03E033I
HH-23E3-44

# Sustainable Development Mini-Guides

An
Interactive Qualifying Project Report

Submitted to the Faculty of

WORCESTER POLYTECHNIC INSTITUTE

In Partial Fulfillment of the Requirements for the
Degree of Bachelor of Science

By


Richard A. Ballard

Andrew J. Fowler

Collin J. Joyce

Jason W. Myatt


June 25, 2003

Approved by:

Professor Hossein Hakim, Advisor

# Abstract

This project consisted of the development of a series of mini-guides and a website on four topics in sustainable development: passive solar design, renewable energy sources, sustainable urban drainage systems, and sustainable building materials. The final guides covered techniques and benefits of each topic. The guides were developed for the London Borough of Merton to promote the use of sustainable development techniques and were presented to the Merton Council for incorporation into an expanding series of guides on sustainable development.

# Table of Contents

# Executive Summary

Sustainable development is a key principle in the planning policy of the London Borough of Merton. Merton Council refers to the Brundtland report (as cited in Merton Council, 2001, p. 3) when defining sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The Council is encouraging the implementation of sustainable development techniques by taking into account the overall sustainability of a development proposal when considering whether to grant planning permission.

While the Council has published general information on its criteria for evaluating sustainability, it does not currently provide guidance on specific sustainable construction techniques. To meet this need, the Council decided to develop a series of mini-guides on sustainable construction topics. These guides aim to provide information to Merton developers and Merton Council Development Control officers on the specific topics identified as relevant to the Council's sustainability criteria. A team of WPI students designed the first three of these mini-guides for Merton during March and April of 2003.

The goal of this project was to continue the development of this series of mini-guides. First, minor revisions were made to the three initial guides, incorporating changes suggested by the previous team's review process. Four new guides were then created, covering passive solar design, sustainable building materials, renewable energy sources, and sustainable urban drainage systems. The four new guides were produced in the same format as the previously completed guides: short, A4-sized booklets and companion brochures. In addition, preliminary investigation

identified the Web as an effective medium for presenting the mini-guide content, so a Web site was created containing the content of all seven guides.

Producing and improving the guides involved a number of stages. First, considerable content research was conducted, drawing primarily on books, journals, and websites. Once research was complete, outlines were drawn up for each guide to organize the writing process. The guides were then written by individual team members and subjected to a multi-stage review process. This process began with a team review of the guides, followed by initial revisions. The project sponsors reviewed these refined guides, and their feedback directed a second set of revisions. The mini-guides were then sent to selected officials within Merton Council; each completed a survey and participated in a brief interview, giving feedback and suggestions for improving the guides. A final set of revisions based on the analysis of this data resulted in the finished version of each guide, which was then presented to Merton Council. To facilitate additional future review and improvement, a survey and a set of guidelines for conducting an outside review of the mini-guides were produced and delivered to the project sponsors.

Creating the mini-guide Web pages took place in parallel with the guides' development. Web usability and information architecture were first researched, followed by the drafting of a set of design goals and layout possibilities. Several prototypes were constructed and then discussed with the Merton Council Web Team, whose guidance helped to establish the final design choice. At this stage, it was found that the Merton Council Web site was organized in a way that would hinder the effectiveness of the mini-guide Web pages; the decision was made to find a solution to this problem, as this would increase access to all of the Council's sustainability Web content. After interviewing the Merton officials responsible for maintaining the Environmental Services Web pages, an outline was drafted for a "Developer's Guide to

Sustainable Planning" organization section. New content on Merton policy and sustainability advantages was written to aid in marketing the sustainable planning information to developers; this content was included as the organizational planning section was constructed. Finally, the mini-guide content was placed on the Web site; this content was edited slightly to be more suitable for display on the Web, but it was otherwise identical to that presented in the print mini-guides.

The mini-guide content research, exploratory interviews, and Merton staff feedback provided data and suggestions for a significant number of recommendations regarding sustainability education. The Council was advised to create more organizational Web sections similar to the Developer's Guide to Sustainable Planning for other users; a sustainability section aimed at homeowners, for example, could greatly increase informational accessibility. It was recommended that the mini-guides' future maintainers update the guides frequently with new information, ensuring that cross-references between educational materials are added where appropriate. The Council was advised to fund or promote experimental case studies of new technologies where possible, as this would supply needed, currently unavailable cost and feasibility data, as well as encourage the use of new sustainable techniques. An approach for distributing the mini-guides effectively was suggested, based on feedback from both Merton Development Control and Plans & Projects officers. The need for further prescriptive sustainability policy was highlighted, as without it Development Control will not have the backing to deny planning permission based on sustainability issues alone. Finally, the importance of implementing an integrated program of education and incentives was reinforced; such an approach could remove the major obstacles to clear the way for a sustainable future.

# 1. Introduction

Sustainable development has emerged in recent years as a concept at the forefront of global consciousness. Since the UN conference at Rio de Janeiro in 1992, the global community has set forth the need for policies designed for economic growth, social development, and environmental protection (United Nations Department of Economic and Social Affairs [UNDESA], 2002a). These policies are a reaction to widespread poverty, the degradation of the global environment, the increasing gap between the rich and the poor, and the challenges faced by developing countries in an age of globalization (UNDESA, 2002b). In the UK, and particularly in the Greater London area, implementing sustainable policies has become a strong priority; planning for a sustainable future is well underway.

Greater London policy exemplifies the UK's sustainability planning. The objectives of Greater London policy are set forth in the 1996 Strategic Planning Guidance for London Planning Authorities. These objectives include promoting urban regeneration, maximizing London housing provisions, maintaining the natural environment, promoting business, improving air quality, and reducing pollution and energy use (Merton Council, 2000). These policy goals are clearly consistent with the aims of sustainable development.

Much of the UK sustainability movement is being driven at a local level through planning permission policies. Each local planning authority in Greater London has produced a Unitary Development Plan (UDP) that presents the development and environmental protection policies of those authorities. Parliament's 1991 amendment to the 1990 Town and Country Planning Act requires that development control decisions be made in accordance with these policies (Merton Council, 2000).

The UDP for the London Borough of Merton states, "The council will encourage development which is sustainable and resist development proposals which substantially fail to follow the principles of sustainable development" (Merton Council, 2000). As Merton development control decisions are made in accordance with this policy, sustainable technologies must now be considered when planning new developments in Merton. For this policy to work, however, both Merton building professionals and Merton development control officers must be informed on both the concept and practice of sustainable development.

Merton Council currently provides relatively broad range of information. The council's UDP covers all of the Borough's development policy, including sustainable development policies, though it does not cover specific techniques or technologies. The council has also produced a Sustainability Checklist. This checklist presents categorized criteria which are used to rate the sustainability of a proposed development, and thus to determine whether it complies with UDP policy well enough to issue planning permissions. Also in development is a householders guide; this booklet contains the sustainability checklist as well as specific methods for a homeowner to use to implement sustainable practices.

What the Borough of Merton lacks is a way to educate both its council policymakers and Merton building professionals on sustainable development specifics. They need some way to provide information on what sustainable development is, how it can be done, and most importantly, why it should be done.

To fill this information gap, the goal of this project was to provide a series of educational materials in the areas of passive solar design, sustainable building materials, renewable energy sources, and sustainable urban drainage systems. To achieve this goal, a series of paper mini-guides and a companion website were produced. These guides addressed the scope of the topics and included explanation of the theory behind each topic, methods of implementation, and benefits from utilizing the techniques. The website contained similar information, but presented it in a more accessible manner. These guides were designed for people involved in development in the Borough of Merton, but the process used to develop the guides and the website will be useful to Merton's Partners in the Asia Urbs project and other similar organizations involved in promoting sustainable development around the world.

# 2. Background

## *2.1 – Defining Sustainable Development*

Many groups and organizations have attempted to define sustainable development, each with their own agenda and goal. Since its early usage, the term has taken on many different characteristics. The London Borough of Merton refers to the Brundtland Commission's 1987 definition in their attempt to define the term.

> 'Development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Bruntland[*sic*] Commission 1987). The concept of living within the capacity of supporting ecosystems has also been suggested as a basis for sustainable development. (Merton Council, 2000)

Agenda 21, a result of the United Nations Conference on Environment and Development, provides a series of points that help define the need for implementation of sustainable development techniques at the global level. These points include the need to "equitably meet developmental and environmental needs of present and future generations" (United Nations Division for Sustainable Development, 1992). With this statement, Agenda 21 addresses the need to protect and preserve the environment and natural resources and the need for sustainable development to be addressed at the local level but fails to specify particular techniques or courses of action. If sustainable development is going to be successfully implemented worldwide, then specific guidelines and methods must be laid out for national and local governments to follow.

The UK government web site on Sustainable Development makes a broader and simpler statement about sustainable development: "At its heart is the simple idea of ensuring a better quality of life for everyone, now and for generations to come" (UK Department for Environment, Food, and Rural Affairs, 2003b).

Taking into consideration these definitions and our own conceptions of sustainable development leads to our working definition: "Sustainable development provides for current needs without reducing the ability to provide for future needs."

## 2.2 – A Brief History of Sustainable Development

Sustainability awareness has its roots in the modern environmental movement. From Earth Day in 1970 to the present day London Plan and the Johannesburg Summit, public awareness of our sustainability needs has grown from practically nothing to worldwide concern. While many sustainable construction practices are not yet common, governments and development organizations across the world have begun to change their policies to protect the future of our environment, our resources, and our quality of life.

### 2.2.1 – Sustainability's past.

History is full of examples of the effects of unsustainable practices. One oft-mentioned case is that of the Roman occupation of Carthage.

At one point in time, the fertile lowlands in Carthage supported a population of over one million. After their victory over Carthage, Rome turned the Carthaginian lands into a colonial food source. The Romans over-cultivated the land, reducing the fertility of the soil and beginning a vicious cycle of decline as they steadily increased production to overcome the reduction in yield. Rome's efforts eventually turned Carthage (now part of Tunisia) into the barren land that it is today (Muschett (Ed.), 1997).

Other historical examples of the effects of unsustainable practices include the near-extinction of the buffalo in the US, and, more recently, the effects of the Aswan Dam in Egypt. It has even been theorized that the decline of Spain as a world power was a direct result of the over-harvesting of their scarce forests to meet their shipbuilding needs (Muschett (Ed.), 1997).

### *2.2.2 – Earth Day.*

The environmental movement had its first real awaking in 1962 with the publishing of Rachel Carson's *Silent Spring*. While Carson's work has since been criticized for its shaky science, the fears raised in the book brought environmental issues to public attention (Lewis, 1985).

April 22, 1970 is widely regarded as the true birth of the modern environmental movement. Gaylord Nelson, a US Senator at the time, founded Earth Day "to shake up the political establishment and force this issue onto the national agenda" (Earth Day Network, n.d.).

> On April 22, 20 million Americans took to the streets, parks, and auditoriums to demonstrate for a healthy, sustainable environment. Denis Hayes, the national coordinator, and his youthful staff organized massive coast-to-coast rallies. Thousands of colleges and universities organized protests against the deterioration of the environment. Groups that had been fighting against oil spills, polluting factories and power plants, raw sewage, toxic dumps, pesticides, freeways, the loss of wilderness, and the extinction of wildlife suddenly realized they shared common values. (Earth Day Network, n.d.)

Earth Day opened the door to a widespread environmental consciousness and set in motion the beginnings of a change in US national policy. Two years later, the UN Stockholm Conference on the Human Environment marked the international debut of the movement (Sustainability Reporting Program, 2000).

### *2.2.3 – The Brundtland Report.*

During the 1980s the international environmental movement was picking up steam fast. The U.N. created a commission in 1983 to investigate how best to pursue sustainable development, and in 1987 the commission released *Our Common Future*, more commonly known as "The Brundtland Report." *Our Common Future* concluded that the world was facing a number of serious environmental dangers, but that remedying the situation was possible, saying

> It is clear that a low energy path is the best way towards a sustainable future. But given efficient and productive uses of primary energy, this need not mean a shortage of essential energy-services. Within the next 50 years, nations have the opportunity to produce the same levels of energy-services with as little as half the primary supply currently consumed. This requires profound structural changes in socio-economic and institutional arrangements and is an important challenge to global society. (The Brundtland City Energy Network, n.d.)

This had a significant impact on the sustainability movement, as the resulting increase in public awareness led governments across the world to begin to take action on environmental protection measures. In 1988, after several years of increasing pressure from the European Union, British Prime Minister Margaret Thatcher – who had until then treated economic growth as paramount over environmental protection – publicly spoke out for Britain's duty to protect the environment for future generations (Lafferty and Meadowcroft (Ed.), 2000).

### *2.2.4 – Agenda 21.*

In 1992 the UN Conference on Environment and Development (UNCED) met in Rio de Janeiro, Brazil, in what is perhaps the tipping point in the history of sustainable development. Their political leaders from more than 178 nations met to discuss sustainable development (United Nations Division for Sustainable Development, 2003).

Three documents came out of this effort: the "Rio Declaration on Environment and Development", the "Statement of principles for the Sustainable Management of Forests", and Agenda 21. These three documents established a set of principles and a call to action for forging a sustainable future. As the preamble to Agenda 21 stated,

> Humanity stands at a defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health and illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being. However, integration of environment and development concerns and greater attention to them will lead to the fulfillment of basic needs, improved living standards for all, better protected and managed ecosystems and a safer, more prosperous future. No nation can achieve this on its own; but together we can - in a global partnership for sustainable development. (United Nations Division for Sustainable Development, 1992)

The conference at Rio has been criticized for not instituting a specific plan of reform. As Lee and Lee (Muschett (Ed.), 1997, p.71) point out, "...the documents were all nonbinding. This gave many countries the opportunity to show the world that they were taking a stand for environmental concerns, but they committed themselves to no particular action." Still, UNCED greatly increased public awareness of the need for sustainable development (Muschett, (Ed.), 1997).

### 2.2.5 – Modern sustainability.

The 1990s saw sustainable development move from a background issue to a cornerstone of modern governmental policy changes. Under the Labour Party in the UK, a series of annual white papers detailed and refined Britain's national strategy for acting on Agenda 21. These white papers led to "A Better Quality of Life: a Strategy for Sustainable Development for the UK," which outlined the need for change, the objectives for sustainable development, and the UK plan for action (UK Department of the Environment, Transport, and the Regions, 1999). While the US had been an early leader in environmental policy, by the late 1990's it had fallen behind Britain and the European Union in taking effective action to implement sustainability (Lafferty and Meadowcroft (Ed.), 2000).

In August of 2002, ten years after the summit at Rio, 104 heads of state and over 21,000 other people met in Johannesburg, South Africa for the greatly anticipated UN summit nicknamed "Rio+10." Many felt that global sustainable development progress had not met the expectations set in 1992. The Johannesburg Summit aimed to reaffirm international commitment to the blueprint set forth in Agenda 21 and strengthen partnerships working to implement sustainable development (United Nations Department of Economic and Social Affairs, 2002b).

Sustainability has, over the past thirty years, gone from a non-issue to one of the international community's foremost concerns. Still, the implementation of sustainable development techniques has been limited at best. If the goals of at Rio and Johannesburg are to be realized, the international community must multilaterally act to bring significant change.

## 2.3 – Current Sustainability Policy

### 2.3.1 – Current UK sustainability policy.

The UK has approached the implementation of Agenda 21 in the spirit of the popular saying, "Think globally, act locally." Britain's approach involves both reforms to national agencies and regional plans of action for local communities.

At the UN World Summit on Sustainable Development (WSSD) in 2002, Britain committed to working towards economic, industrial, and social sustainability. The UK Department for Environment, Food, and Rural Affairs is taking the lead in helping UK national agencies to organize their plans for meeting the WSSD commitments (UK Department for Environment, Food, and Rural Affairs [UKDEFRA], 2002).

At the U.N. General Assembly Special Session on the Environment in 1997, Prime Minister Tony Blair said, "I want all local authorities in the U.K. to adopt Local Agenda 21 strategies by the year 2000" (UKDEFRA, 2003a). On April 1st, 1999, local sustainability initiatives were pushed forward when eight Regional Development Agencies (RDAs) were created to "...work together at the regional level with the Regional Assemblies and Chambers to identify the overarching sustainable development priorities in the regional sustainable development framework for their region and to ensure that they deliver on the targets they have signed up to" (UKDEFRA, 2003a).

The Greater London Authority (GLA), created on July 3rd, 2000, was the ninth RDA. The duties of the Mayor of London under the Greater London Authority Act included the production of a "Spatial Development Strategy" (Greater London Authority, 2002). This was published in June of 2002 as The London Plan.

The vision expressed in the London Plan follows three major themes: "Strong, diverse long term economic growth", "Social inclusivity to give all Londoners the opportunity to share in London's future success", and "Fundamental improvements in London's environment and use of resources" (Greater London Authority, 2002). This plan goes hand in hand with Mayor's Draft Air Quality Strategy, Economic Development Strategy, Draft Waste Strategy, and Draft Energy Strategy.

"Green Light to Clean Power: The Mayor's Draft Energy Strategy" (Greater London Authority, 2003) details much of the Mayor's plans on sustainable development in London. A major goal of the plan is the creation of a "radically different energy system" than what London currently has. The document details increased reliance on renewable energy sources instead of fossil fuels, deployment of high-efficiency appliances and buildings, and development of fuel cell motor vehicles (Greater London Authority, 2003). The mayor plans to realize this vision by setting achievable targets for London, using his position as Mayor to promote sustainable construction and development, and "working in partnership" with other organizations (Greater London Authority, 2003). There are a number of specific goals for the City of London that are described in the draft, though all have little explanation of the specifics that will be used to achieve each goal. The Draft Energy Strategy is useful in understanding the City's plans for a sustainable future, but its omission of specifics leaves a gap between the City's goals and its methods.

### *2.3.2 – Current Merton sustainability policy.*

While the GLA's plans affect the whole of London, the individual Boroughs are also taking action on a local level. The creation and implementation of Local Agenda 21s for the advancement of sustainable development has been an ongoing process for London's Boroughs. The Borough of Merton defined their sustainability initiative within their overall plan for development in Merton, the Merton Unitary Development Plan (UDP). The creation of a UDP was required for each local planning authority in Greater London by the U.K.'s 1990 Town and Country Planning Act. The current UDP details Merton's goals for the next 13 years from a development standpoint, including the many "green" development policies Merton wishes to implement (Merton Council, 2000).

In 1991 Parliament amended the Town and Country Planning Act to require that development control decisions be made in accordance with the local UDPs (Merton Council, 2000). The result of this is that the sustainable development policies in Merton's UDP have significant affect on the future of development within Merton.

Another Merton document, the "Supplementary Planning Guidance Note," covers the specific policy of the Merton Council on Sustainable Development. Its five major ideas are "Resisting developments that don't take into account sustainable building practices", "Promoting sustainable land use and transport", "Promoting equality of opportunity", "Compliance of sustainable development aims in mixed-use developments", and "Protecting the environmental capital of the Borough" (Merton Council, 2001).

The "Supplementary Planning Guidance Note" also discusses Merton's "Sustainability Checklist," a chart of 20 categories used to measure the sustainability of new developments. The checklist is a two-part document, including both a pre-application checklist for developers applying for planning permissions and a final checklist for assessing completed building applications. The Final Checklist has specific guidelines grouped by category to determine the sustainability rating the building application will receive, while the pre-application list instead offers space for developers to describe the sustainable practices they plan to use. These checklists provide a useful analytic tool for progress assessment.

Several London Boroughs, among them Brent and Enfield, have created guides on sustainable construction for the building professionals in their communities. These guides serve a useful role in bridging the gap between the goals of London and its Boroughs and their current situations. By providing resources on sustainability to the construction community, the Boroughs intend to encourage the adoption of sustainable development practices. Merton has proposed the production of a new set of "mini-guides" on a range of topics, rather than designing one large guide aimed at a broad cross-section of sustainable practices.

## 2.4 – Current Sustainability Application

### 2.4.1 – Beddington Zero Energy Development.

Beddington Zero (Fossil) Energy Development (BedZED) is a sustainable, high-profile development that implemented many of the newest sustainable techniques available at the time of its conception. It is located in the London Borough of Sutton, and contains 100 properties for sale or rent as well as daycare facilities and green space for residents. The project is named after its biggest selling point: the development uses no fossil fuel based energy. The entire complex is heated by a central furnace that operates off sustainable recycled biomass, and conserves a huge amount of energy with passive solar, super-insulation in walls, and insulating windows. A huge amount of effort went into making the development as sustainable as possible, and many of the techniques used actually resulted in a cost savings compared to traditional methods. They sourced nearly 60% of their materials from suppliers within 35 miles, saving thousands of tons of $CO_2$ from being released into the air due to shipping, and they used recycled or reclaimed building materials whenever they were feasible (in certain cases stringent construction standards, sourcing problems, or extremely cost-prohibitive price quotes made the more sustainable materials impractical or impossible to acquire or use). Not only was a viable sustainable development complex created, but the information on the sustainable techniques used in BedZED's development has also been extremely valuable in determining the feasibility of sustainable development techniques, their benefits, and barriers to their use.

### *2.4.2 – Gallions Ecopark.*

The Gallions Ecopark is a 39-unit housing development in Thamesmead in the London Borough of Greenwich. It utilizes many sustainable development techniques; passive and active solar design are most prominent, but it also includes use of sustainable materials, renewable energy, and water conservation. The Ecopark was designed to show the economic and physical feasibility of implementing a large number of sustainable development techniques, as well as the benefits derived from the interaction of those techniques. The Ecopark also aimed to obtain an "excellent" rating from the Building Research Establishment (BRE) Ecohomes rating system. The BRE Ecohomes rating system is becoming widely accepted and adopted for rating the environmental impact and soundness of construction.

The Ecopark development implemented multiple active and passive solar techniques, including solar water heaters, which are solar collectors on the roofs of the buildings that preheat water before sending it to a hot water cylinder, saving energy. It also implements sun spaces and advanced glazing, both of which are passive solar techniques. The Ecopark does not just implement solar techniques, however; it also used sustainable lumber in building the park, as well as improved performance insulation, energy efficient light bulbs, and water saving techniques such as spray taps, which can reduce water output by up to 50% without reducing efficiency.

### *2.4.3 – Asia Urbs.*

The Asia Urbs Program is a venture run by the European Commission designed to fund and facilitate cooperation between cities in Asia and the European Union (EU). The program's focus is on "technical and economic co-operation, capacity building, partnership development, good governance, and poverty alleviation," with a heavy emphasis on sustainable development (European Communities, 2002).

Merton Council's involvement in Asia Urbs is through the project "Sustainable building design: Strengthening capacities for planning and implementation". This project originated in the Gurgaon district in Haryana, India, through the Delhi based Tata Energy Research Institute (TERI). The project is a three-country partnership involving Merton Council, TERI-Europe, and Renewable Energy in the Urban Landscape (RENUE) in the UK, TERI and the Haryana State Energy Development Agency (HSEDA) in India, and the Institut Catalá d'Energia (ICAEN) in Spain.

The goal of the project is to improve the urban environment of Gurgaon by enhancing the economic regeneration and community development through the promotion of sustainable development and renewable energy technologies. Merton Council's main role in the project is in providing TERI with informational packages, such as mini-guides and websites, and in providing the benefit of their experience in sustainable building design. The other project partners' contributions are primarily in implementing renewable energy sustainable buildings in Gurgaon, India.

## 2.5 – Current Merton Sustainable Development Resources

### 2.5.1 – Planning permission.

Before any construction can take place in the Borough of Merton, the contractor must seek planning permission from the Merton Council Development Control. Because developers require planning permission, Development Control is in the best position to enforce sustainable development as a standard; they can influence builders and developers into using sustainable practices by making it a prerequisite for planning permission.

### 2.5.2 – Checklist.

The Checklist is the more specific implementation of the UDP: it actually consists of two checklists, a self grading general checklist on sustainability that is completed before a building professional applies for planning permission, and a much more specific checklist used to actually determine the sustainability and amount of sustainable practices being used. Both have a number of categories, with specific guidelines that allow easy determination and grading of the sustainability. These checklists are the Borough's most useful tool in both determining sustainability of a project and providing this information in an easy and qualitatively useful way to those who can use it best, specifically Developmental Services.

### 2.5.3 – Unitary Development Plan.

The UDP is the current policy guidebook for Merton, providing much of the current guidance for what course any project should take. It contains both broad general recommendations along the lines of "promote such projects that seek to further sustainability while resisting those projects which are unsustainable," and more specific topic and subject based guidelines. While a helpful document, and providing good guidance on the direction Merton should go, it lacks the specificity to make decisions on what is and isn't sustainable easy, and thus loses some of its power on implementation, especially when the broader statements can be debated.

### 2.5.4 – Supplementary Guidance Note on Sustainable Development.

The Supplementary Guidance Note on Sustainable Development provides information on sustainable development topics in relation to UDP policy ST.1a. The guidance note describes the different sustainable development issues, explains what each of them are, and discusses some of the other pertinent Merton policies. However, it does not provide information on specific techniques in the sustainable development topic. The Supplementary Guidance Note is a good step towards educating the borough on sustainable development topics, but it does not go into enough depth regarding how the topics can be applied and why to apply them.

### 2.5.5 – Householder's guide.

The householder's guide is a booklet containing the Sustainability Checklist and then a guide providing information on how to meet the specific goals of the checklist and increase ones rating in relation to sustainability. It contains specific information on every topic and how to implement these sustainable practices. That information is mainly targeted at individual householders, and is created to be pertinent to them. This book is still in the approval phase and has not yet been released to the public.

## 2.6 – Topics in Sustainable Development

### 2.6.1 – Passive solar design.

One of the many facets of sustainable development is passive solar design. Passive solar design is defined by the Green Building Program as

> the use of the sun's energy for the heating and cooling of living spaces. In this approach, the building itself or some element of it takes advantage of natural energy characteristics in materials and air created by exposure to the sun. Passive systems are simple, have few moving parts, and require minimal maintenance and require no mechanical systems. (Sustainable Sources, 2003)

In a similar vein, the Northeast Sustainable Energy Association defines Passive Solar Design as "providing cooling and heating to keep the home comfortable without the use of mechanical equipment. This style of construction results in homes that respond to the environment" (Northeast Sustainable Energy Association, 2000). Examples of Passive solar design techniques include optimal building orientation, thermal glazing on windows, and the use of "thermal mass," or materials which store and release solar energy.

### 2.6.2 – Sustainable building materials.

Sustainable building materials are those materials that are harvested, used, and can be disposed of in a renewable and environmentally sound manner, as well as those materials used in other areas of Sustainable Development. Sustainable building materials vary from timber harvested in a forest maintained and developed for harvest where non-sustainable practices, such as clear cutting, are not employed, to bricks and stone used as thermal mass in conjunction with utilizing solar energy.

These materials vary from those that address reusability and recyclability to those that are non-toxic or less toxic than traditional materials. The topic also covers the use of those materials with a long life span and those that are biodegradable. Materials that reduce energy consumption or limit the waste products from the construction process are also a part of sustainable building materials.

### *2.6.3 – Renewable energy sources.*

Another facet of sustainable development is renewable energy. Renewable energy is the use of relatively unlimited resources to generate power or to provide heat. Some sources that fall into the category of renewable energy include biomass energy, geothermal, hydrogen and fuel cells, hydropower, and wind.

Bioenergy uses "renewable biomass resources to produce an array of energy related products including electricity, liquid, solid, and gaseous fuels, heat, chemicals, and other materials" (US Department of Energy, 2003). Biomass is any organic matter that is available on a renewable basis.

Geothermal energy uses the naturally occurring heat in the earth to produce power or heating for direct use applications. Geothermal techniques include direct use processes, geothermal heat pumps, and electricity production.

A more experimental and still developing method in renewable energy is the use of hydrogen and fuel cells, which utilize the molecular and chemical properties of various materials to generate power. Hydrogen and other types of fuel cells would be versatile and the power that they generate could be applied in a wide variety of areas, from powering a car to heating a building and producing electricity.

Hydropower, also called hydroelectric power produces energy in several ways. The most common of these are impoundment, diversion, and pumped storage.

With a historical background stretching back for ages, harnessing the power of the wind is hardly a new concept. Wind has been harnessed through ancient windmills to grind grain and in the modern day it has become a resource for the generation of power or as a means for pumping water. Techniques to harvest its power vary from a single turbines used by private landowners to fields of modern windmills on wind farms used as a means of providing power for a regional grid.

#### *2.6.4 – Sustainable urban drainage systems.*

Sustainable urban drainage systems (SUDS) are structures built to deal with surface run off in the urban environment. The goal is to minimize the amount of time that water will spend in a run off situation. Techniques to do this vary, but they include swales, filter strips, permeable surfaces, infiltration areas, and basins, ponds and wetlands.

Swales allow for water and run off to enter the drainage system in a situation where it would often not have that opportunity in an expansive area. Additionally, when applied to proper soil conditions swales may allow for direct infiltration of water into the soil.

Filter strips are a piece of land through which surface water run off flows through. The land is often planted with grass or shrubs to improve the filtration of the system and to improve the water quality of the run off water. Filter strips often separate an area of surface run off from a receiving body of water, typically a stream or reservoir.

Permeable surfaces are typically surfaces that allow rainwater and runoff to pass through the surface layer to an area that can collect the water. The water is filtered as it passes through the surface. Some permeable surface options are gravel or hard but permeable surfaces for parking lots or driveways.

Infiltration areas may include an open expanse of land where soil conditions are conducive to accepting large amounts of water. The infiltration devices also provide filtration as the water is absorbed and accumulated.

Basins, ponds, and wetlands provide an area of collection for drainage techniques that accept run off but have no place to store it. Pipes coming from other drainage elements that require a place to send the water from a rainfall event feed these basins, ponds, and wetlands.

# 3. Methods

The goal of this project was to develop a system to educate people involved in all areas of development, from members of the Merton Council involved at the development control level, to developers presenting proposals for planning permission and homeowners examining possibilities for remodeling their properties on various aspects of sustainable development. Through research and designs developed by an earlier project team, a basic form for the mini-guides was established and then revised and improved upon, incorporating feedback on the best way to present the information.

After establishing the form and style and finally composing the guides, they were subjected to a multi-stage review and feedback process. Through interviews, discussions, and surveys the guides were refined to present the information to the target audience in the best way possible.

In conjunction with the guide development, the group created a website to convey the information presented in the guides through a different medium. The development of both the mini-guides and the website required research in various forms, such as surveys and interviews, to be successful in developing a product to meet the needs of the Merton Council and the community at large.

## *3.1 – Data Collection*

The first step in constructing the mini-guides was to gather information on the subject matter. While there was a very broad scope of information to cover at the outset, this scope narrowed as the project sponsors provided more information on specific topics and conclusions were reached on the direction and target audience of the guides. This led to a new direction in research: finding the best form and method of presenting and organizing both the content and layout of the guides. Interviews with construction professionals in the United States trying to identify the most persuasive form and content for the guides provided most of the data collected before arrival at the project site.

At the project site, lengthy discussion with the project sponsors and review of the work done by an earlier project showed that the direction the work would take distinctly differed from initial expectations. Efforts shifted to using the earlier project's research and review feedback in addition to the information already gathered to revise the existing guide layout. This complete, specific topic research to acquire the necessary content for the new guides began. This research was done using three distinct media: Internet sites, literary publications, and interview information.

### *3.1.1 – Internet research.*

Internet sites were the most used media for research and information, as they are the easiest to find and the most accessible. Many are also organized well enough to make finding the specific information needed fast and easy. The main problem with websites was the quality of information; often it is difficult to tell how accurate a particular site is or how credible the source of the information is. Thus, some effort must be spent determining the validity of any particular Internet source. Even with that formidable downside, the ease of use and quantity of information available makes Internet sources very appealing.

### *3.1.2 – Literature research.*

Print materials are much harder to find and acquire than Internet sources, as one is limited to the resources a particular library has or can acquire in the necessary timeframe. This made using many published sources unappealing, as it would mean waiting for them to become available, and then gathering the information from them. Publications in fields with advancing technology also have a tendency to become outdated quickly, as newer and better methods frequently become available. Information in these publications on specific topics looked for can often be scattered, leading to a large amount of effort for a relatively small amount of data. In addition, publications with specific information are often only available for purchase through the company that produces them, and thus an added cost, which can sometimes be prohibitively high, can be a factor in acquiring these documents. Even with their downsides, these sources can be very useful. In books, validity or quality of information is seldom a worry, and with the right publications, much more in-depth and useful data may be available than can be found on websites. Therefore, while books may have more significant downsides than Internet research, they also have many important benefits that make them extremely useful.

### *3.1.3 – Interviews.*

Interviews are quite different from Internet or literature sources. The information gathered from those sources is static, while the information obtained in an interview depends greatly on the questions asked, the skill of the interviewer, and the knowledge of the interviewee. An interview guide was established to provide a guideline for the information interviews were intended to collect, this guide was revised as the project scope and goals changed and evolved. Interviews provided the best information relating to the people targeted by the guides, as well as actual experiential information on our topics. A copy of the interview guide can be found in Appendix F.

## 3.2 – Mini-Guide Development

The intent of the mini-guides was to actively persuade building professionals, policy makers, and to a lesser extent homeowners to implement sustainable building practices. There were two separate yet related guides involved in this project. The first and most important guide was an A4 manual, which was the larger and more detailed of the two guides. The A4 manual thoroughly addressed specific sustainable development practices using text, pictures, and tables. The manual also provided case studies and the life cycle cost analyses for each type of sustainable technique. The brochure was a single paged introduction to a topic in sustainable development and addressed the concepts and benefits in a very general overview. Its goal was to get the reader to look for more in-depth information on the subject matter. As both were based of off similar content, they could be updated at the same time, simplifying the logistics of maintaining the guides.

### 3.2.1 – Guide layout.

To maintain a degree of uniformity between the two sets of guides, a general layout idea was extracted from the three existing guides. The layout concept was then revised and restructured using information collected from earlier interviews and survey data. This modified layout was made up of a main topic, a brief introduction to that topic, and detailed explanations of the subtopics; these included the "what, how, and why," as well as specific case studies and life cycle cost analysis.

### *3.2.2 – The A4 guide.*

The A4 manual mini guide was developed based on the work of a previous group. Their research established a solid basis for the development of this guide type. The A4 manual addressed specific sustainable development practices using text in conjunction with pictures and tables. The manual also provided case studies, and when available the life cycle cost analyses for employed techniques. The manual provided sufficient information to educate the reader on the viability of the sustainable development techniques. The guide was set up as an independent document with a table of contents, references, and contact information. The A4 guides were completed using the Microsoft Word manual template.

### *3.2.3 – The brochure.*

The brochure consisted of a single A4 sized paper folded three times to present six faces of information. The purpose the brochure was to bring attention to the subject matter and to highlight the key benefits of the topic. It was meant as promotional tool and therefore the brochure relied heavily on graphics, lists, and other visually appealing techniques. Because the brochure was essentially an abstract of the A4's highlights, the brochure was written after the A4 guide was completed, and was created using the Microsoft Word brochure template.

## *3.3 – Mini-Guide Website Development*

Initial research and interviews illustrated a number of advantages that could be gained by publishing the mini-guides as a website. The most significant of these advantages was the excellent distribution potential provided by the Web. Whereas a paper booklet must be printed and physically delivered to a potential reader, a website can be delivered to readers by simply telling them the website's Internet address. Access to this information then requires the use of an Internet-connected computer, but the widespread availability of Internet access minimizes the impact of this consideration. Furthermore, public websites can be found easily with the use of free, popular Web search engines. This may increase the number of readers of the mini-guides, as those who would not otherwise know about the guides will be able to find them when searching for sustainable development material. Reduced distribution cost may further increase availability. Printing paper booklets and mailing or delivering them to readers can incur significant cost; the practical implication of this may be a more limited distribution of the mini-guides than is ideal. The cost of delivering a website electronically to viewers, however, is typically very low, allowing increased distribution.

Another important advantage of Web publishing is the increased ease of modifying, adding, or updating information. Updating a print publication requires printing new copies and delivering them to users of the older copies. This makes any unused older copies obsolete; these may need to be thrown away. A website, however, incurs no additional distribution cost when updated. All users of the website immediately have access to the new information, so no users are stuck with obsolete material. These advantages may be especially important when the information to be presented requires frequent updates; the mini-guides likely fall into this category, as new technologies and legislation make sustainable development a rapidly changing field.

The advantages of presenting the content on the web were significant enough to warrant producing a Web version of the mini-guides. This website was intended to act as a complement to the paper guides. While it would present the same content as would be presented in the mini-guides, the content would be adapted as necessary to comply with best practice in Web usability.

### *3.3.1 – Research and planning.*

The first step in developing the website was to do background research and site planning. Research into how the site would be used was necessary, as planned usage heavily influenced the design goals. Information on the Merton Council website and discussions with Merton staff provided much of this information. Additional research into Web usability provided a solid base of design principles to employ, and ideas for structuring the site content in an effective manner were acquired from research into *information architecture*. Evaluation of the current Merton Council website and discussion with the Merton Council Web Team provided information on how to make the mini-guide site maintainable and how mini-guide pages could fit in with the Council's Web content.

This initial research complete, an overall site goal and a list of design goals were written. These goals helped to focus planning efforts and provided a basis for the decisions made during the rest of the site design process. Taking into account these goals, several overall possibilities for the site's design were identified and recorded. Layout sketches were drawn up until a satisfactory prototype layout was found for each of the design possibilities.

### *3.3.2 – Website prototyping.*

The first stage of the website construction was to build prototypes for each of the identified design possibilities, as prototypes would facilitate an effective benefit analysis on each alternative. The prototypes were constructed by writing the code manually and tested in a variety of web browsers. The prototypes were written in XHTML and Cascading Style Sheets (CSS); these technologies allowed rapid site development and easy modifications. Several excellent online resources on web design provided useful design techniques, information on XHTML and

CSS, and lists of web browser bugs. To allow prototyping to begin before the mini-guides were written, filler was used in place of real content at this stage.

### *3.3.3 – Design analysis.*

Once the prototypes were complete, a benefit analysis for each possible design was prepared. The prototypes and this analysis were discussed with the Merton Council Web Team and Mr. Richard Ainsley to get their feedback and settle on a design. After some consideration it was decided that the mini-guide Web pages were to be built into the Merton Council website and integrated fully with the existing Merton site design.

Because the mini-guide pages were now a planned part of the Council website, some additional analysis of the existing Merton site was conducted to determine where the guide content would best fit into the website's structure. This process revealed significant structural problems in the Merton site that interfered with a number of the mini-guide Web design goals. This problem was of sufficient importance that a decision was made to work on fixing it before continuing with the construction of the mini-guide Web pages. To address these structural shortcomings a new organizational webpage was added to the Merton site.

### *3.3.4 – Website construction.*

Discussions with the Web Team, Richard Ainsley, and the Environmental Services personnel responsible for managing Web content provided information on how the Merton website was managed and maintained. Following those discussions, additional research was conducted to discover what specific content needed restructuring. From this research an outline was developed indicating the way in which the specific content would be presented in the new webpage, as well as detailing the actual content to be included.

After presenting the content outline to officers in the Merton Council for review, the text of the webpage was written. The organizational webpage was written using the same software tools that the Merton web team uses and by applying the Merton website design. Because the same tools and techniques were used in the webpage's creation, the page would be easy to maintain by the responsible authority and would be simple to integrate into the Council's existing web structure. Once the website structure was complete, the text was inserted into the webpage. This process was used to both creating the mini-guide webpages and the Sustainable Development webpage. The content of the page was adapted from the paper guides and revised to conform to web usability guidelines.

## *3.4 – Review Process*

After the first drafts of the guides were completed, they were subject to a multistage review process. Because the guides were researched and written by individual group members, it was necessary to begin the feedback process by conducting a group review of the guides. After incorporating the recommendations from the group review process, the guides were given to project sponsors Mr. Steve Cardis and Mr. Richard Ainsley for their review. After addressing the critiques and comments that the sponsors had for the guides, the mini-guides were exposed to an internal council review. At this point the guides were given to various members of the Merton council working within the Environmental Services branch. This included people who had interest in the guides as well as members of development control, who are responsible for reviewing proposals for compliance with Merton's sustainable development policies. After responding to their feedback and revising the guides accordingly, the guides were moved to the external review and feedback phase. This portion of the review process involved people who were not affiliated with the Merton Council, such as contractors and developers in the Merton area and representatives from the various groups affiliated with the Asia Urbs project.

### *3.4.1 – Group review.*

Once all the guides were written, each guide was reviewed by all members of the group and subject to revision. The revision addressed grammar and writing style as well as depth of guide content and the material presentation. This review process was critical because it was necessary to ensure that all the guides being created were of a similar caliber and presented the material in a common cohesive manner. Review was conducted by having each member of the group read the guides and make comments on them, and then convening to discuss potential changes and address areas of confusion.

### *3.4.2 – Sponsor review.*

After completing the revisions of the mini-guides, the draft guides were presented for review to the project sponsors, Mr. Steve Cardis and Mr. Richard Ainsley. Both Mr. Cardis and Mr. Ainsley work in the Plans and Projects section of the Merton Council. Because they directed the project it was necessary that the guides be acceptable to them before they were subjected to the next level of review. This review process was conducted by holding a personal discussion to obtain feedback and recommendations on the draft guides.

### *3.4.3 – Merton internal review.*

It is the responsibility of the Merton Council to regulate development in the Borough, and part of that regulatory process is assessing the sustainability of planned developments. Because of this one of the goals of the mini-guides was to educate the members of the council on the aspects of sustainable development relevant to the policies set forth by the UDP. To this end, the Council needed to be aware of what information was being presented to developers and how that information was relevant to the planning process. The Development Control officers who are responsible for addressing the various aspects of a proposal for planning permission were the Council staff most heavily involved in the planning process.

To obtain feedback from this group a survey was developed and implemented in conjunction with interviews. The goal of the survey was to obtain concise responses and specific information on target areas identified as concerns during earlier review stages. The interviews were intended to get more in-depth responses on similar concerns as well as to explore areas of confusion in the guides that were not addressed in the survey. The survey form can be found in Appendix C, a list of those officials who were interviewed or surveyed can be found in Appendix D, the interview transcripts can be found in Appendix G, and the interview guide can be found in Appendix F.

### *3.4.4 – External review.*

The fourth feedback stage in this process involved obtaining reactions and responses from experts and officials outside the council. After completing the council review, it was necessary to present the guides to the eventual end users and obtain their criticism and critique. Additionally members of the Asia Urbs project were needed to provide their analysis and comments on draft guides. However, because of time constraints, this stage could not be completed in the time allowed for the project. Rather then forego the stage, a guideline for implementing an external review was developed and presented to the Borough of Merton. This guideline contained a modified survey and a series of form letters asking for participation, explaining the purpose and scope of the project, and a request for a follow up interview. The guideline also included comments on data collected during earlier reviews and trends that had been identified and might be apparent in an external review. A copy of this guideline can be found in Appendix H.

# 4. Results and Analysis

Through initial research and review processes, useful data pertaining to mini-guide form and content was obtained. Information was acquired for mini-guide content in areas of technical explanation, reasons for use, and implementation feasibility in the Borough of Merton. Information on web development was obtained and utilized in the website planning and design. During the review process, information was gathered regarding the guide layout and the presentation of content, as well as other content areas to be addressed. In order to provide sound information, the data had to be analyzed for relevance and application, and examined to provide a consensus from which to work. The analysis of this data led us to a series of conclusions on the feasibility of implementing the mini-guide topics. This can be seen in the final form of the guides as well as in the Conclusions and Recommendations section of this report.

## *4.1 – Mini-Guide Layout*

The layout process was the first step in the inception of the guides. Designing how the information in the guides would be presented was critical as a poor layout can hide information and confuse the reader, as well as adversely affect the usability of the guide. Drastically different layouts were required for the A4 Manual and the Brochure guides, as the A4 Manual requires a design to present the details on implementation techniques in a concise yet usable manner, while the Brochure was designed for appearances and to inspire the reader's interest in the topic.

### 4.1.1 – A4 manual layout.

The initial layout and design for the mini-guides was derived from the previous project team's layout, and was then revised based on their external review and preliminary research. Each mini-guide began with an introduction covering what the guide was about, why the guide was useful, and what the guide contained. It is then broken up into multiple sections each covering a single major sustainable concept.

Each section is then divided up into sub-sections. The first sub-section introduces the major topic of that section, covers general information about the topic as well as reasons to use the techniques described in the section. The following sub-sections each address a single specific method for implementing the sustainable concept in the section. These sub-sections include information on what the method is, how to implement it, and why it is more beneficial than the traditional methods. The section is concluded with a final sub-section covering the feasibility of implementing the technique in the Borough of Merton. After all of the technique sections, a final section covering other relevant information concludes the guide. This section contains information on grants, case studies, related links, and references.

Graphics were found to be very helpful, as they break up long blocks of text, provide useful data in a different format, and are visually appealing. Graphics, where relevant, were included in all parts of the guides, most often in specific sub-sections providing a visual explanation of a particular method.

