for North West and West Midlands as we found some regional differences in preference in the choice model, although the differences are relatively small. Notably the values in the tables below are a 'per household per month value' with the assumption of a site of 1 hectare and a distance to the site of 1 mile. We will discuss the impacts of distance to site and size of site in the later section.

From the table it can be seen that, for a PDL site that was used for non-industrial purposes which is currently in use but with permission to redevelop it, but not requiring treatment to eliminate any contamination, the external benefits for redeveloping the site to a city park is £8.10 per household per month. For a similar site but requiring treatment of contamination, the external benefits value is £7.20 per household per month.

Table 31 CS values for redevelopment of PDL to UDL for England (size of site = 1 hectare, distance to PDL site = 1 mile)

PDL Previous Use	PDL type	Contamination	UDL Types (value unit: £ /household/month, rounded to nearest 10p)						
			Urban Core (city park)	Urban Fringe (green belt)	Urban Fringe (forest land)	Rural (forest land)	Agriculture land (extensive)	Agriculture land (intensive)	Natural and semi-natural land
Non-industrial sites	In use	No	8.10	3.90	5.80	4.60	3.00	1.50	4.60
Non-industrial sites	In use	need treatments	7.20	3.40	5.20	4.10	2.60	1.20	4.10
Non-industrial sites	Vacant	no	8.90	4.40	6.40	5.20	3.50	1.80	5.20
Non-industrial sites	Vacant	need treatments	8.00	3.90	5.70	4.60	3.00	1.50	4.60
Non-industrial sites	derelict	no	9.60	4.90	6.90	6.20	4.40	2.40	6.20
Non-industrial sites	derelict	need treatments	8.70	4.30	6.20	5.60	3.80	2.10	5.60
Industrial sites	In use	no	7.60	3.60	5.50	4.30	2.80	1.40	4.30
Industrial sites	In use	need treatments	6.80	3.10	4.80	3.80	2.40	1.10	3.80
Industrial sites	Vacant	no	8.40	4.10	6.00	4.90	3.20	1.60	4.90
Industrial sites	Vacant	need treatments	7.60	3.60	5.40	4.30	2.80	1.40	4.30
Industrial sites	derelict	no	9.10	4.60	6.50	5.90	4.10	2.20	5.90
Industrial sites	derelict	need treatments	8.20	4.00	5.90	5.30	3.60	1.90	5.30

Table 32 CS values for redevelopment of PDL to UDL for the Northwest and West Midlands (size of site = 1 hectare, distance to PDL site = 1 mile)

PDL Previous Use	PDL type	Contamination	UDL Types (value unit: £ /household/month, rounded to nearest 10p)						
			Urban Core (city park)	Urban Fringe (green belt)	Urban Fringe (forest land)	Rural (forest land)	Agriculture land (extensive)	Agriculture land (intensive)	Natural and semi-natural land
Non-industrial sites	In use	no	8.00	3.70	5.70	4.50	2.80	1.10	4.50
Non-industrial sites	In use	need treatment	7.10	3.10	5.00	3.90	2.30	0.80	3.90
Non-industrial sites	Vacant	No	8.80	4.30	6.30	5.10	3.30	1.50	5.10
Non-industrial sites	Vacant	need treatment	7.90	3.70	5.60	4.50	2.80	1.10	4.50
Non-industrial sites	derelict	No	9.50	4.70	6.80	6.10	4.20	2.20	6.10
Non-industrial sites	derelict	need treatment	8.60	4.10	6.10	5.50	3.70	1.70	5.50
Non-industrial sites	In use	No	7.50	3.40	5.30	4.20	2.50	0.90	4.20
Non-industrial sites	In use	need treatment	6.60	2.80	4.70	3.70	2.10	0.60	3.70
Non-industrial sites	Vacant	No	8.30	3.90	5.90	4.80	3.00	1.30	4.80
Non-industrial sites	Vacant	need treatment	7.40	3.30	5.30	4.20	2.50	0.90	4.20
Non-industrial sites	derelict	No	9.00	4.40	6.50	5.80	3.90	1.90	5.80
Non-industrial sites	derelict	need treatment	8.10	3.80	5.80	5.20	3.40	1.50	5.20

The impact of the distance and site size is shown in the table below. It was found that the external benefits of the redevelopment of the PDL sites were affected by the land size and distance to the site. The choice modelling analysis showed that there was a positive relationship between the external benefits and the land size and the impacts varied according to the UDL land type to which the PDL would be restored. For instance, for a PDL site to be redeveloped to Urban Core (city park), the overall external benefits (CS) increase by £0.112 per household per month for each hectare increase of land size (and would decrease in proportion for sites smaller than 1 hectare).

The distance to a site has shown a negative impact on the external benefits of the redevelopment of the PDL site, with every 1 mile increase in distance, the external benefits decrease by £0.1132 per household per month for the Urban core (City Park). Similarly, the incremental impact of distance on the external benefits varies according to the UDL type to which the PDL site would be redeveloped. The adjustment of the values is illustrated by an example in the section below and the case study.

It should be noted that choice experiment covered site sizes up to 5ha as over 90 per cent of the PDL sites in the England were less than 5 ha. Hence the size impact is reliable for sites with sizes up to 5 ha. Similarly, the choice experiment covered the distance from 0 (next to the house) up to 10 miles. It would be conservative to assume that those living beyond 10 miles from a site would obtain minimal benefit from its restoration.

Table 33 The incremental impact of distance to PDL site and size of site (Adjustment to CS values per unit change for redevelopment of PDL to UDL: £/household/month)

Area type	UDL Type	Size (/ha)	Distance (/mile)
Urban	Urban Core (city park)	0.1118	-0.1132
Urban with rural	Urban Fringe (green belt)	0.0711	-0.0696
Urban with rural	Urban Fringe (forest land)	0.0820	-0.0828
Rural	Rural (forested land)	0.0725	-0.1337
Rural	Agriculture land (extensive)	0.0614	-0.1079
Rural	Agriculture land (intensive)	0.0416	-0.0677
Rural	Natural and semi-natural land	0.0725	-0.1337

The CS values reported above from the analysis of the choice experiments represent the values of an average household within the population. There are therefore two further steps required in converting these to values appropriate for use in appraisal.

Grossing up to the affected population: the impact of developments on the total affected population is required. To make this calculation the total population affected by the redevelopment of the site must be considered, as was done in the previous work on valuing undeveloped land. It is also suggested by some literature (Bateman et al., 1999) and also from our model findings, that the distance to the PDLs has a significant impact on the appraisal values. We incorporate this in our calculation of the total population values by taking account of the diminishing returns that may accrue as the population location moves further from the site.

Discounting over time: typically it is assumed that the value placed on any change in a site is not a one-off gain, but continues in perpetuity. We therefore consider the impact of time on the external benefits, drawing upon appropriate discounting rates to calculate the present value of any change. This both takes account of public's time preference and the opportunity cost of capital. The approach to measure the change in benefits over time is included in Appendix C.

How these values can be used alongside the existing UDL evidence

The set of values for restoring PDL to UDL can be used, together with the existing evidence of appraisal values for developing UDL to DL to achieve the values of moving from PDL to DL. The existing evidence regarding UDL valuation is reproduced below (source: Eftec and Entec report[45]). The appraisal values for UDL reflect the values that studies have found that the public would place on keeping the undeveloped land.

Table 34 land-types and external benefits: partial review of the literature

Area type	Land type	Coverage of benefits (shaded cells)									£/ha/yr (2001)	Present value r = 3.5% p = 3%
Urban	**Urban Core** Public space (city park)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**A**	**S**	£54,000	£10,800,000
Urban with significant rural	**Urban Fringe** ('greenbelt')	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**A**	**S**	£889	£177,800
	Urban Fringe forecast land	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**A**	**S**	£2,700	£540,000
Rural	**Rural** forested land (amenity)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**A**	**S**	£6,626	£1,325,200
	Agricultural land (extensive)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**A**	**S**	£3,150	£630,000
	Agricultural land (intensive)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**A**	**S**	£103	£20,600
	Natural and semi-natural land (wetlands)	**R**	**L**	**E**	**C**	**H**	**A**	**T**	**A**	**S**	£6,616	£1,323,200

R = recreation; L = landscape; E = ecology; C = cultural Heritage; H = hydrology; A = air quality and climate; T = tranquillity; Ac = accessibility; S = soil

From the study, there is a positive gain in utility from the move from PDL to UDL, and then from the existing evidence, a loss of utility from the move from UDL to DL; however, the value that we ultimately require is the net sum of these to capture the value of moving from PDL to DL.

Through the REA in the study, it became clear that the existing UDL evidence for each area type was mainly based on the single study on a specific site, and some of them are based on international evidence. For instance, the values of benefits for Urban (City Park) were derived from the study by Lockwood and Tracy (1995) based on a Centennial Park in Sydney in Australia. The study did not explain how per hectare values may change with the absolute size of the site or depending on the population being affected by the change. In contrast, in our study, we found the size of a site has a positive incremental impact on the values associated with the redevelopment of a PDL site.

Therefore, in practice, due to some limitations with the existing UDL values, the use of the existing UDL evidence should be treated with some caution. We discuss this further in Section 5 on future research.

[45] Valuing the external benefits of undeveloped land: main document, available at: http://webarchive.nationalarchives.gov.uk/20120919132719/http:/www.communities.gov.uk/documents/planningandbuilding/pdf/158136.pdf

Section 5 – Conclusions and future work

This section presents:

- Summary of the research
- Summary of the findings
- Policy implications
- Caveats of the study and suggestions on the future work.

Below we summarise the research methodology and the key findings from the study, starting with general observations and culminating in presentation of CS valuations for redevelopment of PDL to UDL. We also highlight important caveats to the work.

Summary of research

The UK government is actively looking for ways to unlock more developments across the country. Utilising PDL, commonly referred to as 'brownfield sites', is one area being actively explored. The redevelopment of brownfield or previously developed land has been a major policy objective in England since the late 1990s, aimed at reducing urban sprawl and greenfield development, as well as contributing to a more compact form of urban development. Redevelopment of PDL could provide a number of benefits to the public, such as improvements in landscape, opportunities for recreational use, increased accessibility and sense of community. A greater understanding of the magnitude of these external benefits will help to ensure that any future patterns of redevelopment of PDL reasonably reflect the public's preference.

The objective of this study was to estimate the external wider societal benefits of developing on PDL. The research has sought to understand the extent to which the benefits from an improved landscape, better accessibility, increased recreational opportunities and changes in the sense of community are valued by the wider population. The set of values developed were:

- defined using methodologies that are compliant with the Green Book, [46,47]
- consistent with existing values used in appraisal for the external costs of developing on undeveloped land (UDL),
- and additional to private impacts measured by Land Value Uplift.

To ensure consistency with existing UDL values, we have split the appraisal into a two-stage process. In the first stage, we obtained valuations which reflected the gain of utility (i.e. satisfaction or benefits) from restoring PDL to the equivalent of UDL i.e. green space available for recreational use. For the second stage it is possible to take the existing

[46] HM Government. 2018. The Green Book: General Government guidance on appraisal and evaluation. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

[47] Please note that the study design was conceptualised prior to the publication of the 2018 revision of the Green Book.

values for the development of UDL to calculate the utility associated with changing to Developed Land (DL).

To fulfil the research objectives, a systematic research method was designed incorporating a mix of qualitative and quantitative methods. A REA was undertaken, as the first part of the study, to identify readily available, valid and transferable estimates for the external benefits associated with redevelopment of different PDL types. Alongside this literature review, a typology of PDL types was developed. In addition, the REA identified relevant gaps in the existing evidence base and provided suggestions on the method to estimate these values.

The REA concluded that there was insufficient evidence to support the development of robust appraisal values from published evidence. Therefore a second phase of primary research was undertaken to obtain new valuations. At the core of this work was a survey, containing two stated preference discrete choice experiments in which respondents were presented with a series of scenarios with hypothetical scenarios on the redevelopment of PDL sites.

- The first SC experiment, described by the PDL characteristics, was designed to measure the weight placed on different characteristics of PDL for decisions to convert PDL to UDL.
- The second SC experiment, described by the PDL characteristics as well as the external benefits gained from restoring to UDL, was designed to measure the value associated with developing a PDL site, and to assign monetary value to the PDL characteristics.

