ENVIRONMENT AGENCY

North West Region

Sustainable urban Drainage Systems
Case Studies in Central Area

Foreword

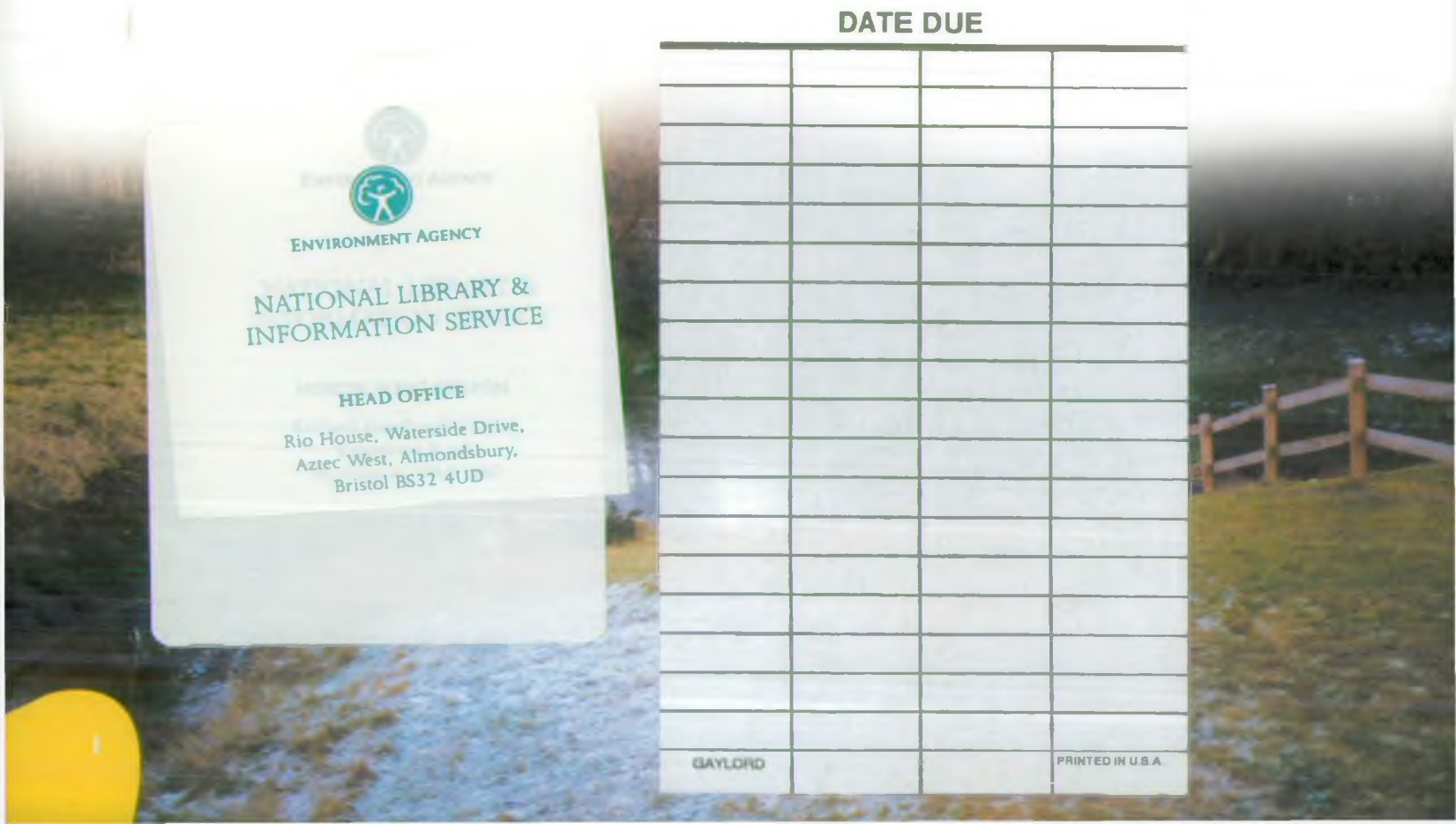
The flooding events in England and Wales since 1998 have raised our awareness of the devastation they bring. Here in the North West, we have for the most part been spared the damage seen elsewhere, but significant numbers of properties, businesses and farms remain at high risk of flooding.

The Environment Agency promotes sustainable development to improve quality of life by balancing the social, economic and environmental needs of us all. Here in Central Area, reducing flood risk is one of our top priorities.