There are a large number of sustainable materials, which made it unrealistic to try to cover specific methods in the standard guide format, which is why this guide's layout was changed. A number of sub-topics of sustainable materials dealing with the methods of sustainable material selection and creation were used, instead of a section/sub-section layout.

This layout works more efficiently than trying to divide up topics arbitrarily into sections, and instead groups them all together under sustainable development.

The SUDS mini-guide varies from the standard mini-guide layout in that there is very little information on individual methods, as they are generally combined in different ways to form a system. Due to that, most of the cost benefits and feasibility analysis as well as case studies are for Sustainable Drainage Systems as a whole, and are not included in the individual subsections.

### *4.1.2 – Brochure layout.*

The brochure was designed to briefly convey the major points of the A4 Manual. The goal of this was to draw the reader in and to make them seek out additional information on the subject. To this end the brochure contains many of the graphics presented in the A4 manual as well as short statements and bulleted lists covering the key issues and techniques of the guide subject.

## *4.2 – Mini-Guide Content Overview*

The mini-guides present educational information on the proposed techniques and the feasibility of their implementation. The educational information describes the important issues related to each of the proposed techniques and establishes a working knowledge of their implementation. Reasons to implement these techniques cover environmental and economic factors, as well as adapting to Merton UDP policies. The feasibility content in the guides covered whether the proposed techniques discussed were feasible for implementation in Merton.

The passive solar design mini-guide was divided into three sections: the introduction, external building layout, and internal building layout. The introduction explained to the reader what the practice of passive solar design is, what the guide covered, and what the reasons are for using passive solar design. These reasons were divided into sections and covered the reduction in maintenance and operating costs, improvement to the quality of life, and benefit to the environment. The external building layout section began with an explanation as to what the topic is, how it can be implemented, and why it should be used to help in passive solar designs. The section then addressed three subtopics: wind blocking methods, shading, and natural lighting. The internal building layout section also began with a brief explanation as to what the topic is, how it can be implemented, and why it should be used in buildings. The section included subtopics on building orientation, conservatories and thermal buffering, thermal mass, and color co-ordination. Each of these subsections included an explanation of the specific topic, ways in which it can be implemented, and reasons for its use.

The sustainable materials mini-guide contained information on the general concepts behind what makes a material sustainable. The guide first addressed the way in which materials are acquired. Long distance shipping can cost more and release more pollutants compared to sourcing a material locally. Simply finding local suppliers from which to obtain materials can significantly reduce the development's impact, and generally will not cost any more than sourcing from traditional suppliers. The guide then addressed the way that the materials are created. The guide covered how much energy the production takes and what harmful materials are used to produce them or result from their production. All of these points must be taken into account when examining the production of a material. Sustainable materials should have a low energy cost, a minimal amount of pollution produced, and do not contain harmful materials, environmentally or otherwise. The guide finally addressed how the necessary resources are acquired to make the materials or products being used. Using lumber obtained from a well managed, sustainable forest makes a major ecological difference, as does using aggregate or other materials that are recycled from demolished sites. Sometimes, materials that have been reclaimed from other sites are available as well, reducing the processing costs and environmental factors significantly.

The renewable energy sources mini-guide covered four distinct types of sustainable energy: geothermal, biomass, wind, and hydrogen fuel cell. Each section explained the basic concept of each topic and then addressed how the energy source can be used. Each section also addressed the feasibility of implementing the energy source in Merton.

The geothermal section of the guide defined geothermal energy and addressed common forms of application, power plants, and ground source heat pumps. It also addressed current research and how geothermal energy might be used in Merton. The biomass section also defined biomass and explained how it can be used. The section explained the different types of biomass and the different mechanisms for implementing biomass energy as a viable energy source. The hydrogen and fuel cell energy section explained the principles of fuel cells and how they can be used as an energy source. The section also included explanations of various types of fuel cells, addressing how each one operates and the advantages and disadvantages to each fuel cell type. The wind section of the renewable energy sources guide explained how wind energy is harvested and the minimum requirements needed to make wind energy efficient.

The Sustainable Urban Drainage Systems (SUDS) mini-guide was split into two sections, one on attenuation, and one on filtration and purification. The attenuation section covered various ways of slowing down and/or redirecting flows during rainfall events. Pervious surfaces are one method; they allow water to flow through them and either infiltrate back into the ground or be redirected to another drainage system. This occurs slower and over a longer course of time than traditional drainage, depending on the particular method and needs of the site. Swales are also an attenuation technique; they are wide, relatively shallow ditch-like indentations filled with a thick grass which both absorbs water and slows down the flow compared to standard ditches or other runoff direction techniques. Reducing flow is important, as it reduces the amount of water released into watercourses after a rainfall; release of too much water over a short period leads to damage to watercourse ecology, as well as possible flooding downstream. Filtration and Purification use natural methods to clean water runoff so that it can be put back into a watercourse without polluting it. Various types of collecting pools and swamps can be implemented, using biological methods to purify the water over time. They also serve as a place for water to collect and release slowly, so they have a secondary attenuation effect as well. Because purification happens on site, a less intensive sewer requirement is needed, if one is needed at all.

## *4.3 – Implementation Feasibility Overview*

One of the key issues that the guides had to address was the feasibility of applying the techniques presented in the guide. The guides had to consider the requirements of each technique and examine both general and Merton specific implementation criteria.

Passive solar design works best when it is incorporated into a building's design from the initial blueprints. In Merton, there are many buildings in development that could greatly benefit from any of the passive solar design techniques described in the guide. External building layout requires carefully evaluation so that wind blocking, shading, and natural lighting techniques can be implemented in the most efficient manner. The internal building layout techniques must be incorporated into the earliest designs of a new building to be effective; incorporating these techniques at a later stage requires extensive, highly expensive interior remodeling. All passive solar design techniques require ready access to sunlight. A building in a shaded area will obtain little benefit from passive solar design.

Using sustainable materials is often very technically feasible, and because of this, they are commonly used. Often they can be cheaper than conventional materials, even after sourcing and other costs are taken into consideration. Depending on the material, they can be more difficult to implement, but the cost savings of the materials often offsets this. While the savings can be significant, they are seldom large enough to make a compelling argument for change or encourage effort and money be put into learning new techniques.

The renewable energy sources addressed all require the utilization of some additional situation. For geothermal energy, the heat must be relatively accessible from the surface, and not too deep, or the cost of drilling to it may become prohibitive. Biomass requires that the material be easily available to the consumer. Fuel cells require that hydrogen, in varying purities, be available and any material that may be required to replenish spent electrolyte be on hand to ensure smooth running. Wind requires a steady flow and an adequate average speed.

SUDS are very feasible and are implemented in many sites around the UK today. The main implementation issue is the engineering aspect: determining what type of system should be used and the specifications needed to deal with any amount of rainfall. This, however, is becoming easier as more people become familiar with SUDS. Additionally, software is being released that can handle the engineering issues.

## 4.4 – Developed Mini-Guides

### 4.4.1 – Passive Solar Design.

See Appendix M

### 4.4.2 – Sustainable Materials.

See Appendix N

### 4.4.3 – Renewable Energy Sources.

See Appendix O

### 4.4.4 – Sustainable Urban Drainage Systems.

See Appendix P

## 4.5 – Website Development

Research into usability resulted in the drafting of a concise set of Web usability guidelines. These guidelines were an aggregation of the most important points made in several high quality usability resources, and were meant to be used when building the mini-guides website. The guidelines can be found in Appendix J.

A clear site goal was drafted to provide direction to the Web development process. This goal identified the project purpose, target audience, and content. The site goal was:

Provide information on selected topics in sustainable development to Merton officials, developers, architects, and contractors. The informational content will be taken from the sustainable development mini-guides. The site should serve as a both an informational resource and a tool for marketing sustainable development.

Secondarily, provide assistance to Asia Urbs partners in Delhi, India in creating a similar website for the Delhi area.

The selected topics for the site are: Renewable Energy, Sustainable Urban Drainage Systems, Passive Solar Design, Sustainable Materials, Life Cycle Cost Analysis, Solar Power, and Water Conservation.

A list of design goals was written to expand upon and reinforce the site goal. These design goals were concise, bulleted-list statements to consider when making design decisions. The design goals were:

- Usability
- Ease of navigation
- Draw readers in (marketing)
- Provide a concise, compelling case for specific design principles
- Readability
- Compatibility with web standards
- Ease of maintenance
- Credibility
- Widespread access

Several possibilities were identified for the website's design. First, it could be built as a standalone site using layout and design optimal for presenting the mini-guide content. Second, it could be built into the Merton Council website, using the same layout and design constraints used in the rest of that site. Finally, the site could be built into the Merton Council website but with a compromise between the layout and design constraints used in that site and the layout and design identified as optimal for the mini-guide content.

An evaluation of each possibility was conducted using prototypes built for the three scenarios. The third possibility was ruled out by the Web Team, as it violated their need to maintain a consistent design and layout throughout the Merton Council website. One of the advantages of the standalone site possibility was that it allowed proper use *web standards*; a summary of the benefits of standards-compliant design was included as part of the evaluation, and can be found in Appendix K. The evaluation results for the remaining two possibilities were:

If the site is not part of Merton's website, then:

- Maintenance cannot be done by the Merton Council Web Team
- Someone with technical knowledge would need to update the website when needed
- The site cannot be hosted on the Merton Council web server
- Hosting must be arranged. Approx. cost: £5/month?
- Domain name must be purchased. Approx. cost: ?
- The site can employ standards-compliant design.
- The site can be designed to fulfill each of the design goals and adhere to the usability guidelines

- If the site is part of Merton's website:

- The site can be maintained with the new Content Management System
- Site must adhere to the Merton Council website design constraints
- This may negatively impact usability and effectiveness
- Unrelated navigational elements on the Merton Council website will make site navigation confusing
- The available content area is small
- The Merton Council website is not structured to make finding sustainable development material easy.
- Site will not be easily reusable by Merton's Asia Urbs partner
- Merton Council website visitors may more easily find the mini-guide content.

Discussions with the Merton Council Web Team and Mr. Richard Ainsley indicated that integration with the new Content Management System was the highest priority, and additionally that not hosting the site on the Merton Council Web server was a significant disadvantage. The second possibility – building the mini-guide content into the Merton Council website – was therefore identified as the preferable design choice.

Research into the current Merton Web site structure and organization was conducted in order to ensure that the mini-guide webpages would be found by developers visiting the site. This investigation revealed two significant structural problems. First, the sustainable development content on the Merton Web site is not organized in a *user-centric* manner. Second, the Web pages of many different Environmental Services departments present related information, but they do not link to each other.

User-centric structure organizes content into related chunks based on the information that is relevant to visiting site users. This means that visitors to the site can quickly and easily find the information that they care about, leading to increased exposure for the Web content. The Merton Web site employs some user-centric practices, like organizing the entire site's content into sections like "Living," "Working," and "Learning," but it falls short when it comes to much of the important content, such as the Merton sustainable development materials. This is because the site is largely organized by department; each department independently posts their sustainability materials to the website, and they is little collaboration to present related information in one convenient place.

This problem is compounded by the lack of links between departmental pages. An excellent example of this problem can been seen in the Plans and Projects and the Planning and Building Control Web pages. These two web pages, maintained by Plans and Projects and Development Control, respectively, contain sustainable development and planning content that is clearly related. Neither page links to the other, however, so users may never find important pages on the site. If the pages linked to each other, site visitors who found either page would know to look at the other department's material as well; this should be important to Merton as they try to increase developer exposure to sustainability information.

Since these problems could seriously impact the exposure of the mini-guide Web pages, a decision was made to produce an organizational solution to the issues. This solution took the form of a user-centric webpage referencing and explaining the sustainable development material on the Merton Web site, designed specifically for Merton developers. This solved both problems neatly; it provided developers with a structural model of the Web site designed for their needs, and it linked between the related departmental pages, helping developers navigate through the content currently on the site.

The finished page, titled "Developer's Guide to Sustainable Planning," presented information on the advantages of using sustainable development, Merton Council planning policy addressing the use of sustainable practices, links to Development Control and Plans and Projects pages for more related information, links to the SPG on Sustainable Development, Sustainability Checklist, and Mini-Guide Web pages, and references to other related Merton Web site resources at the end. The information on the advantages of using sustainable development was placed on a secondary page linked to from the Developer's Guide to Sustainable Planning; it presented the bulleted list of benefits from chapter five of the SPG on Sustainable Development. Likewise, the introduction to planning policy addressing sustainable practices was also placed on a separate page; the page's text was written from UDP and SPG research on the policies Steve Cardis indicated as especially relevant.

Once these pages were complete, the mini-guide Web pages were created. The text and illustrative pictures from the A4-sized mini-guides were used as the content of the Web pages. The pages were designed to comply with best practice in Web usability where possible; the pages were broken up into manageable chunks, and headings were used judiciously. Unfortunately, it was not practical to significantly alter the guide content for better Web usability, because this would make updating the guides difficult, impeding proper maintenance. For example, rewriting the content to be more concise, as usability guidelines suggest, would mean that future content updates and revisions to the guides would require separate, rewritten updates for the Web site; the extra time this requires would discourage frequent updates of the guides.

While the mini-guide Web pages were not able to take full advantage of web usability practices, they still did provide content in a form suitable for effective distribution and easy updates. PDF versions of the mini-guides were additionally made available for download, allowing those readers who prefer printed versions to make their own hard copies of the guides. The final Web products produced for Merton provided a structured, user-centric introduction to the Council's sustainable development information along with specific, accessible guidance on seven pertinent sustainability topics.

## *4.6 – Group Review*

The group review stage involved members of the group reading and revising the guides. The goal of this process was to obtain feedback at the group level about the depth of content and the continuity of content presentation, as well as to edit the guides for grammar and writing style. The comments obtained during this process led to grammar correction as well as to increased depth in content and improvements in content presentation. These revision topics covered include:

- Address the benefits of each topic
- Provide more depth of content
- Remove spurious sections that are not applicable in Merton
- Include explanation of feasibility for each section
- Correct grammar issues

The first revision of the guides addressed issues that had been overlooked by the group member responsible for writing each guide, as well as improvements to clarity and writing style. Additionally, the group review provided the opportunity for each group member to become familiar with the content addressed in each guide. It gave a better understanding of the depth of information that was available in the guides. The review also provided a chance to ensure that the guides maintained a similar format to ensure continuity between the guides.

## 4.7 – Sponsor Review

The sponsor review was critical in providing initial feedback on guide content and orientation. It involved providing the project sponsors, Mr. Steve Cardis and Mr. Richard Ainsley with current copies of the guide content. The sponsors then read the guides and made comments on the material contained in the guide, particularly examining the guide techniques for feasibility in Merton and addressing the relevance of several of the techniques covered in the guides. The review also addressed content holes, where compelling material or specific issues that would be relevant to the guide material was not addressed. These review also provided information on other issues that needed to be addressed in the guides that would make them relevant to the Borough of Merton. The sponsor comments included:

- Include graphics to augment descriptions
- Refer to other guides such as Life Cycle Cost Analysis
- Provide examples
- Refer to relevant Merton policy

- Provide local references
- Provide more depth of content
- Remove extensive sections on points that are not relevant or compelling
- Expand discussion of Merton Feasibility

By incorporating these revisions and suggestions, this sponsor driven revision of the guides provided more depth and more compelling information on the use of the guide topics. The review provided additional information on relevant references that had been overlooked in the initial guide development and the group review. It also offered ways in which to make the guides more compelling and increasingly relevant to the Merton community. The review also covered content presentation and word choice. For example, in the Sustainable Building Materials mini-guide, references were made to sustainable "lumber." In an effort to make the guides conform to the local language, "lumber" was replaced with "timber" because "timber" is the commonly used word in the UK. The sponsor review provided the guides with a very useful revision and established the guides as appropriate and ready to advance further along the review process to the Merton internal review.

## *4.8 – Merton Internal Review*

The internal review and revision process involved providing copies of the mini-guide content and a survey form to various members of the Merton Council. The members of the Council then read and made comments on the guides based on the directed survey questions. They were then asked to be involved in an interview to try to get in depth and more specific information, along with any other information that may have been inadequately addressed in the survey. Analysis of this information led to four main points regarding the mini-guide development:

- Strongly emphasize benefits of sustainable development.
- Ensure references to relevant Merton policy.
- Provide information regarding implementation.
- The guides are credible, accurate and well focused for the target audience.

The first point, emphasizing the benefits of the sustainable development methods over their conventional counterparts, was addressed in nearly all of the interviews and surveys and is considered extremely important for the guides. Specifically, it was often stated that more information on initial cost and buyback time, as well as other life-cycle cost analysis information would be beneficial to the guides. It was an original goal of the guides to provide as much information as possible on these topics. More depth is needed because detailed cost information was not readily available on the relevant guide topics. This is a major issue and one that cannot currently be addressed with the information that is openly available.

Ensuring references to Merton policy was the next primary point that was covered by the interviews. While policy was generally mentioned in the guides, there were some gaps in referencing specific relevant policy. This was taken into account during the revision, and the relevant policies and their descriptions were added to the guides. As new policy is developed by the Borough, the guides should be updated to incorporate those revisions and developments.

Another point referenced during this review process was providing information to building professionals about implementing specific methods. While this would prove to be useful, including names and contact information for individual companies in the guides could lead to issues of propriety where failing to include a set of contact information could be construed as favoritism. Bearing in mind those issues, the guides did not provide specific information in this area.

The last major point drawn from the interviews and surveys was that the guides appeared very credible, the information was accurate, and the information focus was appropriate to our target audience. These points were reassuring in the development process indicating that the guides contained the necessary and proper material.

Numerous small and specific issues were discovered during the internal review process and the issues that could be incorporated in the remaining time were addressed and applied. These included specific topic additions, word changes, and content clarification.

## 4.9 – External Review

A set of guidelines was produced for the Borough of Merton to assist in implementing a review process outside the council. The guidelines contain recommendations on how to proceed with an external review. Some of the recommendations were:

- Participants who have expertise in an area covered by one of the guides should be provided with the matching guide; when a participant's expertise is not relevant to a specific guide, provide them with no more than two guides.

- Attempt to schedule interviews with participants who are likely to have especially important feedback. This should be done in conjunction with the survey.
- Use the recommendations generated from the review to modify, correct and update the mini-guides.

In addition to these guidelines, other documents meant to streamline the external review were produced. These documents include a form letter, a survey, modified from the survey used for the internal review process, and an interview guide, similarly modified from the interview guide used during the internal review process.

## 4.10 – Education and Incentives

In addition to collecting feedback on how to improve the mini-guides, the interviews and surveys resulted in a significant amount of information on how best to use the completed guides and educate Merton about sustainability. The key issues raised were the need for sustainability education, the mini-guides' uses, the importance of case studies, specific cost data, and additional resources, the need for sustainability incentives, including prescriptive Council policy, and the current Development Control plans for sustainability education. The survey results and full transcripts of the interviews are available in Appendixes E, and G.

The need for education on sustainability issues was the reason for creating the mini-guides. The interviews with Merton staff reinforced this point, as the need to provide educational materials for Merton developers and Development Control officers was raised as a common theme. The first of the main reasons for producing these materials was that many developers have poor knowledge of sustainable methods, making the promotion of sustainability in Merton difficult. John Hill, manager of Merton Development Control, said that he'd found that "oftentimes...[developers have] got a vague understanding of sustainable development." He added, "Major developers tend to have a better understanding [than minor developers]," but also noted, "I think even major developers are quite lacking in their knowledge of sustainable principles." Interview participants during the Merton internal review echoed this view, expressing a need for education and the usefulness of the mini-guides to developers.

The second main reason for producing education materials was to provide Development Control with the information they need to "enable them to be able to advise the general public on new developments and extensions," as Development Control officer Francis Saayeng noted. He pointed out that, while the Development Control officers are reasonably educated on sustainable development, the guides give them enough additional, specific information to advise people. Mr. Hill put it similarly when he said, "I think there's a need for training in my offices here. We understand the principles, but we haven't done a lot of the research work."

Most of those who participated in the Merton internal review thought that the mini-guides were well suited to both of these purposes. While areas in need of improvement were highlighted, interview participants indicated that the guides were very useful; Business and Environmental Partnerships Unit (BEPU) officer Nick Smart said, "it's going to be very helpful having these around...I'll be using these guides." The one interview participant who felt that the guides would not be useful was Building Control officer Paul Cannadine; he felt that the mini-guide on passive solar design "lacked credibility" and was "just a taster of the subject." He also noted, however, that he was "interested in data and details that help [him] make decisions," and that "this guide doesn't provide that." This point may explain why he had a very different opinion of the guide than the other interview participants; while most of those interviewed saw the guides as a tool for developer education and a basis for advice, Mr. Cannadine was looking for a source of detailed, practical data. The points he raises are important, but they are not directly relevant to using the guides as an introduction to sustainable development.

One issue raised frequently by interview participants was the need for more specific information on the cost and feasibility of sustainable technologies. This issue had been taken into consideration while researching the guides, but in many cases, specific cost and feasibility information could not be found. As Principal Environmental Officer Adrian Hewitt pointed out, "Basically, the technology is so new, it's only just beginning to happen, so we are still evaluating the financial rationales and the financial feasibility studies." This has resulted in an absence of Merton area case studies for certain sustainable technologies. If more sustainable methods are implemented in Merton for case study purposes, useful cost and feasibility data may become available. Plans and Projects officer Lone Le Vay noted, "These sort of things kind of change with time...so maybe if that kind of information becomes available it can be added to the guides." She suggested frequent updates to the guides to incorporate new case study information as it becomes available. Another possible approach is to create illustrative fictional case studies where real case studies aren't available. "Architects sort of do costing for buildings, and you can sort of figure out a square meter price. You should be able to come up with a sort of square meter price for sustainable materials and compare with more conventional [materials]," suggested Ms. Le Vay. She noted that this process could be very time consuming; the preparation time required and the possibly lessened credibility of fictional case studies may reduce the utility of the approach, but in the absence of real case studies to draw upon, consideration may be warranted.

Another issue raised in many of the interviews was the need for the guides to refer readers to additional resources, such as suppliers of sustainable materials and experts on sustainable practices. BEPU officer Nick Smart declared that what landowners and potential developers "most want" is a list of local suppliers and engineers that can help them meet the sustainability policy requirements. He also said, however, that including such a list in the guides would be inappropriate; "Because you're always going to leave somebody out, you're going to receive charges of preferential treatment...so you've got to leave it out, for reasons of propriety." While a list of sustainable experts could be tremendously useful in helping developers move away from conventional methods, Mr. Smart made it clear that the mini-guides were not the right place for that information.

While developer education is necessary for widespread adoption of sustainable methods, developers also need incentives. When asked about educating developers, "green" architect Kel Keleher said, "The simple [way to encourage sustainable development], which is the least effective, is just to do education. You know, come to the workshop, learn more about it, etc. The next highest level is to give them incentives, and that can either be in the free market or legislative – tax credits, subsidies, etc. You can get them interested if it will meet their bottom line. Another kind of legislation is just to mandate [certain sustainable practices]." Merton internal review participants frequently stressed the need for information on incentives, including environmental benefits, cost savings, and policy requirements. Unfortunately, developers focus on the bottom line may not be swayed by environmental benefits, and some technologies are not financially beneficial to individual developers. As Principal Environmental Officer Adrian Hewitt pointed out, "There are lots of cost rationales for society... so there are financial rationales, but there's not for the bloke who's paying the money." Because of this, statutory policy is sometimes the only way to encourage adoption of sustainable methods. Development Control officer Francis Saayeng gave a recent example to illustrate this: "The council has approved an office block to be built in Wimbledon. And policy E13 requires them to...use sustainable materials. And that is part of the commission. And we couldn't have done that if we didn't have a policy in the UDP. So policy E13 of this UDP enabled the Council to say look, we have granted this permission – in terms of developing this office block, you have to use sustainable energy."

While the Plans and Projects section drafts UDP policies and supplementary guidance elaborating on those policies, Development Control is the section responsible for enforcing many of the UDP policies, as they can require proposed developments to comply with applicable policies to receive planning permission. Plans and Projects has supplied Development Control with a sustainability checklist to use to evaluate the sustainability of proposed developments; this evaluation can then be taken into consideration when deciding whether to grant planning permission. Current UDP policy is, however, not specific enough to deny planning permission because of a poor sustainability evaluation. When asked if Development Control was using the sustainability checklist to deny planning permission, Development Control manager John Hill answered, "No, it's used as an evaluation. So in the assessment we'd comment on the checklist evaluation, but we've never refused, to my knowledge, planning permissions based on the sustainability checklist." He explained this by saying, "There are limited policies, and it would be very brave to deny planning permissions based on sustainability issues. I think one of the concerns that we may have, is that to refuse something because it doesn't meet sustainability requirements – is do we have the backing and the expertise to support that position. I think that's an issue as well. I think we don't really have the policy to refuse that, so our role is more to get developers to think about it in a different way."

Development Control, as Mr. Hill noted, has no current plans on how to get sustainability information to developers. Mr. Hill stated, "I see that as a role for [Plans and Projects]." He indicated that Plans and Projects should have an increased developer relationship; "[Development Control officers] understand the principles," he said, "but we haven't done a lot of the research work." While Development Control does not have all the information necessary to properly advise developers, they do meet for pre-application discussions on major Merton developments. As Plans and Projects officer Richard Ainsley pointed out, this puts them in an ideal position to deliver information to developers. As Plans and Projects is producing developer guidance on sustainability, and as Development Control has the developer contact necessary to deliver the guidance, the two sections can together plan and deliver on the necessary sustainability education. With the sustainable development mini-guides as an educational tool, Development Control can advise Merton developers on the incentives for, feasibility of, and benefits from sustainable development.

# 5. Conclusions and Recommendations

The mini-guides meet the primary project goal of promoting sustainable development: informing the professional building community of the sustainable development techniques available to them, as well as the benefits of using those techniques. The guides also serve to inform the Merton council members on the sustainable development options, so they may make better policy decisions regarding sustainable development.

To this end, the research and interviews all pointed to one central concept: sustainable development techniques, even ones where the benefits far outweighed the negatives, are not being sufficiently implemented. While the educational materials created by this product should help with this, change is seldom easy, and usually needs a strong driving force. Thus, it is believed that for specific sustainability topics as well as sustainability in general to become more widely used, strong policy measures to encourage sustainable construction techniques are necessary. Measures to support and promote sustainable construction methods while discouraging unsustainable methods would be strong motivating factors, and should be implemented in order to incept the changes needed to make sustainable development a feasible reality.

## 5.1 –Conclusions

### 5.1.1 Passive Solar Design.

Many passive solar techniques address the initial design of the building. Thus, while some things can be done to a pre-existing building, most of the passive solar methods are not feasible to implement on a pre-existing construction.

External building layout feasibility depends greatly on the size and location of the building. The wind blocking methods are less feasible for most developments in Merton because there are rarely fast, cold winds in Merton. All other passive solar methods, external and internal, rely on ready access to sunlight, especially on a building's southern face, and thus these methods are ineffective and not feasible in locations where a building is shaded. The need for sunlight is the main restricting factor for natural lighting, and as long as shading is not a problem, natural lighting is very feasible and cost-effective in the design or remodeling phases.

The feasibility of the internal building layout techniques, while independent of the size of the building, is still extremely hard to implement on pre-existing buildings. As long as a good design utilizing building orientation and natural lighting is implemented, solar mass and direct gain methods prove to be very economical from a life cycle cost perspective, paying for their additional initial cost in a couple of years.

Generally, all of the solar design methods are applicable to Merton. The only barriers to feasibility are that passive solar methods are much harder to implement if they were not considered in the initial design of a development. Location may also cause shading issues that would limit the passive solar methods' effectiveness.

### *5.1.2 – Sustainable Materials.*

All of the sustainable materials methods addressed in the mini-guide are available for implementation in Merton. Local sourcing is quite feasible, as there are numerous suppliers of building materials, sustainable or otherwise, within a reasonable distance of the Borough. The problem with local sourcing is that it can often require more effort than using the suppliers that have been used in the past. While it can prove to be less expensive, the cost savings is by no means guaranteed, and depends on many factors. The environmental benefits are notable, but it is doubtful that they alone are enough to convince building professionals to put effort and money into addressing local sourcing. A comprehensive database of local suppliers as well as policy requiring some amount of local sourcing would aid in promoting this type of sustainable development.

Recycled and reclaimed materials are also reasonably available in Merton, and are currently quite appealing. Taxes on virgin materials make the already less expensive recycled and reclaimed materials even more financially appealing, and the lessened environmental impact is an additional bonus. The problem with recycled materials is that specified requests may not always be available, so starting the sourcing process earlier than usual is necessary to make utilizing recycled and reclaimed materials viable. The sustainable materials guide will help to promote this type of sustainable construction by informing building professionals about these types of materials, and of the availability and cost-effectiveness of those materials.

Sustainable certification and certified timber is available, and there is no cost difference between that and uncertified timber. The environmental benefits alone are good, but seldom enough to convince building professionals to use certified timber. Thus, policy specifically regarding certified timber would be instrumental in promoting its use.

### *5.1.3 – Renewable Energy Sources.*

Geothermal power generation is not a feasible option for implementation in the Borough of Merton because of the conditions that are required for geothermal energy to be a viable power source. However, conditions do exist for Merton to readily implement ground source heat pumps, but it is presently unknown whether ground conditions in the greater London area will be able to provide similar results to ones demonstrated in other parts of the UK.

Utilizing biomass energy to heat a building or provide hot water is a very viable option for development in the Merton area. This technique can be applied in both an economically and an environmentally beneficial manner because it is possible to draw fuel from sustainable sources, however, using fuels that are not sustainable significantly reduces the benefits of this method.

Hydrogen fuel cells are both costly and require a fuel source that is not readily available in Merton. Because many fuel cells require pure or near pure hydrogen to run in the most efficient manner there must be a readily available source to provide this fuel. Additionally, fuel cells are far more expensive than other, more traditional power generation sources. Because of their fuel needs and the relative initial expense of the cells, they are not currently a feasible option for the Borough of Merton, however, as this technology develops, fuel cells may become a more feasible option for implementation in the near future.

Wind energy has several basic requirements that are necessary for power generation including a consistent, relatively unbroken wind flow of sufficient velocity to maintain adequate rotation of the wind turbine. Unfortunately, because of the location of Merton, the conditions do not exist for the feasible implementation of wind turbines as a power generation source. Technology is also advancing in this area as well. There are ongoing investigations and attempts to develop an adequate wind turbine for an urban area as well as turbines with less stringent wind flow and velocity requirements. The borough should be aware of these developments as there may soon come a time when wind turbines are feasible for implementation in urban areas.

### *5.1.4 – Sustainable Urban Drainage Systems.*

As a whole, sustainable urban drainage systems are not feasible in Merton, as land tends to be relatively scarce and sustainable drainage systems require significantly more land than conventional drainage systems. Pervious surfaces, on the other hand, take up no more space than the conventional surface it would replace, may even increase useable space as no extra space is needed for drainage systems for the surface, and provide a valuable environmental benefit. Pervious surfaces are applicable practically everywhere, with the exception of main roads, and provide a sustainable and environmentally friendly solution to current drainage issues. Swales and soakaways are both useful replacements for conventional drainage systems as well. The rest of sustainable urban drainage systems, including holding and purification ponds and wetlands, are only applicable to expansive developments, and because SUDS requires more open land to implement they are not likely to be used in place of a conventional drainage system. Thus, while possible, the a significant portion of SUDS are not feasible in a highly developed, urban environment such as the one found in Merton.

### 5.1.5 – Sustainable Development Website.

The Merton Council website currently presents information organized in a largely department-oriented manner. While this makes the website easier for Merton staff to maintain, it would be easier for website visitors to find useful information if the site were organized in a user-centric manner. The information on sustainable development could especially become easier to use if it was organized specifically for developers.

## 5.2 – Recommendations

### 5.2.1 – Website recommendations.

While dividing the website up among the different Merton Council departments makes the website easier for Merton staff to maintain, it would be easier for a website visitor to find useful information if the site were organized by subject. The information on sustainable development could become easier to use as well if the website where organized to meet the needs of a developer.

To achieve this organization without sacrificing the ease-of-maintenance gained by managing the website departmentally, it is recommended that the Environmental Services departments coordinate their efforts for presenting sustainable development information. The page on sustainable development information for developers should be maintained by Environmental Services staff; this page should link to all relevant information on the Merton Council website, and the page's maintainer should be notified whenever new relevant information is added to the Merton Council website. Additionally, similar pages should be produced for different audiences; for example, a "Resident's Guide to Sustainable Planning" could organize and present sustainable development information that is of interest to Merton residents and homeowners.

The mini-guide Web pages should be updated frequently as new sustainability information becomes available. Since the updating the online guides incurs no distribution cost and allows immediate access to the new information, frequent updates to the mini-guide website are quite feasible.

### *5.2.2 – Cross referencing and updating.*

While cross referencing between mini-guides, other sustainable projects, including the sustainable development funding database, and current policy was done to some degree, access to the most relevant information possible is best. When new information is discovered or created, it should be linked to in all relevant guides as well as anywhere else that would benefit from that information. Also, if any links are found to be missing between related topics in the guides or other sustainable development materials, they should be added to create a better education system.

Associated with this is the need for updates to the guides. As many sustainable development techniques are quite new, the technology is changing quite fast, and new techniques are rapidly emerging. Thus, to have a guide that covers all of the relevant information on a subject, updating the guides regularly is very important so that the guides remain current and informative.

### *5.2.3 – Sustainability implementation information.*

While these mini-guides provide a basis of information on sustainable development techniques, they do not have the requisite information for building professionals to implement these techniques. That type of information is beyond the scope of these guides. While including information on specific organizations that do implement these techniques and would be able to provide that information would remedy this problem, impropriety becomes an issue. A list or database independent of the guides could be developed of organizations who have implemented sustainable development, along with a description of what sustainable techniques they use and how to contact them. This could be created in such a way to both verify that sustainable development techniques are being used and that they are being implemented properly, and to avoid questions of impropriety. This list or database would provide the link for building professionals between the education and implementation aspects of sustainable development. While this link can and is made without an informational tool of this sort, it would make the jump from wanting to implement a technique to actually implementing that technique much easier and less time consuming for anyone interested in sustainable development.

### *5.2.4 – Experimental development.*

One of the major issues both realized throughout the entire mini-guide development process and pointed out explicitly in the internal review stage is the lack of case studies and other hard financial information. As is widely known and represented in data collected from every stage of the project process, cost is one of the most important considerations for developers, and presenting the cost benefits (be it initial investment or long term savings) of a technique is one of the most persuasive methods of getting people to implement those techniques. The lack of data on sustainable development costs makes it difficult at best to present a persuasive document, and was found to be from the lack of implementation, and poor or non-existent information gathered when implimented.

A remedy to this problem is to organize a program to provide funding and support for theoretical or new and untested sustainable development techniques, and to conduct rigorous analyses of the benefits and barriers of the techniques. This would provide adequate information on the feasibility and initial cost information, as well as projected life cycle cost analysis and environmental impacts of the techniques. That information is crucial to present the techniques in the most persuasive manner to building professionals. Supporting sustainable experimental development would provide two main benefits: first, it would enhance both credibility and persuasiveness to current and future guides on sustainable development, and second, it would promote new and better sustainable development techniques to be tried and created. While the added cost and workload is an issue that must be taken into consideration, it is believed that the future benefits of supporting experimental development will far outweigh their added costs.

### *5.2.5 – Distribution of educational materials.*

Interviews with key personnel in the Plans and Projects department as well as the Development Control department revealed a major communication issue involving the dissemination of educational information on sustainable development. Each of the departments believes that the other is the better department to distribute the information, and thus is under the impression that the other should be handling the issue. Because of this, educational material related to sustainable development is not getting properly addressed by or distributed to building professionals it is meant to target, and this is a gap in the system of promoting sustainable development.

The problem can be remedied by the two departments discussing the issue and coming to a conclusion on how to remedy the issue between the two, probably involving both working to overcome the issues of each department where they are less suited to dealing with distributing this information. Specifically, Plans and Projects is knowledgeable enough on the subject to be able to provide support for sustainable developments, but is not in contact with developers when this information is most useful, and Development control is in contact with developers at the time with the information is most useful and influential, but isn't knowledgeable enough on the subject matter to try to persuade developers to use sustainable practices.

### *5.2.6 – Policy supporting Development Control.*

A policy issue was realized after interviews with Development Control personnel. While some sustainable development policy exists, it is not believed to be strong enough for Development Control to put pressure on developers to implement sustainable development techniques. Development Control feels that they do not have the policy support to deny planning permissions to those who they see as not implementing sustainable development to a minimum standard recommended by the policy. To address this issue, stronger and more specific policy that can support Development Control in promoting sustainable development and hindering or even denying non-sustainable developments from gaining planning permission would need to be created. This would give Development Control the power and support to make a significant change on the direction of promoting sustainable development.

### 5.2.7 – Education and incentives.

This project was established on the basis that education was needed to inform building professionals of sustainable development techniques. The mini-guides created by this project are a strong form of education, but this is only part of what is needed to truly promote sustainable development; incentives to change from traditional techniques to the sustainable techniques are also needed.

Many incentives are already in place: there are a number of programs and organizations willing to provide grants, loans, and other forms of financial assistance to those wishing to implement sustainable techniques; this will often solve the main problem of high initial cost with sustainable development techniques. In addition, policies promoting or even requiring sustainable development are starting to appear in many levels of government infrastructure. This is a good start, but reaching the goal of fully sustainable development is still far off. Continuing to develop education programs and materials as well as providing incentives to sustainable developers while starting to put barriers and restrictions on non-sustainable techniques is the best way to continue the drive towards sustainable development. These guides provide a strong basis for educational materials on sustainable development, and while incentives for use exist, stronger motivational measures need to be created. More stringent policy regarding non-sustainable development would make sustainable development more appealing, especially policy that development control can use as support to direct developers to using more sustainable techniques.

Changes take time and effort, and while the sustainable development movement is only beginning, the groundwork laid out in Merton policy and educational programs is strong, and well suited for its position as the starting point in the continuing drive towards truly sustainable development.

# References


The Brundtland City Energy Network. (n.d.). *Brundtland Report*. Retrieved on March 26th, 2003, from http://www.brundtlandnet.com/brundtlandreport.htm

Earth Day Network. (n.d.). *Earth Day Network - About Us*. Retrieved on March 26th, 2003, from http://www.earthday.net/about/history.stm

Environmental Agency. (2003). *Sustainable Drainage Systems (SUDS)*. Retrieved April 15, 2003, from http://www.environment-agency.gov.uk/ commondata/105385/a5_suds_v3.pdf

European Communities. (2002). About Asia Urbs. *EUROPA – EuropeAid – Asia Urbs Programme*. Retrieved June 13, 2003, from http://europa.eu.int/comm/europeaid/projects/asia-urbs/about_asia_urbs.htm

Great Britain Department of the Environment, Transport, and Regions. (1999). *A Better Quality of Life: a Strategy for Sustainable Development in the United Kingdom*. London: The Stationary Office. Retrieved April 27, 2003, from http://www.sustainable-development.gov.uk/uk_strategy/content.htm

Greater London Authority. (2003). *Green Light to Clean Power: The Mayor's Draft Energy Strategy*. London: Greater London Authority.

Greater London Authority. (2002). *The Draft London Plan: A Summary*. London: Greater London Authority.

Kim, J.J. (1998). *Sustainable Architecture Model: Qualities, Use, and Examples of Sustainable Building Materials*. Retrieved April 12, 2003, from http://www.umich.edu/~nppcpub/resources/compendia/ARCHpdfs/ARCHsbmIntro.pdf

Lafferty and Meadowcroft (Eds.) (2000). *Implementing Sustainable Development*. New York: Oxford University Press Inc.

Lewis, J. (1985). *EPA History – the Birth of the EPA*. EPA Journal. Retrieved March 27th, 2003, from http://www.epa.gov/history/topics/epa/15c.htm

Merton Council. (2001). *Supplementary Planning Guidance Note: Sustainable Development.* Morden, Surrey: Merton Civic Centre. Retrieved March 25, 2003, from http://www.merton.gov.uk/plansandprojects/acrobat/sustainabledevelopment.pdf

Merton Council. (2000). *Revised Unitary Development Plan; Second Deposit Draft*. Morden, Surrey: Merton Civic Centre

Muschett, D. F. (Ed.) (1997). *Principles of Sustainable Development*. Delray Beach, FL: St. Lucie Press.

Northeast Sustainable Energy Association. (2000). *Passive Solar Design*. Retrieved on April 14th, 2003, from http://www.nesea.org/buildings/passive.html

Sustainability Reporting Program. (2000). *A Brief History Of Sustainable Development.* Retrieved on March 26th, 2003, from http://www.sustreport.org/background/history.html

Sustainable Sources. (2003). *Sourcebook Passive Solar Design*. Retrieved on April 14th, 2003, from http://www.greenbuilder.com/sourcebook/PassiveSol.html

Sustainable Urban Drainage Scottish Working Party. (n.d.). *Sustainable Urban Drainage Systems – Setting the Scene in Scotland*. Retrieved April 13, 2003 from the World Wide Web: http://www.sepa.org.uk/publications/leaflets/suds/setting_the_scene.pdf

UK Department for Environment, Food, and Rural Affairs. (2003a). *Sustainable Development Factsheets*. Retrieved April 27th, 2003, from http://www.sustainable-development.gov.uk/uk_strategy/factsheets/local/

UK Department for Environment, Food, and Rural Affairs. (2003b). What is sustainable development? *Sustainable Development - the UK Government's approach*. Retrieved April 27th, 2003, from http://www.sustainable-development.gov.uk/what_is_sd/what_is_sd.htm

UK Department for Environment, Food, and Rural Affairs. (2002). *Achieving a better quality of life*. Retrieved April 27th, 2003, from http://www.sustainable-development.gov.uk/ar2002/

United Nations Department of Economic and Social Affairs. (2002a). *Global Challenge, Global Opportunity: Trends in Sustainable Development*. Retrieved May 22nd, 2003 from http://www.johannesburgsummit.org/html/documents/summit_docs/criticaltrends_1408.pdf

United Nations Department of Economic and Social Affairs. (2002b). *Report of the World Summit on Sustainable Development*. Retrieved May 22nd, 2003 from http://www.johannesburgsummit.org/html/documents/summit_docs/131302_wssd_report_reissued.pdf

United Nations Division for Sustainable Development. (2003). Agenda 21. *United Nations Division for Sustainable Development*. Retrieved on March 27th, 2003, from http://www.un.org/esa/sustdev/documents/agenda21/index.htm

United Nations Division for Sustainable Development. (1992). *Report of the United Nations Conference on Environment and Development, Rio Declaration on Environment and Development*. Retrieved March 25, 2003 from http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

United Nations General Assembly. (1992). *Report of the United Nations Conference on Environment and Development, Rio Declaration on Environment and Development*. Retrieved March 25, 2003 from http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm

US Department of Energy. (2003). *Energy Efficiency and Renewable Energy: Bioenergy*. Retrieved on April 14th, 2003, from http://www.eere.energy.gov/RE/bioenergy.html

# Appendix A – Project Schedule

| | May 2003 | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Tasks** | 12-18 | | | | | | | 19-25 | | | | | | | 26-31 | | | | | |
| | M | T | W | R | F | S | Su | M | T | W | R | F | S | Su | M | T | W | R | F | S |
| Initial Preparation | ■ | ■ | | | | | | | | | | | | | | | | | | |
| April '03 Guide Revision | | | ■ | | | | | | | | | | | | | | | | | |
| Guide Content Research | | | | ■ | ■ | | | ■ | ■ | ■ | ■ | | | | | ■ | ■ | ■ | ■ | |
| Initial Website Research | | | | ■ | ■ | | | ■ | | | | | | | | | | | | |
| Initial Website Planning | | | | | | | | ■ | ■ | ■ | ■ | | | | | | | | | |
| Outline Guides | | | | | | | | | ■ | ■ | ■ | | | | | ■ | | | | |
| Write Guides | | | | | | | | | | | | | | | | ■ | ■ | ■ | ■ | |
| Website Prototypes | | | | | | | | | | | ■ | | | | | ■ | ■ | | | |
| Web Prototype Analysis | | | | | | | | | | | | | | | | | | ■ | | |
| Further Web Planning | | | | | | | | | | | | | | | | | | | | |
| Sustainability Pages Work | | | | | | | | | | | | | | | | | | | | |
| Group Guide Review | | | | | | | | | | | | | | | | | | | | |
| First Guide Revision | | | | | | | | | | | | | | | | | | | | |
| Arrange Internal Review | | | | | | | | | | | | | | | | | | | | |
| Sponsor Guide Review | | | | | | | | | | | | | | | | | | | | |
| Second Guide Revision | | | | | | | | | | | | | | | | | | | | |
| Interview Planning | | | | | | | | | | | | | | | | | | | | |
| Survey Design | | | | | | | | | | | | | | | | | | | | |
| Internal Review | | | | | | | | | | | | | | | | | | | | |
| External Review Guide | | | | | | | | | | | | | | | | | | | | |
| Third Guide Revision | | | | | | | | | | | | | | | | | | | | |
| Create A4 Guide | | | | | | | | | | | | | | | | | | | | |
| Create Brochure Guide | | | | | | | | | | | | | | | | | | | | |
| Final Guide Revision | | | | | | | | | | | | | | | | | | | | |
| Final Presentation | | | | | | | | | | | | | | | | | | | | |
| **IQP Report** | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ | ■ | ■ | ■ |

| Tasks | June 2003 | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1-8 | | | | | | | | 9-15 | | | | | | | 16-22 | | | | | | | 23-27 | | | | |
| | S | M | T | W | R | F | S | S | M | T | W | R | F | S | S | M | T | W | R | F | S | S | M | T | W | R | F |
| Initial Preparation | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| April '03 Guide Revision | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Guide Content Research | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | ■ | | | ■ | ■ | ■ | ■ | ■ | | | | | | | |
| Initial Website Research | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Initial Website Planning | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Outline Guides | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Write Guides | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | | | |
| Website Prototypes | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Web Prototype Analysis | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Further Web Planning | | ■ | ■ | | | | | | ■ | | ■ | ■ | | | | | ■ | ■ | ■ | | | | | | | | |
| Website Construction | | ■ | ■ | ■ | | | | | | ■ | | | | | | | | | | ■ | | | ■ | | ■ | | |
| Group Guide Review | | | | | | ■ | | ■ | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| First Guide Revision | | | | | | | | | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| Arrange Internal Review | | | | | | | | | | ■ | | ■ | ■ | | | | | | | | | | | | | | |
| Sponsor Guide Review | | | | | | | | | | | ■ | ■ | | | | | | | | | | | | | | | |
| Second Guide Revision | | | | | | | | | | | ■ | ■ | ■ | | | ■ | ■ | ■ | | | | | | | | | |
| Interview Planning | | | | | | | | | | | | ■ | ■ | | | | | | | | | | | | | | |
| Survey Design | | | | | | | | | | | | ■ | ■ | | | | | | | | | | | | | | |
| Internal Review | | | | | | | | | | | | | | | | | ■ | ■ | ■ | ■ | | | | | | | |
| External Review Guide | | | | | ■ | | | | | | | | | | | | | | | ■ | | | | ■ | | | |
| Third Guide Revision | | | | | | | | | | | | | | | | | | ■ | ■ | ■ | | | | | | | |
| Create A4 Guides | | | | | | | | | | | | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | | | | ■ | ■ | | | |
| Create Brochure Guides | | | | | | | | | | | | | | | | | | | ■ | ■ | | | ■ | ■ | | | |
| Final Guide Revision | | | | | | | | | | | | | | | | | | | | | | | ■ | ■ | | | |
| Final Presentation | | | | | | | | | | | | | ■ | | ■ | ■ | ■ | | ■ | ■ | | ■ | ■ | ■ | ■ | | |
| **IQP Report** | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | |

# Appendix B – Survey Request Email

This is the standard version of the email.

