Valuing Attractive Landscapes in the Urban Economy

Action 4.2

Level II Report

A Contingent Valuation of Green Investments in The Wicker Riverside, Sheffield

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Executive Summary

The EU Interreg NWE IVB project on Valuing Attractive Landscapes in the Urban Economy (VALUE) requires all partner cities to undertake research assessing the economic value of green investments. A number of evaluation techniques have been used by partners to perform this task, resulting in the development of an extensive evidence base that can be applied to current and future greening projects.

In the UK, two cities have contributed to the VALUE project: Manchester and Sheffield. This document reports the research undertaken in Sheffield in 2010-2011. The Sheffield case study focussed on the installation and valuation of VALUE funded green investments in Blonk Street and a number of proposed investments in the Nursery Street area of The Wicker Riverside. These investments were part of a programme of projects developed by the South Yorkshire Forest Partnership (SYFP) utilising VALUE funding. Other projects included the Centenary Riverside Park in Rotherham and the A61 River Don Corridor improvements in Sheffield. Each investment aimed to reinforce the ecological and social value of Green Infrastructure in urban riparian areas, and to demonstrate the economic value of such investments to local authorities, developers and landscape planners.

A contingent valuation experiment was designed to examine the willingness to pay (WTP) for investments in urban greening of residents, employers and employees, commuters and other users of The Wicker Riverside. The experiment provided scope for respondents to discuss their general understanding and perceptions of Green Infrastructure resources. These feelings formed the context for a WTP scenario for specific green investments. Respondents' views on local authority services and provision of Green Infrastructure were also examined to assess whether they influenced WTP.

The fieldwork was conducted by the social research company Ipsos-Mori (Manchester office) over a six-week period in August-September 2011[1]. A total of 1939 people were approached to achieve 510 completed survey questionnaires; a response rate of 26%. The questionnaires were completed in The Wicker Riverside and were independently checked and verified. The data derived from these surveys

[1] A technical report of the process is available on request from the University of Sheffield VALUE project team. The VALUE questionnaire survey can be viewed on request but remains the intellectual property of the University of Sheffield and should not be reproduced without permission.

were analysed to examine the relationships between WTP, the values attributed to Green Infrastructure and preferences for investments in urban greening.

A number of relationships were identified between respondents' WTP and their perceptions of green investments. Although disparities could be seen between those who were WTP more (in rents or mortgage interest) and those who were not and various socio-economic characteristics, there was a general consensus that an economic value could be attributed to different Green Infrastructure development options.

Respondents identified the greenest 'before' image for Blonk Street (average WTP £10.56 per month) and the 'Floods' option for Nursery Street (average WTP £29.28 per month) as the two most preferred options (see Table 1). 53% of respondents stated that they would prefer to see investments that contained higher proportions of visible Green Infrastructure on Blonk Street, with a further 40% showing a preference for the VALUE investment with additional greening (VALUE+).

Table 1. Green Investment preferences and willingness to pay

	WTP (with True Zero) nothing + not stated)	No WTP responses (with True Zero) nothing + not stated	% of WTP responses (with True Zero) nothing + not stated	Number of Positive WTP	% Number of Positive WTP	Protest Zero	% Protest Zero	Other (Don't know Refused)	% Other know Refused (Don't	Total %
Before	£10.56	397	77.84	78	15.29	16	3.13	19	3.72	100
VALUE	£4.28	437	85.68	39	7.64	19	3.72	15	2.94	100
VALUE +	£8.00	400	78.43	74	14.50	17	3.33	19	3.72	100
As is	£12.17	374	73.33	94	18.43	17	3.33	25	4.90	100
SCC / Dev	£3.87	449	88.03	34	6.66	16	3.13	11	2.15	100
Floods	£29.28	260	50.98	209	40.98	14	2.74	27	5.29	100
Streets	£6.69	418	81.96	62	12.15	14	2.74	16	3.13	100

For the Nursery Street development, the 'Floods' option was clearly preferred (by 84% of respondents) and adduced the highest WTP value (£29.28). Following the 'Floods' option, the reported WTP values were: 'as is' option (£12.17), Streets (£6.88)

and the Sheffield City Council (SCC/Dev) option (£3.87). These figures suggest that respondents are WTP higher rents/mortgage interest for options that consist of visibly greener, potentially more functional or larger investments.

Analysis also indicates that a number of respondent characteristics influence WTP and preferences. For the 'Floods' option for Nursery Street and the 'before' option for Blonk Street, employment status, user status and income are linked to higher WTP values. Whilst there are variations in the relation between work status, user classification (resident, employee etc) and WTP for various options, there is a clear preference for 'greener' Green Infrastructure investments.

When the respondents' wider context is taken into account, the results are similar. Green issues such as naturalness, pollution, flood mitigation and access to nature are important influences on WTP. However, these factors should be considered alongside a number of social and economic influences to capture the full range of characteristics that impact upon perceptions of Green Infrastructure. Furthermore, the majority of respondents placed a high value on the usefulness of the landscape in Sheffield. This suggests that an understanding of landscape functions informed assessments of the actual and proposed green investments in The Wicker Riverside.

The research conducted in The Wicker Riverside indicates that preferences and WTP are associated with the perceived greenness of each investment option. Where investments present visibly greener characteristics, higher economic values are placed upon them in the assessments of Blonk Street and Nursery Street. This is supported by the analysis of the contextual data. In addition, Green Infrastructure and the landscape of Sheffield were deemed by respondents to be of high quality and to offer many and varied opportunities for local use, as indicated in related Green Infrastructure literature (Landscape Institute, 2009; Natural England and Landuse Consultants, 2009; Madureira *et al.*, 2011). Respondents therefore appear to be WTP more rent or mortgage interest for investments that provide additional or sustained ecological benefits and that provide or enhance the visible greenery of the urban environment.

1. Introduction

The Valuing Attractive Landscapes in the Urban Economy (VALUE) project is a multi-partner initiative assessing the value of Green Infrastructure investments in urban areas (cities and city-regions). Working across Belgium, Germany, The Netherlands and the UK, the project aims to obtain evidence on the economic benefits of investment in urban greening projects derived from a number of evaluation techniques. The challenge of the VALUE project is to establish where to target Green Infrastructure investments to deliver the greatest economic benefits, while ensuring that high quality green and open space is protected and remains integral to the fabric of the urban environment. The project also aims to develop a framework for the delivery of prosperous environments that provide high quality Green Infrastructure, which is crucial to the promotion of strong and integrated communities throughout North-West Europe.

The VALUE project is particularly timely because project development is increasingly being scrutinised for economic viability at a city and city-region scale. By increasing awareness and understanding of the economic value of Green Infrastructure and attractive landscapes, VALUE helps to improve the quality of open spaces and foster social cohesion.

Partners within the VALUE project have developed and applied economic valuation tools to the assessment of Green Infrastructure. These tools address value impacts at the landscape scale as well as using earlier innovations that focus on green investment at the site scale. The project utilises a number of approaches to the valuation of Green Infrastructure to achieve the following objectives:

1. To demonstrate how cities/regions can target green space investments to locations where they will maximise economic benefits; and
2. To take a transnational approach in promoting the competitive benefits of Green Infrastructure.

The VALUE project is being pursued by a six-city multi-partner team of academic and delivery partners in Amersfoort (NE), Bruges (BE), Manchester (UK), Sheffield (UK), Stuttgart (GE) and Verviers (BE). One of the central assumptions proposed by VALUE is that urban greening has an economic value regardless of whether it is ecologically or socially focused. The current assessments of the European

Landscape Convention, and its discussions of landscape valuation provide a legislative framework to support this claim (Roe *et al.*, 2009). The issue in applying such a principle is that there has been a lack of economic evidence to support it.

By approaching the VALUE research within a multi-partner framework, each city partner has been able to develop a theoretical understanding of the Green Infrastructure planning issues under investigation. By examining the wider benefits that Green Infrastructure development can deliver, partners have been able to contextualise their findings against current and future investments in urban greening. A number of evaluation techniques were applied within the VALUE project to establish economic values for green investments. These included Cost-Benefit Analysis (CBA), contingent valuation (stated preference testing), computer assisted visualisation models and online green toolkit economic valuation models. To facilitate a North-West Europe approach to valuing green investments, VALUE aims to package each city evaluation into a single useable framework or toolkit, which can be applied to a range of urban locations in any city-region.

1.1. Case study area: The Wicker Riverside

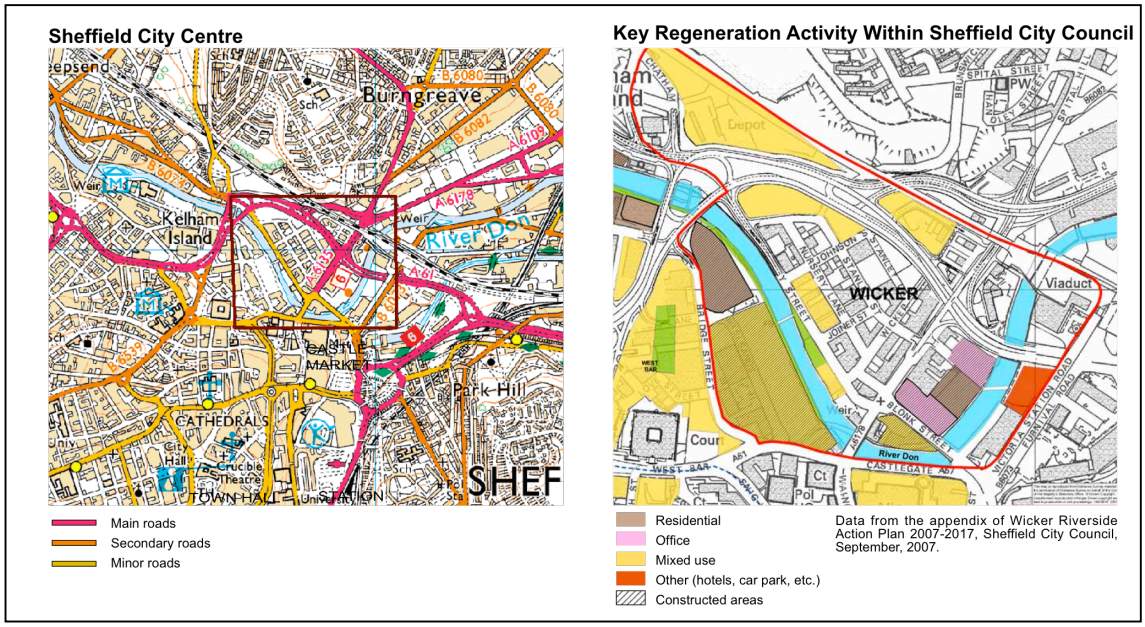
The Wicker Riverside, Sheffield has been subject to a series of development master plans. Its proximity to the centre of Sheffield and its strategic role as a gateway to the city has established it as a key development site for Sheffield City Council (SCC) (see Figure 1.1). However, due to its industrial heritage, The Wicker Riverside has been viewed as a transitional zone of different uses. It is also potentially isolated and excluded from the city centre both physically and psychologically. The Wicker Riverside has also been associated with crime, anti-social behaviour and lacks an appropriate housing stock. SCC and the SYFP aim to address some of these issues through a series of greening projects outlined within the VALUE investment programme.

The location of The Wicker Riverside in one of Sheffield's five valleys has made it susceptible to flood events. The area was extensively flooded in 2007 when the River Don burst its banks and inundated large tracts of the study area. The need to adapt the river channel to mitigate the effects of extreme weather events was a major influence on the VALUE green investment programme.

The aim of the VALUE investment in The Wicker Riverside was to promote access to and the additional greening of the area, to improve perceptions of its landscape

quality and to address traffic issues by reducing congestion, improving public transport and facilitating improvements in personal mobility (the area was also the subject of research by URSULA[2]). SCC's vision for The Wicker Riverside is to unlock the potential of key development sites through the transformation of access routes and the improvement of the public realm. This combination of aims supports the principles of Green Infrastructure, especially the interactions and intersections between its ecological, economic and social functions (Benedict and McMahon, 2006; Landscape Institute, 2009).

Figure 1.1. Sheffield case study sites



Source: URSULA (2011) Wicker Riverside: Options for Sustainable Redevelopment

Evaluations of green investments on two sites are presented in this report. Firstly, there is the investment on Blonk Street aimed at improving access, supporting flood mitigation / control and enhancing urban green space. Secondly, there is a number of development scenarios, developed by SCC and URSULA, that incorporate significant green infrastructure elements and affect the Nursery Street area. The scale of development differs between the two sites. The Blonk Street investment is discrete and clearly defined and affects a single location. It was completed in 2011 (see Figure 2.2). The development scenarios proposed for Nursery Street are more exploratory and wide-ranging in their nature and potential effects (see Figures 2.4 – 2.7).

[2] URSULA considered sustainable development in urban river corridors (for further details see: http://www.ursula.ac.uk/**).**

2. Methodology

Each VALUE partner applied a range of evaluation techniques to assess the economic value of green investments delivered through the Interreg IVB NWE project. The choice and focus of techniques differed depending on location (urban or city-region scale), the focus of the project, and its links with other green investments. However, the main aims of this process were the same - to assess and provide evidence of the economic value of investments in Green Infrastructure. This chapter outlines the development of the research methodology undertaken in Sheffield to assess the economic value of investments on Blonk Street and of the proposed development scenarios as they related to the Nursery Street area.

2.1. Introduction

To investigate the economic value of Green Infrastructure investments VALUE partners utilised a number of methods including Cost-Benefits Analysis (CBA) and Contingent Valuation (CV). In Sheffield a CV experiment was conducted using 3D visualisations of the investments undertaken in Blonk Street plus ex ante and ex post scenarios and of four proposed development scenarios for Nursery Street. URSULA and the University of Sheffield developed the 3D visualisations used in this study. CBA and Choice Experiments (CE) were deemed inappropriate or impractical due to their focus, the level of detail needed to undertake them and the time requirements associated with these methodologies. The vehicle for the CV was a large-scale survey of perceptions of the economic value of selected Green Infrastructure in Sheffield.

2.2. Contingent Valuation Methodology

The economic evaluation undertaken for the Sheffield VALUE investment utilised a Contingent Valuation (CV) experimental methodology. This was used to assess the willingness to pay (WTP) for green investments of commuters, residents, users and businesses in The Wicker Riverside study area. Respondents' perceptions of Green Infrastructure across the City of Sheffield were also investigated. The survey focussed on four main issues:

1. General attitudes to green space[3];

[3] Green space was defined as 'areas of land in urban areas including woods and street trees, grassed areas, parks, gardens, playing fields, children's play areas, cemeteries and allotments that provide amenities for local people and help to develop an attractive and useful places to live, work and relax. Green spaces also have a role to play in protecting wildlife and enabling people to move around an urban area by foot or bicycle.' This definition has been

2. Preferences for different green investment options;
3. WTP for green investments; and
4. Attitudes towards the services and green spaces provided by Sheffield City Council.

The selection of questions was derived from an extensive literature review and from the results of two focus groups[4] conducted in Sheffield prior to the development of the survey (Beattie *et al.*, 1998; O'Garra *et al.*, 2007). The structure of the survey enabled respondents to consider broadly, and then in a more detail, their use of green spaces, the economic values of these sites and their utility in promoting Sheffield as a place to work, live and recreate. The relation between their behaviour and views in these regards and their WTP for green investments could then be examined.

Socio-economic/demographic data were collected to enable an analysis of whether age, gender, education or income influenced WTP for green investments. Information relating to the VALUE project and the green investments was made available to all respondents during the focus group events and the survey. This information described the benefits associated with green investments and outlined the objectives of the VALUE project. Additional information was provided that focussed on the need for and availability and use of resources. Contact information for VALUE partners was also included (Bateman *et al.*, 2002).

Cue cards showing 3D computer-modified images of the greening options were considered the most appropriate method for conveying the nature of the investments. Such cards and visualisations offer more scope and choice to the researcher than images or maps, and also provide more robust data for analysis (Crompton, 2001). Compared to the use of structured written statements outlining the investments proposed (Lindsey, 1994), such cards allow respondents to engage more directly with the options under investigation. The use of visual media provides greater scope

adapted from work produced by Greenspace Scotland. Definitions of green infrastructure differ from Greenspace Scotland's understanding of 'greenspace'. Discussions of green infrastructure and its principles can be found in Benedict and McMahon (2006), Natural England & Landuse Consultant (2009) and Mell (2010). Greenery is used within this document to mean all forms of terrestrial flora and fauna, as well as larger green infrastructure resources such as parks and urban woodlands.