Our ability to control flood risk through legislation such as the Land Drainage Act and Water Resources Act is limited. Planning Policy Guidance note 25, 'Development and Flood Risk' (DTLR, July 2001) helps the Agency, in its role as statutory consultee, to influence the planning system to reduce flood risk. In addition much of the Agency's work depends on effective working with our partners in local government, the development industry, local communities and other government bodies. The Agency's technical expertise can help to deliver reduced flood risk while achieving other benefits such as improving our environment and creating new opportunities for recreation.

I am encouraged by the examples of Sustainable urban Drainage Systems showing what we have achieved as partners so far. I commend this document and its good practice examples which show how we can achieve more sustainable forms of development in the future.

Annette Pinner
Central Area Manager
North West Region
Environment Agency



Contents

Map showing location of each Case Study

The map shown includes operational river catchment boundaries.
The map on the back cover shows the area administrative boundaries which are slightly different.

Sustainable urban Drainage Systems (SuDS) - Introduction

When rain falls on undeveloped land, most of the water soaks into the topsoil and then slowly migrates to the nearest watercourse or groundwater. A small part of the rainfall drains slowly overland through the vegetation to the watercourse. In this natural way the effects of rainfall are spread out. As flow progresses towards the watercourse any pollutants are reduced by the natural reactions within the soil and vegetation and through settlement. On undeveloped land even short periods of torrential rain may have little immediate impact, as much of the rain may be absorbed by the ground.

Following development a good part of the ground will be covered by impervious surfaces. Rain falling on roofs, roads, car parks, driveways and pavements is usually directed immediately to the watercourse by the sewer system. Piped systems are very effective at moving water from one place to another very quickly, but this allows no time for settlement of particulates or for any natural remediation processes to take place. Surface water can easily be contaminated with water used for washing cars or by oil spilt on the roadway or poured down the drains. Even the remaining open ground often loses its absorption capacity or flow routes following compaction or topsoil removal.

Whilst the quantity of rain is unchanged, the rate at which it flows to the watercourse can dramatically increase following development. Watercourses may be unable to carry these sudden run-off flows, and an increased risk of flooding inevitably follows. Large quantities of rainwater arriving unchecked can destroy riverbanks and habitats through scouring and erosion.

Many drainage problems can be reduced by Sustainable urban Drainage Systems as they attempt to mimic nature. They can reduce the need for expensive improvement works downstream of the scheme, and reduce flooding and pollution problems caused by combined sewer overflows. Groundwater and watercourses can be replenished naturally helping to create wildlife habitats and improving the amenity value of developments.

SuDS within the North West Region, Central Area

This booklet contains brief details of some of the SuDS promoted by the Agency within Central Area. The knowledge and experience gained from these sites is invaluable in the promotion of SuDS elsewhere. Increasing acceptance of sustainable systems generally is due in no small part to our ability to use sites such as those outlined within this booklet as examples of best practice. In each case the adopted design cost less than a traditional system and in some cases considerable saving were made.

The efficiency of SuDS can be readily confirmed as the systems control run-off at source. All the completed systems described here have been monitored during severe rainfall and have been found to be operating well. Any potential problems with siltation or contamination will also become readily apparent and encourage early preventative action.

If you require any further detail or information about the examples in this booklet or SuDS in general please contact the Development Control Engineer for the area on 01772 339882.