[Mr./Ms. NAME]

We are a team of American undergraduates developing a series of mini-guides on sustainable development for Steve Cardis and Richard Ainsley in Plans and Projects. These guides aim to give a brief but useful introduction to techniques and technologies potentially available for use in Merton, and are targeted at both Merton developers and Merton Council staff.

At the moment the guides are at an intermediate draft stage; we would like some feedback so that we can evaluate their effectiveness and revise them to increase the guides' utility. To collect this feedback we are conducting short interviews with selected Merton Council staff and providing quick associated surveys. We would be grateful if you would agree to fill out our survey and participate in a short interview.

We have attached our guides on [GUIDE TOPICS FOR RECIPIENT] along with the associated survey. If you wouldn't mind giving us your feedback, we would like to drop by at your convenience next week for a brief interview. We are conducting interviews and collecting surveys on Monday (May 16th) through Thursday (May 19th). In order to make productive use of the interview time, we would appreciate it if you would read through the guide and complete the survey (one for each guide would be the most helpful) before we meet. Please let us know if and when we can plan to meet with you.

Additionally, at 12:30 on Wednesday, May 25th, we will be delivering a presentation on the development of these mini-guides and our recommendations to the Council. You are welcome to attend; please let us know if you would like to come, and we will let you know once the committee room has been finalized.

Thank you for your time and your consideration.

----

- Jason Myatt

  Collin Joyce

  Drew Fowler

  Rick Ballard

Environmental Services, Plans and Projects division

wpistudents@merton.gov.uk

This Version of the Email is for those officials receiving all four guides for review and, and may have contacts with other people not covered by our initial survey.

[Mr./Ms. NAME]

We are a team of American undergraduates developing a series of mini-guides on sustainable development for Steve Cardis and Richard Ainsley in Plans and Projects. These guides aim to give a brief but useful introduction to techniques and technologies potentially available for use in Merton, and are targeted at both Merton developers and Merton Council staff.

At the moment the guides are at an intermediate draft stage; we would like some feedback so that we can evaluate their effectiveness and revise them to increase the guides' utility. To collect this feedback we are conducting short interviews with selected Merton Council staff and providing quick associated surveys. We would be grateful if you would agree to fill out our survey and participate in a short interview?

We have attached our 4 guides (Passive Solar Design, Sustainable Materials, Renewable Energy, and Sustainable Urban Drainage Systems) along with the associated survey. If you wouldn't mind giving us your feedback, we would like to drop by at your convenience next week for a brief interview. We are conducting interviews and collecting surveys on Monday (May 16th) through Thursday (May 19th). In order to make productive use of the interview time, we would appreciate it if you would read through the guides and complete the surveys before we meet (one per guide would be the most helpful). Please let us know if and when we can plan to meet with you.

If you could also provide us with additional people to contact within your department who could provide useful feedback on any of the guides, that would be most helpful.

Additionally, at 12:30 on Wednesday, May 25th, we will be delivering a presentation on the development of these mini-guides and our recommendations to the Council. You are welcome to attend; please let us know if you would like to come, and we will let you know once the committee room has been finalized.

Thank you for your time and your consideration.

----

- Jason Myatt

Collin Joyce

Drew Fowler

Rick Ballard

Environmental Services, Plans and Projects division

wpistudents@merton.gov.uk

# Appendix C – Merton Internal Review Survey

***Sustainable Development Mini-Guide Survey***

We appreciate your thoughtful, honest response to this survey. Once completed, this survey can either be emailed back to wpistudents@merton.gov.uk or dropped off in Plans and Projects; if you'd like us to come pick it up for you, you can reach us at x3003. If you are evaluating more than one guide, we would appreciate your completing a separate copy of this form for each. Please read the mini-guide(s) before beginning this survey. Thank you.

Your Name:________________________ Department/Section:_________________________

You are reviewing the mini-guide on (indicate one):

a) Passive Solar Design b) Sustainable Materials c) Renewable Energy Sources d) SUDS

For the following questions, please indicate one of a, b, or c

1) The guide provided: a) too much detail, b) about the right amount of detail, or c) not enough detail

2) The guide was: a) too technical, b) appropriately technical, or c) not technical enough

3) The guide: a) tried to cover too much material, b) covered an appropriate amount of material, or c) did not cover enough material

4) The guide: a) feels highly credible, b) is reasonably credible, or c) lacks credibility

5) The organization of the guide: a) is clear and logical, b) is adequate, or c) is confusing or problematic

6) The guide: a) needs major revisions before use, b) needs minor revisions, or c) is publishable

The following questions cover the type of information presented in the guides. Keeping in mind that the guides are intended to present concise, pertinent information rather than comprehensive discussion, please indicate for each topic whether the guide contains more information than is needed, the right amount of information, or not enough information.

| | | | |
|---|---|---|---|
| 7) Cost | Too much | Appropriate | Not enough |
| 8) Feasibility in Merton | Too much | Appropriate | Not enough |
| 9) Environmental benefits | Too much | Appropriate | Not enough |
| 10) How the techniques work | Too much | Appropriate | Not enough |
| 11) Relevant Merton policy | Too much | Appropriate | Not enough |
| 12) Incentives to use sustainable development | Too much | Appropriate | Not enough |

13) Grants and financial support Too much Appropriate Not enough

14) References to additional resources Too much Appropriate Not enough

Which of the following aspects of the guide require significant improvements or additions? Indicate as many as desired:

Content Breadth Content Depth Clarity Organization Layout

Reference to Additional Resources Applicability in Merton Content Accuracy

Other – please specify:

Please answer the remaining questions in brief writing:

15) What is the most important thing needed to improve this guide?

16) Are there any specific organizational changes that should be made?

17) Does the guide lack information that it should contain? If so, what is it missing?

18) What were the strongest and weakest aspects of the guide?

19) Do you feel that this guide will be useful to Merton developers and Merton staff? Are there any serious issues that hinder its usefulness?

20) Other recommendations:

# Appendix D – List of Surveyed Officials

- Adrian Hewitt (Business and Environmental Partnerships Unit)
- Lone LeVay (Plans & Projects)
- Alec Johnson (Building Control)
- John Hill (Development Control)
- Tim Cutts (Development Control)
- Nick Smart (Business and Environmental Partnerships Unit)
- Francis Saayeng (Development Control)
- Paul Cannnadine (Building Control)

# Appendix E –Survey Responses

Please reference the Survey in Appendix C when reading these surveys.

Name: Adrian Hewitt

Guide: Passive Solar Design

Department/Section: Business and Environmental Partnerships Unit

Date survey response was received: June 18, 2003

1) b
2) [circled option b, then crossed out "b) appropriately technical"]
3) [circled option b, then crossed out "b) covered an appropriate amount of material"]
4) a
5) a
6) b
7) Not enough
8) [No response]
9) Appropriate
10) Appropriate
11) Appropriate
12) Appropriate
13) [circled "Not enough", then crossed it out and wrote "N/A", then later circled "Not enough" for both questions 13 and 14]
14) [circled "Appropriate", then later circled "Not enough" for both questions 13 and 14]

Unnumbered) Layout [wrote and crossed out N/A]

15) Graphics
16) None.
17) Graphics.
18) • Strength – Bredth[*sic*]
    • Weakest – visual layout

19) Yes

    No

20) [No response]

Other notes:

Name: Alec Johnson

Guide: Passive Solar Design

Department/Section: Building Control

Date survey response was received: June 17, 2003

1) b
2) b
3) b
4) a
5) a
6) b
7) Not enough
8) Appropriate
9) Appropriate
10) Appropriate
11) Not Enough
12) Not Enough
13) Not Enough
14) Not Enough

Unnumbered) Reference to Additional Resources, Applicability in Merton

15) Clarification that proposals incorporating solar passive design will be viewed favorably by planning.
16) It seems OK.
17) See No. 15.
18) The information provided is very good but developers and owners should be confidant that they will be supported fully by planning.
19) Yes the guide is useful
20) [No response]

Other notes:

Name: Lone Le Vay

Guide: Passive Solar Design

Department/Section: Plans and Projects

Date survey response was received: June 19, 2003

1) a, b [both choices indicated]
2) b
3) b
4) [No response]
5) a
6) b
7) Not enough
8) Appropriate
9) Appropriate
10) Appropriate
11) Appropriate
12) Appropriate
13) Not enough
14) Not enough

Unnumbered) Layout, Reference to Additional Resources, Other: Could include some case studies in addition to BedZED, also information on costs that could be saved compared to conventional construction/planning methods.

15) Illustrations
16) Format/Page layout can improve the published version of the guide's attractiveness
17) Examples of good practice/case studies and/or illustrations/diagrams
18) Very comprehensive/lack of illustration
19) Yep – mostly developers rather than homeowners as it is really applicable site layout developments. [*sic*]
20) Could have a shorter version of the guide for homeowners focusing on things that they could do to improve passive solar design focusing on measures that could be applied to existing buildings and sites (such as tree planting ideas and windows.)

Other notes:

Name: Paul Cannadine

Guide: Passive Solar Design

Department/Section: Building Control

Date survey response was received: June 19, 2003

1) c [wrote "who is the guide aimed @?"]
2) c [wrote "no practical detail."]
3) a
4) c
5) a
6) a [wrote "what is its purpose?"]
7) Not enough
8) Not enough
9) Not enough
10) Not enough
11) Not enough
12) Not enough
13) Not enough
14) Not enough

Unnumbered) Content Depth, Reference to Additional Resources, Applicability in Merton,

Other: The building industry & the builders I meet in mitcham are <u>not</u> ready for this.

15) i) who is it aimed @.

ii) How can it be made more practical?

iii) what is it's purpose?

iv) There are potential conflicts with life safety issues & foundation design – safety glazing – guarding – falling.

v) Changing methods of accepted construction increases ["risk"?] of ["failure"?] increases need for education & enforcement.

vi) No reference to Part ["2"?] of Approved documents. B.R.'s 2002

16) No.

17) i) Building Control legislation

ii) Alt sources of info.

18) [Circled "strongest" in the question and drew a line to where he wrote "['general'?] intro to subject." Circled "weakest aspects of" in the question and drew a line to where he wrote "lack of Practical details."]

19) [drew a line from the words "Merton developers and Merton staff" in the question to where he wrote "No." Drew an arrow from the end of the sentence, "Art there any serious issues that hinder its usefulness?" in the question to where he wrote "quality of ['designers'?] of builders that I met. Educate the Industry."

20) [No response]

Other notes: In the explanatory text for the questions 7-14, Paul Cannadine underlined the words "present concise, pertinent information rather than comprehensive discussion".

Name: Tim Cutts

Guide: Passive Solar Design

Department/Section: Development Control

Date survey response was received: June 19, 2003

1) b
2) b
3) b
4) b
5) b
6) b
7) [No response]
8) Appropriate
9) Not enough
10) Appropriate
11) [No response]
12) Not enough
13) Not enough
14) Not enough

Unnumbered) [Nothing circled]

15) [No response]
16) Maybe more diagrammes should be added. Also more links to other info sources or a bibliography.
17) [No response]
18) [No response]
19) [No response]
20) [No response]

Other notes on this survey:

Mr. Cutts filled out one survey for both Passive Solar Design and SUDS. When asked about this, he said that his survey responses were the same for both guides. These survey responses have thus been recorded for both PSD and SUDS as if they were on separate, identical surveys.

Mr. Cutts drew a line between his circled answers for questions 9 and 12. He did this during his interview, and it has been noted in the interview transcript.

Name: Adrian Hewitt

Guide: Renewable Energy Sources

Department/Section: Business and Environmental Partnerships Unit

Date survey response was received: June 18, 2003

1) b
2) b
3) b
4) a
5) b
6) b
7) Appropriate
8) Appropriate
9) Appropriate
10) Appropriate
11) Not enough
12) Not enough
13) Not enough
14) Appropriate

Unnumbered) Layout, Applicability in Merton

15) Emphasising the financial rationalé
16) No
17) No
18) Strongest – detail

    [wrote and then crossed out "weakest –"]
19) Yes.

    No
20) <u>None</u>

Other notes:

Name: Francis Saayeng

Guide: Renewable Energy Sources

Department/Section: Development Control

Date survey response was received: June 19, 2003

1) b
2) b
3) b
4) a
5) a
6) c
7) Appropriate
8) Appropriate
9) Appropriate
10) Appropriate
11) Appropriate
12) Not enough [wrote in a "?"]
13) Not enough [wrote in a "?"]
14) Appropriate

Unnumbered) Reference to Additional Resources [wrote in "additions" above the word "Additional"]

15) To include its contents in the UDP and SPG, ensuring members support it. The guide should be printed into a booklet for marketing and also encourage developers to use it. There is also the need for architects to be aware of this guide, to incorporate it in the drawings for developments.

    The Building Control surveyors should also encourage the use of Sustainable and Renewable Energy in the Building Control drawings to assist the promotion of the guide.
16) [No response]
17) More examples to be stated for each Renewable and Sustainable Energy.
18) Weakest aspects, is not enough examples of developments within the borough or UK given to enable reference to be made to.

19) It will be useful and should be included in the Council's UDP & SPG and published to promote the guide.

20) The professionals in Planning, Building Control, Environmental Health, Engineers and Architects needs[*sic*] to have some training/education of[*sic*] this guide to enable them advice[*sic*] the general public on the benefits of using sustainable materials and Renewable Energy Sources for new developments and for extensions.

Other notes:

Name: Nick Smart

Guide: Renewable Energy Sources

Department/Section: Business and Environmental Partnerships Unit

Date survey response was received: June 19, 2003

1) b
2) b
3) a [wrote "Hydrogen section may be less appropriate at this stage in its technological development."]
4) a
5) a
6) b
7) [No response]
8) Appropriate [wrote "If not feasible in Merton should the guide include explanation of a technology?"]
9) Appropriate
10) Appropriate
11) [No response, crossed out "Relevant" in the question and wrote "Coverage of" and "Attention?" above it]
12) Appropriate [wrote "If ref. to financial guide [means funding database?]."]
13) [No response]
14) [No response]

Unnumbered) Other: Integration – solar mini-guide with this renewable energy mini-guide

15) Relative cost advantages of these renewable energy technologies will change over time. General reference to possible future changes in the market for conventional energy – e.g. increased costs, insecurity of supply, etc. Justification for "dispersal" energy generation
16) [No response]
17) [No response]
18) [No response]
19) [No response]
20) [No response]

Other notes:

Name: Adrian Hewitt

Guide: Sustainable Urban Drainage Systems

Department/Section: Business and Environmental Partnerships Unit

Date survey response was received: June 18, 2003

1) b
2) b
3) b
4) b
5) a
6) b
7) Not enough
8) Not enough
9) Appropriate
10) Appropriate
11) Appropriate
12) Appropriate
13) Appropriate
14) Not enough [wrote "E['7'?]"]

Unnumbered) Layout

15) More emphasis on financial rationalé

    Examples of successful projects.
16) No
17) [Drew arrow from answer to question 15] As above + <u>UK Environmental Agency</u>
18) Strongest – Bredth[*sic*] Weakest – Finance
19) [No response]
20) [No response]

Other notes:

Name: Alec Johnson

Guide: Sustainable Urban Drainage Systems

Department/Section: Building Control

Date survey response was received: June 17, 2003

1) B
2) B
3) B
4) A
5) A
6) B
7) Not enough
8) Appropriate
9) Not enough
10) Appropriate
11) Not enough
12) Not enough
13) Not Enough
14) Not Enough

Unnumbered) Reference to additional resources

15) More guidance on how more detailed technical information can be obtained
16) [Slash through the response area]
17) See No. 15
18) The guide provides various interesting options with regard to drainage but incentives to developers/owners, whether environmental/sustainable or financial should be given a higher profile.
19) Yes it is useful but refer to questions 15 and 18
20) [No response]

Other notes:

Name: Tim Cutts

Guide: Sustainable Urban Drainage Systems

Department/Section: Development Control

Date survey response was received: June 19, 2003

1) b
2) b
3) b
4) b
5) b
6) b
7) [No response]
8) Appropriate
9) Not enough
10) Appropriate
11) [No response]
12) Not enough
13) Not enough
14) Not enough

Unnumbered) [Nothing circled]

15) [No response]
16) Maybe more diagrammes should be added. Also more links to other info sources or a bibliography.
17) [No response]
18) [No response]
19) [No response]
20) [No response]

Other notes on this survey:

Mr. Cutts filled out one survey for both Passive Solar Design and SUDS. When asked about this, he said that his survey responses were the same for both guides. These survey responses have thus been recorded for both PSD and SUDS as if they were on separate, identical surveys.

Mr. Cutts drew a line between his circled answers for questions 9 and 12. He did this during his interview, and it has been noted in the interview transcript.

Name: Adrian Hewitt

Guide: Sustainable Materials

Department/Section: Business and Environmental Partnerships Unit

Date survey response was received: June 18, 2003

1) c
2) b
3) c
4) a
5) a
6) b
7) Appropriate
8) Appropriate
9) Appropriate
10) Appropriate
11) Not enough
12) Appropriate
13) Appropriate
14) Not enough

Unnumbered) Content Breadth, Reference to Additional Resources

15) More info on how to access sustainable materials
16) No
17) [Arrow drawn from response to question 15] Ditto
18) • Strength – Rationalés
    • Weakness – Bredth[*sic*]
19) Yes
    No
20) [No response]

Other notes:

Name: Francis Saayeng

Guide: Sustainable Materials

Department/Section: Development Control

Date survey response was received: June 19, 2003

1) b
2) b
3) b
4) a
5) a
6) c
7) Appropriate
8) Appropriate
9) Appropriate
10) Appropriate
11) Appropriate
12) Not enough [wrote in a "?"]
13) Not enough [wrote in a "?"]
14) Appropriate

Unnumbered) Reference to Additional Resources

15) To improve this guide only requires the guide to be presented to the professionals in Planning, Building Control, Architects, Engineers, Environmental Health departments to enable them to be able to advise the general public on new developments and extensions. More publicity is required for this guide to succeed; The general public should be educated about the benefits of using Sustainable Materials and where they can get the financial assistance and technical advice for use in new development and extensions.
16) [No response]
17) More examples to be stated for each Renewable and Sustainable Energy.
18) Weakest aspects, is not enough examples of developments within the borough or UK given to enable reference to be made to.

19) It will be useful and should be included in the Council's UDP or SPG and published to promote the guide.

20) The professionals in Planning, Building Control, Environmental Health, Engineers and Architects needs[*sic*] to have some training/education of[*sic*] this guide to enable them advice[*sic*] the general public on the benefits of using sustainable materials and Renewable Energy Sources for new developments and for extensions.

Other notes: The third page of this survey (questions 16-20) was a photocopy of the third page of the Renewable Energy Sources guide survey that Francis Saayeng filled out. He told us that this was because his responses for those questions were the same for both guides.

Name: Lone Le Vay

Guide: Sustainable Materials

Department/Section: Plans and Projects

Date survey response was received: June 19, 2003

1) b
2) b
3) c
4) a
5) b
6) b
7) Not enough
8) Appropriate
9) Appropriate
10) Appropriate
11) Appropriate
12) Appropriate
13) Not enough
14) Not enough

Unnumbered) Reference to Additional Resources, Other: Cross references to other mini guides and also information sources added (it looks as if it is proposed to add in information on other resources from the document's structure. [*sic*] I have made a few suggestions in the text.

The guide would probably be of interest to different groups of people – design professionals (local architects and builders) and also home-owners.

15) Information on sources of sustainable materials.
    Information on organisations that can provide advice an expertise.
16) Some illustrations may make the guide more attractive and encourage people to read on.

Case studies based on a fictional or a real building project may be useful to illustrate the benefits.

17) Have made a few comments on the document emailed under a separate cover. [referring to a copy of the mini-guide sent with some suggested additions]
18) [No response]
19) I would imagine that it would more likely to be of use to professionals in the building industry. With respect to homeowners and developers it may encourage them to consider using sustainable materials – they will be more interested in the cost implications.

    May have some educational uses as well.
20) [No response]

Other notes:

# Appendix F – Merton Internal Review Interview Guide

Interviews should begin with the interviewer briefly reading over the participant's survey response, if they have not already had a chance to do so. This will give the interviewer an initial idea of the problems the participant has identified and the participant's suggestions for improvement; starting the interview with this knowledge allows the interviewer to ask follow-up questions on these with the participant.

Each interview will ask different questions, as the questions asked depend upon the feedback given in the survey and the initial responses of the participant. The standard questions should be asked of every interview participant, however, and many other questions should be in response to problems identified in the participant's survey. Questions asked in the interview should be recorded along with the responses.

At beginning of each interview, the participant should be thanked for giving us their time to review the guides and answer the questions. They should also be told that we appreciate their feedback, and that we'd like them to answer our questions as frankly as possible; sugarcoating the responses will only hinder the eventual effectiveness of the guides.

All interviews should include the following questions:

1) Briefly, what did you know about [THE GUIDE TOPIC] before reading the guide, and what new knowledge or understanding, if any, did the guide impart?
2) After reading the guide, what was your overall impression of the feasibility and commercial viability of [THE GUIDE TOPIC] in Merton?

3) Did you believe the guide's content to be accurate? Would a Merton developer believe this guide to be credible?
4) Do you feel that the guide's overall focus is appropriate?

Interviews should then proceed with questions that follow up on the participant's survey. To make efficient use of time, pick survey responses that are surprising or indicate a problem with the guide as the important responses to follow up on.

Finish the interview by asking the participant if they have any other feedback they'd like to give. After their response, thank them for their time and responses. Ensure that all interview responses are transcribed as soon as possible to a source that is legible and understandable.

# Appendix G – Internal Review Interviews

**Interview with Adrian Hewitt**

June 18, 2003

Department: BEPU (Principal Environmental Officer)

Guides Reviewed: SUDS, Passive Solar, RES, SustMat

Q) Briefly, what did you know about the guides' topics before reading the guides, and what new knowledge or understanding, if any, did the guides impart?

A) I've got considerable knowledge of the areas covered.

Q) After reading the guides, what was your overall impression of the feasibility and commercial viability of the guides' topics in Merton?

A) I thought that the viability is strong, though I do think that there was maybe not enough about the relevance to Merton.

Q) Did you believe the guides' content to be accurate? Would a Merton developer believe this guide to be credible?

A) Yeah, I do. That's a general thing all the way down the line, the thought that yeah, this is going to be taken seriously.

Q) Do you feel that the guides' overall focus is appropriate?

A) Yep.

Q) On your survey for the Sustainable Materials guide you noted that the guide did not have enough detail. Can you elaborate?

A) My main thing that was lacking on that was how to actually get your hands on the sustainable materials.

Q) You also noted that there was not enough on Merton policy and additional resources.

A) When you say policy I assume you mean more on UDP policy…there needs to be more on UDP policy. This is relevant to the content breadth; what I meant with that was…change that, make that "reference to additional resources" [on the survey unnumbered question]. What I mean there is, who can access that stuff for you – [mentions London Remade] which is specifically the organization that's set up by the regional government, funded by the regional development authority, which helps facilitate people's access the green supply chain. This [London Remade] is the first organization which you should refer to.

Q) You note that rationales for sustainable materials was a strength?

A) Yeah…but I think financial rationales needs to be maybe punched up a bit more strongly, and the rationales about the green economy…it's a key component to the green economy, it creates jobs. I think you need to mention the green economy more strongly, but you have made clear references to the financial rationales…so that is a strength, but just because it is a strength does not mean that it's not something that you can feed more in.

Q) On the passive solar guide survey, if the middle option ["appropriately technical"] on question two weren't available, which would you go with?

A) I would go to almost "too technical"...but that's a good thing, because it being very technical means that developers will take it seriously. But on that specifically, I would go with "appropriately technical".

Q) What about for question one?

A) I would, I would a bit more clearly go "too much" of that [detail]...I mean, "shading advisories" [pointing to term in guide], what the [expletive deleted] is that? – I'm sure that there are going to be architects that want more of that but...I kind of wouldn't want any more. You push me just to the limit.

To an extent there's a smorgasbord here...you're a developer or an architect, and you're selling this to whoever's paying the money – they'll recognize – it's a natural item, they'll recognize that; whoever's paying may not understand all of that, but that's fine. It's got enough about the relevance and importance of that, so it's...ehm, ok, I'm prepared to believe that. As far as I'm concerned this was good.

Q) The survey mentions that there is not enough cost information; this is probably an issue with all of the guides.

A) Yeah, because they're going to ask, "how much is it going to cost?" And that's a question always. So you say, "the capital infrastructure cost will be more, but the overall cost will be less." You say, "it will cost x amount to put in these windows, but the benefits will be this and this and this and this"...always keep stressing the financial rationales. The capital infrastructure cost is more, but the payback is that they [sustainable buildings] are cheaper to run. You have to ask, "how much will it cost me to pay that back?" You have to realize, as well – that's the cost now. [Gives example of levy going up changing payback timeframe, speeding it up.]

You kinda need to get hammering it home, every top paragraph should be, "This is an investment" – I'm not entirely sure I came across the word investment in these guides, but people love the word investment. It's not just investment in the financial quality – it's an investment in the quality of life, it – it kind of looks cool, an investment in the quality of life and you've got the most dynamic futuristic cool building, and you'll attract smart people.

Q) We've actually had trouble finding costing information on a lot of these technologies. It seems that, for some things at least, the information isn't available.
A) Basically, the technology is so new, it's only just beginning to happen, so we are still evaluating the financial rationales and the financial feasibility studies. Some of the technologies have already been proven to pay for themselves – solar water heating, [gave another example], etc. One of the problems you have is with photovoltaic cells. You know, maybe it takes 120 years to pay for them, so they won't have paid for themselves when they fall off your roof after 30 years. So you've got to emphasize the cost of not saving the planet.

Q) Can you elaborate on solar water heating?
A) Mainly that's the evacuated tube ones. The sophisticated systems – they'll pay back in no time.

Q) We didn't include those in the passive solar guide because Merton isn't always sunny and...should we include those?

A) Yes. The evacuated tube ones are really interesting. In Finland – there's lots of them in Finland. And they're not affected so much by the external temperature even…what happens is the [something - sun?] hits these fins which are coated by a special material – I can give you some technical information, but you don't want it. But trust me – the evacuated tube ones work well in cloudy environments. It's a viable technology. We've got these systems on 6 of our primary schools. We've got business down the road that do it. The key about solar hot water is, sure – you need hot water to have your shower, but how much hot water are you going to need? The real value is when you heat your house – a system underneath heating the house, rather than lots of radiators. That way you don't need to get the solar water heater up to a good temperature, you just keep it that way, and it goes all through the house.

Q) You indicate a need to improve layout…

A) Well…hey, can we have a couple diagrams then, some pictures?

Q) These copies of the guides aren't really laid out yet, and we're adding pictures…by layout, did you mean guide organization?

A) No, no. That's fine then.

Q) What was your general opinion about the SUDS guide? It seems that you were less favorable.

A) I'm more very very blunt about these things. It was the right amount of detail – it's good. There was more stuff in this than I maybe expected, and this is maybe a difficult one. It's more – some people are going to think about further down the line, and a more distant concept for developers to wrap there brains around, and it's kind of scary – it's never going to be a big thing, it's more an information leaflet. The big thing you didn't do was link it to the UK Environment Agency. The UK Environment Agency is *the* organization in the United Kingdom that deals with this, that deals with SUDS. I think if you log onto their webpage you'll find a whole section covering SUDS. There should be references to this all over the guide. It should be, "This is the information leaflet, for more information log onto the UK environment agency site".

[moving down the SUDS survey] I think it's gone through very well – it's clear and it's logical, but it needs some minor revisions. But, as you've rightly pointed out, the cost thing is an issue.

Q) We weren't sure about SUDS feasibility. Is there space in Merton for SUDS – things like swales?

A) Yeah, yeah, there is. There's a school site which is going to be built up the road, which is about 3 hectares, and the environment agency have made it very clear that they're concerned about SUDS at this site. If it's just conventional building the water'll just pour off and you'll get drainage system swell. You'll see that we have really heavy showers, so we have drainage problems here. You get this weird situation where you have water forcing up over the drain, and it creates a rapid.

We've got lots of sites…we've got three, four, five school fields which are going to have building on them, we've got an old soccer field which is going to have building on it, we have smaller sites that are going to have building on them. There are a range of sites that can be identified, and if you ask, Steve Cardis can reel of the names.

[looking on] Merton policy's fine, and the incentives are fine…fine…the additional resources, that's the issue about the Environment Agency.

I think the layout business again, that's….got a drawing? A pretty picture for me? It's just that visual thing where you…people are simple souls, even developers…you can have a million quid sticking out of your pocket, but just a simple drawing…a techy looking sort of thing [would help].

More emphasis on the financial rationale. What I mean by that is, in short, insurance costs. It's difficult to get insurance for houses in a lot of areas in the UK because of flooding. It never used to happen. And also the financial rationale behind removing pressures on drainage systems, and that kind of thing – you get flooding, the car park floods, and that causes damage. There are financial rationales behind this kind of thing. You turn to the developer and say, "Hey, you're going to have increasing rainfall in this country, so you've got to use extra drains in car parks…you've got to use sustainable drainage systems."

An example with any of these things will really help.

Q) We've found a lack of case studies for this sort of thing. A lot of the time, there's nothing to point to as a feasible example.

A) That's an interesting fact which I assume you'll flag up in your IQP.

Q) To go back real quick to the pictures – what kind of pictures are you looking for? Graphs?

A) No, not graphs…nice colorful drawings, kind of cross-section pictures and that sort of thing. Really, I don't care – just something to act as punctuation, kind of techy…

Q) Sorry to jump back to passive solar, but [looking at passive solar survey] you feel that there are enough additional resources? We felt that there could be a lot more.

A) I think what I was meaning by looking at that is…you…you had the BedZED examples, but there was other stuff in this where… Although it's not links…"additional resources"…some of the technical information, which is making it clear about, you almost…by default you're giving me the alternative information, because you're ruling out certain materials. Maybe also as I'm a lover of BedZED I'm totally biased towards it, so I kind of look towards it and think "anything you ever want to know, you get from BedZED." They've made so many TV programs about Bill Dunster and BedZED, so many magazine articles, [etc]. It's generally recognized to be the most sustainable, groovy, cutting edge building in Europe. [Other prominent architects] were describing him as genius – he's a major heavy-hitter. Government ministers or whatever *love him*. What it means is, there's a reason for that, and the reason for that is that almost every technology that you want to talk about – BedZED will give you everything you need.

So ok, maybe [the passive solar guide has] not enough, but you understand what I mean. I think you're probably right [that it is a weakness] now that you draw my attention to it.

Q) On the renewable energy guide survey, you mention that there's not enough on Merton policy, incentives, and grants…

A) There're sackloads of relevant UDP policy – Steve [Cardis] should've been able to point them out to you. I think you mentioned a couple, but there's other stuff, I'm sure. Because this is the one where we've got the prescriptive legislation, 10% [of energy must come from renewable sources] and so forth. People are going to wiggle and try to get out of it, so we've got to pile on the pressure and show all the relevant policies.

Q) You mentioned layout as an issue…

A) Again, I sort of misinterpreted it. Just more pretty pictures and that sort of thing, though you've got some of that sort of stuff – please don't attach too much importance to this layout stuff.

Q) You indicated that information on applicability in Merton needed improvement – was that the same policy stuff?

A) Yeah, that's the policy stuff.

Q) You said that financial rationale needs improvement. Can you elaborate?

A) What I mean by that is you kind of need to go hammering on about, this is going to save x amount of money now, and the cost saved is going to increase as the cost of fossil fuel energy rises.

Q) We've had trouble finding that data on a lot of the technology…

A) Yeah, that's the problem. There are lots of cost rationales for society…[pointing at renewable energy guide] he's put stuff here, like [sentence about contribution to acid rain etc]. And I've added [bit he added about rain causing flooding] [added in Adrian Hewitt's revision notes on the guide]. So there are financial rationales, but there's not for the bloke who's paying the money.

Q) Yeah; as we're trying to convince individual developers to implement these technologies, there's only so much that pointing out cost to society will do.

A) Yeah. But there are other things…[gives solar panel example;] any one who rents one of those units, that'll reduce the rent cost. Whether that'll pay for the cost of the solar panels, that's another question, but it'll look good regardless. While people are doing well financially… One of the groups dealing with this is the social housing people…the social housing people are pretty much the only ones building housing now. What happens is that the central government has a pot of money for housing. You then have a bunch of social housing associations which build and rent, and satisfy housing situations. These have a bunch of criteria…they've got to comply with local legislation and so forth. The agency is The Housing Corporation...one of the financial rationales for them to use these [technologies] is fuel poverty. These are social housing units, lower income, and people have problems with not being able to pay their rent. That's a stain on the housing association. If these people don't have big heating bills, that frees up money that lets them pay their rent. So while the financial rationales may not be immediately evident, you start to look around…

I mentioned this thing before [points at bottom of guide and reads a bit about capital costs]. So, if a developers comes to you and says "screw you, it'll take me x amount of years to pay this off," you say, "yeah, but energy costs are going to go up."

And another really important one is, some of the financial rationales – you have to look a little harder for them. If you bolt solar panels on your roof, when you're out during the day, and you're generating electricity that you're not using, you can sell that back.

Q) Photovoltaics are actually covered in a separate guide; we're not covering them in the renewable energy sources guide.

A) Ok, well…you can reference that, just mention that about PVs. If a developer builds a building without this stuff now, it may look good now, but in 10 years time it'll look like crap. There's no evidence of that [in the guide], which is like, wise up, do you want to be on board in 10 years time? [referring to developers building without "this stuff"]

I mean…[points to sentence on incentives to use renewable energy, adding after "UDP policy"] – "*and* regional and central government policy". There are more policies, and they can trump Merton policies – they need to respond to these policies.

[Moving on to page in the renewable energy guide wood chip burning graphic] Energy from waste…biomass…talking about generating energy from burning waste…it's very very controversial. I've written here that it's highly controversial. If you don't mention this controversy it'll compromise the guide, people will think "Ok, this is not environmental."

You can put it in as a potential renewable energy source, but if you don't say this is a controversial issue because of the Dioxins issues [burning waste releases Dioxins]…anyone with an environment background would take the guide and go "This is a worthless document"…it's like a red bullseye, that issue. Just take a step back and understand that, as a technology, it's debatable.

[goes on]…just the phrasing of the last sentence with hydrogen fuel cells…

Q) You seem to suggest that the guides should be very forceful with sustainable development, rather than just presenting the information. Would you rather the guides just present the material or really throw it at them [readers]?

A) Well, it's a marketing issue, isn't it. And I kind of don't know. On one hand... If you really push something at people, they can kind of back away from it, where if you kind of put it on the table and they take it, they feel it's their idea...

I think just idea of pushing the benefit, not the message...not, "Hey, do you want to murder children in the third world by not doing this," but push the benefits. Don't be proselytizing about this, but the benefits...this is an investment opportunity...that's what I mean by that, but don't turn this into a flag-waving sustainable development pamphlet.

Q) Any other recommendations?

A) No, I think I've gone over everything I wanted to.

**Interview with Alec Johnson**

June 17, 2003

Department: Building Control

Guides Reviewed: SUDS, Passive Solar

Q) Briefly, what did you know about SUDS and Passive Solar before reading the guides, and what new knowledge or understanding, if any, did the guides impart?

A) I work in building control, so I knew a bit about SUDS and passive solar design, because the building regulations deal with drainage, and in the latest revisions there's now provision for dealing with greywater. Also, rather than draining surfacewater into the sewer, there's provision for draining it back into the land.

Passive solar design is reasonably obvious, because we deal with SAP (standard operating provisions) for buildings, and we also look at the carbon regulations for building. So you can deal with basic u-values, you can deal with – there's the elemental method, and then the u-value methods, and then there's looking at the actual carbon emissions, and if your carbon emissions are within certain levels, the building would comply. You look at everything – the level of glazing, type of glazing, type of boiler, ventilation…

Q) Did you learn anything new?

A) Not personally, no. But I think they're useful for [homeowners for?] convincing developers.

Q) Do you think the guides are more useful for homeowners, rather than for developers?

A) Well, there are a lot of naive developers out there. Builders will stick to the minimum requirements, and they don't go above that. I went to a seminar, and the lecturer was saying, "You should convince developers to go beyond the minimum." But they never do.

Q) So you think that there needs to be more in the way of incentives?

A) With the passive solar, I think they need to be told that they get the full support of development control – that we support them.

I think that also you need to point them in the right direction, not so much with the passive solar, but certainly with the SUDS scheme – where they can go with the porous or pervious parking surfaces, and that sort of thing. It probably needs a bit more guidance on where they can get that sort of advice.

Q) Do you mean that the passive solar guide doesn't need to refer to further advice?

A) I think that if you want to talk about solar panels, that does, and the cladding you talk about does, but a lot of it is fairly obvious. South-facing windows, that a conservatory will give you a buffer, that concrete and brick-block provides heat absorption…I think that's quite useful for people to know. Also, that black surfaces absorb more heat. So I think that's reasonably self-explanatory. Certainly if there's more technical information in the guide (I read it quite quickly), than more on that could be useful.

Q) Do you think it would be useful if the guides referred you to developers that could be helpful?

A) It would, but you have to be careful, because the guides are put out by the Council. But there are certainly organizations out there. In building control we have a folder with information on the back, and it points you at further info. Like there's an energy design consultancy in [PLACENAME?].

Q) After reading the guide, what was your overall impression of the feasibility and commercial viability of passive solar design and SUDS in Merton?

A) I think passive solar feasibility is very possible. As long as you can get the backing of planning…you know, if you've got a building with all its windows south-facing, how is that going to blend into the surroundings?

Q) What about SUDS?

A) That's fine. I think that's very feasible.

Q) Did you believe the guides' content to be accurate? Would a Merton developer believe these guide to be credible?:

A) Yes. Though, you know, a few more pictures might help, photographs of…

Q) What kind of pictures would you recommend?

A) Well, I'm thinking…it's difficult to have a picture of a pervious and impervious surface. But the criss-cross patterns of…

It's difficult. But I think pictures help as well. Long documents can be monotonous, and pictures help break them up. You can put graphs in, I suppose, where you look at heating cost comparisons and that sort of thing.

Q) Do you feel that the guides' overall focus is appropriate?

A) Yes. And architects I suppose…and for architects it may not be technical enough, but…for developers. And you've got to get the owners, which are the developers and the clients, onboard.

Q) You said that they would be useful to developers; do you think that they're just useful to developers, or to Merton staff as well?:

A) Yeah, I think they may be useful to Merton staff as well, especially if they just triggers an idea. They won't be relevant to someone who's not building a house, or buying a house, but they may get them thinking about the usefulness of a conservatory.

Q) Do you know if there are building regulations on how much glass you can have on the outside of a building?

A) For something to be considered a conservatory, the roof has to be 70% glass, and the walls 50% (this is a loose guide). If someone builds a conservatory in the back of the property and it's less than 30 square meters in area, and they maintain the separation between the house and the conservatory, that conservatory will be exempt from conservatory regulations. In this country there's a tendency to build a conservatory as part of the house, including heating, and that defeats the whole point of a conservatory. In some cases a conservatory can be very useful as a buffer, but if they're abused that can be very wasteful.

Q) Do you have any other recommendations for the guides?

A) I don't think so, but if I think of any other suggestions I'll let you know.

Q) Your survey responses on the SUDS guide indicates the need for more incentives, including cost information, and more reference to additional resources. Can you speak more about that?

A) You need to kind of convince developers. You've got to sell it to them, don't you. Developers and owners need incentives. You can convince them of the environmental benefits, if not the financial. People just won't do it unless they see something, whether it's their conscience or concern about their finances.

Q) Your survey responses on the passive solar guide indicate a need for more policy and grant information. Can you speak more about what we should add?

A) Probably where they can get further advice, I suppose. If the developer wants to expand…they've read your guide, they've got that info. Now, where can they go to expand?

Q) We should point out places where they can get more information?

A) Yeah, I think you should.

**Interview with Francis Saayeng**

June 19, 2003

Department: Development Control

Guides Reviewed: SustMat, RES

[Note: Francis Saayeng's two surveys were pretty much identical, so references to survey responses apply to both guides].

Q) Briefly, what did you know about the guides' topics before reading the guides, and what new knowledge or understanding, if any, did the guides impart?

A) I think the only knowledge I picked up from the guides is on solar energy, and uh…windmill energy.

In reading this guide on materials I've actually learned a lot because, um, I've learned about this geothermal energy, which is pretty, well, good. And it's well documented – just the way you've laid it out. And quite easy to follow.

Now, the biomass [section] is also quite clear. Biomass energy. Um…well, can I just comment about this geothermal energy? It's quite good, but in terms of examples, I mean, I don't know whether there are any examples within the Borough or within the UK that you can point to, just in case somebody wants to…they can go and have a look, and they want to see whether they can [build?] a similar type of development.

Q) There's some progress, but there's not much of anything we can point to. There is some research, just on the area's geological condition, but we don't know if we can put it in the guide.

A) Just in terms of this geothermal energy, if somebody would like to use it, and we are more or less incorporating this in our Unitary Development Plan, they're going to need to know the type of rocks in the Borough. For example, if I want to build a house in Wimbledon and I don't know the type of rocks, I can't use this.

Q) London is on a bed of clay, and our understanding is that it's an appropriate depth to use this. The other geological stuff comes into play when you go below that, when you start looking at the hot rocks and stuff, but particularly for the heat pumps, they're not getting down that deep. But addressing the geological formation makes sense.

A) I was going to pick up[talk about?] the windmill that you referred to. You're quite right in terms of the wind in Merton. I don't think we have many hills here...[indicates that windmills probably can't be used in Merton]. You're probably right in terms of pointing out technology that's going to be successful within the Borough.

Q) After reading the guides, what was your overall impression of the feasibility and commercial viability of the guides' topics in Merton?

A) The feasibility. Uh...well, in terms of within the Borough, I think some of the energy resources are feasible, so...uhm...it's a question of which ones can we promote. And, if we can...[if] we know those that we can promote, then we can implement that in the development plan, in the policy that's in place in this second UDP draft.

Q) So you feel that these technologies are feasible within Merton?

A) Yeah, they are.

Q) Did you believe the guides' content to be accurate? Do you think Merton developers will believe that these guides are credible?

A) Yes, I do. You want to convince them…we need to convince the general public that the information that is presented is accurate and credible. And to support that, we've got…umm, the references that you've given after each study, the references. So if I'm doubting the credibility of it, I can make references to this, references you've given.

