

Sustainability Indicators and their Application in Decision-Making Processes for Eastside, Birmingham, UK

D.V.L. Hunt ^{a,*}, D.R. Lombardi ^a, C.D.F. Rogers ^a, I. Jefferson ^a

^{a,*} School of Engineering, Civil Engineering, The University of Birmingham, Edgbaston, Birmingham, B152TT, U.K.

ABSTRACT

Birmingham Eastside, an area of 130 hectares, is located to the eastern side of Birmingham's city centre. Over a 10 year period this once deprived inner city area is being regenerated through public and private finance estimated at £6 billion. The regeneration scheme is rapidly bringing about changes to the local environment, economy, and the society therein. The key players (e.g. landowners, developers and planners) involved in the decision-making processes for Eastside have the power to see that these changes are brought about in a sustainable manner. For this to happen it is necessary to assess in which direction the development should go, and to provide benchmarks for implementing and measuring sustainable changes along the way. This process can be facilitated by the use of sustainability indicators, of which there are many.

This paper outlines the sustainability indicators (e.g. SPeAR, BREEAM, Sustainability Checklists and other benchmarks) that might be used within the decision-making processes for Eastside. In particular, it details those indicators operating at city level, quarter level and then individual development site level. Several case study sites are included (Masshouse, City Park Gate, the Learning and Leisure Quarter, the New Technology Institute – nti, and Warwick Bar). The paper discusses the role of indicators in achieving a sustainable Eastside, and analyses how they are / are not forming an integral part of the decision-making process for Eastside.

Key words: Urban Sustainability, Assessment Methods, Urban Regeneration

1 INTRODUCTION

Over a 10 year period (approximately 2000-2010) the built environment on the eastern side of Birmingham's city centre, the second largest city in the UK, is undergoing significant changes. A major regeneration programme funded through public and private investment, estimated to be worth more than £6 billion, is well underway. The first element of the project was delivered over an 18 month period starting in January 2002: the £24.2 million removal and recycling of 20,000m³ of concrete from Masshouse Circus, the elevated roadway that had prevented expansion of the city centre into the eastern quarters (including Digbeth and Nechells areas). It has also seen more than £500 million of investment into the rebirth of the Bullring shopping centre (opened in 2003) located at the western boundary of the Eastside quarter, now reported to be the third most popular shopping destination in the UK behind Glasgow and London (Townsend, 2006).

The masterplan for the 420 acre brownfield area was commissioned in 2001 and completed in February 2002 (HOK, 2002). The various sites for development are shown in Figure 1. At the time of writing, the development at each of these sites was at different stages of the overall project timeline: some have been completed (e.g. Millennium Point, Mathew Boulton College, nti building, refurbished Moor Street station, one of the buildings on Masshouse) whilst some are being constructed (e.g. the rest of Masshouse). Others are still in the planning stages and of these sites some had developers selected (e.g. City Park Gate, Warwick Bar) and some did not (Learning and Leisure Quarter). The regeneration scheme will provide new offices, apartments, hotels, retail sectors and a new 8.5 acre city park, the first new city park in Birmingham for over 200 years. Eastside has two canals (Digbeth and Grand Union), a culverted river (the Rea) and a large conservation area located below the railway line which runs east to west – the only canal-based conservation area in Birmingham. The area is home also to Curzon Street Station, Birmingham's first railway station, and a railway bridge designed by Brunel; the bridge was never connected to the station and the station is no longer in use, being superseded by New Street Station. In addition, the area was once home to producers of Typhoo tea and Birds custard. These buildings remain and are being preserved and enhanced during the regeneration programme.

One of the key aspirations for Eastside development, as set out in the early stages of development, is for it to be sustainable, see Ecotec (no date) Design and Movement Framework (BCC, 2003)., The key questions addressed in this paper are: what definition of sustainability is being used by whom, and how can progress toward it be measured within the context of a real-life redevelopment project such as Eastside? This paper explores the role of sustainability guides and indicators in answering these questions and discusses how they are (or are not) being incorporated currently within the decision-making processes for Eastside. Their application is illustrated through five case study sites at various stages within the development 'timeline.' The

paper highlights important lessons being learnt from within the Eastside development which can be applied to other developments being undertaken elsewhere.

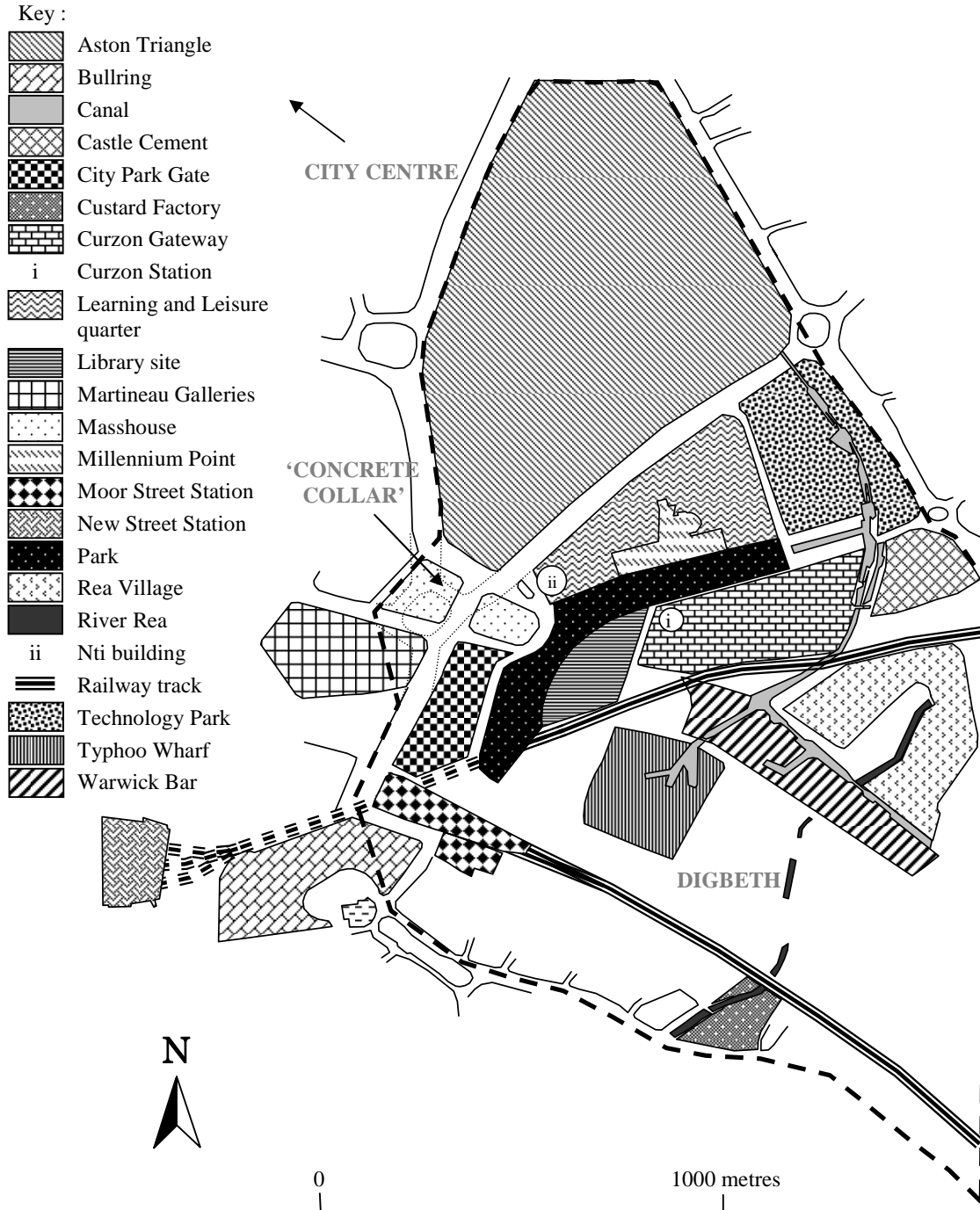


Figure 1 Map of Eastside showing developments (after Jefferson et al. 2006)