CASE STUDY 1

Residential Site – Simonwood Brook, Kirkby

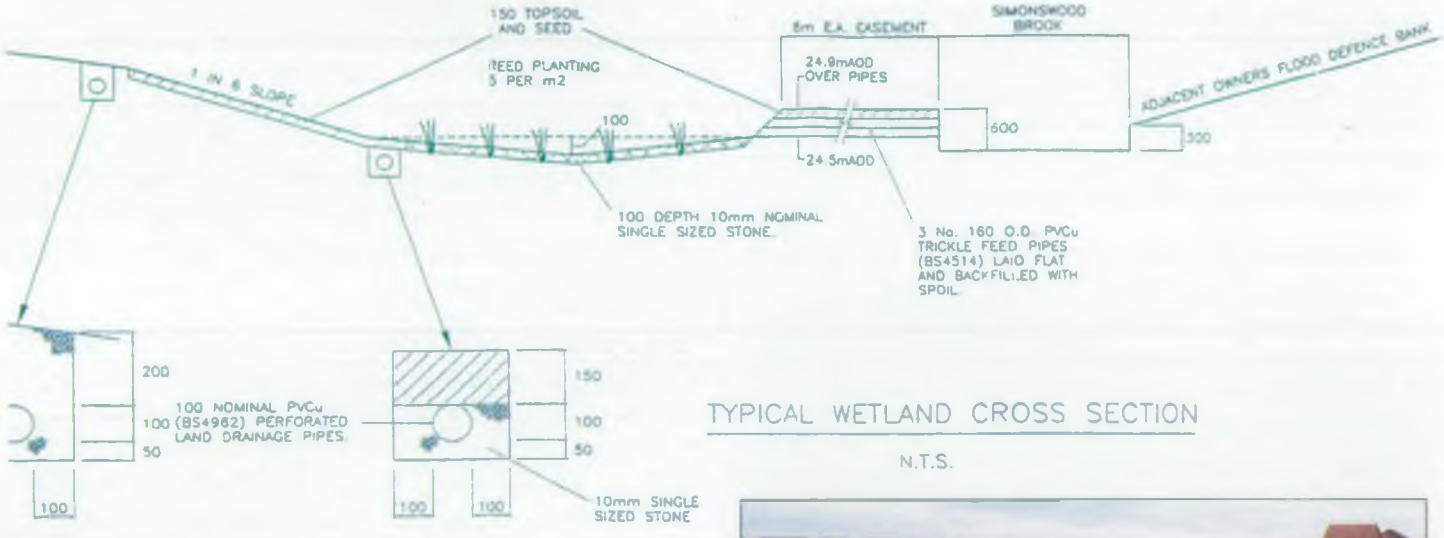
Flood storage basin and reed bed wetland
Grid Reference SD408 010

Maunders Westburys' large 600 house development at Saxon Way, Kirkby included a planning condition, requested by the Agency, to restrict surface water run-off to existing 'greenfield' rates. The Environment Agency suggested a SuDS as an alternative to the proposed underground storage system.

Simonwood Brook is a 'main river' which forms the northern boundary of the site and would be the receiving watercourse. Just downstream of the site the brook flows through an outcrop of sandstone, which constricts the channel forming a natural control to peak flows. We suggested an off line storage area adjacent to the brook constructed as a permanent wetland planted with reed. Outfalls from the development are directed into this reed bed to improve low flow water quality. Calculations confirmed the practicality of the scheme, which was also supported by Knowsley MBC. The wetland is sited within public open space and maintained by the Council.

In order to ensure the wetland remains wet during prolonged dry periods a small feed from Simonwood Brook is provided. A full width weir at the downstream end of the reed bed will ensure an even flow across the bed.

We are particularly pleased with the design of the outfalls to the wetland (pictured below). The large diameter surface water outfall pipes reduce to smaller pipes at a chamber set back from the wetland. The smaller pipes have permitted an unobtrusive and intrinsically safe outfall design, which requires no safety screen.

