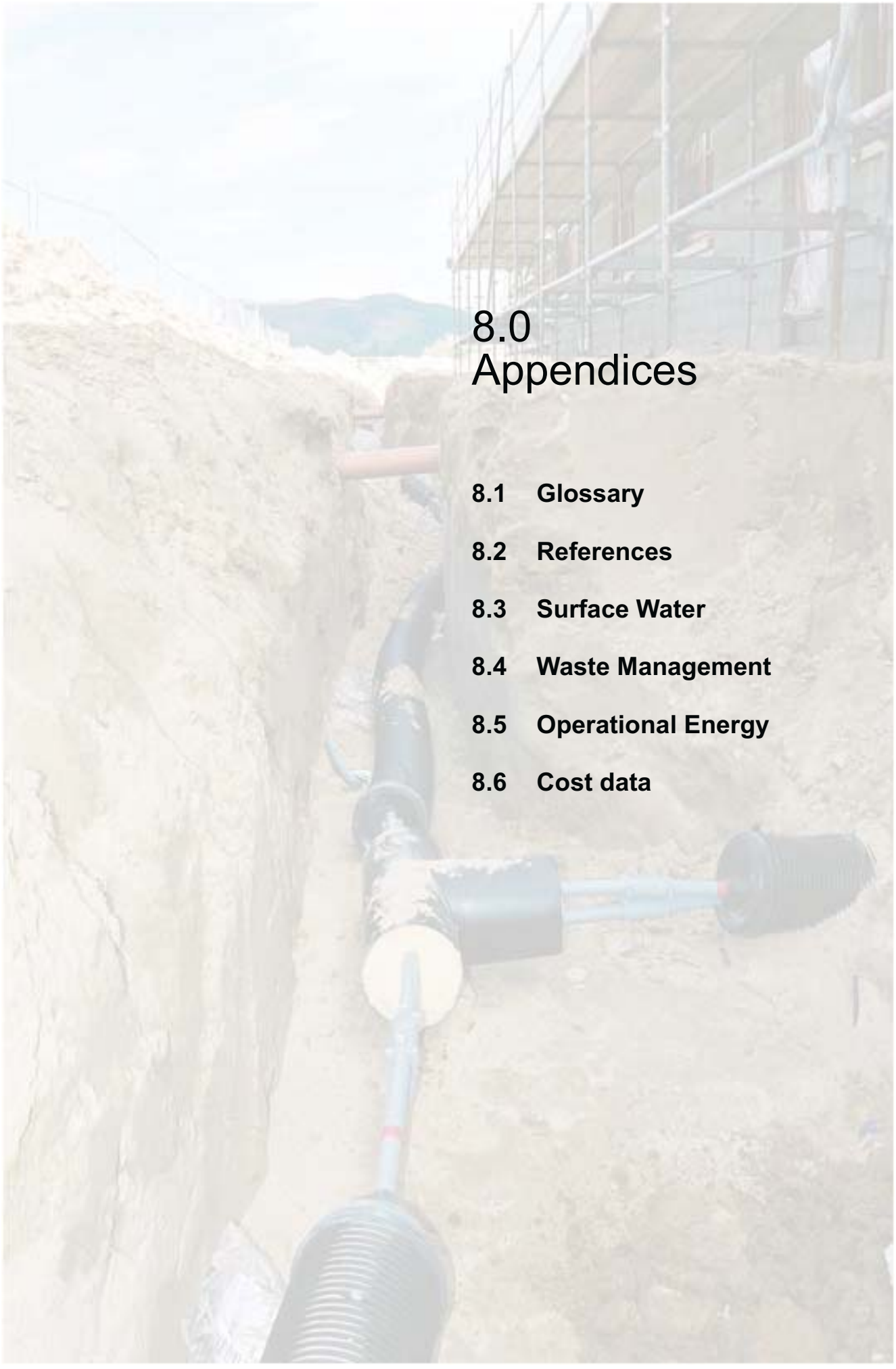

8.0 Appendices

Appendix 8.1
Glossary

Attenuation - Storage of water to reduce the peak flow and increase the duration of a flow event

Bioretention Area - Shallow landscaped depressions, which are typically underdrained. Designed to promote pollutant removal.

Conveyance - Transportation of surface water from one location to another.

Catchment - Characterizes an area, by which all runoff, which lands within its boundaries is conveyed to the same discharge point.

Curtilage - Land within property boundaries.

Design criteria - A set of standards agreed by the developer, planners and regulators that the SUDS system will have to satisfy.

Detention Basin - Are vegetated depressions in the ground that are dry during dry weather and provide temporary flood storage and controlled release of rainwater during storm events.

Evaporation - The process by which water is converted from its liquid form to its vapour form and thus transferred from land and water masses to the atmosphere.

Evapotranspiration - The transport of water into the atmosphere from land and water (evaporation) and from vegetation (transpiration).

Filter drain - Shallow excavations containing a perforated or porous pipe and are filled with a permeable material, such as rubble or stone.

Filter strip - Grassed or densely vegetated surface where water is allowed to pass over.

First Flush - Initial runoff from a site following the start of a rainfall event. This first portion of the flow usually carries the highest load of dissolved pollutants.

Floodplain - Land adjacent to a watercourse that would flood repeatedly under natural conditions.

Geocellular storage system - Plastic box structure used in the ground to attenuate surface water.

Greenfield runoff rate - Surface water runoff from a Greenfield site before development.

Groundwater recharge - Addition of surface water to water that is stored below the surface of the ground.

Groundwater Protection Zone - Areas that influence water supply boreholes where groundwater must be protected from pollution.

Infiltration - Passage of water through the ground.

Infiltration trench - Linear excavation filled with permeable granular material, designed to encourage infiltration.

Interflow - Shallow infiltration into the soil, from where it may flow horizontally at a shallow depth to a watercourse or move vertically to an aquifer.

Management train - A combination of drainage techniques are linked together to both control flows and volumes as well as treat surface runoff in stages.

Peak runoff rate - The maximum volume flow rate passing a particular location during a storm event.

Permeable Paving - Paving surface with voids between paving blocks.

Pond - Depressions in the ground that hold water permanently and are designed to provide storage above the permanent water level.

Rainfall event - A single occurrence of rainfall before and after which there is a dry period that is sufficient to allow its effect on the drainage system to be defined.

Rain Garden - Densely planted shallow depression in the ground.

Rainwater Planter - Above ground planting containers which are partially filled with soil and densely planted.