2 DEFINING SUSTAINABILITY

The chairman of the Sustainable Commission in the UK captures the complexity of attaching an exact definition to Sustainable Development (SD): *'it is an idea that everybody supports, but no-one really knows what it means in practice'* (Porritt, 2004). It is true that the definition of SD is likely to vary with the country, region and/or personal circumstances of an individual defining it, and this goes some way towards explaining why there are now reported to be more than 200 definitions within the literature (Pearce and Walrath, 2001). The Brundtland Commission on Environment and Development (WCED, 1987) after much deliberation defined SD as *'development that meets the needs of present generations without compromising the ability of future generations to meet their needs and aspirations'*. Although considered by many to be inadequate, this definition forms a global benchmark to which all others are, and will continue to be, compared. An early document from the UK Government's sustainable development strategy 'A Better Quality of Life', sets out four principles (DETR, 1999):

- Maintenance of high and stable levels of *economic* growth and employment
- *Social* progress that recognises the needs of everyone
- Effective protection of the *environment*
- Prudent use of *natural resources*

This definition existed at the start of the regeneration programme in Eastside and it is the definition to which SD within Eastside was originally conceived. Whilst there are many definitions of SD, there are equally as many ways of measuring it and one way is through the application of sustainability indicators and checklists. Whilst subsequent debate on the inadvisability of economic growth has amended marginally the target of the first principle, it should nevertheless be to these principles that the Eastside site-specific indicators align.

3 MEASURING SUSTAINABLE DEVELOPMENT

An indicator is something that helps you understand where you are, which way you are going and how far you are from where you want to be (see Hart, 1998-2000). The choice of indicator thus determines the nature of action taken, and as such, is critical to defining not only the end goal but the path of action to it. By examining case study sites that have achieved a measure of success in terms of sustainability (e.g. Bedzed in U.K. and Malmö in Sweden) it is clear that a three pillar approach (economic, environmental and social) is used. It is evident also that SD indicators should be applied at the earliest stages within the decision-making processes, these being outlined as essential criteria for achieving sustainable outcomes (Trinius, 1999).

In June 2003, the Construction and City Related Sustainability Indicators (CRISP) internet database contained more than 500 indicators gathered in 39 systems (CRISP, 2007) and in 2005 it was reported that there were more than 675 tools applicable to the assessment of sustainability in urban developments within the sustainability literature (see Walton et al, 2005). Sustainability is an all encompassing entity and therefore it is not surprising that indicators thereof encapsulate measures which are both quantitative in nature (e.g. for recorded thefts, distance to public amenities) and those which are more qualitative (i.e. for quality of social participation). Given that some dimensions (economic, social and environmental) are more easily quantified, and even within a dimension, some aspects are more easily quantified (energy use per person or per square metre) – how can one hope to measure the whole of sustainability? (Bell and Morse, 1999)

This section details SD indicators that are commonly used within the UK and therefore applicable for measurement of SD within Eastside. The derivation of new indicator systems is beyond the scope of this current paper.

3.1 National and Local Headline SD Indicators

The overarching set of headline indicators for measuring SD in the UK is based around the three pillars of sustainability (economic, social and environmental) as shown in Table 1, first published in the Quality of Life (DETR,1999) document. These were readily available to developers, planners, and councillors at the start of the Eastside project.

Table 1: Headline Indicators of Sustainable Development for the UK

Economic Growth						
H1 Economic Output		H2 Investment		H3 Employment		
Social Progress						
H4 Poverty and Social Inclusion		H5 Education		H6 Health	H7 Housing	H8 Crime
Environmental protection						
H9 Climate Change	H10 Air Quality	H11 Road Traffic	H12 River Water Quality	H13 Wildlife	H14 Land Use	H15 Waste

By considering changes to these indicators (e.g. GDP in H1, recorded thefts in H8, fuel poverty in H4 and CO₂ emissions in H9) progress towards or away from SD can be measured over time on both a national (UK) and regional or city (Birmingham) level. The indicators could be used also at the development level to assess the

overall sustainability of redevelopment schemes such as the Eastside project and to provide some measure of the quality of life for those currently living (86 residents as of 2004) or about to live in such areas once regeneration is completed. The *Regional Quality of Life Counts* (Defra, 2003a) covers nine regions including the West Midlands (where Birmingham is located) and allows for interpretation and application of the headline indicators at a regional level. The UK government published *Achieving a Better Quality of Life* in 2003, the fourth and reportedly last in the series documenting the main strategic developments in 2003, including progress and government actions to further SD since the start of the programme in 1999 (Defra, 2003b,c). The *Sustainable Development Indicators in your Pocket* (Defra, 2004a) was produced as a pocket size booklet which included 50 indicators taken from the 160 indicators found in the 2004 update to the *Quality of Life Counts*. The indicators are given a 'traffic light' assessment to show whether progress is for the better or worse. Whilst such systems are ideal for measuring progress of city regions towards SD it can be difficult for councillors to translate high level goals into actions, and even more so for developers interested in contributing to a sustainable Eastside. The *Taking it on* initiative (Defra, 2004b,c) was aimed at translating this earlier ideology into action with a new strategy for delivery; ultimately this should have facilitated decision-making for local councillors when deciding upon strategies for progress towards SD. However, the redefinition of SD indicators can delay this process; this is particularly relevant in the UK where the government moved towards the use of 68 national indicators which include 20 Framework indicators for measuring progress towards SD (Defra, 2006). These indicators are now split into four categories: (i) Sustainable consumption and production; (ii) Climate change and energy; (iii) Protecting our natural resources and enhancing the environment; (iv) Creating sustainable communities and a fairer world. To further complicate the issue, these categories do not easily map onto the 4 key criteria identified in *A Better Quality of Life*, discussed previously.

On a more local scale, Birmingham City Council (BCC) produced a set of 22 indicators for measuring SD within Birmingham (BCC, 1999). These are updated and published annually and form a direct link between sustainable policy (i.e. Local Agenda 21) and the public. These indicators are all freely available from the government website in an easily accessible form. Once again these operate at a city level and fall within the remit of the Sustainability Team within the Council. The Sustainability Team deals with SD issues within the city but has little or no involvement in the decision-making (i.e. planning) processes for new developments such as Eastside. Ironically this means that opportunities for shaping sustainability in Eastside, which will ultimately impact upon SD at city level, would be missed. In addition it means that there would be a lack of sustainability guidance for new developers in Birmingham. Fortunately for Eastside the situation is not quite as dire as it may first seem, as explained in Section 3.2.