[4] Anyika, B. (2011) Work Package 4, Action 4.1: Report on Focus Group Interviews in Sheffield. VALUE Investment site 1: Sheffield North Bank Business District Greenway Programme. South York Forest Partnership, Sheffield

for debate in perception and economic evaluation studies. However, CVs are only valid when the constructed evaluation market and payment methods are considered realistic (Atkinson *et al.*, 2008; Lindsey, 1994).

These latter two points were addressed during the design of the survey to ensure that sufficient information was provided to allow participants to make informed assessments of the investments under examination. Question form and the payment vehicle must be considered carefully to ensure that the payment elicitation question is phrased and framed as realistically as possible. Section 2.3 provides further details on this point.

Table 2.1. Category and number of participants for The Wicker Riverside survey

Category	**Interviews achieved**	**% of sample**
Resident	87	17
Employee	92	18
Business owner/senior manager	25	5
Commuter	61	12
Passing through	46	9
Visiting family/friends	36	7
Customer of shop/restaurant/ other business	132	26
Some other reason	31	6
Total	**510**	**100**

510 questionnaires were completed in The Wicker over a six-week period covering 49 data collection sessions. Four shifts were defined and used to conduct interviews solely with local businesses. In the remaining 45 sessions interviews were conducted with people using The Wicker Riverside and were not targeted at any one specific user group. A total of 1939 people were approached to achieve the 510 responses; a response rate of 26%. The breakdown of respondents by type is shown in Table 2.1. Cue cards with visualisations were used to support interviewees' understanding of the investment options (see Figures 2.1-2.7). Economic values were investigated using a constructed market for green investments (see section 2.3). All data were recorded by the social researchers and verified at the end of each data collection shift.

2.3. Willingness to Pay (WTP)

An appropriate WTP scale was developed in line with the literature and correspondence with WTP practitioners and experts[5]. The WTP elicitation question was complimented by further questions allowing the survey to establish a deeper understanding of preferences because '…cost is not 'just money': it is an expression of resources that could be used for all kinds of other, perhaps equally deserving, purposes' (Bateman *et al.*, 2002: 19).

The WTP elicitation question was posed in the form of a regular monthly payment rather than a one-off payment. This enabled respondents to consider the on-going value of the investments and the potential benefits they may have for their lives. The use of one-off payments results in greater variability in responses to the elicitation question (DTLR, 2002; Bateman *et al.,* 2002; Atkinson *et al.,* 2008), as single payments have been shown to report a lower level of commitment to funding investments. One-off payments are effectively a condensed capitalisation of the value attributed to an investment, which should reveal a comparable WTP to a repeated payment. However, in reality, research has shown that people are unable to assess the long-term value of a project when asked to provide a one-off payment value. Respondents were therefore asked to make a judgement of the immediate and longer-term value of the investment and incorporate this within an on-going monthly WTP value. This supports the argument presented by Stenger *et al.* (2009) that trees and Green Infrastructure provide direct ecological and socio-economic benefits and value, which can be easily understood by respondents and subsequently interpreted against a given timeframe of investment or payment.

An open question was proposed to elicit WTP values. This differed from the incremental scale used in the Manchester VALUE survey, as the investments under investigation were considered *realistic* in terms of Blonk Street but *hypothetical* for Nursery Street[6]. An open-ended question was used as the cost could not be calculated for all the investments and could not therefore be assessed against current allocations from existing council taxes. The scope of the investment for Nursery Street was particularly relevant in this process as the development options

[5] Personal communications with Professor Guy Garrod, University of Newcastle and Professor Liisa Tyrväinen, Finnish Forest Research Institute.

[6] The term realistic is applied to investments that are either currently being implemented or are planned for the near future. Hypothetical investments projects could be considered longer-term investments that may not be delivered for a number of years. The timescale of an investment is therefore central to its identification as realistic or hypothetical.

may not be fully realised. A hypothetical payment market was created to limit expectations of what development could be expected (Bateman, *et al.,* 1993; Willis & Garrod, 1992; White and Lovett, 1999; Atkinson *et al.*, 2008; Tyrväinen and Väänänen, 1998).

Comparable rental/mortgage values for a 'typical' two-bedroom apartment in The Wicker Riverside[7] were presented to respondents to establish the cost of living in the area. The evaluations provided were therefore related to this cost. Evaluations therefore reflected the added value people attributed to the actual and proposed developments in The Wicker Riverside and indicated by the WTP values generated from the survey responses.

Tyrväinen argued that the use of a constructed but realistic WTP question 'enables the comparison of provision costs and received benefits both at the land use planning and management level' when discussed in conjunction with other aspects of the CV survey (2001:76). Consequently, it was considered possible to investigate use and non-use values[8] in The Wicker Riverside. This has a further utility for the SYFP in highlighting the changing nature of value associated with green investments. An increase in rental/mortgage payment was proposed as the most appropriate WTP method assessing respondent perceptions of direct and indirect values because:

1. It is a payment most respondents are familiar with and pay;
2. It is a cost that people can interpret against their perceptions of local service provisions;
3. It elicits responses, both positive and negative, as people are likely to have an opinion on rental/mortgage costs; and
4. It reflects the potential added value of green investment in the regeneration being undertaken in The Wicker Riverside.

The use of a WTP method to assess the value of green investments was supported by SYFP as it provided data that addressed demographic, as well as financial issues.

[7]The average rental price for a two-bedroom apartment in The Wicker Riverside was established as approximately £575 per month. This figure was generated from a review of the local housing market.

[8] *Use values* include 'direct use values' i.e. consumptive products and non-consumptive products; 'indirect use values' i.e. ecosystem services and 'option value' i.e. the retention of a given resource for future benefits. *Non-use* values include 'existence values' i.e. knowledge that a resource will remain, 'altruistic values' i.e. an acknowledgement that there are available to others and 'bequest values' i.e. an acknowledgement that a resource will be available on ten future.

SYFP (and SCC) may be able to use the data to focus future investments in areas demonstrating signs of deprivation if it can be shown that Green Infrastructure can generate added values to the urban environment. Evidence of the value and role of Green Infrastructure in meeting the needs of different demographic groups also addresses a number of central government agendas relating to social inclusion and quality of life (England's Community Forests, 2004; DCLG, 2009; Social Exclusion Unit, 2004; ODPM/National Audit Office, 2006; DTLR, 2002). The influence of these government departments and environmental agencies can be seen in the application of the UK government's Place Survey (DCLG, 2008), which informed the development of the contextual questions used in this survey.

The articulation of the WTP question was an important issue considered during the development of the questionnaire. Incremental rises in payments were not used, as they were considered inappropriate for the hypothetical investment options under investigation in Nursery Street. However, the use of an open-ended rental / mortgage payment WTP question enabled people to apply a more interpretative evaluation to the investments. The literature also suggests that people are WTP relatively modest amounts for green investments (see Table 2.2) where large-scale or potential development scenarios are discussed (see Atkinson *et al.*, 2008). Consequently, although the research in The Wicker Riverside did not use the same structured WTP question as the VALUE research in Manchester, it did reflect the nature of the investments under evaluation (White and Lovett, 1999; Tyrväinen and Väänänen, 1998).

Table 2.2. Research studies assessing WTP for green investments

Location	**Investment type**	**Average monthly WTP**	
Yorkshire Dales National Park (Willis & Garrod, 1992)	National Park resources and visitor facilities	£2.19 (Residents)	£1.60 (Visitors)
North Carelia, Finland (Tyrväinen & Väänänen, 1998)	Urban trees/forests	£2.42	
New York (Peper et al., 2007)	Urban/street trees	£0.34-0.67	
Guangzhou (Jim & Chen, 2006)	Urban greenspace and trees	£1.70	
London Olympics (Atkinson *et al.,* 2008)	Olympic Games venues, greenspace and infrastructure	London - £1.83 Manchester - £1.00 Glasgow - £0.92	
UK Botanical Gardens (Garrod *et al*., 1993)	Access and maintenance of botanical gardens	Edinburgh - £1.29 Sheffield - £1.12 Cambridge - £0.86 Westonbirt - £2.23	

2.4. Contextual green infrastructure questions

To support the WTP questions a number of contextual questions were developed to assess respondents' understanding and evaluation of Green Infrastructure in urban areas. These covered people's views of their local environment and the factors that indicated good or bad places to live. Interviewees were also asked about their uses of Green Infrastructure, their assessments of its quality and usefulness and about the factors that influenced their WTP for green investments.

A number of the questions were derived from the UK Place Survey (DCLG, 2008), whilst others - reflecting the evaluation and attitudes to Green Infrastructure - were developed by the University of Sheffield, SYFP and Ipsos-Mori. The focus of the context questions reflected the influences outlined by Mell (2010), Peper *et al.* (2007) and Beatley (2000) that preferences for Green Infrastructure are based upon assessments of connectivity, access, functionality and attractive landscape resources.

The aim of the non-WTP questions was to provide the SYFP with a contextual examination of the role of Green Infrastructure in establishing value in the lives of respondents. Asking people to think about their use of green spaces enabled them to think critically about the development options being presented. Having a site-specific survey also provides SYFP with an evidence base of social and ecological data with which to develop, design and deliver future investment programmes.

2.5. 3D Visualisations

The constructed WTP market and associated questions were used in conjunction with a set of 3D visualisations for Blonk Street (Fig. 2.1 - 2.3) and Nursery Street (Fig. 2.4 - 2.7) of the proposed investments. Unlike the Manchester case study (Mell *et al*., 2011), where a photograph was combined in Photoshop with 2D visualisations similar to a photomontage, in Sheffield the images used were detailed virtual landscape models developed by URSULA.

Virtual landscape models have several advantages for WTP studies, including the ability to build scenarios of future landscape investments or model proposed impacts in the existing landscape. A range of applications using GIS data can be incorporated within digital terrain modelling in a virtual environment (Hehl-Lange, 2001). People can also move freely around the virtual model to view a site from different perspectives; this avoids the bias of selecting a single viewpoint for evaluations.

Simmetry3d, a real-time visualisation software package was used to build the interactive landscape visualisation. Within Simmetry3d it is possible to use interactive walkthroughs at eye-level that enhance interpretations of virtual landscapes (Morgan et al. 2009). Simmetry3d also has the capacity to import GIS, image data and data from other software including SketchUp and LENNÉ3D. Vector GIS data was used to build models in SketchUp. Models were also built from photographs using the "PhotoMatch" feature in SketchUp (Morgan *et al.*, 2009).

Site plans of alternative scenarios were developed by URSULA by hand and then digitised into 2D models before being developed into 3D visualisations. Simmetry3d and LENNÉ3D were used to model the vegetation in each image. The virtual model of The Wicker Riverside consists of a digital terrain model (DTM) provided by Ordnance Survey Land-form profile DTM with a resolution of 10 m onto which an aerial photo of 0.2 m resolution from Cities Revealed was draped within Simmetry3d. All built form - building footprint, roads, paths and river channels and land usage data - was imported as GIS vector data from Ordnance Survey MasterMap. Data was available through licensing agreements through the University of Sheffield.

Figure 2.1. Blonk Street (Before)

Figure 2.2. Blonk Street (VALUE investment option – As is)

Figure 2.3. Blonk Street (VALUE+ greener investment scenario)

Figure 2.4. Nursery Street (As is)

Figure 2.5. Nursery Street (Sheffield City Council – SCC/Dev scenario)

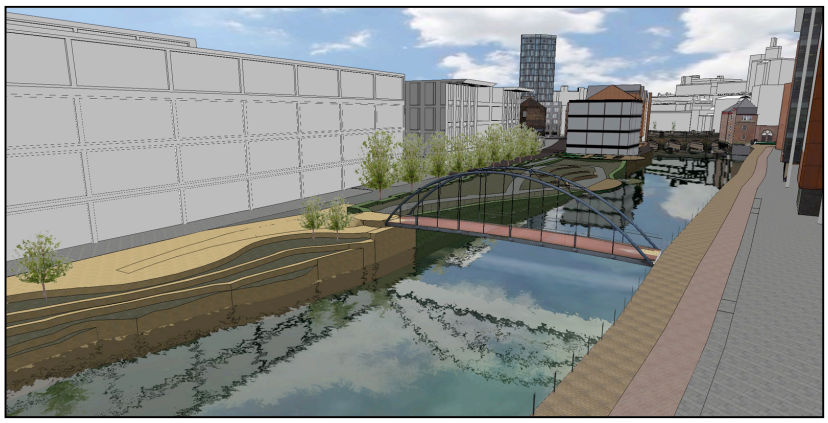
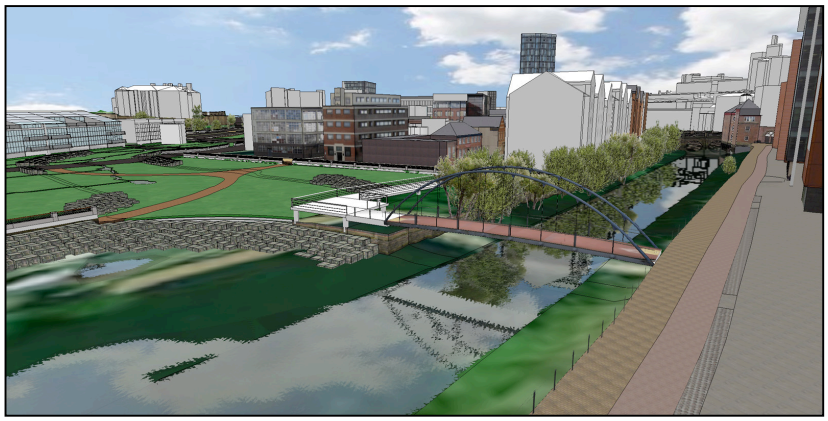


Figure 2.6. Nursery Street (Streets scenario)

Figure 2.7. Nursery Street (Floods scenario)



2.6. Application of the research survey in The Wicker Riverside

The University of Sheffield team produced a draft questionnaire prior to commissioning fieldwork with a social research company. This questionnaire defined the key topics to be covered in the interviews and was used as the basis for developing the final questionnaire. The chosen research approach required consideration of several factors in developing the questionnaire:

1. Length – keeping the interview to 15 minutes or less;
2. Focus - ensuring that the questions used were simple and easy to understand;
3. Overall conduct - ensuring a rounded interview experience for the respondents; and

4. Quality of the survey - providing appropriate visual aids to allow the questionnaires to be administered efficiently and effectively.

Each of these issues was discussed internally within the University of Sheffield VALUE team prior to the tendering and the fieldwork. Further modifications were made during this process. The following sections discuss the development of the survey's application with Ipsos-Mori (Manchester office) highlighting the allowances made for practical constraints, which parts of the questionnaire worked well and where modifications may have been beneficial.

2.7. Questionnaire length

The initial version of the questionnaire was timed by Ipsos-Mori at 17 minutes. This was deemed too long for an on-street interview, whose maximum advisable length is 15 minutes. The questionnaire was modified according to comments and feedback from the University of Sheffield VALUE team and Ipsos-Mori. All aspects of the data to be gathered and the information that respondents would need were reviewed to identify elements that could be removed or redesigned. For example:

1. Much of the detailed background information was removed and put into a separate information leaflet, which was given to participants;
2. The contextual introduction to and wording of questions was rationalised; and
3. Questions focused on participants' direct experience of their local area rather than on more general assessments of Green Infrastructure.

The sections of the questionnaire addressing attitudes to green spaces in Sheffield and the participant's local area were aligned more closely with the VALUE objectives. Questions focussing on the wider Green Infrastructure resource base in Sheffield were removed as they were felt to be outside the direct experience of many participants. Similarly, questions concerning the role of Sheffield City Council in providing and managing green spaces were replaced with questions about the participants' local councils for the same reason (participants might live within the City of Sheffield, another local authority council in the Sheffield area or elsewhere). Before fieldwork began, the final questionnaire was timed at 15-17 minutes; this timing was confirmed as the average during fieldwork.

2.8. Developing understandable questions

The issues covered by VALUE are highly technical. Participants in the research were unlikely to have specialist town planning knowledge or understand its related terminology. The research questions therefore needed to be reviewed and reworded, where necessary, to avoid the use of jargon. Some questions were replaced with others that gathered the same information in a simpler way. The most important and technical aspect of the questionnaire was the questions relating to WTP. Much effort was concentrated on the design of these questions to ensure that they were easy to understand, gave participants the information they needed and gathered the data required for statistical analysis. The role of the payment vehicle was especially important in this process.

