Sustainability Guide

Launch Edition 0.0

Broads Authority
The Broad
l Park family

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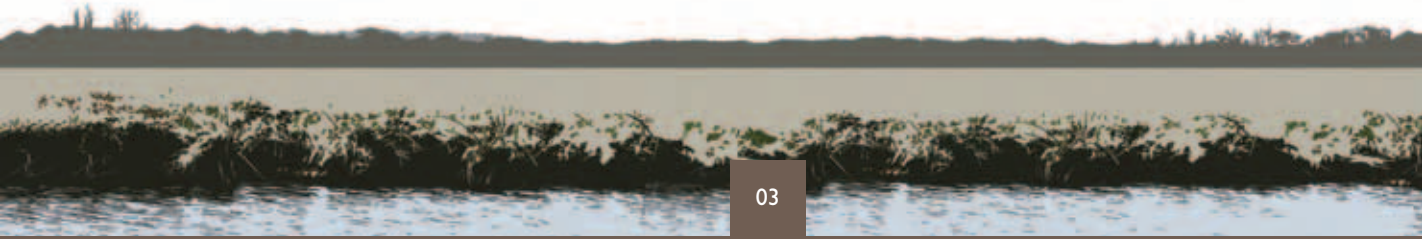
www.LSIarchitects.co.uk

Contents



Introduction

The Broads is one of England's most recently designated National Parks and its location between the fens and the ever-present force of the North Sea represents one of the UK's most finely balanced habitats. The wetlands and waterways, together with the managed planting and natural grasslands, bring nature closer into the lives of the people who live and work there, while providing the necessary resources to create sustainable development in the future.

The objective of this guide is both practical and ethical to ensure that buildings can contribute to biodiversity and a sustainable future by using natural local resources and by creating suitable interventions within the Broadland landscape.

The intention of this guide is not to be prescriptive but to suggest ways in which the built environment can compliment the sustainable balance of the Broads.

'Our Strategy for sustainable development aims to enable all people throughout the world to satisfy their basic needs and enjoy a better quality of life without compromising the quality of life of future generations.'

The UK Government Sustainable Development Strategy

The UK Government Sustainable Development Strategy
http://www.sustainable-development.gov.uk
http://www.breeam.org/

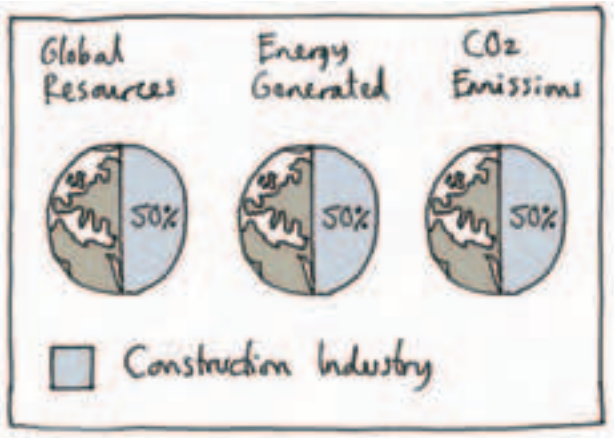
Principles

The role of buildings in the Broads is fundamental to the realisation of sustainable development. Buildings are long lived: they stretch into the future realm, a future of unknown resources, pollution and climate.

50% of all resources globally go into construction.
50% of energy generated is used in their construction and use.
50% of CO_2 emission comes from buildings.

This is a fact that must be considered in the selection of building design, materials and the processing of waste, but sustainability is not just about saving the Earth's resources. It is also about economic vitality and lowering the financial burden of energy and transport costs.

Finally, the regeneration of exciting buildings, structures and infrastructures is vital to the retention of character and critical mass in existing settlements, and thus plays an essential role in ensuring healthy and sustainable social interaction.

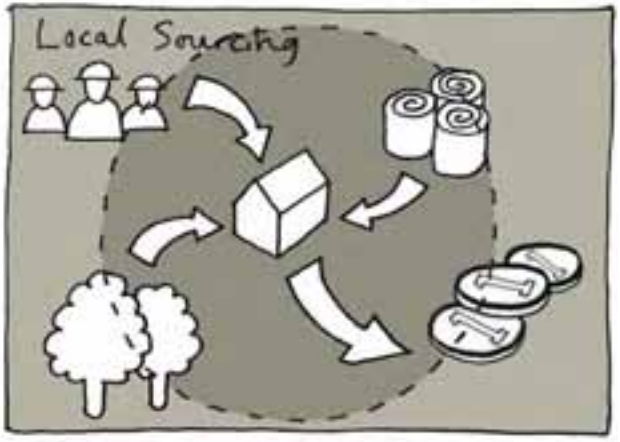


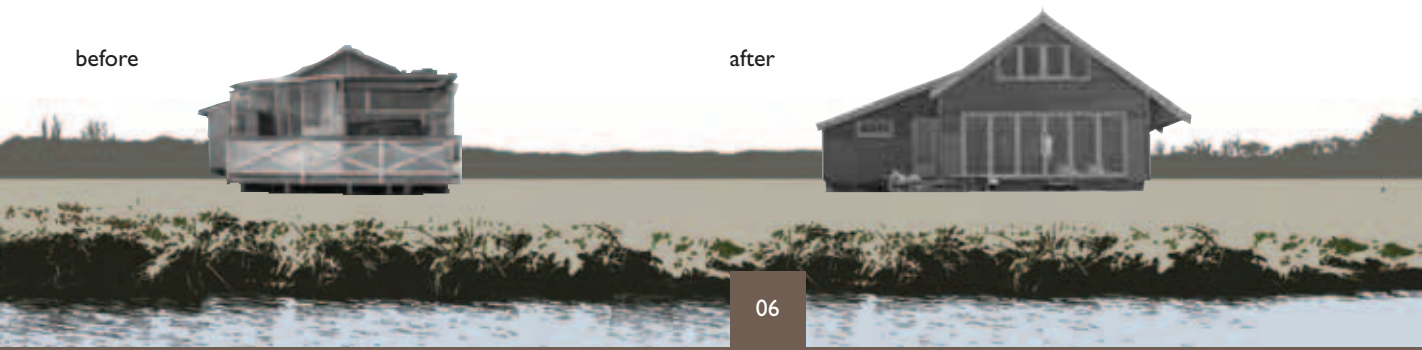
http://www.broads-authority.gov.uk
http://www.countryside.gov.uk/publications/articles/publication_tcm2-20983.asp

Priorities

The checklist provides a simple way of raising the level of sustainability of development in the Broads. But in the real world of tight budgets and timescales, best intentions can often get lost in the execution. Effecting a cultural change in the whole building design process is what is required. Establishing local sourcing and connections can encourage this, which in return can boost economic regeneration. Maximising opportunities for redevelopment of existing buildings can encourage traditional construction, and minimising green field development promotes a design ethos, which is contextual and sensitive to locality.

Consider biodiversity right from the begining of a project, and ensure that biodiversity considerations are incorporated into all stages: planning, design, construction, and follow-up.





http://www.bre.co.uk
http://www.bre.co.uk/service.jsp?id=397
http://www.bre.co.uk/service.jsp?id=51

Culture Change

A long-term shift towards sustainable development will only come about through a combination of planning, building regulation legislation and guidance, as well as a local determination to promote and uphold the recommendations in this Guide.

Education, informally through the media, and formally through traditional building workshops etc. will raise the awareness of the local community, building procurers, contractors and designers. Integration with local schools and their curricula means that sustainability will be seen as a priority by the next generation.

Statutory Authorities provide specific agendas for the following:

- Biodiversity, water management, renewable energy sources (Environment Agency).
- Increased insulation, good practice detailing and construction (Building Control).
- Waste generation and management, recycling strategies (Local County Council).

This Guide provides principles approved by the above Agencies.

http://www.environment-agency.gov.uk/

http://www.defra.gov.uk/rural/ruraldelivery/natural-england.htm

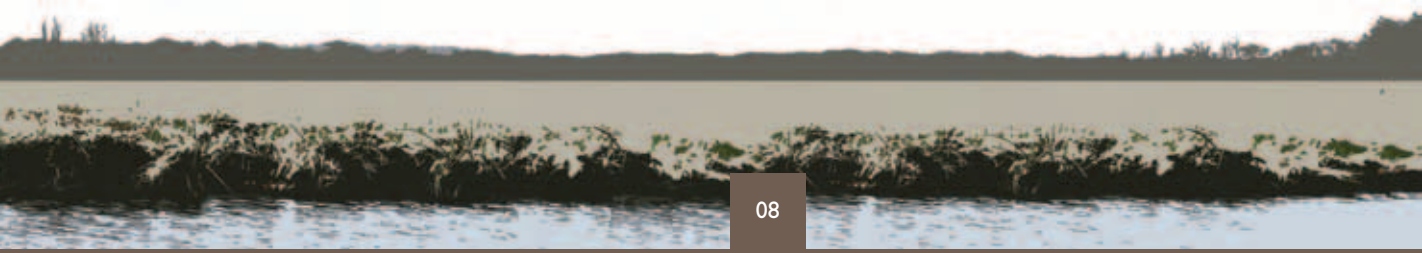
http://www.toolkit-east.org.uk

http://www.defra.gov.uk/rural/ruraldelivery/natural-england.htm

Local Sourcing

A key to sustainability in the Broads will be local sourcing and networks. Finding a local builder and specifying materials that are produced locally will reduce transport costs and vehicle emissions, as well as contributing to the local aesthetic. Materials that are available locally are probably materials that have been used locally for centuries in the making of buildings.

The Broadland characteristic is defined by local sourcing.