3.2 SD Design Guides for Developers

Since the early 1990s there has been a renaissance of regeneration in cities in the UK (UTF, 1999). Many regions have shared aspirations to achieve SD as a central part of regeneration, and in promoting their cause many (e.g. Cambridge, London, Leeds and the North East) have produced sustainability guides. A typical example is '*The Sustainable Development Design Guide*' produced in 1999 for use by developers and site designers in Leeds (Leeds City Council, 2002), which detailed the principles of SD and defined strategies for putting them into practice. The document now forms part of supplementary planning guidance (SPG10) under the umbrella of the Leeds Unitary Development Plan (UDP). The SPG status of the guide shows that the document is endorsed by Local Government and as such carries some legal status in driving sustainability through the planning process. A very similar guide was produced for the Eastside project by a collective of 18 non-profit groups led by Friends of the Earth Birmingham and Groundwork Birmingham entitled '*Sustainable Eastside: A Vision for the Future*' (ESAG, 2002). This document does not have SPG status, although it is referred to in many planning applications. It was envisaged that the *Design and Movement Framework* (BCC, 2003), a document drafted by city planners in Birmingham outlining the redevelopment plans for Eastside around a new metro system, would be granted this status and form part of the UDP for Birmingham. It was envisaged also that a daughter document entitled the '*Sustainable Action Plan*' (GHK, 2004) would set out in detail the sustainability aspects of the redevelopment scheme and set targets (i.e. benchmarks) and indicators for developers and for the development. Changes to the political structure have seen the metro sidelined in favour of an underground system (Dale, 2004), hence SPG status for the original version of the *Design and Movement Framework* is unlikely; a new version is being developed.

At this time, therefore, the achievement of sustainable credentials relies more on voluntary actions by the developer than on legally binding agreements within the decision-making / planning process. The important thing here is that documents do exist, albeit without legal status, that can provide guidance to developers in achieving a more sustainable Eastside. In addition, Groundwork has been involved in the funding of feasibility studies (e.g. energy, water, biodiversity, green roofs – each linked to research work being undertaken at the University of Birmingham as part of Sustainable Urban Environment programme) and design guides (including local material sourcing) for the Eastside area highlighting what can be done within the redevelopment programme. This information can be downloaded from the website, which was established for direct dissemination to developers, stakeholders and decision makers in Eastside (www.sustainable-eastside.net, Prangle, 2006). In many cases, developers within Eastside have experience of delivering sustainable projects elsewhere and their in-house SD policies are directly aligned with government SD policies, but they have not introduced the same level of sustainability in their Eastside projects.

3.3 SD Assessment with Existing / New Indicator Systems

The UK Building Research Establishment (BRE) produced a 'self assessment' method called *A Sustainability Checklist for Developments* in 2002 (Brownhill and Rao, 2002). This checklist was envisaged as a common framework for use by developers, planners and advisors. There are 4 stages of assessment (Rao, 2004):

- highlight issues for consideration during visioning
- explain dimensions of issue
- assess performance for these issues based on best practice
- score performance on each of 3 SD pillars.

The checklist considers the social, environmental and economic aspects under eight key headings – Land Use and Urban Form and Design, Transport, Energy, Impact of Individual Buildings, Natural Resources, Ecology, Community Issues, and Business Issues – and therefore is in line with the UK headline indicator system shown in Table 1 and outlined in Section 3.1. The original checklist was formed through consultation with Local Authorities such as Leicester, Newcastle, Hertfordshire and Watford. At this moment, there is no such system at work in Eastside.

In 2004, the BRE, in collaboration with the World Wildlife Fund (WWF), Regional Development Agencies (RDAs), Office of the Deputy Prime Minister (ODPM) and South East Environmental Development Agency (SEEDA), commenced a three year programme to develop regional specific sustainability checklists (Rao, 2004). The RDA for the West Midlands, Advantage West Midlands (AWM), has a pivotal role in the redevelopment of the Eastside area (having invested large amounts of capital into buying up pockets of land), but has not applied a regional specific checklist to the development in Eastside. This is surprising given that it was the first RDA to produce a Sustainable Development Policy and Action Plan, which reflected the new 2005 UK Sustainable Development Strategy (AWM, 2006). The recommended method for the BRE checklist is 'self-assessment' in application, although it would seem sensible for it to be applied by a neutral body with experience in the SD field. Fortunately, in 2004 two sustainable advisors (one for the built environment and one for open spaces) were seconded to the Birmingham City Council Eastside team with the role of advising developers on the potential for incorporating sustainability into all aspects of the design. Hence for Eastside that neutral expert body already exists. Whilst there are no plans to implement it immediately, the advisors are involved in producing a checklist for developers (Coyne, 2006). This checklist is based upon benchmarks adopted from existing systems, including the Regional Sustainability Checklist (about to be launched), the Birmingham Climate Change strategy (about to be approved for public consultation), and the Wolverhampton Climate Change Strategy. The checklist includes 73 indicators under 6 key objectives: (i) Address climate change mitigation and adaptation, (ii) Improve resource efficiency, (iii) Improve procurement process,

(iv) Create a better place to live and work, (v) Protect and enhance the natural and historic capital of the area, and (vi) Improve business performance. Currently this is being critically examined by developers and councillors for possible approval as a guidance document.

An alternative approach to the checklists is the SPeARTM (Sustainable Project Appraisal Routine, ARUP, 2006) method established by Arup. This uses a colour-coded rose diagram to assess the sustainability of a project under four main pillars (economic, environmental, social, and natural resources). Using qualitative scores from -3 (worst case) to +3 (optimum case), problem areas can be highlighted within 20 sub-themes (dealing with issues such as Air Quality, Land Use, Water, Ecology, Cultural Heritage, Design & operation, Transport, Materials, Energy, Waste, Health & welfare, User Satisfaction, Form & Space, Access, Amenity, Inclusion, Viability, Social Costs & Benefits, Competitive Effects, Employment/Skills). The method links directly with the UK Government's headline indicators set down in Table 1, has been used as a master planning tool in Eastside and elsewhere (see McGregor and Cole 2003, Arup, 2006), and is ideal for gauging where a project such as Eastside is pre- and post-construction.

3.4 SD Indicators for Planning Applications

The planning system itself has an essential role in helping deliver sustainability for Eastside (Porter and Hunt, 2005). Sustainability Appraisals were introduced in 2004 as a compulsory part of the planning process for Eastside. All planning applications will now include a section related to sustainability, although not always in enough detail to demonstrate how this translates on the ground since measurable benchmarks are often missing. For example, when considering an application for a Go-Kart Track in Eastside (BCC, 2004a) the effect on sustainability was stated as neutral. Yet what does this mean for the emissions from the go-kart vehicles themselves, or the impact of patrons' transport to the site, for example? There are no measures (i.e. benchmarks) attached to such applications to allow for accurate qualification and quantification of such labelling.

The Environmental Impact Assessment (EIA), already included in the planning process, is weighted towards the environmental pillar (e.g. Water Resources, Waste, Noise, Air Quality, Archaeology), thus not traditionally classified as a sustainability indicator system. If geared in the right direction, a modified EIA procedure could effectively include social, participatory and economic issues to address the key links between environmental impact and sustainable development (Dalal-Clayton, 1993). However, incorporating the other pillars would not suffice to provide an indicator system: attaching a measure to the indicators would be necessary to advance sustainability in the decision-making process through these tools. EIAs have been drawn up for many developments, and will be submitted side-by-side with outline plans to the planning authorities in Birmingham.