Return Period - (e.g. 1 in 100 year flood event or 0.01 annual probability) The average time interval between occurrences of a flood event of a given or greater magnitude. 1 in 100 year flood event refers to an event that occurs on average once every 100 years. This can cause confusion as many people believe that following a 1 in 100 year event there will be a 100 year gap between the next one takes place. In order to avoid confusion the risk of a flood event occurring can also be described as an annual probability. This is the statistical probability of a storm event of a given magnitude being equalled or exceeded in any given year. A rainfall event with 1 per cent annual probability of occurrence is therefore the same as an annual return period of 100 years.

Traditional drainage system - Use of underground pipes and storage tanks.

SAB (SUDS Approving Body) - County or Unitarian Authority which deals with the approval of surface water drainage systems.

Soakaway - Below ground structures (can be filled with stone or rubble) promoting infiltration of surface water.

Storage volume - Volume of surface water which needs to be stored on site before it is slowly released at allowable discharge rates. Water is stored when the inflow is greater than the controlled outflow.

Swale - Shallow, grassed channel covered by grass or dense vegetation.

Appendix 8.2 References

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• Energy Policy Statement 09/03 - The Energy Hierarchy (Institute of Mechanical Engineers, 2009) www.imeche.org/NR/rdonlyres/9C7E8DCD-150C-4ECAA387-D71DEAAAAFAD/0/ EnergyHierarchyIMechEPolicy.pdf

• Feed-in Tariffs, Government's Response to the Summer Consultation (DECC, 2010a)

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•http://www.letsrecycle.com/do/ecco.py/ view_item?listid=37&listcatid=364&listitemid=10998 (WRAP)

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• Waste Management Infrastructure: Incentivising Community Buy-in (APSRG, 2010)

• The Waste Strategy for England, 2007

• Water Regulations Advisory Scheme. 1999. no. 9-02-05. Information and Guidance Note: Marking and Identification of Pipework for Reclaimed (Greywater) Systems.

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Acronyms

• CABE - Commission for Architecture in the Built Environment

• CAPEX - Capital Expenditure

• CHP - Combined Heat and Power

• CLG - Communities and Local Government

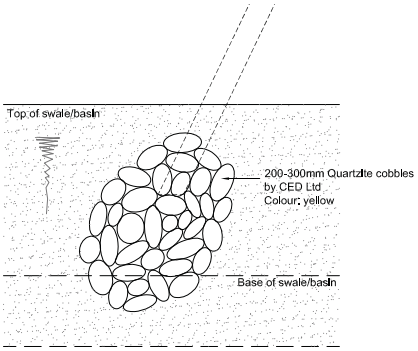
• "Code" - Code for Sustainable Homes

• DECC - Department for Energy and Climate Change

• FIT - Feed-in Tariff

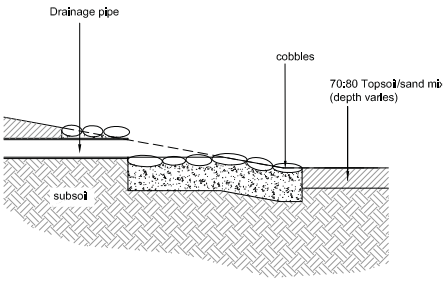
• LDP - Local Development Plan

• RHI - Renewable Heat Incentive



INLET INTO SUDS FEATURES - PLAN
Scale 1:20

Appendix 8.3
Surface Water



TYPICAL SECTION THROUGH INLET/OUTLET
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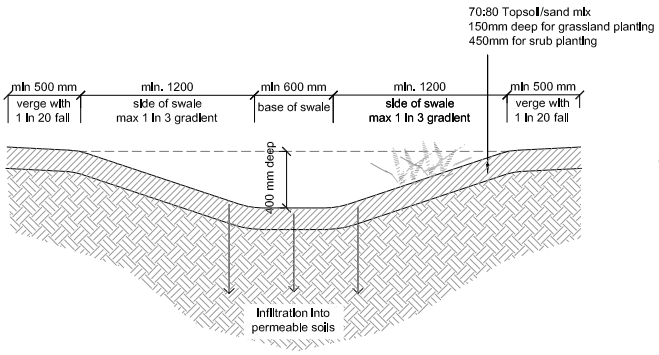
Credits in the Code for Sustainable Homes

The following credits specifically relate to the management of water:

Category 2 – Water
Five credits can be achieved for reducing indoor water consumption. Some of these credits can be achieved through using rainwater harvesting techniques
1 credit – for the use of grey water internally
1 credit – for reduction in external water use, and harvesting via water butts or tanks

Category 4 – Surface water run-off
Systems must comply with CIRIA guidance (this is likely to be updated to include compliance with the new National Standards)
2 credits – for ensuring peak run-off rates and annual volumes of runoff are not greater than they were prior to development. These two credits are mandatory for all levels of the Code
1 further credit – for improving water quality
1 further credit – for establishing clear ownership and maintenance of the SUDS

SUDS can also assist in achieving credits under the Health and Wellbeing category, and under the Ecology category, where the integration of amenity features, and improvements to species diversity can attract further credits.



TYPICAL SECTION THROUGH MEDIUM UNLINED SWALE - min 4m width
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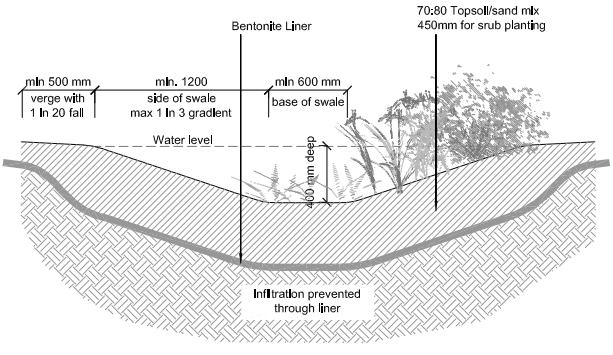
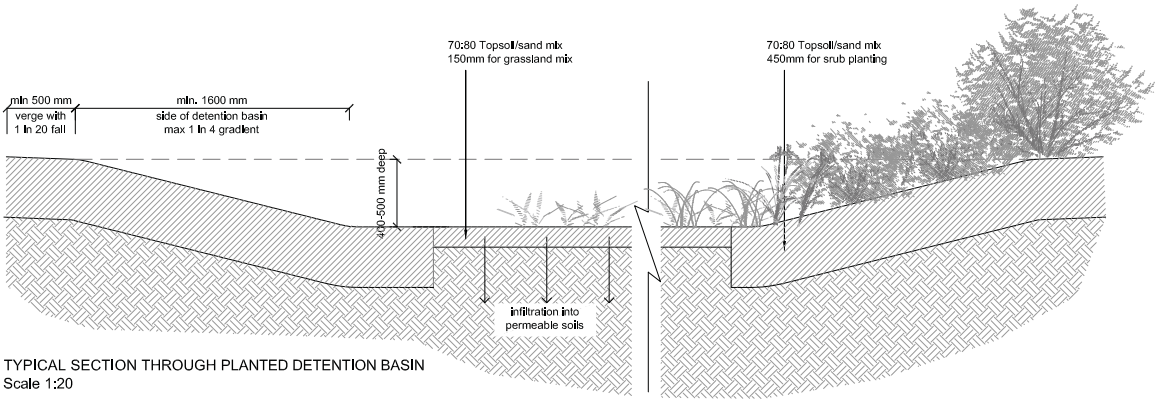