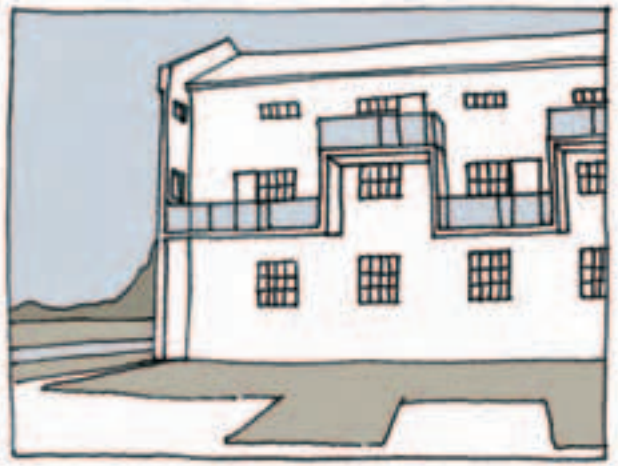


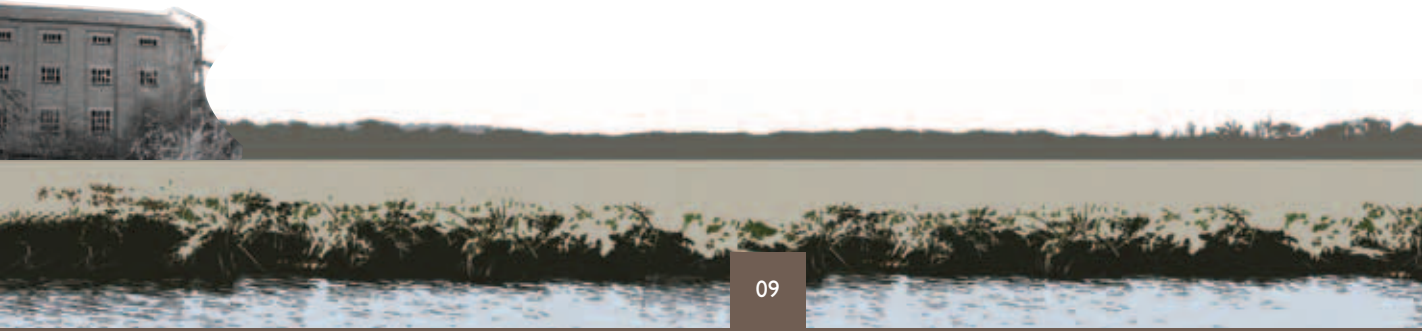
Re-cycle Re-use

Opportunities should be taken to re-use existing buildings, which with some modifications might meet their requirements perfectly. This is sometimes considered a costly alternative to making a new building, but when you consider the recycling potential released in the re-use of lime mortared bricks, timber, clay tiles and hardcore, cost savings and sensitivity to context are the ultimate benefits.

An 'existing building register' could be considered so potential developers are made aware of opportunities.

Planning guidelines already favour re-use and brown field sites. Especially relevant in the Broads.





Sensitivity

In a protected environment like the Broads, a design ethos, which is contextual and sensitive to locality, is a priority. To 'touch the ground lightly' by means, for example, of screwed spiral anchor pile foundations allows bio diversity to thrive below the building. Semi-permanent, adaptable and re-usable structures are well suited to waterside locations, but are not as suitable for areas of higher land, where a hillside context hints at permanence against the landscape backdrop. The marshland suggests structures that sit low for protection from the elements with occasional height and verticality to act as markers in the landscape.

Some of the technologies in this guide such as wind turbines, solar water heaters and wind catchers etc. will require planning permission and the Broads Authority should be consulted in the first instance.

The effectiveness of some technologies referred to may be seasonal and in some instances it will be appropriate to combine systems to achieve the best results.

http://www.rspb.org.uk/
http://www.ukbap.org.uk

Landscape Character

Landscape character is defined as a distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another. Essentially, landscape character is that which makes an area unique.

It is essential to consider this sense of place when making decisions about how to change, manage or restore landscapes. Only by paying proper regard to the existing character of a place can informed and responsible decisions be made, and sustainable future landscapes planned for. Through understanding how places differ we can also ensure that future development is well situated, sensitive to its location, and contributes to environmental, social and economic objectives.

The Broads Authority has undertaken a landscape character assessment which divides The Broads into a series of local character areas and types, each of which provide advice about the qualities that make the area unique and what aspects should be considered by potential planning applicants.

http://www.ukbap.org.uk/lbap.aspx?id=376
http://www.norfolkbiodiversity.org
http://www.norfolkwildlifetrust.org.uk/

Context

The Broads…

An unrivalled naturally functioning wetland ecosystem of international natural and cultural importance, with a landscape that: comprises a mosaic of interconnecting rivers and shallow lakes, fens, marshes, wet wood-lands, mud-flats and coastal dunes; supports a wealth of plants and animals; and reflects historic patterns of human activity over many hundreds of years.

A place where people live or work in harmony with it's natural and cultural qualities and where the local economy is sustained through small and medium-sized enterprises: building and hiring boats; providing services and accommodation, and producing food and other products locally to meet the needs of visitors; harvesting the fens; and farming livestock on the marshes.

(Adapted from the 2004 Broads Plan)

Broads Authority Local Development Framework:
http://www.broads-authority.gov.uk/planning/planning-policy/local-development-framework.html
http://www.countryside.gov.uk/lar/landscape/cc/index.asp

Principles

The following pages describe sustainable principles for building in The Broads.

These are accompanied by icons which refer to the Checklist, and icons which represent the initial cost of the technology involved. The icons for cost are shown below from cheapest to most expensive.

Cost Return

Some of the principles listed may appear expensive, however with an increase in demand it is inevitable that technologies will become more cost effective.

Ultimately some of the technologies will pay for themselves over time. The icons on the right represent the time it will take to expect a return on the money invested. Immediate return, 2 – 5 year return, and 10+ year return.

http://www.renewables-east.org.uk
http://www.greenregister.org/
http://www.thenbs.com/

Checklist

The following is intended as a quick checklist to use when commissioning or designing buildings to be sustainable.
Follow the icons throughout the guide to find out more about the specific topics.

Climate
Design buildings to be as flexible as possible for future adaptation to climate and temperature change, and changes in water level.

Energy efficiency
Design buildings to be as energy efficient as possible, reducing effects of depletion of natural resources and pollution produced by conventional energy generation.

Sustainable materials and construction
Understand the impacts, which materials specified may have on the environment, resource depletion and energy consumption.

Biodiversity and quality environments
Consider existing plant and wildlife, acoustic insulation, thermal comfort, natural daylight and ventilation.

Water resource management
Understand the importance of conserving limited natural resources, minimise consumption, reduce flood risk and relieve demands on infrastructure.

Waste management
Reduce, re-use and recycle.

Renewable energy
Develop sites to maximise opportunities for generating and using renewable energy (small scale windmills, Photovoltaics etc).

Micro-climate and pollution
Create shelter from excessive exposure to sun and wind, and improve air quality by reducing pollution.

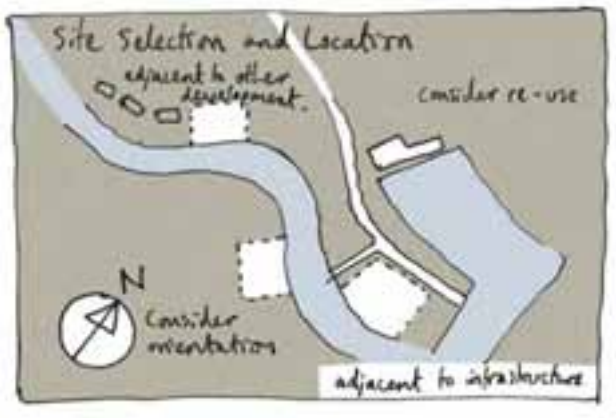
Energy Saving Trust http://www.est.org.uk

Centre for Alternative Energy http://www.cat.org.uk

Site Selection

The Broads Local Plan and its successor, the Broads Local Development Framework outline planning policies for the Broads and should be consulted in the first instance. Secondly, in order to select a site which will contribute sustainably to the area:
Consider adjacency to existing infrastructure and services.
Consider re-use of existing buildings rather than demolition (consult Broads Authority for information on redundant buildings).

Consider the orientation of the site – covered later under 'Building Orientation'.



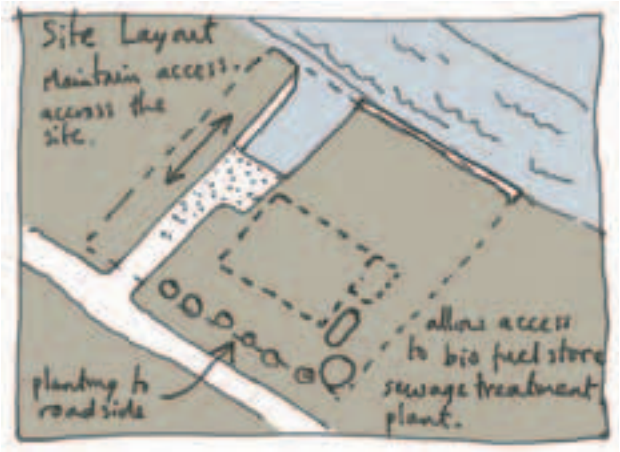
Any demolition should be supported by a statement of intent to re-use materials from the existing building.
Buildings reaching the end of their predicted life - if demolished carefully - can provide a useful resource in the re-use of their materials.

The selection of a site is a fundamental and low cost decision. Natural habitats and micro-climates should not be disturbed.

Site Layout

Site layout for waterside development will be dictated by orientation and access to the waterside. Access across the site, from water to road, should be maintained in strategic locations; strengthening the transportation network, providing access for the delivery of materials for construction and up-keep. These access routes will help maintain public views and help prevent the isolation of the road network from the river frontage.

Mooring access will depend on suitability of the bank side habitat. Piling method should be appropriate to risk from flooding/ erosion. See Bank Protection.



The building's orientation is discussed later in this guide.
Access should be provided to possible bio-fuel stores and sewage treatment systems.
Planting might be considered to the roadside to provide privacy and deaden sound.

The possibility of using micro-renewable energy technologies such as wind turbines and solar panels should be a consideration in site layout.

Site Density

Restrictions on height as dictated by the local context and impact on landscape. New development will be considered successful if it continues the pattern of historic development.

New development should support local shops, schools, and employment whilst utilising existing infrastructure. A network of short journeys should encourage walking and riding bikes, whilst longer journeys should be achievable via public transport, through bus and rail networks. In theory this creates a series of sustainable communities throughout the Broads, which create their own economic viability.

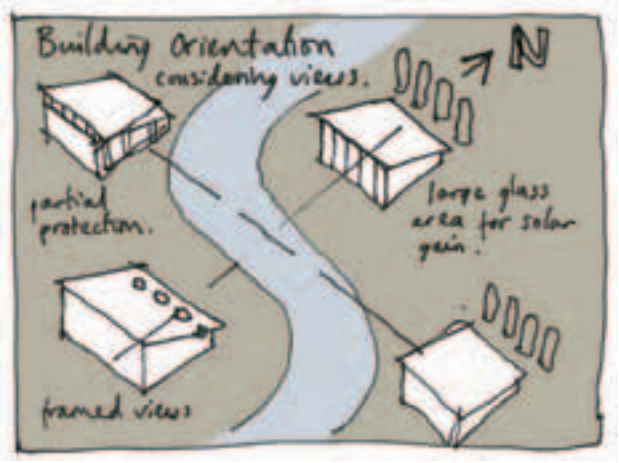
The sustainable community could create enough economic viability to bring redundant buildings back into use.
The aim is to generate social interaction via a density, which neither isolates, nor over-crowds.

The correct site density can create healthy social environments.

Broads Authority Local Development Framework:
http://www.broads-authority.gov.uk/planning/planning-policy/local-development-framework.html

Building Orientation

Exploiting visible connections with the landscape is a priority in an area like the Broads. Waterside buildings will evidently be orientated to maximise views of the water. Where this results in larger areas of glazing facing south, solar gain is increased and heating costs can be reduced. The down side to this is glare from the sun, which can controlled via the use of projecting eaves (i.e. sun only penetrates deep into the building in the winter) or applied solar shading (external louvres, etc.)