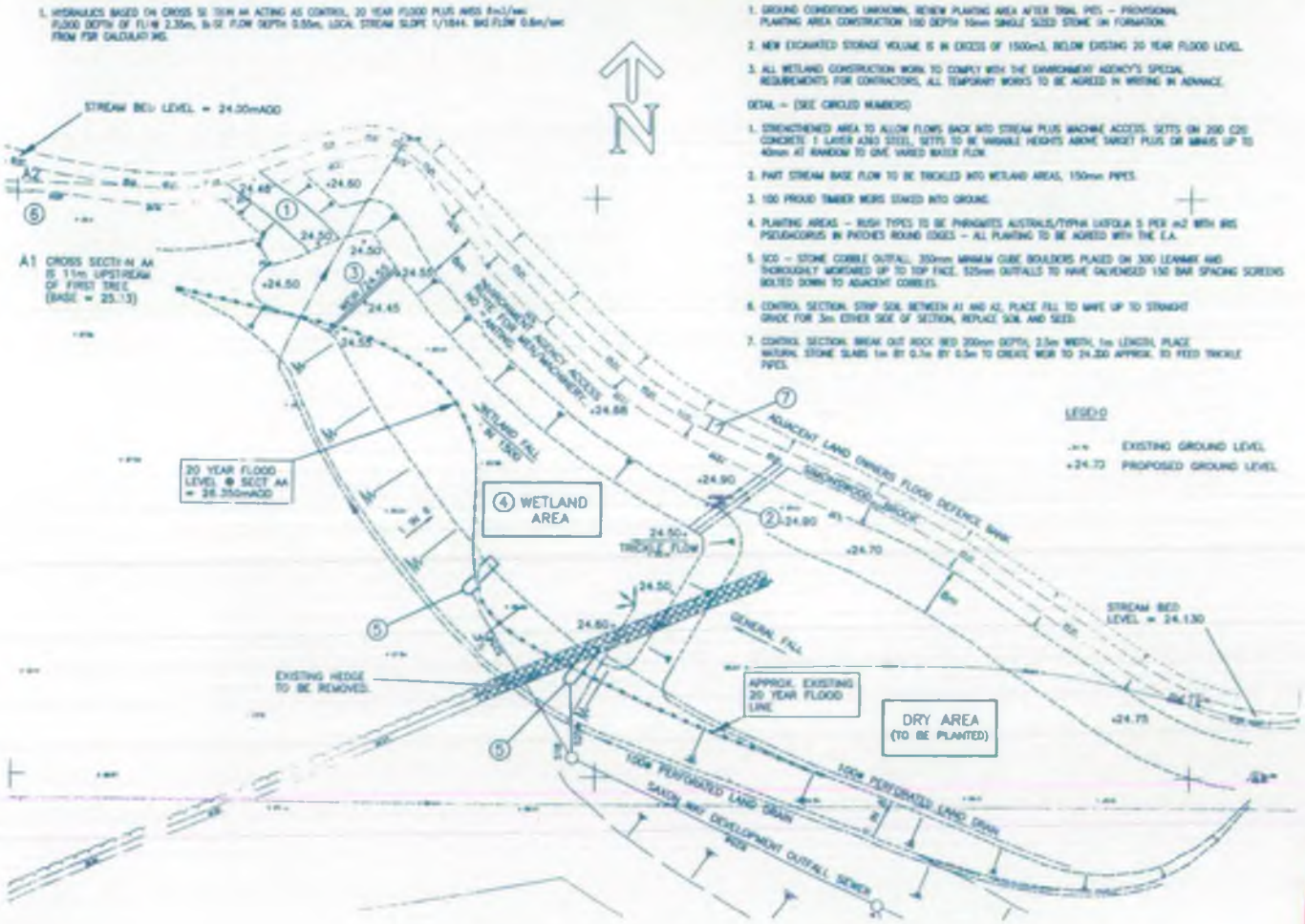


TYPICAL WETLAND CROSS SECTION

N.T.S.

CASE STUDY 1

Site Plan



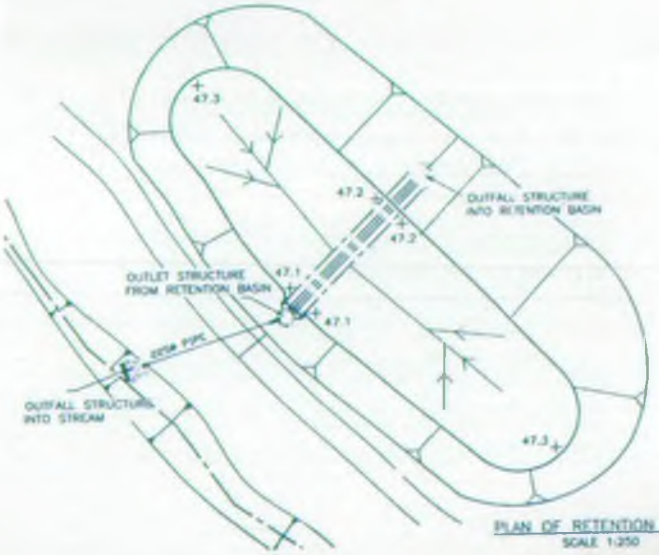
CASE STUDY 2

Eastway Housing Development – Sherwood, Preston

Detention basin
Grid Reference SD542 337

Sharoe Brook flows through a heavily urbanised area of north Preston. At the development site, the watercourse is designated as a 'non-main' river. The Agency were aware of several serious flooding problems on this watercourse and recommended to the Local Authority at the planning stage that surface water run-off from the proposed development be attenuated at existing 'greenfield' site rate.

In order to attenuate run-off, the developers, Crowder & Co., produced a design for a 'dry pond'. During heavy rainfall the restricted outfall from the pond temporarily causes water to be stored within the pond. The stored water slowly drains to the watercourse after the storm, so reducing the risk of contributing to flooding problems elsewhere in the catchment. A further environmental benefit would have been to create an attenuation basin with additional ecological features to enhance the wildlife and nature conservation status of the pond.



