Appendix A

Environmental Design and Construction

A good practice guide for smaller Council building projects

Draft – October 2011

Contents

Introduction

Background and policy context

Calderdale Council's Building Environmental Standards (BES) were approved by full Council on XXX. In accordance with the standards, the *Environmental Design & Construction Checklist* must be completed for all Council building projects (i.e. new builds, extensions and refurbishments of buildings either owned or leased by the Council) with a capital cost between £60,000 and £500,000. The Checklist must be completed for all projects within this budget, whether the work is carried out in-house or by a third party. Projects costing more than £500,000 are required to undergo a full BREEAM assessment with the aim of achieving a minimum rating of 'Very Good'.

The purpose of the BES is to reduce the environmental impact of Council buildings in relation to four broad issues: mitigating climate change by reducing greenhouse gas emissions; adapting to the effects of inevitable climate change; sustainable and efficient use of resources; and local air, land and water pollution. (More information about these issues can be found in Section 7 of this Guide.)

The BES, the Environmental Design & Construction Checklist and the accompanying guidance documents seek to support, strengthen and develop a number of other corporate, local and regional policies, as laid out in the Council's Environmental Policy*, the Corporate Priorities*, the Calderdale Sustainable Community Strategy*, the Unitary Development Plan* and the Regional Spatial Strategy*. Adherence to the BES will also play an important role in reducing the Council's carbon footprint and consequent liability under the Carbon Reduction Commitment Energy Efficiency Scheme (CRCEES)*.

It should be noted that all new buildings and significant improvements to existing buildings are covered by the UK Building Regulations (Part L* is of particular relevance in terms of environmental standards). Calderdale Council's Building Environmental Standards do not seek to replicate the content of the Building Regulations, and compliance with the Regulations is assumed as a minimum standard.

How to use the Environmental Design & Construction Checklist and Guide

This good practice guide forms an explanatory accompaniment to the *Environmental Design and Construction Checklist*. The Checklist provides a set of environmental criteria for consideration at the design stage of smaller construction or refurbishment projects. More information on how to complete the Checklist is provided in the introduction to that document.

The scope of the Checklist is similar to that of the BREEAM standards, although in some places it is narrower. This reflects the difference in the size of projects assessed by the two different methods. This Guide is divided into six sections which correspond to the sections in the Checklist: energy, water, biodiversity, materials, waste and travel. There are also two 'general' questions at the beginning of the Checklist, which are dealt with below. Each section provides an introduction to and explanation of all the design features, technologies and terms covered by the Checklist, along with important legal and policy requirements and sources of further information. Section 7 provides an overview of the different impacts that buildings can have on the local and global environment.

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*See References, p.26

General questions

At the beginning of the Checklist there are two general questions about the project:

G1 Have existing buildings suitable for renovation been researched prior to the decision to build new?

G2 Has consideration been given to the maintenance requirements of all building features, ensuring that these are kept to a minimum and can be easily understood by the building occupants?

G1 is important because it can easily get forgotten until it is too late. Sometimes the assumption is that a new facility is needed, when in fact there is an existing building that could be adapted to meet the demand. The Council has a portfolio of hundreds of buildings, many of which are unused or only partly in use. Contact Land and Property Services to discuss your needs, and find out whether there are any existing assets that you could make use of.

G2 is also an essential consideration for any building project, but particularly if you are intending to incorporate innovations in the building fabric and services. It is no good designing an energy and water efficient, low carbon building that the occupants don’t know how to use. Best practice is to ensure that a Building User Guide is compiled which explains clearly how to operate and maintain all the systems in the building. Consideration must also be given to the maintenance requirements of the design, ensuring both that these are kept to a minimum and that maintenance can be easily carried out when necessary.

Section 1: Energy

The Calderdale Unitary Development Plan (UDP) sets out a number of policies relating to energy in new developments - see Policies EP25 and EP26 and associated notes*.

The Town and Country Planning Association (TCPA) guide, *Sustainable Energy by Design**, is a useful source of further information and guidance on low energy design, energy efficiency and renewable energy generation.

GreenSpec* is a comprehensive online guide to environmental building design and construction. It provides useful information on a wide range of topics, and includes listings for products and suppliers.

The International Organization for Standardization* (ISO) has launched a new standard for the building industry to help increase energy efficiency. The new International Standard ISO 23045:2008 provides specific design guidelines for new buildings and building mechanical equipment to reduce energy demand.

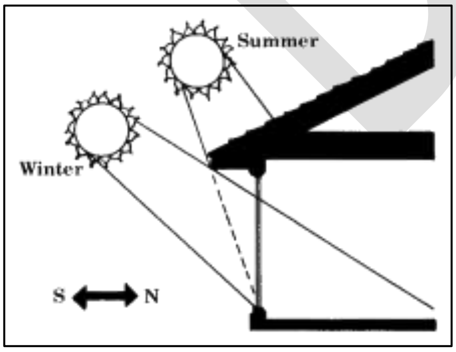
The UK Government's Zero Carbon Task Force is currently conducting research into non-domestic buildings, with the intention of introducing zero carbon targets for 2019.

E1: Designing for low energy use

The basic principle of **passive solar design** is to provide a thermally comfortable, well-lit environment all year round, without the need for active energy inputs such as electric lighting or combustive heating systems. The following section provides some further information on passive solar design techniques for both new-build and refurbishment projects:

The main glazed elevation of a building should be oriented within 30° of south, with a correspondingly small proportion of glazing on the north elevation. This is in order to maximise solar gain, which is useful for both heating and lighting a building without using extra energy.

High occupancy rooms should usually be located on the south-facing side of the building, unless the room has high internal heat gains (for example, an office). Rooms with either low occupancy (toilets, stairwells, storage rooms) or high internal heat gains (kitchens, server rooms) should usually be situated on the north-facing side.



How solar shading works

Glazed areas will benefit from incorporation of **solar shading** (see image, left), whereby high summer sunlight can be blocked but the lower light of winter is still accessible (see diagram). This helps to maximise solar gain in winter whilst protecting from summer overheating.

Building elements with high **thermal mass** such as stone, brick and rammed earth can help to stabilise internal temperatures throughout the year. These materials store heat during periods of warmth, and release it slowly once the air temperature drops.

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*See References, p.26

Thermal mass elements can be used to reduce both the heating and cooling loads of a building. More information is available from the Building Research Establishment (*Information Paper - Modelling the Performance of Thermal Mass*, available to buy from the BRE Bookshop*).

Shallow plan buildings (up to a maximum of 12 metres from external wall to external wall), or deep plan buildings incorporating a central courtyard or atrium, allow natural daylight to penetrate across the whole depth, thereby reducing the energy demand from electric lighting. Window position and height in relation to the building will also play an important part in ensuring optimal daylighting. Further detailed guidance can be found in the Chartered Institute of Building Service Engineers (CIBSE) *Lighting Guide 10: Daylighting and Window Design**. It will also be important to control glare through careful design, and by providing user-controlled shading mechanisms (e.g. blinds) to prevent users from unnecessarily blocking out daylight.