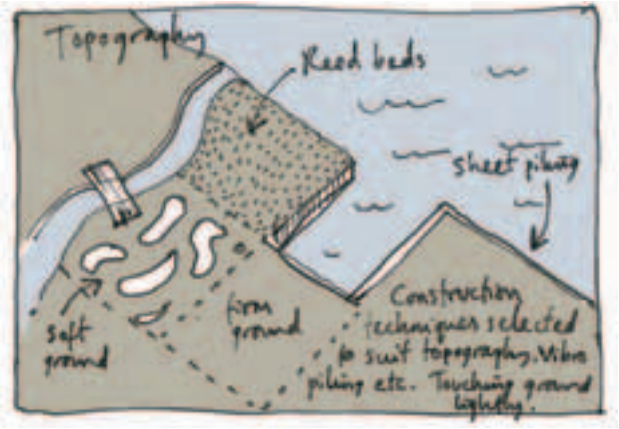
If the principal views are to the north, smaller windows, setting up framed views may be preferable in what should be a heavily insulated wall. Solid 'rammed earth' or gabion walls can provide levels of protection from the elements required of a north facing façade.

Natural day lighting will improve a building's interior and reduce the requirement for artificial lighting.

Topography / Construction

The topography of the selected site will affect the method of construction implemented.
A priority for the Broads is the re-use of materials from buildings reaching the end of their expected life. Demolition materials can be used as a piling mat to avoid the need for importing virgin materials into site.

The following are some examples of sustainable piling techniques. In preference to in-situ concrete retaining walls, driven steel sheet piling should be avoided, except in areas susceptible to flooding See Bank Protection.

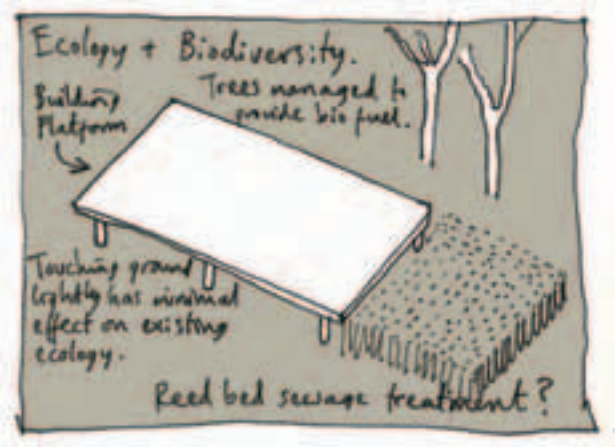


Screwed spiral anchor pile foundations are lightweight, avoid large amounts of concrete, excavation and disposal of subsoil. The principle of 'touching the ground lightly' with a technique like this also allows biodiversity to thrive below the building.

Dynamic compaction and vibration techniques with or without the addition of local stone or recycled concrete into the piling hole can provide piled construction without using imported material, i.e. no new concrete.

Ecology and Biodiversity

Whether the site is waterside, hillside or marshland, the objective must be to ensure that a development has minimal impact on its natural habitat. Positive enhancement of the environment must be a key aim.
Ecological surveys may need be undertaken to accompany planning applications. Advice should be sought from Natural England or the local Wildlife Trust.
If the site has a number of environmental implications, it would be worth considering the services of an Environmental Consultant.



Protection of existing trees and the addition of green sedum moss roofs (where appropriate) should be considered in an environment like the Broads where Ecology and Biodiversity is a priority.

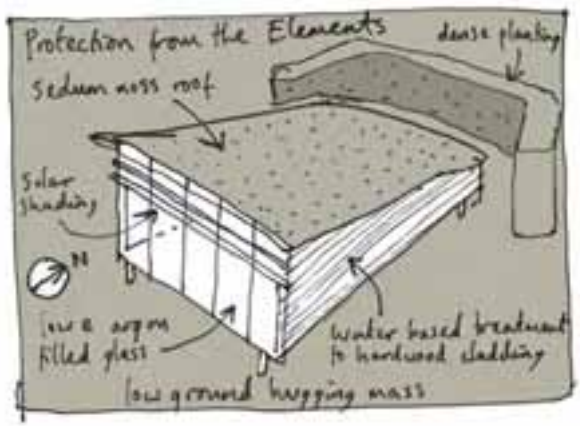
Consider - Reed-bed filtration systems
Gabion walls in reed-beds provide high surface area for beneficial bacteria growth

http://www.norfolkbiodiversity.org/SAPsHAPs/Guidelines.pdf
http://www.norfolkbiodiversity.org
http://www.wildlifetrusts.org/

Protection from the Elements

The majority of sites in the Broads suffer from exposure to the elements: be it harsh wind and rain in the winter or exposure to the sun in the summer. Planting can be used to moderate the environment. Tree planting can provide useful solar shade in the summer, but when the leaves drop in the autumn the same trees offer little obstruction to the penetration of winter daylight and desirable solar gains. Evergreen planting to the north can provide protection from wind and driving rain in the winter.

Artificial methods of protection like louvred panels on south facing glass or brise soleil canopies can be integrated into a building's design. Studies can be carried out by architects/ designers to ensure that the shading device will work as intended.



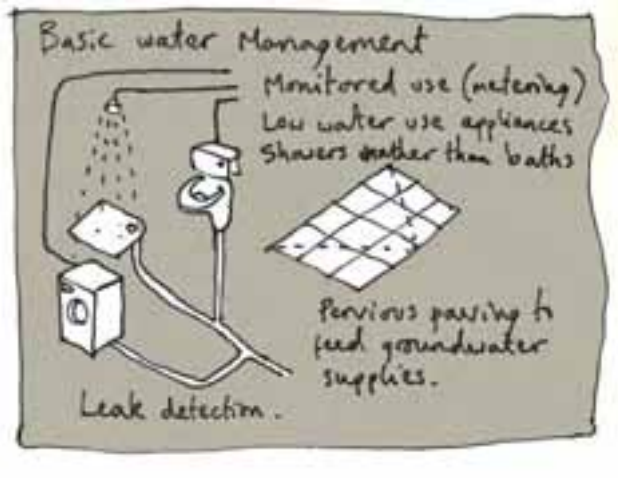
The north side of a building should be heavily insulated to protect from harsh conditions. Solid 'rammed earth' or gabion walls provide increased thermal mass, meaning they provide insulation in the winter and absorb the heat from the sun in the summer.

- **Employ methods to keep sun off glass (Sun shading by louvres)**
- **Deciduous tree planting adjacent to building**
- **Heavily insulated north facing walls.**

Basic Water Management

Hosepipe bans and flood warnings suggest instability in our climate. The way water impacts directly on health and food production means that careful use of freshwater has become a key concern and water conservation has become as important as energy conservation.

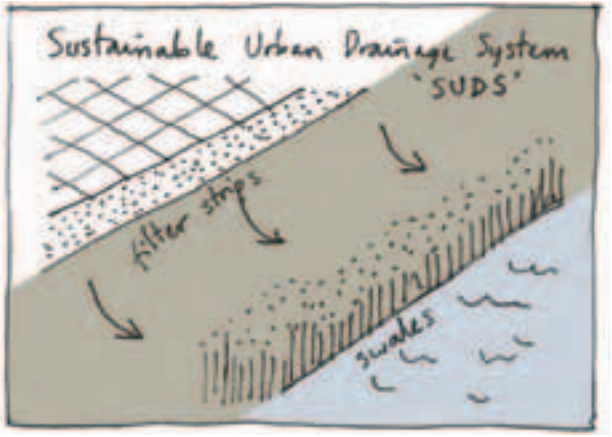
There are generally two categories of water conservation: The first being the use of water by the end user (drawn from the mains) which can be controlled by use of metering, high efficiency fittings, spray taps, showers rather than baths, and by the collection of rainwater for general recycling. See Rainwater Harvesting. The second is action taken to avoid depletion of the water table such as the design of hard surfaces. Car Park surface



finishes should be porous to allow the large quantities of water they collect to drain into the ground. Gravel filter strips, swales (water collecting ponds), infiltration devices and filter drains help maintain the water table.

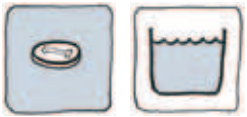
Sustainable Drainage Systems

Sustainable drainage systems remove the need for conventional pipe work and excavation by managing the drainage and filtration of surface water above ground. The system reduces construction costs as well as reducing the overall flow of water through a series of storage ponds, which minimise distress on downstream drainage and receiving waters. The drainage system creates natural features in the landscape creating attractive surroundings in which biodiversity thrives. Sustainable drainage systems are simple and cost effective, and avoid the need for expensive specialist contractors.



Benefits:

- Eliminates underground pipe work and manholes.
- Reduces flows by over 50%.
- Reduces construction/transportation costs
- Keeps plants watered
- Traps pollution in topsoil and vegetation, where it bio-degrades
- Trapped grit and silt in vegetation, keeps the drainage system clean

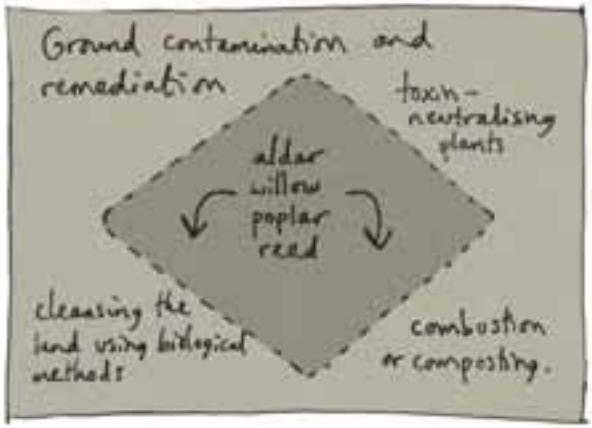


http://www.ciria.org/suds/

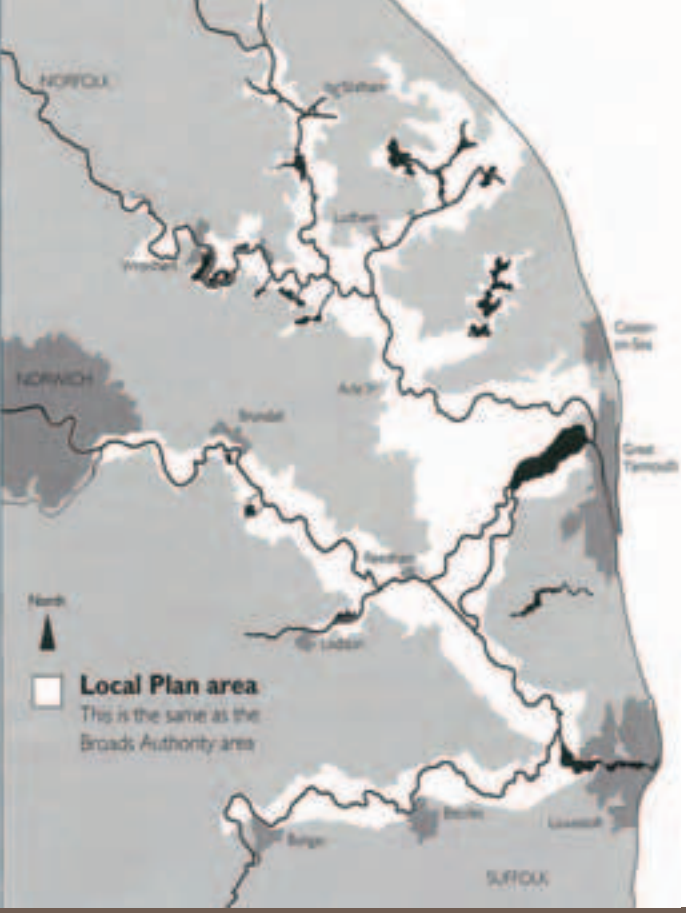
Ground Contamination and Remediation

Because the Broads Authority endorses the re-use of existing building plots (brown field sites) it is often likely that ground contamination will be discovered. This is especially so adjacent to boat yards where diesel, petrol solvents and other carbon based substances are in evidence.