The SC experiments were defined following the findings from the REA in Phase 1 and refined through a small-scale pilot study. The main survey was then carried out in March – April 2019 in England. 2,400 completed surveys were obtained which formed a sufficient database for the modelling analysis. Descriptive analysis of the sample was carried out to understand the characteristics of the research sample. Discrete choice models were developed to quantify the public's preferences in terms of restoring of PDL sites. From the discrete choice models, consumer surplus values were calculated to quantify the external benefits of redevelopment of PDL to different types of UDL. Separate values were calculated by the PDL type, previous use and area type. We accounted for the impact of land size, distance to site, affected population and time values in the calculation. In addition, a case study has been developed to illustrate the steps of calculation using a real PDL site from the NLUD database.

Summary of findings

The REA found that the present literature was insufficient to generate the values of redevelopment of PDL to UDL required for use in appraisal.

In order to identify readily available, valid and transferable estimates of the existing evidence on the values for the external benefits associated with redevelopment of different PDL types, an REA review was undertaken as the first phase of this study. The REA concluded that the existing literature was insufficient to generate the values required for use in appraisal. The findings from the literature review and research gaps identified on the valuation of redevelopment of PDLs are:

- The studies reviewed covered a diverse range of previous land uses, spatial areas and geographical locations. However not all of the previous uses of PDL and the area type were covered in the literature.

- A number of studies estimated valuations, using hedonic pricing and/or SP (both stated choice and contingent valuation) techniques. It is difficult to directly compare these valuations due to the different research focus of each study. The evidence is not sufficient for a robust analysis / comparison of the valuations for different types of PDLs. Transferring these values to new appraisal or valuations would be challenging as there is insufficient evidence to justify the validity of such a transfer.
- There is limited literature focusing on the quantitative valuation of specific external impacts, for example, there is very little available evidence on the value associated with changes in the sense of community and accessibility. In addition, it is difficult to conduct direct comparisons as no single study covers all of the aspects of interest.
- Moreover, most of these valuations are for overall values of the redevelopment of PDL to greenspace or other recreational uses. Values for the disaggregate impacts of interest to this study are not available from these.
- From the literature reviewed, there is not much evidence on the valuation of the PDLs by different sub-groups of the population.

In summary, the values on external impacts derived from the literature are a valuable resource. However, no single high quality study is identified providing the full range of values for the different impacts being sought. Insufficient quantitative values are reported in the literature that could allow a rigorous meta-analysis.

We therefore recommended that a new survey be undertaken to obtain values for restoring PDL to UDL. The approaches used in the studies reviewed informed the design of the survey, including providing useful methodological insights (i.e. Selection of the research method). Qualitative survey rankings also provide some useful information as to which impacts are expected to be valued most highly by consumers, informing the survey design. The existing values and the studies from which they are taken also provide useful figures for comparison.

A PDL typology was developed based on the REA and analysis of NLUD data

The typology has considered the previous use and location characteristics of PDL sites. It was then modified to define the framework for the SC experiment design.

Table 35: PDL typology

PDL type (by previous use)	Area type		
	Predominantly Urban	Urban with Significant Rural	Predominantly Rural
Housing			
Office, shop or business site			
Factory or industrial use			
Local authority site (school, hospital, council buildings)			
MOD barracks or airfield			
Quarry or landfill			

This typology has been developed on the basis of our analysis of the available PDL stock; however, it is also important to ensure that the typology is capable of supporting analysis into key policy issues.

We also emphasise that this typology will need to be reviewed periodically to ensure that the typology covers the land use types and area types that could be needed in the future.

Below the findings are from the main stage data analysis with 2,400 completed responses from England.

Respondents tend to agree that benefits accrue from restoring PDL

We have examined respondents' attitudes towards the benefits of redeveloping PDL. The analysis showed that most of the respondents (over 70 per cent) agreed with the statements on the environmental, landscape and recreational benefits. 82 per cent selected "agree" or "strongly agree" to statements about the benefit of creating green open spaces and creating and protecting wildlife habitats.

The PDL characteristics showed important impacts on the public's preference to restore the PDL.

Respondents prefer to restore PDL sites that are used for housing, business, office and local authority sites

We found that respondents in the sample would, on average, rather PDL sites previous used for non-industrial purposes ("housing", "office, business sites" and "local authority sites") were restored over those previously used for industrial purposes ("factory or industry use", "MOD barracks or airfield" and "Quarry or landfill"), when all other things are equal. Within the non-industrial and industrial sites categories, we did not identify significant differences in preferences with regards to the previous use of PDLs to be restored.

Respondents prefer to restore more derelict PDL sites

Respondents prefer to restore PDL sites that are more derelict compared to sites where buildings are currently in use but with permission to develop or those where buildings are currently vacant but the land is usable. The preferences varied according to area type and employment. Respondents who resided in "urban with significant rural" areas showed much lower preferences for redeveloping the sites that are "currently in use but with permission" and the sites "currently vacant but usable" compared to respondents who resided in urban and rural areas.

Respondents prefer to restore uncontaminated PDL sites

Respondents strongly disliked the idea of restoring sites that they were told were currently contaminated and required treatment, even with the emphasis of the 'safely treatment/removal of the contaminated materials from the site" (compared to sites with no contamination). This indicates that respondents were more likely to select the non-contaminated PDL sites to be restored, all else being equal.

We found a few differences in the preferences on the current level of contamination across sub-groups of population: we found all else being equal, female, respondents who currently rent their place with housing benefits, and respondents from South and West regions of the country disliked the options presenting sites requiring safe clean up, compared to average. Respondents with a degree or higher education showed a relative small preference for options where the sites require safe clean up. However, overall, this group of respondents dislike the option that the sites being restored require safely treating the soil.

The size of the PDL site and distance to the site has strong impact on respondents' preferences

We found all else being equal; respondents prefer to restore the sites that are larger in size. The impact of size of site varies according to the different types of UDL to which the PDL would be redeveloped to.

Respondents prefer to restore PDL sites that are closer to their home. Respondents residing in the "urban with significant rural" area showed a more negative preference towards the options with sites that are farther from their home to be re-developed. Similarly, the impact of distance to the site varied by the different type of the UDL to which the PDL would be redeveloped to.

The public showed strong preferences for the external benefits from redevelopment of the PDLs

Respondents prefer PDL sites to be restored with landscaping features

We found respondents strongly prefer sites that have landscaping features and trees, compared to the option of the PDL site being restored to a greenspace without landscaping features. Among the sample, females showed a higher preference towards the landscaping features compared to average, whilst young people (aged 18 – 34) are indifferent to the landscaping features.

Respondents prefer PDL sites to be restored which lead to recreational benefits

Respondents strongly prefer options where the PDL sites being restored will result in recreational benefits. Further, their value of the benefits increases with the increase in the scope of recreational activities possible within the restored sites. Differences in these preferences include: respondents that reside in rural areas and "urban with significant rural" areas show a stronger preference for recreational benefits compared to those who reside in urban areas. The younger (aged 18 – 24) and older (aged 65 and above) respondents have a stronger preference for the option to "fully access all of the site for sports and recreation", compared to the other age groups.

Respondents prefer PDL sites to be restored which will lead to improvements in accessibility

Compared to the option that PDL sites are restored with no accessibility benefits, respondents prefer options where they can pass through the restored site to other destinations. Moreover, respondents who have lived at their current place for less than 1 year show less preference for these accessibility benefits.

Respondents prefer PDL sites to be restored to sites that will be used by others

Respondents have a strong preference for cases where the restored PDL land would be frequently used by those from their own area and from elsewhere. Female respondents show a higher preference towards the options that the restored sites would be frequently used by other people.

There is variation between respondents in their preference towards restoring any PDL site

After controlling for all of the above factors, we find that there is still variation in respondents' preferences as to whether a given PDL site is restored or not. More specifically, younger people (aged 18 – 34) and respondents who rent a place with housing benefits show greater preference for PDL sites to be kept as now, all else being equal. Moreover, all else being equal, those who work full or part time, those from areas in the North and West showed a greater preference for PDL sites to be restored to greenspace.

Respondents dislike options where they are asked to pay more towards restoring the PDL sites

Respondents have a strong negative preference towards the cost associated with restoring PDL. This indicates that people dislike options where restoring PDL requires greater payment from themselves. The sensitivity to cost is affected by the area types. Respondents who reside in the "urban with significant rural" and rural areas, are more sensitive to the cost changes compared to respondents who are in urban areas.

Policy implications

Our research showed evidence of a number of factors that affect the public's preference for restoring PDL sites.

Our study showed that the characteristics of existing PDL sites have a strong impact on people's preferences regarding the selection of which sites to restore. One of the key influencing factors is the current condition of the site. For example, people strongly preferred to restore a more derelict site compared to the sites that are currently in use or usable. Another important factor is the previous use of the PDL site, i.e. people prefer a site that was previously used as non-industrial site to be redeveloped compared to the industrial sites. Moreover, our study provided evidence on the impact of distance to the site and the size of the site on the overall benefits of restoring a PDL site. We found people preferred to redevelop a site nearer to them and/or with a larger site size. This has helped fill in some key research gaps identified in the literature review in the earlier stage of the study. The evidence above can inform decision-makers in the design of policies thus helping to ensure the future redevelopment of PDL reasonably reflects the public's preferences.

Our study found that the public prefers to restore a PDL site with no contamination compared to a contaminated site which required treatment of the soil. This evidence can support decision-makers in designing appropriate supporting economic schemes or subsides to ensure the future redevelopment of PDL sites with contamination compensate for the disbenefits perceived by the public with regard the treatment of the pollution.

Our study showed that respondents strongly valued the potential benefits accrued from the redevelopment of PDLs. Among the landscape, recreation, accessibility and sense of community benefits, people valued the recreation benefits the highest, followed by sense of community, landscape and accessibility.

The CS valuations obtained from this study helped us to understand the value that the public place on restoring PDL. They can be used to help quantify the social benefits of programmes aimed at redevelopment of PDL. These benefits can then be compared to the costs of these investments to provide an assessment of the overall value of these

investments. The CS valuations for PDL to UDL should be applied to the affected population in England.

Caveats and potential future research

We emphasise several caveats to the study findings.

First, stated preference choice experiments may over-estimate external benefits valuations, and this should be recognised in quantifying the benefits of proposed schemes.

Second, the valuations are relevant for estimating the benefits of restoring PDL sites to UDL sites for those who are affected by the redevelopment of PDL in England. While the consumer surplus values for the redevelopment of PDL to UDL captured many important features such as the land characteristics before and after the change and the four benefits accrueing from the redevelopment that may influence the value placed on that redevelopment, the calculation is not able to account for each PDL site's unique characteristics which was outside the scope of the study. The values from the study should therefore be interpreted as the values that the public would place on the restoration of a typical PDL site.

Third, the consumer surplus calculation in the case study could be conservative due to the assumptions regarding the number of households affected. However, these assumptions are consistent with those used in previous studies estimating values for use in appraisal for the development of UDL and so provide values that should be comparable.

Below we set out potential future work that could further inform the issues investigated in this study.

Further research on the contamination treatment and impact on preferences for different PDL sites

A key aspect of this study was to quantify the value of external benefits of restoring PDL sites to greenspace. Through surveys we also explored some of the issues of treatment of the possible contamination of the PDL site. Interestingly, the current study found that people dislike the option of redeveloping contaminated PDL sites (relative to non-contaminated sites). Further quantatitive and qualitative research is required to better understand the cases in which the public would like to see sites decontaminated and their apparent preference to reutilise sites that have not been contaminated over those that have.

Wider benefits of restoring of PDL sites

The current study focuses on the value the value of external benefits of restoring PDL sites to greenspace by the affected population. However, the revitalisation of PDL could have wider benefits, for instance in terms of improvement of public health (due to the improvement of access to recreational facilities), reduction in travel costs (due to the improvement of accessibility to other places) and reductions in environmental pollution. The redevelopment of PDL therefore could provide further contributions to the future sustainability of land use. Whilst these benefits were not directly investigated in this study, and considered out of scope, this is something that could be investigated further, and

should be monitored with the roll out of schemes and policies regarding the redevelopment of PDL.