TYPICAL SECTION THROUGH PLANTED AND LINED SWALE
Scale 1:20

Typical sections through SUDS components



TYPICAL SECTION THROUGH PLANTED DETENTION BASIN
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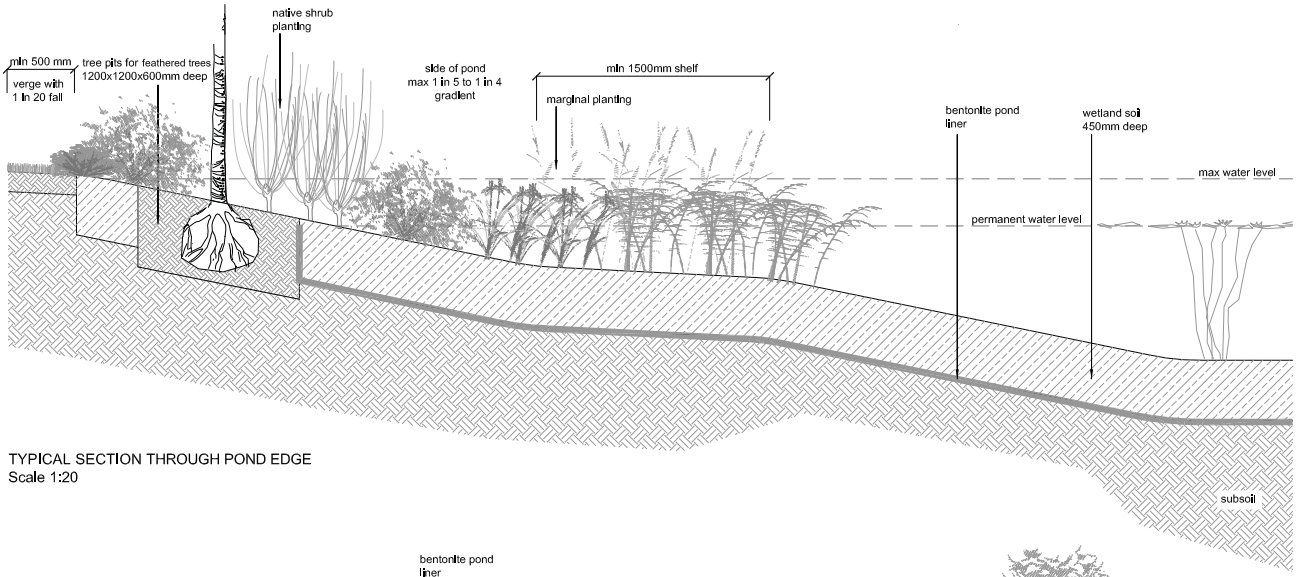

TYPICAL SECTION THROUGH POND EDGE
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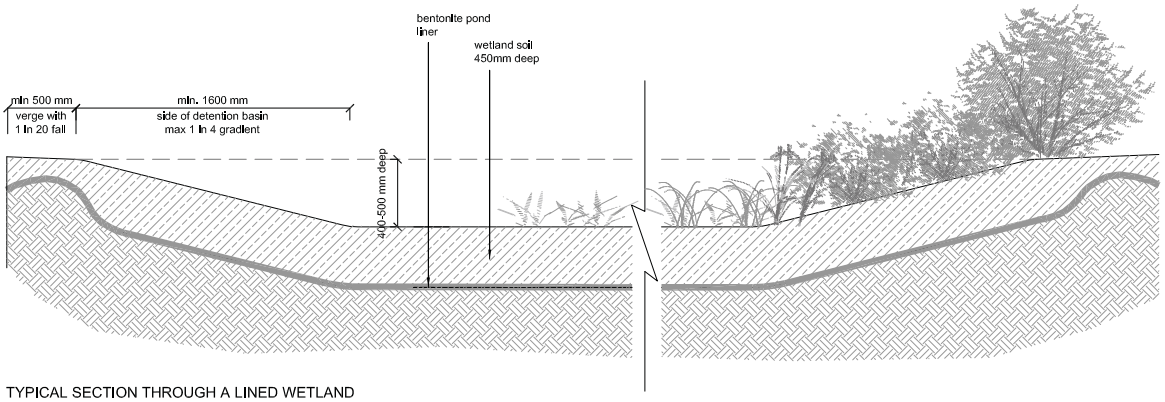

TYPICAL SECTION THROUGH A LINED WETLAND
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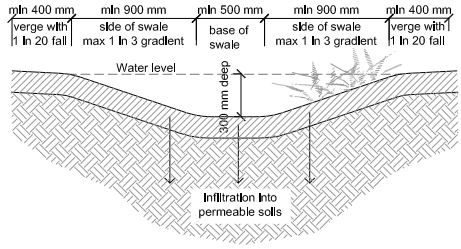
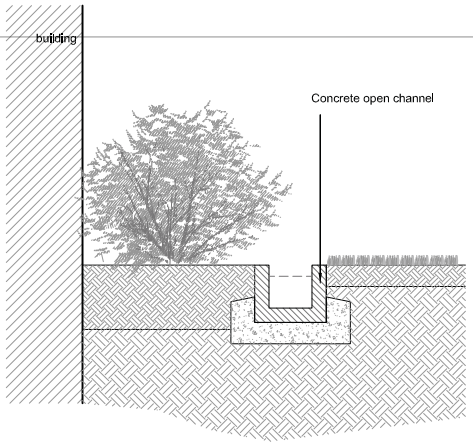