Q) Do you feel that the guides' overall focus is appropriate?

A) Yeah.

Q) Looking at your survey, you felt that the amount of cost information was appropriate…

A) Ah, cost. I felt that it was appropriate…but in some of the given costs, I felt that…in some of the…

It's the cost of running the house and heating the house that you put in there. What about the cost of doing it [initial cost]? I don't know if you have any – it's difficult. Each development would depend on the …the size, the location, basically. I'd want to find out, in terms of the…if somebody says they'd like to…implement the geothermal energy. Now, they'd want to know the overall cost. That is, the architects – how much are they going to charge for the drawings. The implementation…the overall general costs. Drawings, implementation, and running.

The rest, I think, in my view…appropriate, appropriate, appropriate [pointing at his answers to questions 8, 9, 10, and 11] there. The question 12 [points at the survey]…incentives to use sustainable development…I said "not enough", not enough because…uhm…in the guide, I mean you've talked about the benefits of each, but then it is difficult to get developers because of the cost involved, they have to have a margin, a wider margin because of the cost involved, to convince them to want to go down this route.

So the incentives, I mean, when you say incentives…I don't really understand when you say incentives, are you referring to like, well, "if you use sustainable development materials you are going to get x amount of grant"?

Q) Well, we mean cost incentives, environmental benefits, policy requirements…anything that would get developers to implement sustainable technologies.

A) In that case, if you can tabulate all this in your guide, it would give more, more, more incentive to people to want to use it.

Q) We've had a problem with some technologies where the cost benefits just aren't there right now, and also problem finding any costing information for some things.

A) What about in America?

Q) There's some spotty stuff, but, for example, with fuel cells it's still developing so quickly that no one's willing to publish financial information until it slows down and the information isn't going to be out of date in a week or 10 days. But with the geothermal stuff, it's still being analyzed, and until it's really implemented no one wants to put out numbers with their name on them, because it's still changing. So there isn't really a lot of cost information out there…there are a few general statements on, "we expect it to save money eventually," but it's difficult to put facts behind.

A) Ok. I'm aware of the…something I'm aware of…Tim Cutts [a Merton Development Control officer] dealt with that one…the solar one [Tim Cutts reviewed the passive solar guide], because I know people are using the solar design, because it's quite easy to implement, and cheaper to run. But still, people are not convinced, because there isn't enough information out there for people to rely on.

[Moving on down the survey] Uh, now…grants or financial support…I haven't come across, I don't know whether I missed that in here [points at the renewable energy sources guide]…

Q) No [shakes head]

A) Ok, I haven't come across that…what if people come and say, ok, where can I get financial support?

Q) Well, the students working for Adrian [Hewitt] are working on a database of funding sources, and we're planning to reference that once it's complete. There's some stuff out there…not as much as people want to see…there's some stuff out there, it just has to be put in.

A) [moves on to where he's indicated a need for more reference to additional resources] Ok, reference to resources…if you can add more reference to resources than what you had in there…

Ok, let's see [looks at question 15, "What is the most important thing needed to improve this guide"]. Yeah, this is my lengthy background thing [reads from his response]"To include its contents in the UDP and SPG ensuring members support it." From my point, it's straightforward, and to improve it, just promote it, basically.

Q) Do you mean that the most important thing to improve this guide is promoting it?

A) Promoting the guide will improve it. For example, if you print the guide into small booklets, or pamphlets, where the public can come in and pick them up, and read it – they will know all this stuff.

Q) We're actually producing a separate pamphlet version of the guides, and adding pictures to both versions…

A) Pictures, well, um…yeah, that would help to improve this. But if you have examples of properties that you could include…

Q) When you say, "include its contents in the UDP and SPG"…

A) Yeah, for…Merton Council to be able to say, look, this is the best type of energy to use when you're developing your property…yeah, you can say that, but to have a legal background…the only way to have a legal background is through the UDP plan. That's the statutory recommendation of the Council.

Q) So you're saying tthat to have an effect, use of the technologies we discuss must be enforced with UDP policy?

A) Yeah. For example, the council has approved an office block to be built in Wimbledon. And policy E13 requires them to have the heating system…they have to use sustainable materials. And that is part of the commission. And we couldn't have done that if we didn't have a policy in the UDP. So policy E13 of this UDP enabled the council to say look, we have granted this permission – in terms of developing this office block, you have to use sustainable energy to develop it.

And the council has got the power to take action if, in developing the office block, they don't use sustainable materials. Because that is the statutory policy, and we can take enforcement action against the developer. Without that, we couldn't.

The SPG… supplementary planning guidance, is part of the design guide for the council.

Q) [Points to second sentence of response to question 15] This is what you were taking about with pamphlets, yes?

A) Yep…well, there's also, if I hadn't read this, there are a lot of things I'd not be educated about. What I was saying here...there is a need for architects and Development Control officers to be educated. So that the architect or Planning or Building Control officers can advise the general public about the use of sustainable energy or renewable energy.

Q) So, then, do you think the Development Control officers aren't educated enough to advise people?

A) Well, we are, but we didn't know about these kind of energies. So with the guide material we are educated enough to advise people. When we've got the guide material we can use it to advise.

Q) Can you talk a bit more about the role you think Building Control should play?

A) Ok. The Building Control officers, they are responsible for inspecting the structural part of buildings when it's being built. So they will be able to advise builders how to implement these type of various energies. And also they will be able to convince the owners of houses or developers that look, it will be cheaper to run, these energies, and they will also inspect during the development works. And also in terms of the drawings, they would be able to approve drawings that are submitted.

Q) [looking at the response to question 18] The guides need more examples of sustainable developments in the UK, you say…

A) Yeah.

All these various departments, we work together to, um, bring about the built environment.

Q) Do you have any other recommendations?

A) Recommendations? [thinks]…that's a big question. I can't think of any recommendations right now, but if I do have any, I'll come back and let you know.

Q) Oh, here [on question 20], you mention that Environmental Health professionals and Engineers may use these guides. Can you tell us who you mean by "Environmental Health"?

A) In terms of the health, if you are living in a residential property, for example if there's poor heating, it's an environmental health issue, they will look into it. Engineers…well, basically, if you have complex buildings, you need some kind of engineering to achieve a good building works. So I think that the engineering drawings come into it.

Q) Do you think these guides are suitable for all those audiences, or that different guides should be tailored to each?

A) No, I think these are suitable.

**Interview with Lone Le Vay**

June 19, 2003

Department: Plans & Projects

Guides Reviewed: PSD, SustMat

Q) Briefly, what did you know about the guides' topics before reading the guides, and what new knowledge or understanding, if any, did the guides impart?

A) I knew a little bit about them, more from an architectural more than any other sort of view. There's a lot in the architectural press that sort of focuses on the issues. Both on materials and passive solar, though.

Q) After reading the guides, what was your overall impression of the feasibility and commercial viability of the guides' topics in Merton.

A) I think they were sort of practical, basically. They seemed feasible to me.

Q) Did you believe the guides' content to be accurate? Would a Merton developer believe the guides to be credible?

A) I think they certainly seemed accurate in terms of, you can get materials that are either recycled, or reclaimed, or ones that are energy efficient.

Q) So you think the guides do feel credible?

A) Yep.

Q) Do you feel that the guides' overall focus is appropriate?

A) My overall comment would be sort of who your target audience is – is it homeowners, is it developers…

Residents would be interested in what they can do, what they've got. Developers would be looking at what they can build so maybe it's a case of defining new buildings from existing.

Q) Do you mean that the guides might appeal to both audiences, or that the guides aren't clear about what audience they address?

A) I just thought both audiences might be interested. Maybe developers would even be interested in existing buildings, so maybe you could focus more on buildings that are already there…if you're replacing windows, how you replace them, that sort of thing.

Q) Did the guides focus too much on new construction, then?

A) Possibly, yeah. I think in an area like Merton, quite a lot of development is on existing buildings.

Q) We did consider that, but part of our problem was that it seemed that many passive solar techniques are only feasible for new buildings.

A) Well, even if you were adding on a conservatory to your house, you could talk about how to locate that…maybe a diagram of how to locate it. Or when people add in lofts, there are sometimes opportunities to adapt the roofs.

Q) On the passive solar guide survey you indicated that there was not enough information on cost. Can you elaborate on that?

A) I think if people have an idea of what the savings are likely to be, that can persuade. Kind of say, if you're going to do this, it will pay for itself in so many numbers of years.

Q) We actually had a lot of trouble finding costing information on many of these techniques. It seemed that a lot of the information wasn't available.

A) Yeah...these sort of things kind of change with time, though, so maybe if that kind of information becomes available it can be added to the guides. Kind of a working document…I don't know what kind of cycle you'd use to update it, probably fairly frequently. [Also,] if they have a new development in the Borough and they follow the guidelines within the guides, you could ask the developer at the end of the day to provide some feedback, and maybe [have the guides] review it [the development] over a period of time.

Q) You also indicated that the passive solar guide did not have enough on grants and on additional resources…

A) It would be useful, as I think there are quite a few grants available. Just a list of names…community type projects, you know, if you're doing community sustainable building.

Q) You also noted problems with the layout. Can you elaborate on that?

A) It's just sort of…diagrammatic. Maybe showing how site layout would work, you know, where the sun is. I think you could find, you know – there are publications out there. Just to illustrate the tree planting, you could have a diagram showing how to plant it and so forth. And there's one [part in the guide] about how light reacts once it's gone through a window; you could sort of show that.

Q) You mentioned that there could be a shorter version of the guide for homeowners. There actually is a homeowners guide being produced; we really aimed these guides at developers, and also at Development Control officers. Do you think that the homeowners guide is the right approach, or should versions of the mini-guides be made for them?

A) Maybe cross-reference them. If they're interested in that, they can see, oh, I can get this document, which is related.

Q) You noted that the sustainable materials guide did not cover enough material…

A) [noted that she added comments about that in a version of the sustainable materials guide she sent to us]

It's not just the materials, it's how you use them, and the sort of detail with building.

Q) With your notes on cost information here – is that the same issue as you noted with the passive solar guide?

A) Yeah, it's a similar sort of thing. It might be a bit easier to do with materials…[shows BedZED pdf on sustainable materials]...in this, they went into quite a bit of detail…what the cost implications of using one type of construction or another type of construction are.

Q) And where you noted problems with information on grants and on additional resources?

A) In that one, it said sort of "reference here", and I think he's planning to put that [more references] in– it had sort of gaps. And I was saying that would be useful. The more, the better.

Q) You noted a need for cross-references to other guides…can you go into that more?

A) I think the one on passive solar sort of does. Certainly I think there are connections between…so I think the sustainable materials guide should sort of [cross-reference], because I think they sort of work well as interlinked guides, rather than standalone guides.

Q) You note that there needs to be information on organizations that can provide expertise…

A) I mean – I can't think of the exact ones…you'll probably find there's [organizations concerned with] alternative building materials, so maybe search and put a few of those in. Maybe suppliers, like suppliers of recycled materials. You know, how do you find where a building site is to get steel or…

Q) So do you mean organizations that provide expertise, or suppliers of sustainable materials, or…

A) Well, sort of both. I mean, there are organizations, and then there are sort of…[suppliers like] recycled yards…

Q) You suggest here that case studies based on a fictional or real building project would be useful. If we can't find real case studies on certain technologies, do you suggest that we create an illustrative fictional case study?

A) You could theoretically…I mean, architects sort of do costing for buildings, and you can sort of figure out a square meter price. You should be able to come up with a sort of square meter price for sustainable materials and compare with more conventional…might take a bit of time [laughs]

Q) When you note here [on question 19 that the guides are useful to professionals and homeowners]…do you think that these guides are not particularly useful to Merton staff and Development Control?

A) I don't honestly what sort of detail they [Development Control] go into. I think it's really for them to…the question I would have is if they refuse something [planning permissions for a proposal] because it was not complying with the guides, how would the appeal go…is it a valid planning…probably worth asking them that question.

Q) Do you have any other recommendations?

A) Not off the top of my head, no. I think I've covered most if it in the ideas that came up. Apart from, you know, make sure you update it on a regular basis, because I think more is going to be happening as time goes on.

**Interview with Nick Smart**

June 19, 2003

Department: Business and Environment Partnerships Unit

Guides Reviewed: RES

[At the beginning of the interview, Nick Smart let us know that he had skipped lines in some parts of the guide due to time constraints.]

Q) Briefly, what did you know about renewable energy before reading the guide, and what new knowledge or understanding, if any, did the guide impart?

A) Um…I knew about solar, which isn't really covered here. I know a fair amount about solar. And I know a little bit about wind power. But not about all the others, and so I was very interested in reading, you know – the geothermal thing I thought was very interesting. So, yes, I mean I learned quite a lot new. Except, where I said, I decided to skip because of lack of time. But it will look relevant and interesting. Obviously, the relevance to Merton is depending on the technology type. On the other hand, if it's at all relevant to Merton, I think it's worthwhile to include them, if only to challenge people, and inspire people. So I think it's all a good idea…I mean, I had slight reservations about hydrogen [fuel cells], if only because I didn't read it thoroughly, so I didn't understand all about it…but if it's at all relevant, then fine. At the end of this, where you say [pointing at the wind section] that it's not really relevant because the wind speeds aren't high enough…I was going to ask you – I mean, if it's not relevant at all, then I'm not sure it's got a place in this guide.

Q) They're developing turbines that don't have the same requirements, so once they've got this basically new urban turbine, we can include that.

A) Well what would be really useful would be to put turbines on the tops of buildings…obviously, what you could put on the top of a building, I mean, in a place like Southwest London there's very little land available. And [there is] this huge competition, land use allocation…to allocate a little bit of land for wind turbines is never going to be an advisable option. However, if you're building a new building anyway, you might as well put a turbines on the top. [In] industrial areas, where we have lower standards of physical appearance – people expect industrial areas to be ugly and functional – that would be one area in which turbines on the roofs of buildings would be acceptable. The question is therefore – wind power would certainly fall within our [UDP] policy E13 [which requires renewable energy use]. The question I have is a technical one, which is – what would be the marginal cost of putting a wind turbine on the roof of a building anyway, and would it significantly affect the engineering cost of a building anyway.

And the second question is, in this area – you've kind of answered it, with this second generation of wind turbines that would work in this area. Maybe [in the guide] you could be explicit about that.

I mean, I think….yeah, if you, rather than ending your wind power section with "however it's not very relevant to Merton because of lack of consistent high winds", say what you've said to me [about second generation turbines]. And if you can put anything about the extra costs in infrastructure so that you can take a reasonably….well, I would have thought that a tiny turbine, like – [points at a nearby fan] like that might be able to run something. Is there…

Q) Well, the development of a turbine like that is generally more expensive than the electricity it generates. But something along those lines might be at least theoretically feasible.

A) I mean, I just don't think any owner of land in the Borough would find it economically feasible to have this big turbine sticking…I mean, even if it wasn't physically a problem, I just wouldn't think it'd be able to compete.

Q) After reading the guide, what was your overall impression of the feasibility and commercial viability of these renewable energy sources in Merton?

A) I…my overall impression was that these are the more marginal technologies, in terms of their economic value. And I think you agree with that.

Q) Did you believe the guide's content to be accurate? Would a Merton developer believe this guide to be credible?

A) I think it came across as credible, but I'm not really sufficiently technically equipped to be a good judge of that. All I can say is, I would have believed it if I had no other reason to disbelieve it.

Q) Do you feel that the guide's overall focus is appropriate?

A) Yeah, I mean given that it was kind of sweeping up the technologies that haven't been covered in more detail before [in other guides]. I can't think of any technologies of importance that it missed. So yeah, it's fine.

I mean, bearing in mind, with these things you have to keep reminding yourself who it's [the guide is] for. And I guess the brief you've sent to yourself is that it's for architects, engineers, developers involved in new development in Merton. I mean, it's not for potential occupiers, although it could be I suppose if the occupier was going to be commissioning a building for their own use. It does the right kind of level of job. I mean there will be people who will be employed right from the start on the design and engineering of buildings who will know more than is contained in these guides, but there are a lot of architects and engineers whose knowledge of this is actually quite limited.

[Gave an example where engineers with sustainability expertise were called in to help with a development in Merton.] They wouldn't have been called in at all if this policy [UDP policy E13] hadn't been in place. The guides will have a role in the early stages of our negotiation with developers. More so that the client…these will be particularly useful for the client or the client's agent, the landowner or whatever, at the very early stages, partly to give them a good enough understanding of what our requirements are, that they can then go on to brief a specialist engineer, in…what do they call it…facility engineering is what they call it. Designing the air conditioning systems and the lighting systems and whatever. If you've got access to this level of information, it's much easier to both choose the right consultant and brief them effectively. If you don't know what you're talking about it's very difficult to brief them on what you're supposed to do, and I think these [guides] sort of provide a very good level of understanding.

I know that from these peoples' points of view…you know, the landowner, the client, the potential developer – one of the things they always ask early in the process is, where can I get technical advice on this? So there is an important role to be played…by a list of local business and local engineers that specialize in renewable lighting systems, and that sort of thing. That's what they most want – you know, who can we turn to meet that kind of requirement. But I don't think that it [the list of potential suppliers] [should be] in the mini-guides. You know, we're all on a learning curve like this [raises hands very high] here. But you've got [could have] a little list like that [shows a list of suppliers he has] that you can compile. Obviously it can grow, and grow, and grow, and grow, but since it can change, it's not appropriate for this. And because you're always going to leave somebody out, you're going to receive charges of preferential treatment and that sort of thing. So you've got to leave it out, for reasons of propriety and so forth. But that's what they most want.

Q) [Looking at survey] You didn't answer the question on cost…

A) Umm…yes, that's right, that's because I had something specific to say. I felt that there wasn't sufficient clarity in the cost sections [of the guide]. Not sufficient distinction laid between capital costs and revenue costs. And I just, I mean – for example, you've got an...there's a sentence here [looking at guide]…Yeah, "By using renewable energy techniques, the cost of providing power to run a building or the cost of heating and cooling a building may be driven down, especially if energy conservation measures are implemented, however it is possible that energy costs may increase." There are a number of sort of ambiguities in that sentence. I think the text is actually saying a number of things. First, you're saying the capital costs may be high, but the revenue costs to the owner, the energy costs to the occupier...I think you need to distinguish between the capital costs to the owner and the energy costs to the occupier. And when you say that the energy costs may increase, now – which energy costs? Do you mean the renewable energy costs? Or the costs from conventional sources? I might suggest that you – in your introduction you might say a little bit more about the possibility of rising…the markets for conventional energy sources, the costs are expected to rise simply because of shortage. I mean they are rising, aside from the environmental costs.

You might put in a bit about security of supply. And what I call the sort of sustainability that comes with dispersed generation. Not just that these are environmentally sustainable technologies because they're renewable energy sources, but the very fact that they can be adopted all over the place, and so the generation is dispersed, is a more sustainable way of supplying your energy requirements then it all being delivered by an offshore source. I mean, even a wind farm, even if it was supplying 100% of your energy requirements, is insecure, in that you could knock it out with a nuclear bomb. It's insecure in that sense. I mean, you might even mention terrorist threat. I think it's worth mentioning that in the introduction, as…it's a separate reason, it's not a reason for using renewable energy, but it's a reason for generating energy in a dispersed way.

Q) You have a question mark over "Relevant Merton policy" [question 11 on the survey]…

A) Yes, I'm not quite sure what you're…can you put that question another way? I don't quite understand the question.

Q) We're referring to Council policy – like E13 – that either requires developers to implement sustainable practices, or is in some other way relevant to sustainability.

A) I see. So…attention to Merton policy. Um…I think you've mentioned it enough. I thought that there it [the guide] was a bit confusing. It sort of takes you away from these issues. I'd sort of mention it here [points in guide]. You've mentioned it perfectly well there [points in guide]. I think you might find people…there are several distinct benefits…complying with UDP policy isn't a benefit in of itself. But I think what you have here is just right. Yeah, I mean that's quite adequate.

Q) You didn't answer questions 13 or 14 [on grants and additional resources]…

A) Umm, yeah…the incentives question [referring to question 12]...let me rephrase your question...did you give too much…does the mini-guide emphasize the incentives to use sustainable development enough. Umm. You know, the costs are the main incentive for a lot of people. There should really be more on financial assistance, but I gather that there's a separate – it wouldn't be appropriate to put it in here, because there's a separate mini-guide [referring to the funding database project] on financial assistance.

Q) The team working with Adrian [Hewitt] are working on that, and when it's completed it'll be referenced in the guide.

A) In that case, as long as it's referenced I think that's an appropriate level. [changes answer to question 12]. I suppose you could consider…I think all of these technologies would be eligible for our grant scheme. You know about our grant scheme, do you? [Finds for grant scheme information packet and gives it to us] It's a new scheme. We haven't got a lot of money in the pot. But…I think that all of the technologies you've got in the mini-guide we would treat as eligible for the financial assistance we're talking about. And it may be a good idea to list all these technologies explicitly. [Points at a sentence on the grant packet] Here, we might expand that to cover the sort of technologies you're covering [in the guide], even though they're less economical…and you can cross-reference that in your leaflet. But you don't want to cover all of this finance information and the available sources of funding for each of these technologies in your pamphlet, would you.

Q) [Points at survey where there is a note on integrating the solar mini-guide with the renewable energy guide] What you've got here…

A) Yeah, I was wondering whether it's a good idea to integrate all these together with the solar mini-guide…

Q) We think the point of having them separate was to put the emphasis on the solar as the most economic and feasible.

A) [Agrees] And it's more efficient that way, isn't it.

[Moving on the question 15] Yeah, this is the point I made earlier actually. I think you need a section in the introduction…a general section…what I said was, relative cost advantages of these renewable energy technologies will change over time. It's just a general point, and it's an obvious point, but it's something that consumers will need to be reminded of. [Reads out the next sentence of the survey question response] "General reference to possible future changes in the markets for conventional energy – e.g. increased costs, insecurity of supply etc." That in itself is a justification for the dispersion that I was talking about earlier.

But overall I thought it was clear and helpful and interesting. Obviously the actual design and layout [which was not completed in the this draft of the guide] was another question.

Q) Can you elaborate on that?

A) Sure. I mean, I think it's quite important to resist…I mean, I suspect you will show this to people who'll say it's a bit dense, it doesn't leap off the page, it's not sexy – it's not instantly readable. I would say if anything it would be best to resist the temptation to simplify. I think that by the time this gets picked up by people….it is well pitched at the level that the kinds of people are going to need this information. People who really do want to understand, at a basic technical level. I mean, apart from anything else, we produced a ….we're in the process of producing…a directory of all the businesses in the Borough. And we've got a section on renewable energy – it's very simplistic, it's just a checklist. That serves and we…if we use that kind of information before, we'll refer them to the more detailed guides that you've produced. So I think it serves its purpose well.

Q) Do you have any other recommendations or feedback?

A) I mean, you've done a great job just at the right time for us here. And it's, um…it's going to be very helpful having these around. I mean, I'm among other responsibilities around here the person who has to start negotiating, you know – shoving this policy down the throats of architects and developers. Hopefully I'll get enough early warning of developments that don't fall within these guidelines. And I'll be using these guides.

I've scribbled here under geothermal heat pumps, in the cost section [points out some comments on the copy of the guide he reviewed].

Umm…under wind power, I thought you were missing a cost section. There's a cost section in relation to all the others, but not that.

That's all, really. I thought it was very good.

**Interview with Tim Cutts**

June 19, 2003

Department: Development Control

Guides Reviewed: SUDS, Passive Solar

[Participant starting giving feedback before any questions were asked]

A) One improvement you could maybe make was to add some more graphics or more diagrams. [shows the SUDS guide as an example]. Generally, I think the more graphics you can put in, the better. Keep people's attention, and...some of this stuff is quite technical as well. I think that's [pictures are] quite important.

Another comment was maybe you could provide some more links to other web pages or other information...sources. Books, or a bibliography...books, or whatever. I know, because I just finished my masters degree in town planning, and we looked at these kinds of things - there are there are some quite good books.

Q) Do you have any suggestions?

A) Yeah, I think...there's one – I think it's called "Sustainable Settlements", By a guy called Hugh Barton. That's quite a...he was actually my tutor, but that book is quite commonly used, I think, by university students, and also certainly professionals. And it's got good diagrams and that sort of thing. I don't know if on the...the web page for the Office of the Deputy Prime Minister [http://www.odpm.gov.uk], I think they've got diagrams, and...links to sustainability resources. If you have a look through there, there are lots of guides. But I think yeah generally if you could provide more links, and that sort of thing. Because what I think you're providing here is an introduction, so you need to point people at where they can go to get more...more information.

Just looking at some of these questions here…um….This one here, on [question] 13 [on the survey], grants and financial support…you didn't really provide…I didn't see much information in there on…maybe you could put some information on there. I wasn't sure what you meant by some of these questions as well, when you say "relevant Merton policy"…what do you mean by that?

Q) That's Merton policy that might provide incentives for developers – or require developers – to implement sustainable practices. Like [UDP policy] E13.
A) Ok, ok. Yeah, then I mean maybe, for example in…the passive solar design, or in the ones Francis is doing [the guides reviewed by a colleague]…there could be a reference to that policy.

Q) Briefly, what did you know about the guides' topics before reading the guides, and what new knowledge, if any, did the guides impart?
A) Umm…since I looked these things last year in my masters degree, most of these things are still quite fresh. Um…they're kind of technical things, I guess, that I've learned from these documents. Just looking at this first page [of the passive solar guide], things like structural insulation panels, which are quite new to me.

Q) Do you feel that there's enough info on structural insulation panels to see how to use them and how they're useful?
A) Yeah, generally, there's enough here that I can get the gist of it. I mean, if I wanted to know more, maybe… links to other sources of info.

But, I mean, I'd probably compare to…certainly a lot of householders within Merton, or even compared to a lot of developers….I mean, I probably know more than most householders would know about these things. So I did, yeah, I did learn  fair bit about these things…it was mainly technical – structural insulation panels...

Q) After reading the guide, what was your overall impression of the feasibility and commercial viability of the guides' topics in Merton?

A) In terms of feasibility, I think – I mean, this provides you with an introduction. But you think – every situation is going to be different, so…I mean, you contact a specialist to see for your situation. I mean, it's difficult to see just from the introduction what the feasibility might be. [looks at the guides]…talking about feasibility, and planting [a technique in the SUDs guide] for example here.

Yeah, no, I think in terms of feasibility you've included a range of different techniques and technologies. From very simple things like growing ivy up your building to more complex things. But I think you need again more links to further resources.

Q) That's useful feedback, but what we really meant was, not whether the guides provide enough information on feasibility, but – do you think that the technologies that the guides cover are feasible in Merton?

A) In principle, yes. But I'd say that there are costs associated with them, and depending on the scheme, these costs will vary. I recently went to an EcoHomes project, and we were looking at costs there. And I know the lady giving the presentation said that it was still very expensive to put solar panels on your roof, and that the payback time was still 15 or 20 years, with the kind of tech that they have there.

So I think that's one of the issues, the cost.

Q) We're a little confused about the survey questions you left blank…

A) Sorry, it was…I was kind of wondering…I wanted to go through them in the interview with you. I think it's sort of appropriate what you've got about the feasibility here…[circles an answer on the survey]...environmental benefits…maybe you could say a bit more about the environmental benefits.

Q) And that's for both guides still, you're saying?

A) Mm….yeah. Maybe you could say a bit more about the environmental benefits…and the benefits to…individuals. The financial benefits…

How the techniques work [circles an answer on the survey]…though I think you should put a bit more…diagrammatic information. At the moment it looks quite…quite dense. [circles another answer on the survey]. Mmm…link those two together [draws a line between his answers – that the guides have "not enough" information – on "environmental benefits" and "incentives to use sustainable development"].

Yeah…in terms of…relevant Merton policy, I mean maybe we do have relevant policies that relate to…sustainable housing, in general, so maybe you could draw attention to those.

Q) Did you believe the guides' content to be accurate? Would a Merton developer believe this guide to be accurate?

A) Um, yes. Yeah.

Q) The guides sound credible?

A) Yeah, I think they sound credible, yea.

Q) Do you feel that the guides' overall focus is appropriate?

A) Um…yeah, yep. No, I think it useful, definitely, to have this kind of supplementary information. Because people to come to us with questions about these sorts of issues. So it's useful to have something to post to them.

Q) So you think they're useful to give to people?

A) Yeah, certainly, because people do ask about these sorts of things. I have an applicant [for planning permission], with the [UDP policy] E13 stuff, and an applicant was asking what sort of things they could do to meet the energy generation requirements.

Q) We've have problems finding examples of costing information and that sort of thing with a lot of these technologies. I don't know if you have any experience with that sort of thing…

A) Um...no…I don't know if they have on BedZED's site, they have information on that sort of thing. Or maybe on the EcoHomes Theamesmead website, they have information on there…

Q) Do you have any other general recommendations?

A) Umm…no, not really, I don't think.

**Interview with Paul Cannadine**

June 19, 2003

Department: Building Control

Guides Reviewed: Passive Solar Design Guide

Q) Is there anything you would like to say before we get started?

A) Who's the guide aimed at? I'm a building inspector, I look at designs, this is like an abstract, bits and pieces of the subject. I don't know who it's pitched at. Why are we doing this? [why are we producing the mini-guides?] It's just a light introduction to the subject.

Q) Did you have any previous knowledge of the topics covered in the guide?

A) Yes, from two sources of information, documents like this [retrieves a small booklet]. The national building regulations and approved documents, these are just one small part of legislation [the booklet's title was *Conservation of fuel and power in dwellings, 2002*]. There is one [of these booklets] for domestic and one for commercial properties. They contain the regulations for things like extensions on a building. There is no mention of national building regulations or the building act 2002.

Q) What was your general impression of the guide?

A) This is my personal opinion; I'm a building inspector in a poor part of London, we're talking about a diverse ethnic community, poor people. I think the ability of contractors and designers and architects… this is outside their scope [or capabilities]. If you got interested, educated and experienced people, this might have a chance. Designers and contractors must work together to have a chance.

Q) Did you feel that the guide was creditable?

A) I thought it lacked credibility.

Q) Why?

A) Who's it for? Why are we doing this? This field is not Merton [pointing to wind blocking picture]. When I see something like this [points to the other picture], I think foundations will be expensive to over come clay subsoil.

Q) Please clarify.

A) Trees take moisture out of the soil and clay which will make the ground go down and damage the foundation unless the foundation is stiff. This part here [Natural Lighting], you can't build an airtight building without immense care and supervision. The user won't know to keep it airtight.

Something important to building inspectors is means of escape. There may have to be special persuasions [for these techniques]. A two story conservatory may help circulate smoke in case of fire, this requires a means of stopping the smoke. Will the duct close in case of fire? I think you're putting extra complexity and cost into domestic dwellings. I just came back from a fire inspection course… this is up in technical expertise and that's expensive and a lot of clients don't bother with expensive expertise. Life safety issue… doesn't mention that glass can be a source of accidents. Doesn't mention safety glass or laminated glass.

Q) Did you feel that the overall focus of the guide was suitable?

A) Focused on the subject… it did.

Q) Did you feel that the level of detail was appropriate?

A) Not enough information, it sounds like a student project, it's just a taster of the subject.

I deal with entrepreneurs, this won't catch them. 'Ok, I'm interested, how do I do it? Where do I buy the materials? Will building inspectors accept it?' Needs references to sources of information.

[Looks through the questionnaire]

Thought that the layout was good.

I think this thrust will be a cost to the industry. It might be nice, but the cost to build will be up. I'm interested in data and details that help me make decisions, this guide doesn't provide that.

Building Control isn't mentioned, I don't like that, building technical details get forgotten and people go off and build their own development without consulting us.

Need to sell it more really. It might wet people's appetite but where do they go from here? Projects like this require intimately involved designers and developers like Robert Harris [I took down his address, telephone number and e-mail address]. If you change construction methods that people are used to, you need to put a lot of effort into educating them. Cost right across the industry.

When you think about it, things go wrong. People could misuse something new. The British public love altering their homes, maybe there should be a guide book telling homeowners not to touch sustainable development components.

There is a lot of failure of glazed windows in this country. Glazed windows are generally made at the project site and then installed. They should be glazed at the factory and then fitted into the building.

I think… I don't know what the purpose of this is, need to address who this is for.

Q) Did you feel that the guide content was accurate?

A) More like a project, more of a purpose to educate the writer. When I did my civil engineering degree… I feel certain that south facing windows don't give good reading light, there's a lot of glare.

Q) Should this guide address curtains and other shade blocking methods?

A) Yes

Q) Would a traditional developer take this guide seriously?

A) No, developers look for profit. Developers don't have the skills at present to do this. West Bury, a building contractor, set up the first factory to build houses and deliver them to the site, prefabrication which the public associates with defects. This guide might be relevant to this developer.

Q) You believe that educating the industry is the first step in pushing sustainable development?

A) First and most important, it is a weakness in development [industry].

Q) Is there anything else you would like to add?

A) No I think I've talked enough. [Collin nods]

# Appendix H – External Review Guidelines

The external review stage will collect important feedback on the mini-guides from their intended audience: developers and building professionals. The review should employ both a survey to collect large amounts of quantitative data and interviews to collect qualitative data from a smaller number of participants. This data can then be analyzed to find out what in the guides needs to be revised or improved before publishing.

The external review process should involve the following:

- A list of Merton developers, building professionals, and any other relevant persons who might be willing to provide feedback should be assembled.
- Copies of the mini-guides and the prepared survey should be sent to the selected review participants. A form letter suitable for emailing has been prepared for this purpose; it can be easily adapted for any desired print mailings. Most participants should only be given the guides most relevant to their area of expertise, as sending all four guides may discourage participants from taking the time necessary to review the materials. Developers with no experience particularly relevant to any of the guides should be sent any one or two of the guides to review.
- Those review participants who are likely to have especially important feedback or are willing to devote extra time to this review should be identified. These participants should be asked to take part in short interviews in addition to completing the surveys. An interview guide has been prepared to facilitate this process.

- Once the surveys have been returned and the interviews are complete, the collected data should be analyzed and the important problems, suggestions, and recommendations should be highlighted for a revision of the mini-guides.

## *External Interview Guide*

Interviews should begin with the interviewer briefly reading over the participant's survey response if they have not already had a chance to do so. This will give the interviewer an initial idea of the problems the participant has identified and the participant's suggestions for improvement; starting the interview with this knowledge allows the interviewer to ask follow-up questions on these with the participant.

All interviews should include the following questions:

5) Briefly, what did you know about and what professional experience have you had with [THE GUIDE TOPIC] before reading the guide, and what new knowledge or understanding, if any, did the guide impart?
6) After reading the guide, what was your overall impression of the feasibility and commercial viability in Merton of the techniques and technologies discussed in the guides?
7) Did you find the guide credible and accurate?
8) Do you think the guide will be useful to Merton developers and building professionals? Why or why not?
9) Do you feel that the guide's overall focus is appropriate?

Interviews should then proceed with questions that follow up on the participant's survey. To make efficient use of time, pick survey responses that are surprising or indicate a problem with the guide as the important responses to follow up on.

Finish the interview by asking the participant if they have any other feedback they'd like to give. After their response, thank them for their time and responses. Ensure that all interview responses are transcribed as soon as possible to a form that is legible and consistent.

## *Sustainable Development Mini-Guide Survey*

We appreciate your thoughtful, honest response to this survey. If you are evaluating more than one guide, we would appreciate your completing a separate copy of this form for each. The completed survey can be emailed to [ADDRESS] or mailed to [ADDRESS]; if you have any questions, you can reach us at [PHONE NUMBER]. Thank you for your time.

Your Name:______________________ Company/Organization:______________________

You are reviewing the mini-guide on (indicate one):

a) Passive Solar Design

b) Sustainable Materials

c) Renewable Energy Sources

d) Sustainable Urban Drainage Systems

For the following questions, please indicate one of Strongly Disagree (SD), Disagree (D), Neutral (N), Agree (A), or Strongly Agree (SA).

1) The guide will be useful to Merton developers and building professionals. SD D N A SA

2) The guide provides enough detail to introduce readers to the topics SD D N A SA

covered.

3) The guide is a credible source of information. SD D N A SA

4) The guide's organization is clear and logical. SD D N A SA

5) The guide presents techniques and technologies that are feasible to implement in Merton. SD D N A SA

6) The guide will encourage sustainable development in Merton. SD D N A SA

Keeping in mind that the guides are intended to present concise, pertinent information rather than comprehensive discussion, please indicate whether the guide contains enough information on each of the following topics.

| | | |
|---|---|---|
| 7) Costs | Enough | Not Enough |
| 8) Implementation feasibility in Merton | Enough | Not Enough |
| 9) Environmental benefits | Enough | Not Enough |
| 10) Available grants and financial support | Enough | Not Enough |
| 11) Other incentives to use sustainable development | Enough | Not Enough |

| | | |
|---|---|---|
| 12) How the techniques work | Enough | Not Enough |
| 13) Case studies and examples | Enough | Not Enough |
| 14) References to additional resources and information | Enough | Not Enough |

Please answer the remaining questions in brief writing:

15) What is the most important thing needed to improve this guide?

16) Does the guide lack information that it should contain? If so, what is it missing?

17) What were the important strong and weak points of the guide?

18) Other recommendations:

## *External Review Form Letter*

[Mr./Ms. NAME]

Merton Council is currently developing a series of mini-guides on sustainable development for Merton area developers and building professionals. These guides aim to give a brief introduction to sustainable development techniques and technologies and provide information on the reasons to implement these techniques, related Council planning policy, and Merton-specific cost and feasibility.

The mini-guides are currently at an intermediate draft stage. To better serve Merton developers, we are soliciting feedback so that we can evaluate the guides' effectiveness and revise them to increase their utility. Your input will enable us to deliver practical and pertinent sustainable development guidance. We would greatly appreciate it if you would read the attached guide[s] entitled "[GUIDE TOPIC FOR RECIPIENT]," and then complete the attached survey[s].

In order to allow us to improve the guides, we would like all surveys back by [DATE]. Please either email the completed survey[s] to [EMAIL ADDRESS] or mail it to [MAILING ADDRESS] by this date. If you have any questions or concerns, do not hesitate to contact us at your earliest convenience.

Thank you for your time and your consideration.

----

[Sender and Contact Information]

# Appendix I – Exploratory Interviews

**Interview with John Hill**

Manager of Development Control

June 18, 2003

Q) How often do developers come in for pre-application discussions prior to submitting a planning app?

A) On major developments we always expect developers to come in for pre-application discussions. For smaller developers it varies.

Q) Where do you draw the line?

A) A major scheme is actually a statutory designation - anything that covers more than 10 homes or [Some number for area - $1000m^2$, I think].

Q) When developers do come in for pre-application discussions, do they usually have a detailed design drawn up?

A) Some of them will and some of them won't. Some are seeking advice on sustainable principles, but some will have done that research already.

Q) Do you see the pre-application discussions as a good time to educate developers about sustainable development?

A) Yes, that is the appropriate time. But I'd expect that they'd have already educated themselves - but oftentimes we find that they've got a vague understanding of sustainable development. Major developers tend to have a better understanding.

Having said that, on a much smaller scale, we had a development with four houses, and the developer (who is a lecturer on sustainable development) made it into a kind of model for sustainable development.

One of the other issues with sustainability is that a lot of the time the guidance should actually be coming from building control, but we don't tend to work in tandem with them. A lot of the time if we have a meeting it'll just be with developers, but we feel that building control has a role to play as well.

Q) Are you at the present using the pre-application meetings to educate developers?

A) Yeah, we are to a point, but most of the work on sustainable development has been done by development planning, and to some extent the BEPU (headed by Adrian). If it's a major development, we'd like to bring in those offices as well. I think there's a need for training in my offices here. We understand the principles, but we haven't done a lot of the research work.

Q)When developers phone you, are you pushing sustainability at this point as well?

A) No, we do that in a formal meeting.

To give an example, for [A recent major development in Wimbledon], we had a meeting with the developers, and we told them that we expect that sustainability will play a major role in their development, but we also refer them to the BEPU, and that sort of thing.

Q) Are you pushing sustainability then more for major developers?

A) Yes. Particularly mixed use developers. It's very hard particularly to push sustainability on small homeowners.

Q) Do a significant percentage of those designing buildings in merton request materials on sustainable construction from the Borough?

A) Yes. Every new development, we always push a condition on the planning permissions requesting information on their use of materials. That initially evolved out of a need for good design - that's why I think that our colleagues in building control have a role to play.

Q) But do the developers request materials from you?

A) No, they don't.

Q) As they don't, does Development Control have any plans on how to get the necessary information out?

A) We don't. I see that as a role for development plans. They're obviously playing a role in sustainable development plans. What we do have is a sustainability checklist, but in terms of sustainability plans, I see that as being very much led by development plans. [Note: John Hill refers to "Plans and Projects" as "Development Plans".]

Q) How is the checklist used here? Is it used to actually deny planning permissions?

A) No, it's used as an evaluation. So in the assessment we'd comment on the checklist evaluation, but we've never refused, to my knowledge, planning permissions based on the sustainability checklist.

Q) You see plans and projects as the driving force behind sustainable development policy?

A) Yes, yes. Though we'd be feeding into that as well.

Q) You mentioned before that building control should play a role. Can you elaborate on that?

A) Yeah, they assess things like new windows, insulation, drainage issues, and that sort of thing. Matters that we don't have control over.

Q) Do you not have the power then to deny planning permissions based on sustainability issues?

A) There are limited policies, and it would be very brave to deny planning permissions based on sustainability issues.

I think one of the concerns that we may have, is that to refuse something because it doesn't meet sustainability requirements – is do we have the backing and the expertise to support that position. I think that's an issue as well. I think we don't really have the policy to refuse that, so our role is more to get developers to think about it in a different way.

Q) What do you think should be done to encourage sustainable development?

A) The drive needs to come from central government initially - not just as a Merton issue. I think we also need wider information available to developers. I think even major developers are quite lacking in their knowledge of sustainable principles.

Q) So is one of Development Control's roles to educate developers?

A) I think we can assist in that, yes. I don't think that it should fall solely to development control.

Q) Should Plans & Projects have much more of a developer relationship?

A) Yes, certainly.

**Interview with Kel Keleher**

Architect for Bruner/Cott & Associates, Inc.

May 7, 2003

Q) Have you implemented sustainable development techniques on any project you've worked on in the past six years?

A) Yes.

Q) Can you give some examples of the sustainable development techniques that you've employed?

A) My role is different than the average architect – I do technical review and promote sustainable design. Some projects you've seen – I was involved in them, but I was not the author of the sustainable components.

Some things I've done are incorporating air barriers in the building envelope and general performance, appropriate location of vapor barriers, high performance glazing, and performance testing of wall construction.

Q) What factors did you consider when choosing to employ those techniques? What was most influential?

A) Each building is unique, so...some buildings you can actually deal with orientation and it matters. Some buildings you can input on the site selection. Some architectural considerations – if you end up with a one-story building, you can do more skylighting. Also, the clients – how amendable are they to doing things differently? Finally is how much money the clients have. One thing we're trying to do is look at the life-cycle cost: frequently these things will pay for themselves. Many people don't think of this – they don't go through that process.

Q) What are the largest barriers to increased use of sustainable development techniques that you face?

A) It's low on the priority list. That means that they don't want to bother with that financial analysis. It also means that even I and architects who want to do the right thing, when they're faced with all of the things that are involved, just forget about it. [Gave an example of designing a building: with all the other things considered in design that you get excited about, "what about climate" etc. is sort of a forgotten afterthought].

Q) If someone offered to design an informational resource for you on any aspect of sustainable development, what specific information would you find most useful?

A) What I would find most useful? This may not be relevant to what you're doing. I find myself awash in a sea of information, so the most useful things to me are things that tell me how to do the things that need to be done. If it's just a theory and you don't have an image of what needs to be done, you don't consider it when designing. So if you're aware of specific ways things can be done and you're inspired by it, you might be more likely to use it. My need: to see it, see how to actually do it, and then it might come to mind more readily.

For your clients the real clients might be the homeowners. I would think that they'd need a parallel, that is, something that applies to them. You want to figure out what the typical house is in that area is, and know what they would use. [Gave an example of how timed thermostats are a big deal in New England, as heat is an issue here]. You might use that as a parable. Find a specific thing that they can do that really applies.

Q) If someone offered to design an informational resource for you on any aspect of sustainable development, what form would you prefer that resource take? Options include, but are not limited to, a web site, a book, a pamphlet, and a CD-ROM.

A) I'd suggest two things: A web site with PDFs, and a booklet [the PDF would be an electronic version of the booklet]. So at a meeting you can hand out booklets, but at home you could download the PDFs and look at them. And then you'd also need a PowerPoint, so you can use it in presentations. I find PDFs are very useful – they can be viewed and look just like the final thing, and you can scale it up and down, and can even copy text, and you can print it out.

I'd also add: very user-friendly software that's fully developed. There's a program out there called "Bees", which has about 20 things in it, compared to about 10,000 we have to deal with. There's another program that's very elegant – it analyzes moisture in walls. The problem is that it too only has about 20 materials in it, because each material has to be fully tested.