Further robust valuation research on the benefits of UDL to DL

A key aspect of this study was to yield a set of the values to measure the external benefits of restoring PDL which are consistent with the existing evidence on the values of developing UDL. Through the REA in the study, it became clear that the existing UDL evidence for each area type was mainly based on the single study on a specific site, and some of them are based on international evidence. For instance, the values of benefits for Urban (City Park) were derived from the study by Lockwood and Tracy (1995) based on a Centennial Park in Sydney in Australia. Further up-to-date local evidence is required for a robust valuation of the (dis)benefits of developing UDL, and we would recommend that the approach used in this study to value the benefits of restoring PDL to UDL could be replicated to provide more robust values of these (dis)benefits. The use of the same approach would allow the strengthening of these values using a consistent appraisal framework.

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Appendix A – Search protocol

Introduction

This appendix provides the search terms, inclusion criteria and databases used in the literature review.

Databases and inclusion criteria

The database selection was made based on experience and the types of journals that were expected to be relevant, given the relevant topic areas and literature already known to the study team. The topic areas and some example journals are listed below.

a. Environment (Journal of Environmental Economics and Management, Land Economics, Journal of Rural Studies)
b. Property (Journal of Property Research, Journal of Real Estate Research)
c. Location and planning (Journal of Urban Economics, Regional Studies)
d. Activities (Journal of Leisure Research)
e. Economic policy (Economic Development Quarterly)

Databases: Econ lit, Scopus

The criteria for inclusion in the literature review at the screening stage were discussed with the client at the inception meeting. The publication date covers material that could not be in the previous valuation study on undeveloped land that included PDL. The geographical criterion limits the review to studies that can be considered similar to the UK and may allow for transferability of monetised values.

Inclusion Criteria

General
Published in or after 2000
English language, UK focus, comparison study with UK or study of OECD/EU countries
Type of publication/study
Conference abstract/paper
Journal article – systematic reviews, REAs, quantitative, high quality observational and qualitative studies
High quality agency reports (e.g. OECD, MHCLG, EU)
PhD theses
Scope
Contains monetised estimates for the external impacts of developing on PDL sought in scope of work (disaggregated by land type, contamination, location etc.)
Information relevant for assessing quality of external benefits

Search strategies

We have used three search strategies.

SEARCH STRATEGY 1

The first search was structured to capture relevant literature using four groups of search terms: land type (previously developed land), the general valuation outcome, methodology and specific outcomes (area of interest).

Search terms:

Land Type	Outcome	Methodology	Area of interest
Previously developed land	Willingness to pay (WTP) / Willingness to accept (WTA)	Stated Preference	Landscape
or	*or*	*or*	*or*
Brownfield	Economic values / valuation	Contingent valuation	Access / Accessibility
or	*or*	*or*	*or*
Regeneration (Regenerated)	External / Environmental benefits	Economic valuation	Recreation / leisure
or	*or*	*or*	*or*
Redevelopment	External / Environmental costs	Revealed Preference	Sense of Community
or	*or*	*or*	
Derelict land	External / Environmental impacts	Hedonic pricing	

The last column contains the particular outcomes that the client included in the brief.

The search terms from the different columns are combined as follows:

a. Land type AND outcome (1496 citations)
b. Land type AND methodology (64 citations)
c. Land type AND area of interest (8673 citations)

The number of citations resulting from each search is shown in parentheses.

As search c resulted in an unrealistic number of citations to screen, we implemented a second search strategy, which separated out the land type and development related keywords to ensure that any citations included both dimensions.

SEARCH STRATEGY 2

Land Type	Development	Outcome	Methodology	Area of interest
Previously developed land	Regeneration (Regenerated)	Willingness to pay (WTP) / Willingness to accept (WTA)	Stated Preference	Landscape
or	*or*	*or*	*or*	*or*
Brownfield	Redevelopment / Redeveloped	Economic values / valuation	Contingent valuation	Access / Accessibility
or	*or*	*or*	*or*	*or*
Contaminated land / site	Development / developed	External / Environmental benefits	Economic valuation	Recreation / leisure

or Industrial land / site *or* Derelict land / site		*or* External / Environmental costs *or* External / Environmental impacts	*or* Revealed Preference *or* Hedonic pricing	*or* Sense of Community *or* Community feeling

The search terms from the different columns are combined as follows:

d. Land type AND Development AND outcome (20 citations)
e. Land type AND Development AND methodology (10 citations)
f. Land type AND Development AND area of interest (138 citations)

The number of citations resulting from each search is shown in parentheses.

We note that there may be some duplication of results between the two search strategies.

The results for searches a and b from search strategy 1 and from searches a, b and c from search strategy 2 (in total 1728 papers).

SEARCH STRATEGY 3

For completeness, two further sets of search terms were used. Firstly, wellbeing and life satisfaction were added as methodologies. Secondly, (vacant) housing was added as a previous use.

The same searches (a,b,c) were run as in search strategy 2.

Search strategy 3 resulted in 395 citations. These were combined with the 1728 citations from the previous searches.

Screening of search results

Each of the combined 2123 results of the full searches were stored in EndNote as a record consisting of authors, title, abstract, publication year and journal or other type of publication. These records were then screened by researchers with literature review experience. The first screening phase was conducted within Endnote and was based on the selection criteria from the search protocol outlined in Table 4. The screening was checked by a researcher with economic valuation and literature review expertise. The resulting longlist of 45 papers was saved in an Excel spreadsheet and included details of the paper such as title, authors, date and abstract.

The longlist was circulated to senior project team members and the supporting expert who independently reviewed the list for inclusion in a shortlist of papers for full review. A final shortlist of 30 papers was then agreed and sent to MHCLG for review and approval.

Appendix B – Main survey questionnaire

Valuation of redevelopment of PDL – Questionnaire Structure (15 minutes online survey)

Introduction

Thank you for agreeing to participate in this interview. The purpose of this project is to develop an understanding of the UK public's preference for redevelopment of previously developed land (PDL),), which are often referred to as brownfields sites. Previously developed land refers to the land that previously been used for housing, industry or other uses. It maybe vacant or derelict or could still be in use but is considered as a possible area for redevelopment.

This study is being undertaken by Accent and RAND Europe, a not-for-profit research institute, for the Ministry of Housing, Communities & Local Government. The aim of the study is to quantify the benefits of developing previously developed land sites.

Please do your best to answer the questions as you understand them. We will undertake analysis on these to understand how preferences differ between different groups within society, but we will not identify individuals at any stage so your identity will be treated as confidential and kept private.

Any answer you give will be treated in confidence in accordance with the Code of Conduct of the Market Research Society. If you would like to confirm Accent's credentials type Accent in the search box at: https://www.mrs.org.uk/researchbuyersguide.
IF MOBILE DEVICE SHOW: **This survey is best undertaken on a tablet or a PC. If you do use a smartphone you can switch between desktop mode and mobile mode at any time by clicking the button at the bottom of the screen.**
For the purposes of administering the questionnaire and for analysis, we may collect demographic information. You do not have to answer any questions that you do not wish to and if you do you can withdraw your consent for us to process this information at any time. Any personal data collected over the course of this interview will be held securely and will not be shared with any third party unless you give permission (or unless we are legally required to do so). Our privacy statement is available at www.accent-mr.com/privacy/.
Do you agree to proceeding with the interview on this basis?

Yes
No **THANK AND CLOSE**

Section 1 Current experience with previously developed land (PDL) (brownfield sites)

Can I just ask you a couple of questions to check that you are eligible to take part in this research?

Q1
How old are you?
1. 18 – 24 years
2. 25 – 34 years
3. 35 – 44 years
4. 45 – 54 years
5. 55 – 64 years
6. 65 – 74 years
7. 75 years or older
8. Prefer not to say

Q2
Are you?
1. Male
2. Female
3. Prefer not to say

Q2A Please can you tell us the first part of your postcode. For example, if your full postcode is ME6 5AH, please just provide the first part i.e. ME6. Please select the letters from the drop-down menu (e.g. ME) and enter the numbers in the box (e.g. 6)

DROP DOWN AND BOX FOR POSTCODE NUMBERS HERE

Prefer not to answer	**THANK AND CLOSE**
None of the above letters	**THANK AND CLOSE**

The postcode you've given us is [insert area and district from look up]. Is that correct?

Yes

No **GO BACK TO PREVIOUS QUESTION**

Q3

Brownfield sites) refers to the land that has previously been used for housing, industry or other uses but is now vacant or derelict.

Do you currently, or have you previously, lived near a brownfield site or derelict land in your local area?

1. Yes, I currently live near a brownfield site / a few brownfield sites
2. Yes, I have previously lived near a brownfield site / a few brownfield sites
3. No, I have not ever lived near a brownfield site **GO TO Q9**

Q4

Thinking about the brownfield site or derelict site you currently live or previously lived nearby in your local area (if you currently live or previously lived near a few brownfield sites, please think about the site that affects / affected you the most), what was the site previously used for?

1. Residential
2. Community (e.g. old schools or hospitals)
3. Defence purposes
4. Business and industrial sites
5. Quarries and landfill
6. Retail and recreation
7. Don't know

Q5

For the brownfield site or derelict site you currently live or previously lived nearby in your local area, (if you currently live or previously lived near a few brownfield sites, please think about the site that affects / affected you the most), what is the current status of the site?

1. Still in use
2. Vacant, but usable
3. Vacant and derelict
4. Previous site with buildings demolished
5. Redeveloped or currently being redeveloped
6. Don't know

Q6

For the brownfield site or derelict site you currently live or previously lived nearby in your neighbourhood area, (if you currently live or previously lived near a few brownfield sites, please think about the site that affects / affected you the most), can you estimate how big it is? (for example , the size of a football pitch is around 0.5 hectares)

1. 0 – 0.5 ha
2. 0.5 – 1 ha
3. 1 – 5 ha
4. Over 5 ha
5. Don't know

Q7

Thinking about the brownfield site or derelict site you currently live or previously lived nearby in your local area, (if you currently live or previously lived near a few brownfield sites, please think about the site that affects / affected you the most), how far is it from you home? (please select the most relevant option)

1. Next to our home
2. Around ¼ mile away (0.4 kms, 5 minutes walk)
3. Around ½ mile away (0.8 kms, 10 minutes walk)
4. Around 1 mile away (1.6 kms, 20 minutes walk, 2-3 minutes driving)
5. Around 5 miles away (8 kms, 10 minutes driving)
6. Longer than 5 miles away (8 kms)
7. Don't know

Q8

For the brownfield site or derelict site you currently live or previously lived nearby in your local area, (if you currently live or previously lived near a few brownfield sites, please think about the site that affects / affected you the most), can you see the site from where you live? (please select the most relevant option)

1. Yes, it is /was visible from your home
2. It is /was not visible from your home, but it is /was visible travelling to / from your home
3. No, it is /was neither visible from your home, nor travelling to / from your home
4. Don't know

Q9

Please indicate whether you agree or disagree with each of the following statements about your neighbourhood (please think of the area within a few minutes walking distance from your home).? RANDOMISE ORDER

1. I think my neighbourhood is a good place for me to live
2. People in this neighbourhood do not share the same values as me
3. My neighbours and I want the same thing from this neighbourhood
4. I can recognise most of the people who live in my neighbourhood
5. I feel at home in this neighbourhood
6. Very few of my neighbours know me
7. I care about what my neighbours think about my actions
8. I have almost no influence over what this neighbourhood is like
9. If there is a problem in this neighbourhood people who live here can get it solved
10. It is important to me to live in this particular neighbourhood
11. The people who live in this neighbourhood get along well.
12. I expect to live in this neighbourhood for a long time

Section 2. Preference for redevelopment of previously developed land (brownfield sites)

Q10A (first choice experiment)

INTRO SCREEN 1

We'd now like you to imagine that you are asked to consider a situation where there may be two different brownfield sites in your area which could be re restored to open green spaces that is available for recreational uses. Each is described by the following characteristics:

Site type:
This is about the current state of the site and what it is/was used for previously.

Size of site:
This is about the size of the site to be restored.