TYPICAL SECTION THROUGH SHALLOW UNLINED SWALE
min 3.1m width
Scale 1:20



TYPICAL SECTION THROUGH HARD CHANNEL
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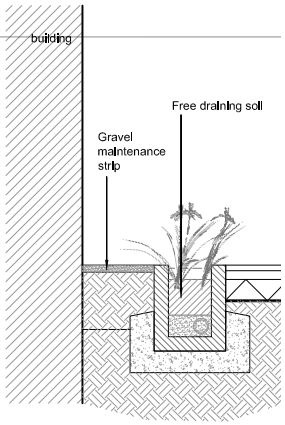

TYPICAL SECTION THROUGH PLANTEI
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Changes to planning and approval system

At present the Flooding and Water Management Bill 2009 is passing through Parliament. Whilst the final shape of the Bill may be amended as part of the process, it has been formulated in response to the growing concern over increasing problems and cost caused by surface water flooding, as illustrated by the disastrous floods in 2007 and since. SUDS are just one aspect of this Bill which also covers water supply, reservoirs, flood defences, coastal flooding and the emergency services response to flooding.

	Flooding and Water Management Bill 2009
Planning principles	County or unitary authorities to become a SUDS Approving Body (SAB). SAB approval required PRIOR to construction commencing S106. of Water Industry Act amended to make right of connection conditional on SAB approval. National Standards governing design, construction, operation and maintenance to be published in 2011 SABs to adopt all approved SUDS serving more than ONE property All SUDS to be placed on a register
Planning approval	**Application with planning application (where planning permission is required)** 1. Pre- application discussion encouraged 2. LPA send SUDS application to SAB 3. SAB considers whether meets National Standards and consults its statutory consultees 4. SAB can set conditions 5. SAB sends its decision to LPA who inform applicant of planning and SAB decision, including conditions 6. SAB decision INDEPENDENT of planning decision **Application direct to SAB (eg. where permitted development rights)** 1. SUDS application direct to SAB 2. SAB considers whether meets National Standards and consults its statutory consultees 3. SAB informs application of decision, and any conditions **Fees and regulatory issues** 1. Fee charged for approval 2. Exemptions from approval will be defined 3. Non-performance bond may be charged 4. Sewer connection for residual discharge allowed post SAB approval 5. Enforcement powers similar to planning to be put in place

The SUDS strategy for Shirebrook (Phase 1) in more detail

Typical SUDS components

The following tables describe the various SUDS components, where they are normally used within the Management Train, and the extent to which they provide water treatment and attenuation

	COMPONENT	IMAGE	TREATMENT	ATTENUATION
SOURCE CONTROL	**Rainwater harvesting** Water butts and tanks	 	None	Not measureable, as assumed system could be full
	Green roofs	 	Some, but roof water is quite clean	Low attenuates run off typically for 1/2 year event (0.5 probability)
	Filter strips Grassed or densely vegetated surface		High Excellent pre-treatment	No Can be used for infiltration for 1/2 year event (0.5 probability)
	Rain gardens/ bio-retention areas Densely planted shallow depressions	 	High	Low Stores typically for 1/2 year event (0.5 probability)
	Rainwater Planters Hard edged features/ containers	 	High	Low -moderate Stores typically for 1/2 year event (0.5 probability) - 1/30 year (0.3 probability), depends on design
	Soakaways/ infiltration trenches Rubble or stone filled pits	 	High	Moderate Stores and infiltrates typically 1/10 to 1/30 year (0.1-0.3 probability)
	Permeable paving with potential storage in the sub-base (stone) - lined or unlined	 	High	Moderate Stores water in stone base typically for 1/10 to 1/30 year (0.1-0.3 probability)

	COMPONENT	IMAGE	TREATMENT	ATTENUATION
CONVEYANCE	**Swales** Shallow grassed/densely vegetated channel	 	Medium-high	Moderate If designed for storage swales should have adequate capacity to store the 10/30 year event (0.3 probability)
	Filter drains Rubble or stone-filled linear excavations	 	High	Low-moderate Can be used for infiltration for 1/2 year (0.5) - 1/30 year event (0.3 probability)
	Hard channels	 	None	Low-moderate If designed for storage swales should have adequate capacity to store the 10/30 year event (0.3 probability)
SITE CONTROL	**Small detention/ infiltration basins** Vegetated depressions		Low-medium (detention basin) High (infiltration basin)	Moderate-high Stores typically for 1/30 year (0.3 probability) - 1/100 year event (0.01 probability)
	Small ponds/ wetlands Hold water permanently	 	High	Moderate Stores water above permanent water level, typically for 1/30 year event (0.3 probability)
	Geocellular/ modular storage systems		None	Moderate-High Stores typically for 1/30 year (0.3 probability) - 1/100 year event (0.01 probability)
REGIONAL CONTROL	**Large basins** Can be used as multi-functunal space	 	Low-medium (detention basin) High (infiltration basin)	High Stores typically for 1/100 year event (0.01 probability)
	Large ponds		Medium-high	High Stores typically for 1/100 year event (0.01 probability)
	Large wetlands		High	High Stores typically for 1/100 year event (0.01 probability)

Appendix 8.4 Waste Management

Credits in the Code for Sustainable Homes

To gain credits under the Code for Sustainable Homes certain criteria must be met for both the provision of bins for waste management and where applicable the way in which a composting scheme is administered. The tables below detail what is required by the scheme but more detailed definitions and interpretations are given in the Code itself.

Criteria for waste bins	Code credits available	Requirements
External storage of household waste	Mandatory to achieve code	Space allocated for waste containers to be able to accommodate containers of 100 litres per one bedroom accommodation with a further 70 litres for each additional bedroom or local authority containers (provided they offer equal or above the volume stated by the code). All containers to be accessible to disabled people
Internal storage of recycled household waste	2 credits	Dedicated internal storage for recyclable household waste can be credited where there is no dedicated external storage for recyclables or no LA scheme, and where the following criteria are met: • all located in an adequate internal space • no individual bin smaller than 15 litres • a minimum total capacity of 60 litres
Combined storage of recycled household waste	4 credits	A combination of internal storage (at least 3 bins with a total capacity of 30 litres where every bin has at least 7 litres or at least a single 30 litre bin where the LA runs a co-mingled scheme) combined with either a LA collection scheme or alternative adequate external storage. For houses adequate external space is where bins have at least: • a minimum total capacity of 180 litres • no bin smaller than 40 litres • all bins located within 30m of an external door For blocks of flats the storage must be appropriately sized and store at least 3 types of recyclable waste in identifiably different bins to also be located no further than 30m from an external door.