2.9. Rounded interview experience

This was an important aspect of the questionnaire for participants. Research relies on the willingness of people to participate. Therefore it is important that respondents feel they have been given the chance to give their full views about a subject, otherwise they will be less willing to take part in future. The inclusion of a question about which of the five options participants preferred was seen as central in establishing links between preferences for green investments, WTP and use of green spaces, even though this information would probably not be used in the statistical analysis.

2.10. Showcards

To aid responses to the contextual and WTP questions, showcards were developed that required more than a simple yes/no/don't know response. Showcards were most frequently related to questions using a Likert scale or a list of options. To avoid any order bias in responses on opinion/attitude based showcards the order of possible responses were alternated to ensure the option were also presented in reverse order. For each survey shift either the original or reverse order version of showcards was used. Fact based showcards (household income, ethnicity, etc) were not rotated.

The 3D visualisations were presented in a pre-determined randomised order. Ipsos-Mori used an automated computer randomisation programme to develop a viewing order for the greening options. To administer the surveys two separate orders were used (Table 2.4). For Blonk Street the order of the three visualisations was randomised across all shifts. On Blonk Street the development proposals had already been implemented when the survey was undertaken. As a consequence, it would have been difficult to anchor the ordering on one image, as this may not have

reflected the landscape. The Nursery Street visualisations were anchored on the 'As is' image as the site has not yet been developed. It was more appropriate to randomise the remaining three options as they reflected future possibilities for the area against the current status quo. Table 2.3 outlines the order that each option was shown throughout the survey sessions. It shows that each of the options on Blonk Street was shown in each of the three positions the same number of times. It also shows that the future investment options for the Nursery Street area were all shown an equal number of times as the second, third and final option, and were anchored against the 'As is' visualisation.

Table 2.3. Overall development option randomisation order

By concept

	Presented 1st
don	23
pocket	25

Images within Concept Don

	Order of presentation		
	1st	2nd	3rd
db	16	16	16
df	16	16	16
dl	16	16	16

Images within Concept Pocket

	Order of presentation			
	1st	2nd	3rd	4th
pg	48	0	0	0
pc	0	16	16	16
po	0	16	16	16
ps	0	16	16	16

Key: db – Before, df – VALUE, dl – VALUE+, pg – As is, pc – SCC/Dev, po – Floods, ps - Streets.

Table 2.4. Development option randomisation order per data collection shift

	Concept order		Concept Don order			Concept Pocket order			
Shift	**1st**	**2nd**	**1**	**2**	**3**	**control**	**1**	**2**	**3**
1	pocket	don	DB	DF	DL	PG	PS	PO	PC
2	pocket	don	DB	DL	DF	PG	PC	PO	PS
3	don	pocket	DF	DB	DL	PG	PC	PS	PO
4	don	pocket	DF	DL	DB	PG	PS	PC	PO
5	don	pocket	DL	DB	DF	PG	PO	PS	PC
6	pocket	don	DL	DF	DB	PG	PC	PO	PS
7	pocket	don	DB	DF	DL	PG	PS	PC	PO
8	pocket	don	DB	DL	DF	PG	PO	PS	PC
9	don	pocket	DF	DB	DL	PG	PO	PC	PS
10	don	pocket	DF	DL	DB	PG	PS	PO	PC
11	pocket	don	DL	DB	DF	PG	PC	PS	PO
12	pocket	don	DL	DF	DB	PG	PO	PC	PS
13	don	pocket	DB	DF	DL	PG	PO	PS	PC
14	don	pocket	DB	DL	DF	PG	PS	PC	PO
15	don	pocket	DF	DB	DL	PG	PS	PO	PC
16	pocket	don	DF	DL	DB	PG	PO	PC	PS
17	pocket	don	DL	DB	DF	PG	PS	PO	PC
18	don	pocket	DL	DF	DB	PG	PC	PS	PO
19	don	pocket	DB	DF	DL	PG	PO	PC	PS
21	pocket	don	DF	DB	DL	PG	PC	PO	PS
22	don	pocket	DF	DL	DB	PG	PO	PS	PC
23	don	pocket	DL	DB	DF	PG	PC	PO	PS
24	pocket	don	DL	DF	DB	PG	PS	PC	PO
25	pocket	don	DB	DF	DL	PG	PC	PS	PO
26	don	pocket	DB	DL	DF	PG	PO	PC	PS
27	don	pocket	DF	DB	DL	PG	PO	PS	PC
28	pocket	don	DF	DL	DB	PG	PC	PO	PS
29	pocket	don	DL	DB	DF	PG	PS	PC	PO
30	don	pocket	DL	DF	DB	PG	PO	PS	PC
31	pocket	don	DB	DF	DL	PG	PC	PO	PS
32	don	pocket	DB	DL	DF	PG	PS	PO	PC
33	pocket	don	DF	DB	DL	PG	PS	PC	PO
34	pocket	don	DF	DL	DB	PG	PC	PS	PO
35	don	pocket	DL	DB	DF	PG	PO	PC	PS
36	pocket	don	DL	DF	DB	PG	PS	PO	PC
37	pocket	don	DF	DB	DL	PG	PS	PO	PC
38	don	pocket	DF	DL	DB	PG	PO	PC	PS
39	don	pocket	DL	DB	DF	PG	PS	PO	PC
40	pocket	don	DL	DF	DB	PG	PC	PS	PO
41	pocket	don	DB	DF	DL	PG	PO	PC	PS
42	don	pocket	DB	DL	DF	PG	PC	PS	PO
43	don	pocket	DF	DB	DL	PG	PS	PO	PC
44	pocket	don	DF	DL	DB	PG	PO	PS	PC
45	pocket	don	DL	DB	DF	PG	PC	PO	PS
46	don	pocket	DL	DF	DB	PG	PS	PC	PO
47	don	pocket	DB	DF	DL	PG	PC	PS	PO
48	pocket	don	DB	DL	DF	PG	PO	PC	PS
49	pocket	don	DB	DL	DF	PG	PC	PS	PO

2.11. Analysis

The data collected from the Sheffield survey were subjected to a three-stage analysis. First, a set of frequencies of each variable and simple cross-tabulations were prepared. Next, this was examined to assess whether any potential relationships could be identified between the demographic, WTP and contextual

responses to the survey, on the one hand, and preferences and attitudes to green investment, on the other. Examples of this process included assessments of WTP against type or frequency of use. Then, any relationships thus identified were explored in more detail to determine whether they were statistically significant, using the chi-square measure. Regression analysis was not undertaken because of the discontinuous nature of the data variables.

Potential relationships between WTP and the socio-economic variables were also assessed using chi-square analysis. A Pearson chi square test, commonly known as *goodness-of-fit test*, was used to establish whether associations existed between one or more variables under investigation. Chi-square tests are used most frequently to examine whether significant differences exist between expected and observed frequencies. By examining a null hypothesis, which states that no significant difference will be observed, a Chi Square test allows us to evaluate the probability that sampling error explains the relationships between the nominal-level variables displayed in the cross-tabulation tables (Rubbin, 2010). Rubbin outlines this process as:

$$\chi^2 = \sum \frac{(Fo - Fe)^2}{Fe}$$

Fo=Observed Frequencies

Fe= Expected Frequencies

Cross-tabulation consists of columns, allocated to each category of the independent variable, and rows allocated to the dependent variable. The groupings of numbers at the intersections of rows and columns are called “cells”. The first number represents the observed count of the raw number of cases in the referent column category that had the referent row category. The second number is the number of cases where this observation can be expected. Finally, the last number is the percentage. This is found by dividing the observed count in each cell by the total count for that column (Rubbin, 2010). In practice Chen and Jim (2008) found that when respondents face a question of accepting or rejecting a proposed environment-related project that changes public goods from Q0 to Q1, the welfare function is given by:

V(Y-WTP,S,Q1)=V(Y,S,Q0)

Where *Y* represents household or individual income, *S* are socio-economic factors and *WTP* is the amount of money respondents are WTP to change a public good from Q0 to Q1. Chi-square analysis examines a null hypothesis and an alternative or research hypothesis to investigate whether relationships can be identified between variables. These hypotheses can be described as:

1. *Ho (Null hypothesis):* There is no relationship between *socio-economic variables* and WTP for different design options.
2. *Ha (Alternative or research hypothesis*): There is a relationship between *socio-economic variables* and WTP for different options.

Chapter 3 examines these hypotheses against the responses for each development scenario. The tests presented are based on the difference between the observed and the predicted counts of "WTP *more than* the mean value" and "WTP *less than* the mean value". Socio-economic variables were categorized into two group based on mean or median value as shown below[9]:

- Age was categorized according to the mean value – above and below 37.7 years of age. Age is calculated from known numerical point data;
- *Education* attainment is split between lower education (primary, secondary and vocational training) and higher education (degree level, graduate and doctorate);
- *Income* is recorded as a) lower income with an annual household income of less than £29,999 and b) income of £30,000 per year or more;
- Living in a house with or without a garden were categorized as two groups;
- Home-ownership was categorized as homeowners and private renters, housing association/council renters, student renters and job renters;
- Length of tenure, including living, working, using, knowing people in the area the attachment time with the area was split between attachments of more or less than 10 years (<10 years>); and
- Ethnicity was reported as 'White' (British, English, Scottish, Welsh, Northern Irish, Irish, European and any other white background) and BME groups

[9]In addition to these socio-economic characteristics, being resident in the area, employment status and the perceptions that "trees are the most important factor in making somewhere a good place to live" were also analysed. No association between these indicators and WTP was identified.

(Asian or Asian British, Black and Black British, Mixed and other ethnic background).

2.12. Summary

The design and implementation of the VALUE survey questionnaire was a collaborative effort between the University of Sheffield, the SYFP and Ipsos-Mori. Each of these three organisations provided valuable insights into the development of the survey and aided its successful completion. Whilst VALUE funded several green investments in and around Sheffield, the survey itself focussed on a number of green investment options in two locations on The Wicker Riverside (Blonk Street and Nursery Street). This concentrated rather then diffused the research effort and maximised the data that could be obtained regarding each green investment. Each section of the survey was refined a number of times to create an appropriate and focussed questionnaire for the VALUE research. Further improvements could have been made but due to practical time and access constraints placed upon the research this was not possible.

3. Results

The following chapter presents the results of the analysis of the data collected from the 510 respondents to The Wicker Riverside, Sheffield survey. Qualitative and quantitative analyses highlighted the relationships between WTP, the contextual questions and respondents' characteristics.

3.1. Willingness to pay for green investments in Sheffield

Table 3.1 and Charts 3.1 and 3.2 show WTP and reported preferences for the various green investments at Blonk Street and Nursery Street. Whilst the scope of the development options differs in terms of their size, function and level of greening, the results suggest that the differences in visible and functional Green Infrastructure influence WTP and preferences.

Analysis of Blonk Street indicates that preference and WTP are linked to the perceived greenness of an investment option. Chart 3.1 shows that the 'Before' and VALUE+ options are preferred to the VALUE option. This suggests that specific elements of the visualisation influence the attribution of higher WTP values. When the options are assessed, the level of greenery in each investment appears to be the most prominent difference. Furthermore, when WTP/preferences are assessed alongside perceptions of relative greenness discussed in the contextual questions, the relationship between WTP and greenery becomes more prominent[10].

The analysis of Nursery Street produces WTP/preferences that are similar to those for Blonk Street. Again, an assessment of each investment option suggests that WTP and preferences are linked to the perceived level of greening, this time in Nursery Street. Large swathes of Green Infrastructure are visible in the 'Floods' and 'As is' options. In contrast, buildings and other hard structures are prominent in the SCC/Dev and 'Streets' options and lower WTP values are attributed to them. They also represent a more 'managed' approach to investment in Green Infrastructure compared to the 'Floods' and 'As is' options.

[10] A positive interpretation of greenery is defined as respondents who agreed or strongly agreed that the scenario shown in the 3D visualisation presented a favourable level of visible Green Infrastructure.

Table 3.1. WTP and respondent preferences for Blonk Street and Nursery Street.

	WTP (with True Zero) nothing + not stated)	No WTP responses (with True Zero) nothing + not stated	% of WTP responses (with True Zero) nothing + not stated	Number of Positive WTP	% Number of Positive WTP	Protest Zero	% Protest Zero	Other (Don't know Refused)	% Other know Refused) (Don't	Total %
Before	£10.56	397	77.84	78	15.29	16	3.13	19	3.72	100
VALUE	£4.28	437	85.68	39	7.64	19	3.72	15	2.94	100
VALUE+	£8.00	400	78.43	74	14.50	17	3.33	19	3.72	100
As is	£12.17	374	73.33	94	18.43	17	3.33	25	4.90	100
SCC / Dev	£3.87	449	88.03	34	6.66	16	3.13	11	2.15	100
Floods	£29.28	260	50.98	209	40.98	14	2.74	27	5.29	100
Streets	£6.69	418	81.96	62	12.15	14	2.74	16	3.13	100

The values generated for both Blonk Street and Nursery Street options indicate that proportionally higher WTP figures are associated with greener options. WTP for the 'Floods' option is 750% higher than the WTP for the SCC/Dev option in Nursery Street. This is significantly greater than the 239% difference in the WTP for the least and most favoured options at Blonk Street. The variation may be attributed to the larger number of options presented for Nursery Street and also the broader range of treatments that they represent.

The preference rates for Blonk Street and Nursery Street also support the view that Green Infrastructure makes Sheffield a liveable city. Each of the contextual questions addressing urban greening was answered positively (Chart 3.3). All five categories received at least 50% positive responses (agree and strongly agree), suggesting that people feel that Sheffield's Green Infrastructure resources make a valuable contribution to the city. Assessed alongside Chart 3.1 and 3.2 this provides evidence that WTP and preferences may be linked to the quality, availability and function of Green Infrastructure at a city scale. However, it is also important to examine the influence that respondents' characteristics may have on their regard for green infrastructure.