A third type of software would be building modeling for energy. There is software out there, but it's not very user-friendly – it can only be run by an energy expert. If architects could run it – and that's a big if – it's a very complicated question. Kind of a pipe dream. Any architect could, like they do in word – not have to be an expert, so that when you speak to someone who designs a building, and they're not a expert in AutoCAD, and they have to give a sketch to a client without time to get an expert in AutoCAD.

Q) Have you received or acquired any informational material on sustainable development in the past six years?

A) Only about 10,000 things [laughter]. It's taken about all forms: books, booklets, PDFs, Web sites, software...

Q) Which would be more useful to you: a resource on some aspect of sustainable development that provides specific, technical details, or a resource that gives a general overview of a topic?

A) For me, I don't need an overview; I've had the specifics.

Well, personally – there's only two ways to make things change in a specific way. One is to legislate it, and I'm working on that – to require life-cycle cost analysis. The other is to change attitudes. If we do a project, like in Concord [Massachusetts, US], that has the sustainable elements show – if we can make the Photovoltaics show, and label the glass that retains heat – just make it more evident that how you build affects sustainability of the projects.

The other is to actually incorporate...There's a neat toy, well it's not really a toy, but it's a "build your own house" – it's about a foot high. You can put Photovoltaics in, and have it absorb sunlight, [etc,] and actually have it do all the things that are sustainable. You can start thinking about, "do we need electricity," "do we need water," etc. It's sort of an adjunct to the science program...it's made by a company in New England. It's that sort of thing – a booklet is only good for someone who's already interested in it. Someone else will just pick it up and say, "That's nice," and throw it away.

Maybe specific things – like the Concord Light Plant is giving away free energy-efficient light bulbs, and people can try them, and once they realize that they work just like a regular incandescent…

Q) How useful would you find a discussion of specific products in a resource on sustainable development?

A) As a designer, that's the piece I'm looking for. There's a wash of information called "Greening Federal Facilities"; it's got all these things in it – glazing, water use, dehumidification, a section on lighting, food service, laundry equipment, lighting controls, fluorescents…each of these are a two page spread – showers faucets and drinking fountains, Photovoltaics, power system analysis, high-efficiency motors, construction waste management, etc. They're fairly detailed, and they have references you can look up more information on. You might get a copy of that – it's free, if you go on Google, it's under [http://www.eere.energy.gov/femp/techassist] …no, wait, that's not it, that's the software. There it is – Green Federal Facilities…ok ,there it is. [http://www.ere.energy.gov/femp/green_fed_facilities.html].

That'll bring you to a page where it says you can…you can view the guide online, or, if you want to order it, …take that same address, and after "femp" put "/ordermaterials.html", and if you scroll down near the bottom, that is where you'll find it.

Anyway, that's the kind of thing that you like to use. I'd find a discussion of specifics very useful.

Q) How useful do you think the people you work with would find a discussion of specific products in a resource on sustainable development?

A) It depends. If they're not interested, they don't give a damn…this book is interesting to me, but you might find it too technical, or not technical enough – it's right for me. A lot of these things are things I've heard of, and it provides specific technical details and resources to go deeper on.

Q) Given a resource that conforms to your preferences, do you think that you would use it?

A) Yes. For me, it's a key piece to find where they're at. So one key is to have deeper references, so you can hit somebody who's ready to do that, so they can go, "Ok, where do I go next?" So the answer is obviously "yes" if you've met the needs, but that's very hard, as there are a range of people you need to deal with.

Q) What advice or recommendations would you give to a team working on a series of sustainable development guides?

A) Know your client. Know where they're at, and know the context of the region you're developing in. You know, the issues where the most bang for the buck could be gained. I mentioned the ICLEI project for Concord; part of that is to confirm where our footprint might be. You should know the climate and the energy sources – what would be the good energy sources for the region. And the buildings – what would be the interaction between the buildings and the climate and the users.

Q) Do you have any recommendations on how a series of guides should be designed to increase the percentage of architects and contractors who look at and/or read through the guides?

A) The simple one, which is the least effective, is just to do education. You know, come to the workshop, learn more about it, etc. The next highest level is to give them incentives, and that can either be in the free market or legislative – tax credits, subsidies, etc. You can get them interested if it will meet their bottom line. Another kind of legislation is just to mandate, you know, "you will not put in a washer that is not energy-star rated." And that just lets them know what the point of the law is.

I should add one thing – I'm usually not too much involved, but you might be – there's a fellow called Bill McDunna, I think it's called "Natural Capitalism." He wrote it with someone [Brondgart?] – and it wasn't "Natural Capitalism," I forget what it was. But the point I'm trying to make is, if you look at systems from a large enough point of view, it can make economic sense to be green. Ah, "Cradle to Cradle" is I think what it's called. So he's done a couple things in Europe with a guy named Brondgart to come up with some products that were environmentally safer, and beyond that they were safer to make, so they were less expensive. He's inspired Interface Carpet to do the same. Instead of buying carpet, you rent it. And the advantage of that is that they own the carpet, so if it gets worn out, they have to replace it. So all that carpet gets recycled, and the carpet is designed to be recycled and reused. It cuts down on expense, waste, and energy. If you just look and say "I've got to have carpet, where do I buy carpet," if you just look at the whole system from Cradle to Grave…

Q) Would you be willing to take part in a potential future follow up interview?

A) Yes.

**Interview with Martina Johnson**

Architect for Bruner/Cott & Associates, Inc.

May 7, 2003

Q) Have you implemented sustainable development techniques on any project you've worked on in the past six years?

A) Yes

Q) Can you give some examples of the sustainable development techniques that you've employed?

A) On the Dartmouth College project we're using LEED as a benchmark tool for sustainable design. So we're looking at everything from energy use to mechanical systems to selection of materials, looking at local and renewable materials as well as recycled materials. Looking at indoor air quality, how materials off gas, what their characteristics are, and also in terms of how the building is constructed...trying to avoid use of the mechanical systems while the building is constructed, contaminating the building.

Also, something called enthalpy wheels – that's heat recovery from the fresh air.

Q) What factors did you consider when choosing to employ those techniques? What was most influential?

A) The ability to show cost savings over time. That's basically energy use – so I guess being able to model the energy use, that's important.

Q) What are the largest barriers to increased use of sustainable development techniques that you face?

A) Probably, I guess the amount of time it takes to look into things that aren't standard design techniques. And that means cost, as well as cost to implement.

Q) If someone offered to design an informational resource for you on any aspect of sustainable development, what specific information would you find most useful?

A) I guess…I think, possibly, if you're looking at a specific municipality, as you are, maybe looking at government rebates. And otherwise a list of sources for where to get other information, or specific information about design…that sort of thing.

Q) If someone offered to design an informational resource for you on any aspect of sustainable development, what form would you prefer that resource take? Options include, but are not limited to, a web site, a book, a pamphlet, and a CD-ROM.

A) I think a web site is good because then you feel like it's current and it's able to be updated.

Q) Have you received or acquired any informational material on sustainable development in the past six years?

A) Yes. You saw some of the collection. Other things would be a regular newsletter from Environmental Building News, a reference guide from LEED – that's a book, and then otherwise I guess various guidebooks like the Environmental Resource Guide.

Q) Which would be more useful to you: a resource on some aspect of sustainable development that provides specific, technical details, or a resource that gives a general overview of a topic?

A) The first.

Q) How useful would you find a discussion of specific products in a resource on sustainable development?

A) Yep, that's useful.

Q) Given a resource that conforms to your preferences, do you think that you would use it?

A) Yes.

Q) What advice or recommendations would you give to a team working on a series of sustainable development guides?

A) I'd say, know your target audience well, and the place – I don't know what the particular area is, and I'd say that that would be very useful. I don't know what the general education level of your audience is, but a general guide is not all that useful; that's been done before. I think anything with specific information is useful.

Also anything that has case studies are very useful, so you can see what people doing a similar building in a similar location have done

Q) Do you have any recommendations on how a series of guides should be designed to increase the percentage of architects and contractors who look at and/or read through the guides?

A) I think the web format is useful to people, as everyone gets lots of paper and the web is accessible to people. And also something that's specific to the location and the needs of the people so people don't feel like it doesn't apply to them. Also, cost information is useful – cost implications.

Q) Would you be willing to take part in a potential future follow up interview?

A) Yes, I'd take part in a follow-up.

**First Exploratory Interview**

Cambridge, Massachusetts planning official

May 6, 2003

Q) Can you give some examples of the sustainable development techniques that advocate?

A) Sighting is good pretty much anywhere in Cambridge [Massachusetts, US] – near transit, etc. The city has redone their zoning to allow easy access to transit.

There's a big issue with storm water, because the city has combined sewers – the city is doing work to separate storm water and sanitary flow. Also, building design to reduce runoff. The city is very interested in energy efficiency and renewables. Working with the ICLEI Cities for Climate Protection. The city is interested in easte management – active recycling program, looking into waste prevention. Building materials and indoor air quality are important. This department had indoor air quality problems [mold] – the public heath department also works on indoor air quality.

The Genzime building being built in Kendall [Square] may get LEED platinum [certification]. They came through the planning board for review – the city just gave them moral encouragement.

The city can't enforce building standards – that's done on a state level in Massachusetts, so [the city] can just give "moral support."

MIT has adopted LEED with some MIT additions as their interim standard.

I do all this as part of our climate protection program. We're developing recognition programs, bringing together peer groups, etc.

Harvard has a green campus initiative.

Q) What factors did people you work with consider when choosing whether employ sustainable techniques? What is most influential?

A) Cost, especially first costs are a big factor – frequently people don't factor in operating cost. People look for designers with experience – not a whole lot of green experience yet. Integrating the green design elements with whatever they're already doing is an issue. With Genzime, they want to project a green issue, so that led to them going beyond the standards.

Q) What are the largest barriers to increased use of sustainable development techniques that you see?

A) The way people factor in cost and don't factor in operating cost is an issue. That depends a lot of the property, of course – a city or university is much more likely to have a long-term view. With a private development, someone is going to come in and build and they could care less about operating cost. Being a tenant has a whole other set of issues, since you don't actually own the building and lease arrangements are complicated.

General barriers are technical knowledge – how do you get materials, experienced contractors...the challenge of doing something new.

Q) If someone offered to design an informational resource for you on any aspect of sustainable development, what specific information would you find most useful?

A) Cost is most useful. Fighting the perception that green development costs more.

Q) If someone offered to design an informational resource for you on any aspect of sustainable development, what form would you prefer that resource take? Options include, but are not limited to, a web site, a book, a pamphlet, and a CD-ROM.

A) We're interested in getting information out electronically, probably Web-based. The [US] National Park Service has a nice page on Zion National Park. It's kind of an ideal, though we don't have enough money for something like that.

Q) Why do you like the Zion site?

A) A web site will be accessible to a lot more people. We want to be able to reach people who come into the building, as developers and designers etc. do a lot, and give them something to look at while they're waiting. We'd like people to be able to access info without having to come down to our office. Web-based stuff is also easy to change.

Q) Do you envision some sort of web kiosk in your waiting room then?

A) Yes. We're looking at a system called Heliotronics [heliotronics.com] – it shows info on Photovoltaics. It's a display used in education settings, etc.

Maybe something like that married to a more traditional web page. A virtual tour would be really great for people coming to the building.

Q) Have you received or acquired any informational material on sustainable development in the past six years?

A) We have books and manuals, looked at web pages, looked at what other cities are doing, various journal articles, lots of seminars, and talked to people in the design community.

There's a lot of stuff out there. Case studies have been useful. Once LEED came along [it wasn't there 3 years ago] everything sort of coalesced around it.

Q) Which would be more useful to you: a resource on some aspect of sustainable development that provides specific, technical details, or a resource that gives a general overview of a topic?
A) For us, something more general, as there are other places people can go for technical details. We talk about, "Well, we used this, and it worked for us," and hopefully that will encourage someone else to look into it.

Q) How useful would you find a discussion of specific products in a resource on sustainable development?
A) It would be useful if given in the context of actual projects. I have the "green spec" from the "Environmental Building News", and it's great because you can flip through and see different flooring, windows, etc, but it would be great if you could see other projects that have used these. You worry that if you use something new, you'll have a problem – seeing other projects that have used it would help.

Q) Given a resource that conforms to your preferences, do you think that developers and architects would use it?
A) I think so. We have architects asking about details on our building; we don't have anything we can give them. If we had the electronic display, we could just give them the url and we'd be all set.

Q) What advice or recommendations would you give to a team working on a series of sustainable development guides?

A) Think about how your client wants to use it. One of the things we've concluded is that just giving people information doesn't do a lot – it has to be coupled with outer efforts to get commitments from people to do something different, or get them involved in a active process.

We'd give people information, but it'd be tied into our planning process and our climate protection program. Hopefully it's not just putting information out there – it'll help facilitate these other processes.

Q) Do you have any recommendations on how a series of guides should be designed to increase the percentage of architects and contractors who look at and/or read through the guides?

A) I assume they have some kind of packet they give to developers when they want information over in Merton – it would make sense to give them the guides at the time when they come to pick up their application materials.

If there are printed materials, you can obviously bring them to professional meetings.

Q) Would you be willing to take part in a potential future follow up interview?

A) Yes, I'd participate in a follow-up.

I'd suggest the green roundtable folks – Barbara Batshalom is the director – they're the US Green Building Council affiliate for Kendall Square. She's also an architect, and the point person for promoting this everywhere.

The Northeast Sustainable Energy Association [office in Greenfield] does an annual "Building Green" conference. Last year a bunch of them went over to Europe and did a tour of green buildings, and did a multimedia presentation on it. Barbara would know about that. The question they wanted to answer was "why is all this stuff happening over in Europe, but not over here?" There a book called "Green Urbanism" by Timothy Beatley, which is a nice survey of what European cities are doing.

# Appendix J – Web Usability Guidelines

- Be **concise**; if possible, aim for a maximum of half the text you would use in a hardcopy version of your document.
- Express **one idea per paragraph**, and keep paragraphs short.
- Write for **scanability**.
- Use **meaningful headings** and subheadings. Headings should be able to "stand on their own."
- Emphasize **key words** with highlighting or bolding.
- Keep pages short. Rather than just splitting long documents into multiple pages, try to split the information into **coherent, topic-based chunks** and connect them with links.
- Use the "inverted pyramid" writing style: start with the conclusion, then give the most important supporting information, and finish with the background. A document should be organized as many connected inverted pyramids.
- **Avoid marketese** and stick to the facts. Web users are busy; "promotional language imposes a cognitive burden."
- **Bulleted lists** convey information in a concise and scanable manner.
- Allow readers to select the information that they care about.
- Pages should convey a "**sense of location**"; visitors should be able to start on any page in the site and not feel lost.

- Page titles should start with the most specific information and end with the least specific. As titles are used in search results and bookmark lists, they should allow scanning and be useful even with the end cut off. Example: "Geothermal heat pump cost (Merton Council)"
- When writing taglines, ask yourself if your tagline could be used to describe your "competitors" (other websites presenting similar material). If so, rephrase your tagline so that it is specific to your website.
- Credibility can come from high quality graphic design, good writing, and supporting outbound links.

These guidelines come from Jakob Nielson's Alertbox, the Sun Writing Guide, the A List Apart Writing Guide (alistapart.com), and evolt.org.

# Appendix K – Benefits of Using Web Standards

Designing a web site to comply with modern *web standards* brings a host of benefits. Web standards are the grammar rules for web coding; they dictate proper use of web technology to afford compatibility and accessibility. The World Wide Web Consortium (http://w3c.org) is the official standards body of the web. The benefits of using modern web standards instead of traditional design practices include:

- Greatly reduced page size
- Design 1 test page has 3.2k of html and 2.8k of CSS
- Design 2 has 18.4k of html alone, and many more images than design 1
- Faster load time
- Reduced bandwidth cost
- Reduced server load
- Reduced markup complexity
- Page rendering is much faster, especially on slow computers
- Accessible
- Usable by people who are blind
- Screen-reader friendly
- Usable by people with poor vision
- Text sizing designed to allow user-controlled text resizing
- Adhering to standards makes it friendly to future accessibility devices

- Color choice is color-blind friendly
- Portable
- Text sizing displays using native Web browser text sizes
- Allows for size standard variations across platforms
- Allows for variations in pixel density and screen resolution
- Linux-friendly
- Displays perfectly in modern Web browsers
- "Degrades gracefully" in older Web browsers
- Presentation will not be optimal, but content will be readable
- Small page size & standards compliance -> good for other web-enabled devices
- Has longevity
- Standards-compliant design means that it should not need an overhaul soon
- Ease of Maintenance
- Separates content from presentation
- Content can be edited quickly and painlessly, and without intimate site knowledge
- Presentation can be changed site-wide with one simple edit
- Reduced reliance on tricks & hacks for proper display
- Site is less complicated for a web developer, making his or her life easier (and saving time)
- Source code can be easily human-read and understood

- Display does not break in new Web browsers
- Easy for search and indexing engines (and other web parsers)
- Proper use of header tags means that content is given machine-readable meaning
- XHTML (XML) brings additional potential future benefits

# Appendix L – Previous Mini-Guides

*APRIL 2003*

ENVIRONMENTAL SERVICES DEPARTMENT

# Life Cycle Cost Analysis

merton
moving ahead

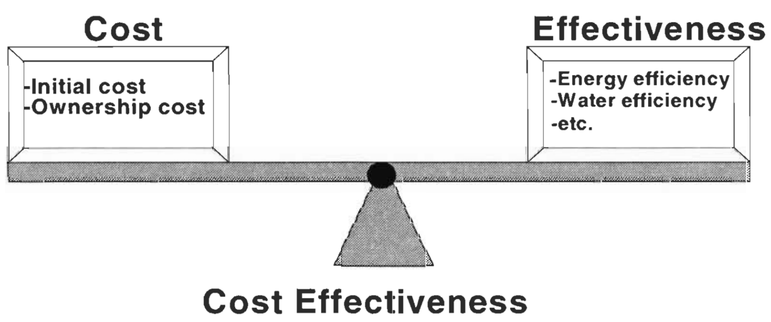
Merton Civic Centre London Road,
Morden, Surrey SM4 5DX

# Table of Contents

This guide is aimed at those directly related to the construction industry. Possible users are, but not limited to, developers, architects, builders, and surveyors. The guide will prove useful for these professionals in attaining sustainable development policies currently found in the London Borough of Merton's Unitary Development Plan (UDP). This guide on life cycle cost analysis is one of a series of information guides on sustainable construction. The purpose of this specific guide is to provide assistance on life cycle cost analysis in order for construction professionals and developers to consider sustainable practices in their designs and to comply with the UDP policies.

The guide will be specifically useful in considering **Policy ST.1a: Sustainable Development**, which states that "The Council will encourage development which is sustainable and resist development which substantially fail to follow the principles of sustainable development. In applying this policy, the Council will apply its sustainability checklist to assess whether development is sustainable. Where large development schemes are proposed developers should normally submit a sustainable development statement with the planning application". If developers are able to respond to the UDP policies then it will be easier for them to receive planning permission for their schemes. For more information on Merton's Unitary Development Plan, visit the London Borough of Merton website: www.merton.gov.uk.

The idea that green buildings improve the financial performance of a building may sound problematic and new to many building professionals. However, the business community is considering green building because it provides many economical advantages. The main benefit behind the application and the success of green buildings is the completion of cost effectiveness in a project. Cost-effectiveness is reached when construction professionals take into account the Life Cycle Cost Analysis in the design stage of the building developments.

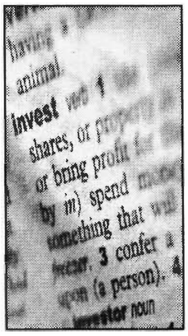



Source:( http://www.ipk.ntnu.no/rams/notater/lcc.doc)

Figure 1. The picture illustrates the relationship between cost and effectiveness in a green building.

## 1. What is Life Cycle Cost Analysis?

The Life Cycle Cost Analysis is a method of assessing cost effectiveness in sustainable buildings. The following are three definitions of what the life cycle cost analysis is:



- The present value of the total cost of that asset over its operating life including initial capital cost, occupation costs, operating costs, and the cost or benefit of the eventual disposal of the asset at the end of its life. (RICS)
- A set of techniques for evaluating all relevant costs of acquiring and operating a project, asset, or product over time.[3]
- The sum of all discounted costs of acquiring, owning, operating, maintaining and disposing of a building project over a determined study period[5]

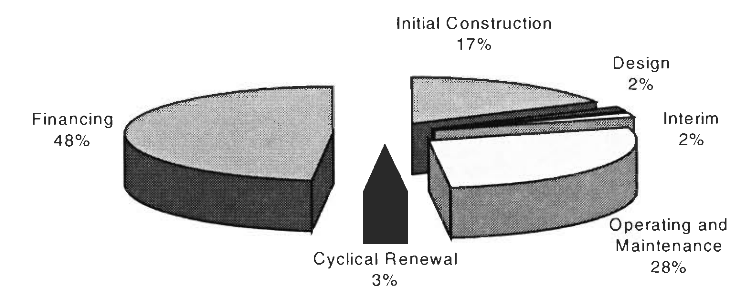
## 2. Why consider Life Cycle Analysis?

There are a number of reasons for developers and building professionals to consider Life Cycle Cost Analysis in the design stage of a building process. As mentioned before, Life Cycle Cost Analysis assess cost-effectiveness of a sustainable project. In addition, the method provides a number of economic benefits listed below:

- Operating Costs: it is possible to reduce building energy consumption by 20 to 30 percent. While in the 1970's energy costs were a major concern among architects and building professionals, the cost of water, operations personnel and maintenance has also been increasing at a rapid rate. Figure 3 shows the importance of operating and maintenance costs of a hypothetical office building over a 40-year period. An increase in energy efficiency will reduce energy costs over the lifetime of a development. The following example shows how operating and maintenance expenses are underestimated when designing a building and therefore the need for sustainable development in early stages of the construction process.[10]

"The average school district spends over $50 a year to operate and maintain $1000 of plant; this means that over a span of less than 20 years these costs equal the cost of the plant itself". *American School and University magazine*

**Figure 3. Total Project Development and 40-year facility operating costs for a Hypothetical Office Building**




- All building costs have risen dramatically in the past years. Fewer owners and architects have been able to deal with the different costs incurred in a development. For instance, in the United Kingdom the *General Building Cost Index* rose 6.1% in the year 2002 ending at the 4th quarter. Figure 1 shows the upward trend of the index for the past 17 years. However, if building professionals incorporate sustainable design approaches like the Life Cycle Cost Analysis of a project the savings there will be able to save money and justify their development.[12]

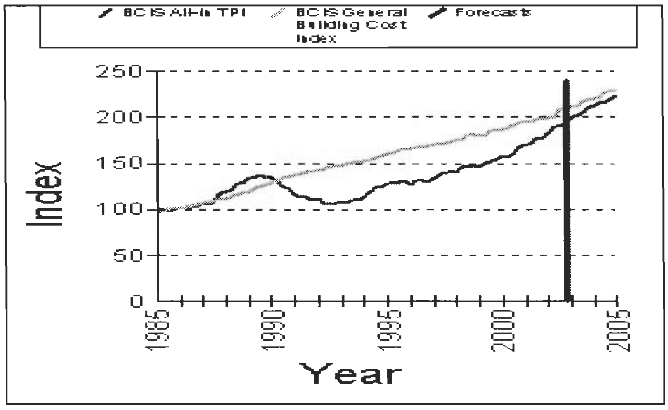



Figure 2. General Building Cost Index

- Over the past decades, there has been a growing interest from developers and building professionals to get involved in sustainable construction practices because it has provided advantages in social, economical and environmental aspects of a construction process. There is also special interest to get a better feel of the long-term costs of a building over its life cycle. In addition, special attention has been given lately to energy and water conservation issues, which are key aspects of a green building.[12]

Chapter

2

# 1. How does the Life Cycle Cost Analysis work?

Buildings and structures influence the environment around them. They must be designed, built, operated and maintained in such way that they meet the varying demands of society. The energy a building consumes in its lifecycle has a far greater effect on the environment than the energy used in construction and extracting the materials. Sustainable construction is about considering the long-term effects of design for the life of the building and its occupants. [8]

Life Cycle Cost Analysis examines each and every possible design alternatives by comparing the possible costs over the life span of the building. This offers the decision-makers a valuable tool to assess the sustainability of a development. A green building may cost more at the initial stage, but saving is attained through lower operating costs over the life of the building. The environmental building approach applies a project life cycle cost analysis to determine the appropriate initial expenditure. [5]

# 2. Steps in a Life Cycle Cost Analysis

The following are seven basic steps to follow when computing a Life Cycle Cost Analysis in a generic green building development. [7]

1) Identify options
2) Establish assumptions
3) Estimate all project costs and their timeframes
4) Discount future costs to present value
5) Compute the LCC for each option
6) Identify the option with the lowest Life Cycle Cost
7) Select the best option

# 3. Calculation of a Life Cycle Cost Analysis

There are several different ways of performing the calculation of a Life Cycle Cost Analysis. The Life Cycle Cost of a project can be computed by adding up the present values of each kind of costs and subtract the present values of any positive cash flows. The following is a very simple method to calculate the life Cycle Cost of a building development. The formula is as follows:

$$LCC = I + R + E + W + OM\&R - S$$ [3]

Where:

I: initial investment cost

R: present value of Replacement costs

E: present value of energy costs

W: present value of water costs

OM&R: present value of operation, maintenance, and repair

S: present value of salvage (resale or residual)

# 4. Assumptions Used in Life Cycle Cost Analysis

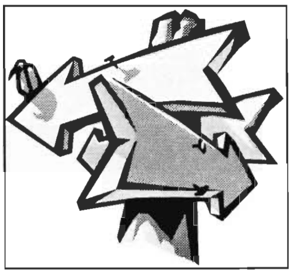
One of the most important factors when conducting a Life Cycle Cost Analysis is to mind the assumptions under the calculations. It is very important to define the assumptions as soon as the options are identified. The following is a checklist of the assumptions to keep in mind when using a Life Cycle Cost Analysis. Make sure your analysis has considered the following implications.

Assumptions Checklist[3]

- ☑ Same discount rate
- ☑ Same study period
- ☑ Present value inputs
- ☑ Inflation rate
- ☑ Borrowing rates
- ☑ Energy Prices Rates

Chapter

# 1. Applications



The next section describes the different applications that the Life Cycle Cost Analysis provides within a sustainable building development. The basic application of the Life Cycle Cost Analysis is to evaluate design and investment decisions by identifying different approaches that will achieve the same goals over the lifetime of a building. The main applications of a Life Cycle Cost Analysis are investment decisions that are strictly related to sustainable construction practices specifically in the areas of water and energy conservation.

### 2.1 Investment Decisions

The Life Cycle Cost Analysis is an approach that may allow the architect or building professional to make decisions such as[3]:

- Accept or reject a project
- Achieve optimal efficiency
- Make optimal system selection

An example of these decisions described above appears in the context of energy conservation (See Solar Energy Guide)[8]. For instance, some of the following questions can be answered using a Life Cycle Cost Analysis:

1. What is the best energy conservation feature among various options such as: solar, wind, biomass, etc? For example conventional heating versus solar power.

2. How much investment is required in an energy conservation feature?

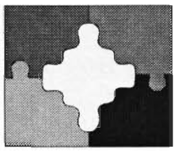
3. Are there any desirable combinations between different energy conservation features?

Another example where the Life Cycle Cost Analysis provides answers to which sustainable construction practices are the most feasible for a development is water conservation in a building design[8]. (See Water Conservation Mini-Guide) Some of these questions are:

1. What is the best water saving device to include in home or in commercial premises over the expected lifetime of the construction?

2. How much is required to save the most in water consumption looking at the long term?

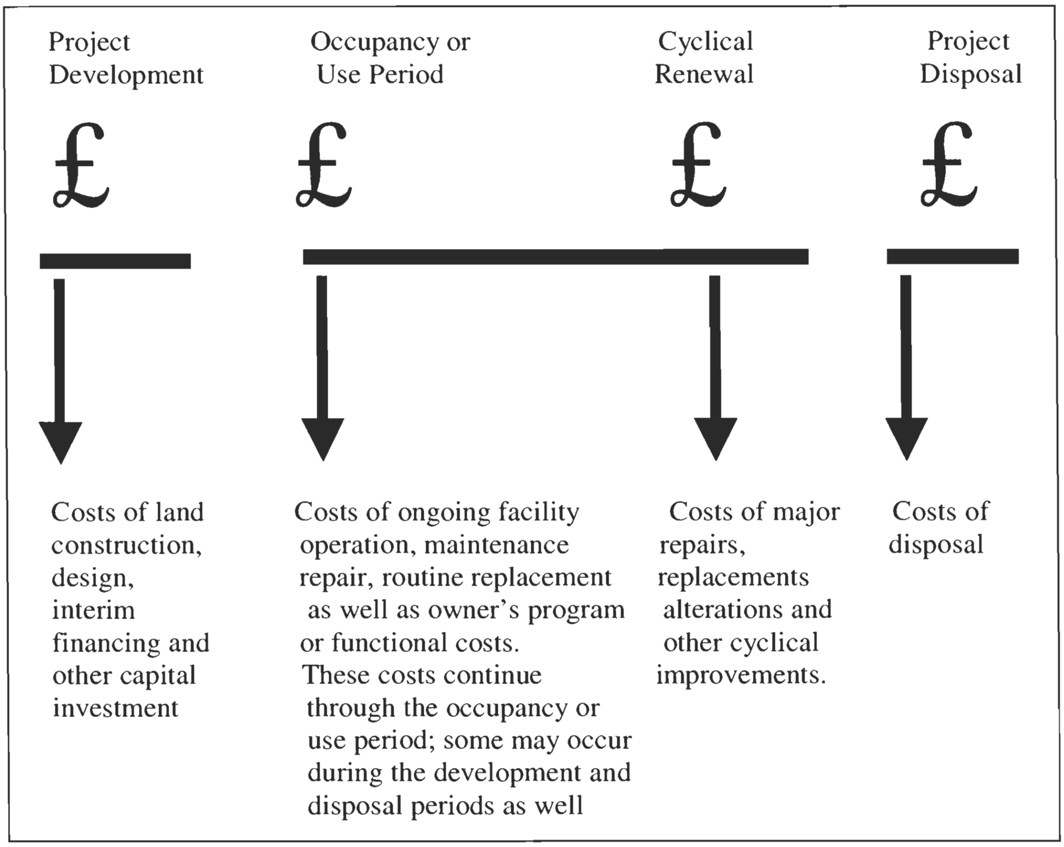
## 2. Stages in a Life Cycle Cost Analysis



Throughout the guide, several costs and terms have been used that are part of the different stages of a green development. This section describes what each of the phases is and what costs are incurred in each of them.

There are different views about how many stages exist in a building development. For instance, Figure 3 portrays four different stages with the different costs and their importance on the analysis.

Figure 3. Stages and components of a Life Cycle Cost Analysis




Source: American Institute of Architects

In Figure 5, the Athena Institute suggests six different stages in a building development starting from the resource extraction until the disposal phase.

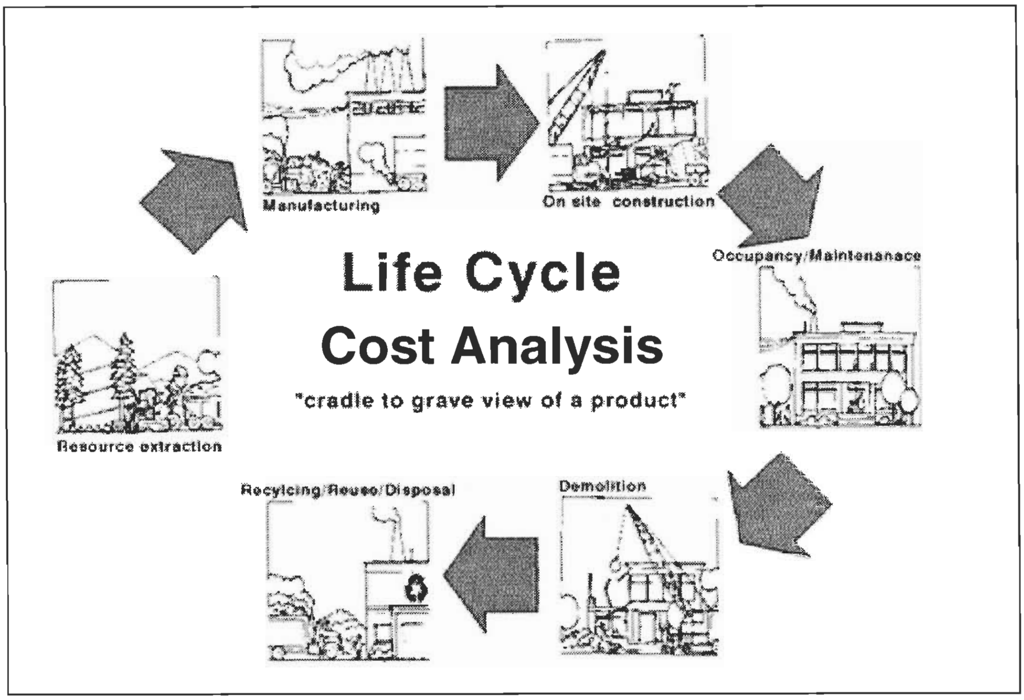



Figure 5: Life Cycle Cost Analysis from the Athena Institute, Canada

Source: Athena Institute

## 3. Recommendations

On a construction development, materials or systems that look like a bargain turn out not to be such a good deal over the long run. They might end up being negative for the owner or for the environment. Selecting materials that cost the least at the time of purchase may load a householder with enormous operating, maintenance, repair, and disposal costs, and even health problems. Some of these inexpensive products also affect negatively the environment, causing severe impacts such as pollution and energy employed in transportation and installation. Comparing the life-cycle costs of materials can be challenging, because there is no single repository of information on the complete life cycles of all types of building products. The following are recommendations for building professionals to include green design in their building developments[11]:

- Choose products that are recyclable at the end of their useful life.
- Give preference to locally- and regionally produced equivalent products.
- Avoid products with components or constituents that are regulated as hazardous waste.

- Consider the expected lifetime and maintenance requirements of all products relative to alternative products.

- Select energy-efficient and water-efficient systems and appliances to reduce lifetime consumption. (See Solar Energy and Water Conservation Mini-Guides)

Chapter

# Additional Information

## References


1. http://www.gvrd.bc.ca/sustainability/GreenBuildConf2001/Workshop%202-Tim%20Spiegel.pdf

2. http://www.eed.state.ak.us/facilities/publications/LCCAHandbook1999.pdf

3. http://www.icfox.com/sg/useful_info/eng/LCC/Content.htm

4. http://www.eere.energy.gov/femp/resources/pdfs/lcc_guide_rev2.pdf

5. http://www.gamc.nsw.gov.au/tam2000/TAM-4-4.asp

6. http://www.bsee.co.uk/news/fullstory.php/aid/1979/A_building_is_for_life_%97_not_just_for_building.html

7. http://fire.nist.gov/bfrlpubs/build96/PDF/b96102.pdf

8. http://irc.nrc-cnrc.gc.ca/cbd/cbd212e.html

9. http://www.buildinggreen.com/features/lc/low_cost.cfm

10. http://www.wgba.org/html/green_building.html

11. http://www.homeasta.org/pattern3.htm

12. Life cycle cost analysis: a guide for architects. The American Institute of Architects. [Washington]: AIA, 1977.

## 2. Contacts in Merton

- Rory Doyle; Environmental Health Energy Advice
- Adrian Hewitt:; Sustainability Officer
- Cecily Herdman; Housing Officer
- Steve Cardis; Unitary Development Plan
- Phil Ryder; Wandle Strategy
- Richard Ainsley; Planning Officer

## 3. Case Studies: Life Cycle Analysis of a Residential Home in Michigan

Please refer to the following web site in order to find details on the following case study: The most relevant information on the Life Cycle Cost Analysis can be found on section 2.8 of the Methods chapter and on section 3.4 of the Results chapter.

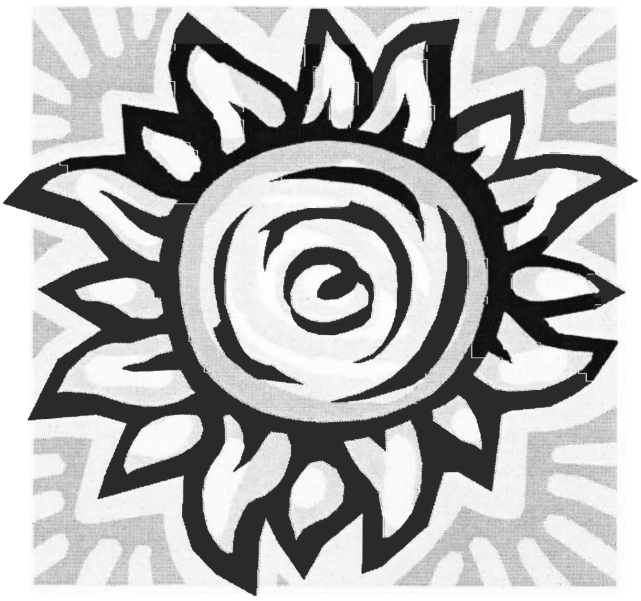
- http://www.umich.edu/%7Enppcpub/research/lcahome/

Volume

2

LONDON BOROUGH OF MERTON

For developers and building professionals



# Solar Energy

APRIL 2003

ENVIRONMENTAL SERVICES DEPARTMENT

# Solar Energy

merton
moving ahead

Merton Civic Centre London Road,
Morden, Surrey SM4 5DX

# Table of Contents

Chapter

# Introduction

## 1. Using this guide

This guide to solar energy is one of a series of information guides on sustainable construction. It is aimed at architects, planners, and developers as a means of raising the awareness of solar energy equipment and its benefits, and encouraging those proposing developments in the borough to include renewable energy production equipment.

## 2. How solar energy is used?

There are two types:
1. Photovoltaics (PV): Produces electricity from light
2. Solar Water Heating: Uses energy from the sun to heat water

## 3. Why consider the use of solar energy?

The use of solar energy reduces the dependence on the depleting fossil fuels and reduces pollution due to emissions. It also reduces global warming which leads to climate changes. Using solar energy in a building adds sustainability and offers a way to meet Policy ST.1a.

Merton Council is aiming to reduce the Borough's reliance on traditional energy sources, and requiring the inclusion of renewable energy in new developments is crucial to achieving this. Merton's new UDP Policy E13 requires all new industrial, warehousing, office and live/work developments over $1000m^2$ to include renewable energy production equipment to provide at least 10% of predicted energy requirements.

Chapter

# Photovoltaics

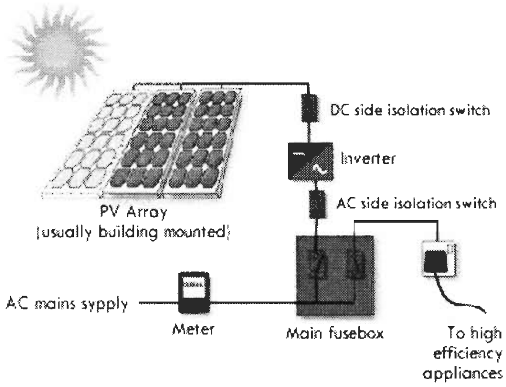



Figure 1: Diagram of a PV System. Source, http://www.pv-uk.org.uk/technology/configuration.html

## 1. How does it work?

PV cells have at least two layers of semiconductors: one positively and the other negatively charged. When light shines on the semi conductor, the electric field across the junction between the two layers causes electricity to flow – the greater the intensity of the light the greater the flow of electricity.

The electrical output from a single cell is small, so multiple cells are connected together and sealed usually behind glass to form a module (or panel). The module is the principle building block of a PV system, as many modules as possible can be linked together to achieve the desired electrical output.

When daylight hits the PV cells it is converted to electricity. The PV cells deliver DC electricity and then an inverter converts this to AC so that the electricity can be used for household appliances. It is then connected a main fusebox.

PV roofs generate electricity all day, so spare electricity goes to the grid. An extra meter can be fitted to show how much electricity is exported. Spare electricity is then sold to the electricity supplier. No electricity can be produced at night, so during the night electricity can be drawn from the grid (if the system is grid connected).[i]

## 2. Why use a PV System?

PV systems are low maintenance and as there are no moving parts energy production is silent. However the main reason for installing a PV system are the environmental benefits. Because the energy produced comes from the sun, this reduces the amount of fossil fuel burning energy that you need to power your building. Therefore Carbon Dioxide ($CO_2$) emissions are reduced.

## 3. How much energy do they produce?

A system with a PV array tilted towards the south would generate approximately 750kWh/year per kWp installed. A typical domestic system of 1.5 kW in the UK would produce around a third of the annual demand of an average family household (taking the average demand to be around 10 kWh per day).[ii]

## 4. What types of systems are there?

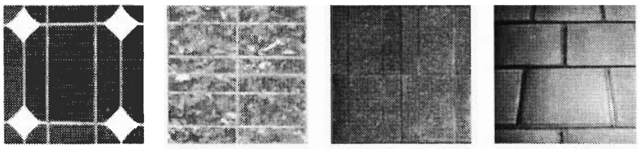
- **Grid Connected**- This is the most popular for homes and businesses. The PV system is connected to the local electricity network allowing any excess solar electricity produced to be sold back to the utility or needed electricity to be drawn from the grid at night.
- **Grid Support**- The PV system is connected to the local electricity network and a back-up battery. Excess solar electricity produced after the battery is charged is sold back to the utility. This is ideal in areas of unreliable power supply.
- **Stand-alone photovoltaic systems/off-Grid**- Completely independent of the grid; the solar power is directly connected to a battery, which stores the electricity generated and acts as the main power supply.
- **Hybrid Systems**- Combines solar power with another power source, such as a biomass generator, wind turbine, or diesel generator. These systems can also be grid connected, grid support, or stand-alone.[iii]

see www.pv-uk.org.uk for more information

## 5. PV Materials

- **Monocrystalline PV**- The most efficient, but costs more than other photovoltaic (PV) technologies because of the complicated manufacturing process
- **Multicrystalline PV**- Cheaper, however, they tend to be slightly less efficient
- **Thick-film PV**- Efficient in poor light conditions and the most environmentally friendly. Silicon is deposited in a continuous process onto a base material giving a fine grained, sparkling appearance. Like all crystalline PV, this is encapsulated in a transparent insulating polymer with a tempered glass cover and usually bound into a strong aluminium frame.
- **Thin-film PV**- Made with amorphous silicon, which absorbs light more effectively than crystalline silicon, so the cells can be thinner. Amorphous silicon can be deposited on a wide range of substrates, both rigid and flexible, which makes it ideal for curved surfaces and "fold-away" modules. These cells are less efficient than crystalline based cells, but they are easier and cheaper to produce. A number of other 'thin-film PV' materials such as cadmium telluride (CdTe) and copper indium diselenide (CIS) are now being used for PV modules. The attraction of

these technologies is that they can be manufactured by relatively inexpensive industrial processes, yet they typically offer higher module efficiencies than amorphous silicon.[iv]



(a) (b) (c) (d)

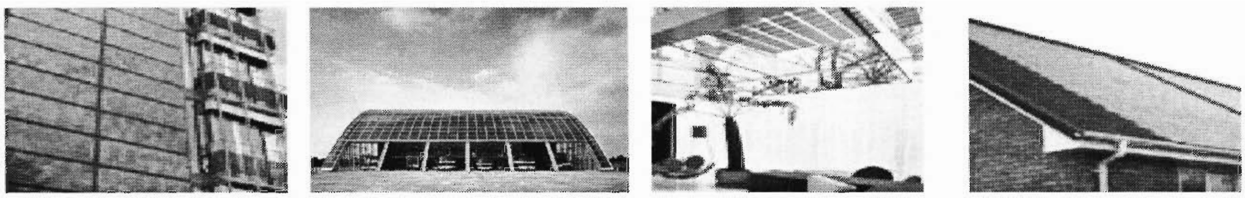
Figure 2: PV materials: (a) monocrystalline, (b) multicrystalline, (c) thick-film, and (d) thin- film. Source, http://www.pv-uk.org.uk/technology/types.html

## 6. What is the estimated lifetime of a PV system?

The PV systems should last 30 years or more. The first PV systems were installed about 20 years ago and are still producing electricity now.[v]

## 7. Is my building suitable for a PV system?

- Any house, offices, commercial and industrial buildings are suitable for instillation.
- PV cells come in a variety of colours, can be made to look like conventional roof tiles, and can be incorporated into building facades, canopies or sky lights



(a) (b) (c) (d)

Figure 3: Integrated PV: (a) building façade, (b) glass roof, (c) skylight window, (d) house roof
Source, http://www.solarcentury.co.uk/content.jsp?sectno=1&subno=1

- For maximum output:
    - Due south orientation
    - 30- 40° roof tilt
    - Avoid shading of cells[vi]

## 8. Cost of PV Systems

As of April 2003, the British Photovoltaic Association states that a typical price for a grid connected, building integrated PV system is between £12 000 - £14 000 for a 2 kWp system for a house. Some installers offer all inclusive systems for between £6,700 - £8,600. This includes site survey, delivery, PV modules, installation, and connection to the mains. For a bespoke solution prices vary but are likely to be around £20,000. Refer to www.pv-uk.org.uk for cost saving tips.[vii]

Chapter

# Solar Heating

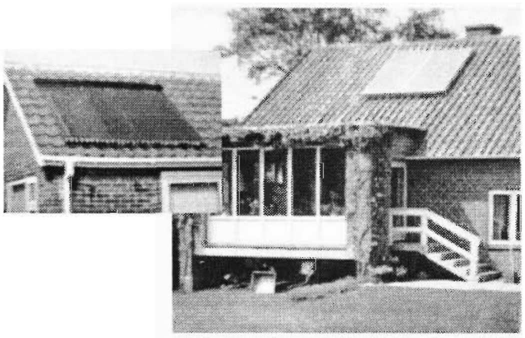


Figure 4: A collector of a solar water heating system. Source, http://www.greenenergy.org.uk/sta/solarenergy/index.htm

## 1. How Does it Work?

A solar water heating (SWH) system uses the sun to heat water in collectors mounted on a roof or some raised, south-facing area. The heated water is then stored in a tank, not unlike a conventional electric or gas water heater tank, and is used as hot water for washing, cooking, etc or is used in the central heating system. As with PV systems, solar water heating systems can be orientated to south, south east or south west. They need to be positioned at an angle of between 10-60°.