To be eligible for the Code certain criteria for the volume of bins must be met so it is important to:

• Check the minimum capacity required for internal and external waste and recycling storage is being achieved by the system.
• Check with the local authority the types of recyclable waste and segregation in operation in the locality currently and if there are likely to be any changes in the future.
• Ensure that the space allocated for the waste collection is adequate for storage of the bins and is accessible to disabled people.
• Where an automated system is used at least 3 different types of waste must be collected.

There is one credit available for a composting scheme which can be satisfied by several means detailed in the table below.

Credits from the code for sustainable homes (potable water)

The Code for Sustainable Homes outlines the target levels for efficient use of water (see table below). To meet the highest levels of the code the internal per person daily water use has to be less than 80 litres. Average household demand has increased by around 55 per cent over the last 25 years. Average consumption of water per person in England and Wales in 2005/06 was around 150 litres/day (l/d) a third of which is used for flushing toilets.

The Code also includes a mandatory requirement to design housing developments which avoid, reduce and delay the discharge of rainfall to public sewers and watercourses. It is aligned with the requirements of Planning Policy Guidance 25: Planning and Flood Risk.

Criteria for composting	Code credits available	Requirements
Individual home composting facilities OR a local community composting service OR a LA green/kitchen waste collection system	1	• Community composting facility must be run by the local authority or have a dedicated management plan in place • All facilities must be in a dedicated position • Be accessible to disable people • Have information leaflet that is delivered to each dwelling

Performance Target for water consumption	Maximum consumption of potable water (litres/person/day)
Building regulation 17.K compliance	125
Code level 1/2	120
Code level 3/4	105
Code level 5/6	80

Requirements for planning for waste management

Planning Policy Statement 10 (PPS10) sets out the Government's policy to be taken into account by waste planning authorities and forms part of the national waste management plan. Informed choices that are based on the principles of sustainable design will help fulfil wider objectives set out in PPS10.

Key planning objectives of PPS10 are to:

- help deliver sustainable development through driving waste management up the waste hierarchy, addressing waste as a resource and looking to disposal as the last option, but one which must be adequately catered for
- provide a framework in which communities take more responsibility for their own waste, and enable sufficient and timely provision of waste management facilities to meet the needs of their communities
- help implement the national waste strategy, and supporting targets, are consistent with obligations required under European legislation and support and complement other guidance and legal controls such as those set out in the Waste Management Licensing Regulations 1994
- help secure the recovery or disposal of waste without endangering human health and without harming the environment, and enable waste to be disposed of in one of the nearest appropriate installations
- reflect the concerns and interests of communities, the needs of waste collection authorities, waste disposal authorities and business, and encourage competitiveness
- protect green belts but recognise the particular locational needs of some types of waste management facilities when defining detailed green belt boundaries and, in determining planning applications, that these locational needs, together with the wider environmental and economic benefits of sustainable waste management, are material considerations that should be given significant weight in determining whether proposals should be given planning permission
- ensure the design and layout of new development supports sustainable waste management

Requirements for planning, EA and building control for grey water recycling facilities

Water Supply (Water Fittings) Regulations

In England the main statutory instrument is the Water Supply (Water Fittings) Regulations 1999 . These regulations deal with the need for backflow protection such as air gaps which vary in type depending on the quality of water stored in the tank, and the need for approved materials to be used for all components. If reused water is to be used for drinking or any other potential human consumption, it will be subject to the Private Water Suppliers Regulations 1991.

New Building Regulations

Government has consulted on changes to building regulations (CLG 2006). The outcome of the consultation is the joint DEFRA and CLG statement (2007) which stated that a whole building water efficiency of 125 l/h/d (litres/household/day) will be brought forward into the building regulations for 2008. This has been delayed, but will be Implemented soon.

DEFRA Future Water Strategy

In 2008, DEFRA released their strategy 'Future Water', (DEFRA 2007). This states that by 2030, DEFRA has an aspiration that average domestic consumption will fall to 130 l/h/d.

OFWAT water efficiency targets

In 2008, Ofwat consulted on setting water efficiency targets. Later that year, OFWAT published its intention to set water efficiency targets at two rates:

- Companies with average domestic pcc (per capita consumption) greater than 130 l/h/d, a reduction of 1 litre per property per day.
- Companies with average pcc less than 130 l/h/d, a reduction of 0.5 litres per property per day.

These targets will be incorporated into water company water resources management plans.

Waste: Useful further information

Community Composting Network: The Community Composting Network supports and promotes the community management and use of waste biodegradable resources . It is a member's organisation, self-managed by an elected committee of members.
http://www.communitycompost.org/aboutus/index.htm

A very useful document on the legal aspects of a community composting scheme and site considerations is available from: http://www.communitycompost.org/info/mipack.htm

Guide to zero waste standard which local authorities can benefit from:
http://www.lga.gov.uk/lga/core/page.do?pageId=4684811

Online Recycling Information System (ORIS) Provides information on Local authority recycling schemes, available from WRAP at:
http://www.wrap.org.uk/local_authorities/research_guidance/online_recycling_information_system_oris/index.html

PPS10 Guidance document:
http://www.communities.gov.uk/documents/planningandbuilding/pdf/150805.pdf

Household waste arisings: Data used to calculate the size of communal bin areas for the design options

Waste fraction	Ave Kg per person per year	Ave Kg per household per year	Ave Kg per household per week
	2008/09	**2008/09**	**2008/09**
[Δ]Residual	295	669	13
[Δ]Recyclate	178	403	8
Total	473	1072	21
***Food waste**		140	2.7

Δ Defra Waste statistics: http://www.defra.gov.uk/evidence/statistics/environment/wastats/bulletin09.htm
*Taken from WRAP research: http://www.letsrecycle.com/do/ecco.py/view_item?listid=37&listcatid=364&listitemid=10998

Bin dimensions

Type of bin	Size in Litres	Dimensions (mm)		
		Height	**Width**	**Depth**
Standard wheelie bin	240	1010	620	860
Large wheelie	360	1070	620	860
Euro bin	770	1370	1260	785
Euro bin	1100	1370	1260	985

Appendix 8.5
Operational Energy

Credits in the Code for Sustainable Homes

The Energy Category is one of the most important in the Code, and this is reflected through the increasing mandatory minimum standards are detailed below. Unless these are met, the relevant Code level cannot be achieved, no matter how many credits are gained from the other Categories. Each of the Credits for Energy is weighted at 1.26, so for example if 8 credits are gained then the total "score" for Energy will equal 10.08 percentage points as a contribution to the overall rating of the home. This would provide the potential to achieve Level 4 as long as the appropriate number of credits are obtained from the other categories.