3.5 Environmental Assessment of Projects and Buildings

When considering the performance of buildings, the most widely used indicator system appears to be BREEAM (the Building Research Establishment Environmental Assessment Method). BREEAM was first devised in 1991 and has developed such that it can now be used for new and existing offices, commercial units, industrial units, and schools, as well as homes and apartments through the related Ecohomes rating. BREEAM covers the whole range of buildings likely to be built in Eastside (see Section 4). The following ratings are given: Excellent - 70%, Very good - 55%, Good - 40% and Pass - 25%. BREEAM is not a sustainability assessment method as it measures only the environmental impact; therefore it should be used within a framework of sustainability indicators incorporating all pillars of SD, for example the sustainability checklist outlined in Section 3.3. The BREEAM system utilises the Greenguide for specification of materials (Anderson et al, 2002), and Ecopoints for rating (Rao et al, 2003).

Whilst there are other environmental assessment systems for buildings (e.g. GEM UK by FaberMaunsell), BREEAM is becoming widely accepted and well used within the UK. For example, in August 2003, it was reported that Ecohomes had been applied to 3,400 units in 100 developments in the UK (Ends Report, 2003). In addition, new Government offices are expected to meet 'Excellent' BREEAM ratings, and refurbished ones 'Very Good' (Defra 2003c). What's more on a localised level AWM, through its land and property and Building Technology Cluster, are promoting high environmental standards such as BREEAM 'Very Good' and 'Excellent' (Slater, 2006); given their role as landowner in Eastside, and the Technology Park in particular (see Case Study 3, below), one may expect these criteria to be translated throughout Eastside although they have not been at this time. Brindley Place, a regeneration project located in close proximity to Eastside, has recently achieved a 'Very Good' rating for its offices also, therefore localised examples exist.

4 MEASURING SUSTAINABLE DEVELOPMENT IN EASTSIDE

This section provides details for five case study sites in Eastside: (1) Masshouse, (2) City Park Gate, (3) Learning and Leisure Quarter and Technology Park, (4) nti building, and (5) Warwick Bar. It highlights where the project is within the overall Eastside timeline and it shows how indicators are or are not being used within the decision-making processes therein.

4.1 Masshouse (Case Study 1)

In June 2001, the 4.4 acre Masshouse site (consisting of two plots, 3 and 7) was marketed as suitable for mixed use development including offices, retail, leisure, hotel, and residential. On 4th September 2001, eight proposals were submitted and considered for short listing. By October 2001 Land Securities, AMEC, Urban Catalyst,

David McLean (DM), Cala/McAlpine, and Alliance/Crosby/Stoford were in the running. In January 2002, GVA Grimley submitted outline plans including EIAs for the area encompassing Masshouse, City Park Gate (Case Study 2) and the Library site, all shown in Figure 1 (GVA Grimley, 2002a,b). During this time developers were asked to resubmit proposals according to criteria drawn up for selection, including: financial bid, details of uses, details of professional team, details of finance track record and a broad indication of the nature of proposals. These dimensions were evaluated by the BCC Eastside Team and Planning, Transportation, Finance and Economic Development departments, assisted by CB Hillier Parker as independent valuers / property consultants. Sustainability was not a selection criterion within this process.

In May 2002 DM was chosen as preferred developer and in August 2002 outline designs by Aedas and Edward Cullinan architects were formerly submitted to Planning for a mixed use development (David McLean, 2002). These outline plans included specific details of how the development would address the issue of sustainability; these are summarised in Table 2 and show a direct understanding of the three pillar indicator approach, albeit without quantitative benchmarks for such measurables such as consumption of energy and water (e.g. per floor area or per person).

Table 2 Sustainable Indicators for Masshouse (adapted from David McLean, 2002)

Economic	Social	Environmental
<ul style="list-style-type: none"> - Economic growth and employment will be stimulated by new accommodation within the proposal 	<ul style="list-style-type: none"> - Mixed use with residential - Physically planned to encourage a vibrant public realm - High quality materials - Signage and lighting will animate the space and increase accessibility, orientation and safety. 	<ul style="list-style-type: none"> - Sustainable energy - Natural ventilation, solar shading and daylighting. - Reduce energy demands by maximising solar potential - Reduce impact of the development on the environment during and after construction - Exceed relevant standards and regulations

In 2004 DM joined forces with Nikal Developments and the Royal Bank of Scotland, and following close consultation with the BCC Eastside Team several changes were made to the design (BCC, 2004b). The £350 million designs now incorporate 13 towers and will provide 1.1 million sq. ft. of high quality space including: residential (550 high specification apartments), Grade A office (0.5 million sq. ft.), Birmingham Magistrates Court (33 court rooms in a purpose-designed complex), ground floor cafes, restaurants and retail space (0.25 million sq. ft.). Masshouse will include two new public squares, with traffic-free landscaped areas, water features, and public art. In addition there will be 800 car parking spaces and new pedestrian routes from the city centre (BCC, 2006). In 2005, the ground work began for the first phase, a 14

storey 170 apartment residential element on plot 3. The structural elements began early in 2006 with completion and occupation due in early in 2007 (Figure 2).



Figure 2 Masshouse Apartments Completed on Plot 3

As part of the planning application, the 'sustainability statement' for this part of the scheme proposed that the mix of uses would encourage activity creating a busy place and the arrangement of buildings would open up towards the park. In addition the development would enhance links to public transport, minimise car parking levels (restricting these to the basement allowing for the creation of a high quality, landscaped, public realm) and maximise off-site fabrication so as to minimise site waste. It specified that 'Good' Eco-Homes Assessment would be sought (BCC, 2004c). In terms of the decision-making process for the Masshouse development, this is the first time such a rating had been discussed. More importantly it was not a mandatory requirement and may not be achieved if significant changes to the current design are made (Cahil, 2006). Still lacking here is the inclusion of measurable targets from the outset of the project. The construction of Masshouse is still in the early stages and it is reported that the upcoming offices, law courts and hotel will be of much higher environmental standards than the apartments already completed (Bishop, 2007).

4.2 City Park Gate (Case Study 2)

In November 2002 the 5.8 acre City Park Gate site (consisting of three plots 4, 5 and 6) was marketed for development; this followed on from submission of the outline plans in January 2002 (GVA Grimley, 2002a,b). In January 2003, a two-stage selection process was adopted by BCC which included strict criteria set down for developers which included the following weightings: 50% design and sustainability (see Table 3), 30% financial and 20% deliverability. This showed significant changes to the decision-making process by including sustainability as a key indicator from the start. At Stage 1, the interested parties were: Urban Catalyst, Carillion, Cala Properties, Alfred McApine, Countryside Properties (CP), and English Cities Fund (ECF). In April 2003, CP and ECF were shortlisted for Stage 2; ECF subsequently pulled out of the race and in December 2003, CP was given preferred developer status by BCC. CP had significant experience in delivering sustainable regeneration projects elsewhere, such as Greenwich Millennium Village (CP, 2003), and was chosen as development partner in September 2004. In May 2005, a report to Cabinet stated that CP had put forward a number of proposals which would ensure that the development would be sustainable. The proposals included achieving at least a 'Very Good' BREEAM Assessment for the offices and a 'Good' Eco-Homes Assessment for the residential element (BCC, 2005). Unlike Case Study 1, these BREEAM indicators, which are a minimum current standard for CP, are applied at the start of the decision-making process.