Instead of removing contaminated earth, which is time consuming, costly and involves transportation, the contamination can be treated with biological methods. The most benign method of remediation is based on toxin-neutralising plants (alder, willow, poplar, reed), which either naturally break down pollution or absorb it.



Heavy materials are most problematic in that they are more difficult to treat. However, liming or stabilisation using cement or PFA materials, or even waste from sugar production, can reduce the mobility of metals in the ground. Capping using reclaimed soils, or spoil, may also provide a satisfactory solution.



The degree of risk of flooding is likely to increase in the light of climate change, sea-level rise and the gradual sinking of Eastern England. All these phenomena are subject to study and continual re-assessment. The current estimate of sea-level rise for inclusion in the design of tidal defences, as recommended by the Department for Environment Food and Rural Affairs (DEFRA), is 6 mm per year.

http://www.environment-agency.gov.uk/
http://www.defra.gov.uk

Flood Risk

The causes of flooding in the Broads are complex and there is significant uncertainty in assessing the future risk of flooding at particular locations and its likely extent, duration and severity. Developers should be aware at the outset that it is not feasible to eliminate all risk of flooding. A range of measures can, however, be applied to reduce the risk of flooding including avoiding development in areas at risk. Where development is appropriate in principle the following are relevant:

Minimum Floor Levels

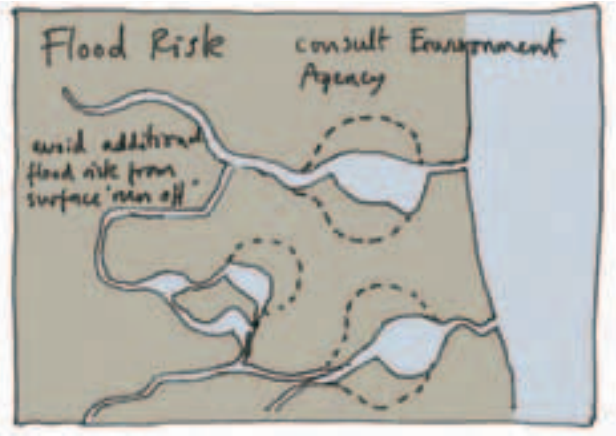
This is a well established approach in the Broads, setting the building floor level above an appropriate flood level. However it can affect access into the building, including access for disabled people.

Raising Plot Levels

Developers may also seek to reduce the risk of flooding by raising the level of the land, either in isolation or in combination with a minimum floor level. However raising land levels can serve to divert floodwater onto neighbouring plots. It can also be damaging to trees and other vegetation on the site.

Bunds or Flood Walls

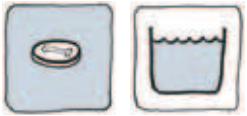
In some cases it will be appropriate to consider the use of earth bunds or flood walls to reduce the risk of flooding of new development or to protect existing development. However, these



are likely to be damaging to the character of the landscape or built environment.

Other

A further approach is to take measures to protect individual properties, for example through the use of raised thresholds, floorboards, waterproofing or the protection of airbricks, electrical installation and foul drainage.



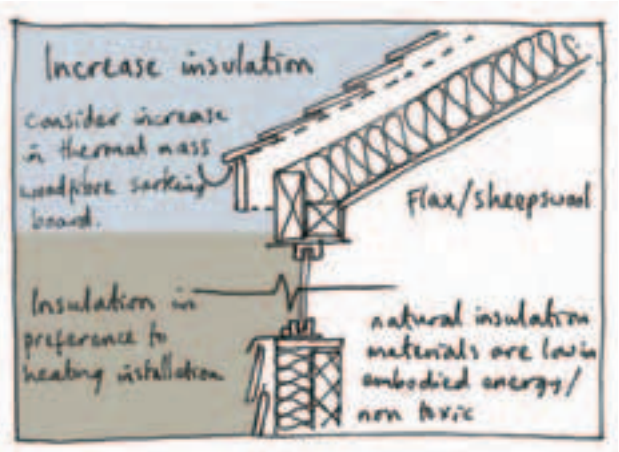
http://www.broads-authority.gov.uk/broads/live/authority/publications/planning-publishing/Dev__Flood_Risk_SPG-_Nov_2000_Updated_Oct_2003.doc

http://www.environment-agency.gov.uk/

Increase Insulation

Solar gain and renewable energy sources are priorities for sustainable development but without increased insulation any beneficial heat gained could easily escape through the fabric of the building. Insulation for sustainable development, however, needs to be carefully sourced as many products contain glass fibres and plastics that do not decompose.

There are now many products on the market, which utilise natural and renewable materials such as Hemp or sheep's wool and these should be used in preference to non-renewable petrochemical materials. Sheep's wool is treated with an inert, naturally occurring mineral, to provide pest, fungal and enhanced



fire resistance. It can be used for solid or cavity 'breathing wall' construction, fire barriers and for reducing airborne and impact noise.

Increased insulation should be used in preference to increased heating installation. Optimum thicknesses of 300-600mm will in most cases exceed building regulations and should help to 'future proof' designs.

http://www.greenspec.co.uk

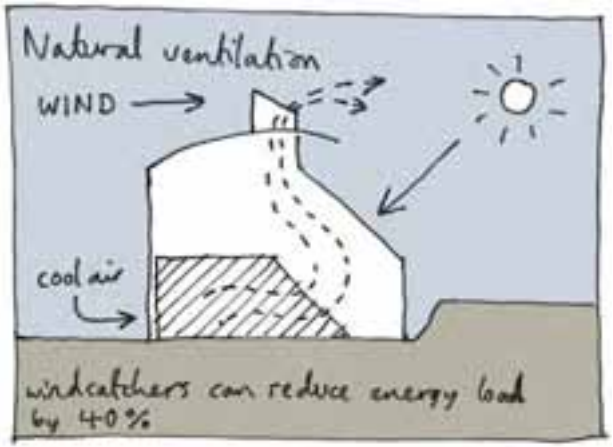
http://www.natural-building.co.uk

Building Regs: http://www.odpm.gov.uk/index.asp?id=1130478

Natural ventilation

Windcatcher systems have proved to be an effective method of providing natural ventilation in buildings, by encapsulating the prevailing wind from any direction. Clean, fresh air, relatively free from contamination, is caught at roof level and is carried down to the rooms below through a controlled damper arrangement.

This natural solution guarantees a comfortable living environment without appealing to energy wasting technologies. Moreover it contributes to a substantial reduction of a building's energy costs and a reduction of its CO_2 emission.



The system can be reversed to provide night time cooling in which large air currents cool off the building and the inside air overnight. Because of this the thermal comfort in summer can be guaranteed with a minimum of energy consumption. Next to the need for enough thermal mass, which stores the cold air, there also has to be enough wind generated airflow (a resource which is abundant in the Broads).

Source: http://www.renson.be

Source: http://www.windcatcher.com

Building Regs: http://www.odpm.gov.uk/index.asp?id=1130478

Building Regs: http://www.odpm.gov.uk/index.asp?id=1130478

Prefabrication

Prefabricated buildings might conjure up images of post war housing, temporary classrooms, or site huts. However the technology has become more and more sophisticated to the point where developers can benefit from mass production, quick installation and quality workmanship. The technology is well suited to the Broads where a principle of light intervention in the landscape is appropriate.

Off-site prefabrication eases the current construction industry skills shortage, using more factory-based production. Factory conditions allow for a more amiable working environment, in which a better quality of work and less wastage is achievable.

However this should be balanced with transportation costs, and a panelised system is preferable to a volumetric solution, which in essence involve the transportation of large volumes of air.

Composite panels should be avoided as these are often difficult to recycle.

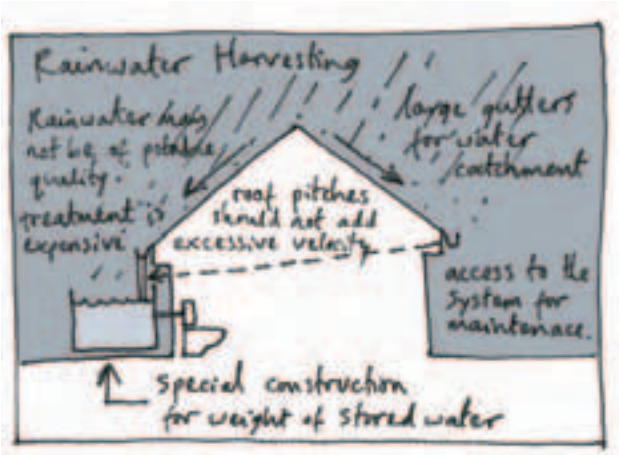
http://www.greenspec.co.uk

Building Regs: http://www.odpm.gov.uk/index.asp?id=1130478

Rainwater Harvesting

Roofs represent large surface areas of buildings and are therefore valuable in their ability to collect rainwater. With conventional drainage systems the water is carried away in storm drains or soak-aways, but Rainwater Harvesting utilises the potential in the volume of collectable water.

Non potable rain water stored in tanks can be a source of water for WC cisterns and urinal flushing, plant irrigation and car washing. Energy can be extracted from stored water heated by high thermal mass (pebbles) roof coverings.