Chart 3.1 WTP, preferences and assessment of greenness – Blonk Street

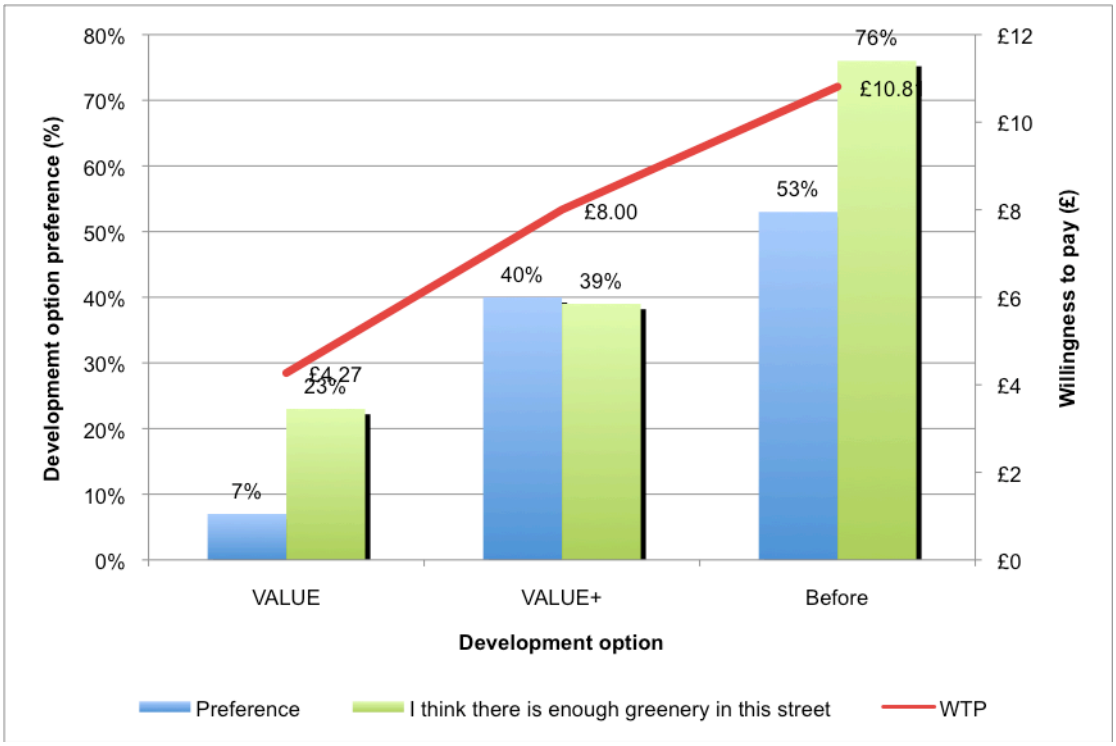


Chart 3.2. WTP, preferences and assessment of greenness – Nursery Street

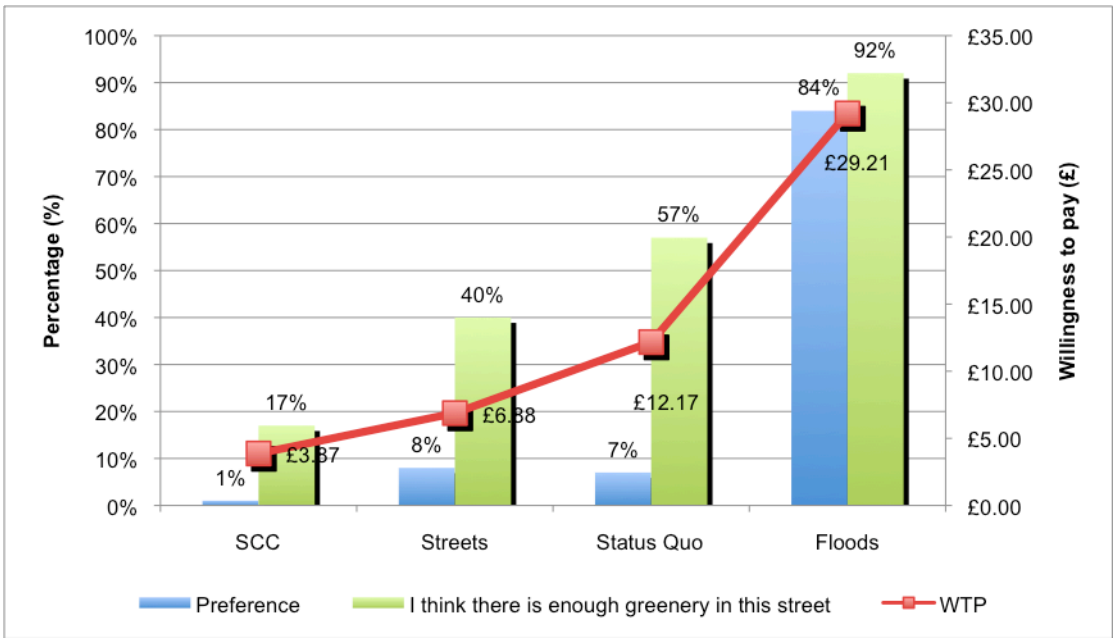
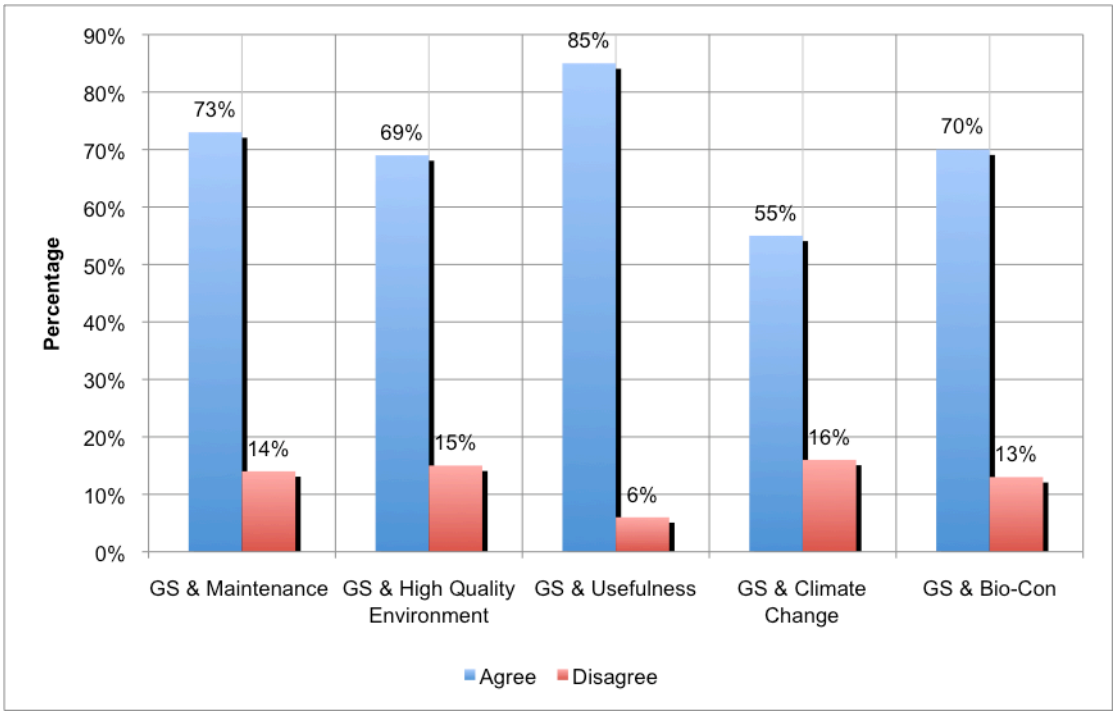


Chart 3.3. Green investment contribution to urban areas[11]



3.2. Respondents' assessments of green investment – contextual questions

Contextual questions were included to allow people to link their WTP values with a wider assessment of Green Infrastructure in The Wicker Riverside and Sheffield. Participants were asked to compare the visual attractiveness, composition and use of the investments under investigation when debating preferences.

Table 3.2. Respondents' assessments of Blonk Street investment scenarios

	I like the look of this image	I do not like the look of this image	I would enjoy walking along the river	I would not enjoy walking along the river	I would use the green spaces	I would not use the green spaces
Before	69%	21%	73%	18%	76%	15%
VALUE	49%	38%	56%	30%	23%	65%
VALUE+	62%	23%	71%	17%	39%	47%

Table 3.2 shows variation between respondents' assessments of the three scenarios on Blonk Street. In each question the 'Before' option was consistently attributed the highest positive values of 69% or more, suggesting that respondents identified this option as providing the greatest number of benefits. The responses for the VALUE and VALUE+ options show greater variation. Responses to the VALUE option reveal

[11]For a full outline of the questions used for Chart 3.3 see Question 5 of the questionnaire. GS relates to Green space and Bio-Con is a shortened version of Biodiversity & Conservation.

the least positive view of the scenarios. Although, the look and 'walkability' of the VALUE option scored approximately 50%, these are lower than the response rates for the other two options. Furthermore, only 23% of respondents said that they would use the green spaces in this option.

Respondents also report that the VALUE+ option presents an attractive scenario with response rates above 62%. However, there is a perceived lack of utility to the option's greenness as 39% of respondents stated they would use the greenery shown. Consequently, the Blonk Street analysis indicates that respondents valued the 'before' image the most because of its visual and functional characteristics, as shown in the visualisation (see Chart 3.12 for additional evidence of this relationship).

Analysis of the Nursery Street options produced results similar to those for Blonk Street. The options perceived as 'greener' received higher positive assessments for aesthetics, use and value. There was a clear preference for the 'Floods' option (see Table 3.3).

Table 3.3. Respondents' assessments of Nursery Street investment scenarios

	I like the image of this view from the apartment	I do not like the image of this view from the apartment	I would enjoy walking along the river	I would not enjoy walking along the river	I would enjoy walking along the river	I would not enjoy walking across the river	I would use the green spaces	I would not use the green spaces
As is	75%	14%	82%	8%	79%	9%	65%	21%
SCC / Dev	27%	64%	40%	45%	37%	45%	28%	57%
Floods	93%	3%	95%	3%	95%	2%	90%	5%
Streets	54%	35%	63%	22%	62%	21%	49%	34%

Respondents' views of the three facets of the 'As is' and 'Streets' options varied significantly. The 'As is' option was awarded consistently high positive values (65-82%) but there is scope to suggest that scenarios with more grey and less Green Infrastructure may influence response rates. Variation does exist between the response rate proportions recorded for each investment option and the contextual questions. Analysis of the 'Streets' option could support the interpretation that people consider a range of influences when responding to the contextual questions. The reported values for the 'Streets' option shows that, whilst there is a view that the investment is attractive and promotes mobility, respondents would not necessarily use any additional green space developed. The 'SCC/Dev' option shows the lowest proportion of positive responses to views of each of its facets (none was higher than

40%). Respondents were also least convinced that the option had enough greenery (see Charts 3.1 and 3.2). This may be because the investment within the visualisation was framed by many buildings that reduced its visual appeal and made it more difficult to identify its nature (see Chart 3.13 for additional evidence of the perceptions of the Nursery Street options).

3.3. Preferences and socio-economic characteristics

The Blonk Street analysis highlighted a preference for the 'Before' option across all respondent classifications (Table 3.4). An average value of 53% was recorded. The VALUE+ option was also consistently preferred by a high proportion of respondents (40.6% on average). Within these two options commuters showed the highest preference for the 'Before' option (65%), whilst employees showed the lowest (46%). In contrast, for the VALUE+ option employees showed highest preference (45%) and commuters showed the lowest (29%).

Table 3.4. Respondents' preferences for the Blonk Street investment options

	Residents	Business Owners	Employees	Commuters	Other	Average
Before	50%	53%	46%	65%	51%	53%
VALUE	6%	8%	-	6%	7%	5.4%
VALUE+	43%	39%	45%	29%	41%	40.6%

It can be argued that these differences are linked to the role Blonk Street holds in the lives of these user groups. Those commuting through the area may prefer a visibly greener environment ('Before' option); however, those who use the area regularly (residents and employees) may derive additional benefits from more formal or managed Green Infrastructure.

The VALUE investment was attributed the lowest proportion positive responses. This may be the result of a perceived lack of 'green' compared to the other options. The VALUE investment is comprised of a mix of green and civil engineering elements whose usefulness and attractiveness may have been difficult to identify – reducing positive views of it.

The analysis for Nursery Street (Table 3.5) again indicates that the 'greenest' options were preferred to less green ones. The 'Floods' option was accorded the highest preference (average 82.4%) by all types of respondent. The 'SCC/Dev' option was the least preferred. This may be related to the relatively high density of development and the lack of additional green space in this option.

Table 3.5. Respondents' preferences for the Nursery Street investment options

	Residents	Business Owners	Employees	Commuters	Other	Average
As is	6%	8%	-	10%	6%	6%
SCC/Dev	1%	-	4%	-	1%	1.2%
Floods	83%	80%	81%	84%	84%	82.4%
Streets	8%	10%	15%	6%	6%	9%

Employees and business owners show a secondary preference for the 'Streets' option that may reflect its utility to these groups. Commuters indicate a preference for the 'As is' option. Greater variation is shown in the reported preferences for Nursery Street compared to Blonk Street. This reflects the wider scope of the proposed investments. Analysis suggests, though, that the greenest option is preferred by all types of respondent.

Table 3.6. Work status and green investment preferences – Blonk Street

	Working	Retired	Not Working	In Education	Average
Before	55%	56%	43%	42%	49%
VALUE	7%	4%	6%	7%	6%
VALUE+	37%	38%	50%	51%	44%

A review of work status indicates a number of interesting trends. People who were working or retired showed a greater preference for the 'Before' option on Blonk Street, whilst those who were not working or who were in education showed a greater preference for the VALUE+ option (Table 3.6). There was a consistently low preference for the VALUE investment compared to the other two options.

Table 3.7. Work status and green investment preferences – Nursery Street

	Working	Retired	Not Working	In Education	Average
Status Quo	7%	6%	4%	7%	6%
SCC/Dev	1%	-	1%	-	0.5%
Floods	84%	92%	83%	84%	85.75%
Streets	7%	2%	1%	9%	4.75%

A more distinctive pattern of preferences in relation to work status was identified for Nursery Stree (Table 3.7). 'The Floods' option was preferred by over 85% of respondents with the 'As is' option a distant second. The great preference for the 'Floods' option held, whatever the respondent's work status, although retired respondents were particularly keen on this option. The remaining options generated the following average preference rates: 'As is' - 6%, 'Streets' - 4.75% and SCC/Dev – 0.5%. Compared to the other three scenarios, greater variation in preferences was

evident for the 'Streets' option, which ranged from 1% to 9%. The SCC/development option was the least preferred by all types of respondent.

The analysis of preferences by income for Blonk Street produced an even distribution of values for each development option (Table 3.8). The greener investment options were preferred to the VALUE investment. Respondents in the median income range (£30,000-39,999) and those earning >£75,000 show the greatest preferences for the 'Before' option. Those with salaries of £50,000-75,000 and >£75,000 show the highest preferences for the VALUE investment and those earning <£15,000 and £20,000-29,999 prefer the VALUE+ (greener option).

Table 3.8. Income and green investment preferences – Blonk Street

	<£15,000	£15,000-£19,999	£20,000-£29,999	£30,000-£39,999	£40,000-£49,999	£50,000-£75,000	>£75,000	Average
Before	48%	58%	49%	61%	52%	56%	64%	55.4%
VALUE	5%	6%	5%	4%	4%	13%	18%	7.86%
VALUE+	46%	32%	46%	34%	44%	31%	18%	35.86%

Table 3.9. Income and green investment preferences – Nursery Street

	<£15,000	£15,000-£19,999	£20,000-£29,999	£30,000-£39,999	£40,000-£49,999	£50,000-£75,000	>£75,000	Average
As is	4%	8%	4%	7%	-	16%	27%	9.4%
SCC/Dev	-	1%	1%	-	1%	1%	-	0.57%
Floods	*88%*	*84%*	*84%*	*84%*	*86%*	*69%*	*73%*	*81.2%*
Streets	1%	1%	1%	1%	4%	6%	-	2%

Variation exists between respondents' income and their preferences for the Nursery Street options (Table 3.9). The greenest option 'Floods' is the most preferred by respondents of all incomes, although the £50,000-£75,000 and >£75,000 options show a lower preference. Greater variation by income can be seen in the preferences for the other three options. These figures do not correspond to previous research by CABE Space (2005) where respondents at the ends of income range, in the lower and higher income brackets, place a higher value on the functionality of Green Infrastructure. Therefore it is difficult to draw conclusions from the data highlighted in Table 3.8 and 3.9.

3.4. WTP and socio-economic classifications

The following section discusses the relationships between respondents' WTP and their socio-economic characteristics.

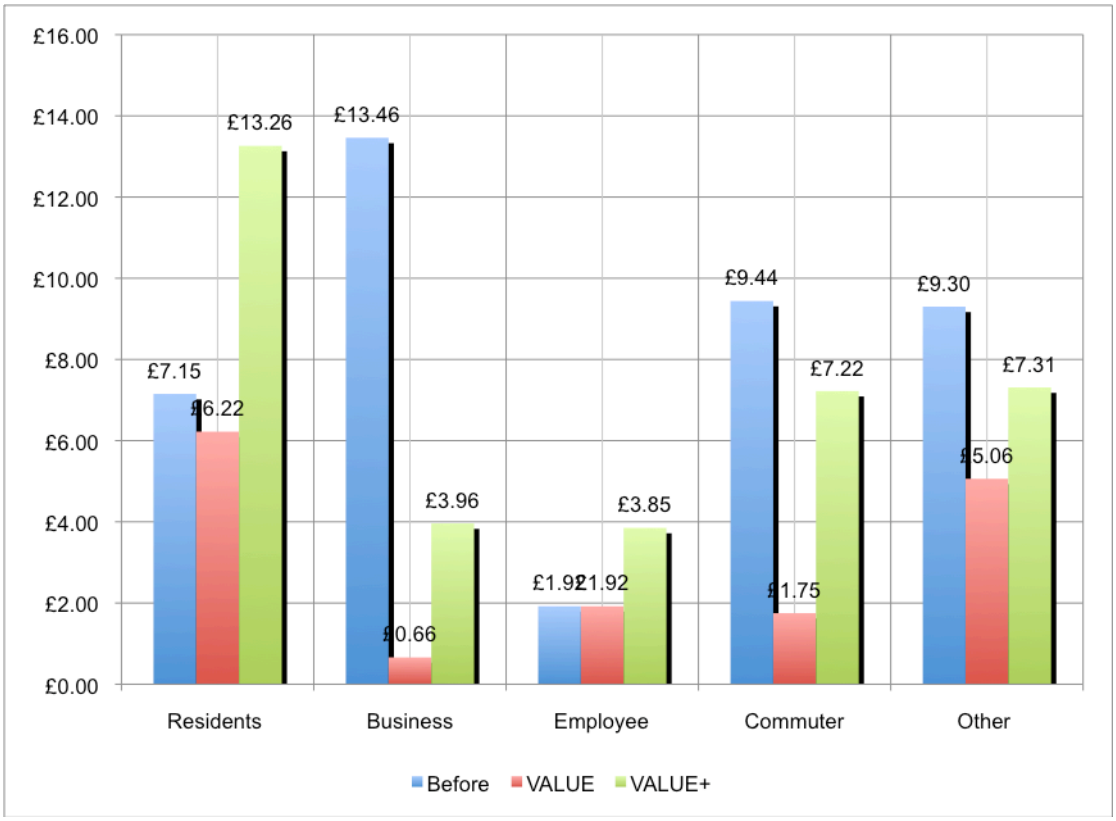
The results of the analysis for Blonk Street are shown in Table 3.10 and Chart 3.4 and for Nursery Street in Table 3.11 and Chart 3.5. The data for Blonk Street indicate

that employees are WTP the least and residents are WTP the most for green investments. However, for the 'Before' option residents are WTP less than businesses, commuters and other users but more for the VALUE and VALUE+ investment options. The 'Before' and VALUE+ options elicit the highest WTP values. Commuters show the greatest variation in their WTP, which could reflect the transient nature of their use of the area.