Distance from your home:
This is about the distance between your home and the site.

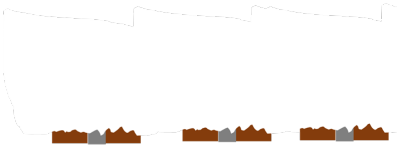
Level of contamination:
This is about the different levels of clean up the site requires to remediate the land.

In each case, we would like you to consider the two alternatives and indicate which you would prefer to see restored to an open green space

Please note that there are no correct answers, please consider each of the 5 scenarios carefully and indicate in each which option you would chose.

Below is an example of the choice:

Which option would you prefer to see restored to a green space?

Scenario xx	Restore Site A to a green space	Restore Site B to a green space
Site type	Buildings currently in use Used for Factory or industrial use 	Empty site with buildings demolished Used for housing 
Size of site (football pitch = 0.5 ha)	0.5 ha	5 ha
Distance from your home	Around 1/2 mile away (10 minutes walk)	Around 1 mile away (around 20 minutes walk, 2-3 minutes drive)
Level of contamination	Site currently contaminated. Restoring will include safely removing these materials from the site	No contamination
I would choose:	O	O

Q10B (second choice experiment)

We'd now like you to imagine that you are asked to consider a situation where there is a brownfield site in your area which could be redeveloped to green space. Please imaging that this is a site which would be around 0.5 miles from your home (0.8km and around 10 minutes walk) with no contamination .. In each case you will be given two different options of the way that the site could be used. Each is described by the following characteristics:

Size of site:
This is about the size of the site to be developed.

Landscape:
This reflects the landscape before and after redevelopment.

Recreational use after development:
This is about the range of recreational activities that you could do after the redevelopment

Accessibility after development:
This is about the ability to travel through to get to another destination by cycle or walking

Likely use by others:
This reflects the likely level of use by other people from your area or elsewhere.

Cost for restoring and maintaining the land (£/month/household):
This reflects the cost associated with the redevelopment and maintenance of the land which would be paid through some small increases in local taxes.

In each case, we would like you to consider the alternatives on offer and indicate whether you would keep the brownfield site as it is or whether you would choose to pay the amount indicated towards one of the ways that it could be redeveloped.

Please note that there are no right or wrong answers. Please consider each of the 5 scenarios carefully and indicate in each which option you would have chosen. Below is an example of the choice:

Would you keep the site in its current condition or choose one of the options for redevelopment?

	Current Land	Redevelopment Option A	Redevelopment Option B
Size of site (football pitch = 0.5 ha)	1 ha		
Previous use	Housing		
Landscape	Buildings currently in use	Restored to greenspace - with landscaping features and trees	Restored to greenspace - no landscaping features or trees
Recreational use after development		Can fully access all of the site and any routes within in for sport or recreation	can only walk, run, cycle around defined routes within the site
Accessibility after development		Can't pass through the site to other destinations	Can pass through the site to other destinations
Likely use by other people		Would be infrequently used by those from your area	Would be frequently used by those from your area and attracts people from elsewhere
Cost for restoring and maintaining the land (£/month/household)		£2.00	£5.00
I would choose :	Remain as Now O	Develop Option A O	Develop Option B O

Q11

Did you feel able to make the choices?

1. Yes **GO TO Q13**
2. No.

Q12

Why were you unable to do that? Please specify in the box below

Section 3. Attitudes towards the redevelopment of previously developed lands (brownfield sites)

Q13

Please indicate the extent to which you agree or disagree with each of the following statements on the benefits of development of brownfield sites RANDOMISE ORDER

1. Increase sense of belonging
2. Improve the public perception of the area
3. Encourage recreation and connectivity
4. Reduce urban sprawl
5. Protect industrial heritage
6. Reduce the use of greenfield sites for development
7. Protect greenbelt
8. Reduce air and water pollution
9. Prevent the spread of contaminants
10. Create and protect wildlife habitats
11. Improve aesthetic quality of the urban fabric
12. Create green open spaces
13. Encourage the people in this neighborhood to share the same values
14. Encourage the people in this neighborhood to get to know each other better
15. Improve the influence that people in this neighborhood have over what this neighborhood is like

Q14

Are you a member of any environmental groups? (TICK ALL THAT APPLY)

1. The National trust
2. English Heritage
3. The Wildlife Trusts
4. Friends of the Earth
5. Keep Britain Tidy
6. Campaign to Protect Rural England (CPRE)
7. Energy Saving Trust
8. Others, please specify_____
9. None

Q15

Which of the following recreational activities using public green space do you participate in, and how often?

What activities do you do?	At least once a week	a few times a month	Less often	Never
Walking / hiking / dog walking				
Enjoying the scenery / bird, wildlife watching				
Jogging / running				
Relaxing, resting or hanging-out / visiting or meeting friends				
Cycling				
Using children's playgrounds				
Eating lunch outside / picnicking or barbequing/ reading outside				
Unorganised active play: Frisbee, catch, rollerblading				
Sunbathing				
Formal / informal sporting activities: football, cricket, etc				
Active court sports: basketball, tennis,				

volleyball				
Fishing				
Swimming / wading				
Boating / canoeing				
Other, please specify				

Section 4. About You

We would now like to ask a few questions which will help us to understand some of the information you have provided us. Please be assured that all details you give will be treated with the strictest confidence.

Q16

Which of the following statements best describes your current employment status?

1. In full-time paid work (or away temporarily) (employee, self-employed, working for your family business)
2. In part-time paid work (or away temporarily) (employee, self-employed, working for your family business)
3. In education, (not paid for by employer) even if on vacation
4. Unemployed and actively looking for a job
5. Unemployed, wanting a job but not actively looking for a job
6. Permanently sick or disabled
7. Retired
8. Doing housework, looking after children or other persons
9. Other, please describe
10. Don't know

Q17

Which of these levels represents the highest academic qualifications you have?

1. No formal qualifications
2. GCSE (or CSE) / O level / School Certificate
3. 'A' levels or equivalent
4. Professional qualification below degree level
5. Bachelor's degree level qualification or equivalent
6. Higher degree
7. Other, please describe

Q18

Do you (or your household) own or rent the accommodation you live in?

1. Own it outright
2. Own it with a mortgage/loan
3. Part own and part rent (shared ownership)
4. Rent it (private renting)
5. Rent it (social renting including those who are on House Benefits or Local Housing Allowance)
6. Live here rent-free (including rent-free in relative's/friend's property but excluding squatters)
7. Other, please describe
8. Don't know

Q19

How long have you stayed in the accommodation?

1. Less than 1 year
2. 1 – 3 years
3. 3 – 5 years
4. Longer than 5 years

Q20

How many adults and children are there in your household?

Number of Adults (aged 18 and plus including yourself):_____

Number of Children (aged below 18):_____

Prefer not to say

Q21

What is your current marital status?

1. Married or in a civil partnership
2. Separated (still legally married or still in a civil partnership)
3. Divorced / Formerly in a civil partnership, now legally dissolved
4. Widowed / Formerly in a civil partnership, partner died
5. Single, that is, never married AND never in a civil partnership
6. Prefer not to say

Q22

What is your household's combined yearly income (before tax and National Insurance has been taken off)?

1. Up to £9,499
2. £9,500 - £15,499
3. £15,500 - £24,999
4. £25,000 - £34,999
5. £35,000 - £49,999
6. £50,000 - £74,999
7. £75,000+
8. Prefer not to say

Q23

How would you describe your ethnicity? Please tick one box only

1. White
2. Black or Black British
3. Asian or Asian British
4. Chinese
5. Mixed
6. Other ethnic group (please specify):_____

Q24

Do you have a physical or mental impairment (including those age-related) which limit your daily activities or the work you can do?

1. No, none
2. Mobility impairment
3. Visual impairment
4. Hearing impairment
5. Learning disability
6. Mental health condition
7. Serious long term illness
8. Other(please specify):_____
9. Prefer not to say

Q25 Do you have any other comments or thoughts on this survey?

No

We really appreciate the time that you have given us today. Would you be willing to be contacted again for clarification purposes or be invited to take part in other research for the Ministry of Housing, Communities & Local Government?

Yes, for both clarification and further research
Yes, for clarification only
Yes, for further research only
No

Thank you. This research was conducted under the terms of the MRS code of conduct and is completely confidential.

Appendix C - Technical details of the choice models

Introduction to discrete choice models

Discrete choice models have been used in this study to explain the choice behaviour of respondents when presented with different options in the choice experiments. The basic tenet of discrete choice modelling is utility maximisation, that is, given a set of alternatives, each individual chooses the alternative which brings them the most utility. It is assumed that utility is derived from the underlying characteristics or attributes (Lancaster 1966) and typically on the Random Utility Model developed by McFadden (1973) and by Manski (1977), under which utility has a systematic and a random component. The random component may result from unobserved or unobservable attributes, unobserved taste variations, measurement errors or specification errors (Ben-Akiva & Lerman, 1985).

The model estimation can therefore be conducted within the framework of random utility theory, thus accounting for the fact that the analyst has only imperfect insight into the utility functions of the respondents. Mathematically, the utility function for an alternative, i, being chosen (from of a set of J alternatives) is decomposed into the systematic component, labelled V_i, and a random component ε_i:

$$U_i = V_i + \varepsilon_i \; \forall \, J$$

The observable part of the utility function (V_i) for each alternative contains the characteristics of the alternatives (the attributes and levels from the choice experiment) and the individual, and can be written as:

$$V_i = \sum_k \beta_{ik} X_{ik}$$

where β_{ik} are coefficients multiplying attributes in the choice experiment and background variables, i.e. X_{ik}. The values of these vary across alternatives (k) and individuals (i).

The assumption that the random components are distributed extreme value type 1 (EV1) enables the choice data to be analysed using the closed-form multinomial logit (MNL) model (McFadden 1974). This produces estimates of the model coefficients that best represent respondents' choices. The standard statistical criterion of maximum likelihood is used to define best fit. The model estimation provides both the values of the coefficients (in utility terms) and information on the statistical significance of the coefficients.

The MNL formulation reflects the probability of choosing alternative i from J alternatives as follows:

$$P_{ni} = \frac{e^{\mu V_{ni}}}{\sum_{n_{j \ni J}} e^{\mu V_{nj}}}$$

where μ is a strictly positive scale parameter.

The key assumption regarding the random component is not so much the shape of the distribution as that the errors are independent of each other. This independence means that the unobserved portion of utility for one alternative is unrelated to the unobserved portion of utility for another alternative. Moreover, the MNL exhibits independence from irrelevant alternatives, which implies proportional substitution between alternatives.

In the second choice experiment each respondent was presented with three alternatives (some of which might be considered as 'similar' in several different dimensions). It was therefore possible to explore a nesting structure (Daly 1987), whereby:

- For any two alternatives that are in the same nest, the ratio of the probabilities is independent of the attributes or existence of all other alternatives; and
- For any two alternatives in different nests, the ratio of the probabilities can depend on the attributes of the other alternatives in the two nests.

In the analysis we explored whether the substitution patterns differed between alternatives of different restoring PDL options.

Table 36 describes the interpretation of the resulting model fit statistics and model coefficients.