Heating/cooling load can be reduced by creating unheated **buffer zones** such as porches or lobbies at a building's main entrances. These areas serve as an insulating space between the heated or cooled part of the building and external conditions.

Strategic **planting** of deciduous trees around the building can provide shelter from summer overheating without reducing useful solar gains in winter.

Outside **surfaces that reflect heat and light** (surfaces with high *albedo*) will assist with natural light levels inside the building as well as reflecting excess heat away during warm periods.

Sunpipes should be considered where 'conventional' natural daylighting is not possible, for example in refurbishment projects. Sunpipes channel and intensify natural daylight by reflecting it down through a mirror-finished aluminium tube – they are so effective they can even capture and intensify moonlight. Suitable for use on both flat and pitched roofs, they can be designed into a new build or retrofitted to an existing building.

E2: Energy conservation and efficiency – building fabric

Overall, the Council should aim to design and procure new buildings with A- or B-rated Energy Performance Certificates (EPCs), and to achieve improved EPC ratings for existing buildings during refurbishment. To facilitate this, some or all of the following features should be included at the design stage.

Energy-efficient glazing: window systems (incorporating both the glazing and frame) should be double- or triple-glazed, argon-filled with low-emissivity (low-e) coatings, and have a maximum U-value of 1. Low-e glazing is a requirement for all new buildings under Building Regulations. This differs from standard clear glass in that one side of the glass has a special metal coating which reflects heat back into the room. For more information about energy-efficient glazing, see the BFRC website*.

Secondary glazing, where a window unit is added to the existing one on the inside wall in order not to change the external appearance of a building, should be of a similar standard to that given above. This technique is of particular value during refurbishment of listed buildings or buildings in conservation areas.

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*See References, p.26

Insulation: walls, roofs, floors, hot water pipes and tanks should all be thoroughly insulated. Draught proofing should be incorporated on all external windows and doors. There are a great many options available in terms of insulation: the National Insulation Association (NIA) can provide more information*.

Provision should be made at the design stage for **airtightness testing** of the completed building to be carried out. Leak testing involves connecting a fan, or a number of fans, to a suitable aperture in the building envelope and pressurising it over a range of pressure differences. Air volume flow rate through the fan is recorded, which is equal to the air leaking through the building envelope. More information about this process can be obtained from the Air Tightness Testing & Measurement Association (ATTMA)*.

Cooling: Good building design, combining passive solar design (see above) with high levels of insulation and an airtight, passively-ventilated building envelope (see below) should render air-conditioning obsolete, by controlling summer temperatures and providing a safe rate of air-change without heat loss during winter. Green roofs and ground- or water-source cooling systems can also help to avoid summer overheating.

Where air-conditioning is entirely unavoidable (for example in some server rooms, although see below for other solutions to overheating in these spaces), systems which use **refrigerants** with low global warming potential (see Appendix 1), and which include leakage detection measures, should be specified.

Passive stack ventilation (PSV) provides continuous and rapid background ventilation without requiring an energy input. Stale air is extracted through vertical ducts running from grilles in the ceiling to roof vents. The ducts extract moist air using the natural 'stack effect', caused by the difference between indoor and outdoor temperatures, together with the effect of wind passing over the roof of the building. Fresh air enters the building through trickle vents in the windows, providing a safe and comfortable rate of air-change.

Mechanical ventilation with heat recovery (MVHR) uses a duct system, whereby air is extracted from server rooms, offices, kitchens and bathrooms and passed through a heat exchange unit. This recovers the warmth from the exhaust air and uses it to warm incoming air, redistributing the heat to parts of the building where it is needed. This recovered heat can also be used to pre-heat water for space heating and hot water needs. These systems use some power, but far less than conventional air-conditioning, where the heat is simply dumped outside the building and thereby wasted.

When designing ventilation systems for a building, it is important to remember the importance of giving the building's occupants some control over their internal environment. A building which relies totally upon mechanised or passive systems without allowing the occupants to choose the temperature or rate of air change will be susceptible to technical problems and/or negative user perceptions.

E3: Space heating and hot water

Consideration should be given early on in the design process to the type of system or systems that will be used for space heating and hot water. The following section provides an outline of the options available and the different features of each.

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*See References, p.26

A minimum of 15% of any major new building's energy requirement should be met through onsite renewables, in accordance with Policy EP27* in the Calderdale Unitary Development Plan. Calderdale Council should aim to lead by example by incorporating renewable energy into any building where the opportunity exists. A range of different renewable energy technologies are now widely available in the UK, and it is unlikely that many buildings will not be suited to generating energy from at least one of these options. This section deals with renewable heating technologies (see Section E4 for renewable electricity generation).

Biomass: A wood chip or wood pellet system can meet all the hot water and space heating demands of a building. Systems can be designed to any size and incorporate automated fuel delivery. The most common type of installation includes an accumulator tank to provide a large hot water storage capacity. Biomass heating systems are typically between 80% and 90% efficient. The Renewable Heat Incentive* offers funding support for biomass boilers, providing a significant financial incentive. Wood fuels are carbon neutral, as the only CO_2 produced is that which would naturally have returned to the atmosphere through plant decomposition.

Solar thermal panels at Bradshaw Primary School

Solar thermal: Solar thermal technology uses energy from the sun to provide hot water. It's a simple principle: the sun heats a liquid as it runs through the panel and into a water tank with a heat exchange. Solar thermal is typically installed alongside a small gas or biomass boiler system that provides additional heat to meet the building's demand. The solar thermal system provides base load heating, which the gas/biomass boiler then 'tops up'. This reduces overall costs as the boiler need not be sized as high as a stand-alone system. The Renewable Heat Incentive* offers funding support for solar thermal, providing a significant financial incentive.

Heat pumps: There are two main types of heat pump: air-source and ground-source heat pumps. Both types require an electrical input – on average, a system will use 1kW of electricity to produce 2kW of heat. Heat pumps are more efficient than other types of electric heating, but should not usually be chosen in preference to an efficient gas heating system. Ground source heat pumps tend to perform much better than air source heat pumps. The Renewable Heat Incentive* offers funding support for heat pumps, providing a significant financial incentive.

Air source heat pumps work rather like a fridge in reverse, in that they transfer heat from the ambient air into the building. Air source heat pumps provide blown-air space heating only, so air-tightness is particularly important with this technology.

Ground or water source heat pumps operate via either a 'slinky' or a bore hole. A slinky system consists of a coiled pipe laid in a shallow trench one metre below ground level.

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*See References, p.26

Liquid running through the pipe absorbs heat from the ground and transfers it to a heat exchanger on the building. This type of system requires that a suitable area of land is available next to the building. On the other hand, a bore hole system uses a hole drilled into the ground, with the pipes inserted vertically - typically the bore hole needs to be 50-80 metres deep. Although this type of system is ideal where there are space constraints, it can be very expensive to drill a bore hole.

Regardless of the collection arrangement, heat from the pipes is transferred via heat exchange to feed radiators or under floor heating. Due to the moderate water temperatures that can be obtained using a heat pump, under floor heating is recommended as a wet (radiator) system requires hotter water.