Table 3.10. Blonk Street – WTP by Type of Respondent

	Residents	Business	Employee	Commuter	Other
Before	£7.15	**£13.46**	*£1.92*	**£9.44**	**£9.30**
VALUE	*£6.22*	*£0.66*	*£1.92*	*£1.75*	*£5.06*
VALUE+	**£13.26**	£3.96	**£3.85**	£7.22	£7.31

Chart 3.4. Blonk Street – WTP by Type of Respondent



A more distinctive pattern of preference is shown in the WTP for options in Nursery Street compared to Blonk Street. Each type of respondent was WTP the most for the 'Floods' option and the least for the 'SCC/Dev' option. In addition, employees in the area were WTP £0.00 for the 'SCC/Dev' and 'Streets' options.

A review of the WTP for the 'Floods' option indicates that local residents would pay the most for this green investment (an additional £33.55 per month). Employees in

the area would pay the least (£16.73). Employees are also WTP the least for the 'SCC/Dev' and 'Streets' options. Commuters, business owners and other users show stable WTP values compared to the averages presented in Table 3.1. This suggests that a relationship can be identified between WTP for green investments in Nursery Street and specific user groups.

Chart 3.5. Nursery Street – WTP by Type of Respondent

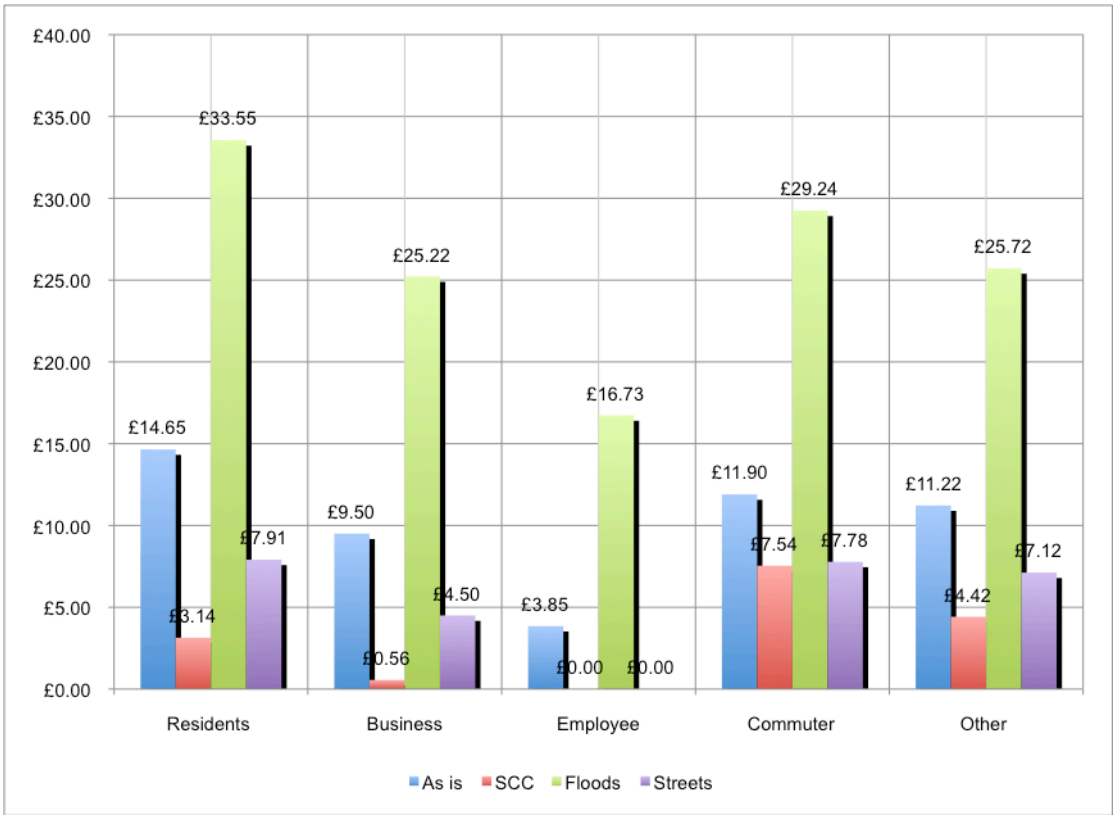


Table 3.11. Nursery Street – WTP by Type of Respondent

	Residents	Business	Employee	Commuter	Other
As is	£14.65	£9.50	£3.85	£11.90	£11.22
SCC/Dev	£3.14	£0.56	£0.00	£7.54	£4.42
Floods	**£33.55**	**£25.22**	**£16.73**	**£29.24**	**£25.72**
Streets	£7.91	£4.50	£0.00	£7.78	£7.12

The analysis of Nursery Street shows that the 'Floods' option is the most preferred followed by the 'As is' and 'Streets' options. The SCC/Dev scenario shows the lowest WTP values. This replicates the results in Section 3.3.

The analysis of WTP by work status (Tables 3.12 and 3.13) indicates that those in education are WTP the most and that retired people are WTP the least. No relationship between education and WTP has been identified in the research literature. The survey results may reflect this group's lack of awareness of the

negative economic or social values associated with The Wicker Riverside and the possibility that they may not be required to make long-term financial commitments like those made by residents.

Chart 3.6. Blonk Street – Works status and WTP

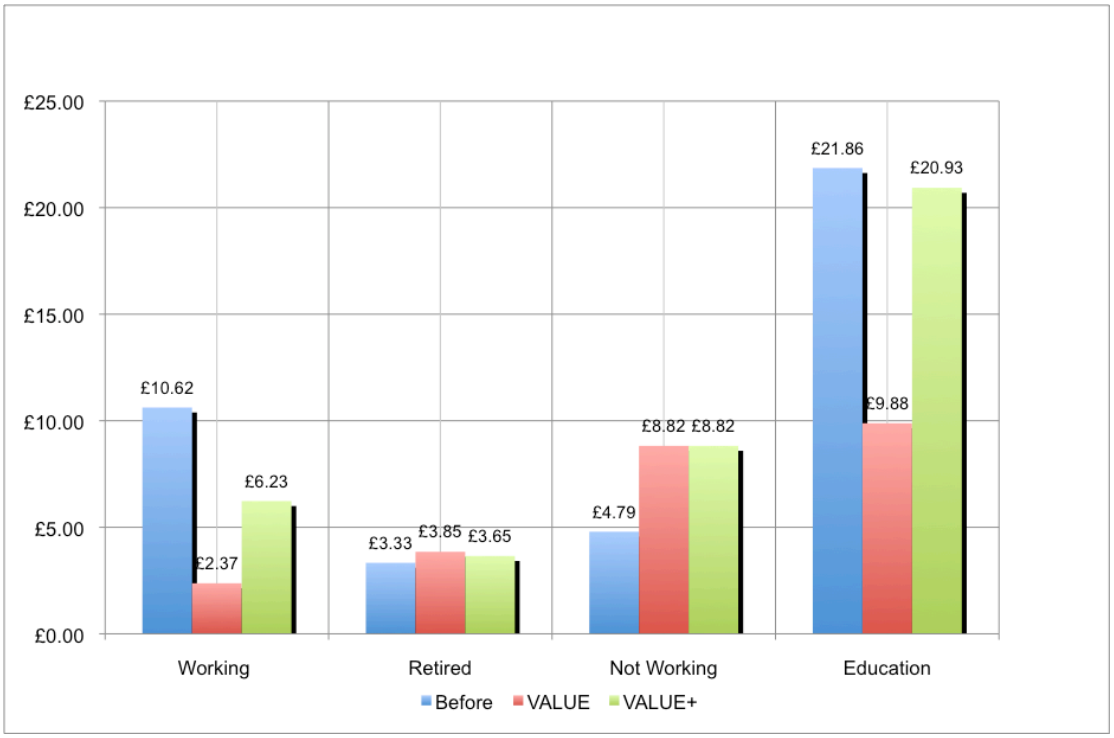


Table 3.12. Blonk Street – WTP and Work Status

	Working	Retired	Not Working	In education
Before	£10.62	£3.33	£4.79	£21.86
VALUE	£2.37	£3.85	£8.82	£9.88
VALUE+	£6.23	£3.65	£8.82	£20.93

Chart 3.6 and Table 3.12 also suggest that there is no overarching relation between WTP and work status for Blonk Street. The 'Before' option though is considered by two groups to be the most economically valuable. The VALUE investment shows the highest reported WTP for retired and joint highest value for people classified as not working. The variation shown within this analysis could suggest that respondents are viewing each investment differently in terms of the visible greenery. It may also promote the view that added value is placed on specific investment elements including accessibility and flood management. However, as is shown by CABE Space (2004; 2005) and Tyrväinen and Väänänen (1998), it is difficult to identify whether a single or a range of influences affect value attribution.

The analysis of Nursery Street shows a more distinctive pattern for WTP (see Chart 3.7 and Table 3.13). Whatever their work status, respondents were WTP the most for the 'Floods' option and the least for the 'SCC/Dev' option. As in the Blonk Street analysis, those in education were WTP the most and those who were retired were WTP the least. The variation in values by work status neither supports nor refutes the research literature, because retired and unemployed people have been reported as providing varied WTP values for Green Infrastructure.

Chart 3.7. Nursery Street – Work status and WTP

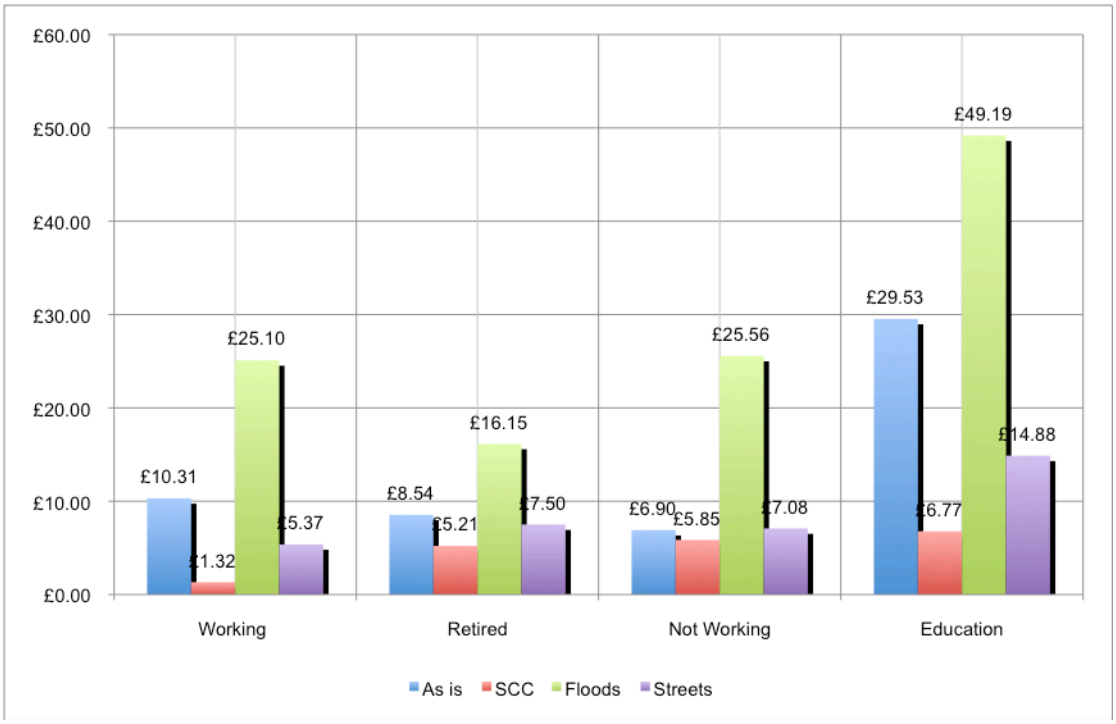


Table 3.13. Nursery Street – WTP and Work Status

	Working	Retired	Not Working	In education
As is	£10.31	£8.54	£6.90	£29.53
SCC/Dev	£1.32	£5.21	£5.85	£6.77
Floods	£25.10	£16.15	£25.56	£49.19
Streets	£5.37	£7.50	£7.08	£14.88

Assessments of WTP by income for Blonk Street did not reveal any clear patterns (see Chart 3.8 and Table 3.14). The 'Before' option and the 'VALUE+' option attracted the highest WTP in particular, but differed between income brackets. However, a consistent relationship between income and the WTP for each option is not visible. For Blonk Street, the VALUE option shows the lowest level of visible green and, as has been noted elsewhere, people may be WTP less for it because of this. WTP for the VALUE option may also have been influenced by a lack of

understanding of the value associated with improved access and flood mitigation. There is also a possible aberration in the data because those with incomes of >£75,000 are WTP significantly more for the VALUE+ option than those in any of the other income brackets. This could be a reflection of the small sample size (N=11). The figures may also be outlier values.

Chart 3.8. Blonk Street – WTP by Income

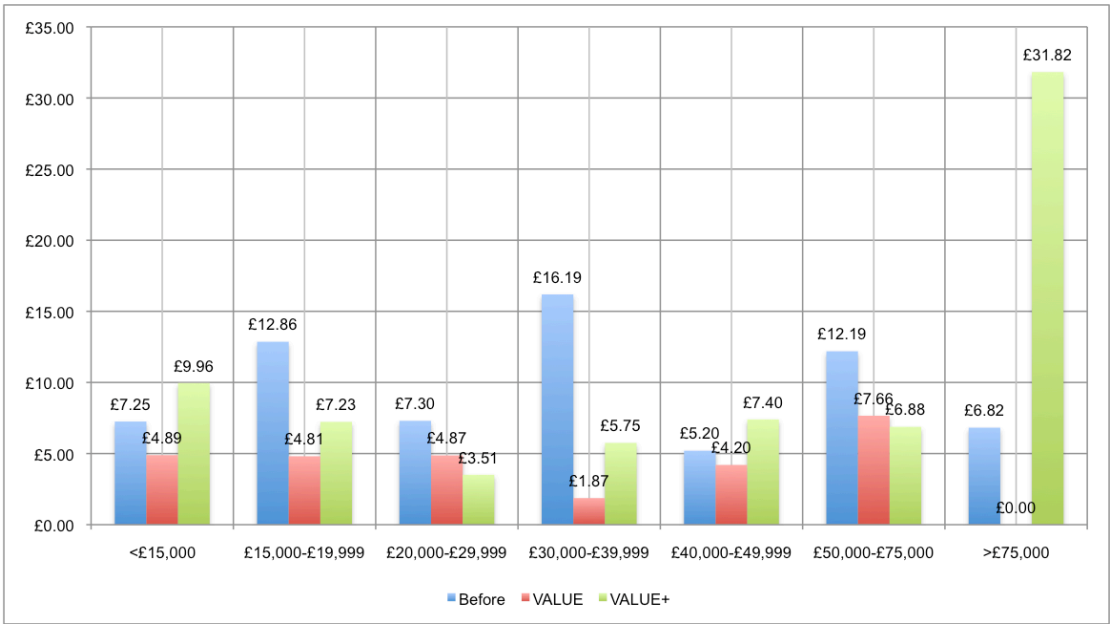


Table 3.14. Blonk Street – WTP by Income

	<£15,000	£15,000-£19,999	£20,000-£29,999	£30,000-£39,999	£40,000-£49,999	£50,000-£75,000	>£75,000
Before	£7.25	£12.86	£7.30	£16.19	£5.20	£12.19	£6.82
VALUE	£4.89	£4.81	£4.87	£1.87	£4.20	£7.66	£0.00
VALUE+	£9.96	£7.23	£3.51	£5.75	£7.40	£6.88	£31.82

The analysis of WTP by income for Nursery Street highlighted that the 'Floods' option was accorded the highest WTP values (see Chart 3.9 and Table 3.15). The difference in WTP between the 'Floods' and the other options varied. The 'SCC/Dev' option had the lowest average WTP in each income bracket. In the £50,000-£75,000 income bracket the 'SCC/Dev' and 'As is' options elicited the joint lowest WTP values. The attribution of a low mean value in this income bracket does not correspond to the overall WTP value of the 'As is' option. In each of the other income brackets it was accorded the second highest WTP values. Furthermore, there are no significant differences between the WTP values shown between different incomes. This reinforces the pattern identified previously in the analysis: the greatest value is

placed on the 'Floods' option, then on the 'As is' option, then on the 'Streets' option and finally on the "SCC/Dev" option.