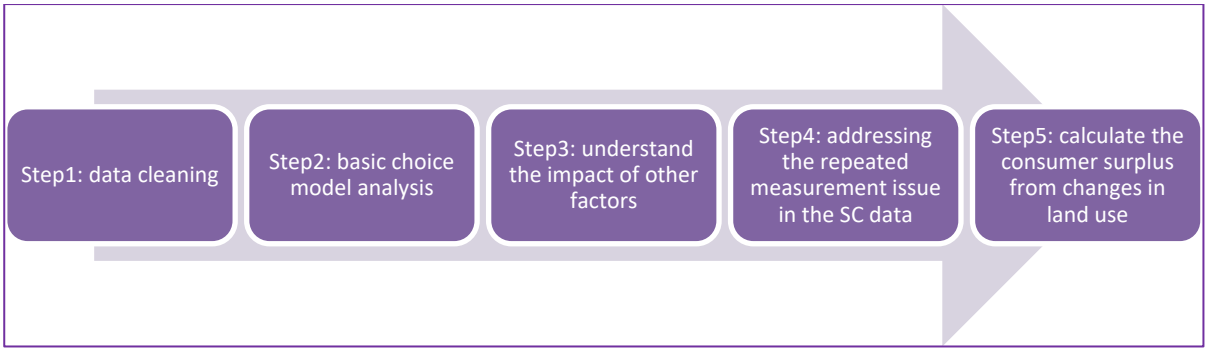
Table 36 Interpretation of the model fit statistics and coefficient estimates

Statistic	Definition
Observations	The number of choice observations included in the model estimation (reflecting the number of respondents and number of choice scenarios).
Final log (L)	This indicates the value of the log-likelihood at convergence. The log-likelihood is defined as the sum of the log of the probabilities of the chosen alternatives, and is the function that is maximised in model estimation. The value of log-likelihood for a single model has no obvious meaning; however, comparing the log-likelihood of two (nested) models estimated on the same data allows the statistical significance of new model coefficients to be assessed properly through the Likelihood Ratio test.
DOF	Degrees of freedom, i.e. the number of coefficients estimated in this model. Note that if a coefficient is fixed to zero then it is not a degree of freedom.
$Rho^2(c)$	If we compare the log-likelihood (LL(final)) value obtained with the log-likelihood of a model with only constants (LL(c)) we get: $Rho^2(c) = 1 – LL(final)/LL(c)$ A higher value indicates a better-fitting model.
Interpreting the coefficient estimation	
Sign	The sign of the coefficient indicates the preference for that attribute. A positive sign indicates that the attribute has a positive impact on respondents' choices, and therefore the attribute is preferred by respondents and vice versa. In the case of attributes with different levels that have been coded as categorical variables in the choice models it indicates the preference for an attribute level relative to its base level. The base level is a fixed attribute level relative to which the effects of other attribute levels are measured. A positive sign indicates that the attribute level is preferred relative to the base level by respondents and vice versa.
Magnitude	The magnitude of the coefficient indicates the degree of preference. The larger the coefficient the stronger the preference for the attribute.
Base level	In the case of categorical variables it is necessary to fix a coefficient related to one of the levels to zero in order to estimate the model. The coefficients estimated for all other levels in that variable are then estimated with reference to the base level.
t-ratio	This indicates the significance of the coefficient. A 't-ratio' numerically greater than (+/-) 1.96 indicates that the corresponding coefficient is significant at a 95 per cent level and in practice is a commonly accepted level at which the effect implied by the coefficient is called significant. A 95 per cent significance level indicates that the corresponding effect identified has only a 5 per cent chance of being purely random.

Data analysis and development of the models in this study

We have undertaken a systematic approach for analysing the main survey data. The process is shown in the **Figure 22**.

Figure 22: Data analysis procedures



STEP1: DATA CHECKING AND CLEANING

Once the data collection was completed, we undertook the data cleaning and checks on the SC responses. The following aspects were assessed:

- We assessed the self-reported assessments of the understanding of the choice tasks and the ease of completing these. These diagnostic questions were used to gauge the respondent's engagement with the task and their level of understanding.
- Any non-trading behaviours (between alternatives) were also examined against the diagnostic questions to assess if the non-trading appears to reflect strong preferences, or whether it indicates a lack of engagement or understanding of the task.
- We have also assessed the time respondents spent on the choice experiment and surveys to see if any respondents with very short or very long completion time.

During the pilot survey stage, we tested the impact of time spent on the first choice experiments on the model performance. We found that the model fit was improved when respondents who completed the first choice experiments in 30 seconds or less were dropped. This accounted for about 10 per cent of the observations. In the main survey, we did the same, and based on the model findings, we dropped the respondents who completed the first choice experiment in 30 seconds. This led to a loss of around 9 per cent of the overall sample.

We emphasise that any exclusion of data observations has been made based on analysis of how these impact model fit (to see if the exclusion would contribute to better interpreting the choice behaviour). We emphasise that our preference is to retain as many observations as is possible.

STEP 2: BASIC MODEL ANALYSIS.

As stated in Section 3, two different SC experiments were undertaken by respondents. First we estimated choice models for each experiment separately and then sought to develop a model pooling both data sets, jointly estimating coefficients common to the two experiments. We explicitly take account of different error variation in the models using scaling coefficients (see Bradley and Daly, 1991). This approach allows us to draw on the relative strength of the two experiments.

The first choice experiment provides a rich understanding of the relative value placed on different attributes of developing previously developed land; whereas the second provides a richer understanding of the willingness to pay for changes, and priorities for doing so.

For the second choice experiment we test a model with a nested tree structure which allows us to represent different substitution patterns between alternatives. This structure allows us to recognise that the two redevelopment options (Redevelopment Options A and B) may be more similar as alternatives to each other than to the "Remain as now" option.

Table 37 (below) presents the model results. Separate models were developed initially for SP1 (column 1) and SP2 (column 2), followed by a joint model pooling the choice observations from both experiments (column 3).

Table 37 Separate model analysis and the joint base model analysis

	SP1 basic SP1		SP2 SP2 - base		SP12 SP1 and SP2 joint	
Observations	10905		10905		21810	
Final Log Likelihood	-7323.3		-9824.1		-17241.5	
D.O.F	13		18		16	
Rho²(c)	0.031		0.106		0.070	
Previous Use						
Housing	0	n/a	0.0000	n/a	0.0000	n/a
Office, shop or business site	-0.0497	-1.14	0.3812	1.48	-0.0497	-1.14
Factory or industrial use	-0.1553	-3.52	1.0745	2.85	-0.1553	-3.52
Local authority site (school, hospital, council buildings)	0.0400	0.90	0.0063	0.03	0.0400	0.90
MOD barracks or airfield	-0.1175	-2.73	1.1710	2.96	-0.1175	-2.73
Quarry or landfill	-0.1471	-3.29	1.5987	3.19	-0.1471	-3.29
Size of site						
size of site (coded as continuous variable)	0.0315	4.62	-0.0575	-1.46	0.0315	4.62
distance from your house						
Distance (coded as continuous variable)	-0.07692	-10.54			-0.0773	-10.63
Level of contamination						
No contamination	0.0000	n/a			0.0000	n/a
Needs contaminated materials to be removed from site	-0.2468	-8.89			-0.2471	-8.85
Land needs treating to remove contamination from soil	-0.2537	-9.18			-0.2556	-9.21
PDL type						
Buildings currently in use, but with permission to redevelop it	0.0000	n/a	0.0000	n/a	0.0000	n/a
Buildings currently vacant, but usable	0.2154	6.31	0.4498	2.27	0.2413	7.79
Buildings currently vacant, and derelict	0.4349	12.80	2.1005	3.54	0.5020	16.25
Previous site with buildings demolished	0.4319	12.62	1.7121	3.57	0.4836	15.55
Landscape after development						
Restored to greenspace - no landscaping features or trees			0.0000	n/a	0.0000	n/a
Restored to greenspace - with landscaping features and trees			0.2613	11.16	0.2793	6.28
Recreational use after development						
No public access within the site			0.0000	n/a	0.0000	n/a
Can only walk, run, cycle around defined routes within the site			0.7185	13.26	0.7304	6.71
Can fully access all of the site and any routes within it for sport or recreation			0.9183	17.05	0.9478	6.88
Accessibility after the development						
Can't pass through the site to other destinations			0.0000	n/a	0.0000	n/a
Can pass through the site to other destinations			0.2011	8.62	0.2000	5.70
Likely use by other people (Sense of community)						
Would be infrequently used by other people			0.0000	n/a	0.0000	n/a
Would be frequently used by those from your area			0.4463	12.22	0.4269	6.14
Would be frequently used by those from your area and attracts people from elsewhere			0.3844	10.44	0.3540	5.76
Cost for restoring and maintaining the land						
Cost for redevelopment (coded as continuous variable)			-0.1103	-30.33	-0.1080	-6.82
Alternative specific constants						

Left bias for SP1 experiment	0.0333	1.70			0.0335	1.70
Alternative specific constants for remain the current PDL land			-0.4946	-2.86	0.0000	n/a
Model structure parameters		t(1)		t(1)		t(1)
Nesting structure parameter for remain the current PDL land opt			1.0000	n/a	1.0000	n/a
Nesting structure parameter for the two development options			0.4055	5.83	0.9418	1.57
Scale parameter for SP1 (base)					1.0000	n/a
Scale parameter for SP2					1.0053	0.04

For SP1: respondents were presented with binary choices to select a PDL site to be redeveloped. To briefly discuss the findings:

- The PDL types are positively estimated relative to the level of "building still in use but with permission to redevelop". This indicates that respondents are more likely to select the more 'demolished' PDL site compared to the one that is still in use to be redeveloped.[48]
- For previous use, compared to "used for housing", the other previous uses were negatively estimated especially for the quarry or landfill (although most of them are not statistically significant at the 95% confidence interval). Respondents prefer the PDL sites that were used for housing purposes compared to other previous type to be redeveloped.
- Size of site, was incorporated as a continuous variable. It is positively estimated which indicates that respondents prefer to re-develop a site that is larger in area size with everything else being equal.
- For distance, the distance was included in the model as a continuous variable. The coefficient was strongly and negatively estimated which indicates that respondents prefer to redevelop the PDL to greenspace nearer to their home.
- For contamination treatment, in the pilot survey we found respondents prefer to redevelop a site that doesn't require the treatment of contamination compared to the ones that are polluted. The level descriptions were clarified to focus on the end product regarding contamination and to be clear that the process of dealing with contamination would be carried out in a safe manner. However, in the main survey, we obtain a similar pattern of results where respondents prefer to restore the land with no contamination. This can be interpreted as the public prefers to have the redeveloped land on the non-contaminated land rather than the contaminated land.

For SP2: respondents were presented with three alternatives (remain as now and two redevelopment options).

- For previous use, we observe that the signs of the coefficients are very different from the results from the SP1 output. Although the coefficients for levels of "offices, shops" and "local authority sites" are not statistically significantly different from the reference level "housing use".
- For land size, again, we found that the sign of this coefficient is different from those of the SP1 results, although it is not statistically significantly estimated.

[48] In the model, the level three (building current vacant but derelict) has a slightly high magnitude compared to the level four (buildings demolished) (0.4369 vs 0.4332). However the differences are not statistically significant at the 95% confidence interval (t = 0.52).

- For PDL type, similarly as the SP1, we found that compared to the level 'building currently in use but with permission to redevelop it', the other three levels are positively estimated which indicates that public prefer to restore the more derelict site.
- For landscape benefits, respondents prefer the sites with landscaped features over no landscaping, which is sensible
- For recreation benefits, respondents prefer alternatives that can be used for recreational purposes. Respondents place more weight on the level that they could fully access all of the site and routes within it for sport or recreation,
- For accessibility, we observe a positive preference for cases where it is possible to pass through the site to other places.
- For sense of community, respondents show a strong preference that the restored PDL land would be frequently used by those from their own area and also the level that attracts people from elsewhere. Interestingly, we found that public placed a slightly higher weight on the likely use by their own area compared to the use by their own area and also attracts people from elsewhere which indicate they dislike the restored land being used by people from outside of their area (although the impact is relatively small).
- Cost is strongly and negatively estimated in the model which is expected.
- A plausible nesting structure is found in this model - there is higher substitution pattern between the two redevelopment options in the SP2.

Comparing the model findings between SP1 and SP2, it is found the sign of PDL types are consistent with each other. However the coefficients for previous use and size of site have different signs (although the size attribute is not significantly estimated in the second choice experiment).

As mentioned in the design stage, the first choice experiment aims to provide a rich understanding of the relative value placed on different attributes of developing previously developed land; whereas the second provides a richer understanding of the willingness to pay for changes, and priorities for doing so. With regards to the respondents' preference in relation to the previous use of the sites to be restored, we think the first choice experiment provides more robust results. Whilst in the second choice experiment with options between developing a PDL or not, we would likely pick up the two extremes of individuals wanting to see development, and those wishing to block it, but potentially not have sufficient sensitivity within the choices to understand preferences for different PDL previous use (which was held constant within each choice scenario). Based on the above, we used the PDL previous use and size coefficients from the first choice experiment to feed these into the joint model analysis.