Table 3 Sustainability Indicators for City Park Gate (adapted from BCC, 2003)

Economic	Social	Environmental
<ul style="list-style-type: none"> - Whole life costing should be used 	<ul style="list-style-type: none"> - High density - Mixed use - 25% Affordable housing - Minimise reliance on car - Safe places - Private spaces - Creating diversity - Moving around easily - Social inclusion and maintenance of a balanced community - Accessible to all including those with sensory and mobility impairments 	<ul style="list-style-type: none"> - Low energy systems - Good thermal and noise insulation - Heat recovery - Rainwater harvesting - Grey water recycling - Combined Heat and Power (CHP) - Photovoltaics (PV) - Retain (grade II) listed buildings - Maximise natural heat, ventilation and light - Minimise environmental effects - Use of renewable and environmentally friendly materials - Contribute to local biodiversity - Sustainable waste management - Flexible for adoption of future technologies - Consider use of groundwater for cooling/heating - Retain and enhance Park Street Gardens - Permeable paving

The report stated that water management options and reducing carbon emissions would be considered. These included connection to the future Eastside Community Combined Heat and Power (CHP) system (funding secured from the DTI in 2005), and the potential of using wind energy and local water sources. CP was made aware of the biodiversity issues regarding the potential presence of the black redstart (a robin sized bird of which there are less than 100 breeding pairs in the UK, see Donovan et al, 2006) in Eastside and City officers, including the Eastside Sustainability Advisor, worked with CP to ensure that all mitigation measures and opportunities were explored. In 2006, CP joined forces with Quintain Estates and Development PLC for this development project. In December 2006 an outline planning application was submitted to Birmingham City Council for a mixed-use scheme designed by MAKE Architects. The proposal comprised apartments (around 844), office space (210,000 sq. ft.), a hotel (230 rooms) and retail space (up to 100,000 sq. ft. including a food store of up to 60,000 sq. ft.). In addition there would be 880 car parking spaces. In January 2007, an issues report to BCC outlined that the building design would consider flexibility of use which will assist in future re-use of materials (something not considered in Table 1). It is considering a green roof on the grade II listed building Island House and use of high efficiency facades and low energy appliances throughout. Solar domestic water heating panels, heat recovery, rainwater harvesting and possible use of sustainable urban drainage were identified as potential options. The use of PV and greywater systems, as outlined in Table 3, were no longer considered. Of most interest was the fact that the developer asked the committee for the measures it wished to see incorporated and those measures it considered as essential to SD (BCC, 2007). This shows the importance of a clear definition of SD from the start of the project and the need for guidance from Council and the Sustainability Advisors with respect to SD in Eastside. This would be best facilitated through the use of sustainability checklists showing SD measures and priorities for all developments. The application is likely to be approved by March 2007. Subject to planning permission, work is expected to start on-site in summer 2007.

4.3 Technology Park and Learning and Leisure Quarter (Case Study 3)

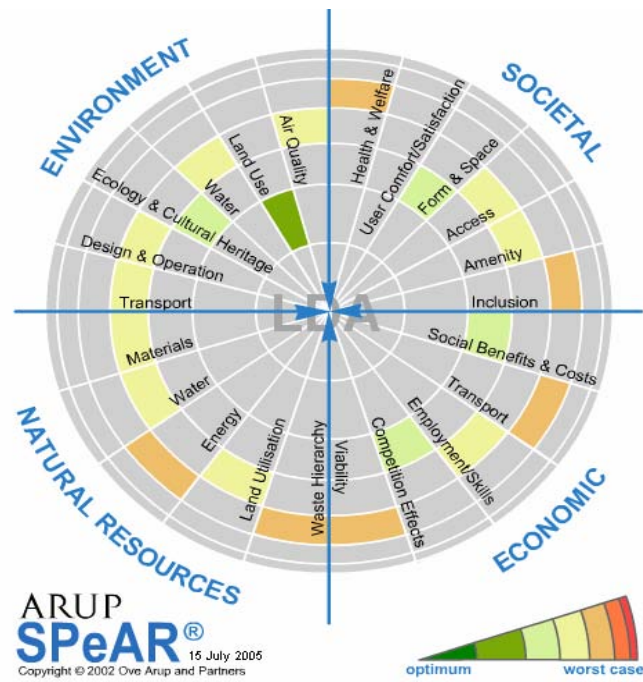
In January 2005, following intense competition from other architects, LDA Design was appointed by AWM and BCC as lead masterplanner for the 19 acre Learning and Leisure Quarter site (LLQ) and the 15 acre Technology Park (TP). In February 2005, LDA Design held a visioning workshop to articulate a vision for the quarter to guide a masterplan, and set clear economic, social and environmental objectives for the development. These were set forward in March 2005 in a preliminary project charter as shown in Table 4 (LDA, 2005).

Table 4 Sustainability Indicators for TP and LLQ (adapted from LDA, 2005)

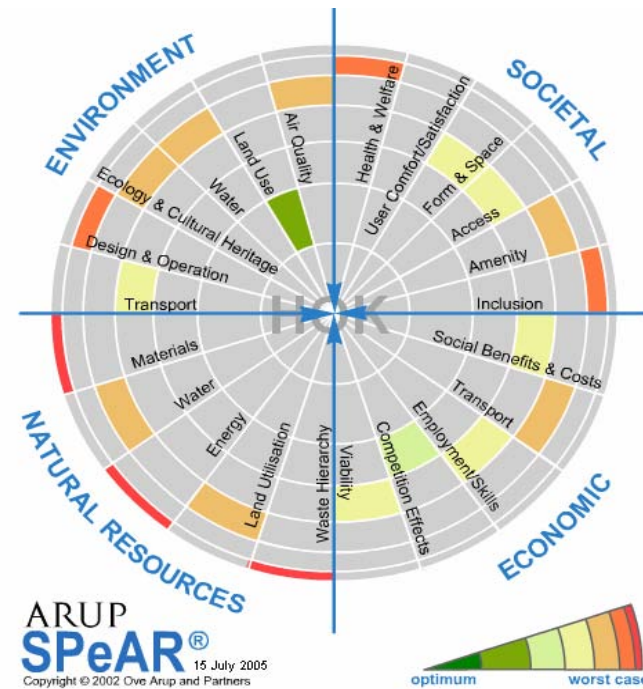
Economic	Social	Environmental
<ul style="list-style-type: none"> - To support the broad economic objective of the city region and to create a world class environment for business, leisure and learning - To provide an environment which can adapt to meet the changing requirements of likely end users over time 	<ul style="list-style-type: none"> - To create a proper neighbourhood and community - To create an environment for healthy living - To create a safe environment - To protect the strong and emotional / cultural connections people have with Eastside 	<ul style="list-style-type: none"> - To protect and enhance the historic and cultural environment - To protect existing biodiversity on the site and identify strategies to enhance it in the future - To minimise CO₂ emissions and use of natural resources

This charter shows clear definition of SD indicators from the outset of the project (i.e. visioning stages), although, again, benchmarks are missing. In March 2005, masterplan options were set forward (LDA, 2005), and these were discussed at a final stakeholder meeting in May 2005. The proposed development masterplan was for a mixed use development consisting of: retail (63,333 sq. ft.), food and drink (22,222 sq. ft.), office (310,000 sq. ft.), science and technology (315,555 sq. ft.), hotel (72,222 sq. ft.), residential (640 units), learning (584,444 sq. ft.), and leisure (24,444 sq. ft.).