Chart 3.9. Nursery Street – WTP by Income

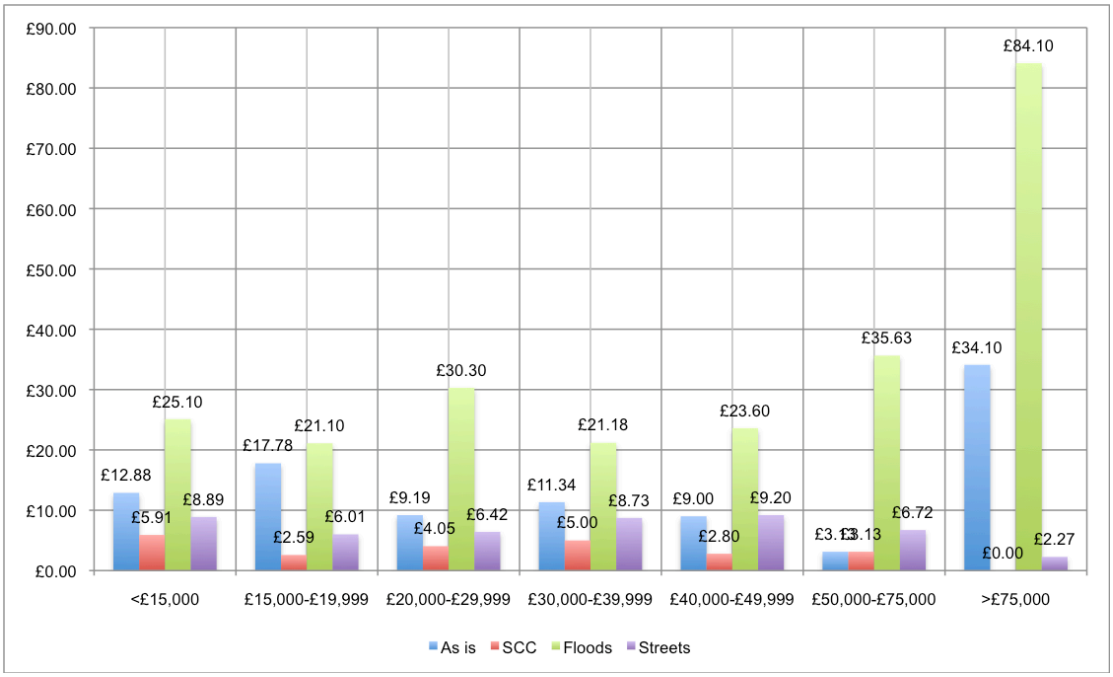


Table 3.15. Nursery Street – WT by Income

	<£15,000	£15,000-£19,999	£20,000-£29,999	£30,000-£39,999	£40,000-£49,999	£50,000-£75,000	>£75,000
As is	£12.88	£17.78	£9.19	£11.34	£9.00	£3.13	£34.10
SCC/Dev	£5.91	£2.59	£4.05	£5.00	£2.80	£3.13	£0.00
Floods	£25.10	£21.10	£30.30	£21.18	£23.60	£35.63	£84.10
Streets	£8.89	£6.01	£6.42	£8.73	£9.20	£6.72	£2.27

3.5. Quantitative analysis of the relationship between respondents' WTP and their socio-economic characteristics

3.5.1. Blonk Street - Before option

Chi-square analysis was used to determine whether relationships existed between respondents' socio-economic characteristics and their WTP. The following section outlines the analysis of a number of socio-economic characteristics exploring these relationships[12]. A 2*2 Chi-square (χ^2) analysis was conducted to examine the possible relationship between WTP and level of education. The reported Pearson

[12] A number of variables including income, education, gender and frequency of use/visiting green areas did not show significantly different results from those of the resident population and are not discussed below.

chi-square *P* value "Asymp. Sig" was 0.001 and less than 0.05 indicating that WTP is related to level of education. A significant relationship (χ^2 = 10.89, df =1, *p* = 0.001) was calculated between WTP and the level of education above and below the mean. The probability of obtaining a χ^2 of this magnitude is remote and the Ho (Null hypothesis) was rejected. The analysis also suggests that WTP is not distributed evenly between the levels of education, as people in lower education category are WTP more than those in the higher education category (Table 3.16).

Table 3.16. Association of Education Level of Respondents and WTP for Blonk Street (Before) Option

Level of Education	**WTP<=£10.56 %**	**WTP>£10.56 %**	**Total %**
Lower Education	61.6	7.1	68.7
Higher Education	24.6	6.7	31.3
Total	86.2	13.8	100
Chi Square=10.892		df=1	p=0.001

Table 3.17. Association of Age of Respondents and WTP for Blonk Street (Before) Option

Age	**WTP<=£10.56 %**	**WTP>£10.56 %**	**Total %**
Younger than <37.7	43.3	9.2	52.5
Older than>37.7	42.5	4.9	47.5
Total	85.9	14.1	100
Chi Square=5.447		df=1	p= 0.02

Table 3.17 outlines the relationship between WTP and age, which is significant (χ^2 =5.44, df =1, *p* = 0.02). The *p value* is less than the confidence factor (p<0.05) and the Ho (Null hypothesis) was rejected. Table 3.17 indicates that younger respondents are WTP more than older respondents for this option.

Table 3.18. Association of Respondents Living in a House with Garden and WTP for Blonk Street (Before) Option

Garden	**WTP<=£10.56 %**	**WTP>£10.56 %**	**Total %**
Yes	63.1	9.0	72.1
No	22.4	37.5	27.9
Total	85.6	14.4	100
Chi Square=3.894		df=1	p= 0.048

Table 3.18 shows that 37.5% of respondents living in a house without a garden were WTP more than the £10.56 average, as opposed to 9% for the people living in a house with a garden. The Chi-square results - χ^2 = 3.894, df=1, p=0.048 – supports the rejection of the Ho (Null hypothesis) in this case and demonstrates that the lack of access to a garden is a significant influence on WTP.

Table 3.19. Association of Ethnicity and WTP for Blonk Street (Before) Option

Ethnicity	WTP<=£10.56 %	WTP>£10.56 %	Total %
BME	28.4	8.8	37.3
British	56	6.7	62.7
Total	84.5	15.5	100
Chi Square=14.087		df=1	p=0.000

Table 3.20. Association of Attachment Period and WTP for Blonk Street (Before) Option

Attachment Period	WTP<=£10.56 %	WTP>£10.56 %	Total %
Less than or Equal 10 years	74.7	11	85.7
More than 10 years	11.2	3.1	14.3
Total	85.9	14.1	100
Chi Square=4.275		df=1	p=0.039

A significant relationship (χ^2 =14.087 df =1, p = 0.00) is shown between WTP and ethnicity. Respondents classified as BME are WTP more than the British group for the Blonk Street (Before) option (see Table 3.19). Table 3.20 shows the Chi-square results (χ^2 = 4.282, df=1, p=0.039) assessing WTP and attachment period. Respondents living in Sheffield for 10 years or more are WTP more for this option than the respondents who have lived in the city for less than 10 years.

Table 3.21. Association of Homeownership and Willingness to Pay for Blonk Street (Before) Option

Homeownership	WTP<=£10.56 %	WTP>£10.56 %	Total %
Owner	47.3	9.6	56.9
Renter	38.6	4.5	43.1
Total	85.9	14.1	100
Chi Square=4.282		df=1	p=0.039

The analysis highlights an association between WTP and homeownership status. Homeowners are WTP more for this green investment than renters. The Chi-square results shown in Table 21 (χ^2 = 4.282, df=1 , p=0.039) support the rejection of the Ho (Null hypothesis).

The analysis for Blonk Street (Before) highlights that the level of education has a more significant association with WTP than age or living in a house with a garden in terms of reported χ^2 values. However, a number of the variables have large chi-squared test statistics and small *p*-values, suggesting strong evidence of associations but not necessarily strong associations (Scheaffer, 1999).

3.5.2. Blonk Street - VALUE option

Table 3.22, Table 3.23 and Table 3.24 show Pearson chi-square *P values* of less than 0.05 indicating that there is an association between the rows and columns and that they are dependent. The null hypothesis (no relationship between variables) can be rejected and it can be argued that WTP for the VALUE investment on Blonk Street is related to the level of education (χ^2 = 9.632, df = 1, p = 0.002) and age (χ^2 = 3.894, df = 1, p = 0.048). It also can be suggested that living in a house with garden has a significant impact on WTP (χ^2 = 4.156, df = 1, p = 0.041).

However, a note of caution should be made because the sample population appears to be skewed towards less well-educated respondents (69%) although this reflects the make-up of the population as a whole[13]. A detailed analysis exploring the social aspects of educational attainment, that is, increased awareness of environmental or social issues, could not be undertaken.

Table 3.22. Association of Education Level of Respondents and Willingness to Pay for Blonk Street (VALUE) Option

Level of Education	**WTP<=£4.27 %**	**WTP>£4.27 %**	**Total %**
Lower Education	65.2	3.5	68.7
Higher Education	27.2	4.1	31.3
Total	92.5	7.5	100
Chi Square=9.632		df=1	p=0.002

Table 3.23. Association of Age of Respondents and Willingness to Pay for Blonk Street (VALUE) Option

Age	**WTP<=£4.27 %**	**WTP>£4.27 %**	**Total %**
Younger than <37.7	46.7	5.9	52.5
Older than>37.7	45.7	1.8	47.5
Total	92.4	7.6	100
Chi Square=3.894		df=1	p= 0.048

Table 3.23 highlights that younger respondents are WTP more for this option. Table 3.24 indicates that respondents living in a house with a garden are WTP more than the people living in a house without garden. Given the same degrees of freedom, the analysis suggests that the level of education, living in a house with a garden and the age of the respondents are relatively important factors in establishing whether people are WTP more rent/mortgage for the VALUE investment at Blonk Street. The results of the analysis of home ownership and WTP are χ^2 = 6.928, df = 1., p =0.0041 (see

[13] The 2001 Census Sheffield Profile reports that 18.8% of city residents are classified as attaining 'higher educational' qualifications with 81.2% classed as 'lower educational' attainment (SCC, 2003).

Table 3.25) suggesting that homeowners are WTP more than renters for the VALUE investment in Blonk Street.

Table 3.24. Association of Respondents Living in a House with Garden and Willingness to Pay for Blonk Street (VALUE) Option

Garden	WTP<=£4.27 %	WTP>£4.27 %	Total %
Yes	67.7	4.4	72.1
No	24.6	3.2	27.9
Total	92.4	7.6	100
Chi Square=4.156		df=1	p=0.041

Table 3.25. Association of Homeownership and Willingness to Pay for Blonk Street (VALUE) Option

Homeownership	WTP<=£4.27 %	WTP>£4.27 %	Total %
Owner	51	5.9	56.9
Renter	41.4	1.8	43.1
Total	92.4	7.6	100
Chi Square=6.928		df=1	p=0.008

Given the same degrees of freedom, larger chi-square values indicate greater significance between the variables. Therefore, the level of education, home-ownership, living in a house with a garden and age are all relatively significant influences on WTP for the Blonk Street (VALUE) option.

3.5.3 Blonk Street - VALUE+ option

Table 3.26, Table 3.27, Table 3.28 and Table 3.29 all contain a Pearson chi-square *P value* that is less than 0.05 indicating that WTP is related to the visiting frequency of respondents (χ^2 = 5.551, df = 1, p = 0.018); education level (χ^2 = 7.490, df = 1, p = 0.006); the age of the respondents (χ^2 = 20.535, df = 1, p = 0.000) and the gender of respondents (χ^2 = 8.199, df = 1, p = 0.004). Therefore, the null hypothesis (no relationship) can be rejected.

Further analysis suggests that respondents who visit green areas every day are statistically WTP more compared to those who visit less frequently (Table 3.26). Table 3.27 shows that people with a lower education level are WTP more than those holding a higher education qualification. Table 3.28 presents data suggesting that younger respondents are WTP more than older respondents. Table 3.29 shows that male respondents are WTP more than female participants.

Table 3.26. Association of Frequency of Use of Respondents and Willingness to Pay for Blonk Street (VALUE+)

Visiting Frequency	WTP<=£8.00 %	WTP>£8.00 %	Total %
Daily Visit	59.8	11.6	71.4
Weekly to never	26.3	2.4	28.6
Total	86	14	100
Chi Square=5.551		df=1	p=0.018

Table 3.27. Association of Education Level and Willingness to Pay for Blonk Street (VALUE+)

Level of Education	WTP<=£8.00 %	WTP>£8.00 %	Total %
Lower Education	61.2	7.5	68.7
Higher Education	25.0	6.3	31.3
Total	86.2	13.8	100
Chi Square=7.490		df=1	p= 0.006

Table 3.28. Association of Age of Respondents and Willingness to Pay for Blonk Street (VALUE+)

Age	WTP<=£8.00 %	WTP>£8.00 %	Total %
Younger than <37.7	41.8	10.8	52.5
Older than>37.7	44.3	3.1	47.5
Total	86.1	13.9	100
Chi Square=20.535		df=1	p=0.000

Table 3.29. Association of Gender and Willingness to Pay for Blonk Street (VALUE+)

Gender	WTP<=£8.00 %	WTP>£8.00 %	Total %
Male	49.9	10.8	60.7
Female	35.9	3.4	39.3
Total	85.8	14.2	100
Chi Square=8.199		df=1	p= 0.004

Table 3.30 presents the analysis of ethnicity and WTP. It shows that BME respondents are WTP more than 'White' respondents for the VALUE+ option. Homeowners also appear to be WTP more for the same investment scenarios (Table 3.31). Given the same degrees of freedom the age, ethnicity, gender, home-ownership status, education and visiting frequency of the respondents are related significantly to their WTP for the Blonk Street (VALUE+) option.

Table 3.30. Association of ethnicity and Willingness to Pay for Blonk Street (VALUE+)

Ethnicity	WTP<=£8 %	WTP>£8 %	Total %
BME	29.8	8.2	38.0
White	56.3	5.7	62.0
Total	86.1	13.9	100
Chi Square=15.604		df=1	p=0.000

Table 3.31. Association of Homeownership and Willingness to Pay for Blonk Street (VALUE+ greener investment scenario) Option

Homeownership	WTP<=£8 %	WTP>£8 %	Total %
Owner	46.9	10	56.9
Renter	39.2	3.9	43.1
Total	86.1	13.9	100
Chi Square=7.534		df=1	p=0.006

The analysis of Blonk Street highlights a number of significant relationships between WTP and socio-economic characteristics. In each development scenario younger respondents (below the mean age) were statistically WTP more than older participants. Furthermore, in respect to education both Blonk Street (Before) and Blonk Street (VALUE+) show higher WTP values for those people with lower educational qualifications. This contrasts with the reported analysis of Blonk Street (VALUE) option where higher educational attainment is related to WTP. Analysis of access to a garden and being male/female are statistically significantly related to WTP for one or more of the options but did not display a consistent trend across all three. From the analysis it can be argued that education and age are the two most consistently significant factors influencing WTP for green investments at Blonk Street.