For the joint model, the coefficients for the PDL type are jointly estimated between the two experiments. The previous use and land size coefficients were drawn from the first choice experiment with a scale parameter to capture the potential differences in error variances between the two choice experiments (Bradley and Daly, 1991). As expected, most of the coefficients in this joint model follow a similar pattern as those in SP1 and SP2 respectively. The scale parameter for SP2 was larger than SP1 which indicate that the choices in the SP2 experiment were more consistent than those in the SP1 experiment (i.e. less variance in the errors), although it was not statistically significant.

The nesting parameter in the joint model is not statistically significantly estimated which indicates that there is no significantly higher substitution pattern between the two redevelopment options.

EXPLORATION OF THE IMPACT OF COST ON CHOICES

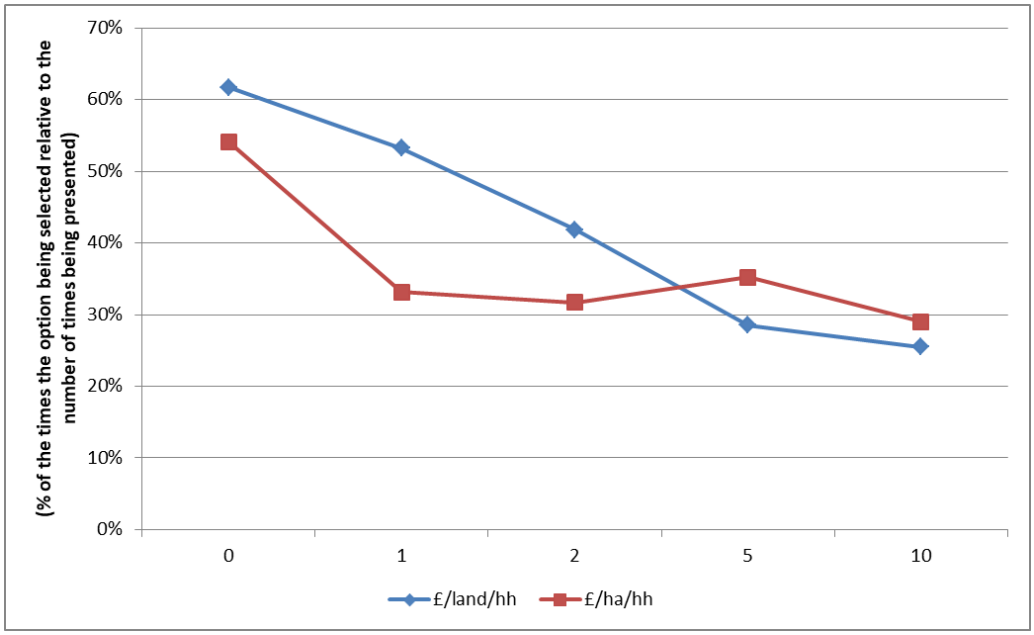
Figure 23 presents information on how the cost presented in the experiments influences the choices that people made, specifically the percentage of respondents that select the option with the particular cost level over the total number of the times that this attribute level has been presented. The analysis excludes the choice of "remain as now" option. A clear downward trend can be seen which indicates that respondents are sensitive to the cost level in the choice experiment, specifically with the increase of the cost respondents were less likely to choose the option.

In the choice experiment, cost was presented in the units of "£/month/household" similar to the format of the council tax. We test two different cost measures in the analysis and model:

- In the unit of £/site/month/ household" which is the same how the costs were presented in the choice experiment
- Converted to the unit of £/ha/month/household using the size of site variable in the experiment,

A clear downward trend can be seen for both of the specifications which indicates that respondents are sensitive to the cost level in the choice experiment, specifically with the increase of the cost respondents were less likely to choose the option. For the first measure, a steady downward trend can be observed until £5/land/hh and then the slope gets slightly flatter. Whilst for the second cost unit, we observed that the slope was relatively deep from 0 – 1 (£/ha/month/hh) and then gets flatter onwards.

Figure 23: Cost attribute analysis



We have tested both cost specifications using data from the second choice experiment data only. Below Table 38 shows the model comparison results.

Apart from v13, the other models (v12, v14, v15, v16) have incorporated cost as the unit price (£/ha/hh/month). And for v13, the cost term is modelled as total price of the land (£/land/month). The best performed model is v15, which contains both linear and logarithmic cost terms, as the best Final Log likelihood is achieved. However, it envisaged to be challenging to have this specification in the consumer surplus values calculation as it would make the appraisal values contingent upon the level of cost passed on to the public (the derivative of β.log(cost) being β/cost).

The second best model, judged on fit to the data, is v13 where cost was modelled as total price rather than unit price. There is only a small loss in model fit with this specification compared to v15, but it is considerably simpler to use for appraisal as the consumer surplus will be independent of the level of cost passed on to the public (the derivative of β.cost being β). This specification based on total price is judged to be sensible – as the total land value may be affected by the size of the land. However, the benefits (landscaping, accessibility, sense of community and recreational) would be less sensitive by the land size. The model reflects that there is greater benefit from larger sites, but does not constrain the benefits placed on other aspects to scale linearly with size. We therefore use the v13 specification (cost included as a linear term using the unit of £/site/month/household) in the model development.

Table 38 Cost specification tests

Model	**SP2_v12.F12**		**SP2_v13.F12**		**SP2_v14.F12**		**SP2_v15.F12**		**SP2_v16.F12**	
Description	**linear cost (£/ha/hh)**		**linear cost (£/land/hh)**		**linear with a zero cost constant**		**linear with a log cost**		**log cost only**	
Obs	10905		10905		10905		10905		10905	
Final LL	-10062.5		-9824.1		-9883.4		-9796.1		-9862.5	
D.O.F.	18		18		19		19		18	
Rho²(0)	0.16		0.18		0.175		0.182		0.177	
Rho²(c)	0.085		0.106		0.101		0.109		0.103	
	Coef	t	coef	t	coef	t	coef	t	coef	t
Cost	-0.0412	(-20.8)	-0.1103	(-30.3)	-0.01119	(-4.6)	0.04902	-11.6	0	(*)
Cost_0					0.9236	-18.1	0	(*)	0	(*)
Log_Cost							-0.7737	(-22.3)	-0.4208	(-28.2)
Access2	0.1294	-5.7	0.2011	-8.6	0.2017	-8.6	0.1913	-8.2	0.154	-6.7
Access1	0	(*)	0	(*)	0	(*)	0	(*)	0	(*)
Recret3	1.02	-18.7	0.9183	-17.1	0.9843	-18.4	0.9225	-17.1	1.002	-18.3
Recret2	0.8251	-14.8	0.7185	-13.3	0.7901	-14.8	0.7116	-12.9	0.7948	-14.2
Recret1	0	(*)	0	(*)	0	(*)	0	(*)	0	(*)
LandSize	-0.130	(-3.2)	-0.0575	(-1.5)	-0.0616	(-2.2)	-0.1745	(-6.1)	-0.1581	(-5.7)
Preuse6	1.699	-3.4	1.599	-3.2	1.183	-4.8	1.27	-4.7	1.187	-4.4
Preuse5	1.297	-3.3	1.171	-3	0.8444	-4	0.9181	-4	0.8925	-3.9
Preuse4	0.0357	-0.2	0.00626	0	0.01292	-0.1	0.1507	-0.9	0.06637	-0.4
Preuse3	1.163	-3.1	1.074	-2.8	0.7827	-3.8	0.8755	-4	0.8264	-3.8
Preuse2	0.4339	-1.6	0.3812	-1.5	0.2902	-1.7	0.4815	-2.7	0.3731	-2.1
Preuse1	0	(*)	0	(*)	0	(*)	0	(*)	0	(*)
Landscape6	0.2647	-11.6	0.2613	-11.2	0.257	-11.1	0.3249	-13.7	0.3065	-13.1
Landscape5	0	(*)	0	(*)	0	(*)	0	(*)	0	(*)
Landscape4	1.84	-4	1.712	-3.6	1.229	-5.5	1.276	-5.3	1.262	-5.1
Landscape3	2.281	-4	2.1	-3.5	1.533	-5.9	1.526	-5.3	1.526	-5.2
Landscape2	0.4375	-2.1	0.4498	-2.3	0.3864	-2.9	0.369	-2.7	0.3441	-2.5
Landscape1	0	(*)	0	(*)	0	(*)	0	(*)	0	(*)
Comm3	0.3765	-10.4	0.3844	-10.4	0.3841	-10.5	0.3884	-10.6	0.391	-10.7
Comm2	0.4864	-13.9	0.4463	-12.2	0.481	-13.4	0.3859	-10.3	0.4502	-12.6
Comm1	0	(*)	0	(*)	0	(*)	0	(*)	0	(*)
ASC1	-0.490	(-3.1)	-0.4946	(-2.9)	0.01482	-0.1	-0.5279	(-4.4)	-0.4001	(-2.9)
Opt_S2	0.3829	-4.3	0.4055	-3.9	0.5474	-7.5	0.5389	-6.6	0.5499	-6.3
Opt_S	1	(*)	1	(*)	1	(*)	1	(*)	1	(*)

STEP 3: UNDERSTANDING THE IMPACT OF OTHER FACTORS ON THE CHOICE BEHAVIOUR.

The utility functions were then developed, testing for and taking into account any differences in preferences that could be observed between different population segments. The current model at each stage was used to forecast the predicted choices of the respondents in the sample, and these were compared with the observed choices across a wide range of background characteristics to identify whether certain subgroups appeared to be responding in ways that the model was not capturing. Additional covariates were introduced to the model to address the potential variations in preferences across different sub-groups of population. The statistical significance of these (through individual coefficient t-ratios) and their impact on the model fit (through likelihood ratio tests) was examined and used to inform whether the additional terms provided a better fit to the data. Table 39 lists the background characteristics that were examined in the model.

Table 39 Background characteristics examined in the choice models

Demographics	Current experience with PDL	Life style
Age, Gender	With or without experience	Member of environmental
Area type	If yes, distance of the PDL	Recreational activities
Marital status	If yes, visible from	Sense of community
Tenure	If yes, distance to the PDL	Whether have disability
Number of	If yes, the size of the PDL	
Ethnicity	If yes, the previous use of	
Occupation		
Level of		
Household		

STEP 4: ACCOUNTING FOR THE REPEATED MEASUREMENT ISSUE WITHIN THE ANALYSIS.

In discrete choice experiments there are multiple observations from the same individuals, and in the case of this study each respondent completed ten choices in the survey (five in each experiment). As such the individual observations on which the model is based are not independent and therefore the naïve model does not provide true estimates of the significance of coefficient values.

The bootstrap technique is applied to provide an improved estimate of the standard errors over those provided by the naïve estimation that assumes independence between observations. The bootstrap procedure (Efron, 1979) is a very general resampling procedure for estimating the standard errors in cases where the theory does not provide an exact estimate of the error49. This resampling technique also identifies and corrects for other aspects of model misspecification.

This procedure is used in the present study. The final model results presented in this report contain standard errors and parameter t-ratios from models that have been bootstrapped.

Final model specification

Below we present the final model results after bootstrapping. The models reflect people preferences regarding PDL characteristics and the external benefits of restoring PDL: landscape, accessibility, recreation and sense of community, accounting for different area

[49] Efron, B. (1979). Bootstrap methods: another look at the Jackknife. Ann. Statist. 7 1-26

type. We explicitly explore differences in preferences across different population segments (for instance the differences by social-economic groups and their current experience with PDL redevelopment). Therefore in the model development, we developed two sets of the models:

- Model to obtain average values across the whole sample (Model 1): across overall sample but allowing variation in preferences by area type and region (we use these to calculate values for appraisal).
- Model that accounts for the preference differences in subgroup of population (Model 2)[50]: based on above Model 1 but also accounting for the impacts of respondents' socio-economic characteristics and their current experience with the PDL (for policy understanding more generally).