Solar water heating can operate in a wide variety of climates. In addition to solar water heating being an environmentally sound choice (SWH systems reduce the amount of greenhouse gas emissions for heating your water when compared to conventional methods), they can be quite cost effective when compared to your monthly energy bill.[viii]

## 2. Why use a SWH system?

The power from the sun is both free and renewable, which means that it is a clean alternative to heating water through conventional methods. Most central heating and hot water systems are powered by fossil fuel sources (usually gas), so installing a SWH would reduce the amount of fossil fuel used by the building, this in turn means that there would be less environmentally harmful emissions into the atmosphere (which are associated with global warming).

# 3. How much energy do they produce?

For a family of four, a well designed Active Solar Heating system should contribute between 1,500kWh and 2,000kWh, which will be equivalent to 40 to 50% of the household's water heating energy needs over a year. The value of this saving will depend on the type of energy displaced.[ix]

# 4. What types of systems are there?

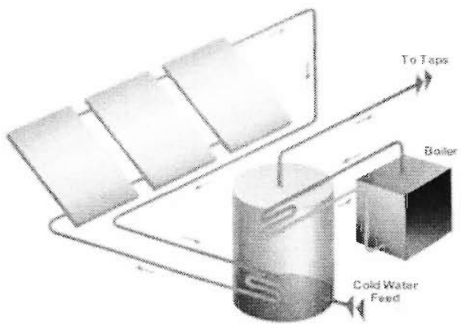



Figure 5: Typical set up for a solar water heating system in the UK. Source, http://www.greenenergy.org.uk/sta/solarenergy/index.htm

The type of system used will largely be dependent on the climate. There are several types of systems available, however due to the UK climate, a typical system would include a collector of some description (situated on the roof) which is separate from the cylinder that feeds cold water into the collector. Once water is heated in the collector it returns to the cylinder, where it is then either tapped off for hot water use (washing, cleaning etc) or goes into the boiler for use in the central heating system. Normally in the UK SWHs will include an auxiliary heating system (powered by natural gas or oil burner) to ensure a constant supply of hot water during winter or at times of low solar radiation. The UK climate also means that systems will include an anti- freeze, to ensure that the collector is not damaged during freezing weather. An electronic controller constantly compares the temperature of the solar collectors with the temperature of the water in the cylinder.

Whenever the collectors are hotter than the cylinder, the controller switches on the system's circulating pump. A mixture of antifreeze and water is then circulated through the collectors and the cylinder's heat exchanger, heating the cylinder in just the same way as a central heating boiler.[x]

# 5. What types of solar collectors are there?

The main part of any system is the solar collector, and this will have a big impact on the efficiency and cost of the system. The main types of solar collectors are:

- **Evacuated tubes**- A series of insulated glass heat tubes containing a vacuum. They are covered in a selective surface. More efficient that flat plate collectors, but more expensive.
- **Flat plate collectors**- Sheets of black metal that absorb the suns energy. The water is fed through the panel in pipes and picks up the heat from the metal. To withstand the UK

climate, the pipes contain a non-toxic anti-freeze and the metal sheet is covered with glass or clean plastic.

- **Selective surfaced flat plate**- More efficient than a flat plate collector because of the selective surface that is good at absorbing energy and does not radiate much energy back to the atmosphere.
- **Non-selective surfaced flat plate**- Normally a black surface that both absorbs radiation and radiates heat back out.[xi]

see www.mysolar.com/nl/index.asp for more information

## 6. What is the estimated lifetime of a SWH system?

A good glass covered water heater can perform well for more than 20 years.[xii]

## 7. Is my building suitable for a SWH system?

A SWH system can be used with all buildings; commercial, residential, etc. They can either be retrofitted or be designed into new development (it can often be cheaper to design in at the start). There are a range of products, some are designed to fit curved or low pitch roofs. This means that including a SWH does not have to compromise architectural flexibility. These types of SWH systems can be particularly suited to public or commercial buildings which require a different design solution to a domestic home. The SWH needs to be positioned in a shade free position as with PV; they can be placed on a roof a wall or at ground level.

A typical installation in the UK has a panel of $3m^2$ to $4m^2$ with a storage tank of 150- 200L. However, the optimum size will depend on actual hot water use. This can be calculated using software to simulate system performance throughout the year. Some are as small as $1.5m^2$.[xiii]

## 8. Cost of SWH systems

As of April 2003, the cost of installing a solar water system into existing households ranges from approximately £500-£1500 for a DIY system and to £2500-£4500 for a commercially installed system. These prices however, are dependent on the size of the system, type of collector, etc. DIY or new build system installations are cheaper, costs can also be reduced particularly in the case of large scale new building projects.[xiv]

Chapter 4

# Grants

## 1. For PV Systems

Grants are now available from the Government as part of the UK Photovoltaic Demonstration Programme. These were introduced in May 2002 by DTI and £20m is available over the next three years. Applicants will need to fill out an application form from the Energy Savings Trust (see their website for more details www.est.org.uk/solar/). Grants range from between 40-65% of total cost of installation.[xv]

## 2. For SWH Systems

The grants currently available from the Government for solar power do not presently extend to those who want to include solar water heating on their buildings. However because there are cost savings each year from reduced use of gas supplies (or other fossil fuel) it means that the initial cost of installing the SWH would effectively be paid back over several years.

Chapter

5

# Planning and constraints

## 1. For PV Systems

One of the main considerations when installing a PV system is to assess whether planning permission is required. Government Guidance on photovoltaics is set out in PPG22 Annex on Photovoltaics.

If a new building is proposed that includes a PV system, Merton Council will assess whether the PV has any visual impact on the amenity of the surrounding area. Where it is proposed to install PV on an existing building Merton's Development Control Section would assess whether the PV would be a material alteration of the external appearance of the building. If it is not considered to be a material alteration, planning permission will not be required. If it is considered to be a material consideration then planning permission will be required.

If it is proposed to install PV on a listed building, or on a structure in the curtilage of a listed building, it is likely that an application for listed building consent will be required. In conservation areas Merton Council have a duty to consider the potential impact on the character or appearance of the area.

If PV is proposed on a building close to a listed building or conservation area, its proximity to such an area or buildings may be a material consideration for the local planning authority in deciding the application. Merton Council will seek to strike a balance between the impact on the character of the area and the desire to promote sustainability. Where it is proposed to install PV they should where appropriate be located away from principal roof pitches and if possible should be set into the roof coverings to minimise projection beyond the existing roof slopes.

## 2. For SWH Systems

Solar water heating systems are not specifically mentioned in Planning Policy Guidance Note PPG22 Annex. However given that the two forms of solar energy use tend to have a similar effect on the appearance of a building it is likely that the planning considerations that are relevant to PV systems are likely to be relevant to SWH systems, however if there is any doubt you should check with Merton's Development Control Section.

Chapter

# Additional Resources

## 1. Websites

The information in this guide came from the following sources. Please refer to them for more information.

- www.pv-uk.org.uk/ - British Photovoltaic Association- examples of projects and installers that are approved under the UK photovoltaic demonstration project
- www.greenenergy.org.uk/sta/ - some background information on PV and SWH.
- www.greenenergy.org.uk/suppliers/index.htm - suppliers
- www.bre.co.uk/brecsu - information on various issues to do with construction
- www.greenregister.org - list of architects, engineers and trades people who have demonstrated a commitment to sustainable building practices
- www.mysolar.com/nl/index.asp - information on how PV and solar water heaters work.
- www.solarcentury.co.uk - information on PV and case studies of PV systems
- www.ecoconstruct.com - includes information on solar water heaters and eco- building merchant

## 2. Case Studies

View www.pv-uk.org.uk/uk/projlist.html for a comprehensive list of PV building projects in the United Kingdom.

Refer to www.greenenergy.org.uk/sta/solarenergy/index.htm to see letters written by solar water heating systems.

## 3. EcoHomes

EcoHomes is the Building Research Establishment's (BRE) system for assessing the environmental performance of homes. EcoHomes assessments are carried out at the design stage by licensed assessors who are trained by the BRE. Listed below are issues that the BRE addresses in their assessments. They can be used as a guide for improving the energy use in a home.

- Carbon Dioxide Emissions- In an EcoHomes assessment, you get the most points for achieving $CO_2$ emissions of less than or equal to 10 $kg/m^2/yr$. Zero points are awarded for having $CO_2$ emissions of more than 60 $kg/m^2/yr$.

- Building envelope performance compared with building regulations- The most points are awarded for a 30% improvement; zero points for less than 10% improvement.

- Provision of a secure drying space

- Provision of eco-labeled white goods

- Provision of external lighting systems which are low energy

## 4. The Householders Guide

This is Merton's new guide for householders to apply sustainable features in their homes.

## 5. Relevant codes of practice and articles of legislation

- BS EN 61215
- BS EN 61646
- The Electric Supply Regulations 1988
- The Building Regulations 1991 (and amendments)
- The Construction (Design and Management) Regulations 1994

# References


[i] http://www.pv-uk.org.uk/technology/whatispv.html

[ii] http://www.pv-uk.org.uk/technology/generation.html

[iii] http://www.pv-uk.org.uk/technology/applications.html

[iv] http://www.pv-uk.org.uk/technology/types.html

[v] http://www.pv-uk.org.uk/technology/configuration.html

[vi] http://www.pv-uk.org.uk/technology/installation.html

[vii] http://www.pv-uk.org.uk/technology/cost.html

[viii] http://www.mysolar.com/mysolar/heat/solarheat.asp

[ix] http://www.greenenergy.org.uk/sta/solarenergy/index.htm

[x] http://www.greenenergy.org.uk/sta/solarenergy/index.htm

[xi] http://www.greenenergy.org.uk/sta/solarenergy/index.htm

[xii] http://www.greenenergy.org.uk/sta/solarenergy/index.htm

[xiii] http://www.mysolar.com/mysolar/heat/yrauswers.asp#q8

[xiv] http://www.greenenergy.org.uk/sta/solarenergy/index.htm

[xv] http://www.pv-uk.org.uk/technology/grant.html

Volume

LONDON BOROUGH OF MERTON

For developers and building professionals

# Water Conservation

*APRIL 2003*

ENVIRONMENTAL SERVICES DEPARTMENTS

# Water Conservation

merton
moving ahead

Merton Civic Centre London Road,
Morden, Surrey SM4 5DX

# Table of Content

## 1. How to use this Guide

This guide is aimed at those directly related to the construction industry. Possible users are, but not limited to, developers, architects, builders, and surveyors. The guide will help these professionals in attaining sustainable development policies currently found in the London Borough of Merton's Unitary Development Plan (UDP). This guide to water conservation is one of a series of information guides on sustainable construction. The purpose of this specific guide is to raise the awareness of water conservation techniques and their benefits to the user.

The guide will first discuss the reason why there needs to be a conscious effort in promoting water conservation. It will provide the user with ideas for reducing water consumption, for both commercial and residential developments, and the benefits that they would bring. It will then offer some information on the need for more conservation due to the climate change around the world. Links to case studies are also included so you can see how certain water saving techniques are being implemented in developments.

## 2. The need for Conservation

It is important to realise that the world's natural resources are gradually depleting. Water is one of the most fundamental natural resources and a major emphasis needs to be placed on conserving and protecting it. Water needs to be purified. This takes a lot of energy from fossil fuels, so water conservation will help reduce carbon emissions and energy bills.

It is also perceived that the UK has an abundant water supply due to rainfall. But the World Resources Institute have categorised the water sources in the UK as low. This is due to increased demand in lifestyles and changing rainfall patterns which have caused droughts in the past. There are different techniques available that can provide developers and construction professionals with water saving alternatives.

Merton's current Unitary Development Plan (UDP) encourages architects, developers, builders and other construction professionals to find ways to maximise water conservation. The policy that deals with this is **Policy BE.31: Sustainable Development**. In the justification it is stated that the Council is keen to see energy and water efficient features incorporated into the planning and design of development wherever practicable. Implementing these types of measures will help construction professionals meet current UDP policies. It will also prove useful in considering **Policy ST.1a: Sustainable Development**, which states that "The Council will encourage development which is sustainable and resist development which substantially fail to follow the principles of sustainable development. In applying this policy, the Council will apply its sustainability checklist to assess whether development is sustainable. Where large development schemes are proposed developers should normally submit a sustainable development statement with the planning application". If developers are able to respond to the UDP policies, then it will be easier to receive planning permission for purposed schemes.

## 3. The facts of water use

The table below shows the water use in a typical household from 1997-1998.

| England & Wales | Percentages (%) |
|---|---|
| | |
| Bath/shower/handbasin | 28 |
| WC flushing | 35 |
| Clothes washing | 12 |
| Dishwashing | 4 |
| Garden use and car washing | 8 |
| Other[1] | 13 |
| 1 Includes kitchen taps, swimming pools, paddling pool, direct heating systems, general cleaning etc. | |
| | |
| Source: Environment Agency | |

Table 1: Domestic Water use in Litres based on total of 150 litres per day
Source: Environment Agency

# Water Saving Techniques

## 1. Toilets and Urinals

Devices in the bathroom account for more than a third of the total water consumption in a home. Currently 9 litres (2 gallons) is the amount of water used in every flush. This amounts to about 52 litres a day in an average home. You can reduce the water usage by implementing alternative methods for both the toilet and showerheads.

Toilets are available that currently only use 6 litres (1.3 gallons) of water per flush.

### DUAL FLUSH TOILETS

Modern dual flush toilets are available with three-litre and six-litre flushes, which can save up to half the water used for WC flushing. Currently, regulations state that only new developments have the option of dual flush toilets. Based on a simple payback period, calculations for single family dwellings show that a £190 dual-flush toilet will have a payback period of approximately 8.5 years. A five-year payback period would be achieved (using the same criteria) if the cost of water was increased to £1.06 per $m^3$ or the cost of the toilet was reduced to £110.[i]

### WATERLESS URINALS

For commercial developments as well as where water supply is limited, waterless urinals should be considered. A conventional urinal flushes periodically in order to remove urine and debris from the bowl. New Waterless Urinal Bowls are normally fitted to either new or existing plumbing. These types of designs generally incorporate a specially designed 'airlock' cartridge in the base of the urinal bowl. This is used in conjunction with barrier oil or other sealant liquid, allowing urine to pass through to the waste pipe but deterring malodour from returning to the room. The cartridges are generally designed to trap sediments and debris, and need periodic replacement - typically between 2 and 4 times per year depending on usage. The advantage of using this system is saving 65,000 litres of water per urinal. The quantity of water passing through waste treatment plants is reduced, and the natural resources required to process the water are saved. [ii]

### WATERLESS TOILETS

Toilets where flushing is not necessary are also available. There are two types currently available: composting and incinerating. Composting toilets are toilet systems, which treat human waste by composting and dehydration to produce a useable end product that is a valuable soil additive.[iii] Incinerating toilets are self-contained units typically consisting of a traditional commode-style seat, which is connected to a holding tank and a gas-fired or electric heating system to incinerate waste products deposited in the holding tank. It produces a fine ash, which can easily be disposed of.[iv] More information can be found at http://www.nsfconsumer.org/environment/. Since 35% of the water use comes from toilet flushing, it will dramatically cut the total consumption. For more information on this, go to www.compostingtoilet.org.

## 2. Taps and Shower Heads

More than a quarter of the water used in an office comes from the tap. By installing spray taps, it can reduce water from tap usage by about 80%. Sensor taps and timed turn-off taps prevent waste and flooding. For home use, sprayers may not be feasible. A device called the Tapmagic can be fitted to most taps with a round outlet hole or standard metric thread, which reduces water flow from domestic taps.

A quick shower uses a third of the water of a bath, but power showers can use more water than a bath in less than five minutes.[v] A typical showerhead provides about 20 litres (4.5 gallons) of water per minute. There are alternative heads that can reduce this number. Substitutes are flow restrictors and aerators. A flow restrictor just restricts the flow that goes through the showerhead. For information on flow restrictors go to www.energyhawk.com. An aerator mixes air into the water stream in a showerhead, which provides a steady and even flow (http://eartheasy.com). A low-flow showerhead:

- costs about £7-£13
- pays for itself in just a few months, and
- use no more than 2.5 gallons per minute at standard residential water pressure.

## 3. Rainwater Collection

Reuse of rain water in a plumbing system either in a commercial or residential setting proves to be environmentally and economically effective. It can reduce the use of clean drinking water for purposes that do not require clean drinking water. Rainwater falling on to the roof is collected via guttering into down pipes that link into a water butts and underground tanks.[vi] Before considering installation of this system one should examine the potential savings. It may not be economic to use in existing homes, but can be used in new developments. For a typical four-person home, a holding tank of 2m$^3$ would suffice. Installation will be easier for new developments and buildings with downpipes at one end and a garage or cellar with a place for a low-cost tank. Other possibilities for this system include clothes washing and toilet flushing because the water is considered "soft". Figure 1 shows a system for rainwater collection for homes.

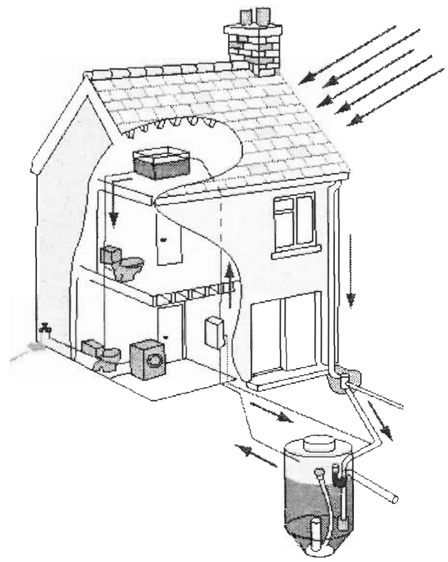


Figure 2.1: Rainwater reuse for homes
Source: Environment Agency

# 4. Grey Water Usage

Grey water systems are viable techniques of water conservation. These systems can be implemented in both residential and commercial settings. Grey water is the liquid waste from domestic fixtures (not including toilets) such as baths, showers, hand basins and laundry facilities.[vii] This is then used for other means, such as irrigation and WC flushing. A more in-depth discussion on the use and effectiveness of grey water can be found at http://greywater.net. A trial by the Environment Agency's National Water Demand Management Centre showed a range of water savings from about five percent to 36 percent for different trialists. Figure 2 shows a grey water system used for irrigation purposes.

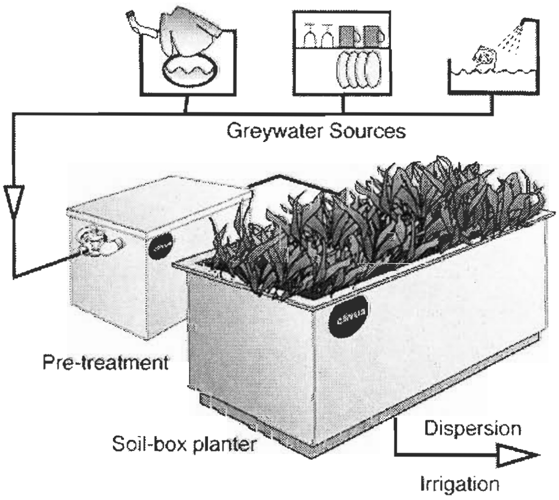



Figure 2.2: Grey Water System for Irrigation
source: http://greywater.net

Below is green water recycling system used in the Beddington Zero Emissions Development (BedZED). It integrates both grey water (foul water) and rain water systems discussed earlier.

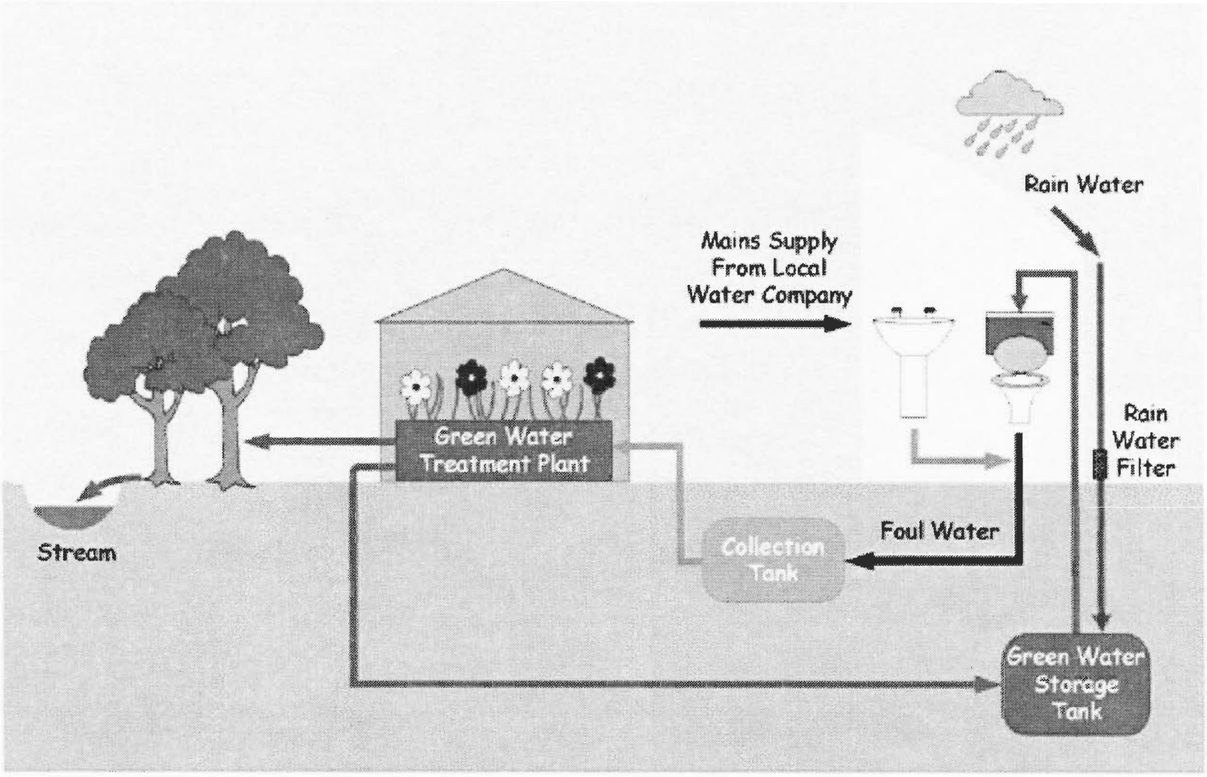



Figure 2.3: Green Water Recycling system

Source: http://www.enviro-logic.com

## 5. Use of water efficient domestic appliances

For home developments, appliances such as washing machines and dishwashers should be as efficient as possible. Current washing machine use accounts for about 12 percent of the water use at home, while the dishwasher accounts for about 4 percent. New washing machines use about half of the water that a ten-year-old machine uses. The new machines now use about 50 litres per wash. According to a study by *Which?*, a test on 13 dishwashers found that 7 use about 16 litres per cycle. The three graphs on the next page show water consumed and cost incurred through old and new washing machines and dishwashers.

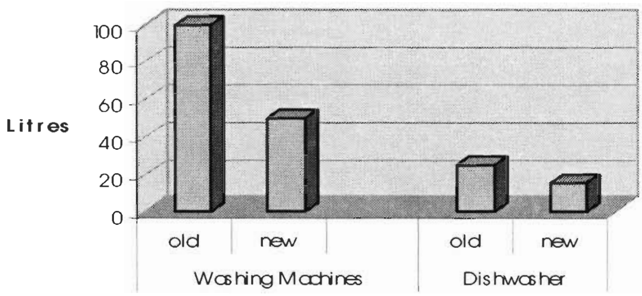



Figure 2.4: Litres per wash (full load)

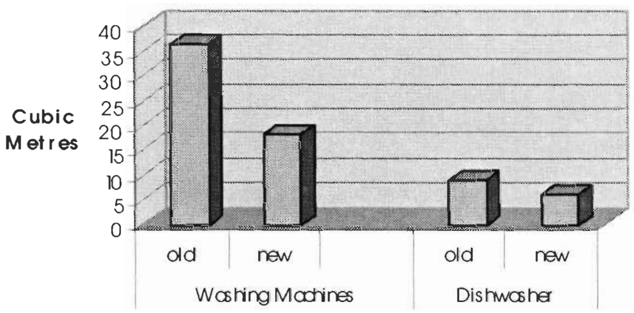



Figure 2.5: Annual Water use

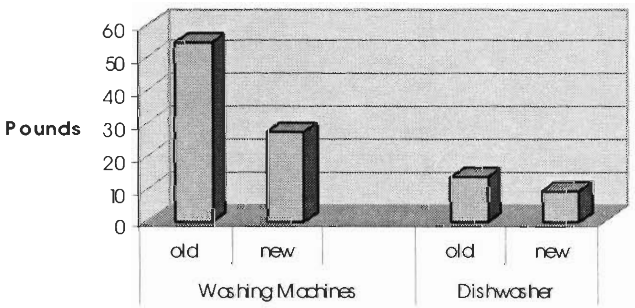



Figure 2.6: Annual water cost
Source: Environment Agency

## 6. Planting – Drought resistant plants

The average water use outside, including garden watering and car washing, accounts for about 6 percent of annual domestic water consumption. On hot summer days, 50 percent or more of the water supply may be used for garden watering when supplies are more stressed.

Drought resistant plants require less water then their counterparts. The following list shows plants that thrive in hot and dry conditions.

| | |
|---|---|
| African lily | Lavender |
| Buddleia (butterfly bush) | Peruvian lily |
| Californian lilac | Pink |
| Californian poppy | Red-hot poker |
| Catmint | Rock rose |
| Daisy bush | Rosemary |
| Evening primrose | Straw daisy |
| Foxtail lily | Thyme |
| French honeysuckle | Tulip |

Source: Environment Agency

## 7. Water Metering

By installing a water meter, there is a clear record of the amount of water being used in a building. This has more benefits than just letting you know of the amount of water being used; it also helps you to detect leaks within homes or buildings. As of 1 April 2000, home developments had the right to a metered water supply. You can ask your water company to install a water meter free of charge. However, if it will be too difficult or cost too much to install a water meter, water companies have the right to charge. Currently all new large-scale developments are required to install water meters.

## Climate Change and Water Conservation

Construction professionals need to be aware of the changing climate of the world and it's response to the earth's natural resources. Its biggest impact would be the water supply.

According to the DEFRA's Climate Change Scenarios for the United Kingdom, April 2002, the UK's climate has changed within the past century with central England temperature rising as much as 1°C. Other factors they have noted relating to climate change are

- Hotter and drier summers will be more frequent
- cold winters will become increasingly rare
- Snowfall amounts will decrease throughout the UK
- Sea level has started to rise

With warmer and drier summers due to global warming, there will be an increase in the use of water. Areas such as gardens and agriculture will account for this rise in water use. Therefore, consideration needs to be placed on how to alleviate the need for this change.

For more information on climate change and water resources, go to www.environment-agency.gov.uk.

# Additional Resources

## 1. Additional Information

The Householders Guide – Merton's new guide for householders to apply sustainable features in their homes.

www.envirolet.com – Provides information and products on waterless compost toilets.

www.buildinggreen.com – Information regarding different techniques for building a green construction.

http://greywater.net – A variety of information regarding the implementation and costing of grey water systems.

www.energyhawk.com – Provides different information on energy and water conservation tips for home and business.

http://eartheasy.com – Information on living and providing a sustainable future.

http://www.environment-agency.gov.uk – The environment agency of Britain. Provides a wide range of literature on green efficiency.

## 2. Case Studies

For examples on how the systems above have been implemented, please see the Water Efficiency Awards found at www.environment-agency.gov.uk. The Water Efficiency Awards recognises those developments which have taken a positive step in applying water conserving techniques.

The BedZED project is also a good source for understanding how many of the techniques discussed in this guide are used. You can find more information about this development at www.bedzed.org.uk.

# References


[i] http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/02-124-e.html

[ii] http://www.ri-research.com/health/newsandt /Watrless/watrless.htm

[iii] http://www.compostingtoilet.org/explain.html

[iv] http://www.nsfconsumer.org/environment/ wastewater_incinerating.asp

[v] Environment Agency – Conserving water in buildings *10 Showers and baths.*

[vi] http://www.selenvironmental.com/stormwater /rainwater%20reuse.htm

[vii] www.geelongcity.vic.gov.au/media/news/1999/ news_99-37.htm

## Planning opportunities and constraints

The Borough of Merton is producing approximately 450 houses a year and the city of London is producing approximately 23,000 homes a year. This rate of development implies that there are many opportunities for passive solar design and other sustainable development practices to be implemented. Passive solar design is also highly encouraged by the Merton Development Control and Building Control offices.

Constraints for passive solar design include a shortage of space in Merton, and a general lack of sustainable development knowledge among professional developers. Refer to http://www.merton.gov.uk for more information.

## Grants

Grants for sustainable development in general are common and well worth a looking into. However, grants for passive solar design are virtually non-existent. However, there are grants that exist that offer money to construction proposals that save energy through other sustainable development practices such as active solar design (photovoltaic panels), and the use of sustainable building materials. It is possible to incorporate elements of these techniques into a passive solar design to benefit from both practices. See the "Solar Energy" and "Sustainable Building Materials" brochures for more information.

## Further Information

- A4 guide to passive solar design
- http://www.greenbuilder.com/sourcebook/PassiveSol.html - introduces passives solar design heating and cooling techniques.
- http://www.greenbuilder.com/sourcebook/ - Addresses topics of passive solar designs such as "Landscaping," "Lighting."
- www.greenregister.org - list of architects, engineers and trades people who have demonstrated a commitment to sustainable building practices.
- The Solar House: Passive Heating and Cooling; by Daniel D., Ph.D. Chiras.
- The Passive Solar House (Real Goods Independent Living Books); by James Kachadorian.
- Passive Solar Design and Construction Handbook; by Michael J. Crosbie.
- Passive Solar Commercial and Institutional Buildings: A SourceBook of Examples and Design Insights; by Robert Hastings.

Merton Civic Centre

London Road

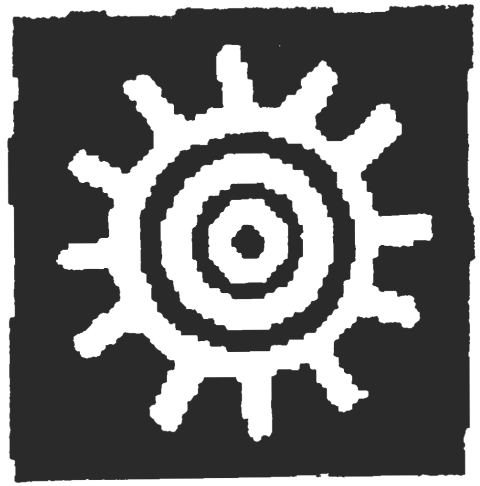
Morden, Surrey SM4 5DX

merton
moving ahead

# PASSIVE SOLAR DESIGN

# MINI-GUIDE

## For developers and building professionals



*London Borough of Merton*

*Draft – Not for Publication*

*June 2003*

Volume

LONDON BOROUGH OF MERTON

For developers and building Professionals

# Passive Solar Design

*DRAFT – NOT FOR PUBLICATION*

*JUNE 2003*

ENVIRONMENTAL SERVICES DEPARTMENT

# Passive Solar Design

merton
moving ahead
Merton Civic Centre London Road,

Morden, Surrey SM4 5DX

# Table of Contents

Chapter

# Introduction

## 1. What is Passive Solar Design

Passive solar design is the utilisation of the sun's heat, the natural currents of warm and cool air and sustainable building materials to maintain a steady and comfortable indoor temperature while maintaining the quality of life and sustaining natural resources.

## 2. What will this guide cover?

This guide will provide information on multiple techniques and benefits of passive solar design which will include, wind blocking, floor planning, and passive solar heating. While this guide will discuss each topic individually, it is best to use as many sustainable construction techniques in conjunction with each other as possible.

## 3. Why use Passive Solar Design?

Other than the fact that passive solar design is fully supported and "positively encouraged" (Alec Johnson) by the Merton Development and Building Control officials, there are three primary reasons to invest in passive solar design: to reduce maintenance and operating costs, to improve the quality of life, and to reduce damage to the environment.

### 3.1 Reduced Maintenance and Operating Costs

By practising passive solar design, building owners can save on maintenance, heating, and electrical bills. Because there are few moving parts in passive solar designs, there is minimal wear on each of the design components. Passive solar designs have been tested by many organisations in various parts of the world, all with promising results. For example, The National Energy Foundation in the UK states "low cost passive solar design features and draught proofing and insulating measures reduced heating bills by 40%. Savings paid back the costs in two years" (http://www.natenergy.org.uk/passol.html). From the United States Department of Energy, "Incorporating passive solar designs can reduce heating bills as much as 50 percent" (http://www.eere.energy.gov/RE/solar_passive.html). When referring to a newly constructed office and residential building, Beddington Zero Fossil Energy Development (BedZED) from the UK states "It is estimated that residents might see a 60% reduction in total energy demand and a 90% reduction in heat demand, compared to a typical suburban home" (http://www.bedzed.org.uk/main.html).

## 3.2 Improving the Quality of Life

Through specific passive solar design techniques it is possible to improve the quality of life for those who occupy the building. For instance, by planting trees along a busy nearby road, wind and noise pollution will be reduced, but also the building will look out onto a row of trees rather than a busy road. Another example is by increasing the size of a building's south facing windows, the heating and electrical bills will go down, the residents will have a better view of the outdoors, and they will be exposed to more sunlight which contains Vitamin D and helps to build stronger bones. Another technique that can improve the quality of life is Structural Insulated Panel (SIP) which is used to build walls. SIP walls not only increases the ability of a building to absorb thermal energy that can be released later, but also are able to absorb large amounts of sound, reducing the indoor noise pollution.

## 3.3 Benefiting the Environment

As indicated in the "Reduced Maintenance and Operating Costs" section (see page 1), when the different elements of passive solar design are properly implemented, the building's heating needs are reduced. By reducing the need for heating, the demand for fossil fuels is also reduced. In turn, the amount of fossil fuel used to heat the building is also reduced; this produces less carbon dioxide to be released into the atmosphere, and thus helps to slow the global warming process. Also, according to the UDP policies, E.13 and PE 14, new non-residential developments over 1000 $m^2$ are required to draw 10% of their energy from renewable energy sources. Passive solar design is a cheap and easy way to meet this requirement.

Chapter

# External Building Layout

## 1. What is External Building Layout?

The external layout of a building is the compilation of that building's surroundings. A few examples of elements that can contribute to an external layout are: natural terrain features, open fields, trees, and roads. The three topics that will be discussed in this chapter are wind blocking, solar shading, and natural lighting.

## 2. How is External Building Layout Important to Passive Solar Design?

The external layout of a building is essential to the success of the passive solar design because external factors have an immense impact on the heating needs of a building. By minimising the building's exposure to cold winds and shade and maximising the building's exposure to sunlight, the building will be able to collect and retain more of the sun's thermal energy for longer periods of time.

Without being conscious of the terrain surrounding a building, it could become subject to cold winds or lack the necessary sunlight to properly implement a passive solar design. Three external building topics to be aware of are landscaping features, such as hills and valleys, that will either focus or disburse wind currents, shade which can heavily damper a building's ability to utilise sunlight as a heat source, and natural lighting which is simply letting the sunlight into the building. The success of a passive solar design is heavily dependent on a building's exposure to natural sunlight, and requires a balanced combination of all three of these topics to succeed.

# 3. Specific External Building Layout Techniques

## 3.1 Wind Blocking

The purpose of slowing down or blocking cold wind is to minimise the heat loss from inside a building. The use of vegetation such as trees, bushes, and ivy to slow down wind is widely practised on farms, in residential areas and in business districts. In each of these cases it has been successful while adding to the natural beauty of the terrain. Tall, wide, fast growing trees, for example pine trees, are best for blocking wind. Pine trees are an excellent choice not only because they grow tall, wide, and fast, but they also do not lose their needles in the winter when winds are especially cold. When planted close together and in a row, such as along a road (see pictures below), trees are able to dramatically reduce wind speeds. Trees that are planted along a road are also able to reduce noise pollution, increase the air quality, and improve the privacy of homes. By planting bushes around the base of the building and planting ivy, such as English ivy, so that it can grow up the outside of the wall, a second windshield is formed much closer to the building. Though trees, bushes and ivy can provide excellent wind cover, they can also block the sun from reaching the building. It is advisable that trees be planted as far to the north as possible and far enough from the building so that when the trees are full-grown they will not cast a shadow onto the building. Bushes and ivy should also be planted towards the north of the building unless extreme winds come from the south. It should also be known before planting ivy if the wall material is able to support it. Ivy can cause damage to walls that are improperly equipped or are made of unsuitable material.

## 3.2 Solar Shading

For a passive solar design to work, sunlight must first reach the house. It is possible that shade from trees or other buildings can completely eliminate the usefulness of a passive solar design. It is strongly advised to avoid constructing a building where it will be overshadowed by another building. It is also advised to avoid overshadowing other buildings so to not hinder a neighbour's ability to benefit from various active or passive solar design techniques. Exposing as much of a building as possible to sunlight optimises the potential thermal energy to be collected by the building and therefore optimises the potential of a passive solar design.

## 3.3 Natural Lighting

The most efficient way to increase the natural lighting of a building is to increase the size and number of the windows and skylights. However, glass windows, window frames and skylights tend to conduct heat unless properly treated. A double or triple glazed window with low emissive glass is the most effective means of insulating windows. Even though an airtight, glazed window is not supposed to let air in or out, it still allows heat, in the form of sunlight, through. When the sunlight passes through the window and shines on the walls and floors, some of that light is absorbed by the walls and floors and converted into heat. Because the windows and window frames are highly insulated and airtight, heat is only coming into the house via sunlight. Due to the curvature of the earth; in the Northern Hemisphere the southern most building face will receive the most sunlight, and therefore, it should have many large windows to optimise the building's thermal gain. Because the north side of a building receives less sunlight, temperatures on this side of the building tend to be cooler and by making the northern facing windows smaller, the heat loss through them is minimised.

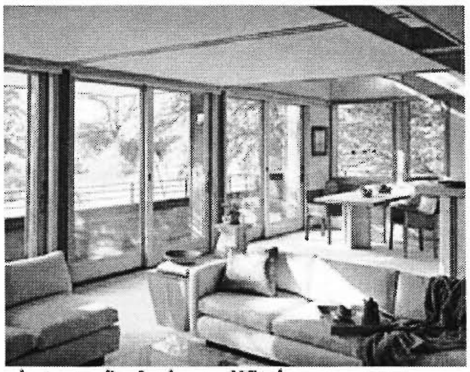


**photo credit: Andersen Windows**

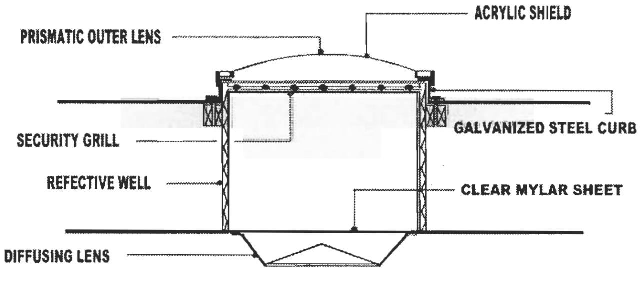
Window frames come in a variety of materials such as PVC, steel, aluminium, and timber. However, PVC is environmentally unfriendly because it takes thousands of years to decompose, while steel and aluminium readily conduct heat. Timber from sustainable woodland suppliers with Forest Stewardship Council (FSC) accreditation, such as those found on this website, http://www.fscoax.org/html/5-3-1.html, is a renewable resource; however, it does not conduct heat nearly as fast as steel and aluminium. Timber window frames are usually less expensive than PVC and aluminium frames, but they require more maintenance. Top-quality, airtight, hardwood timber window frames are more expensive than most conventional timber window frames, but they offer lower maintenance costs, improved insulation (U-values between 1.0-1.6 W/m$^2$), longer life, and a better overall life cycle cost analysis than any other window frame material.

Skylights are another useful tool when trying to naturally illuminate a building. Conventional skylights (see two top pictures below) have been used for many years and are still very effective when trying to lower the electric lighting and heating bills. These skylights can increase the ventilation of a building if they are opened up on a hot day. Conventional skylights have been most common in homes and in single story warehouses. However, these skylights can pose security problems if someone were to try to break in through the roof, and they can create mildly uncomfortable areas where the sun shines directly. A more modern version of the skylight has improved upon these issues by placing a "security grill" directly underneath the outer lens and by installing a "diffusing lens" on the bottom of the skylight to evenly disperse the sun's rays (see bottom picture below). The lens seen at the top of the skylight bends and channels even more sunlight into the skylight, enhancing the brightness of the building's interior even more. This skylight is used most commonly in school gyms, warehouses, grocery stores and other buildings with large rooms and requires a professional to be installed. The only feature that the traditional skylight has that the newer version does not is the ventilation option. It is not possible to open the more modern skylight on a hot day to let excess heat out.

photo credit: Velux Corporation

photo credit: Velux Corporation

## Natural Lighting Systems Components




**Daylight is a free renewable light source for all to enjoy!**

Chapter

# Internal Building Layout

## 1. What is the Internal Building Layout?

The internal layout of a building concerns the building's design, orientation, and the thermal mass materials and structures within the building. The proper utilization of these components is critical to the operation of a passive solar design and must be considered carefully before construction is begun.

## 2. How is this implemented?

As previously indicated, it is best to be aware of passive solar techniques before designing the building so that as many sustainable development techniques as possible can be included in the original designs. This guide will provide an introduction into each topic and explain how it contributes to a passive solar design, but further research should be done before making the initial plans. There are some passive solar design techniques that can be incorporated into already existing buildings, but they require major remodelling of the building's interior.

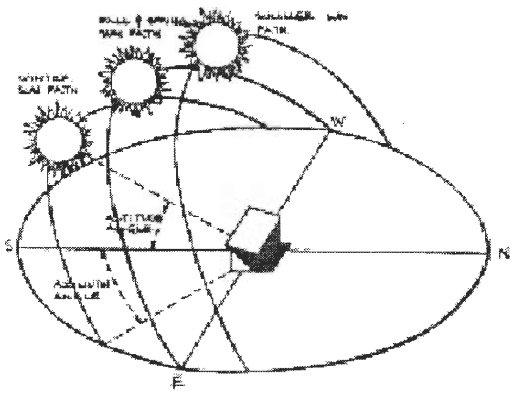
## 3. Why use these techniques?

By using everyday building materials in slightly different ways, the building's indoor temperature can be made more steady throughout the day, more even throughout the building, and more comfortable. By reducing heating needs, the demand for the fossil fuels used for heating can be dramatically reduced. Examples of this can be found in "Reduced Maintenance and Operating Costs" (see page 1). Less demand for fossil fuel results in reduced heating bills as well as less carbon dioxide that is released into the atmosphere. Floor planning and remodelling with passive solar design intentions in mind can also reduce the electric bill by bringing sunlight to the rooms that are used most often, such as the kitchen and dinning room. Using direct sunlight to illuminate the most commonly used rooms allows for a more pleasant indoor atmosphere by exposing the occupants to a wider range of the light spectrum than artificial lights provide.

# 4. Specific Internal Building Layout Techniques

## 4.1 Building Orientation and Design

Building orientation is a very basic, yet highly effective, technique in passive solar design. As previously stated, the southern-most side of a building is exposed to the most sunlight, by having the largest side of the building face as close to due south as possible, the building's interior is able to receive the most amount of sunlight. The diagram below graphically depicts this for three different times of the year. During the summer, the sun is higher in the sky but during winter the sun stays closer to the horizon. Regardless of the season, the southern face of this building always receives the most sunlight.