There are nine Issues in the Energy Category, and these are further described below.

Dwelling Emission Rate - Credits are awarded based on the percentage improvement in the Dwelling Emission Rate (estimated carbon dioxide emissions in kg per m^2 per annum arising from energy use for heating, hot water and lighting for the actual dwelling), over the Target Emission Rate (the maximum emission rate permitted by Building Regulations). See table below.

Building Fabric - Credits are awarded based on the Heat Loss Parameter for each dwelling. Where this is ≤ 1.30, 1 credit is awarded and ≤ 1.10, 2 credits are awarded.

Internal Lighting - Credits are awarded for the provision of fixed dedicated energy efficient internal lighting.

Drying Space - 1 credit is awarded based on the provision for drying space for each dwelling type.

Energy Labelled White Goods - Credits are awarded where information is provided relating to the provision of energy efficient white goods, or where energy efficient white goods are supplied.

External Lighting- Up to 2 credits are available for the provision of dedicated, energy efficient external lighting within the development.

Low or Zero Carbon (LZC) Technologies - At present credits are awarded based on the percentage reduction in total carbon emissions that result from using Low or Zero Carbon (LZC) Energy Technologies for each dwelling. However, as detailed in the start of this section, the consultation on the revision to the Code and the Energy Efficiency Standard (CLG 2009b) will significantly alter this credit.

Cycle Storage – Credits are awarded where adequately sized, safe, secure, convenient and weatherproof cycle storage is provided for each dwelling.

Home Office –a credit can be awarded where sufficient space and services have been provided which allow the occupants to set up a home office in a suitable quiet room, 1 credit can be awarded.

Code Level	Minimum % reduction in dwelling emission rate over target emission rate
Level 1 (*)	10
Level 2 (**)	18
Level 3 (***)	25
Level 4 (****)	44
Level 5 (*****)	100
Level 6 (******)	Zero Carbon House

Sustainable energy technologies

There are a wide range of sustainable technologies now available, many of which have been tried and tested over many years. New and innovative energy solutions are also rapidly appearing in the marketplace but this section highlights those technologies which are tried and tested.

Active solar water heating
This technology is for the production of domestic hot water. An array of solar collectors is used to collect the incident solar irradiation (heat energy) from the sun. A heat transfer fluid is pumped through the panels and the energy collected is transferred to a hot water cylinder.

Typical Energy Production: 400 - 550kWh/m^2/annum

Design and other considerations: Roof type and pitch, roof shading, hot water demand profile. Could be integrated as part of a site wide district heating system. Construction and maintenance is carried out by the company installing the technology. The technology is well proven and reliable. There are no health and safety issues once the technology has been installed.
The introduction of the RHI from April 2011 should significantly increase the financial viability of this technology

Air source heat pumps
This technology is for the provision of space heating, hot water and cooling. It is used to extract low grade solar energy from the ambient air, which would be upgraded by the heat pump to provide space heating and hot water.

Typical Energy Production: Can be sized to meet 100% of the load

Design and other considerations: Location of external unit, heat distribution system, design heat loss, planning consent. Construction and maintenance is carried out by the company installing the technology. The technology is well proven and reliable. There are no health and safety issues once the technology has been installed.
The introduction of the RHI from April 2011 should significantly increase the financial viability of this technology

Ground source heat pumps
This technology is for the provision of space heating, domestic hot water and cooling. It is used to extract low grade solar energy that is stored in the earth which would then be upgraded by the heat pump to provide space heating and hot water. A horizontal or vertical collector pipe would be buried in the earth and an antifreeze mixture pumped through the circuit.

Typical Energy Production: Can be sized to meet 100% of the load

Design and other considerations: Location of heat pump unit, heat distribution system, ground conditions, design heat loss; planning consent. Construction and maintenance is carried out by the company installing the technology. The technology is well proven and reliable. There are no health and safety issues once the technology has been installed.
The introduction of the RHI from April 2011 should significantly increase the financial viability of this technology

Photovoltaic systems
The generation of on-site electricity. This technology is for the production of electricity from sunlight. The solar panels are connected to the mains supply via a suitably sized inverter. The instantaneous electricity provision is used to offset imported electricity from the mains supply. During periods of low demand on site, any surplus power would be exported to the local distribution network.

Typical energy production: 700- 800kWh/kW/annum

Design and other considerations: Roof space, roof type & pitch, roof shading, planning consent. Construction and maintenance is carried out by the company installing the technology. The technology is well proven and reliable. There are no health and safety issues once the technology has been installed.
The FIT has a very positive impact on the financial viability of this technology

Wind energy

Micro wind energy (less than 50kW)

Application: The generation of electricity. Vertical or horizontal axis wind turbines with hub heights in range of 8m - 25m and rotor diameters of 2m - 16m

Typical energy production: 1,300 - 2,200 kWh / kW/annum installed (wind speed dependant and very site specific)

Design and other considerations: Wind resource, site specific issues (e.g. obstacles), ground conditions, planning consent. Construction and maintenance is carried out by the company installing the technology. The technology is well proven and reliable. There are limited health and safety issues once the technology has been installed, apart from the need for the rotor blades to be at a height that will not allow any access or contact with the public.
The FIT has a very positive impact on the financial viability of this technology

Medium/large wind energy (250 - 1,000kW)

Application: The generation of electricity. Due to the scale of this technology it is unlikely that housing sites will be able to accommodate turbines, due to the required exclusion zones and related issues. Agreements should be sought with landowners on sites nearby.

Technology Overview: Predominantly horizontal axis wind turbines with hub heights in range of 30m - 60m and rotor diameters of 23m - 55m

Typical energy production: 1,300 - 2,200 kWh/kW/annum installed (wind speed dependant and very site specific)

Design and other considerations: Wind resource, site specific issues (e.g. obstacles), ground conditions, distribution network connections, planning consent.
It is likely that this option would face local opposition. Construction and maintenance is carried out by the company installing the technology. The technology is well proven and reliable. It is extremely unlikely that a medium or large turbine would be installed in a development site because of a wide range of noise, health and safety and visual issues. The FIT has a very positive impact on the financial viability of this technology

Biomass heating (wood pellets)

Individual house boiler

Application: The provision of space heating, process heat, domestic hot water. This technology provides a fully automated pellet boiler system that would provide all of the hot water and space heating requirements. Typically designed to burn 6mm - 8mm pellets with a hopper/bunker sized to achieve continuous operation of between 5-30 days.