PLAN OF RETENTION BASIN
SCALE 1:250

Residential Site – Langton Brow, Eccleston

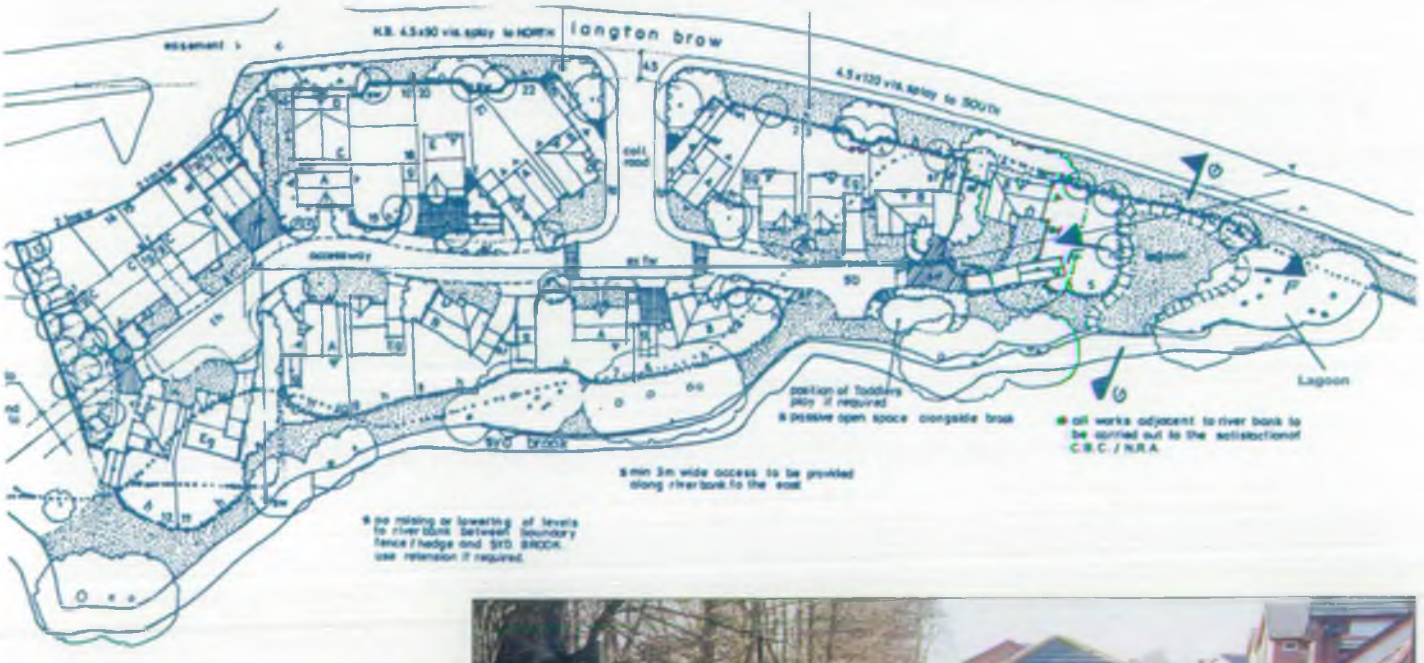
CASE STUDY 3

Flood storage lagoon
Grid Reference SD527 160

This small development lies adjacent to Syd Brook and parts of the site are occasionally subjected to flooding. Therefore the Agency objected to the development. In order to overcome the Agency objection the developer proposed to raise floor levels above anticipated flood levels and to compensate this infilling of the flood plain by providing a flood storage lagoon within the site.

When the brook rises in storm conditions floodwater will overtop the brook bank into the lagoon. As the flood level subsides the lagoon will discharge back into the brook via a non-return valve and control pipe.

The lagoon was originally planned to be within the garden area of the adjacent house. However, the Agency was concerned that the future efficiency of the scheme may be compromised due to lack of maintenance. As a result the Local Authority agreed to take the lagoon area into Council ownership with a commuted sum from the developer for future maintenance.