Fossil fuels: Typical fossil heating fuels include natural gas, oil, coal and liquid propane gas (LPG). These fuel resources are finite and also release large quantities of carbon dioxide into the atmosphere when burned. All can be used to power conventional boiler systems. If fossil fuels must be used, the most efficient system possible should be chosen. Modern condensing boilers will typically have efficiencies of up to 90%. Gas-fired **micro CHP** (combined heat and power) units act like normal high-efficiency gas boilers, providing heat and hot water, but as they work they use waste heat to drive a generator which produces electricity.

Heat distribution: It is also important to consider the efficiency of heat distribution within the building. **Under floor heating** can provide comfortable conditions using lower temperature water than radiators (typically 50°C rather than 60+°C) – but remember that carpeting is not compatible! Appropriate zoned **heating controls** will ensure that heat is only distributed to the areas in which it is required at any given time. However, the control system must be user-friendly in design to ensure that it is not simply overridden by non-technical occupants who find it too confusing.

Advanced heating controls at Whitehill Community Primary School in Halifax

E4: Electricity

Energy efficiency

Internal and external **lighting schemes** should use low-energy fittings. There is now a wide range of energy efficient lighting options available on the market. Zoned lighting controls should be put in place so that small areas of lighting can be operated in isolation at times when the building is only sparsely populated. In some locations, for example in toilets and storage rooms, motion-sensitive lighting or timer switches can also be an effective way of reducing energy consumption. For more information, see the Energy Saving Trust's guide to energy efficient lighting*.

Motors controlling water pumps or ventilation can benefit greatly from **inverters**. An inverter effectively allows the motor to run at lower currents and therefore consume less energy. This is particularly beneficial on larger motors (those with an output greater than 5kW).

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*See References, p.26

Voltage optimisation units can greatly reduce electricity usage in a building. This type of device reduces the voltage coming into the building and provides an output of 220 volts to all appliances. Effectiveness depends on the load factors and maximum electricity demand of the building.

Where a building requires the incorporation of **lifts, escalators or travelling walkways**, these should be designed to be as energy efficient as possible, for example: escalators are fitted with a passenger sensing device for automated operation, so they operate in stand-by mode when there is no passenger demand; lifts include a regenerative unit so that energy generated by lifts running up empty and down full is returned to the national grid or used elsewhere on site; lift cars use energy-efficient lighting and display lighting (e.g. LEDs).

Built-in **appliances** such as fridges, freezers, dishwashers and washing machines should have an energy efficiency rating of A (or A++ in the case of refrigeration equipment). Cold storage appliances should also use refrigerants with low global warming potential (see Appendix 1).

For further information on the energy efficiency measures above, see the Chartered Institution of Building Services Engineers (CIBSE) *Guide F – Energy Efficiency in Buildings**.

For guidance specifically related to office buildings, see *Energy Consumption Guide 19**, produced by the Carbon Trust. Primarily written for technical specialists and facilities managers, this Guide provides "typical" and "good practice" delivered energy, cost and carbon dioxide emission benchmarks for office buildings.

Renewable electricity

10kW wind turbine (15m mast) located near Bradshaw

A minimum of 15% of any major new building's energy requirement should be met by onsite renewables, in accordance with Policy EP27 in the Calderdale Unitary Development Plan†. Calderdale Council should aim to lead by example by incorporating renewable energy into any building where the opportunity exists. A range of different renewable energy technologies are now widely available in the UK, and it is unlikely that many buildings will not be suited to generating energy from at least one of these options. This section deals with renewable electricity generation (see Section E3 for renewable heating technologies).

Wind power: Wind turbines use the energy of the wind to produce electricity. They are available in a wide range of sizes, and small turbines are increasingly found on rooftops in urban settings. However, in most instances a wind turbine will only be suitable on sites with few obstructions and an average wind speed of at least 5m/s – the exception to this is a vertical axis turbine, which can operate efficiently at lower wind speeds. Care must be taken when siting wind turbines, to avoid adverse impacts on wildlife such as birds and bats.

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*See References, p.27
†See References, p.26

Photovoltaics (PV): PV panels convert energy from the sun into electricity. Ideally panels should face between south-east and south-west at an elevation of 30-40°, but they can operate at 90% capacity even on flat roofs. Since there are no moving parts, PV systems require little or no maintenance over a typical lifespan of 25 years.

Solar PV panels at Sowerby Bridge Market

Micro hydro: Sites with access to a watercourse may be suitable for hydroelectric power generation, whereby a turbine is used to produce electricity from the energy of flowing water. The term micro hydro is generally taken to mean schemes with a power output of less than 100kW, although most single-site schemes will be considerably smaller than this. When a micro hydro system is fitted on a weir that acts as a barrier to fish passage, a fish pass may be required.

London Renewables and the London Energy Partnership have developed a toolkit providing decision-making flowcharts which establish the appropriateness of different renewable energy technologies according to site location, entitled *Integrating renewable energy into new developments: Toolkit for planners, developers and consultants**.

Feed-in Tariffs* (or the **Clean Energy Cashback Scheme**) were introduced in April 2010, to support the uptake of renewable energy installations in the UK. The scheme guarantees a minimum payment for all electricity generated from on-site renewables, as well as a separate payment for the electricity exported to grid. These payments are in addition to the bill savings made by using the electricity generated on-site. New renewable electricity installations will attract these payments for up to 25 years, providing an income for the building owner and shortening the financial payback period for the installation. Examples, using tariffs available in 2010, are given below:

Wind

Initial cost of installation (10kW Evoco, 5m/s average wind speed)	£42,000
Annual electricity (based on 22,000kWh @ 10p per kWh)	£2,200
Annual FIT (35p per kWh)	£7,700
Total annual benefit	£9,900
Payback period	4.24 yrs

Solar PV

Initial cost of installation(10kW peak, south-facing 30^{o} pitch, no shading)	£30,000
Annual electricity (based on 8000kWh @ 10p per kWh)	£800
Annual FIT (31p per kWh)	£2,500
Total annual benefit	£3,300
Payback period	9.09 yrs

Hydro

Initial cost of installation (60kW peak, est. output based on average flow of R. Calder)	£400,000
Annual electricity (based on 250,000kWh @ 10p per kWh)	£25,000
Annual FIT (21p per kWh)	£52,000
Total annual benefit	£77,000
Payback period	5.1 yrs

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*See References, p.27

Section 2: Water

The Town and Country Planning Association document, *Climate Change Adaptation by Design**, provides a useful section explaining the principles of rainwater harvesting, greywater recycling, green roofs and SUDS.

WAT1: Water conservation and recycling

Treating and distributing water for human use requires substantial energy resources (water industry greenhouse gas emissions were just over 4 million tonnes of CO_2 equivalent in 2005-06). Reducing the amount of water used can therefore make a significant contribution to reducing greenhouse gas emissions.

Cromwell Bottom, Elland

Water efficient appliances should be specified early in the building design process. A wide range of options is available on the market, including sensor or push-button taps, waterless urinals and low- or dual-flush toilets. Reducing a building's water consumption will have a significant cost benefit during the lifetime of the building as well as reducing its environmental impact.