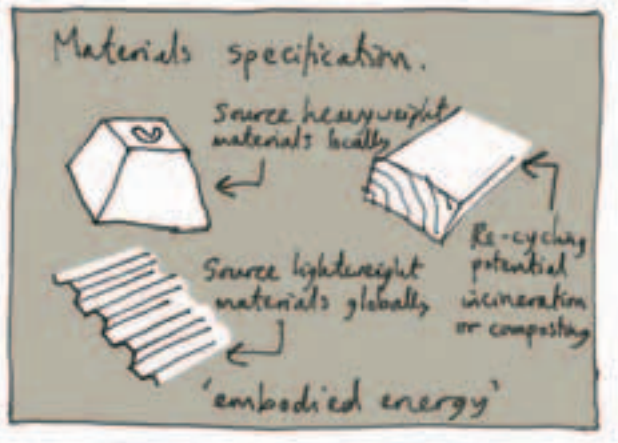


Because the cost of treating the non-potable water on-site is high, harvesting systems usually work alongside conventional piped potable water systems, which effectively doubles the cost of water installation. However with the increasing cost of metered water, rainwater harvesting becomes a valuable resource.

Materials Specification

A priority for the Broads is the re-use of materials from buildings which have come to the end of their useful life. Therefore buildings should be constructed to allow materials to be re-used easily in the future. Reversible construction methods (i.e. mechanical fixings rather than welded joints) help in this process.

When there is no option but to specify new materials, re-cycled materials can be sourced from web-sites like Wrap which gives an independent assessment of the recycled content of most materials.



Generally timber should be sourced from local soft /hard woods. Paints should be water or linseed oil based. Floors should be clay tile instead of carpet, as tiles have a longer lifespan and need less energy to manufacture, and carpets prevent the floor slab from storing heat. Alternative floor finishes are wood, linoleum or rubber. Gutters can be specified as un-coated aluminium which is recyclable. Windows should be timber or metal framed. Avoid PVC products.

Sourcing re-cycled materials

Wrap website gives an independent assessment of the recycled content of most materials with lists of actual products (those with most recycled content) and their contact/ technical info.
WRAP: Recycled Products Selector site.

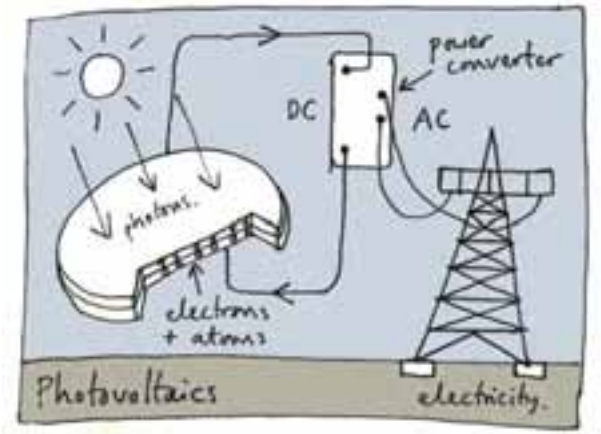
http://www.wrap.org.uk/procurement/products

http://www.greenspec.co.uk

Photovoltaic Cells

With their ultra-modern aesthetic, photovoltaic panels are often at odds with the traditional building style common in the Broads. However roof tiles are being developed with integral photovoltaic cells to suit the domestic market.

The technology has become common in a variety of applications. Sunlight knocks electrons free in the photovoltaic material, which flow out of the device as electric current. The more intense the sunlight, the stronger the electric current.



When specifying photovoltaics for the domestic market the key issue is how much it will contribute to the energy load and therefore how cost effective the technology will be over the lifetime of the building.

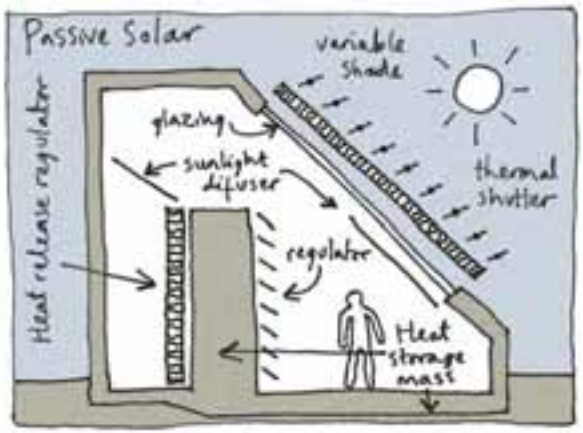
The disadvantages of the system occur in the intermittent nature of sunlight and the difficulty in storing the electricity generated. Unlike conventional energy systems costs are high at installation and low in use, although maintenance and control systems can add to the cost.

Passive Solar Heating

Passive solar energy is common to many buildings but its full potential is rarely exploited. South facing glazing provides useful space heating, creating about 20 per cent of the energy needs of a typical house.

With enlarged windows to the south, the addition of conservatories or atria, and some ducting of the warmed air to the colder parts of the building, passive solar gain can provide nearly 40 per cent of the primary energy heating needs of a typical house in the Broads.

For this to be most efficiently achieved, the solar energy needs

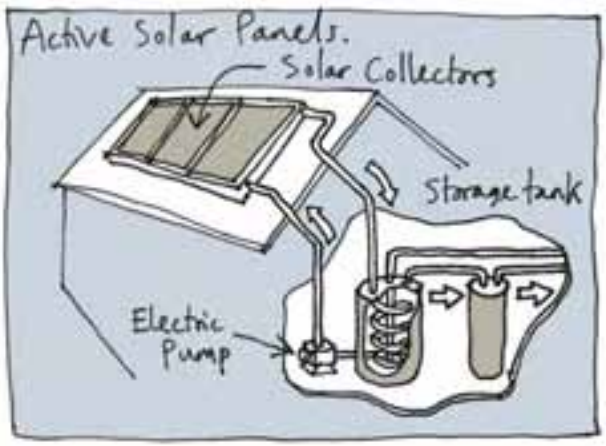


to be stored in a building fabric of high thermal capacity, and the building should be well insulated and relatively airtight. Simple measures such as southerly aspect, differential window area between north and south, and high levels of insulation can achieve a great deal of benefit at little extra cost.

For example, public rooms are placed on the south side and utility areas (kitchens, bathrooms, small bedrooms) to the north. When specifying large areas of glass be awear of possible light polution.

Solar Water Heating

Active solar systems consist of flat plate water heaters and evacuated tube collectors. Solar water heaters are normally placed on south-facing inclined roofs with the heated water taken directly into the hot water storage tank, which is usually positioned in the roof space. A few square metres of solar water heater can provide two-thirds of the hot water requirements of a typical household in the UK. These systems are called "active," as opposed to "passive" because they use electric pumps to move the water from the collectors to the storage tank. In passive systems water moves naturally because of a temperature difference.



Outside the UK, community-based solar district heating systems are to be found. In these instances solar collectors heat the water stored in large thermal (often underground) tanks during the summer, which, because of their size, retain much of the heat during the winter. This pre-heated hot water is then piped to adjoining buildings, where it can be heated further before use either in radiators or as domestic hot water.

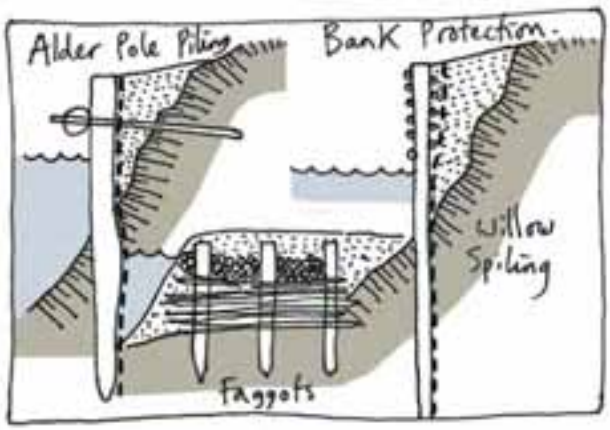
http://www.norfolksolar.co.uk

Bank Protection

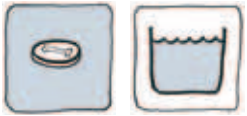
The careful design of new or replacement bank edging is crucial to protect the special landscape character of the Broads. The following designs indicate some alternative methods of sustainable bank protection suitable for the Broads.

Alder Pole Piling
This method uses locally-sourced green Alder poles. Creates a 'softer' effect than traditional timber piling. Suitable only for emergency mooring. Suitable for low to medium tidal ranges.

Faggots
A low cost method using live willow bundles to create living bank protection with high conservation benefits. Low tidal ranges.



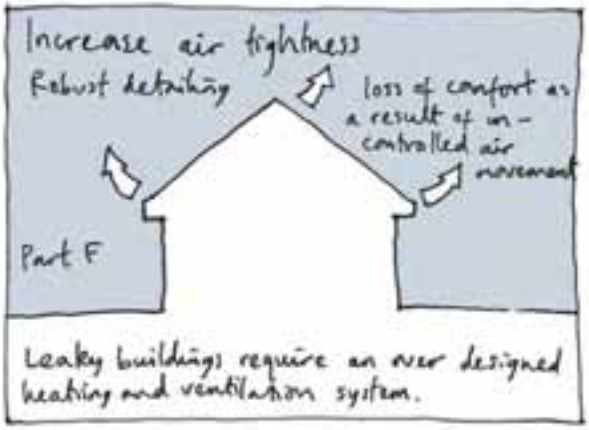
Willow Spiling
A low-cost method of protection using locally-sourced natural material. Not suitable for mooring. Low to medium tidal ranges.



Increased Air Tightness

Like increased insulation, air tightness is fundamental in ensuring that sustainably sourced heat does not dissipate through the buildings fabric. However this needs to be carefully balanced with natural ventilation systems, which are intended to supply the building with fresh air.

The air-tightness tests required to comply with Building Regulation Part F (Ventilation) are conducted with natural ventilation systems masked off and so the issue becomes one of



robust detailing in the construction, with the aim to reduce a loss of comfort as a result of un-controlled air movement.

Leaky buildings require an over designed heating and ventilation system resulting in higher energy bills.

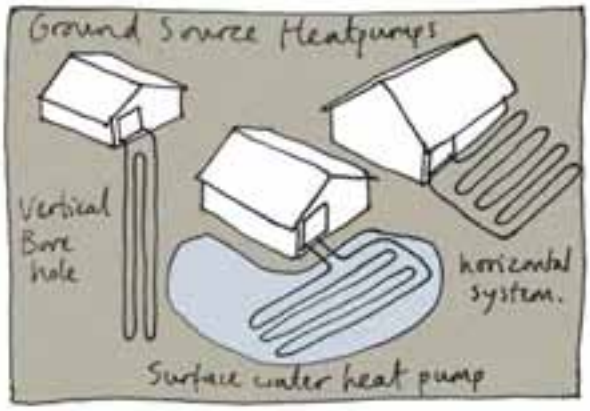
Building Regs:http://www.odpm.gov.uk/index.asp?id=1130478

Ground source heat pumps

Oil fired boilers or electric heaters have been the usual recourse for rural areas, but now ground source heat pumps are a viable alternative. These extract energy absorbed when the sun shines on the earth using a bore hole or shallow trenches. Heat is extracted using water circulated in a ground loop, which is pumped to a useable level by an electrically powered heat pump.