CASE STUDY 4

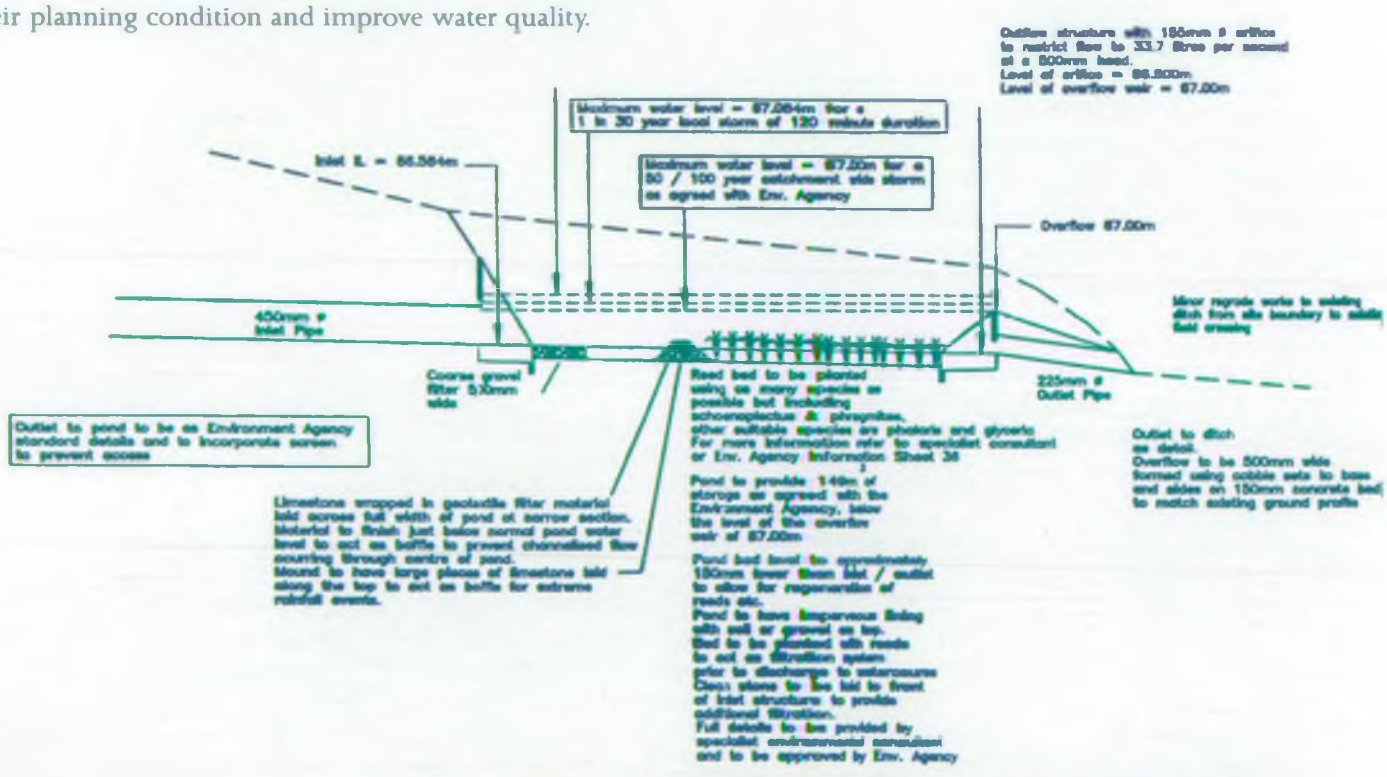
Large Residential Site – Wainhomes, Lancaster Lane, Clayton le Woods

Balancing pond/reed bed in public open space Grid Reference SD561 228

Phase 2 of this large residential development drains naturally west to a site of biological importance and to a watercourse with existing capacity problems. Chorley Borough Council supported the Agency by conditioning Wainhomes planning approval requiring a surface water regulation system to be installed. The quality of the proposed discharge also gave some cause for concern.

The Agency suggested a balancing pond and reed bed to the developer as a cost effective SuDS, which would satisfy their planning condition and improve water quality.

The scheme was agreed and Chorley Borough Council adopted the pond and reed bed, which is within public open space. This SuDS marked a breakthrough in Central Area as it was the first time that such a feature within the public open space of a residential development has been adopted by a Local Authority, supported by a commuted sum from the developer. The commuted sum was considerably less than the cost of a traditional attenuation system.