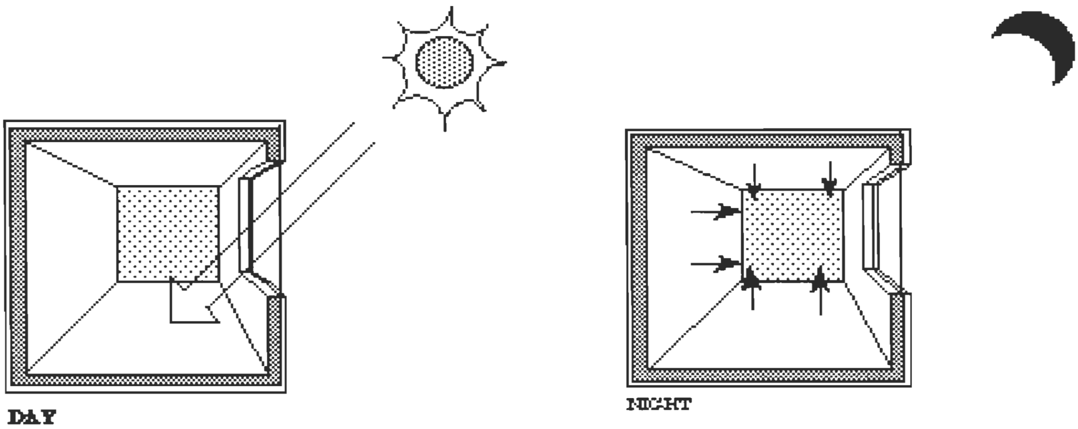

The internal design of a building plays an important role in the effectiveness of a passive solar design. When designing a building, it is best to make the interior rooms spacious and make large pathways between those rooms. This will allow the air currents to move easily throughout the building in order to provide a more even temperature throughout the building.

Another floor planning technique for a building, more specifically a house, is to place the most active rooms, such as the kitchen and living room, along the south-facing wall. Because the southern side of the building will be the brightest, fewer electric lights will have to be used inside during the day.

Weatherproofing is a technique that should be taken seriously when first designing a building. It is important that a building draught proof and well insulated so that the glazed windows, timber window frames and other passive solar components can perform to their optimum capacity.

## 4.2 Thermal Mass

Thermal mass is any material that collects, stores, and distributes the sun's thermal energy. Thermal mass is a valuable tool in passive solar designs because these materials are cool during the day while they collect the thermal radiation from the sun's light then they release the thermal energy during the night when the building is cooler. Examples of thermal mass materials are tile, stone, brick, concrete, clay, and even water. Typical implementations of thermal mass materials are tile floors, brick or stonewalls, a concrete slab underneath a building, and masonry heaters. Both walls and floors can be made from these thermal mass materials, however, when doing so it is important to not cover the floors with carpets or the walls with large paintings so that they are fully exposed to sunlight and able to absorb its energy. Another example of a thermal mass building material is Structural Insulated Panelling (SIP). SIP uses two pieces of either ply wood or sheet rock for the wall's exterior, then the space between the two is filled with insulating foam, this is similar to how windows are glazed. According to the Oak Ridge report concerning a SIP walled room the "SIP room is 15 times less leaky" when compared to a traditionally walled room subjected to the same conditions. Because of its thermal insulating properties, SIP walls are capable of being both interior and exterior walls. SIP walls are constructed at a factory, shipped to the construction site where they are then cut to the proper dimensions. This is much faster than conventional construction techniques, and SIP materials are cheaper as well.

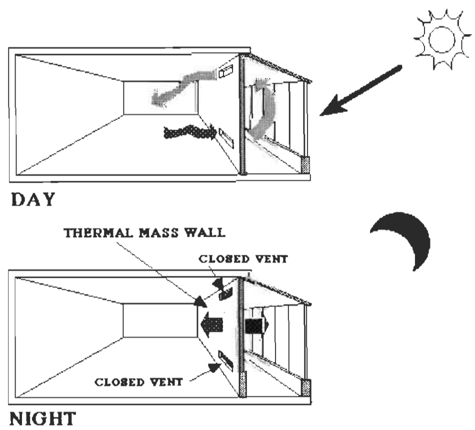



## 4.3 Insulation

The insulation in a building is what makes it possible to regulate the indoor temperature of that building. This fact makes insulation very important to passive solar designs that are solely aimed at regulating indoor temperatures. Insulation can be made of many different sustainable materials such as fiberglass, mineral fiber, cellulose, vermiculite, rigid foam, urethane foams, rockwall, and $CO_2$ blown polystyrene. A recent BedZED project has used rockwall and polystyrene (though it was accidentally blown with the wrong gas) for its walls and roof insulation. It is highly recommended that biodegradable insulation materials, such as sheep's wool and hemp, be avoided to reduce maintenance costs and replacement needs. Well-installed, durable insulation will save money for up to 60 years and will pay back the cost of instillation after a few years through savings on heating bills. Insulation must be properly installed to optimise its efficiency. Improperly installed insulation can reduce the effectiveness by 50%. Insulation should be placed on any surface that is in contact with an unheated area, such as the attic, exterior walls, floors, foundation and ductwork, the walls of a heated basement, and crawl spaces. Not insulating a building is the heating equivalent of leaving the windows and doors open night and day by allowing heat to escape through the walls, floors and ceiling making it impossible for a passive solar design to have any impact on the temperature of a building. Houses in the UK make up for 29% of the total energy consumption. Insulation and other passive solar design techniques can help to reduce this percentage, the first step is to install the proper kind and amount of insulation in both new developments and old structures.

## 4.4 Conservatories and Thermal Buffering

A conservatory is an excellent passive solar tool. When designing or remodelling a building with a conservatory, it should be placed on the south side of the building and made the entire height of the building if possible. According to the building regulations in Merton, an extension to a building must have a roof that is approximately 70% glass and walls that are approximately 50% glass to be considered a conservatory. Also, if the conservatory covers less than 30 m$^2$ of ground, it is exempt from the building regulations for conservatories. A well build conservatory will create a larger area to catch the sun and to help heat the attached building. The diagram below shows how a conservatory can help heat a building during the day. A conservatory provides a bright, airy living space that traps the sun's energy to passively heat air entering the home. However, because conservatories are not insulated, it is very important that they are not heated like the rest of the building. It is also very important to adequately insulate the walls separating the conservatory and the main building; this wall is called the thermal buffer or the thermal mass wall as seen in the diagram below. If the thermal buffering is inadequate, then the conservatory will drain the warmth out of the building at night when it has cooled down outside. For information on sustainable insulating materials, see the mini-guide "Sustainable Building Materials."



## 4.5 Colour and Passive Solar Design

Something as simple as the colour of a wall can affect its ability to absorb the sun's thermal energy. As a general rule, if an object is meant to absorb heat, it should be black or another very dark colour. If an object is meant to stay cool, then it should be white or another very light colour. The reason for this is that black absorbs nearly the entire light spectrum, whereas white reflects nearly the entire light spectrum. When the whole visible light spectrum is absorbed, so is the thermal energy it carries which is why objects, such as masonry heaters, SIP walls and other objects which are meant to absorb heat, should be painted black.

Chapter

# References

## 1. Websites

Then majority of the information in this guide has come from the following websites. Please refer to them for more information.

- http://www.nrel.gov/clean_energy/passivesolar.html
- http://www.greenbuilder.com/sourcebook/PassiveSol.html
- http://www.epsea.org/mass.html
- http://www.unl.edu/nac/windbreaks.html
- http://www.consumerenergycenter.org/index.html
- http://www.consumerenergycenter.org/homeandwork/homes/construction/solardesign/insulation.html
- http://www.fscoax.org/html/5-3-1.html
- http://www.eere.energy.gov/RE/solar_passive.html
- http://www.daylightingtechnology.com/chart.asp
- http://www.eere.energy.gov/consumerinfo/refbriefs/bd1.html
- http://www.natenergy.org.uk/passol.html
- http://www.eere.energy.gov/RE/solar_passive.html
- http://www.bedzed.org.uk/main.html

## 2. Printed Materials

BioRegional Development Group; Beddington Zero (Fossil) Energy Development Construction Materials Report, 2003

http://www.bioregional.com/zero/construction%20materials%20report.htm

Nayak, J. K., Hazra, R., Prajapati, J. (1999). Manual on passive solar architecture (1st ed.). New Delhi, India: Solar Energy Centre, MNES.

Merton Civic Centre Library

# Appendix N – Sustainable Materials Mini-Guide

Insulation is another big issue with healthy materials. Some older insulation can be a health hazard, and many newer insulation's use toxic and atmosphere destroying gasses (HCFCs are the most common) during creation. There are many sustainable alternatives, including natural or recycled insulation's. These insulation's, while generally are not as good of insulators, are both less expensive and more environmentally friendly, and if designed for initially, can provide the same insulating ability for the same cost as conventional insulation by using more.

While just a few examples of healthy materials, the healthiness of any material should be checked to provide the healthiest construction possible. Healthier materials vary in cost compared to conventional materials, but are often less expensive or equal in price. The more expensive ones usually offer a very significant health benefit, which can be considered an investment in both the environment and the health and wellbeing of the occupants of the building.

## Further Information

A4 guide to Sustainable Materials – more information on these and further topics.

The Householder's Guide – Guide for householders to use sustainable features in their homes.

www.environment-agency.gov.uk – Provides range of information on Sustainable Development

www.buildinggreen.com – Information regarding different techniques for building a green construction.

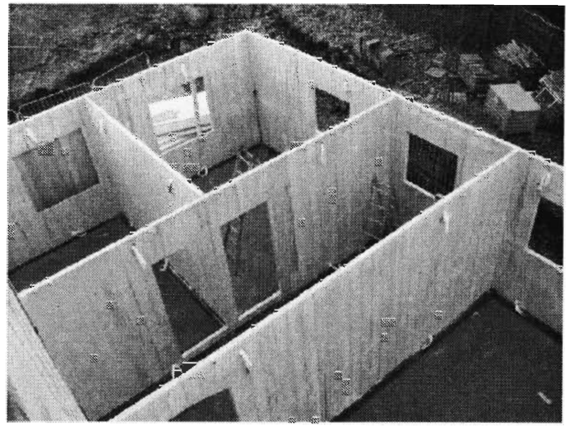
http://eartheasy.com – Information on living and providing a sustainable future.

merton
moving ahead

Merton Civic Centre
London Road
Morden, Surrey SM4 5DX

# SUSTAINABLE MATERIALS MINI-GUIDE

## For developers and building professionals



*London Borough of Merton*

*Draft – Not for Publication*

*June 2003*

# SUSTAINABLE MATERIALS

## Why use Sustainable Materials?

The world has a finite amount of resources we can use, and eventually we will run into problems where some of these resources have been exhausted and thus are no longer available. The concept behind sustainable materials is that they will always be available for use, and we will never exhaust their supply.

Using sustainable materials not only has the future benefit of their availability, but many others as well. Part of what makes a sustainable material actually sustainable is that it has less of an environmental impact than conventional materials, which means that the world is and will continue to be a better and healthier place to live. They also are often less expensive than conventional materials, or are nearly the same cost. The main barrier to sustainable materials is their availability and ease of supply: often they are harder to find and source than conventional materials, and sometimes sourcing them can take more work or is more time-sensitive than conventional materials.

## What are the available techniques?

There is no one sure method to acquire a sustainable material, but a number of methods, which when used together as much as possible will ensure that the most sustaiable materials possible are used.

*Local Sourcing*

Local sourcing is a way to lower the environmental impact of acquiring the material. By sourcing a material from a nearby supplier, the amount and length of shipping needed can be greatly reduced, which means that the means of shipping (usually by truck) emitted much less carbon dioxide and other combustion by-products.

There is seldom a significant price difference for most standard building materials between suppliers, so the only real downside to local sourcing is the small amount of effort required to find a local supplier that can meet a projects needs. The environmental benefits from the reduced shipping requirements improve the world for everyone, and should be considered worth the small amount of extra effort.

*Recycled and Reclaimed Material*

Recycled and Reclaimed materials are sustainable because they do not use any new material harvested from the planet, and thus cannot exhaust resources. Recycled materials are materials that are reprocessed from older or scrapped materials into a new product, while reclaimed materials are materials that are taken from their previous site and reused without reprocessing.

Recycled materials are often less expensive than new, virgin materials, especially now that the government has started to tax virgin materials. They are also more enviromentally friendly, as all of the resources that are expended extracting new base materials from the earth are saved.

Reclaimed materials are also usually less expensive than conventional materials, and they share the same environmental benefits that recycled materials have.

While not suitable for all purposes, the environmental benefit of using materials that would be discarded, the cost savings, and the compliance with policies encouraging or recommending sustainable development make recycled and reclaimed materials an obvious choice to use where available.

*Healthy Materials*

Healthy materials are those that have little to no harmful effect on a building's occupants. A healthy material is not-toxic, doesn't contain any harmful chemicals that could be released into the air over time, doesn't harbour allergens, insects, or moulds that could hurt people or damage the building, and didn't release any toxic or otherwise environmentally harmful chemicals during production. While finding a material that is completely healthy is nearly impossible, using the healthiest materials available and suitable for the job leads to better health for the occupants, which means a more valuable building.

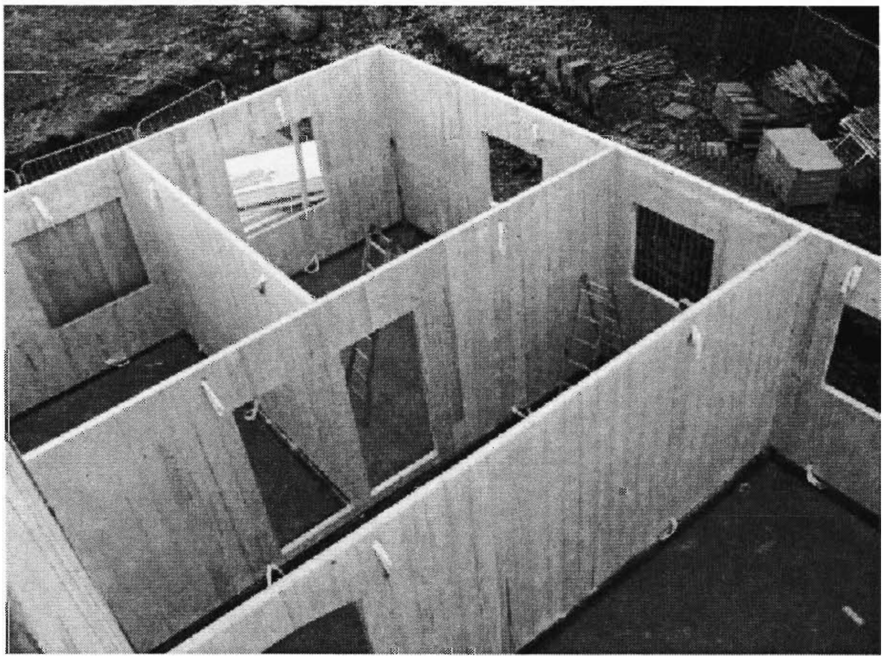
There are a variety of healthy building materials: non-VOC (Volatile Organic Compounds) paints are one example. Most paints use VOCs to evaporate and allow the paint to set, but the VOCs themselves are harmful to people. Using alternative paints that do not release these harmful chemicals into the air is one example of healthy materials.

(continued on other side)

Volume

LONDON BOROUGH OF MERTON

For developers and building professionals



# Sustainable Building Materials

*DRAFT – NOT FOR PUBLICATION*

*JUNE 2003*

ENVIRONMENTAL SERVICES DEPARTMENTS

# Sustainable Building Materials

merton
moving ahead
Merton Civic Centre London Road,
Morden, Surrey SM4 5DX

# Table of Contents

# Introduction

The concept of sustainable materials encompasses a huge number of products and ideas. The overall concept behind them is that the materials being used for construction are a resource that cannot be exhausted, or to ensure the continuation of the global environment to prevent drastic world-changing effects. There are a number of ways to accomplish this. They range from using products harvested or created in a sustainable fashion, such as lumber from sustainable forests, to re-using construction materials, to using materials with the least negative environmental impact.

Sustainable materials have five major benefits:

- Similar or lower price compared to traditional materials.
- Don't exhaust existing supplies of finite materials
- Save energy and reduce harmful emissions
- Are sustainable, following Merton Unitary Development Plan policy ST.1a
- Encouraged by Building Control, Planning Permissions are more likely to be received
- Less harmful to occupants, which makes for healthier buildings

The problem with sustainable materials is that there isn't a group of materials that are sustainable and a group that are not. An overall evaluation of the total energy and environmental impact of the material and its creation process, as well as the long-term efficiency of the material (maintenance and replacement costs as well as possible energy savings) is needed to determine the sustainability of a material. More sustainable materials generally have less initial and lifetime environmental impact. Making a material more sustainable can happen in any number of different ways, including reducing travel time of transporting the materials (which reduces the environmentally harmful emissions of the vehicles used to transport it), re-using materials to eliminate initial energy requirements and environmental damage caused when they are extracted or harvested, choosing materials that have a manufacturing process that has a low energy requirement and the smallest amount of environmentally damaging by-products, as well as others not mentioned here.

# Local Sourcing

Local sourcing is finding the closest available supplier of the particular materials, and using them instead of a standard or better-known supplier. This is very straightforward, and the only real work involved is the research into the local construction suppliers. The simplest method of accomplishing this is to set a certain distance and use that as a radius within which to source as much of the construction materials as possible. While with more specialised or complicated materials, this method may not work, as there may only be a few suppliers of such materials, this technique is most effective with the simple materials, such as bricks, blocks, aggregate, mineral and rock component of concrete, as well as sub-base material for roads and pavement, and others, as there are often multiple suppliers within a local area.

The main benefit of using this technique is the reduced environmental impact due to the shorter distance that the materials need to be transported. This saving in pollutants from transportation is not insignificant, especially when dealing with heavy materials and large projects. Although prices will vary from one supplier to another, it is possible the transportation cost can outweigh any increased cost. The cost may be less than if a traditional source was used. The extra effort required to find, compare, and source from local suppliers is negligible. For instance, BedZED (Beddington Zero Energy Development) used local sourcing, and established a 35-mile radius. They managed to acquire over half of their materials (by weight) within that radius, and comparing their haulage figures with the average UK figures, they saved 120 tonnes CO2 emissions, or about 2% of the total embodied CO2 of the project. (BioRegional Development Group, 2002 pg. 35).

# Recycled Materials

Recycled materials are created from reprocessing materials that have already been used. While at times this involves being re-made into the same product, radically different products can be made from recycled material as well. Common construction examples are recycled aggregate for road sub-base and crushed glass as a sand replacement. Recycled materials can be acquired through specific suppliers, usually those that specialise in recycled or other sustainable materials.

Recycled materials have a number of benefits when compared to virgin materials. Recycled materials are almost always significantly cheaper than virgin materials, and in certain cases save even more as the government continues to create and increase taxes on virgin materials. They provide a significant ecological benefit as they are re-using existing materials, and thus prevent all of the negative ecological impact of creating or extracting the materials fresh. The BedZED project used recycled aggregate made from crushed concrete for the road sub-base. They saved £3.50 a tonne on slightly under 1000 tonnes of this aggregate, for a saving of over £3,400. The savings today would be increased further, as the tax on virgin aggregates has been increased by an additional £1.60 a tonne since that case study. (BioRegional Development Group, 2002 pg. 30)

While there are numerous up-sides to using recycled materials, there are some negatives as well. British regulations and Building Control groups are not as familiar with the specifications and construction qualities of recycled materials versus traditional materials. This means that it may be harder to determine whether specific recycled materials meet building standards for implementation.

Chapter

# Reclaimed Materials

While similar to recycled materials, reclaimed materials differ in that they are not reprocessed, but are simply collected from a demolition site and held to be re-sold. Reclaimed materials can be of all types, but the most common are structural materials that have no exposed surfaces, so appearance, which is degraded upon reuse, doesn't matter, such as internal framing and supports. Other specific products may be available depending on many factors, including the specific suppliers and the point in time. Exploring available materials at reclamation yards can often provide a quality product for much cheaper than a traditional product.

Benefits of reclaimed materials include the large ecological benefit of not needing to expend the energy and resources to both harvest or extract the required materials and process them for a sellable product. Nearly all of the environmental damage caused by processing plants, harvesting areas, mines, or other required development sites are completely avoided with reclaimed materials. They are also in most cases significantly less expensive than new materials.

For example, the BedZED project used reclaimed timber for internal studwork on their development. The timber was found to be 14% cheaper than using new imported timber of a similar quality, with a total savings of over £4,500. This savings does not include the extra sourcing time, which was estimated at £1,200, thus reducing the total savings to just over £3,300. Not only was it a cost effective solution, but the environmental benefits as well as complying to local sustainability policy made using sustainable materials in this case very appealing.

While these are significant benefits, they are not without their downsides. First, finding and sourcing acceptable reclaimed materials of any kind requires more effort than with traditional materials, and to be the most effective, the sourcing process must begin much earlier. Often reclaimed materials are very time sensitive with prices and availability change greatly on a day to day basis due to the nature of supply and demand with both the reclamation and construction processes. While the cost even including the extra sourcing time and effort is almost always still less than traditional materials, not planning ahead and then hoping to save money on sustainable materials is a dangerous proposition. Storage space can also be an issue. To acquire the most cost effective reclaimed materials, they must often be bought and transported at a specific time, sometimes a significant amount of time before those materials will be used. This can lead to large area storage requirements for these materials, which can be a problem for small developments or developments with little extra space. Quality of reclaimed materials is not always guaranteed, and depending on the particular use and structural requirements, the materials may need extra treatment or inspection and certification.

While still improving, the current structural rating and certification system for reclaimed materials isn't close to the efficiency and quality of the system for traditional materials. Thus more care must be taken, and more effort put forth to make sure any extra inspection or treatment of reclaimed materials is done as efficiently as possible. As this can be a major problem with important structural members, such as studwork and building supports, an investigation into whether reclaimed materials will become more cumbersome than the materials are worth is a good precaution to take. In summary, knowing the specific requirements including stress grading, appearance, general amount and size/dimensions of the materials needed can greatly improve the sourcing process for reclaimed materials, and can make it much easier to determine whether reclaimed materials are available and acceptable for each particular need.

# Sustainable Certification

There are various forms of certification for forests to determine whether a forest is sustainable. The criteria are based upon various principles, but usually address worker conditions, retention of natural woodland, economic stability, and long term management practices. (BioRegional Development Group, 2002 pg. 20) FSC (Forestry Stewardship Council) is considered the highest form of accreditation, and although many other certifications exist, none carry as much weight.

Sustainable timber is purported by timber yards to cost nearly the same amount as uncertified timber, although slight variations may occur between suppliers. While structurally there is no difference between certified and uncertified lumber, certified lumber is better environmentally, due to the conditions and management of the forest producing it. Thus, there is little reason not to use certified timber wherever possible. The only problem with sourcing sustainable lumber is the scarcity of suppliers certified to maintain the certification of the timber, although this situation is improving as more suppliers are becoming certified.

Pan European Forest Certification, or PEFC, is a self-certifying initiative created as an alternative to FRSC certification. The criteria for PEFC certification were defined by forest owners, managers, and timber producers from all over Europe. PEFC certification is given according to sustainable guidelines developed for the specific region, and inspections are done on a regional basis to check the region's specific criteria, but private woodlands are certified by themselves.

The UK Woodland Assurance Scheme (UKWAS) is a forestry standard created by the UK government and approved by the UK forestry industry as well as the FSC. While not a certification by itself, this is an independent scheme designed to determine if UK forests qualify for the FSC logo. Most major timber producers in the UK are encompassed in UKWAS and thus produce FSC certified timber.

Sustainable certification programs are more expensive for the smaller organizations in the timber industry, and it is not the idea of sustainable development to eliminate or discriminate against these organizations. In this regard, initiatives are being taken to both reduce the cost of certification, as well as create certification programs that are not cost-prohibitive to the smaller timber producing organizations.

Chapter

# Healthy Materials

All materials have a health impact on the people who live in a building constructed with those materials. A sustainable material should have the smallest negative effect and largest positive effect possible on its occupants. The biggest concern with materials is any toxic or harmful substances that are contained in or released by the materials.

Older examples of unhealthy, unsustainable materials are asbestos insulation, and lead based paint. Any material which contains dangerous substances, like lead based paint, should be avoided if at all possible as it can be a health threat to the residents, especially small children. A current health threat is VOC containing paints. VOCs, or volatile organic compounds, are what evaporate from paint making it dry, and are very toxic to people. Even after the paint has dried, VOCs can be released from the paint for years, hurting the occupants. The easiest solution is to use paints that do not contain VOCs, and instead use a non-harmful drying agent.

Pressure treated lumber can also be a health risk, as the chemicals used to make the lumber weather and rot resistant are very harmful to people. Painting the lumber can contain the problem, but paint wears and chips away with time. While this lumber is very useful in exterior or other exposed areas, one should be very careful to make sure that it won't be a threat to the building's occupants, if it is to be used at all.

While this is only a few examples of unhealthy and healthy building materials, how healthy any particular material is should be taken into consideration when construction materials are being chosen for a product. If materials that may be hazardous to the occupants are to be used, proper precautions should be taken to ensure the safety and wellbeing of the occupants.

# Environmental Impact Rating Systems

Determining the actual environmental impact of a material is very difficult, as it is very hard to take into account everything involved in the process between the materials inception and it being delivered and installed at a construction site. To take into account the environmental impact of a material, so as to measure that aspect of a material's sustainability, a number of systems have been created. None are perfect or all encompassing, and thus choosing one method over another depending on which aspect one wants to concentrate, or even using multiple rating systems is ideal.

Measuring the embodied energy and $CO_2$ of a material is one method of determining its environmental impact, and is the easiest to both understand and to evaluate. It simply determines the total energy that was used in creating the material. For example, Aluminum has a much higher embodied energy (nearly 6 times greater) per unit of mass than Steel. While this is a simple method of determining the energy, and thus indirectly the environmental impact of the material, it can often be misleading. The useful life of the material needs to be taken into account, as even though a material may have a higher embodied energy, it may last much longer than the material with the lower embodied energy, thus making up for the initial cost. Also, not all energy is the same: heat energy and electrical energy are quite different, as heat energy is much cheaper and more efficient to create and acquire than electrical energy, and often some processes will have waste heat energy that can be reclaimed, while electricity inherently cannot be reclaimed or reused. This is where embodied $CO_2$ is more useful: embodied $CO_2$ measures the total $CO_2$ emitted throughout the entire material creation process. This takes into account the differences in heat and electrical energy needed, as well as reclaimed head used, and electricity gained from renewable (non-$CO_2$ emitting) sources.

The benefits of embodied $CO_2$ and energy is its simplicity and ease of comparing data. It is not without its downsides, though. First, it relies on the specific impact of $CO_2$ emissions, currently and widely considered to be the most important environmental issue, but still is in contention whether its negative environmental impact is as drastic as to be believed. Also, it neglects any other environmental impacts the material's creation process may have included, such as toxic or harmful pollutants, natural ecosystem destruction, or any other environmental problems.

Building Research Establishment, or BRE, has their own system, called BRE Environmental Profiling. It uses a Life Cycle Assessment method, measuring environmental impact throughout a product's life, including manufacture, installation, use, and removal. While quite complicated and involved, the system used 12 areas to measure a material's impact, with each area being weighted for importance according to methods determined by extensive research by the BRE. Each area is assigned an Ecopoint score, which is based on the average UK citizen having a total impact of 100 Ecopoints over their lifetime, and is measured in different units for different areas. For example, the area of Fossil

Fuel Depletion is based on tonnes of oil equivalent used, while Acid Deposition is based on kg of $SO_2$ equivalents added to the atmosphere.

The BRE Environmental Profiling system is very comprehensive, and does a good job of covering nearly every area of environmental impact as well as weighting those areas according to importance. The main problem with the system is that even though much research and analysis has gone into the weightings of the areas, it is still a subjective matter, and only represents perceived importance, and it is unable to incorporate wildlife habitat destruction as measuring and quantifying the environmental impact of that is quite complicated and difficult, and has not been established to a degree where it would be viable to include in this system.

Eco-Footprinting is another method of measuring the sustainability of a development. It measures the area of land required to sustain a product or population, and compares that need with the available area on the world and in that way checks to see if we are living within the earth's capacity with regard to that specific product or population checked. The footprint is made up of all of the footprints of activities and products related to the process or person. This is measured in area of land per year, usually hectare-years. For an individual building, the requirement is measured as a one time use, while an overall look would have to consider all developments happening over the course of time.

This system is useful in that it is the only one that actually relates environmental impact and resource consumption to the sustainable capacity of the earth. It also is not based on any subjective weighting, and thus cannot present a skewed perspective on the issue if the weightings are not representative of the actual importance of the areas being weighted. Its downsides are it is quite new, and information on the eco-footprint of a given material or process is not always available, and pollution and toxic substance release has not yet been included in the eco-footprinting system.

# Additional Resources

## 1. Websites

The information in this guide came from the following sources. Please refer to them for more information.

- www.pv-uk.org.uk/ - British Photovoltaic Association- examples of projects and installers that are approved under the UK photovoltaic demonstration project

## 2. Case Studies

View www.pv-uk.org.uk/uk/projlist.html for a comprehensive list of PV building projects in the United Kingdom.

## 3. EcoHomes

- EcoHomes is the Building Research Establishment's (BRE) system for assessing the environmental performance of homes. EcoHomes assessments are carried out at the design stage by licensed

## 4. The Householders Guide

This is Merton's new guide for householders to apply sustainable features in their homes.

## 5. Relevant codes of practice and articles of legislation

- BS EN 61215

## References


http://www.conservationeconomy.net/content.cfm?PatternID=46

http://www.ciwmb.ca.gov/GreenBuilding/Materials/Review.htm

http://www.westminster.gov.uk/housing/sustainable/index.cfm

http://www.wri.org/office/material.htm

http://www.bc.bangor.ac.uk/pdf/workshop_28March03_web.pdf

http://www.actin.co.uk/

http://www.engj.ulst.ac.uk/CST/smp.htm

http://www.suscomp.net/

http://www.stepin.org/

http://www.battlemccarthy.demon.co.uk/SDC/Materials.htm

http://www.bedzed.org.uk/

http://www.materials-exchange.org.uk/

http://www.oakdenehollins.co.uk/tech1.html

http://www.defra.gov.uk/environment/sustainable/research/gapsopps/06.htm

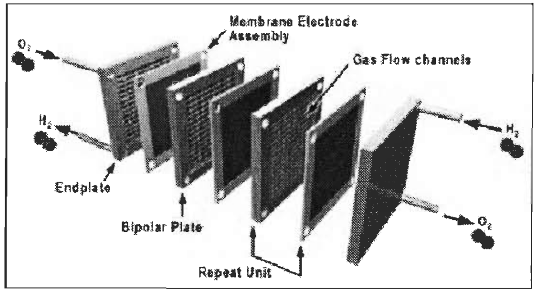
http://www.umich.edu/~nppcpub/resources/compendia/ARCHpdfs/ARCHsbmBib.pdf

# Appendix O – Renewable Energy Sources

# Mini-Guide

## Hydrogen Fuel Cell Energy

Hydrogen fuel cells operate like a big battery. They tap the chemical energy of the reaction of hydrogen and oxygen through an electrolyte to produce electricity. Fuel cells are still in a developmental stage and are expected to become a viable cost effective option for use in the coming years. Below is a diagram of how a fuel cell operates.




Source: www.3m.com 3M Corporation

Figure 2: Diagram of Hydrogen Fuel Cell

## Wind Energy

Wind Energy uses the power of the wind to turn a turbine to generate electricity. Unfortunately with the current wind turbine technology and the wind conditions in Merton, wind energy is not currently a viable option. However, wind turbines are advancing and as they do so wind energy may become viable.

Figure 3: A Wind Turbine

## Further Information

A4 guide on Renewable Energy Sources– more information on these and further topics.

A4 Guide on Solar Energy – Information on Solar Energy, a renewable energy source

A4 Guide on Passive Solar Design – Information on designs to use passive solar techniques

The Householder's Guide – Guide for householders to use sustainable features in their homes.

Merton Unitary Development Plan – Information on Merton Development Policy

www.energyprojects.co.uk – A Guide to UK local Agenda 21 Renewable Energy Projects

www.greenenergy.org.uk – Information on Green Electricity and Renewable Energy

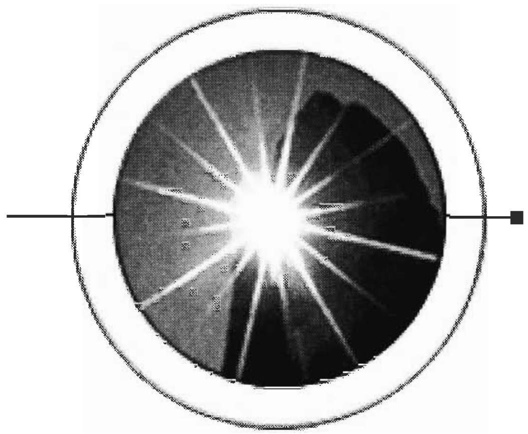
merton
moving ahead


Merton Civic Centre
London Road
Morden, Surrey SM4 5DX


# RENEWABLE ENERGY SOURCES

# MINI-GUIDE

# For developers and building professionals



*London Borough of Merton*

*Draft – Not for Publication*

*June 2003*

# RENEWABLE ENERGY SOURCES

## Why use Renewable Energy Sources?

Using renewable energy sources can drastically reduce a building's reliance on a diminishing fossil fuel supply. Renewable energy sources can provide a building with heat or electricity while reducing the building's dependence on the local power grid. This reduces the amount of energy drawn from that grid, and it in turn saves the operators money. Because renewable energy sources do not use finite fossil fuel resources, they reduce emissions that can lead to global warming and climate change. Additionally using renewable energy sources adds to the sustainability of a building and will help meet sustainable development and renewable energy Merton Unitary Development Plan (UDP) policies such as:

- Policy ST.1a: Sustainable Development
- Policy E.13: Energy Efficiency and
- Policy PE.14: Energy Efficiency and Renewable Energy
- Policy PE.13: Energy Generation and Energy Savings
- Policy BE.31: Sustainable Development

General information regarding renewable energy sources can also be found in the Supplementary Planning Guide on Sustainable Development. Both this document and the UDP can be found online at www.merton.gov.uk.

## What are some renewable energy sources?

Renewable energy sources provide power without consuming the world's finite resources. They cover both power generation and direct benefit methods. Renewable energy sources include geothermal energy, biomass energy, hydrogen and fuel cell energy, and wind energy. They also include solar energy, which is covered in two other guides produced by the borough, Solar Energy, and Passive Solar Design.

## Geothermal Energy

Geothermal Energy uses the heat of the earth to provide electricity and heat for use. A common small-scale application of geothermal energy is ground source heat pumps. These pumps use the constant heat in the ground to run a central heating system or provide hot water to a tap for direct use. Because ground source heat pumps run at a higher efficiency than traditional heat pumps, they can prove to be cheaper to operate. The figure below shows how a ground source heat pump operates.

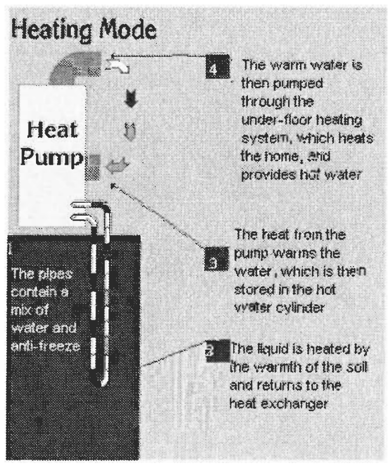



Figure 1: Ground Source Heat Pump

## Biomass Energy

Biomass energy is energy derived from organic material, commonly through combustion. It includes such materials as wood, arable crops and grasses, animal wastes, and food processing wastes. Some of the key characteristics that define biomass are:

- It is endlessly renewable.
- It is stored solar energy.
- It is carbon neutral.

Biomass is commonly applied in three methods:

- Direct combustion to produce heat
- Conversion to a Gas Fuel such as Methane
- Conversion to a Liquid Fuel such as Ethanol or Methanol

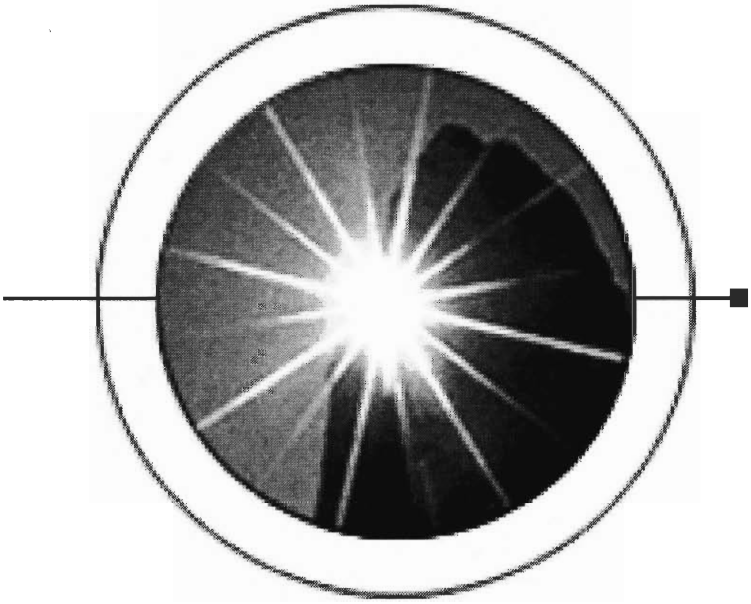
*WOOD*

One of the widely used biomass fuel sources is wood. Because it is such a prolific resource and one that can be sustainably harvested, wood provides a good opportunity to utilise biomass energy. Wood may be applied through use in wood stoves to generate heat for a building or in a power generation process to heat water to run a turbine and generate electricity.

Volume

LONDON BOROUGH OF MERTON

For developers and building professionals



# Renewable Energy Sources

*DRAFT – NOT FOR PUBLICATION*

*JUNE 2003*

ENVIRONMENTAL SERVICES DEPARTMENT

# Renewable Energy Sources

merton
moving ahead

Merton Civic Centre London Road,
Morden, Surrey SM4 5DX

# Table of Contents

Chapter

# Introduction

## 1. What are Renewable Energy Sources?

Renewable energy sources provide power without consuming the world's finite resources. They cover both power generation and direct benefit methods. This guide includes information on geothermal energy, biomass energy, wind energy, and hydrogen fuel cells. Another form of renewable energy, solar energy, is discussed in two other guides available from Merton Council. This guide addresses the various ways in which each source produces power as well as how each might be implemented. It also addresses the costs of implementation, the feasibility of each option, and the advantages and disadvantages of use.

## 2. Why Use Renewable Energy?

There are several distinct benefits from and reasons to use renewable energy sources. These include cheaper production of electricity and reductions in the cost to create the energy to maintain the living environment in a building, a reduction in the production of carbon dioxide and other greenhouse gasses, and compliance with the Merton Unitary Development Plan policy ST.1a or other local sustainable development policies as well as central and regional government legislation and guidance.

By using renewable energy techniques, the cost of providing power to run a building or the cost of heating and cooling a building may be driven down, especially if energy conservation measures are implemented, however it is possible that energy costs may increase. If by using one of these renewable energy sources a building owner is able to satisfy 20% of the power needs for the building, it would follow that the draw from the local grid would be 20% less and then the power bill would go down accordingly. So by providing heating or generating electric power, the overall cost of the energy needed to run the building may decrease. Additionally, capital infrastructure payback timescales are based upon current, conventional energy costs, however it is likely that as technology advances and existing resources exhausted, those conventional costs will increase and the payback time on renewable energy sources will be reduced.

Because renewable energy sources do not use finite resources such as oil or coal to generate their power, the harmful emissions generated by the combustion of these materials are not added to the atmosphere where they can contribute to climate change and acid rain. Climate change is already a cause of flooding, which currently compromises the development of large tracts of land and increases insurance costs. Reducing emissions from this combustion eventually proves very beneficial to the environment and to the human community at large.

The incorporation of renewable energy sources in building plans also helps to satisfy the Merton Unitary Development Plan policy ST.1a as well as other central and regional government policies. ST.1a encourages the use of sustainable development techniques. By incorporating renewable energy sources along with other sustainable development techniques into plans, the development covers the requirements of ST.1a, and the plan will be more likely to receive planning permission from the council. Additionally, policy E13, now superseded by PE.14 in the Merton UDP require any new non-residential development over 1000 $m^2$ to provide 10% of the building's expected energy demands from renewable energy sources. Additionally the national target is to produce 10% of energy demands from renewable sources by the year 2010.

# 3. Geothermal Power Plants

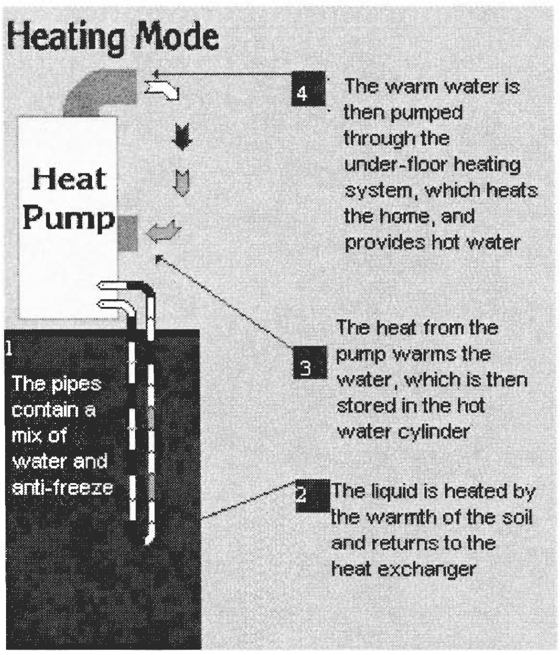
Geothermal power plants operate by using the heat of the earth to create an impetus to turn a turbine and create power. This is most efficient on a large scale, where the plant is connected to the regional grid, and is not necessarily applicable to individual development. Geothermal power plants typically use either an underground reservoir to produce or direct steam for use in the turbine, or a heat exchanger to draw the heat from water in the earth to produce the electricity. Because of the size and scope of geothermal power plants, they are not likely to be a feasible option in Merton.

# 4. Geothermal Heat Pumps

Geothermal heat pumps (also known as ground source heat pumps) use the heat of the earth to provide heat and hot water to a building; they do not generate electric power to drive another system. Unlike geothermal power plants, ground source heat pumps are a feasible option for implementation in Merton.

## 4.1 How do Geothermal Heat Pumps Work?

Beneath the frost line, the temperature of the surface of the earth remains fairly constant at approximately 10°C. To take advantage of this, pipes in a closed system are filled with fluid and placed underground to capture this heat. After absorbing the heat the fluid travels back up to a heat pump unit where it is heated to approximately 60°C. The heat is then removed to lower the temperature below 10°C and the residual heat is used to heat water, which is then sent to a hot water cylinder. There it is used by under-floor heating systems to heat the building or sent to hot water taps. The process continually repeats itself and provides a steady flow of heat for use by the building.




## 4.2 Maintaining a Geothermal Heat Pump

Geothermal heat pumps require minimal maintenance to continue operation. The components of the system are simple to operate and are manufactured to be durable. Because of this, and unlike oil or gas fired heat pump systems, a geothermal heat pump does not require regular checkups, cleaning and part replacement. It is common for the underground piping to be designed to last for 50 years, and the heat pump system can run for 30 years. This means that the geothermal heat pump can run for decades without needing major maintenance, and if problems do occur it is typically with the above ground plumbing, which can be easily fixed by a certified plumber.

## 4.3 Geothermal Heat Pump Costs

Using a geothermal heat pump as the primary source of heat and hot water for a building can reduce the energy costs associated with running the building. While the heat pump requires a small amount of electricity to operate, it is much less than what other heating systems require. When the heat pump is run it consumes as much as 25% to 50% less electricity than more traditional systems.

Consider a small house that in an average year uses 10,000 kWh thermal energy per year to produce heat and hot water. Using a gas system that operates at 80% efficiency, it would cost £250 per year to run. An electric system also operating at 80% efficiency would cost £1250 per year. The ground source heat pump, operating at 400% efficiency, which is standard for the geothermal heat pump, would cost only £250 per year to run. The geothermal heat pump is far cheaper than the electric heat pump and comparable to the gas system.

## 4.4 Environmental Benefits

Because ground source heat pumps run on renewable energy, namely geothermal, they are more environmentally friendly than traditional heat pumps. The geothermal heat pump, unlike the oil or gas fired heat pumps, produce no in-house combustion of fossil fuels. This means that there are no harmful emissions, such as carbon monoxide, in the building. Pollutants are produced from the power station that generates the minimal amount of electricity needed to run the heat pump associated with the ground source heating system. Using the ground source heat pump can reduce overall energy consumption and inherently the pollutant emissions by up to 50%. A geothermal heat pump system can reduce carbon dioxide emissions to 1700kg per year, compared with up to 3400kg from other fossil fuel heating systems. By utilizing a ground source heat system, there will not only be distinct environmental benefits, but there will also be a safer, healthier environment for the residents of the building.