Ground source heat pumps can be very efficient at extracting heat or cooling from in-situ resources, e.g. river, pond, underground water.

Always insulate well first or the efficiency is squandered.



- Existing underground services must be located accurately
- Efficiency depends upon heat transfer rates. Solid ground is more effective than porous, and damp conditions better than dry.
- Horizontal pipe systems are cheaper than vertical
- GSHP should be sized to meet 60-70% of total energy requirements.
- Water tightness is essential for piping to avoid antifreeze loss.

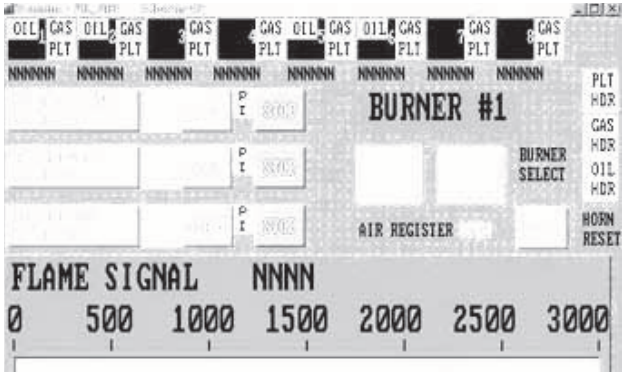
http://www.greenspec.co.uk

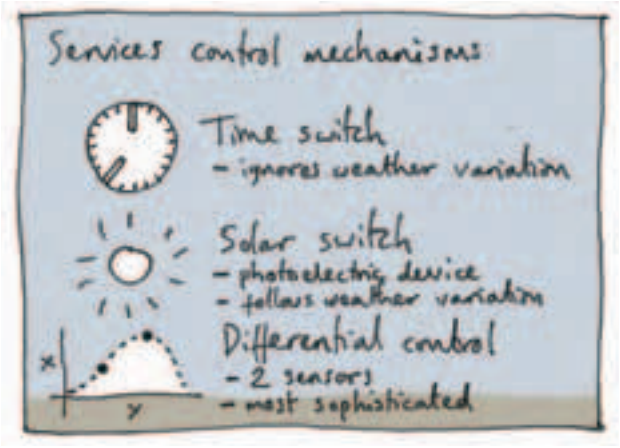
Ground Source Heat Pump Club: http://www.nef.org.uk/gshp/

Building Management Systems

The integration of combined sustainable techniques in a building can create a complex management scenario. Building management systems are designed for the control, monitoring and optimisation of various functions and services provided in a building, including heating and cooling, ventilation, lighting and often the management of electric appliances.

The use of these technologies allows the optimisation of various services often with large energy savings. There are numerous methods by which services within buildings can be controlled. Most systems seek to control either by time, temperature, or





illuminance and these parameters can be programmed to vary with time.

The technology ranges from time switches to complete 'intelligent' systems.

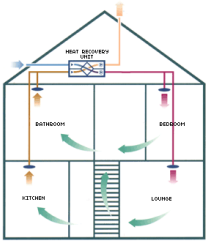
http://europa.eu.int/comm/energy_transport/atlas/htmlu/manint.html

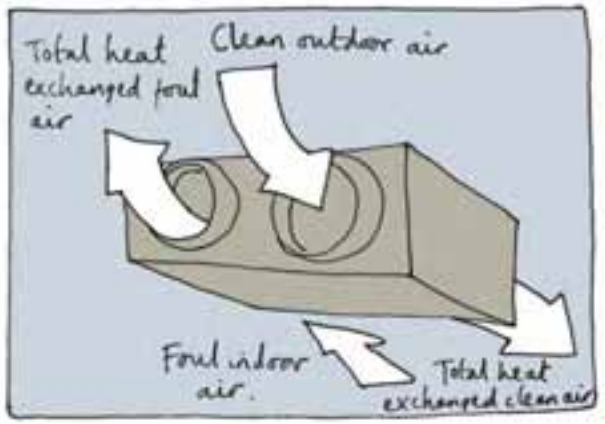
Heat recovery

This is a principle suited more to commercial buildings where air conditioning units create wasted heat. Heat recovery avoids throwing away heat with stale or moist air by use of heat exchangers which pre-warm incoming cool fresh air.

The heat exchanger is a device composed of a series of independent tubes divided by a middle partition, thus ensuring the separation of supply and exhaust air flows. The tubes contain refrigerant that vaporizes on the warmer airflow channel and condenses on the colder air channel, thus accomplishing the heat transfer.

While recovering the otherwise waste energy from the exhaust air and transferring it back to the supply air, the efficiency of the cooling and heating devices in the air-handling units is greatly improved.





AVOID:
Throwing away heat with stale or moist air in ventilation/ extraction systems

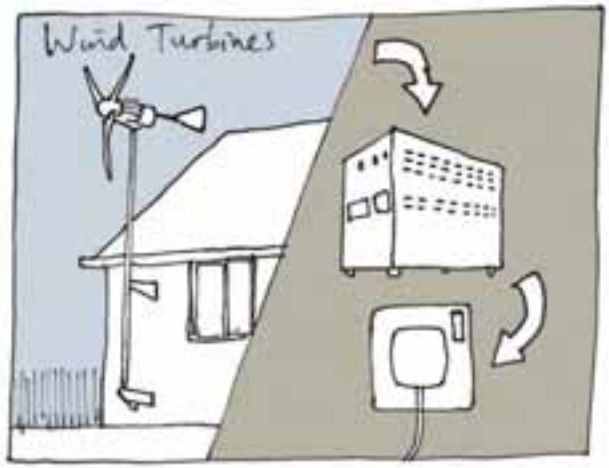
CONSIDER:
All ventilation systems should have heat recovery from stale warm exhaust air to pre-warm incoming cool fresh air using recovered heat

Wind Turbines

As an alternative to large-scale production there has been a growth in micro-wind generators suitable for building-related application. The turbine is fixed to the roof in the manner of a TV aerial and feeds power into the building at 240 volts. Unlike large wind-powered systems the surplus energy cannot be fed into the national grid, but installers are eligible to receive government subsidies in the form of Renewable Obligation Certificates.

The appropriateness of wind turbines needs to be considered in relation to the buildings context (see Sensitivity page 10).

Micro wind generators can, on average, cut annual electricity bills by a third.



Generators should be fixed to robust masonry and sited in the prevailing wind.

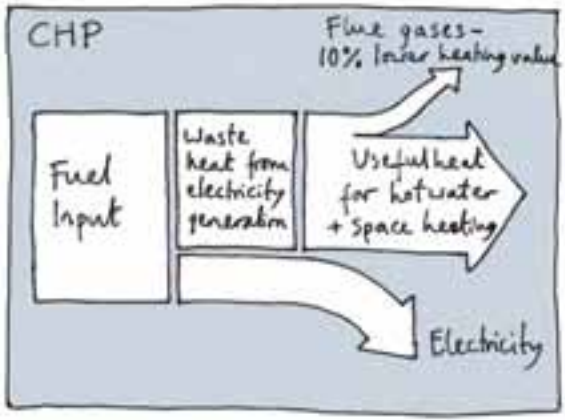
The British Wind Energy Association provides data on wind strength and recommends companies from which micro wind generators can be sourced.

http://www.bwea.com

Small Scale CHP

Combined heat and power systems make use of the wasted heat created in the electricity making process, converting it into useful heat for hot water and space heating. Emissions are 10% that of conventional electricity manufacture.

Small scale CHP systems are emerging as a new product for central heating markets. The aim is to replace a central heating boiler with a device of similar physical size that provides some electricity as well as heat – and the potential to reduce carbon emissions.



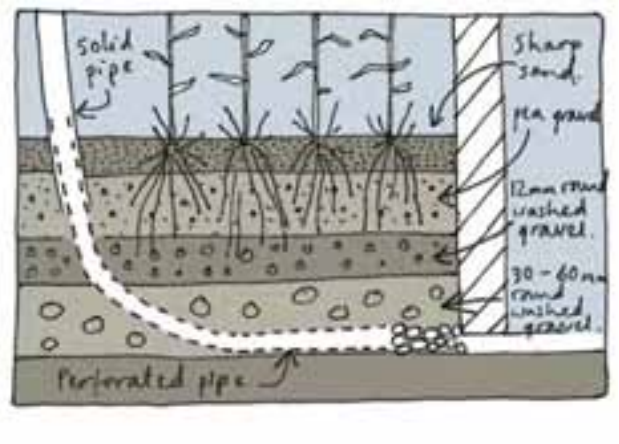
CHP can provide a secure and highly efficient method of generating electricity and heat at the point of use. Owing to the utilisation of heat from electricity generation and the avoidance of transmission losses because electricity is generated on site, CHP typically achieves a 35 per cent reduction in primary energy usage.

This can allow the host organisation to make economic savings where there is a suitable balance between the heat and power loads.

Reed Beds

Reed beds work by cleaning the soiled water biologically. The roots of reeds (and other plants) supply oxygen to the naturally occurring bacteria in the water, which then digest any pathogens present. Faecal coliforms are broken down with the residual matter, supplying nutrient-rich water to a lake, which can then provide a habitat for wildlife or food for fish.

The reeds are relatively low maintenance because they control their own growth and don't require cutting. Operational costs are lower than conventional systems and the reed bed won't smell if the system is designed correctly to treat the loadings



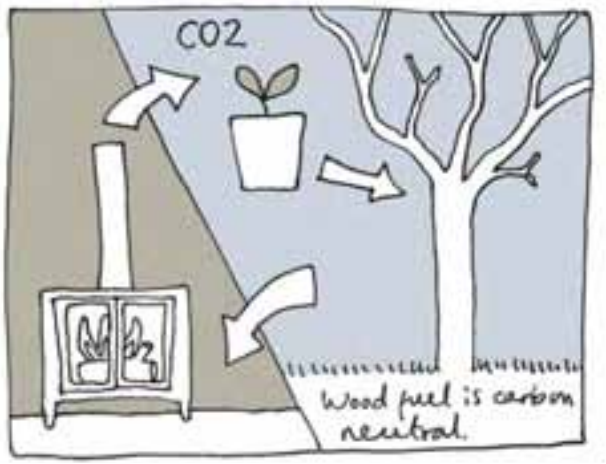
from the site. Reed beds require a large area of land to work, so they are not suitable in all locations, but the fact that reed occurs regularly in The Broads means it is a contextual sustainable solution.

Biofuel

Biofuel technology ranges from wood-burning stoves, which can combine hot water systems, to crops which are grown specifically to be harvested and burnt in power stations or heating systems.

When burned as a fuel, biomass releases into the atmosphere the carbon dioxide it absorbed during the growth stage, meaning it is carbon neutral. Biofuels also encourage a stable rural economy through their growth and management.

Wood pellets have advantages over solid wood fuel because they flow like a liquid and can be used in automatic self feed stoves and boilers. They also take up less volume, have less ash and emissions, and are easier to ignite. However they involve a manufacturing process and transportation cost where as timber can be sourced and seasoned on-site.