ENLARGED SECTION THROUGH POND & OUTFALL

CASE STUDY 4


TO 1.002
TO 1.000
TO 1.003
TO 3.001
TO 3.000
TO 3.001
TO 1.004
TO 3.002
TO 1.001
TO 1.005
TO 1.006
PUBLIC OPEN SPACE
TO 1.007
TO 3.003
TO 2.000
POND
TO 3.008

CASE STUDY 5

Safeway – Ormskirk

Adapt pond to balance surface water run-off
Grid Reference SD411 082

The new Safeway food store in Ormskirk drains to Hurlston Brook, a main river watercourse with existing capacity and flooding problems. West Lancashire District Council supported the Agency by conditioning the planning approval so that surface water run-off rates must be attenuated to existing greenfield rates.

The Agency suggested that an existing pond within an adjacent Council owned park be adapted to act as a balancing pond for the supermarket. The existing pond outfall was in a poor state of repair and the pond leaked, so an increased feed to the pond would be advantageous. The Council accepted the benefit of the suggestion and approved the proposal. Roof water is fed directly to the pond whilst car park drainage is via an interceptor to remove pollutants.

The new outfall control was constructed using several small pipes set beneath the existing footpath, which runs between the pond and Hurlston Brook. The pond now actually over attenuates run-off from the site thereby providing a small reduction in flood risk whilst at the same time increasing the amenity value of the pond. This imaginative scheme resulted in a significant saving to Safeway, compared to traditional engineering solutions.

Small Residential Site – Ansar Homes, Edge Hall Road, Orrel, Wigan

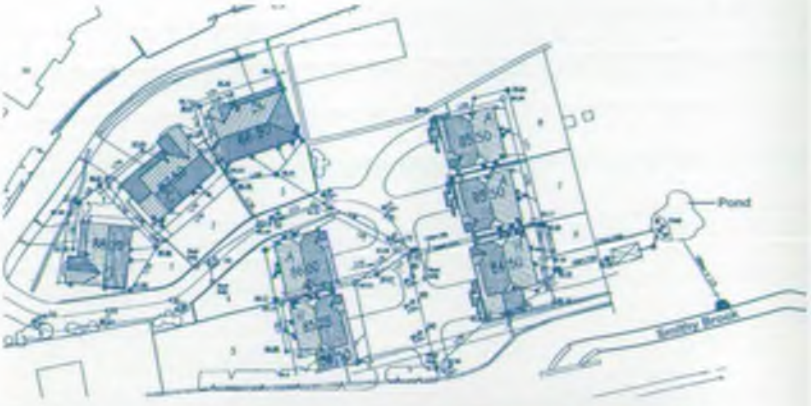
CASE STUDY 6

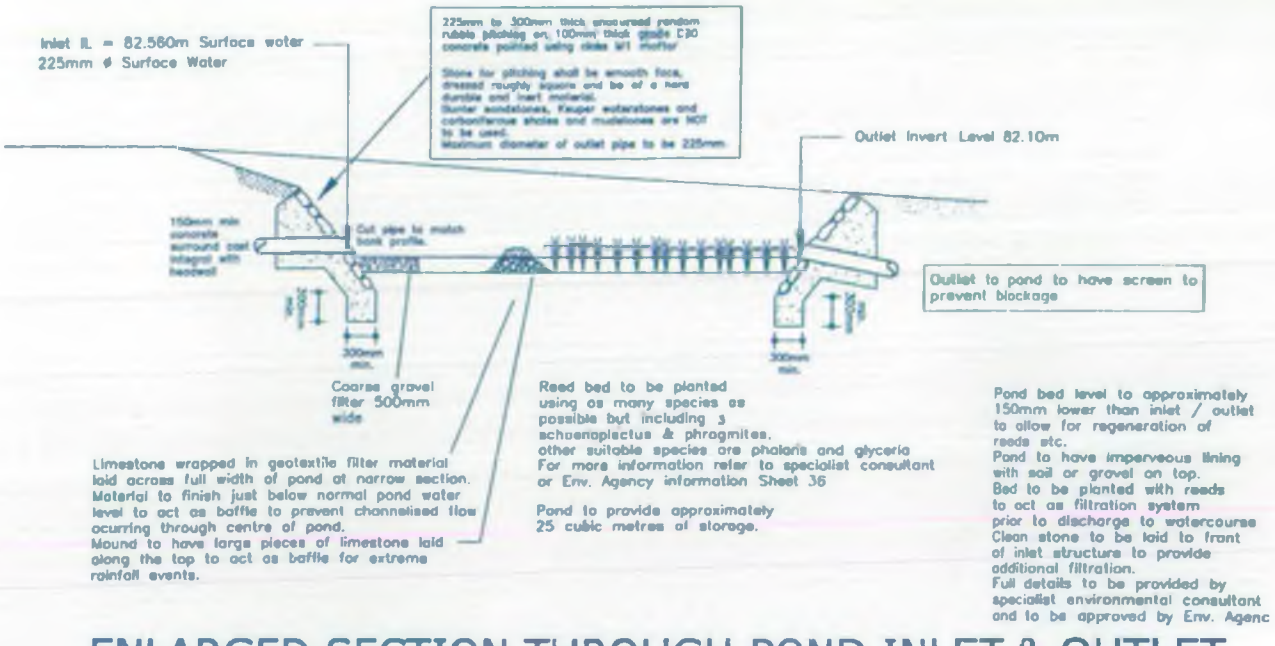
Reed bed and balancing pond
Grid Reference SD533 040