Typical energy production: Can be sized to meet 100% of the load

Design and other considerations: Space for biomass plant, accessibility for pellet deliveries, pellet quality and availability, planning consent, air quality assessment. Could be integrated as part of a site wide district heating system. The technology is well proven and reliable. There are limited health and safety issues once the technology has been installed, apart from the obvious need to exclude the public from the heating plants as they reach a very high temperature. Regular monitoring of the air quality will be required to prevent any local problems.
The introduction of the RHI from April 2011 should significantly increase the financial viability of this technology

Biomass district heating

Application: The production of sustainable heat for individual homes through a centralised heating plant.

Typical energy production: 1,000 – 1,200 KwH / kW/annum

Design and other considerations: Storage for the biomass, air quality and planning issues. Availability of biomass. There are limited health and safety issues once the technology has been installed, apart from the obvious need to exclude the public from the heating plants as they reach a very high temperature. Regular monitoring of the air quality will be required to prevent any local problems.
The FIT has a very positive impact on the financial viability of this technology
The above cost estimate is for a complete turnkey solution from design, installation through to commissioning and would include: Energy centre building, all plant and equipment (biomass boiler, hopper/bunker chip store etc.), district heating pipe-work, hydraulic interface units (for the connection of each dwelling to the DH network) and heat metres at each property.

Future innovation and good practice

As with everything, sustainable energy technology is improved all the time. This Appendix highlights very briefly some of the developments in the marketplace. Other products are of course available.

SolarWall® PV/TTM cogeneration system
This produces both heated air & electricity. It combines the high-efficiency SolarWall® air heating technology with photovoltaics to create a total energy solution with a payback period that is substantially less than a typical PV installation.
A PV/T system will generate 200-300% more energy (in the form of heat and electricity) than a standalone PV system for approximately 25% more cost.
www.solarwall.com

Quiet revolution vertical access wind-turbine
The quietrevolution was designed in response to increasing demand for wind turbines that work well in the urban environment, where wind speeds are lower and wind directions change frequently. The elegant helical (twisted) design of QR ensures a robust performance even in turbulent winds. It is also responsible for virtually eliminating noise and vibration.
www.quietrevolution.co.uk

Solar / wind powered street lamps
Street lamps can now be powered by solar energy and wind energy storing up renewable energy into a high powered sealed battery that can store up to 5 days of battery power from a 50W solar panel at a wind speed of 2.5m/s, this is then used to provide light during the hours of darkness.
The benefit of these types of street lamps is they are totally independent of the national grid, very cost effective and environmentally friendly.
www.essentialspark.com

Wind Cowls
The in practice wind cowl supplies and extracts air to minimise heat loss resulting in better ventilation within homes therefore minimising heat loss. An average wind speed of 4m/s can generate a flow rate of 50-70 litres per second.
www.zedfactory.com/pdf%20downloads/zf_wc_spec.pdf

Electro Kinetic Power Ramps
The Ramp operates by virtue of a number of articulated plates placed in the road. When vehicles weight is exerted on the plates they are moved up and down and by means of a specially designed mechanism, a generator is driven, which is capable of producing AC or DC current.
In either event, the generator's output will vary according to the frequency and weight of traffic, but in general terms will be capable of producing between 5 and 10kW.
www.hughesresearch.co.uk

Cooking and backup heating
Using biomass and waste materials from domestic use
Small biomass stoves could be installed in some homes to provide an attractive backup heating source and could be used for some forms of slow cooking / hot water. They can be run from sustainable sources of biomass and waste materials from domestic use – low grade paper, packaging and cardboard etc.. This gives an additional advantage of reducing domestic waste.
www.woodstoves.net

Appendix 8.6
Cost Data

NOTES / COMMENTS

WATER

- For the Shirebrook site there may be alternative SUDS solutions that would mean higher initial costs in “Phase 1”. These designs would need to be developed
- These costs EXCLUDE maintenance costs

WASTE

- Individual bins – here it is assumed that there are 20 metres squared of road area per house
- Communal bins have been assumed as “free issue” from the Local Authority / Waste Service but the costs of bases and screens are included
- There are 15 no. communal bin stores serving 3/4 houses each
- The Composter and enclosure costs include power and water supplies
- Assumed individual storage per house and pumping to WC’s etc. for the communal greywater systems
- Several manufacturers do not currently recommend a single greywater system to serve 250 homes due to robustness / usual requirement for a back-up service
- Possible reductions are available for the Shirebrook site is orders can be placed at the outset of the development and not phased

ENERGY

- Feed in Tariff (FiT) is assumed as 36.1p/kWh, Photovoltaics (PV) on newbuild
- Renewable Heat Incentive (RHI) is assumed as 1.6p-2.5p/kWh - with an estimated average of 2.05p/kWh

GENERAL

- In terms of water and waste, for Shirebrook, we have assumed that the ratio of costs will be the same, i.e. five times the cost of the Middlemore site

WATER - BASED ON THE MIDDLEMORE PROPOSALS

MIDDLEMORE (50 DWELLINGS)

	Total Cost £	**Cost per dwelling £**
Full SUDS solution	171,000	3,420
“Traditional drainage solution”	175,000	3,500
Semi-engineered SUDS (“End-of-pipe”) solution	238,000	4760

SHIREBROOK (250 DWELLINGS)

	Total Cost £	**Cost per dwelling £**
Full SUDS solution	855,000	3,420
“Traditional drainage solution”	875,000	3,500
Semi-engineered SUDS (“End-of-pipe”) solution	1,190,000	4760

WASTE (BASED ON THE MIDDLEMORE PROPOSALS)

MIDDLEMORE (50 DWELLINGS)

	Total Cost £	**Cost per dwelling £**
Individual bins (including additional road construction)	75,000	1,500
Communal bins	31,500	630
Greywater recycling (one per dwelling)	40,000	800
Greywater recycling (communal system)	35,000	700

SHIREBROOK (250 DWELLINGS)

	Total Cost £	**Cost per dwelling £**
Individual bins (including additional road construction)	375,000	1,500
Communal Bins	157,500	630
In-Vessel Composter (installation cost and enclosure only)	19,000	76
Bring Site	3,000	12
Greywater recycling (one per dwelling)	200,000	800
Greywater recycling (shared communal system)	175,000	700