3.5.4. Nursery Street – 'As is' Option

Tables 3.32, 3.33, 3.34, 3.35 and 3.36 contain Pearson chi-square *P* values of less than 0.05 for the relationship between WTP and each of the respondent characteristics of education, age, living in a house with a garden, gender and frequency of use. The null hypothesis can be rejected as the analysis suggests that WTP is related to education level (χ^2 = 18.250, df = 1, p = 0.000); the age of respondents (χ^2 = 10.380, df = 1, p = 0.001), whether participants live in a house with a garden (χ^2 = 5.180, df = 1, p = 0.023); the gender of respondents (χ^2 = 7.744, df = 1, p = 0.005); frequency of use (χ^2 = 4.323, df = 1, p = 0.038), ethnicity (χ^2 = 23.257, df = 1, p = 0.000) and homeownership (χ^2 = 5.861, df = 1, p = 0.015).

Table 3.32. Association of Education Level and Willingness to Pay for Nursery Street (As is) Option

Level of Education	WTP<= £12.17 %	WTP>£12.17 %	Total %
Lower Education	58.9	8.6	67.5
Higher Education	23	9.5	32.5
Total	81.9	18.1	100
Chi Square=18.250		df=1	p=0.000

Table 3.33. Association of Age of Respondents and Willingness to Pay for Nursery Street (As is) Option

Age	WTP<=£12.17 %	WTP>£12.17 %	Total %
Younger than <37.7	40.6	12.8	53.4
Older than>37.7	40.8	5.8	46.6
Total	81.4	18.6	100
Chi Square=10.380		df=1	p=0.001

Table 3.34. Association of Respondents Living in a House with Garden and Willingness to Pay for Nursery Street (As is) Option

Garden	WTP<=£12.17 %	WTP>£12.17 %	Total %
Yes	60.8	11.8	72.6
No	20.4	7	27.4
Total	81.2	18.8	100
Chi Square=5.180		df=1	p=0.023

Table 3.35. Association of Gender of Respondents and Willingness to Pay for Nursery Street (As is) Option

Gender	WTP<=£12.17 %	WTP>£12.17 %	Total %
Male	46.3	13.7	60
Female	35.0	5	40
Total	81.3	18.7	100
Chi Square=7.744		df=1	p=0.005

Table 3.36. Association of Visiting Frequency of Respondents to Green Areas and Willingness to Pay for Nursery Street (As is) Option

Visiting Frequency	WTP<=£12.17 %	WTP>£12.17 %	Total %
Daily Visit	56.4	15	71.4
Weekly to never	25	3.6	28.6
Total	81.4	18.6	100
Chi Square=4.323		df=1	p=0.038

Table 3.37. Association of Race and Willingness to Pay for Nursery Street (As is) Option

Race	WTP<=£12.17 %	WTP>£12.17 %	Total %
BME	26.9	11.3	38.2
British	54.5	7.3	61.8
Total	81.4	18.6	100
Chi Square=23.257		df=1	p=0.000

Table 3.38. Association of Homeownership and Willingness to Pay for Nursery Street (Before) Option

Homeownership	WTP<=£12.17 %	WTP>£12.17 %	Total %
Owner	43.6	12.6	56.2
Not owner	37.8	6	43.8
Total	81.4	18.6	100
Chi Square=5.861		df=1	p=0.015

Table 3.32 shows that people with a higher education level are WTP more than those with lower educational qualifications. Younger respondents are WTP more than older people as shown in Table 3.33. Table 3.34 indicates that respondents living in a house with a garden are WTP more those without a garden for the 'as is' option and Table 3.35 indicates that male respondents are WTP more than the female participants for that option. Table 3.36 suggests that respondents who visit green spaces every day are WTP more for the 'as is' option than those who visit such locations less frequently. Table 3.37 shows that respondents classified as BME are WTP more than 'White' respondents to maintain Nursery Street in its current form. Analysis also suggests that homeowners are WTP more than renters to maintain the Nursery Street area as it currently is (Table 3.38).

3.5.5. Nursery Street – 'SCC/Dev' Option

Table 3.39, Table 3.40 and Table 3.41 present Pearson chi-square *P values* for WTP by education level, age and access to a garden that are all lower than 0.05. This indicates that the WTP values for the Nursery Street (SCC/Dev) option are statistically related to these respondents' characteristics (education level, $\chi^2 = 8.567$, df = 1, $p = 0.003$; age, $\chi^2 = 12.4777$, df = 1, $p = 0.000$; whether respondents live in a house with a garden, $\chi^2 = 8.830$, df = 1, $p = 0.003$). The Null hypothesis is therefore rejected and the alternative accepted.

Table 3.39. Association of Education Level and Willingness to Pay for Nursery Street (SCC/Dev) Option

Level of Education	WTP<= £3.87 %	WTP>£3.87 %	Total %
Lower Education	65.1	3.2	68.3
Higher Education	27.8	3.9	31.7
Total	92.9	7.1	100
Chi Square=8.567		df=1	p=0.003

Table 3.40. Association of Age of Respondents and Willingness to Pay for Nursery Street (SCC/Dev) Option

Age	WTP<=£3.87 %	WTP>£3.87 %	Total %
Younger than <37.7	47.4	5,8	53.2
Older than>37.7	45.5	1.2	46.8
Total	93	7	100
Chi Square=12.477		df=1	p= 0.000

Table 3.41. Association of Garden of Respondents and Willingness to Pay for Nursery Street (SCC/Dev) Option

Garden	WTP<=£3.87 %	WTP>£3.87 %	Total %
Yes	68.4	3.6	72
No	24.4	3.6	28
Total	92.8	7.2	100
Chi Square=8.830		df=1	p=0.003

Table 3.39, indicates that people with higher levels of education are WTP more than those with lower educational qualifications for the SCC/Dev option. The analysis also suggests that younger respondents are WTP more for this proposed investment in Nursery Street (Table 3.40). Whilst Table 3.41 indicates that living in a house with a garden is associated with a greater WTP.

3.5.6. Nursery Street – 'Floods' Option

The data shown in Tables 3.42, 3.43 and 3.44 include Pearson chi-square *P values* of less than 0.05. This indicates that the socio-economic characteristics under investigation and WTP are related and that the null hypothesis can be rejected. There are significant associations between WTP and the level of education ($\chi 2$ =8.187, df=1, P<0.004), the age of participants ($\chi 2$ =7.307, df=1, P=0.007), whether or not respondents live in a house with a garden or not ($\chi 2$ =, df=1, P<0.01) and gender ($\chi 2$ =6.169, df=1, P<0.01).

Table 3.42. Association of Education Level and Willingness to Pay for Nursery Street (Floods) Option

Level of Education	WTP<=£6.88 %	WTP>£6.88 %	Total %
Lower Education	61.6	6.5	68.1
Higher Education	25.9	6	31.9
Total	87.5	12.5	100
Chi Square=8.187		df=1	p= 0.004

Table 3.43. Association of Age of Respondents and Willingness to Pay for Nursery Street (Floods) Option

Age	WTP<=6.88 %	WTP>6.88 %	Total %
Younger than <37.7	44	8.8	52.7
Older than>37.7	43.3	4	47.3
Total	87.3	12.7	100
Chi Square=7.307		df=1	p= 0.007

Table 3.44. Association of Garden of Respondents and Willingness to Pay for Nursery Street (Floods) Option

Garden	WTP<=6.88 %	WTP>6.88 %	Total %
Yes	63.1	9	72.1
No	22.4	5.4	27.9
Total	85.6	14.4	100
Chi Square=3.894		df=1	p= 0.048

Table 3.45. Association of Gender of Respondents and Willingness to Pay for Nursery Street (Floods) Option

Gender	WTP<=6.88 %	WTP>6.88 %	Total %
Male	51.2	9.8	60.9
Female	35.9	3.2	39.1
Total	87	13	100
Chi Square=6.169		df=1	p= 0.013

Table 3.42 shows that people with lower levels of educational attainment are WTP more than those with higher qualifications for the 'Floods' option, whilst Table 3.43 indicates that younger people are statistically WTP more than people above the mean age. Analysis assessing access to a garden (Table 3.44) suggests that respondents living in a house with a garden are WTP more than those without a garden. Finally, Table 3.45 highlights that male respondents are WTP more than females for the 'Floods' option.

3.5.7. Nursery Street – 'Streets' Option

The results of the analysis of the Nursery Street 'Streets' option are shown in Table 3.46, Table 3.47, Table 3.48 and Table 3.49. They contain Pearson chi-square *P values* of less than 0.05. This suggests that statistically significant relationships exist between WTP and level of education (χ^2 = 14.013*, df = 1, P = 0.000)*, age (χ^2 = *8.261, df = 1, P = 0.004)*, gender (χ^2 = 9.912*, df = 1, P = 0.002)* and income (χ^2 = 6.92*, df = 1, P = 0.009).* The null hypothesis can therefore be rejected.

The analysis highlights that people classified as having lower educational qualifications are WTP more than those with higher educational attainment (Table 3.38). Table 3.39 presents evidence that younger people are WTP more than older

respondents and in Table 3.40 male respondents are shown to be WTP more than their female counterparts for the 'Streets' option. People classified as having lower incomes are also WTP more than participants with higher incomes (Table 3.41). The level of education, gender, age of respondents, income level can all reported as being significant factors in attributing WTP for the Nursery Street (Streets) Option.

Table 3.46. Association of Education Level and Willingness to Pay for Nursery Street (Streets) Option

Level of Education	WTP<=£29.21	WTP>£29.21	Total
Lower Education	51.2	16.3	67.5
Higher Education	19.1	13.4	32.5
Total	70.3	29.7	100
Chi Square=14.013		df=1	p= 0.000

Table 3.47. Association of Age of Respondents and Willingness to Pay for Nursery Street (Streets) Option

Age	WTP<=£29.21	WTP>£29.21	Total
Younger than <37.7	34.7	19.4	54
Older than>37.7	35.1	10.9	46
Total	69.8	30.2	100
Chi Square=8.261		df=1	p= 0.004

Table 3.48. Association of Gender of Respondents and Willingness to Pay for Nursery Street (Streets) Option

Gender	WTP<=£29.21	WTP>29.21	Total
Male	38.8	21.5	60.3
Female	31.0	8.7	39.7
Total	69.8	30.2	100
Chi Square=9.912		df=1	p= 0.002

Table 3.49. Association of Income of Respondents and Willingness to Pay for Nursery Street (Streets) Option

Income	WTP<=£29.21	WTP>£29.21	Total
Lower	49.1	18.9	68
Higher	18.9	13.2	32
Total	68	32	100
Chi Square=6.92		df=1	p= 0.009

The analysis of Nursery Street highlighted a number of statistically significant relationships linking WTP with specific socio-economic characteristics of respondents. Across all four options age was reported as being significant. Those respondents who fall below the mean age were statistically more likely to be WTP more than those respondents with above average age. Furthermore, in three of the four options ('As is', 'SCC/Dev' and 'Floods') respondents with access to a garden were shown to be WTP more than those without gardens.

In addition, male respondents are WTP more that female participants for the greening options. Unlike the analysis of Blonk Street, a varied association between WTP and education is reported. For the 'As is' and 'SCC/Dev' options, participants with higher educational qualification are WTP more. However, the opposite was the case for the 'Floods' and 'Streets' options, where those with a lower standard of qualifications were WTP more.

Age and educational attainment for Blonk Street and Nursery Street were both reported as being statistically related to WTP across all seven development options. The chi-square analysis for gender, access to a garden and number of visits to a green space showed greater variation, with relationships being linked to specific development options. In terms of application, this analysis will benefit planners and developers by enabling them to target investment in areas focussing on specific demographic groups (that is, the young, those with lower educational qualifications and males). This provides scope for them to ensure that financial support (WTP) could be identified for new developments prior to investment.

3.6. Positive and Negative Influences on Preference

A number of factors were reported as influencing preferences and WTP. Charts 3.10 and 3.11 highlight the range of positive and negative comments recorded during the The Wicker Riverside survey. The most prominent positive factors were that investments improved the attractiveness of both Blonk Street and Nursery Street. Because of the light industrial and commercial nature of The Wicker Riverside area, investments in greening might be considered improvements to the visual quality of the area. People also noted that the investments made the area look more natural, enabled people to see others more easily and clearly and, in some cases, made the area seem more appealing to use. These influences combined ecological elements (naturalness) with social interpretations of crime reduction or utility. They suggest that respondents assessed the value of each option in terms of the physical appearance of the area and how individuals or communities could interact with it.

In contrast, the issues associated with a lower WTP differed. The most obvious difference was the frequent reporting of economic factors. Respondents felt that they already paid too much in rent/mortgage, couldn't afford an increase or simply didn't want to pay more to invest in the area. The other significant relationship that was recorded was that a number of people would be WTP more if the delivery options presented a greater proportion of green and open space. This supports the

assessment of WTP and preferences made throughout this chapter that suggest that although a number of social and economic factors influence WTP, an increase in the visible greenery is of equal importance.

Chart 3.10. Positive influences on WTP

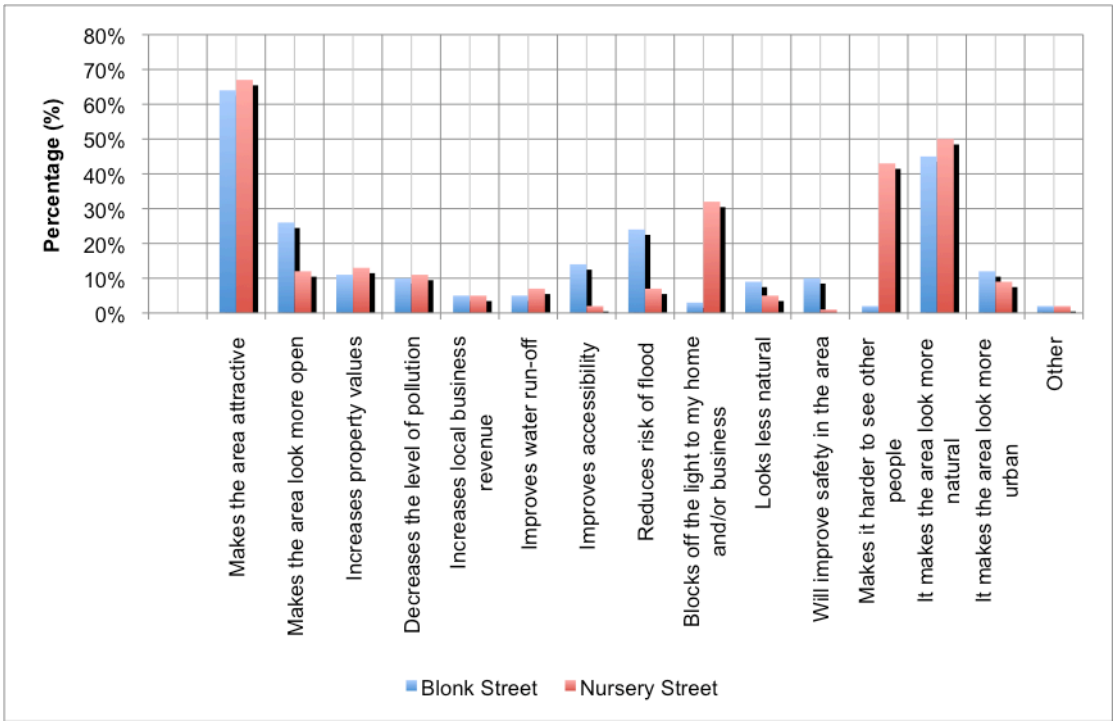
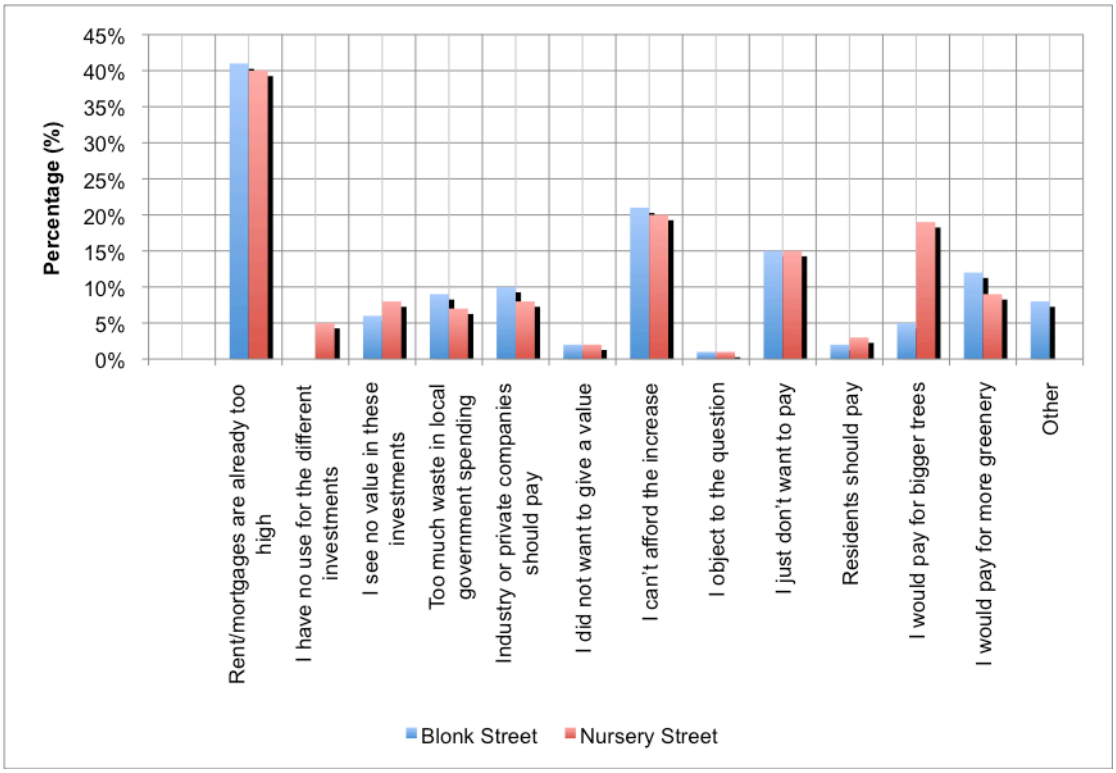


Chart 3.11. Negative influences on WTP



3.6 Summary

The analysis presented in this chapter highlights a number of factors that are associated, qualitatively and statistically, with WTP for green investments in urban areas. The analysis of both Blonk Street and Nursery Street identifies characteristics that impact upon people's perceptions of landscape value and influence economic evaluations. This is reflected in a variation in WTP, preferences and answers to the contextual questions.