Table 40 Final model specification

	Model 1		Model 2	
Observations		21810		21810
Final Log Likelihood		-17181.7		-17098.1
D.O.F		25		37
$Rho^2(c)$		0.074		0.078
Previous Use				
Housing, office, business site, and local authority sites (school, hospital, council buildings)	0.0000	n/a	0.0000	n/a
Factory or industrial use, MOD barracks or airfield and Quarry or landfill	-0.1341	-3.98	-0.1341	-3.98
Size of site				
Land size (continues variable)	0.0318	3.70	0.0318	3.70
Distance from your house				
Distance (continuous variable)	-0.0331	-6.35	-0.0333	-6.42
Distance (continuous variable) - urban with rural (additional)	-0.0300	-2.33	-0.0292	-2.31
Level of contamination				
No contamination	0.0000	n/a	0.0000	n/a
Site currently contaminated. Restoring will include safely removing these materials from the site or treating the soil to clean up the site	-0.2362	-9.24	-0.2285	-5.56
- South west (additional)	-0.1673	-1.86	-0.1598	-1.69
- female (additional)			-0.0895	-1.96
- housing benefits (additional)			-0.1859	-2.33
- with a degree or higher education (additional)			0.2039	3.39
PDL type				
Buildings currently in use, but with permission to redevelop it	0.0000	n/a	0.0000	n/a
- urban with rural (additional)	-0.2796	-3.79	-0.2416	-3.13
Buildings currently vacant, but usable	0.2284	7.58	0.2286	7.24
- urban with rural (additional)	-0.2719	-4.07	-0.2427	-4.09
Buildings currently vacant, and derelict, buildings demolished	0.4152	14.91	0.4283	14.49
Landscape after redevelopment				
Restored to greenspace - no landscaping features or trees	0.0000	n/a	0.0000	n/a
Restored to greenspace - with landscaping features and trees	0.3107	5.37	0.1680	4.18
- aged 18 - 34 (additional)			-0.1993	-3.18
- female (additional)			0.0896	2.24
Recreational use after development				

[50] Model 2 is an extended version of Model 1 but with covariates to capture the differences by sub-group of population. The log likelihood ratio test shows that Model 2 has a b significantly better fit to the data than Model 1.

No public access within the site	0.0000	n/a	0.0000	n/a
Can only walk, run, cycle around defined routes within the site	0.6610	4.54	0.4713	4.64
- urban with rural (additional)	0.2089	1.53	0.0000	n/a
- rural (additional)	0.3042	1.98	0.1926	1.69
Can fully access all of the site and any routes within it for sport or recreation	0.8591	5.55	0.5476	5.14
- urban with rural (additional)	0.3209	2.48	0.0936	1.70
- rural (additional)	0.4123	2.49	0.2286	1.80
- aged 18 - 24 (additional)			0.1209	1.83
- aged 65 and plus (additional)			0.1501	2.44
Accessibility after the development				
Can't pass through the site to other destinations (reference)			0.0000	n/a
Can pass through the site to other destinations	0.1554	3.73	0.1587	4.41
- stayed at the current place for less than 1 year (additional value)			-0.1662	-2.46
- urban with rural (additional)	0.1585	2.76		
Likely use by other people (Sense of community)				
Would be infrequently used by other people	0.0000	n/a	0.0000	n/a
Would be frequently used by those from your area and people from elsewhere	0.4570	5.33	0.2321	4.64
- female (additional)			0.1237	1.95
Cost for restoring and maintaining the land				
Cost for redevelopment (coded as continuous variable)	-0.1033	-5.80	-0.0672	-4.84
- urban with significant rural (additional)	-0.0560	-3.76	-0.0317	-3.72
- rural area (additional)	-0.0381	-3.06	-0.0224	-2.61
Alternative specific constants				
Left bias for SP1 experiment	0.0332	2.26	0.0329	2.22
- Aged between 18 - 34			0.3140	3.18
- full or part time employment			-0.1393	-1.81
- North and West	-0.2694	-2.12	-0.1680	-2.11
- housing benefits (tenure)			0.2213	2.24
- stay at the current place for less than one year			-0.3958	-2.77
Scale_1	1.0000	n/a	1	n/a
Scale_2 (scale parameter for SP2 observations)	0.8684	1.05	1.3859	1.17
Opt_S	1.0000	n/a	1	n/a
Opt_S2 (nesting parameter for two redevelopment options in SP2 experiment)	1.0000	n/a	0.6349	4.66

* this is the t-ratio measured relative to 1 (reference parameter)

STEP 5: CALCULATION OF CONSUMER SURPLUS FROM CHANGES IN LAND USE (TO FOLLOW)

The choice model has been structured to reflect a choice between maintaining a given PDL site (with varying previous use, level of dereliction, level of contamination, size and distance) or restoring to an undeveloped state (with varying levels of landscaping, use for recreation, accessibility, and impact on sense of community). It is therefore possible to run a range of scenarios through this model to understand the levels of consumer surplus that will accrue to the population in each.

The consumer surplus for different scenarios of PDL and restored UDL can be directly calculated from the logsums from the choice model, divided by the marginal utility of income (in our case the cost coefficient).

In our choice experiment we asked respondents to consider that they would have to pay towards the restoration of different sites through increases in their council tax. This acted as a mechanism to allow us to estimate their relative senility to cost (their marginal utility of income) in a framework that ensured consistency with the measures of utility gained from the other benefits being valued. However, in practice we would not expect that local residents would be asked to contribute towards restoration for any individual

redevelopment site. Therefore, in the calculation of the consumer surplus we assume that there is no direct cost to residents in the various scenarios for different configurations of PDL being restored with differing levels of benefit.

The consumer surplus for each respondent is calculated and the individual consumer surpluses are summed across the sample (with weighting if required) to derive a total surplus:

$$CS_n = \frac{\ln\left(\sum_{j=1}^{J} e^{V_{nj}}\right)}{\beta_{cost}}$$

The choice model derived different cost coefficients for each area type which is used to derive the CS for each area type.

To ensure that we obtain the values consistent with the existing evidence for the UDL values, we mapped the PDL area type to the UDL type with the combination of the benefits using the attribute levels from the choice experiment (these are summarised in Table 19).The mapping is shown in Table 30 in Section 4 of the main report.

Table 41 presents an example of calculation of the CS values for a PDL site that was previously used for non-industrial purpose and is currently in use but with permission to redevelop. We calculate the CS for each UDL type (described by different combinations of the benefits as listed in the table).

Table 41 Calculating the consumer surplus for each PDL type and previous use (for a Non-industrial site that is currently in use but with permission to redevelop as an example, distance = 1 mile, size of site = 1 ha)

PDL area type	Previous Use	PDL type	Contamination	UDL land type	Recreation	Landscape	Accessibility	Sense of Community
Urban	Non-industrial	In use	No	Urban Core (city park)	R3	L6	A2	C2
Urban with rural	Non-industrial	In use	No	Urban Fringe (green belt)	R2	L5	A1	C1
Urban with rural	Non-industrial	In use	No	Urban Fringe (forest land)	R2	L6	A1	C2
Rural	Non-industrial	In use	No	Rural (forested land)	R2	L6	A1	C2
Rural	Non-industrial	In use	No	Agriculture land (extensive)	R2	L5	A1	C1
Rural	Non-industrial	In use	No	Agriculture land (intensive)	R1	L5	A1	C1
Rural	Non-industrial	In use	No	Natural and semi-natural land	R2	L6	A1	C2

We then run the same process for all PDL previous use (non-industrial and industrial sites) and type (in use, vacant and derelict) and level of contamination (no or with) to generate the CS for each relevant combination. In the calculations, we assumed that the distance to the site is 1 mile and the size of the site is 1 ha. The impact of distance to site and site size is discussed in the following sections.

The incremental impact of distance and land size on the CS values

To incorporate the impact of distance and land size (which are coded as continuous variables in the model), we have run a series of the values calculations for each distance point from 0.25 to 10 miles (with 0.25 mile for each interval) for each type of the UDL and then calculated the average the distance effect from across the types. A similar procedure was followed for the calculation of the land size effect. Figure 24 and Figure 25 show the impact of distance and land size on the CS values using PDL non-industrial sites that are current in use but with permission to redevelop.

Figure 24: Impact of distance on the CS for each UDL type values (using PDL non-industrial sites that are currently in use as example)

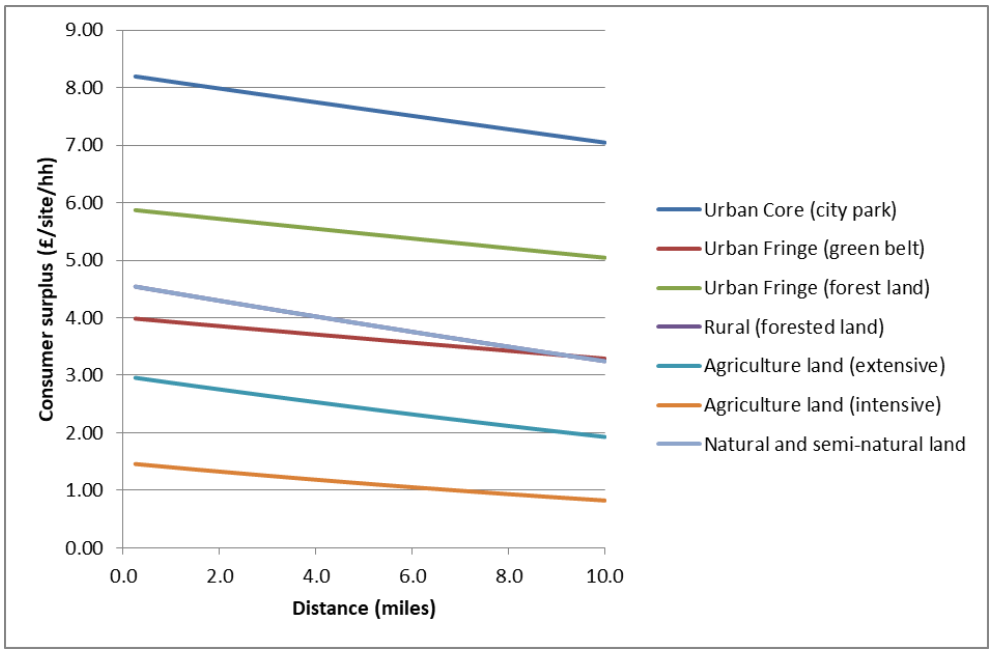
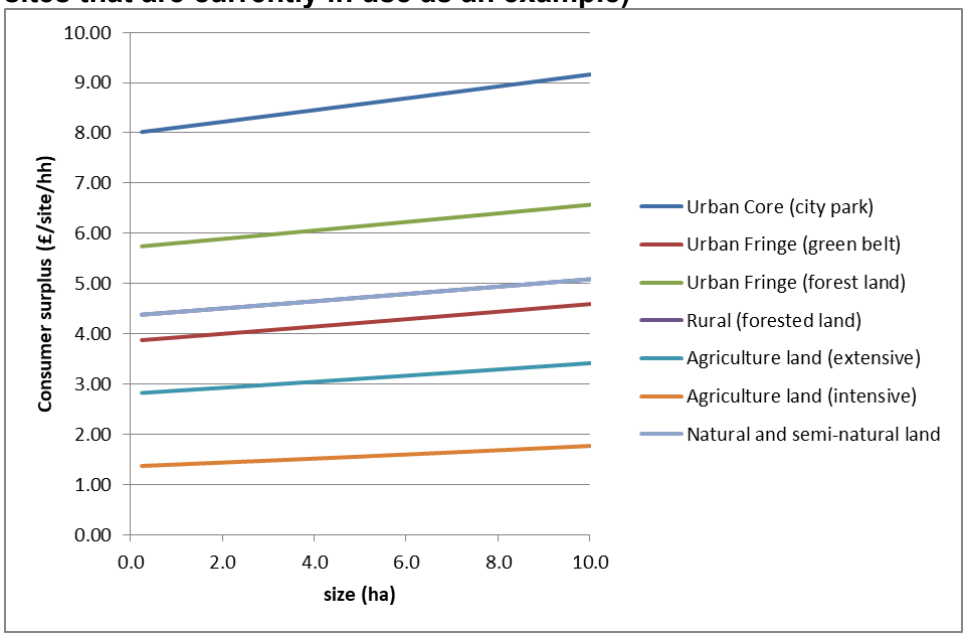


Figure 25: Impact of land size on the CS for each UDL type values (using PDL non-industrial sites that are currently in use as an example)



Typically the values reported in the literature, and those emerging from an econometric analysis of a choice experiment, represent the values of an average individual within the population. There are therefore two further steps required in converting these to values appropriate for use in appraisal.