Designing hot-water systems so that pipe-length is kept to a minimum will reduce the volume of water that has to be drawn off each time a hot-water appliance is used (the **dead-leg**). Ideally all water fittings should be grouped closely around the hot-water source, but for larger buildings this may not be possible, and localised water heaters will usually provide energy and water savings. Hot-water pipes should be placed above cold-water pipes to reduce heat transfer, and longer hot and cold pipes should be **insulated** to prevent heat gain and loss.

Leak detection equipment should be fitted to all mains water supplies to the building in order to reduce the potential for water wastage should a major leak occur.

Rainwater harvesting captures and diverts rainwater for use in irrigation, outdoor cleaning or toilet flushing. Costs and CO_2 emissions are reduced since less mains water is required by the building, and flood-risk during storms is lessened by diverting water from the drainage system. There are also potential savings to be made during design and construction, since fewer drainage outlets will be required. Typically, rainwater is collected from rooftops and diverted into barrels or storage tanks. The amount of rainwater collected from a rooftop can be significant - a $100m^2$ roof can catch 500 litres of water from just 5mm of rainfall. Rainwater harvesting on a commercial building typically replaces up to 80% of the building's mains water requirement.

For further information, visit the UK Rainwater Harvesting Association website*.

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*See References, p.27

Greywater recycling takes water from showers, sinks and laundry and re-uses it for toilet flushing and non-edible plant irrigation. Filtration and disinfection mechanisms are required to avoid the build-up of bacteria during greywater storage. Greywater can be a valuable resource for landscape architects, builders, developers and contractors because of the design and landscaping opportunities afforded by on-site greywater treatment and management.

The Environment Agency's publication, *Conserving water in buildings**, contains useful information on many different water conservation and efficiency measures, including low-use appliances and design ideas for water conservation.

Business Link* is also a useful source of information on water efficient products and techniques.

WAT2: Minimising risks of flooding and surface water pollution

Impermeable surfaces around the building should be avoided entirely or kept to a minimum. In accordance with Policy EP22† in the UDP, **Sustainable Urban Drainage Systems** (SUDS) should be incorporated wherever possible and appropriate.

SUDS offer an alternative to traditional approaches to managing runoff from buildings and hard standing by mimicking natural drainage patterns. They can reduce surface water runoff, encourage recharge of groundwater, and provide amenity and wildlife enhancements. SUDS approaches include:

Green roof at Wellholme Children's Centre

- **Green roofs**, made from turf, sedum or other vegetative materials, which reduce runoff and lower flood risk. They can also store water as part of a rainwater harvesting system (see above) to satisfy a portion of the building's demand.
- Permeable and porous pavements, gravel and grass surfaces will allow water to infiltrate below surface level – more information on **permeable surfacing** alternatives can be found on the CIRIA* website.
- **Filter strips and swales**: vegetated landscape features with smooth surfaces and a gentle downhill gradient to drain water evenly off impermeable surfaces - such features will also reduce urban heat island (UHI) effect by providing vegetative cooling.
- Infiltration devices such as **soakaways**, which incorporate a network of pipes laid under the ground and allow water to drain directly back to the soil at a manageable rate.
- Other landscape features such as **basins, reed beds and ponds** which are designed to hold water when it rains.

It is important that consideration is given to the long term maintenance requirements of SUDS, including the need to remove silt, and that space requirements for maintenance are allowed for in the building design.

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*See References, p.27
†See References, p.26

Where SUDS techniques cannot be employed, fuel and oil separators must be installed to protect receiving waters from contamination.

Part H of the Building Regulations* provides advice and guidance related to sustainable drainage systems.

CIRIA is a research and information organisation that works to improve standards in construction. CIRIA's dedicated SUDS website* provides comprehensive advice and guidance for incorporating SUDS techniques into building design.

The Environment Agency website* also provides advice and guidance related to SUDS. Information about the use and design of fuel and oil separators is also available from the Environment Agency*.

Guidance on soakaway design is available to purchase from the Building Research Establishment's (BRE) online bookshop*.

WAT3: Managing ground conditions

Greater volumes of surface water caused by storms may increase potential for subsidence or landslip. For new buildings, foundations should extend downward below the zone that may be affected by seasonal variations in moisture content. During major renovation works, existing buildings can be underpinned with concrete supports that extend under the original foundations into more stable soils.

Improvements in external surface protection such as vegetative cover will also play a role. Design must include careful consideration of size, species and placement of trees to avoid subsidence of individual buildings. Though vegetation helps to reduce runoff and landslip risk at larger scales, trees can cause damage to the built environment as they grow: through disruption or displacement of structures, through direct damage as branches fall, or because they abstract water from soils leading to soil shrinkage. More information on this subject can be found in the TCPA's *Climate Change Adaptation by Design**.

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*See References, p.27

Section 3: Biodiversity

Buildings and associated land can provide, or have the potential to provide, important wildlife habitats, especially for nesting birds and roosting bats.

Under the Natural Environment and Rural Communities Act (2006)* all local authorities have a duty to have regard to the conservation of biodiversity Including enhancement) in exercising their functions. Planning Policy Statement 9 (Biodiversity and Geological Conservation)* states:

"*Development proposals provide many opportunities for building-in beneficial biodiversity or geological features as part of good design. When considering proposals, local planning authorities should maximise such opportunities in and around developments using planning obligations where appropriate*".

The Calderdale Biodiversity Action Plan* sets out the wildlife habitats and species of urgent need of conservation.

Many species, including bats and nesting birds, are protected by legislation. More information on protected species is available from the Bat Conversation Trust* and Natural England*.

The Calderdale Unitary Development Plan† (UDP) contains several policies relating to biodiversity in new developments – see Policies GNE2 and NE13–NE18.

B1: Site assessment

To minimise the risk of delays to the project, an ecological assessment should be made at the earliest opportunity. An ecological report should be prepared by a suitably qualified ecologist. This should include a data records search with West Yorkshire Ecology*.

The scope of the survey will depend on the site and nature of the proposed works. For larger and more complex projects where the impact on biodiversity is likely to be high, the scope of the survey should be agree with the Council's Conservation (Biodiversity) Officer, Hugh Firman: hugh.firman@calderdale.gov.uk, tel: (01422 39) 3214. The need or otherwise for bat surveys should be assessed using the Bat Alert Layer on PlanWeb* and associated guidance – contact Hugh Firman for further information.

B2: Biodiversity protection

Projects should be designed to minimise loss or damage to habitats and species during and after development. An ecological report should specify how identified species and habitats will be protected. Where loss or damage is significant, a method statement will be required. This should set out the means, including timing, which will be used to protect biodiversity. Where habitats require long term management, a management plan should be produced. Measures to protect biodiversity include:

- Timing of works, e.g. to protect nesting birds or roosting bats
- Designing the project to minimise wildlife loss or damage
- Fencing to protect trees and vegetation
- Protecting water courses and water bodies from polluted runoff

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*See References, p.27
†See References, p.26

- Minimising light spill and ensuring that bat roosts and bat commuting or foraging features are not adversely affected

B3: Biodiversity enhancement

All building projects are expected to include biodiversity enhancement. It is important that the enhancement measures are site specific and take account of the type and size of development, biodiversity priorities and the likelihood of attracting target species. Advice from a suitably qualified and experienced ecologist should be obtained. Enhancement features should be considered at the design stage, since bird boxes and bat tubes can effectively be built into the fabric of the building.