In July 2005, sustainability appraisals using SPeAR were carried out for the LDA masterplan for LLQ and TP and the original HOK masterplan for Eastside. The resulting plots can be seen in Figures 3a and 3b. (As illustrated in the coloured wedge in Figure 3, best practice is indicated with green toward the inside of the bull's-eye; worst practice is red toward the outer edge.) This was the first time an appraisal of any masterplan had been carried out in Eastside showing a step change within the decision-making processes with respect to SD indicators and Eastside. More importantly, it highlighted the lack of attention to energy, waste and materials within the original masterplan. The masterplan for LLQ and TP showed significant improvement in these areas. In July 2006, the Eastside Technology Park and Learning and Leisure Quarter Development Framework was launched (LDA, 2006). In late 2006 / early 2007, the TP site is being marketed to find a lead development partner. One of the key requirements, as set down by AWM and BCC, is for the developer to have a sustainable approach to development (Ventureast, 2006), and this is strongly allied with the approach taken in Case Study 2. However, during the tender process, it was reported that Council officials were unwilling to engage in a serious debate about sustainability issues with respect to LLQ and TP (Dale, 2006), hence how these SD ideals will translate in practice is as yet unknown.



(a) LDA's TP and LLQ masterplan



(b) HOK's Eastside masterplan

Figure 3 SPeAR as a SD appraisal tool (Arup, 2005)

4.4 New Technology Institute - nti (Case Study 4)

Case Study 4 is very different from Case Studies 1 to 3 in that it refers to a single building, rather than a large number of buildings within a site development. The £10 million five-storey nti office building (Figure 4) is a purpose-built training venue for business, management, IT training, seminars, meetings, video conferences, product launches and networking events. The building was one of 18 nti's to be built in the UK following the launch by the Higher Education Funding Council in England (HEFCE) in May 2002. The nti in Eastside is located within the Learning and Leisure Zone and forms strong links with the LLQ in Case Study 3, and as such it was strongly promoted by AWM and BCC. The project was led by the University of Central England (UCE) and was part-financed through HEFCE and European Structural Funds (which require strict environmental criteria to be met).



Figure 4 Achieving High Office Standards at the nti Building in Eastside. Metal grills and brille soleil may be seen in front and to right of the building.

The contractors on the project led by Shepard Construction were: Mace (Project Management), Shepard Robson (Architect), Gardiner and Theobald (Quantity Surveyor) and Arup (Structural, Mechanical and Electrical Engineering, who joined the team in August 2003). Unlike Case Studies 1 to 3, no SD indicators were used on

the project, although consultation with the Sustainability Advisors occurred during the planning stages. Interestingly the benchmarks set by Planning in BCC at this early stage with respect to SD were relatively weak and easily achieved within the development, specifically: (1) the encouragement of native habitats for the black redstart was made through provision of gravelly roofs, and (2) provision was made for connection of a hot water CHP scheme, should it go ahead in Eastside. Despite this limited guidance, UCE had a very clear vision from the outset of the project that the nti should be sustainable (Cochrane, 2007) and '*set a new standard for learning accommodation and facilities in Birmingham*' (nti, 2006). One of the key elements in its leadership was the decision to allow temperature ranges within the building to fluctuate, removing the requirement for large energy-consuming air conditioning units. This necessitated an early commitment from UCE to accept the risk that that this thermal drift would be acceptable to future tenants of the building (Cochrane, 2007). In addition it meant that there was an element of 'lock-in' within the decision-making processes with respect to the type of building envelope that was required and the low intervention systems for heating and cooling that could be used (i.e. mixed-mode natural ventilation including exposed concrete soffits, metal grills and brille soleil for solar shading - see Figure 4 - and internal compartmentalisation to capture heat and recover energy through a heat wheel). The greywater recycling option was explored during the decision-making processes but omitted by the QS, due to high cost outlay and long payback period, primarily because there is limited greywater production in offices (Hunt et al, 2006). Construction began in February 2005, and the building was occupied in January 2006. In 2006, the nti was given a regional award from the British Council for Offices. It was stated that the nti went quite a way towards providing a sustainable solution whilst very much staying within the comfort zone of institutional acceptability (BCO, 2006). Even though the building exceeds current regulations (e.g. air leakage of 3.5m³ compared to 10.0 m³ standard, Cochrane, 2007) and it could likely achieve a very high BREEAM indicator rating, it has not been sought. This is partly because labelling of the building was not recognised by UCE as a unique selling point that would gain tenants or other market advantage.

4.5 Warwick Bar (Case Study 5)

The 4.56 acre Warwick Bar site in Eastside borders Fazeley Street, the Warwick and Birmingham Canal (cut in 1793) and Digbeth Branch Canals (cut in 1790), and the River Rea. It is in the Warwick Bar conservation area in Digbeth, the first canal-based conservation area in Birmingham (BCC, 2000), home to three nationally-listed and one locally-listed canal buildings (Figure 5). The Warwick Bar development team is pursuing a mixed use scheme: offices and retail on the ground floor to attract activity; and residential units above, including family accommodation.



Figure 5. The Warwick Bar conservation area in Eastside

The site is being developed by ISIS Waterside Regeneration, a relatively new developer formed in 2002 as a joint venture between British Waterways, AMEC Developments, and IGLOO Regeneration Fund.

Table 5: ISIS Waterside Regeneration Sustainability Charter – Headings.

Theme 1: Regeneration	Theme 2: Environmental Sustainability	Theme 3: Waterside Urban Design
1.1 Location and Connectivity	2.1 Energy Strategy	3.1 Permeable Streets
1.2 Contextual Analysis	2.2 Car Dependency	3.2 Public Realm
1.3 Stakeholder Engagement	2.3 Waste Minimization	3.3 Density and Mix of Use
1.4 Neighbourhoods and Liveability	2.4 Food Supply	3.4 Cultural Diversity and Distinctiveness
1.5 Community and Stewardship	2.5 Construction Materials	3.5 Urban Ecology
1.6 Economic Diversity and Independence		

ISIS is differentiated from the developers discussed in Case Studies 1 to 4 by its sustainability charter, which lays out the 16 sustainability principles that all ISIS projects follow (Table 5). These are grouped into 3 themes: regeneration, environmental sustainability, and waterside urban design. The charter is used to assess all new opportunities; those sites that have the potential to advance the objectives of the charter are taken on, and a Project Sustainability Plan is drafted for the project. Ideally, this Project Sustainability Plan essentially becomes the agenda for the development team (ISIS team members alongside architects, engineering and

construction specialists, any community partners, and so on). According to the ISIS documentation:

The purpose of the Project Sustainability Plan (PSP) is to ensure that the issues that need to be addressed and resolved in order to bring forward a truly sustainable development are fully scoped and defined through a continuing iterative process. The PSP is a document that is completely integrated into the decision making processes that will bring forward the scheme design, implementation, and on-going use and management.

While the development is still cost- and value-engineered, as with mainstream developers, it is done so in conjunction with advancing the PSP as much as possible, making explicit the tensions and trade-offs between the multiple objectives that exist on all projects. For example, Principle 2.1 of the ISIS Sustainability Charter requires the development of an energy strategy with the aim of achieving a 60% reduction in carbon dioxide emissions from 1997 levels. This target will translate to site- and project-specific actions in the PSP such as: establishing criteria and researching best practices for the area; setting standards to meet or exceed Building Regulations Part L 2006 for residential units; and undertaking microclimate assessments. The trade-offs become explicit in part during the value engineering, when items to address Principle 2.1, such as photovoltaics, may well be dropped due to high cost outlay and long payback periods (as happened at the nti building; Lawrence, 2007). The names of relevant team members are put against each action, and the responsible person will report on these actions at regular team meetings. Sometimes all PSP topics will be touched on at a meeting; other times special meetings are scheduled to address a particular subset of issues. The project is scored against the objectives on a continuing basis using the 'traffic light' system.