Grossing up to the affected population: the impact of developments on the total affected population is required. To make this calculation the total population by geographic region must be considered, as was done in the previous work on valuing undeveloped land. It is also suggested by some literature (Bateman et al., 1999) and also from our model findings, that the distance to the PDLs has a significant impact on an individual's values. We incorporate this in our calculation of the total population values by taking account of the diminishing returns that may accrue as the population location moves further from the site.

Discounting over time: typically it is assumed that the value placed on any change in a site is not a one-off gain, but continues in perpetuity. We therefore consider the impact of time on the external benefits, drawing upon appropriate discounting rates to calculate the present value of any change. This both takes account of the public's time preference and the opportunity cost of capital.

We adopted the same method to measure benefits over time as that previously used when developing the UDL appraisal values. The net change in WTP (in our case CS) over time can be calculated using the formula[51] shown as below:

$$PV(B) = \sum_{t=1}^{\infty} \frac{B}{(1+r-p)^t} = B/(r-p)$$

[51] See the details in DCLG (2006) Annex 3.

Where:

- 'PV' is the present value, i.e. the discounted value of the benefit (Bt) in year *t*, As land yields benefits in perpetuity the appropriate time scale for discounting is infinity.
- *r* is the discount rate. We employed the same rate as in the DCLG (2006) study at 3.5 per cent. In the Green book,[52] the discount rate is known as the 'social time preference rate' (STPR). The STPR used in the Green Book is set as 3.5 per cent.
- *p* is the percentage rate of appreciation of WTP (in our study, CS) over time. This reflects that people would be willing to pay more in the future for the benefits of preserving land due to the following reasons:
    - People's income increase over time,
    - Land becomes scarcer,
    - Or educational developments will make people more appreciative of the restoring the PDL.

Therefore the p is referred as 'relative price effect'. And the expression (r-p) is the 'net' discount rate. The *p* is affected by the change in real income over time and the income elasticity of CS. The DCLG (2006) study used the GDP growth rate as a proxy for the change in real income over time. We have used the same approach. The current trend growth rate of UK GDP is 1.8 per cent per annum (ONS, 2019).[53]As a sensitivity analysis, we use the *p* values of 1.8, 2.2 and 2.5 (which reflect 1, 1.2, 1.4 times of the GDP growth rate respectively) in the calculations. The values are shown in Tables 43 – 48.

[52] HM Government. 2018. The Green Book: General Government guidance on appraisal and evaluation. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/685903/The_Green_Book.pdf

[53] Office for National Statistics (ONS) Gross domestic Product (GDP), As of 09/06/2019: https://www.ons.gov.uk/economy/grossdomesticproductgdp

Table 42 Change in benefits over time for redevelopment of PDL to UDL for England (size = 1 hectare, distance to PDL site = 1 mile)

PDL Previous Use	PDL type	Contamination	UDL Types (value unit: £/ household) (r = 3.5%, p = 1.8%)						
			Urban Core (city park)	Urban Fringe (green belt)	Urban Fringe (forest land)	Rural (forested land)	Agriculture land (extensive)	Agriculture land (intensive)	Natural and semi-natural land
Non-industrial sites	In use	No	5718	2753	4094	3247	2118	1059	3247
Non-industrial sites	In use	need treatments	5082	2400	3671	2894	1835	847	2894
Non-industrial sites	Vacant	no	6282	3106	4518	3671	2471	1271	3671
Non-industrial sites	Vacant	need treatments	5647	2753	4024	3247	2118	1059	3247
Non-industrial sites	Derelict	no	6776	3459	4871	4376	3106	1694	4376
Non-industrial sites	Derelict	need treatments	6141	3035	4376	3953	2682	1482	3953
Industrial sites	In use	no	5365	2541	3882	3035	1976	988	3035
Industrial sites	In use	need treatments	4800	2188	3388	2682	1694	776	2682
Industrial sites	Vacant	no	5929	2894	4235	3459	2259	1129	3459
Industrial sites	Vacant	need treatments	5365	2541	3812	3035	1976	988	3035
Industrial sites	derelict	no	6424	3247	4588	4165	2894	1553	4165
Industrial sites	Derelict	need treatments	5788	2824	4165	3741	2541	1341	3741

Table 43 Change in benefits over time of PDL to UDL for the Northwest and West Midlands (size = 1 hectare, distance to PDL site = 1 mile)

PDL Previous Use	PDL type	Contamination	UDL Types (value unit: £/ household) (r = 3.5%, p = 1.8%)						
			Urban Core (city park)	Urban Fringe (green belt)	Urban Fringe (forest land)	Rural (forested land)	Agriculture land (extensive)	Agriculture land (intensive)	Natural and semi-natural land
Non-industrial sites	In use	No	5647	2612	4024	3176	1976	776	3176
Non-industrial sites	In use	need treatments	5012	2188	3529	2753	1624	565	2753
Non-industrial sites	Vacant	no	6212	3035	4447	3600	2329	1059	3600
Non-industrial sites	Vacant	need treatments	5576	2612	3953	3176	1976	776	3176
Non-industrial sites	Derelict	no	6706	3318	4800	4306	2965	1553	4306
Non-industrial sites	Derelict	need treatments	6071	2894	4306	3882	2612	1200	3882
Industrial sites	In use	no	5294	2400	3741	2965	1765	635	2965
Industrial sites	In use	need treatments	4659	1976	3318	2612	1482	424	2612
Industrial sites	Vacant	no	5859	2753	4165	3388	2118	918	3388
Industrial sites	Vacant	need treatments	5224	2329	3741	2965	1765	635	2965
Industrial sites	Derelict	no	6353	3106	4588	4094	2753	1341	4094
Industrial sites	Derelict	need treatments	5718	2682	4094	3671	2400	1059	3671

Table 44 Change in benefits over time for redevelopment of PDL to UDL for England (size = 1 hectare, distance to PDL site = 1 mile)

PDL Previous Use	PDL type	Contamination	UDL Types (value unit: £/ household) (r = 3.5%, p = 2.2%)						
			Urban Core (city park)	Urban Fringe (green belt)	Urban Fringe (forest land)	Rural (forested land)	Agriculture land (extensive)	Agriculture land (intensive)	Natural and semi-natural land
Non-industrial sites	In use	No	7477	3600	5354	4246	2769	1385	4246
Non-industrial sites	In use	need treatments	6646	3138	4800	3785	2400	1108	3785
Non-industrial sites	Vacant	no	8215	4062	5908	4800	3231	1662	4800
Non-industrial sites	Vacant	need treatments	7385	3600	5262	4246	2769	1385	4246
Non-industrial sites	Derelict	no	8862	4523	6369	5723	4062	2215	5723
Non-industrial sites	Derelict	need treatments	8031	3969	5723	5169	3508	1938	5169
Industrial sites	In use	no	7015	3323	5077	3969	2585	1292	3969
Industrial sites	In use	need treatments	6277	2862	4431	3508	2215	1015	3508
Industrial sites	Vacant	no	7754	3785	5538	4523	2954	1477	4523
Industrial sites	Vacant	need treatments	7015	3323	4985	3969	2585	1292	3969
Industrial sites	derelict	no	8400	4246	6000	5446	3785	2031	5446
Industrial sites	derelict	need treatments	7569	3692	5446	4892	3323	1754	4892

Table 45 Change in benefits over time of PDL to UDL for the Northwest and West Midlands (size = 1 hectare, distance to PDL site = 1 mile)

PDL Previous Use	PDL type	Contamination	UDL Types (value unit: £/ household) (r = 3.5%, p = 2.2%)						
			Urban Core (city park)	Urban Fringe (green belt)	Urban Fringe (forest land)	Rural (forested land)	Agriculture land (extensive)	Agriculture land (intensive)	Natural and semi-natural land
Non-industrial sites	In use	No	7385	3415	5262	4154	2585	1015	4154
Non-industrial sites	In use	need treatments	6554	2862	4615	3600	2123	738	3600
Non-industrial sites	Vacant	no	8123	3969	5815	4708	3046	1385	4708
Non-industrial sites	Vacant	need treatments	7292	3415	5169	4154	2585	1015	4154
Non-industrial sites	Derelict	no	8769	4338	6277	5631	3877	2031	5631
Non-industrial sites	Derelict	need treatments	7938	3785	5631	5077	3415	1569	5077
Industrial sites	In use	no	6923	3138	4892	3877	2308	831	3877
Industrial sites	In use	need treatments	6092	2585	4338	3415	1938	554	3415
Industrial sites	Vacant	no	7662	3600	5446	4431	2769	1200	4431
Industrial sites	Vacant	need treatments	6831	3046	4892	3877	2308	831	3877
Industrial sites	derelict	no	8308	4062	6000	5354	3600	1754	5354
Industrial sites	derelict	need treatments	7477	3508	5354	4800	3138	1385	4800

Table 46 Change in benefits over time for redevelopment of PDL to UDL for England (size = 1 hectare, distance to PDL site = 1 mile)

PDL Previous Use	PDL type	Contamination	UDL Types (value unit: £/ household) (r = 3.5%, p = 2.5%)						
			Urban Core (city park)	Urban Fringe (green belt)	Urban Fringe (forest land)	Rural (forested land)	Agriculture land (extensive)	Agriculture land (intensive)	Natural and semi-natural land
Non-industrial sites	In use	No	9720	4680	6960	5520	3600	1800	5520
Non-industrial sites	In use	need treatments	8640	4080	6240	4920	3120	1440	4920
Non-industrial sites	Vacant	no	10680	5280	7680	6240	4200	2160	6240
Non-industrial sites	Vacant	need treatments	9600	4680	6840	5520	3600	1800	5520
Non-industrial sites	derelict	no	11520	5880	8280	7440	5280	2880	7440
Non-industrial sites	derelict	need treatments	10440	5160	7440	6720	4560	2520	6720
Industrial sites	In use	no	9120	4320	6600	5160	3360	1680	5160
Industrial sites	In use	need treatments	8160	3720	5760	4560	2880	1320	4560
Industrial sites	Vacant	no	10080	4920	7200	5880	3840	1920	5880
Industrial sites	Vacant	need treatments	9120	4320	6480	5160	3360	1680	5160
Industrial sites	Derelict	no	10920	5520	7800	7080	4920	2640	7080
Industrial sites	Derelict	need treatments	9840	4800	7080	6360	4320	2280	6360

Table 47 Change in benefits over time of PDL to UDL for the Northwest and West Midlands (size = 1 hectare, distance to PDL site = 1 mile)

PDL Previous Use	PDL type	Contamination	UDL Types (value unit: £/ household) (r = 3.5%, p = 2.5%)						
			Urban Core (city park)	Urban Fringe (green belt)	Urban Fringe (forest land)	Rural (forested land)	Agriculture land (extensive)	Agriculture land (intensive)	Natural and semi-natural land
Non-industrial sites	In use	No	9600	4440	6840	5400	3360	1320	5400
Non-industrial sites	In use	need treatments	8520	3720	6000	4680	2760	960	4680
Non-industrial sites	Vacant	no	10560	5160	7560	6120	3960	1800	6120
Non-industrial sites	Vacant	need treatments	9480	4440	6720	5400	3360	1320	5400
Non-industrial sites	Derelict	no	11400	5640	8160	7320	5040	2640	7320
Non-industrial sites	Derelict	need treatments	10320	4920	7320	6600	4440	2040	6600
Industrial sites	In use	no	9000	4080	6360	5040	3000	1080	5040
Industrial sites	In use	need treatments	7920	3360	5640	4440	2520	720	4440
Industrial sites	Vacant	no	9960	4680	7080	5760	3600	1560	5760
Industrial sites	Vacant	need treatments	8880	3960	6360	5040	3000	1080	5040
Industrial sites	derelict	no	10800	5280	7800	6960	4680	2280	6960
Industrial sites	derelict	need treatments	9720	4560	6960	6240	4080	1800	6240