Enhancement measures may include:

- Bat roosting/hibernation features
- Bird nesting opportunities see the Swift Conservation* website
- Green roofs*
- Living walls
- Habitat creation, such as hedgerow planting or pond construction. Planting should use native species of local provenance
- Habitat restoration

Further information and advice is available from the Council's Conservation (Biodiversity) Officer, Hugh Firman: hugh.firman@calderdale.gov.uk, tel: (01422 39) 3214.

Natural England produces some useful free publications*:

Green Roofs: their existing status and potential for conserving biodiversity in urban areas
Living Roofs
Bats In Buildings

The Town and Country Planning Association guide, *Biodiversity by Design* (2004)†, is also a useful resource.

The British Standards Institute PAS 2010 – Planning to halt the loss of biodiversity (2006) is available to buy from the BSI Group†.

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*See References, p.27
†See References, p.28

Section 4: Materials

M1: General principles

Construction materials, hard landscaping, boundary protection, fixtures and finishes should all be chosen for minimal environmental impact, in accordance with Policies EP25 and GM3 in the UDP*. Where possible they should have a low **embodied energy,** and should not contribute to the **depletion of finite resources** or produce unnecessary **waste**. 'Embodied energy' refers to the energy used to extract, process and transport a material prior to its use, and the energy required to dispose of the material at the end of its lifetime.

The Building Research Establishment's (BRE) *Green Guide to Specification*† rates a comprehensive range of materials according to a standardised method of whole-life environmental impact assessment. Choosing A-rated products from the *Green Guide* is a straightforward method for specifying more sustainable materials across the entire building project. BRE Global also publishes Green Book Live†, a free-to-use online resource where you can find sustainable products and services.

The Waste and Resources Action Programme (WRAP) offers a Net Waste Tool†, which can calculate the potential for recycled content in the procurement of construction projects as well as forecasting the waste likely to be generated by the project. WRAP also produces general guidance on all types of recycled construction products†. Salvo† also produces a directory for sources of reclaimed timber and other building materials.

Renewable/natural materials: This includes materials such as timber for structures and frames, rammed earth or straw for wall elements, and lime or clay for both internal and external wall surfaces. All these materials occur naturally and need little or no processing prior to use. Whilst these materials are also renewable, in that they can regenerate after they have been harvested or mined, it is important to ensure that they do originate from a sustainable source where removal of the material does not cause environmental degradation and regeneration of the material is part of the process.

Shelf village hall extension – the walls are constructed of load-bearing straw bales

M2: Construction materials

Local Authorities are coming under increasing pressure to comply with the UK Government's **Timber** Procurement Policy. This stipulates that all procured timber and wood-derived products should originate from legal *and* sustainable sources or, alternatively, FLEGT (Forest Law Enforcement, Governance and Trade) licensed sources. For building works, compliance with the policy requires the use of a legally-tested model specification clause (see Annex B of the UK Government's Timber Procurement Advice Note [TPAN])†. In addition, the model contract condition (Annex C of the same document) should be included in the contract preliminaries. A model paragraph on timber procurement should be included in the invitation to tender (ITT) following the wording of Annex D of the TPAN. Potential tenderers should be required to sign a statement indicating their acceptance of the contract conditions as part of their tender. If they do not

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*See References, p.26
†See References, p.28

agree to abide by the contract conditions at this stage, their tender should be rejected as being non-compliant.

Once a contractor is appointed, the Council (or its appointed consultants) should check that the timber and wood-derived products that are supplied and used on its building projects are compliant with the timber procurement policy. This includes temporary timber or wood-derived products such as might be used in formwork etc. It also includes furniture, plywood and wood composite products.

Forest certification schemes provide the best avenue for proving compliance. Currently, the UK Government has approved certification under the Programme for Endorsement of Forest Certification schemes (PEFC) and the Forest Stewardship Council (FSC). Sustainable Forest Initiative (SFI) and Malaysia Timber Certification Council/ Scheme (MTCC/MTCS) certification can only be accepted as complying with UK Government policy when it is covered by a PEFC certificate. The Central Point of Expertise on Timber (CPET) website* should be consulted for the up-to-date position on approved schemes.

Checking for compliance need not be an onerous task and is preferably carried out at appropriate times during the contract works. It is possible to carry out the checks after the work is finished but this risks the disruptive effects of having to replace non-compliant timber. There is a flow chart available on the CPET website* that should be followed. This breaks the checks down to the following five stages:

1. Authenticity of supplier's PEFC/FSC certificate;
2. Certificate has been issued to that supplier;
3. Certificate validity i.e. not suspended;
4. Certificate applies to the product concerned; and
5. Invoices/delivery notes specify FSC/PEFC under product descriptions.

FSC/PEFC certification is known as 'Category A evidence'. Category B evidence is also an acceptable means of proving compliance. However, this is a more difficult and time-consuming avenue and so should be avoided if possible.

In practice, almost all softwood supplied in the UK is covered by PEFC or FSC certification. If only softwood or softwood-derived products are supplied, contravention of the policy is highly unlikely. Hardwoods present greater opportunities for non-compliance. If hardwood is to be specified at all, it should be specified by performance rather than by species. Recycled and reclaimed timber/timber products are also covered by the procurement policy. Documentary evidence and independent verification is still required for these products but the focus will be on the previous use of the timber.

Concrete requires cement, the production of which is responsible for around 10% of global carbon emissions. However, sustainable alternatives are increasingly available where the cement is replaced wholly or partly with reclaimed materials such as pulverised fuel ash (from coal-fired power stations) or ground, granulated blast furnace slag (from iron manufacture).

Steel is frequently used for the structural framework of buildings. However, steel production is energy-intensive and contributes to land contamination. Where there is no other alternative but to use steel, a recycled product should be specified.

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*See References, p.28

Polyvinyl chloride (**PVC**) and unplasticised PVC (**uPVC**) are widely used in modern construction, particularly for pipes, guttering, window frames, doors and electric cables. Plastic production is energy-intensive, and since plastics are oil products there is the issue of resource depletion to consider as well. Plastics – and particularly PVC - are also difficult to re-use or recycle, which means they create large quantities of waste and associated pollution. Alternatives include aluminium or stainless steel for pipes and guttering (both easily recycled), wood for windows and doors, and polyethylene (a recyclable plastic) for cabling. Well-maintained wooden window frames will last just as long as uPVC, and have the further advantage of being reparable if part of the frame becomes damaged.

Another area in which natural alternatives can work extremely well is **insulation**. There are now a number of well-established products on the market, including cellulose fibre insulation made from recycled newspapers – manufacturers' information is provided in the References section*. Other insulation materials with good environmental credentials can be found in the BRE's *Green Guide*, or on Green Book Live*.