Another differentiating feature of this development site is that it is owned by British Waterways, and development rights were transferred to ISIS at its creation in 2002; thus there was no developer selection process as with Case Study sites 1 to 4. In August 2005, ISIS and Birmingham City Council did, however, hold a design competition to determine the architect masterplanners for the site. The competition was organised by the Midlands Architecture Design Environment (MADE), which had coincidentally just relocated to a listed building on the Warwick Bar site. The brief specified that the development should be an exemplar of sustainability, referring to the BRE criteria for physical and environmental sustainability criteria. Forty-five architects applied to the competition; seven were short-listed. A website was then created for those short-listed that provided the following tools: the vision for Warwick Bar specifying sustainability exemplar; the ISIS charter also making explicit the ISIS commitment to sustainability; supporting documents mentioned in Case Studies 1 to 4, including the Eastside Design and Movement Framework, and the Eastside Vision; and other relevant BCC policies. In November 2005, Kinetic AIU was named as masterplanners. Examples of sustainability in their winning concept included a

carbon neutral scheme (environmental sustainability), and distinctiveness of place and recognition of site heritage (social sustainability). The need to balance economic realities and sustainability aspirations, as well as the constraints of a conservation area, has resulted in a long, involved masterplanning process, which continues in 2007.

CONCLUSIONS

This paper has presented an overview of sustainable indicator systems directly applicable to, and being used within, five case study sites located within the Eastside regeneration project in Birmingham, UK. The paper has briefly described the development 'timeline' for each case study site and highlighted where SD was first conceived and where sustainable indicator systems were first employed within the decision-making processes.

In Case Study site 1, SD was not part of the developer/architect selection criteria; it was first defined at the detailed masterplanning stage. The desirability of achieving an Ecohomes 'Good' rating was considered near the end of the detailed planning stages, leaving little room for modification of design. The apartments are now complete and achievement of such a rating is not guaranteed. Case Study site 2 highlighted the use of SD criteria for influencing developer / architect selection (i.e. selection criteria to include a 50% weighting for design and sustainability). SD was defined early within the decision-making process (i.e. masterplanning stages) and early commitment was made to achieving BREEAM 'Excellent' for Offices and Ecohomes 'Good' for apartments. The construction phase of this development has not yet started. Case Study site 3, which began later within the overall Eastside timeline than Case Study sites 1 and 2, adopted SPeAR to help appraise the localised masterplan. In addition post-analysis of the overall Eastside masterplan, which included early designs for all development sites, was undertaken and weakness therein highlighted. The developer / architect is to be selected on their ability to deliver sustainability and once this process has occurred detailed planning will follow. The incorporation of SD indicators within this process is, as yet, unknown, although close monitoring of the decision-making processes will be undertaken as part of this current research project. In Case Study site 4 SD criteria were fundamental to developer / architect selection. SD indicators were not used directly within the process, but the client was very focussed towards delivering sustainable office space. This required early commitment to the building envelope, exposing thermal mass and shading, etc. The building is now completed and has achieved higher standards than required by current Building Regulations. In Case Study 5, the property was already under the control of a developer with a Sustainability Charter; the architect was selected on its ability to meet the demands of all three pillars of SD and, although it is early in the process, the development team is pursuing a sustainability exemplar development.

Throughout the decision-making process the criteria for SD set down by Birmingham City Council appear to have been weak, seeking only for provision of CHP and the black redstart to be made within developments. A lack of SD benchmarks will mean that the achievement of sustainability from the private sector relies on the goodwill of investors / developers to build beyond current standards rather than it being a statutory requirement. Good implementation of SD relies on knowledge, which requires guidance. This has been lacking in Eastside, although the introduction of the Sustainability Advisors has helped and the SD checklists will help further, albeit at a very late stage within the overall Eastside development timeline. Many of the developments have yet to be completed in Eastside and therefore it is too early to conclude whether the inclusion of SD indicators early within the decision-making processes has facilitated a more sustainable outcome. The developments will be monitored closely over the coming years.

Acknowledgements

The Eastside Sustainable Development Project is a joint venture between the University of Birmingham and the University of Central England in Birmingham. The authors wish to thank EPSRC for their financial support during this Sustainable Urban Environments (SUE) research project under grants GR/S 20482, EP/C 513177 and EP/E 021603.

References

- Anderson, J., Shiers, D.E. and Sinclair, M. (2002). Greenguide to Specification, 3rd Edition. Building Research Establishment, Garston, UK. Blackwell Publishing, UK, pp. 112
- Arup, 2005. Eastside Partnership: Technology Park & Learning/ Leisure Quarter Sustainability Appraisal, Ove Arup and partners Ltd, Solihull, West Midlands, July 2005, pp 22.
- Arup, 2006. Sustainable Assessments: Masterplanning. Ove Arup and partners Ltd, Solihull, West Midlands, Draft 1, October 2006, pp 12.
- AWM, 2006. Sustainable development framework and action plan. AWM, 2006. Sustainable Development Framework and Action Plan. Advantage West Midlands, UK.
<http://www.advantagemw.co.uk/downloads/sustainable-development-framework-and-action-plan.doc>
accessed 6/02/2007
- BCC, 1999. Sustainability Indicators for Birmingham. Appendix 7B, Birmingham City Council, UK. www.Birmingham.gov.uk. Accessed 31/08/2004
- BCC, 2000. Conservation Area 30, Digbeth Deritend and Bordesley High Street. 31st May, Planning Control, Planning Committee Report and Maps, pp. 15
- BCC, 2003. The Design and Movement Framework (draft), Birmingham City Council, Birmingham, UK. pp. 28

- BCC, 2004a. Application Number C/01832/01/FUL. 202 Fazely Street, City. June 9th 2004. Birmingham City Council, UK, pp. 5
- BCC, 2004b. Application Number C/05789/01/FUL. Masshouse Redevelopment Scheme, Plots 3 and 7, City. December 22nd 2004. Birmingham City Council, UK, pp. 19
- BCC, 2004c. Application Number C/06556/RES. Masshouse Lane/Moor Street Queensway, City December 22nd 2006. Birmingham City Council, UK, pp. 11
- BCC, 2005. City Park Gate, Masshouse Progress Report, Report of the director of planning and regeneration, Birmingham City Council, May 5th, pp. 10
- BCC, 2006. Application Number C/04345/05/RES. Masshouse Lane/Moor Street Queensway, City – Masshouse Plot 3. January 26th 2006. Birmingham City Council, UK, pp. 6
- BCC, 2007. City Park Gate Issues Report, Report of the Director of Planning and Regeneration, Birmingham City Council, January 4th, pp. 15
- BCO, 2006. British Council for Offices Awards 2006: Regional Awards
www.bcoawards.org.uk/winners/2006/corporate/#newTechInstitute
- Bell, S. and Morse, S., 1999 Sustainability Indicators: Measuring the immeasurable, Earthscan publications, UK, pp 192
- Bishop, A. 2007. Personal communication. Director of Eastside, discussion at the Eastside Sustainable Research steering group meeting held at the University of Birmingham, 16th January 2007.
- BREEAM, The Building Research Establishment Environmental Assessment Method, BRE, Watford, UK.
- Brownhill, D. and Rao, S., 2002. The Sustainability Checklist. www.sustainability-checklist.co.uk
- Cahil, M. 2006. Personal communication. Site manager, Masshouse, Eastside. Site visit and interview at Masshouse residential apartments on Plot 3 Block H and I given by on 6th July 2006.
- Cochrane, P., 2007. Personal communication. Associate Director of Estates, UCE Birmingham. Site visit and interview at nti offices in Eastside on 26th January 2007.
- Coyne, R., 2006. Draft Guidance for Sustainable Design and Construction in Eastside. November 2006, pp38
- Countryside Properties, 2003. Delivering Sustainability Communities Brochure, Essex, UK, pp16
- Dale, P., 2004. Brum to go underground. The Birmingham Post, May 14, 2004.
- Dale, P. 2006. City slammed over Eastside project. The Birmingham Post, Chief reporter, December 8th 2006
- David McLean, 2002. Masshouse Development Plots 3 & 7: Detailed Masterplan and Design Statement presented to Birmingham City Council by David McLeans Development. August 2002, pp. 27