## 4.5 Geothermal Heat Pump Efficiency

A geothermal heat pump can operate at 400% efficiency. This means that for every unit of energy put into the system, it can output four units of heat. This can reduce cost when compared to a unit that operates at an efficiency that is much lower, such as a gas or oil fired system, which operate at less than 100% efficiency. This efficiency both saves money and protects the environment by reducing the energy demand and therein reducing the emissions from the energy generation.

## 4.6 Feasibility in Merton

Investigation has begun into feasibility of implementing ground source heat pumps in the borough and initial results appear promising. While implementing a geothermal heat pump in an existing building may not be appropriate or possible without extensive and necessary renovations, using a ground source heat pump in new development, where it is designed as an integral part of the heating system appears feasible. Additionally, while geothermal heat pumps have been implemented with success in other parts of the UK, the geological potential in the London area is still being examined. London sits on a bed of clay, and it is possible that the system will not operate in a similar fashion as has been shown in other implementations.

# Biomass Energy

Biomass energy is energy derived from organic material, commonly through combustion. It includes such materials as wood, arable crops and grasses, animal wastes, and food processing wastes. There are several key characteristics that help define the scope of biomass.

- It is endlessly renewable.
- It is stored solar energy.
- It is carbon neutral. The only carbon released by using biomass is that which has been stored in the material over its lifetime.

There are three primary ways that biomass is used. These are burning to produce heat or electricity, converted to a gas fuel such as methane, or converted to a liquid fuel, also called biofuels, in the form of ethanol or methanol.

## 1. Biomass Systems

There are two types of biomass systems, a closed loop system and an open loop system. A closed loop system uses crops that are specifically grown for fuel. An open loop system encompasses all other biomass material.

### 1.1 Closed Loop Systems

The potential of a closed loop system is primarily limited by the amount of space available that can be devoted to growing fuel crops. Currently, land set aside for fuel crops in the UK could provide 2.5 GW, which is approximately 5% of the UK's total electricity needs.

### 1.2 Open loop Systems

The potential for an open loop system is as large as the amount of agricultural crops produced. As the crops are consumed, the waste can be collected and used as a biomass energy source.

## 2. Carbon Neutral

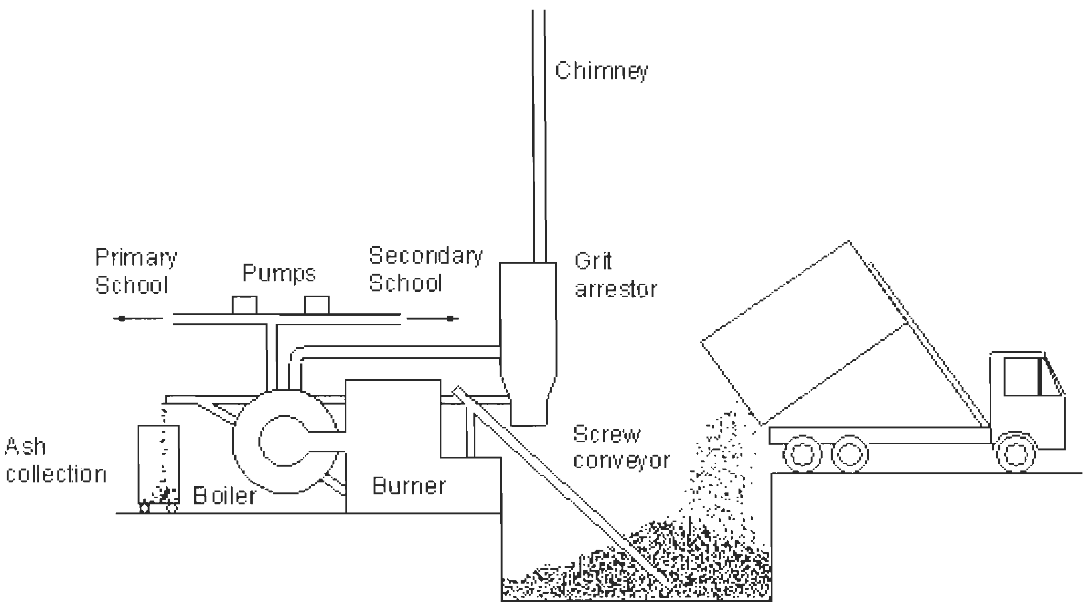
Biomass is a carbon neutral source. This means that the only carbon emissions released by combustion are what has been absorbed by the fuel source over its lifetime. To prevent excessive release of carbon dioxide it is necessary to use sources harvested sustainably. This would mean using wood harvested from a sustainable forest, where the carbon that will be released from the combustion of one tree is absorbed by trees planed to replace it. This also provides advantages to the use of fast growth forests, where less carbon emissions are absorbed and therefore less are emitted when the product is burned.

# 3. Some types of Biomass

## 3.1 Wood

One of the most common and widely used biomass fuel sources is wood. Because it is such a prolific resource and one that can be sustainably harvested, wood provides a good opportunity to utilise biomass energy. Wood may be applied through use in wood stoves to generate heat for a building or in a power generation process to heat water to run a turbine and generate electricity.

A good example of wood being applied to heat a building comes from the Weobley School in Herefordshire. The system uses a 350 kW wood combustion boiler to meet the heating needs of the primary and adjacent secondary school. The system uses between 150 and 300 tons of dried wood chips per year. They are generated from local wood thinning as well as from poplar and willow short rotation forestry. The chips are regularly delivered to a silo where they are fed into the stoking mechanism. Hot water, generated by the combustion of the wood chips is then delivered to the schools' under floor heating mechanism. The exhaust from the process is scrubbed and released and the ash is used to fertilise the school garden.




From: http://www.sac.ac.uk/envsci/External/WillowPower/CaseStdy.htm#Weobley

## 3.2 Energy Crops

While wood is often grown for biomass fuel, there are other types of energy crops that can be grown in the UK. These tend to be fast growing and can be used to produce biofuels as well as simply combusted to provide heat. While wood is at the forefront of UK energy crops, crops such as wheat or oil seed rape can be useful as well. The UK is also exploring the feasibility of using fast growing grasses as another energy source. Grasses have been imported from Africa, and tests are ongoing to see if they are feasible for production here as an energy crop.

### 3.3 Waste Energy

The UK produces 46 million tons of waste per year. While some of this can be reduced through recycling there remains a need for a way to deal with waste products. The organic waste has the potential to become a useful part of biomass energy generation. If the organic waste takes the place of fossil fuel combustion and the possible emissions from the combustion process are monitored and controlled, it can be used to produce usable and sustainable electricity. However, this is a highly controversial issue because of the dioxin by-product emissions released into the atmosphere from the combustion of organic residue waste. Unless the application of this energy source is carefully designed and implemented, it may not be a safe or sustainable energy source.

## 4. Wood Burning Stoves

There are a variety of wood burning stoves presently on the market. They all produce heat through radiation and convection, and, assuming that they have an adequate air supply and are well sealed; they can burn dry wood efficiently and cleanly. Running along with a central heating system, a wood stove can often reduce bills. Because of the nature of wood, and the emissions released when it is burned, it is important to remember to use local wood harvested sustainably. This is the only way in which wood stoves will be a sustainable and renewable energy source. Avoid using wood harvested from old growth forests and only buy wood from reputable and sustainable sources. This will ensure that the wood being used is not contributing to global climate issues and that the emissions from the combustion are readily absorbed by trees planted to replace those harvested.

## 5. Feasibility in Merton

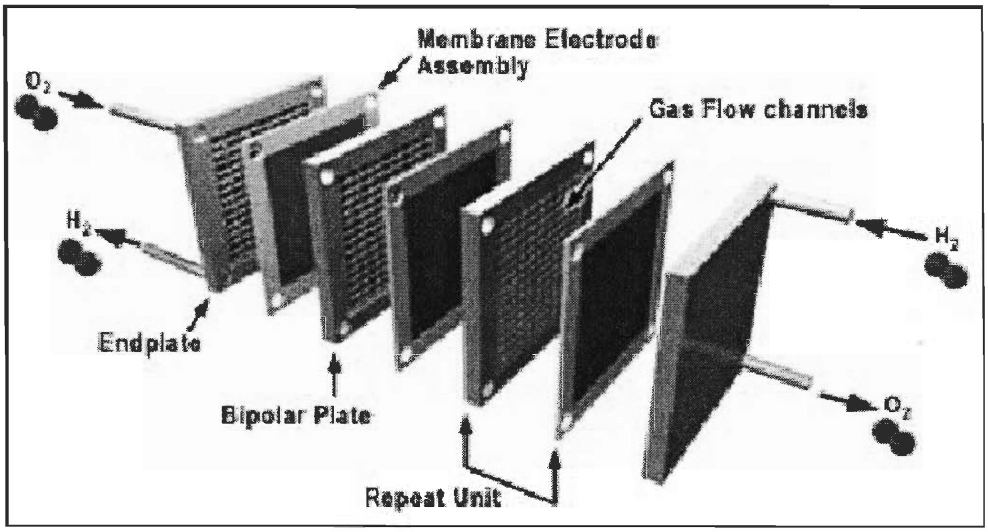
Biomass is a feasible option for implementing in the London Borough of Merton. By using sustainably harvested fuels, biomass can provide an implementable and sustainable option for both existing construction and new development. However, care must be taken when implementing biomass energy systems to ensure that waste products from use are appropriately handled. This may involve using ash as fertilizer or recycling the waste products for future use as biomass fuel. Wood stoves currently are the easiest biomass system to implement and while care must be take to ensure that fuel come from a sustainable source, it is a reasonably simple task.

Chapter

# Hydrogen Fuel Cells

Using Hydrogen in various fuel cell technologies to generate power is a relatively new and still developing technology. While this is still rapidly advancing, the principles behind the process remain consistent. Fuel cells operate on the principle of converting chemical energy directly into electricity and heat. They do this rather than burning a fuel, which is less efficient and not as clean as the chemical conversion. The most common source of the fuels chemical energy is hydrogen.

A fuel cell works by inputting fuel that is catalytically reacted in the fuel cell, removing electrons from the fuel and creating an electric current. The cell is constructed using an electrolyte material sandwiched between two thin electrodes, an anode and a cathode. The fuel passes over the anode while oxygen passes over the cathode, where it is split into ions and electrons. The electrons are passed to an external circuit to generate an electric load and the ions are sent through the electrolyte to the oppositely charged electrode there. At the electrode, the ions combine with the fuel and create by-products, primarily water and carbon dioxide, however these by-products will vary depending on the fuel and the type of electrolyte used in the cell. Below is a diagram of a theoretical fuel cell.




*Source www.3m.com, 3M Corporation*

From http://www.crest.org/articles/static/1/1034094663_1008081206.html

# 1. Combined Heat and Power (CHP)

Combined Heat and Power uses excess heat produced by an operation to run a power generator. This is often used in conjunction with fuel cells because of the amount of heat that they release during their operation. This combined system can increase the power output from the fuel cells and can provide increased versatility in the application of fuel cells. CHP can also be applied in conjunction with other heat producing processes and in some situations can produce sufficient power to negate the need for outside power use.

# 2. Types of Fuel Cells

There are many different types of fuel cells, using different materials for an electrolyte and producing different by-products. The cell types, which are often named after their electrolyte material, include alkaline cells, phosphoric acid, molten carbonate, and solid oxide

## 2.1 Alkaline Fuel Cells (AFCs)

Alkali fuel cells typically operate on a combination of compressed hydrogen and oxygen with a solution of potassium hydroxide in water acting as the electrolyte. The internal operating temperature of the cell typically runs from 150 to 200 C and generates power at close to 70% efficiency. Additionally, the cell produces potable water along with electricity. A downside to the alkali fuel cell is the need for pure hydrogen fuel, to avoid creating a solid carbonate that interferes with the chemical reactions. Additionally, it requires a large amount of a costly platinum catalyst to make the chemical reaction work. The alkali fuel cell has been used by NASA in both the Apollo missions as well as in their Space Shuttle fleet and currently many companies are attempting to develop a way to reduce cost and improve versatility.

## 2.2 Phosphoric Acid Fuel Cells (PAFCs)

Phosphoric acid fuel cells use liquid phosphoric acid in a Teflon bonded silicone carbide matrix. The construction of the matrix keeps the acid in place through capillary action via its small pore structure. Because of the nature of the matrix, after many hours of operation, it may be necessary to add additional acid to the electrolyte. The PAFC is the most advanced fuel cell in terms of system development and commercialisation efforts. Porous carbon electrodes are used for both the anode and the cathode, and platinum catalyses both the fuel and the oxidant. Phosphoric acid fuel cells show electrical efficiency rates between 36% and 42% and a portion of thermal energy is found from 250 to 300 F while the majority is found around 150 F. The fuel cell has a power density from between 160 and 175 $W/ft^2$. An issue with PAFCs comes from the derivation of their fuel. If the hydrogen is derived from reforming gasoline, the fuel must be additionally filtered to remove any sulphur and prevent it from entering the cell to prevent damage to the catalyst.

## 2.3 Molten Carbonate Fuel Cells (MCFCs)

The Molten carbonate fuel cells use a molten carbonate salt mixture, such as potassium carbonate or lithium carbonate surrounded in a ceramic matrix their electrolyte. MCFCs operate at temperatures ranging from 600 to 800 C and use a lithium-doped nickel oxide cathode and a nickel-chromium alloy anode. The cell can run at 60% to 80% depending on the application of excess heat from the cell.

There are several complexities that stem from the use of the molten carbonate fuel cell; the first of these is the difficulties that come from using a liquid electrolyte. A liquid electrolyte is more difficult to use and apply that a solid electrolyte. Another drawback is that the reaction through the electrolyte uses carbon ions necessitating the periodic addition of carbon dioxide to replenish the electrolytic fluid. The hydrogen used in the cell can be derived from a base fuel using either an internal or external reformer. Cells of this type have reliably produced 2 MW of power, however recent research has indicated the feasibility of, and plans exist for a 50 MW or 100 MW cell.

## 2.2 Solid Oxide Fuel Cells (SOFCs)

To reduce corrosion and eliminate the electrolytic management concerns that a liquid electrolyte presents, the solid oxide fuel cell uses a solid phase ceramic electrolyte. A common electrolyte is dense yttria-stabilised zerconia and the SOFC typically uses a porous nickel/zerconia cermet for an anode and magnesium-doped lanthanum manganate for a cathode. The durability of a solid oxide fuel cell is impressive, with a lifetime covering more than 30,000 hours. The current SOFCs can operate at up to 45% efficiency, however cells under development and research indicate that future SOFCs could have efficiencies approaching 60%. The solid oxide fuel cell can tolerate much more sulphur than most other fuel cell types, without destructive reactions occurring. The SOFC operates at approximately 1000C and because it uses both hydrogen and carbon monoxide as fuel sources, it can be run on carbon based fuels such as gasoline, jet fuel, or alcohol. Because of the high temperatures that the fuel cell runs at, it is estimated that use for loads below 1,000 W would not be practical.

# 3. Fuel Cell Implementation in the UK

One In the Woking borough, a fuel cell combined heat and power (CHP) system was implemented to support a pool and a leisure centre. The council received a £500,000 grant to implement this system. The fuel cell runs on hydrogen reformed from natural gas and oxygen extracted directly from natural air and has a phosphoric acid electrolyte. The cell powers the pool's heating and lighting systems as well as the Woking Park lighting. During the summer, excess heat from the cell can be used to run the building's air conditioning system. The companion CHP system provides energy for the Leisure Centre and any excess energy is provided to the council's sheltered housing scheme.

# 4. Feasibility in Merton

Fuel cells are a rapidly advancing and still developing technology. However, even at their current development level fuel cells can theoretically be implemented in both existing and planned construction. To do so would require a source of clean hydrogen and adaptations to an existing building's power layout. It would also require the initial purchase of a fuel cell, or multiple fuel cells sufficient to meet the power demand. The number and size of these cells will vary with the type of fuel cell being used and with the amount of power being drawn. Hydrogen, while a common and plentiful resource, does not commonly exist as a pure element. Harvesting pure hydrogen for use in fuel cells requires still advancing and expensive technologies. However it is a universal expectation that within a decade hydrogen will be a readily available fuel source and at that point it is possible that fuel cells will be a viable and cost effective energy option for widespread use.

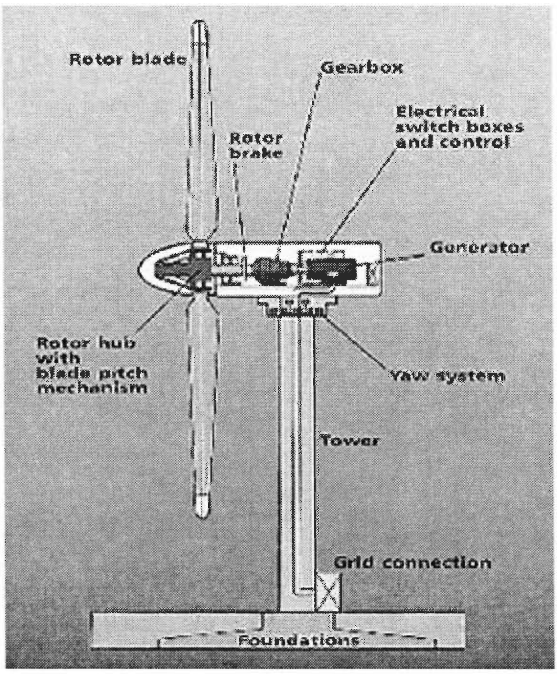
Chapter

# Wind Energy

The power of the wind can be harnessed to produce things that make living easier. In the past people used windmills to pump water or grind grain. Using the same concept, it is now possible to use the power of the wind to generate electricity. Wind power generators, called wind turbines, operate on the same principle as an old windmill, using the wind to turn blades that rotate a shaft which will run some sort of system. In the case of a wind turbine, it will run a generator and produce electricity.

## 1. How a Wind Turbine Works

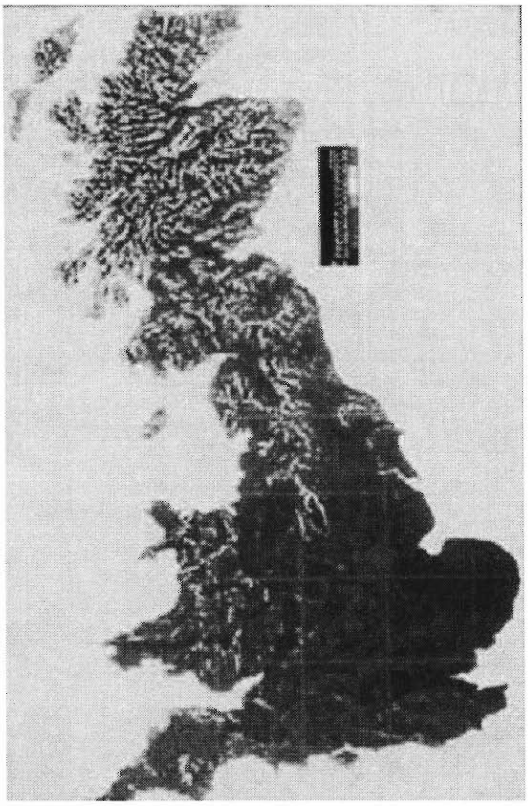
When the wind turns the blades of the turbine, they rotate a shaft that is attached to a gearbox. After using the gearbox to rotate the gear shaft at an adequate speed the shaft spins in the generator creating power which is sent down the tower for immediate use or off to the grid for storage. The wind turbine also has a shaft break to prevent the RPMs from becoming too high for the gearbox and generator to handle, as well as a mechanism to feather the rotor blades and pivot the system towards the direction of the wind.




From: http://www.greenenergy.org.uk/renewable_energy/wind_small.htm

## 2. Feasibility in Merton

Wind turbines require a consistent flow of wind at a reasonable speed to be effective and work properly. While the UK is very well suited for wind power, with the potential for producing 6% of the power demands by the year 2010 and up to 10% over the next twenty years, much of this potential is along the coast, and in the highlands in northern Britain and Scotland. Because the wind in the Merton area is not constant enough and does not blow with enough sustained speed, it is not feasible to implement wind turbines as a power generation system with out further technological advancement. However, the technology around Wind Turbines is advancing and it is expected that in the future, there will be turbines that are suitable for an urban environment with less than optimal wind conditions, and at this stage, wind energy will be a viable renewable energy source in the Borough of Merton.



From: http://www.dti.gov.uk/energy/renewables/ed_pack/1116wind.html#

# Additional Resources

## 1. Websites

The information in this guide came from the following sources. Please refer to them for more information.

- www.energyprojects.co.uk – A Guide to UK local Agenda 21 Renewable Energy Projects
- www.greenenergy.org.uk – Information on Green Electricity and Renewable Energy

## 2. Case Studies

View http://www.heatpumpcentre.org/cases/home.htm for a list of Geothermal Heat Pump projects in the United Kingdom and the rest of the world.

Visit http://www.managenergy.net/submenu/Scs.htm for a comprehensive Database of Renewable Energy Case Studies in the United Kingdom and the rest of Europe.

View http://www.esru.strath.ac.uk/EandE/Web_sites/01-02/RE_info/biomasscase.htm for a list of Biomass Case Studies and projects in the UK

## 3. Funding Information

For a comprehensive database of Renewable Energy Grants, Loans and other funding methods, view Merton Council's funding database. This database contains a variety of funding types and sources for both London and the world.

## References

Geothermal References:

http://www.eere.energy.gov/geothermal/geopowerplants.html
http://www.global-issues.co.uk/acro/061934.pdf
http://iga.igg.cnr.it/uk.php
http://www.crest.org/articles/static/1/995653330_5.html#geoc
http://www.eere.energy.gov/geothermal/geofaq.html
http://www.energyprojects.co.uk/geothermal.htm

Biomass References:

http://www.greenenergy.org.uk/renewable_energy/index.htm
http://www.crest.org/articles/static/1/1004994679_6.html#biof
http://www.eere.energy.gov/biomass.html
http://www.energyprojects.co.uk/biomass.htm

Geothermal References:

http://www.crest.org/articles/static/1/1034160155_1008081206.html

Wind References:

http://www.dti.gov.uk/energy/renewables/ed_pack/1116wind.html#
http://www.greenenergy.org.uk/renewable_energy/wind_small.htm

# Appendix P – Sustainable Urban Drainage Systems (SUDS) Mini-Guide

*Holding and Purification Ponds*

Holding and purification ponds are similar, but serve slightly different purposes. Holding ponds are generally large areas designed to hold water drained from a larger development, and infiltrate it into the ground, and if necessary slowly release it into a watercourse over time. This attenuates drainage into a watercourse, reducing flooding.

Purification Ponds are generally impermeable and do not allow infiltration, but instead have multiple sections filled with various materials that serve to remove impurities and pollutants. By forcing the water to flow through the pond, many impurities are removed, and the pond also acts to attenuate the flow of water out of the pond into a watercourse, or other drainage system.

*Wetlands*

Wetlands are similar to purification ponds, but instead use biological means to purify the water. They establish a small wetland ecosystem, and drain water into the wetland. The plants and micro-organisms in the wetland serve to absorb and process the impurities in the water, and water flowing out of the wetlands is clean, as well as the water that slowly infiltrates into the ground.

## Further Information

A4 guide to Sustainable Materials – more information on these and further topics.

Water Conservation Mini-Guide – Information on grey water recycling methods

The Householder's Guide – Guide for householders to use sustainable features in their homes.

www.environment-agency.gov.uk – Provides range of information on Sustainable Development

www.buildinggreen.com – Information regarding different techniques for building a green construction.

http://eartheasy.com – Information on living and providing a sustainable future.

http://www.ciria.org.uk/suds.htm - Information on general implementation of SUDS

merton
moving ahead

Merton Civic Centre
London Road
Morden, Surrey SM4 5DX

# SUSTAINABLE URBAN DRAINAGE SYSTEMS MINI-GUIDE

## For developers and building professionals

*London Borough of Merton*

*Draft – Not for Publication*

*June 2003*

# SUSTAINABLE URBAN DRAINAGE SYSTEMS

## What are Sustainable Urban Drainage Systems, and why use them?

Conventional Drainage systems work by channeling water and draining it into a watercourse as it is collected. This causes a number of problems, as the main cause of need for drainage is rainfall, and this happens for short periods of time. Thus, conventional drainage systems are usually handling very little water, and occasionally dealing with large quantities of water.

The drastic variation in flow rates causes a number of problems, including flooding of watercourses, erosion, and damage to the watercourse ecosystem (as constantly changing flows disrupt activities of wildlife). Also, the water is generally polluted with the impurities drained along with the water. SUDS works to fix these problems through two main methods: Attenuation and Purification.

Attenuation is the act of spreading out the flow of water over time. Instead of draining all of the water to be handled as soon as possible, SUDS works to collect and gradually drain the water over a long period of time. This results in a more stable flow of water into the watercourse, and thus reduces erosion, flooding, and ecology damage.

Purification is using natural, sustainable methods to remove the impurities that collect in the water, so that water being drained doesn't pollute the watercourse and thus the entire water system which drinking water is drawn from. This not only improves the environment, but also means cleaner water from the tap.

## What are the available techniques?

Certain SUDS methods are useful for implementation for every development, while others are more useful for larger scale developments. Those applicable for most any development are:

- Pervious Paving
- Swales
- Soakaways

Those only really applicable for larger scale development are:

- Holding and Purification Ponds
- Wetlands

*Pervious Paving*

Pervious paving is a broad class of sustainable drainage systems covering all sorts of surfaces that water can flow through. The sub-base under the surface stores water and either allows it to infiltrate back into the ground, or redirects and attenuates the flow to another part of a drainage system, depending on the engineering specifications of the surface and the underlying ground.

These systems are the easiest to implement of all sustainable drainage systems, are the most effective standalone drainage system, as they both reduce the impermeable surface area of a development, so less water is needed to be handled by the drainage system, and work to attenuate and infiltrate the water back into the ground, removing more need for other drainage systems.

Pervious paving can be used in place of conventional pavement in all applications with the exception of main roads, and although they have more stringent design requirements than standard paving due to the additional concerns with water flowing in the paving and sub-base, are generally no more expensive than their conventional, impervious counterparts.

*Swales and Soakaways*

Swales are a form of ditch designed to infiltrate water. They are wide and shallow, and covered with grass, so while they redirect water, the water is slowed and drained slowly, while some is infiltrated back into the soil.

Soakaways are narrow, deep ruts filled with stones or other materials, and have a high ground surface area that allows water to infiltrate into the ground quickly. Water from other drainage systems, such as roof gutters or impermeable lots are often drained into a soakaway to allow the water to infiltrate.

Both are useful for moving and infiltrating water into the ground, to reduce or eliminate drainage needed further on in the system. They are best used alongside roads or other impervious systems as a standalone drainage and water infiltration system.

**Volume**

LONDON BOROUGH OF MERTON

For developers and building professionals

# Sustainable Urban Drainage Systems (SUDS)

*DRAFT – NOT FOR PUBLICATION*

*JUNE 2003*

ENVIRONMENTAL SERVICES DEPARTMENT

# Sustainable Urban Drainage Systems (SUDS)

---

merton moving ahead

Merton Civic Centre London Road,

Morden, Surrey SM4 5DX

# Table of Contents

# Chapter

# Introduction

This Sustainable Urban Drainage Systems (SUDS) are designed to deal with water runoff in a better fashion than traditional drainage methods. The main problem with current drainage techniques is that buildings and paved areas collect large amounts of rainwater during a storm, and direct this water to a sewer. This means that the system has to deal with large flows occasionally, but most of the time has very little flow. A key principle of sustainable urban drainage is *attenuation*, or spreading out the flow over the course of time so that at any point during a rainfall event the maximum flow is less than it would be using conventional drainage. The other part of SUDS is using natural infiltration and purification techniques to remove contaminants and impurities from the water before it is returned to a watercourse.

SUDS have 3 main benefits over conventional systems:

- Ecologically sound
- Cost effective
- Building Control supported

The main ecological problem with conventional drainage systems is that during a rainfall event, they drain large amounts of water over a short amount of time, usually into a nearby watercourse (river or stream). This damages the ecosystem of the watercourse because constantly changing flows and water levels, as well as the contaminated water that is being drained into the watercourse is not conducive to sustaining an ecosystem. Sustainable urban drainage systems serve to attenuate the flow, spreading the amount of water being drained into a watercourse over a longer time than conventional methods, which results in a more stable ecosystem as the water level and flow speed in the watercourse is more stable, less erosion will take place, and flooding downstream is much less likely. SUDS also removes impurities from the water, which means the drainage causes less damage to ecosystems as the water contains less harmful substances which would damage or destroy wildlife.

SUDS are becoming more cost effective as more is becoming known about their capabilities, and they are becoming more standard of a practice. Costs may vary widely from system to system, and thus it can be hard to determine if a Sustainable Drainage System will be more or less expensive than a conventional system. This is covered further in Chapter 4.

SUDS, as with all sustainable construction methods, are strongly supported and encouraged by local Building Control, conform with UDP Policy ST.1A and other Merton UDP sustainable development policies, and make a particular development much more likely to receive planning permission.

Chapter

# Flow Attenuation

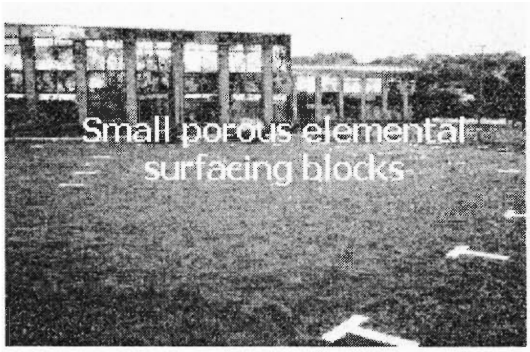
Flow attenuation is the first half of SUDS: dealing with the flow of water during rainfall from the large surface areas of buildings, parking areas, and other impermeable constructions. Conventional drainage methods usually involve transporting the water as fast as possible to a drainage point, either a waterway or a sewer hook-up. Sustainable drainage systems work to slow down the accumulation and flow of water into these drainage points.

Heavy flows into watercourses can have dramatic negative impacts on the ecology of the watercourse, as well as cause possible flooding downstream. Flow attenuation methods can also mean that a construction requires a smaller or less comprehensive hook-up to a sewer system, which can save money.

## 1. Pervious Surfaces

Pervious surfaces are various surfaces, usually pavement and car parks, which allow rainwater to seep through them. There are numerous different types of pervious surfaces, divided into two categories: porous surfacing and permeable surfacing. Porous surfacing is made up of a material that is itself pervious, while permeable surfacing is made up of a material that is impervious but leaves spaces for water to flow through it. Both work by allowing water to flow through the surface into the supporting sub-base, which either works to filter impurities and allow the water to filter into the soil over time, or filters and slows the flow of water, while also directing it to another part of the drainage system. Often a combination of these techniques are used: if the rainfall is light enough the soil can handle the water, all of the water is dispersed into the ground, but if the flow gets too heavy the ground can't hold it some is directed to the other parts of the drainage system.

There are many different types of porous surfacing. Gravel or other open-textured material is the most common. It is only suitable for pedestrian or low-volume lightweight traffic, such as walkways and personal driveways, but is very easy to implement and quite inexpensive compared to other methods. Porous blocks are an interlocking block system formed so that the blocks have many small holes throughout, allowing water to flow through. These can be used in heavier volume areas, such as commercial car parks. Continuous-laid porous systems are any type of poured construction material that is pervious, such as porous asphalt or porous concrete. These surfaces can take large volumes of traffic and thus are suitable for low-traffic service roads as well as high-density car parks.





There are many different types of permeable surfacing with different uses. Large element blocks have large holes that are filled with soil, and allow grass to grow in the holes. The surface is only suitable for medium foot traffic or occasional cars, but has a definite aesthetic benefit due to the mostly grassy surface. Small element blocks are impervious blocks that fit together in such a way to leave small openings in the joints between the blocks, allowing water to flow through. These blocks can take more and heavier traffic than large element blocks. The last type is poured permeable surfacing, which is form poured concrete or other poured construction material with openings left in it for soil and grass. This is rather similar to large element blocks except it can be tailored to take more or less traffic, and is more versatile in placement and installation than blocks.

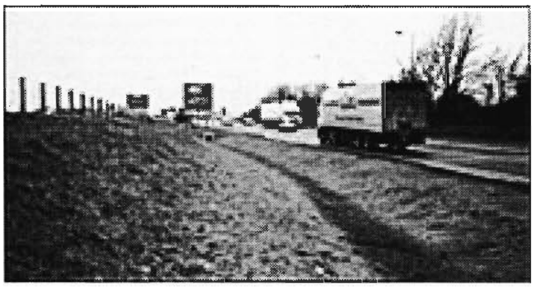



The benefits of pervious surfacing are rather impressive. They reduce or even remove the need for other drainage methods required for an impervious surface, which can save money and time, as well as the space that would be required for the drainage equipment. If other drainage is necessary, the pervious paving acts to attenuate the flow, so as to require less capability from the rest of the drainage system.

Because of their benefits, one type of pervious paving technique or another can be implemented pretty much anywhere (except main roads) a new surface is being installed, be it walkways, driveways, or parking areas, or other such surfaces. Costs vary greatly, depending on the development, drainage required and the amount of traffic the surface will provide for, as well as the availability of the applicable pervious paving materials and labour to install them. Therefore, a simple cost analysis cannot be performed, but specific cost analysis for any development should be done as pervious paving could prove to be similar in cost or cheaper than traditional drainage methods (see Life Cycle Cost Analysis mini-guide on more information).

## 3. Swales

Swales are the main transportation form of attenuation. They are wide and shallow ditches covered with a thick grass used to direct and transport drainage water, usually to a retention or purification pond. Their design acts to slow water flow down, as well as to allow some of it to disperse into the soil. This reduces the maximum flow of water, which means drainage systems have an easier time dealing with it.



Swales themselves are hard to examine for feasibility and benefits alone, as they are almost always part of a larger drainage system. They are essentially a better-designed and more effective ditch, and cost no more to create than a ditch. They are much cheaper to both install and maintain than the piping that might be used instead of swales to transport water, as they cost very little to create, and maintenance is much easier and requires only minimal landscaping care while pipes can require digging and repairs or replacements. Their main drawback is they generally require more surface land than either conventional ditches or pipes. This can be a serious design consideration, especially where surface land is extremely limited. If the land is available, swales prove to be very economical as well as ecologically friendly.

## 3. Soakaways

Soakaways are another form of sustainable water diversion techniques. They are a deep, somewhat narrow cutout in the ground that is filled with a permeable material, usually loose gravel. Water can either be drained into them from the top, if they are positioned at the edge of an impervious surface, or into them directly via a drainage pipe, which directed the water to the soakaway from elsewhere in the development. Due to the large ground surface area within the soakaway, water is able to infiltrate quickly back into the soil, and the loose filling material allows the water to spread out over the entire length of the soakaway, as well as provide an attenuating effect if the soakaway is not enough of an infiltration method to handle the drainage, and thus itself drains into another part of the drainage system, often a swale to a holding pond. High flow soakaways, such as the ones placed on the edges of impervious main roads, require a larger capacity than the loose gravel can provide, and thus a different filler is needed. The current filler for soakaways such as these are specially designed plastic boxes, which are mostly hollow, with a web of plastic supporting members inside, so to provide some attenuation while increasing the available empty space for water to flow dramatically.

Soakaways are best implemented along the sides of impervious surfaces, such as parking areas, with those surfaces designed to flow into the soakaway. Also, near the edge of a building is a good position, for the drainage from the roof to go into the soakaway. Soakaways are also a good alternative to swales when land usage is an issue, as soakaways, while generally not as effective as an attenuation and infiltration method, take up significantly less surface area, as most of the soakaway is underground.

Soakaways provide the same ecological benefit all sustainable drainage systems provide: attenuation to prevent damage to water-based ecologies and erosion to nearby ground, as well as preventing flooding downstream. This is a very important environmental benefit, as conventional drainage has damaged or destroyed many rivers, as well as caused flooding problems which are dangerous and expensive to correct. They can be cheaper than the conventional drainage required for a development, especially when a hookup to the local drainage system is somewhat far away and would require running pipes a long distance. Soakaways, as with all sustainable drainage systems, are also fully supported and encouraged by local Building Control, and can even assist in getting planning permissions, as it adheres to

## 4. Holding Ponds

Holding ponds are a depression in the ground designed to hold runoff water. They can be designed to be dry except in a rainfall event, or to constantly have a certain level of water in them. They are generally lined with grass, although sometimes gravel or other pervious material is used. Holding ponds allow water runoff to collect in them, and slowly infiltrate into the ground, as well as slowly feeding a sewer, filtration pond, or some other drainage system. When more water is delivered than the system can handle, the holding ponds serve to prevent flooding or overflowing of the drainage system. They do this by providing a chokepoint, so only a fixed amount of water can flow out, and the rest is stored until the flow of water slows enough so that the system can catch up. They are a necessary stopgap measure, used in developments that have a high surface area that requires drainage as these large developments can create very large flows during a rainfall event.

Holding ponds provide a strong ecological benefit, as they lower peak flows during rainfall, which causes flooding and other problems, especially when draining into a watercourse. The main problem with holding ponds is the amount of area required: they need a sizable portion of land, depending on the drainage needs and size of the development. Creation costs can vary greatly depending on the soil type in the area, the size of the holding pool required, and any other special considerations. Maintenance costs are generally quite low as holding ponds are nearly self-sufficient; the only maintenance required is usually small amounts of landscaping or occasionally clearing accumulated debris.

Chapter

# Natural Infiltration and Purification

Natural infiltration and purification are sustainable methods for first removing impurities and contaminants from the water and then infiltrating the water into the ground, to return it to the water table. While many of the attenuation techniques also provide some infiltration capacity, it is usually not enough to handle the runoff from an entire development site or area, depending on the system. Thus, additional systems designed specifically for that purpose must be added. These systems include wetlands and purification ponds. It should be noted that the purification process is referring to standard levels of contaminants caused by water flow over roofs and other impermeable surfaces and through drainage systems, and not contaminants caused by industrial processes.

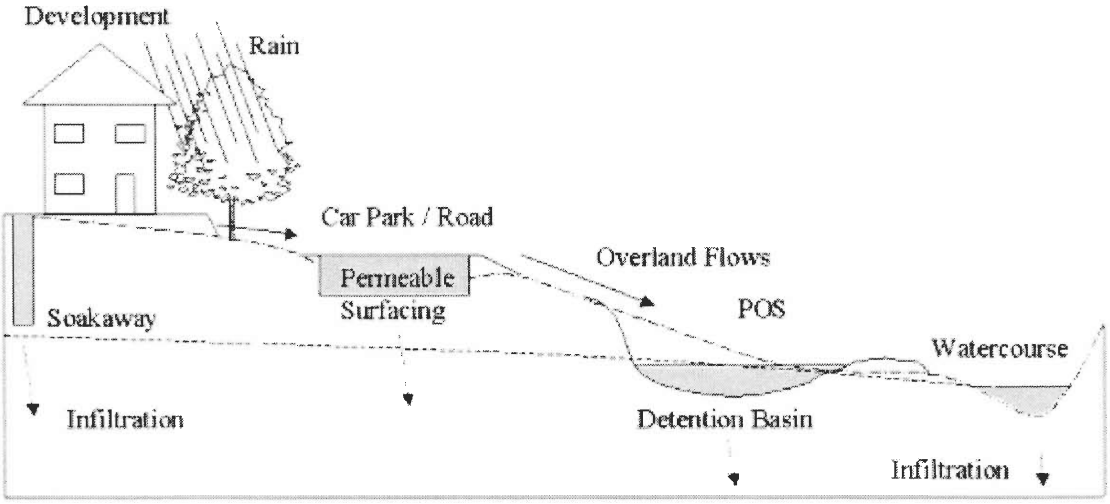
## 1. Wetlands

Wetlands may be somewhat of a misnomer: what a wetland system for sustainable drainage involves is a small wetland ecology established at the exit point for a developments' drainage system. Wetlands provide strong biological purification ability as the numerous plants, animals, and micro-organisms living there serve to slowly disperse or consume the contaminants in natural processes. They work by allowing water runoff to feed into the wet land and allow the ecology to process the water, releasing it slowly back into the ground, and possibly (depending on the system) allowing treated water to flow slowly into a nearby watercourse.

The benefits of a wetland system are many: it provides very good contaminant removal and infiltration ability and can deal with the water runoff of a number of large developments, depending on its size. It also provides an aesthetic appeal as well as sustaining a diverse ecosystem. The downsides are maintenance of the wetlands, possible safety concerns, especially in a residential area where small children are often near, and the relatively large area needed to maintain a wetland system, as well as the high initial cost to create it. Thus, while extremely useful and ecologically sound, they are seldom implemented without policy requirements.

## 2. Purification & Infiltration Ponds

Purification ponds use various methods to purify water as it flows through the pond (or sections of the pond depending on the system). Most use various forms of sand, gravel, or other sediment to remove impurities as water flows through. Some ponds have semi-permeable barriers which divides the pond into sections. Each section allows the water to sit, causing some impurities to settle out. The water slowly infiltrates through the barrier, which is made up of a material that removes specific impurities. The multiple sections can often use different materials, so as to deal with many different impurities in a systematic fashion. After being purified, the water is then funnelled to a pond that allows it to infiltrate back into the water table, or to flow at a fixed rate into a watercourse.




These ponds serve a valuable purpose, and deal with water much better than conventional drainage. They clean the water so it doesn't pollute the water table or nearby watercourse, and prevent heavy flows during a rainfall event, which cause flooding and disturb the river ecology. They can also provide a valuable aesthetic benefit, as they can be eye pleasing when designed to fit with a development, and can also provide a recreational area. Safety issues are very similar to wetlands, as well as the relatively large land area required and the higher initial cost compared to conventional direct drainage. Thus, while the aesthetic or recreational benefits combined with the ecological benefits can make these systems somewhat appealing; the land requirement and initial cost can limit their use.

# Overall Cost Effectiveness and Evaluation

An overall cost evaluation of Sustainable Drainage techniques is most useful. SUDS has proven to be financially sound in many cases, especially when sewer hook-ups are far away or the development is large enough to put a strain on the sewer system. Thus, SUDS is especially appealing to big developments such as large commercial centres or industrial areas, but can still be useful in smaller developments.

The main deterring factor is the reliance of SUDS on natural factors, as the capabilities of natural systems is variable, and thus it was expensive to implement due to the uncertainty factor with the ability of the system to handle the drainage load. With SUDS becoming more widespread, and with many more building professionals becoming more experienced in the design and implementation of SUDS, it is much easier to know the exact system that is right for a particular development, and thus much easier and more efficient (and thus less expensive) to implement. While systems vary from development to development, and needs and capabilities differ due to soil quality and current drainage systems, a sustainable drainage system can often prove to be cheaper over time, if not cheaper initially (see Life Cycle Cost Analysis mini-guide for more information on lifetime cost).

# Additional Resources

## 1. Additional Information

The Householders Guide – Merton's new guide for householders to apply sustainable features in their homes.

www.envirolet.com – Provides information and products on waterless compost toilets.

www.buildinggreen.com – Information regarding different techniques for building a green construction.

## 2. Case Studies

For examples on how the systems above have been implemented, please see the Water Efficiency Awards found at www.environment-agency.gov.uk. The Water Efficiency Awards recognises those developments which have taken a positive step in applying water conserving techniques.

The BedZED project is also a good source for understanding how many of the techniques discussed in this guide are used. You can find more information about this development at www.bedzed.org.uk.

# References


http://www.selenvironmental.com/storm_main.htm

www.sustainabledrainage.co.uk/

www.ensr.co.uk/suds.htm

http://www.be.coventry.ac.uk/events/drainage.htm

www.coventry.ac.uk/se/research/conf_timetable.doc

http://www.waterpolicyteam.org/Wetland%20Habitats%20&%20Species/Publications/Factsheets/sustainable%20Drainage%20FS3%20Version%202.pdf

http://www.environment-agency.gov.uk/business/444304/502508/464710/?version=1&lang=_e&region=

www.southglos.gov.uk/acrobat/sus_drainage.pdf

www.ciria.org.uk/suds/

http://www.ciria.org.uk/water_drainage_flooding.htm

www.mdx.ac.uk/www/uprc/15-1.pdf

http://www.cheltenham.gov.uk/libraries/documents/thefuturepdf/local%20plan%202001/supplementaryguidance/suds.pdf

http://www.sepa.org.uk/dpi/suds/

http://www.entecuk.com/downloads/ppg25_d.pdf

http://www.waterambassador.org/

http://www.hbf.co.uk/specialisms/technical/highways_drainage.html

http://www.scotland.gov.uk/library/pan/pan61-00.asp

http://www.formpave.co.uk/prod_storm_case.html

www.johnstonsmith.co.uk/fact15.html

http://www.ciwem.org.uk/policy/policies/diffuse/index.asp

http://www.lifesciences.napier.ac.uk/wmfiles/SUDS.htm