As well as choosing materials with low greenhouse gas emissions, consideration should be given to materials which help us to adapt to climate change. For example, metallic **sheet roof coverings** may be less vulnerable to high winds than roofing tiles. Some materials, such as cool building materials and green roofs, can help to prevent summer overheating. **Cool building materials** are materials that are highly reflective and emissive, ensuring that excess solar gain is avoided during hot periods. **Green roofs** provide evaporative cooling during hot weather, when the vegetation releases moisture into the air taking heat with it as well.

M3: Fixtures, fittings and finishes

Generally, the same principles as above apply to materials chosen for fixtures, fittings and finishes – where possible local, natural, recycled or reclaimed materials should be given preference. However, a couple of specific issues are worth further consideration:

Flood resilient materials – materials which can withstand direct contact with floodwaters for some time without significant damage - should be considered. These include ceramic tiles, pressure-treated timber, glass block, and metal doors and cabinets.

Specified finishes and decorative schemes should always be approved with the building's end users before they are implemented, in order to avoid materials being wasted by immediate redecoration upon occupation of the building.

A durable and sustainable alternative to vinyl **flooring** is linoleum, which is derived from linseed oil extracted from flax seeds and then dried out and ground into a fine powder, called 'linoleum cement'. This is then mixed with fine plant material, such as ground cork, wood flour and pine resins and then combined with a jute fibre backing.

Conventional paints and finishes release carcinogenic **volatile organic compounds** (**VOCs**) into the air around them, which create low-level ozone which contributes to climate change. A range of VOC-free alternatives are now available on the market.

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* See References, p.28

Section 5: Waste

Waste is marked as an Action Area under the Council's Environmental Policy*, and waste management is also a key policy in the Regional Spatial Strategy* (Policy ENV12, p124).

WAS1: Construction and demolition waste

Site Waste Management Plans (SWMPs) are now a legal requirement for construction projects over £300,000 (the full regulations can be obtained from the Office of Public Sector Information†).

This section offers best practice advice when developing an SWMP, as well as a number of general good practice measures for reducing construction and demolition waste.

By designing buildings to use **standard manufactured sizes** or quantities, for example standard lengths of timber or whole sheets of flooring material, you can ensure that far less waste is generated.

If a new build project is replacing an existing building, the **demolition waste** can be effectively utilised as infill for the foundations or as hardcore underneath access roads and paved areas. It may also be possible to salvage useable materials from the facade or structure of the old building through careful demolition. These materials can then be incorporated into the new building or sold on as reclaimed materials, reducing the overall cost of the project.

Most modern buildings have a relatively short lifespan of between 30 and 70 years. As a result of this, best practice in construction is to deliver buildings that can be usefully '**deconstructed**' rather than demolished, allowing reclamation of their materials for new buildings or for recycling. This 'closed-loop' approach to waste minimisation should be incorporated from the initial design stage of a new building, by minimising use of mixed-composite materials in the design.

Further good practice measures include:

- Thoroughly consult with all project stakeholders to ensure that the accommodation will meet their needs fully without the need for change either during or after construction
- Design for durability and low maintenance
- Specify materials that are not excessively fragile during handling, construction and/or end use
- Ensure that all disciplines co-ordinate their designs to prevent clashes and site modification
- Maximise utilisation of modern methods of construction (off site manufacture/prefabrication)
- Modular dimensional co-ordination – specify and design board and linear materials to fit together without the need for cutting and/or the need for disposal of unusable offcuts
- Minimise wet trades
- Eliminate small quantities of specialist materials
- Optimise pipe and cable runs by logical positioning of equipment and ancillaries
- Specify materials that can be repaired if damaged during construction
- Design for future flexibility in delivering different configurations of accommodation

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*See References, p.26
†See References, p.28

- Eliminate the need for certain materials e.g. underfloor heating eliminates radiators and associated pipework, holes in the structure, pipe brackets, insulation, ancillaries, pipe boxing, radiator covers and decorations

The Building Research Establishment's (BRE) SMARTWaste system* is a web-based tool offering sustainable waste management solutions. Amongst other things, SMARTWaste can monitor waste levels, provide segregation targets and identify local opportunities for re-use and recycling.

Also for information and advice about resource efficiency and how to reduce or eliminate construction waste, the Envirowise document *An Introduction to Site Waste Management Plans** is a useful resource.

WAS2: Designing for minimisation of waste-to-landfill in use

Waste separation at Battinson Road depot

A sustainable building design will incorporate measures that enable the end-users to minimise the amount of waste they send to landfill. Depending on local or site waste collection arrangements, designated space for dry recyclables (glass, metal, plastic, paper/card), food waste, green waste (cut grass, leaves, tree thinnings) and residual waste (landfill) should be provided in a convenient location outside the building, and incorporated into the design of the internal space according to the building's use.

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*See References, p.28

Section 6: Travel

T1a: Travel plan

Buildings over a certain size require a Travel Plan to be submitted at the planning stage. The purpose of a Travel Plan is to reduce single occupancy car journeys to and from a site, and to encourage alternative, more sustainable travel behaviour amongst building users. The inclusion of a Travel Plan at the building design stage will embed sustainable transport practices in the culture of the building's use from the outset.

For more information about designing and implementing a travel plan, see the Department for Transport's *Essential Guide to Travel Planning**.

T1b-c: Car parking

Policy T18 of the Calderdale UDP[†] sets a *maximum* number of parking spaces for new buildings of different types. However, sustainable building design should seek to minimise car use associated with the building by reducing these numbers as far as possible. Best practice is for no more than one parking space to be provided for every four building users. Consideration should be given to the following:

- How many building users are there?
- How well is the site served by public transport?
- How far will building users be travelling– what is the potential for walking and cycling?
- What is the potential for building users to car share/use pool cars?

Car share spaces, disabled, mother and baby and motorbike spaces can be excluded from these considerations, provided they are clearly identified as being solely for these uses.

T1d-f: Walking and cycling

Users of the building will be encouraged to walk and cycle if adequate facilities exist to make these activities simple and pleasant. Policy T19 of the UDP[†] sets out minimum bicycle parking requirements for different types of new building. Secure, covered cycle storage, showers, changing facilities and lockers in which to store clothing and equipment are all important considerations, and should be designed into the building plans.

Indoor cycle storage at Northgate House, Halifax

Pedestrian and cycle access to the site should be safe, attractive and well-maintained. Any cycle routes provided should give direct access to cycle storage without the need to deviate from the cycle path and, if relevant, connect to offsite cycle paths where these run adjacent to the development's boundary. Pedestrian access routes should follow similar principles, and should connect to safe public footpaths and public transport nodes near the site. Further information regarding best practice in the design of pedestrian and cycle paths can be obtained from Sustrans*.

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*See References, p.28
[†]See References, p.26

Section 7: The environmental impacts of buildings

There are four broad issues to consider in terms of a building's environmental impact: mitigating climate change by reducing greenhouse gas emissions; adapting to the effects of inevitable climate change; sustainable and efficient use of resources; and local air, land and water pollution. These issues are explained in more detail in this section.

Following environmental design principles makes economic sense in terms of the 'whole life cost' of a development –that is, capital cost, maintenance and running costs, and disposal at the end of the building's life. Good design can deliver buildings with low maintenance and running costs of benefit to both the owners and building occupants. The requirement to consider 'whole life costing' of alternative options with a capital cost of more than £250 000 during the procurement and refurbishment of buildings is written into the Council's Corporate Property Policy & Strategy*.