Variation in the association of different socio-economic factors with WTP was identified. Due to the diverse nature of the development options, differences in WTP were to be expected. The reasons provided for respondents' preferences for each development option and WTP for them suggests that the nature of the green investment is central to that investment's value. Analysis also suggests that there is a strong relationship between the perceived greenness of an investment and people's WTP and preference for it. In both sets of scenarios WTP was linked to perceived greenness. Although this may not reflect the sustainability of each option or its role in maintaining/protecting the resource base, perceived greenness appears to be central to valuation. However, although variation can be seen across each of the development scenarios, the 'Floods' option is preferred by respondents in almost all socio-economic classifications and they are WTP the highest amount for it. This is the only option universally perceived in a positive light.

The differences between Blonk Street and Nursery Street may be associated with the physical structure and potential social impact of each set of options. At Blonk Street respondents were asked to value a set of investments fixed in one location. They were also asked to assess an existing investment against an ex ante and an ex post scenario. However, the Nursery Street assessments were of an area scenario. The options presented for Blonk Street might therefore be considered more restrictive, despite being more realistic. The breadth of investment shown in Nursery Street elicited higher WTP values. However, it is apparent across all the options that the perception of the greenness of green infrastructure and the functions (ecological, social or economic) that it performs directly influenced WTP for it.

Chart 3.12. Respondent assessment of Blonk Street investments scenarios

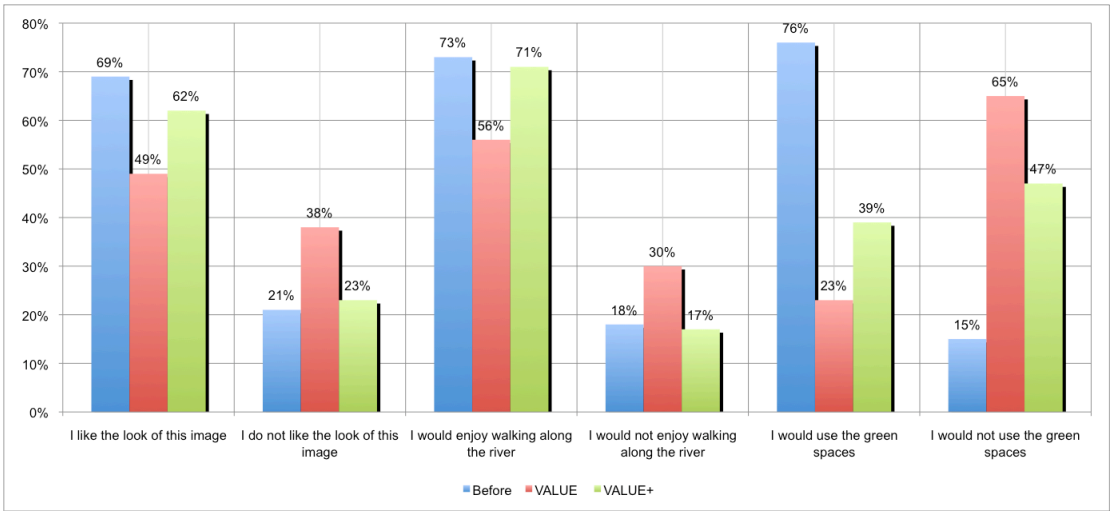
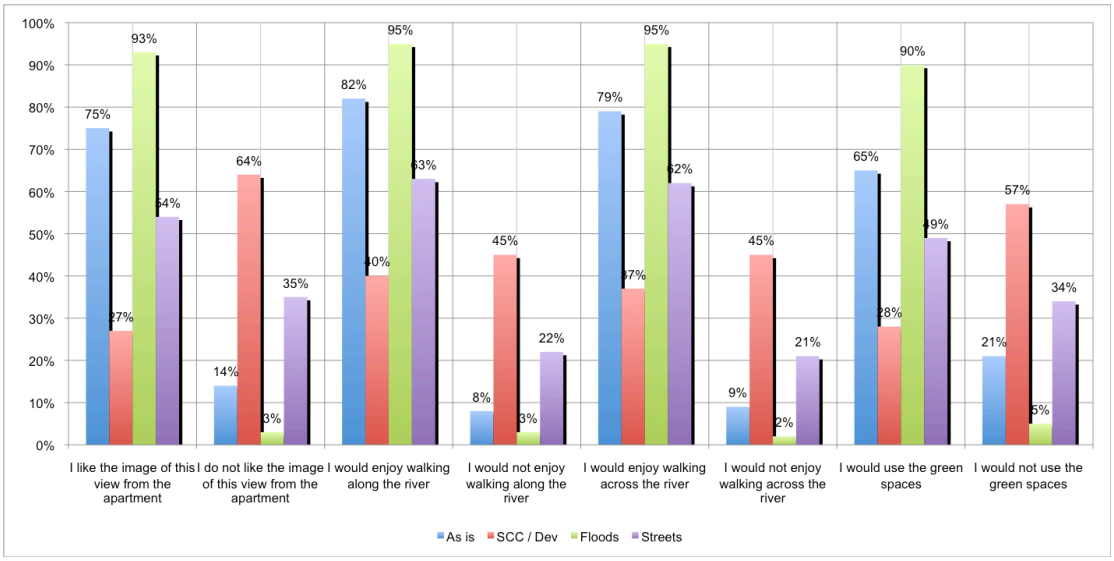


Chart 3.13. Respondent assessment of Nursery Street investments scenarios



4. Discussion and Recommendations

The results presented in Chapter 3 identify the amount that people are WTP for greener investments in The Wicker Riverside. WTP varies markedly with the investment option under investigation. For Blonk Street, the WTP ranged between £4.27 and £10.81 and the equivalent figures for Nursery Street were £3.87 to £29.21. Despite these variations, there was consensus across both investment sites in support of investments that increased levels of Green Infrastructure above those currently existing at Blonk Street and Nursery Street. The form an investment takes is central to its economic valuation. An understanding of how people interact and attribute multi-functionality to a green investment is therefore important to its economic as well as social valuation.

The variations in WTP by socio-economic characteristics indicate which factors influence valuations of green investments. Residents of The Wicker Riverside and those in education appear to be WTP the most for a greener environment, whilst businesses and employees in the area are WTP the least. This suggests that a number of contrasting factors influence the valuation process. The ecological and social benefits appear to be prominent in individual assessment and economic issues are important for businesses. The Chi-square analysis also highlights a number of socio-economic characteristics that influence preferences and WTP for green investments. Age and education level are both shown to influence WTP for all options. Whilst living in a house with a garden (or not), the frequency of use and gender are all reported to influence WTP.

Furthermore, residents, business owners, employees, commuters and different users are all WTP for green investments if they provide functional, natural and attractive urban spaces. These responses are similar to the results of the UK Place Survey (DCLG, 2008) which proposed that a combination of environmental assessments, social interpretations and economic evaluations are discussed when people are asked to explain what makes a high quality environment. A review of the value of local Green Infrastructure in Sheffield also elicited positive responses with all categories of green space (Chart 3.3) showing a minimum 50% positive rate. People also had a positive view of maintenance (73%), high quality resources (69%), usefulness (85%) and supporting biodiversity and conservation (70%). Only the response assessing the role of Green Infrastructure in adapting or mitigating climate change was relatively low (55%). This suggests that people in Sheffield place a high

value on the functionality of the environment and Green Infrastructure resources, a view that supports their WTP and preferences for greener investment options.

The majority of those surveyed reside within the Sheffield City Council (SCC) authority (84%) and are WTP for additional Green Infrastructure. They think that green infrastructure has a positive impact on their lives. Most (53%) also think that the council provides high quality services and 44% felt that it provided value for money. This suggests that SCC is seen as an effective land manager. The analysis of the Sheffield survey identifies a number of influences on WTP. The WTP amounts compare favourably with the results for the Manchester VALUE research and with the wider literature assessing investment in Green Infrastructure (Jim & Chen, 2006; Peper *et al.*, 2007; Tyrväinen & Väänänen, 1998; CABE Space, 2004; 2005). However, because of the variation in the nature of the investments and their presentation within the visualisations, care should be taken when making comparisons between studies.

4.1. Extrapolations of WTP and Grossing Up

The values calculated for the Blonk Street and Nursery Street investments highlight that respondents in Sheffield are WTP more rent or mortgage interest to live in green and functional environments. However, it is important to assess the extent to which these values can be used to show added value for the area. Using extrapolations and a process of grossing up it is possible to estimate the potential added value of green investments to The Wicker Riverside and surrounding areas through increases in house prices and land values. However, a note of caution is needed. Although extrapolations can be made based on the WTP values presented in this survey, a number of uncertainties and constraints need to be addressed.

Firstly, extrapolation is based on the premise that the sample population is representative of the wider population of the area and the City of Sheffield. The socio-economic characteristics of the respondent population do not mirror those of Sheffield's total resident population. Secondly, the two development scenarios posed different WTP questions; one asked about the value of the Blonk Street investments and the other about the value of the view of the Nursery Street options. There is a clear distinction between the two. One asks for a specific point assessment - the view of the area – whilst the other requests a wider interpretation of the investments as a whole (Blonk Street). Consequently the WTP values should be considered indicative

of what people would pay for a specific investment project (Blonk Street) and a wider area initiative (Nursery Street).

However, the breadth of data collected and the large sample size allows a process of extrapolation to be undertaken. This process reviews the current rental/mortgage market and uses hedonic pricing techniques to calculate benefit transfers associated with the delivery of green infrastructure investments. A proportional scaling increase in value is associated with this process, which is reflected in the calculations made below. The data presented in Tables 4.1, 4.2 and 4.3 should be considered indicative only. Much more information would be required to produce robust assessments of added value.

Table 4.1. Extrapolation for Blonk Street

	Recent Average Price	**No. of housing units with view**	**Investment Option**	**Av. WTP**	**Uplift (Housing Price)**
Blonk Street	£129,560.00	155	Before	£10.81	*£253,469.50*
			VALUE	£4.28	*£100,356.10*
			VALUE+	£8.00	*£187,581.50*

The uplift in housing price values attributed to the different investment options are calculated by:

> Uplift= Number of Housing unit with view*(Estimated Housing Price-Recent Average Housing Price)
>
> Estimated Housing Price (Market Value)= [(Recent Average Rent+WTP)*12]/Yield

Table 4.2. Extrapolation for Nursery Street

	Av price	**No. of housing unit with view**	**Investment Opt**	**Av. WTP**	**Uplift (Housing Price)**
Nursery Street	£102,716.00	223	As is	£12.17	*£421,371.56*
			SCC/Dev	£3.87	*£133,994,08*
			Floods	£29.21	*£1,013,784.66*
			Streets	£6.88	*£231,633.18*

Table 4.3. Average added value associated with grossing up of WTO values from Blonk Street and Nursery Street.

	Av price	No. of households	Investment Opt	Av. WTP	Av. WTP Yr	Added value to rental/mortgage payments (pr yr)
BURNGREAVE	£106,011	9,900	Before	£10.81	£129.72	*£1,284,228.00*
			VALUE	£4.27	£51.24	*£507,276.00*
			VALUE+	£8.00	£20.00	*£198,000.00*
			As is	£12.17	£146.04	*£1,445,796.00*
			SCC/Dev	£3.87	£46.44	*£459,756.00*
			Floods	£29.21	£350.52	*£3,470,148.00*
			Streets	£6.88	£82.56	*£817,344.00*
	Av price	**No. of households**	**Investment Opt**	**Av. WTP**	**Av. WTP Yr**	**Added value to rental/mortgage payments (pr yr)**
CENTRAL (S1 postcode)	£131,408	7,300	Before	£10.81	£129.72	*£946,956.00*
			VALUE	£4.27	£51.24	*£374,052.00*
			VALUE+	£8.00	£20.00	*£146,000.00*
			As is	£12.17	£146.04	*£1,066,092.00*
			SCC/Dev	£3.87	£46.44	*£339,012.00*
			Floods	£29.21	£350.52	*£2,558,796.00*
			Streets	£6.88	£82.56	*£602,688.00*

Tables 4.1, 4.2 and 4.3 indicate the potential uplift for mortgage and rental prices associated with urban greening.

4.2. Recommendations

The analysis undertaken for the VALUE investments in Sheffield highlights a number of relationships between WTP, interpretations of Green Infrastructure and the nature and functions of green spaces. Overall, the greener were the investments the more people were WTP for them. The physical form and utility of the investments and their functionality, location and accessibility affected WTP. Attractiveness and the support green investments may provide for local business were also important factors. A layered process of interpretation therefore appears to underpin valuation. Respondents assess ecological, economic and social benefits when valuing green investments in urban areas. In conclusion, a number of specific findings and recommendations can be made:

1. Respondents are WTP for investments in urban greening. The function, size and composition of a green investment affects WTP.

2. Preferences and WTP for Blonk Street favoured the greener investment options. People were WTP markedly more for the 'Before' and 'VALUE+' options. The same pattern was evident in their preferences.

3. Preferences and WTP for Nursery Street also favoured the greener investment options. The 'Floods' option was consistently deemed the most economically and socially valuable development option. Greener development options were associated with markedly higher WTP. People's preferences exhibited the same pattern.

4. Greater WTP and preferences were consistently associated with increases in the proportion of greenery shown in the investment options. In both Blonk Street and Nursery Street the greenest options ('Before' investment and 'Floods') elicited the greatest WTP and the strongest preferences.

5. Whilst greenness is an important influence on WTP, the perceived value of physical infrastructure needs also to be considered. At Blonk Street the civil engineering elements of the investments were valued less than the green elements. The nature, size and function of all elements of a Green Infrastructure project need to be assessed to ensure the maximum value is attributed to an investment.

6. The openness and accessibility of green investments were an important influence on the WTP for them. Where a scenario appears more open or has a lower development density, WTP for it is greater and preferences for it are stronger.

7. There is a relationship between the visual attractiveness of a development option, its accessibility and permeability and the level of greenery. Where an option is perceived to be aesthetically of a high quality a corresponding interpretation of high accessibility was also noted. Both visual attractiveness and promoting access are linked with higher rates of greenery. Furthermore, where each of these three variables is reported positively, WTP increases. This trend is seen in both Blonk Street and Nursery Street.

8. There is a statistically significant relationship between respondents' age and level of educational attainment and their WTP for each development option.

Associations between frequency of use, gender, access to a garden and income showed greater variation. Analysis suggests that the design of green investments could be refined to generate greater WTP.

9. The management and development of Green Infrastructure by Sheffield City Council was consistently considered to be of a high value and to provide functional and valuable green spaces across the city.

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