ENERGY - MACRO OPTIONS

Biomass District Heating System

1 Middlemore
Assumes 50 houses built in one phase

2 Shirebrook - Option 1
Assumes 5 phase of 50 houses
1no. 150kW boiler installed per phase
The Energy Centre building is built in phase 1 to accommodate 5 separate 150kW boilers

3 Shirebrook - Option 2
Assumes 5 phases. Each phase has a combination of 35 houses and 15 flats
1no. 150kW boiler installed per phase

4 Shirebrook - Option 3
Assumes 5 phases of 50 houses
1no. 600kW boiler installed in phase 1

5 Shirebrook - Option 4
Assumes 5 phases. Each phase has a combination of 35 houses and 15 flats
1no. 600kW boiler installed in phase 1

NOTE: Excludes maintenance costs

ENERGY - MICRO OPTIONS

MIDDLEMORE (50 DWELLINGS)

Option 3.2.1 Photovoltaics (PVs) - 18m2
Ground source heat pump (GSHP) in SUDS paving - 94m2 of paving

Option 3.2.2 Photovoltaics (PVs) - 26m2
Air Source Heat Pump (ASHP) - c5kW

Option 3.2.3 Gas condensing boiler
Photovoltaics (PVs) - 22m2
Evacuated tube Solar Thermal Panels (ST) - 4m2

SHIREBROOK (250 DWELLINGS)

Option 3.2.1 Photovoltaics - 18m2
Ground source heat pump (GSHP) in SUDS paving - 94m2 of paving
Note: possible reduction in unit rate if orders can be placed for the 5 phases from the outset

ENERGY - MICRO OPTIONS

MIDDLEMORE (50 DWELLINGS)

Options	**Description**		
Option 3.2.1	**2.4kWp PVs+ GSHP**		**£**
	comprised of (x 50 dwellings)		
	PV (extra over cost)	18m2	450,000
	GSHP	1no.	300,000
	SUDS paving (extra over rate)	94m2	517,000
	SITE TOTAL		1,267,000
	COST PER DWELLING		25,340
Option 3.2.2	**3.5kWp PVs + c5kW ASHP**		**£**
	comprised of (x 50 dwellings)		
	PV (extra over cost)	26m2	650,000
	ASHP	1no.	300,000
	SITE TOTAL		950,000
	COST PER DWELLING		19,000
Option 3.2.3	**Gas boiler + PVs + ST**		**£**
	comprised of (x 50 dwellings)		
	Gas condensing boiler	1no.	120,000
	Gas infrastructure works	1no.	50,000
	PV (extra over cost)	22m3	550,000
	ST	4m2	107,500
	SITE TOTAL		827,500
	COST PER DWELLING		16,550

SHIREBROOK (250 DWELLINGS)

Options	**Description**		
Option 3.2.1	**2.4kWp PVs+ GSHP**		**£**
	comprised of (x 250 dwellings)		
	PV (extra over cost)	18m2	2,250,000
	GSHP	1no.	1,500,000
	SUDS paving (extra over rate)	94m2	2,585,000
	SITE TOTAL		6,335,000
	COST PER DWELLING		25,340
			(including 10% bulk purchase discount)

NOTE: With a larger ratio of flats to houses it may be difficult to accommodate GSHP in a horizontal (trench) format

ENERGY - MACRO OPTIONS
(Biomass district heating system with Photovoltaics on each dwelling)

MIDDLEMORE - 50 houses

	£		£
Energy centre building	150,000	1no.	150,000
150kW boiler costs	70,000	1no.	70,000
Pipework distribution (100mm pipe) 260	650	m	169,000
Pipework supply to houses (50mm pipe)	200	1000m	200,000
1.6kWp PV (12m2 per roof)	500	600m2	300,000
SITE TOTAL			889,000
COST PER DWELLING			17,780

OPTION 1 - SHIREBROOK- 250 houses - 5no. 150kW boilers

	£		£
Energy centre building	250,000	1no.	250,000
150kW boiler costs	70,000	5no.	350,000
Pipework distribution (100mm pipe)	260	3250m	845,000
Pipework supply to houses (50mm pipe)	200	5000m	1,000,000
1.6kWp PV (12m2 per roof)	500	3000m2	1,500,000
SITE TOTAL			3,945,000
COST PER DWELLING			15,780

OPTION 2 - SHIREBROOK - 175 houses, 75 flats - 5no. 150kW boilers

	£		£
Energy centre building	250,000	1no.	250,000
150kW boiler costs	70,000	5no.	350,000
Pipework distribution (100mm pipe)	260	2762.5m	718,250
Pipework supply to houses (50mm pipe)	200	3500m	700,000
Pipework supply to flats (50mm pipe)	200	375m	75,000
1.6kWp PV (12m2 per roof)	500	3000m2	1,500,000
SITE TOTAL			3,593,250
COST PER DWELLING			14,373

ENERGY - MACRO OPTIONS
(Biomass district heating system with Photovoltaics on each dwelling)

OPTION 3 - SHIREBROOK - 250 houses - 1no. 600kW boiler

	£		£
Energy centre building	250,000	1no.	250,000
600kW boiler costs	200,000	1no.	200,000
Pipework distribution (100mm pipe)	260	3250m	845,000
Pipework supply to houses (50mm pipe)	200	5000m	1,000,000
1.6kWp PV (12m2 per roof)	500	3000m2	1,500,000
SITE TOTAL			3,795,000
COST PER DWELLING			15,180

OPTION 4 - SHIREBROOK - 175 houses, 75 flats - 1no. 600kW boiler

	£		£
Energy centre building	250,000	1no.	250,000
600kW boiler costs	200,000	1no.	200,000
Pipework distribution (100mm pipe)	260	2762.5m	718,250
Pipework supply to houses (50mm pipe)	200	3500m	700,000
Pipework supply to flats (50mm pipe)	200	375m	75,000
1.6kWp PV (12m2 per roof)	500	3000m2	1,500,000
SITE TOTAL			3,443,250
COST PER DWELLING			13,773

FURTHER BREAKDOWN

	Middlemore	Shirebrook
Energy Centre - approximate building size	250m2	600m2
50mm insulated pipes in trenches	£200 per metre allowed for	
100mm insulated pipes in trenches	£260 per metre allowed for	
Average length of pipes per house	20 metres per house allowed for	
Average length of pipes per flat	5 metres per flat allowed for	

NOTES