Halifax town centre

In addition, good quality building design which considers the needs of the building's occupants over its lifespan will generally lead to greater levels of occupant comfort and satisfaction. Healthier, happier staff will tend to take fewer sick days and be more productive at work, providing cost savings for employers.

1. Mitigating climate change

Climate change – sometimes referred to as 'global warming' - is now widely recognised as one of the most urgent global issues of our time. Fossil fuels such as coal, oil and gas release large quantities of carbon dioxide (CO_2) into the atmosphere when they are burnt. This atmospheric CO_2 acts like a one-way barrier, allowing long-wave radiation from the sun to reach Earth but trapping short-wave radiation in the form of heat. This is causing the Earth's atmosphere to heat up far faster than it would under 'natural' conditions, with alarming consequences. Polar ice caps are melting at an unprecedented rate, deserts are spreading and extreme weather events of all kinds are becoming more frequent across the globe. Scientists currently predict that the Earth can only stand at most another 2°C of warming before a global 'tipping point' is reached, runaway climate change begins and it is too late for human efforts to redress the balance.

Mitigating climate change through reduction of CO_2 and other greenhouse gas emissions is therefore of vital importance. This can be achieved by reducing fossil fuel consumption

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*See References, p.28

through energy conservation and energy efficiency measures, as well as increased use of renewable energy technologies. Another important consideration is methane emissions from landfill sites, so waste management issues also pertain to this theme.

For a comprehensive view of current scientific research into climate change, visit the Intergovernmental Panel on Climate Change (IPCC) website*. The Department for Energy and Climate Change (DECC) website* provides useful information about the science of climate change and Government plans to tackle the issue.

In 2001 the UK Government set up the Carbon Trust* to work with organisations on reducing carbon emissions and developing commercial low carbon technologies. In 2006 they also commissioned *The Stern Review** to assess the economic implications of climate change.

2. Adapting to climate change

Experiments using global climate models have shown that reducing CO_2 emissions reduces the rate of rise of average global temperatures, lessening the rate and impacts of climate change. We can therefore slow the rate of warming by changing our behaviour. However, once released into the atmosphere, CO_2 remains there for about 100 years. So even if emissions are reduced now, a certain amount of warming is already inevitable until around 2040. In 2007, the IPCC* concluded that if all greenhouse gas emissions were held at 2000 levels, there would be a further global average warming of 0.3 to 0.9°C by the end of the century, owing to greenhouse gases currently in the atmosphere.

It is therefore crucial that, as well as mitigating against further greenhouse gas emissions, our response to climate change includes adapting to the inevitable consequences. This is a huge and complex subject area, but in terms of building design and construction the UK Climate Impacts Programme (UKCIP)* identifies the following major issues: increased risks of flooding, erosion and subsidence; greater pressure on drainage systems; increased likelihood of winter storm damage; and increased demand for summer cooling. The effects of these changes are already being felt in Calderdale and throughout the UK, with a rising number of extreme weather events every year.

The UK Climate Impacts Programme (UKCIP) provides detailed information on this topic: www.ukcip.org.uk.

Flooding near Hebden Bridge in 2007

The Town and Country Planning Association guide, *Climate Change Adaptation by Design*[†], provides detailed guidance and further information on matters relating to building design and climate change adaptation. The South East Climate Change Partnership document, *Adapting to climate change: a checklist for development**, is also a useful resource.

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*See References, p.28
[†]See References, p.27

3. Resource use

In the context of this Guide, resource use relates to the 'ecological footprint' of a building (as opposed to just the carbon footprint). Ecological footprint is measured in terms of the area of land needed for a particular purpose, an activity or the life of a person. In terms of a building, this will include the land needed to produce the raw materials for construction, the fuel for running the building, the water to meet the occupants' needs etc. WWF reports* that if every person on Earth lived like the average European, we would need three planets to provide enough materials, food, fuel and water. Currently, the developed world is depleting the planet's resources at an unsustainable rate.

Resource use is closely linked to issues of waste management, particularly in terms of the re-use and recycling of waste into 'new' resources. Waste is thereby diverted from landfill sites which currently cause a great deal of concern in terms of both land use and climate change.

At one step further on, energy is also considered as a resource that should be conserved wherever possible. Energy from fossil fuels is running out, and the by-products of combustion are the leading cause of climate change. Energy from renewable sources, whilst in itself harmless, must also be used prudently and efficiently – the recent furore over bio-fuels replacing food crops is a prime example of why we cannot just use as much energy as we like. We make life more difficult for ourselves by living such energy-intensive lifestyles, which require high levels of infrastructure to support them – achieving these levels with renewable energy sources will be a tall order, but if we reduce consumption by increasing efficiencies and designing for low-energy use, we stand a far greater chance of success.

The River Calder

Similarly, resource use covers water – like energy, this crucial resource has been given its own section within the Guide, since it is such a complex issue. The same principles as for energy apply – smaller systems for water provision and treatment are easier and cheaper to manage, and therefore sustainable solutions are less costly and complicated to achieve.

For more information about energy, water or specific materials please see the relevant Sections of this Guide.

4. Local pollution/degradation

As well as global atmospheric pollution, this Guide seeks to help minimise local emissions of harmful substances to air, ground and water, which cause human health risks and degrade the natural environment. This can be achieved through a number of measures, including: discouraging private car use to ease congestion and its associated emissions; avoiding use of construction materials and finishes which contain hazardous chemicals; diverting waste from landfill sites which damage local land resources; and designing sustainable drainage systems so that surface water is not polluted by foul drains during storms.

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*See References, p.28

Section 8: References and further information

References

Executive summary – existing policies and targets

The Council's **Environmental Policy** can be found on the website: http://www.calderdale.gov.uk/environment/sustainability/environmental-projects/environmentalpolicy.html

The Council's **Corporate Priorities** can be found on the website: www.calderdale.gov.uk/council/performance/priorities/index.html

The **Calderdale Sustainable Community Strategy** can be viewed on the Calderdale Forward website: www.calderdaleforward.org.uk

The Calderdale **Unitary Development Plan** can be found on the website at: www.calderdale.gov.uk/housing/planning/developmentplan/index.html

The Yorkshire and Humber **Regional Spatial Strategy** can be found within the National Archives records for the Government Office Yorkshire & Humber: http://webarchive.nationalarchives.gov.uk/20100528142817/http://www.gos.gov.uk/goyh/plan/regplan/?a=42496

Information about the **Carbon Reduction Commitment Energy Efficiency Scheme** can be found on the Department for Energy and Climate Change website: http://www.decc.gov.uk/en/content/cms/what_we_do/lc_uk/crc/crc.aspx

Part L of the Building Regulations can be found on the Planning Portal website: www.planningportal.gov.uk

Section 1: Energy

The Town and Country Planning Association guide, ***Sustainable Energy by Design***, can be downloaded at www.tcpa.org.uk