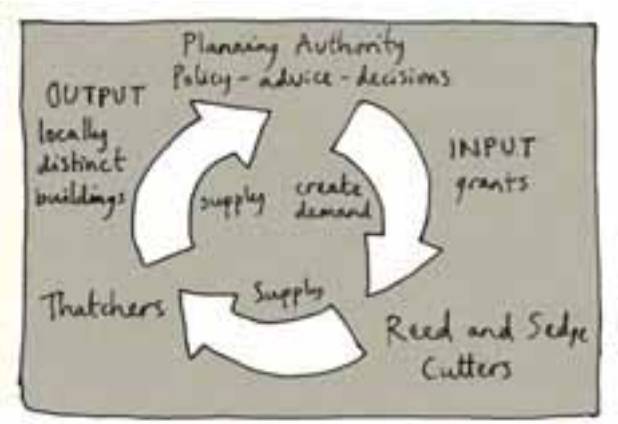
Biofuels (such as coppiced willows or Miscanthus) are commonly employed in district combined heat and power (CHP) plants, while fuel from rapeseed and recycled cooking oils provides an alternative for the transport industry.

http://www.greenspec.co.uk
http://www.defra.gov.uk/erdp/pdfs/ecs/miscanthus-guide.pdf
http://www.biodiesel.co.uk

Reed Cutting

The Broads Authority sought to discover why reedcutting was dying out locally while reeds for thatching were being imported from Eastern Europe. Although this led to the illusion of retaining the character of traditional Broads buildings it was at the expense of the environment and local skills.

The results showed the lack of living wage was at the core of the decline and consultants recommended that the reed and sedge cutters form a group to access grants for basic equipment and acquire further skills to provide earnings during the closed cutting season.
The Broads Authority has persuaded landowners and managers to reduce or drop royalty payments for cutting reed and plans



to work with the East Anglia Master Thatchers Association to ensure a ready market.

The project has resulted in reed-beds being restored and reed being cut commercially on some sites for the first time in many years.

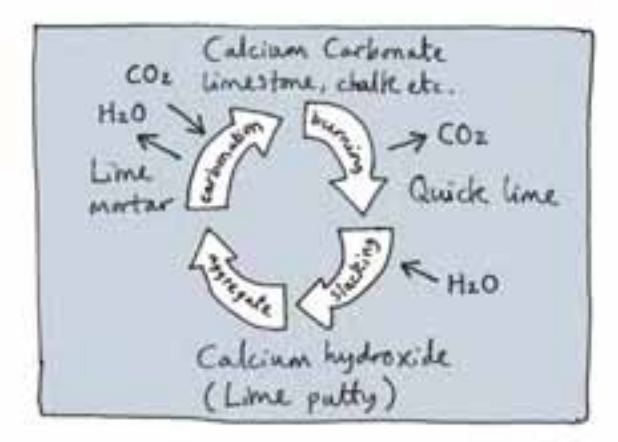
The restoration of arable land as reed beds reduces the risk of flooding by absorbing rather than repelling flood water.

http://www.broads-authority.gov.uk/news/press-releases/2005/bright-future-for-broads-reed-cutting-industry.html

Lime

Lime has been the principal binder in mortars, renders, plasters and washes for thousands of years. Cement, by contrast, has only been around since 1811, although it has managed almost completely to take over from lime. It is a hard, brittle and unyielding material.

Lime has been essential to the repair and maintenance of our historic building fabric, but is also appreciated for it's sustainable crudentials. Bricks laid in a lime mortar can be used over and



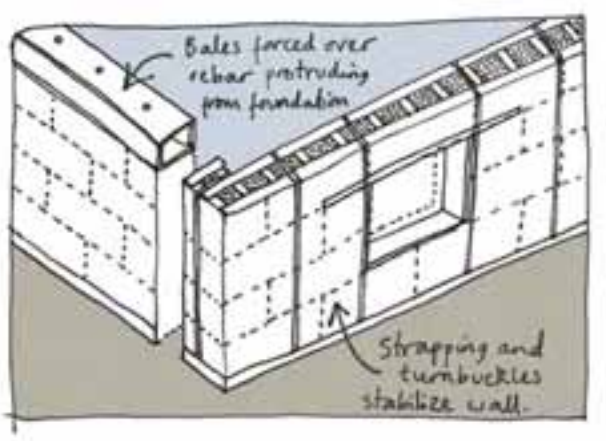
over again, where as bricks bonded with cement mortar can only be used once, after which they have to be broken up.

Environmentalists approve of lime as a binder because the firing temperature of 900°C is far less harmful to the environment than the temperatures in excess of 1300°C required when producing cement. Furthermore, a proportion of the carbon dioxide emitted when burning lime is absorbed back into the lime as it cures.

http://www.thelimecentre.co.uk/
http://www.spab.org.uk/

Straw Bale

Sustainability – Straw is an annually renewable product, fuelled by the sun. About 4 million tonnes are produced surplus to requirements in the UK each year.
Highly Insulating – straw is super-insulating at a low cost. With a U-value of 0.13W/m2K, this means it is two or three times better insulating than contemporary materials.
Sound Insulating – strawbale is acoustically super-insulative. This means that not only are the sounds of the inside kept in, but external noise which may otherwise be obtrusive is kept out. Straw is also used in earth building techniques traditional to the area.



Methods

Load bearing because the bales work like big bricks, they are stacked on top of each other and directly support the weight of the structure, including the roof.

Infill is based around a frame (normally wood) which carries the weight of the roof. The strawbale acts as an infill material that is simply placed in between the supporting structure for insulation.

http://www.strawbalefutures.org.uk
http://www.eartha.org.uk/

Case Studies

These case studies show how the strategies of the guide can be implemented in 4 specific Broads topography's: Waterside, Hillside, Marshland, and Boat Yard.

The techniques used in each case, respond to their context in an attempt to harmonise with the environment and maintain landscape character.

The objective is to show how combinations of sustainable technology can be used sensitively in different locations.

Waterside

The waterside building layout and orientation should work with the pattern of linear development typical in The Broads. A building like this will typically replace a building that has reached the end of its life expectancy, and it would be expected that any salvageable materials be re-used in the new construction.

Screwed spiral anchor pile foundations allow the building to have minimal impact on the ecology and bio-diversity by raising it above ground level, which will also reduce the risk of flooding.

Consider sustainable bank protection such as alder pole piling (suitable for mooring) adjacent to the dwelling. Whereas away from the dwelling Willow Spilling will reduce bank erosion and restricts mooring in protected areas.

Maintaining access across the site strengthens the possibilities of the transportation network. Planting to the North side provides protection from the elements privacy from the roadside and deadens sound. A small-scale wind turbine could provide 30% of the buildings electricity and a wood-burning stove would reduce heating costs.

Orientation works with pattern of linear development

Replaces a building at the end of its useful life

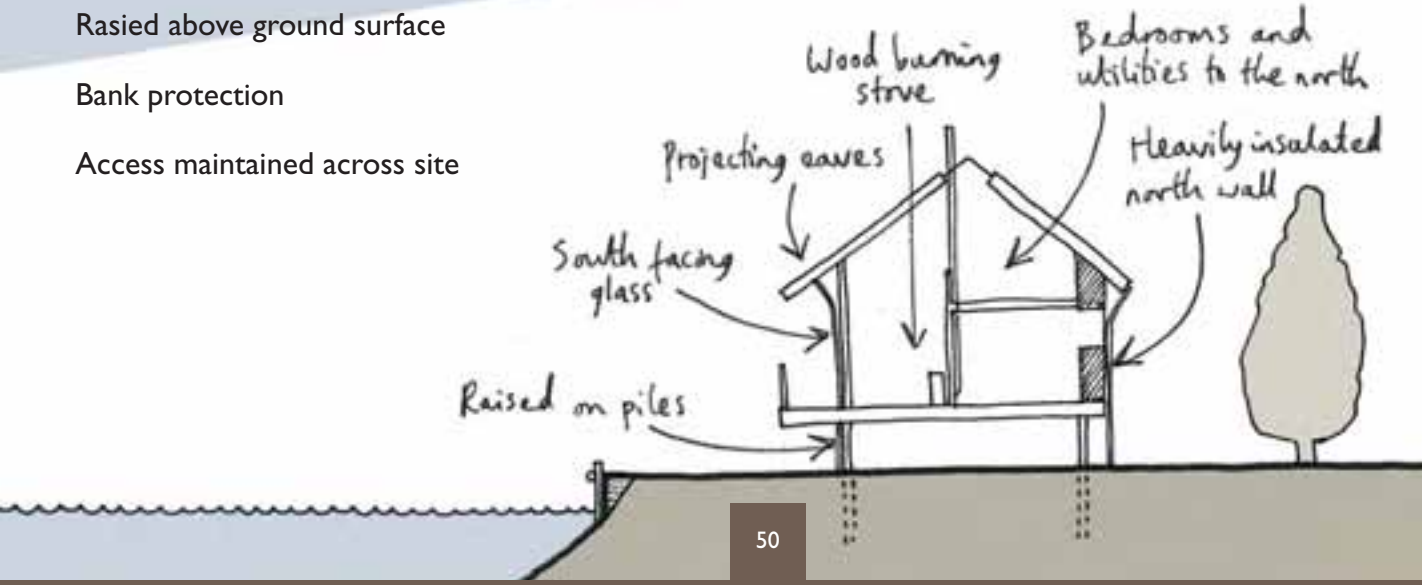
Materials salvaged in construction

Screwed spiral anchor foundations

Rasied above ground surface

Bank protection

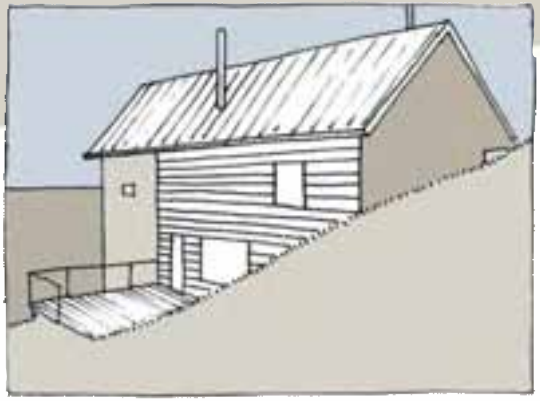
Access maintained across site



Hillside

On an exposed hillside site robust detailing and materials will be required to maintain an airtight envelope and reduce heating costs. The building can benefit from its context by being partially buried in the hillside, which will provide protection from the elements and provide good insulation.

The exposed location would provide the ideal location for small-scale wind generation, which could cut annual electricity bills by a third.



Porous hard surfaces would allow surface water to naturally drain to the water table and could be combined with a sustainable drainage system in a hillside location.

Rainwater harvested from the roof could provide water for WC cisterns, plant irrigation and car washing, while Reed bed filtration benefits from the natural incline of a hillside site to provide the falls for the gravity fed system.