- Defra, 2003a. The Regional Quality of Life Counts
www.sustainable-development.gov.uk/indicators/regional
- Defra, 2003b. Achieving a Better Quality of Life. Review of Progress Towards Sustainable Development: Government annual report.
- Defra, 2003c. Sustainable Development in Government: Second Annual Report
<http://www.sustainable-development.gov.uk/publications/report2003/glossary.htm>
- Defra, 2004a. Sustainable Development Indicators in Your Pocket (SDIYP) www.sustainable-development.gov.uk/indicators/sdiyp
- Defra, 2004b. Taking It On: Developing UK Sustainable Development Strategy Together
www.sustainable-development.gov.uk/taking-it-on/index.htm
- Defra, 2004c. Taking It On: Consultation letter www.sustainable-development.gov.uk/taking-it-on/index.htm
- Defra, 2006. National Sustainable Development Indicators
<http://www.sustainable-development.gov.uk/progress/national/index.htm>
- DETR, 1999. A better quality of life. Government annual report. www.sustainable-development.gov.uk
- DETR, 2000a. Local Quality of Life Counts: A Handbook for a Menu of Local Indicators of Sustainable Development, Department of the Environment Transport and the Regions. The stationary office. London, UK.
- DETR, 2000b. UK Strategy for Sustainable Development. Department of the Environment Transport and the Regions. The stationary office. London, UK.
- Dickie, I. and Howard, N. 2000. Assessing Environmental Impacts of Construction: industry consensus. BREEAM and UK Ecopoints. BRE Digest 446, Building Research Establishment, Garston, UK, pp. 12.
- Donovan RG, Haigh Z, Gerrard AJ, Bennett P, Parry CR, Sadler JP (2006). Eastside Biodiversity Strategy - A Guidance Note. 32pp.
- Ends Report (2003). Demand Grows for Sustainable Homes. ENDS Report 343: Marketplace, August, Environmental Data Services, London, UK.
- Ecotec (n.d.) Eastside: bid to ERDF, Birmingham, Ecotec & Birmingham City Council.
- ESAG, 2002. Have we got Eastside Sussed?: Sustainable Eastside, A Vision for the Future. Eastside Advisory Group. Groundwork Birmingham and Friends of the Earth, March, pp. 102
- GHK, 2004. An Action Plan for Sustainable Eastside (Working draft).
- GVA Grimley 2002a. Design Statement – Masshouse Redevelopment: Planning Statement (outline planning), January, REF: C/00412/02OUT, Birmingham, Birmingham City Council.
- GVA Grimley, 2002b Masshouse Redevelopment, Birmingham – Environmental impact assessment, January 2002, pp. 229.

- Hart, M. (1998-2000). Sustainable measures: Indicators of sustainability www.sustainablemeasures.com/Database/index.html (accessed 12/11/2006)
- HOK, 2002. Eastside Masterplan, January 2002, HOK International Limited, London, UK
- Hunt, D. V. L., Lombardi, R. and Jefferson, I. J. (2006) Sustainable Water?: A feasibility study for Birmingham Eastside 4th CIWEM Annual conference, CD-ROM, September, Newcastle, UK.
- Jackson T. 2004. A prosperous nation. www.sd-commission.org.uk/news
- Jefferson, I., Rogers, C. D. F. and Hunt, D. V. L. (2006), Achieving Sustainable Underground Construction in Birmingham Eastside?, *The 10th International Congress of the IAEG*, Nottingham, UK, CD-ROM, September 2006.
- Lawrence D. 2007. Personal communication. Principal Engineer, ARUP. Site visit and interview at nti offices in Eastside on 26th January 2007.
- LDA, 2005. Birmingham Eastside: Technology Park and Learning / Leisure Quarter: Preliminary Project Charter. LDA Design, March 2005
- LDA, 2006. Birmingham Eastside: Technology Park Learning / Leisure Quarter development framework, LDA Design, June 2006, pp. 80.s
- Leeds City Council, 2002. The Sustainable Development Guideline. www.leeds.gov.uk/sustain/ssdframe.asp accessed 10/01/2007
- McGregor, I.M. and Cole, R., 2003. Using the SPeARTM Assesment Tool in Sustainable Masterplanning. *Proc. of US Green Building Conference – Greenbuild 2003*, Pittsburgh, USA, pp.10.
- Nti, 2006. One Click, Inside the New Technology Institute in Birmingham. Christmas 2006. pp 2.
- Pearce, A. and Walrath, L., 2001. Definitions of Sustainability from the Literature Maven.gtri.gatech.edu/sfi/resources/pdf/definitions.pdf
- Porter, E.J. and Hunt, D.V.L. 2005. Eastside: Making Steps Towards Sustainability? Local Environment, Taylor and Francis Group 10 (5) October, 525-542.
- Prangle, K. 2006. Sustainable Eastside <http://www.sustainable-eastside.net>, accessed 01/11/2006
- Rao, S., Yates, A., Brownhill, D. and Howard, N. 2003. ECOHOMES: the environmental rating for homes. BRE Report 389. Building Research Establishment, Garston, UK. pp. 23
- Rao, S. 2004. Sustainable checklist for developments. Seminar on Sustainability Indicators, Austin Court, Birmingham.
- Slater, S. 2006. Policy: Sustainability Development. www.advantagewm.co.uk/downloads/sustainable-development-policy-summary.pdf, pp. 1
- Townsend, D. 2006. South West Birmingham Regeneration: Forward motion www.birmingham.gov.uk, accessed 02/02/2007

Trinius, 1999. Environmental Assessment in Building and Construction: Goal and scope definition as key to methodology choices. Doctoral thesis, October 1999, pp52

UTF (1999). Towards an Urban Renaissance'. The Report of the Urban Task Force Chaired by Lord Rogers of Riverside, 29 June 1999. Published by DETR.

Ventureast, 2006. Promotional Brochure for a Major Redevelopment opportunity: Approximately 90,000 sq m of mixed use development potential in Birmingham City Centre. Venture East, A partnership between Birmingham City Council, Advantage West Midlands and GVA Grimley. www.ventureeast.co.uk/about.asp, pp. 12

Walton, J.S., El-Haram, M., Castillo, N.H., Horner, R.M.W., Price, A.D.F. and Hardcastle, C. 2005. Integrated Assessment of Urban Sustainability. Engineering Sustainability. 158 (2) p57-65

WCED, 1987. Our Common Future World Commission on Environment and Development, Oxford, Oxford University Press.