GreenSpec: www.greenspec.co.uk

The **International Organisation for Standardisation** (ISO): www.iso.org

Building Research Establish bookshop: www.brebookshop.com

The Chartered Institution of Building Services Engineers (CIBSE), 1999. ***Lighting Guide 10: Daylighting and Window Design***. London: CIBSE. ISBN: 0900953985

The **British Fenestration Rating Council** (BFRC): www.bfrc.org

The **National Insulation Association** (NIA): www.nationalinsulationassociation.org.uk

The **Air Tightness Testing and Measurement Association** (ATTMA): www.attma.org

More information on the **Renewable Heat Incentive** can be found on the Department for Energy and Climate Change website: www.decc.gov.uk

The **Energy Saving Trust** guide to efficient lighting can be found at www.energysavingtrust.org.uk

The Chartered Institution of Building Services Engineers (CIBSE), 2004. ***Guide F – Energy Efficiency in Buildings***, 2nd edition. London: CIBSE. ISBN: 1903287340. A copy of this Guide is available to loan on request from the Environmental Management team

Energy Consumption Guide 19 (ECON19) is available to download from www.carbontrust.co.uk

London Renewables/London Energy Partnership, 2004. ***Integrating renewable energy into new developments****: Toolkit for planners, developers and consultants*. Available online from: www.lep.org.uk

More information about **Feed-in Tariffs (the Clean Energy Cashback Scheme)** is available at www.energysavingtrust.org.uk

Section 2: Water

The Town and Country Planning Association's guide, ***Climate Change Adaptation by Design***, can be downloaded at www.tcpa.org.uk

The **UK Rainwater Harvesting Association**: www.ukrha.org

The Environment Agency document, ***Conserving water in buildings***, can be found at www.environment-agency.gov.uk, as well as useful information about **Sustainable Urban Drainage Systems (SUDS)**

Advice on water efficiency from **Business Link** can be found at www.businesslink.gov.uk

CIRIA's website dedicated to **SUDS** can be viewed at www.ciria.org.uk/suds

Part H of the Building Regulations is found at www.planningportal.gov.uk

Environment Agency: www.environment-agency.gov.uk

Building Research Establishment (BRE) guidance on **soakaway design** can be bought from www.brebookshop.com

Section 3: Biodiversity

Natural Environment and Rural Communities Act (2006): http://www.legislation.gov.uk/ukpga/2006/16/contents

Planning Policy Statement 9: Biodiversity and Geological Conservation can be accessed at www.communities.gov.uk

Calderdale Biodiversity Action Plan: http://www.calderdale.gov.uk/environment/countryside/conservation/publications/biodiversity/index.html

Bat Conservation Trust: www.bats.org.uk

Natural England: www.naturalengland.org.uk

West Yorkshire Ecology: http://www.ecology.wyjs.org.uk/

PlanWeb can be accessed via the Launcher on your desktop.

Swift Conservation: www.swift-conservation.org

Green roofs: www.livingroofs.org

The Town and Country Planning Association's guide, ***Biodiversity by Design***, can be downloaded at www.tcpa.org.uk

The BSI Group bookshop: http://shop.bsigroup.com/

Section 4: Materials

The Building Research Establishment (BRE) ***Green Guide to Specification*** is available to buy from www.brebookshop.com. Green Book Live is available at: www.greenbooklive.com

The Waste and Resources Action Programme's (**WRAP**) **Net Waste Tool** and guidance on **recycled construction products** can be viewed at www.wrap.org.uk

Salvo: www.salvo.co.uk

The Government's **Central Point of Expertise on Timber** website is www.cpet.org.uk. The **Timber Procurement Advisory Note** can be found here.

Section 5: Waste

The full **Site Waste Management Plans** (SWMPs) regulations can be found at www.opsi.gov.uk

The BRE **SMARTWaste** system is explained in more detail at www.SMARTWaste.co.uk

The Envirowise document, ***An Introduction to Site Waste Management Plans***, can be viewed at www.envirowise.gov.uk

Section 6: Travel

The Department for Transport's ***Essential Guide to Travel Planning*** is available at www.dft.gov.uk

Sustrans, 1997. *The National Cycle Network – Guidelines and Practical Details* (issue 2). Available online at www.sustrans.org.uk

Section 7: Environmental impacts of buildings

Council staff can view the Council's **Corporate Property Policy & Strategy** on the intranet, via the Land & Property pages. Non-staff members should request copies from environment@calderdale.gov.uk

The **International Panel on Climate Change** (IPCC): www.ipcc.ch

The **Department of Energy and Climate Change** (DECC): www.decc.gov.uk

The Carbon Trust: www.carbontrust.co.uk

A copy of ***The Stern Review*** can be viewed on the National Archives website: www.nationalarchives.gov.uk

The **UK Climate Impacts Programme**: www.ukcip.org.uk

The South East Climate Change Partnership's ***Adapting to Climate Change*** checklist can be found at www.climatesoutheast.org.uk

WWF's **One Planet Living** campaign: www.oneplanetliving.org

Further information

The **Chartered Institute of Building Service Engineers'** (CIBSE) ***Guide L: Sustainability*** is designed to help engineers and construction professionals improve the environmental performance of buildings. A copy of Guide L is available to loan from the Environmental Management team.

The **UK Green Building Council** report, ***Carbon Reductions in New Non-Domestic Buildings*** (2007), investigates opportunities for achieving zero carbon in new builds. Available from www.communities.gov.uk.

The **Carbon Trust** can offer free or subsidised design advice for construction projects dependent on size and potential carbon savings. For more information, visit www.carbontrust.co.uk.

Appendix

Refrigerants and their Global Warming Potentials (GWP)

GWP is defined as the potential for global warming that a chemical has relative to 1 unit of carbon dioxide, the primary greenhouse gas. Table 1.0 includes available substances which are capable of acting as refrigerants. Many are not currently used as such and some have been phased out and withdrawn from the market.

Table 1 Refrigerant GWP

Refrigerant type	GWP	Refrigerant type	GWP
R11 (CFC-11)	4000	R32 (HCFC-32)	580
R12 (CFC-12)	8500	R407C (HFC-407)	1600
R113 (CFC-113)	5000	R152a (HFC-152a)	140
R114 (CFC-114)	9300	R404A (HFC blend)	3800
R115 (CFC-115)	9300	R410A (HFC blend)	1900
R125 (HFC-125)	3200	R413A (HFC blend)	1770
Halon-1211	N/A	R417A (HFC blend)	1950
Halon-1301	5600	R500 (CFC/HFC)	6300
Halon-2402	N/A	R502 (HCFC/CFC)	5600
Ammonia	0	R507 (HFC azeotrope)	3800
R22 (HCFC-22)	1700	R290 (HC290 propane)	3
R123 (HCFC-123)	93	R600 (HC600 butane)	3
R134a(HFC-134a)	1300	R600a (HC600a isobutane)	3
R124 (HCFC-124)	480	R290/R170(HC290/HC170)	3
R141b (HCFC-141b)	630	R1270 (HC1270 propene)	3
R142b (HCFC-142b)	2000	R143a (HFC-143a)	4400

(taken from *BREEAM Education 2008 Issue 2.0*, p.314)