Robust detailing in exposed location

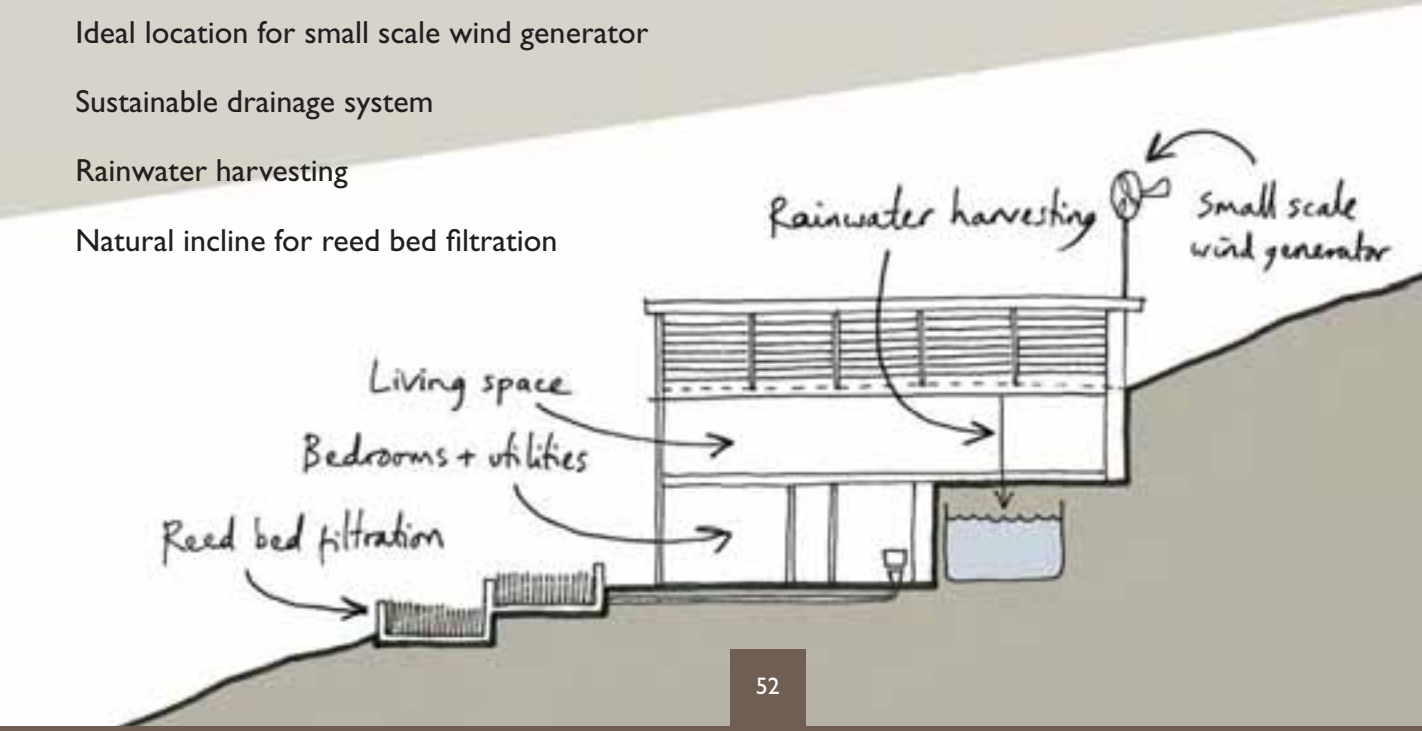
Partially buried for protection from the elements

Ideal location for small scale wind generator

Sustainable drainage system

Rainwater harvesting

Natural incline for reed bed filtration



Marshland

The marshland building sits low for protection from the elements with occasional height in the form of wind catchers, which provide natural ventilation. The building is orientated to maximise views to the south and takes advantage of passive solar heating with its large glass area on this elevation. The earth extracted to form the foundations could be amassed on the north side to provide protection from the elements and allows bio diversity to thrive over this area of the building.

In a flat land location, horizontal ground source heat pumps utilise the energy absorbed by the surrounding land. The utility areas, kitchen, bathroom, small bedrooms, are buried below ground to the north where they are insulated by the earth.

Materials should be selected to respond to context and photovoltaics integrated into the building construction could provide a percentage of the buildings electricity whilst also providing solar shading.

Sits low for protection from the elements with occasional height

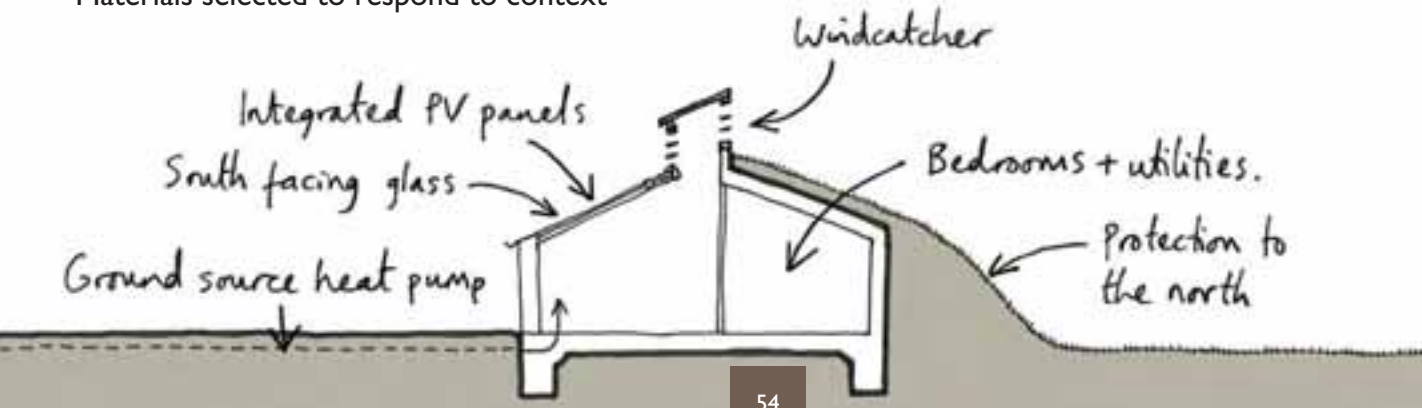
Windcatchers provide natural ventilation

Horizontal ground source heat pumps

Excavated earth creates protection to the north

Photovoltaics take advantage of increased light levels

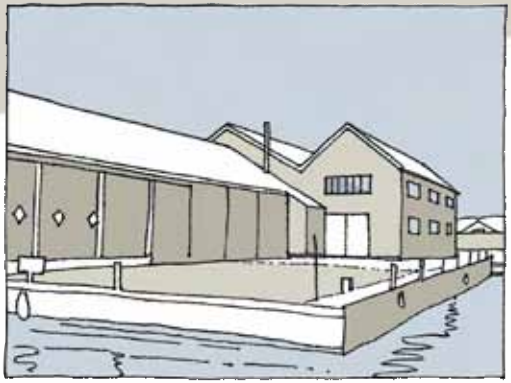
Materials selected to respond to context



Boat Yard

The Boat Yard context provides the biggest opportunities in terms of sustainability in the Broads. It is a building type that provides landscape character and local employment.

The services that the Yards offer are very important in terms of sustaining navigation and they can be diversified if permission is given to re-use buildings at the end of their useful life. Holiday accomodation may allow existing facilities and environmentally friendly use to remain on site by providing a year round income for the yard.
Principles that should be taken into consideration include:



sustainable types of bank protection, the treatment of land that might be contaminated by diesel or petrol solvents with biological methods, hard surfaces should be porous to avoid depletion of the water table. Bio fuel stacks for wood burning stoves are well suited to the industrial aesthetic.

The preservation of the Boat Yards is key to creating sustainable communities in The Broads.

Re-uses building at the end of its useful life

Treatment of contaminated land

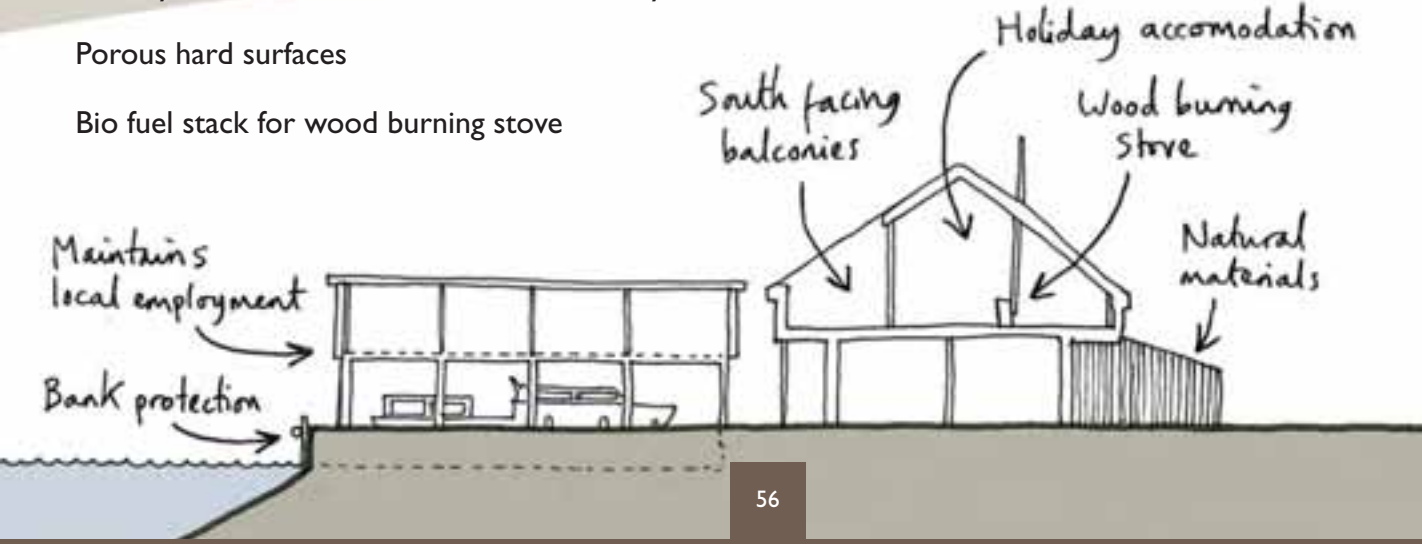
Bank protection

Maintains historic development/character

Holiday accomodation adds to local economy

Porous hard surfaces

Bio fuel stack for wood burning stove



Conclusion

This 'production' has been prepared by LSI Architects funded by the Broads Authority Sustainable Development Fund.

We hope the ideas have inspired you and that there are some which you can incorporate in your next building project.

You should not feel restricted by the suggestions made in this guide. It is not a formula for creating buildings which all look the same, but a framework of opportunities whose objective is a unique sustainable future for the Broads.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