This 8 house development is sited adjacent to Smithy Brook, a main river tributary of the River Douglas. The Council supported the Agency by, as requested, placing a condition on the planning approval to attenuate surface water run-off. A particular problem on the site was the absence of a foul sewer.

Small developments are particularly difficult to attenuate as the final discharge control pipe is often so small as to be impractical. Therefore Robert E Fry and Associates, the consultant, proposed a balancing pond adjacent to Smithy Brook in order to attenuate surface water run-off.
A sewage treatment plant and reed bed treats the foul sewage. The reed bed discharges into the balancing pond thereby providing further dilution. The system will be maintained by a management company. Formal permission was obtained from the Agency for the discharge from the treatment plant and Land Drainage Consent for the outfall.

Where a balancing pond is sited adjacent to watercourses it is essential that the pond is not within the flood plain of the watercourse. Otherwise the pond could be drowned out during an event and rendered useless as an attenuation system at the very time it is needed most. In this instance the brook is contained within a deep valley and the pond is well above flood level.





ENLARGED SECTION THROUGH POND INLET & OUTLET

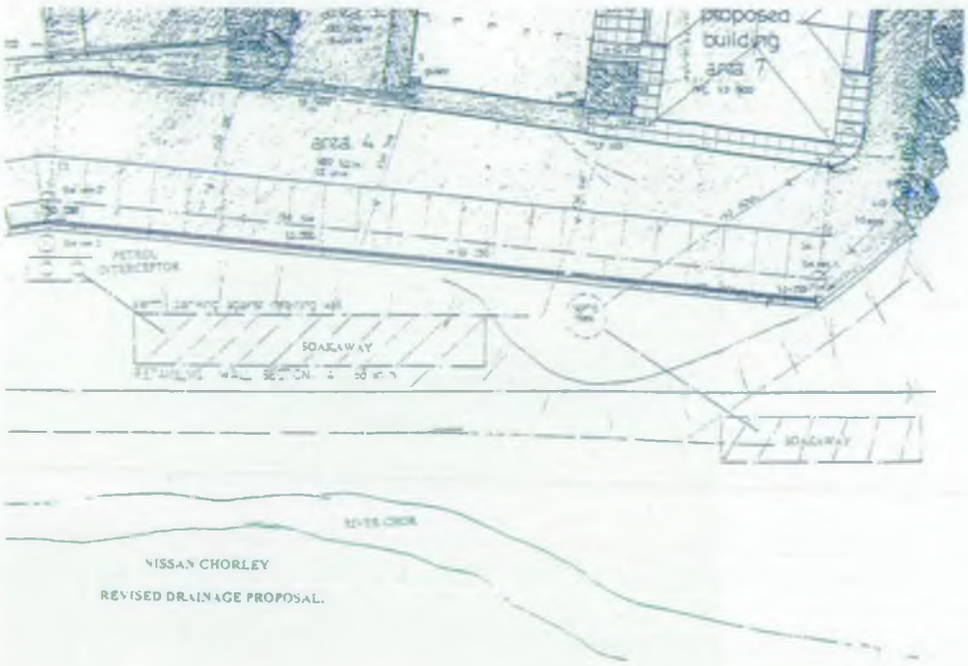
CASE STUDY 7

Nissan Chorley – Industrial Development, Chorley

Industrial unit soakaway system
Grid Reference SD569 179

The drainage system for Nissan Chorley provides a typical example of the use of simple soakaways. The site drains to the River Chor, which has existing flooding problems.

Nissan's planning permission required surface water run-off restricted to existing greenfield rates because of this. The site also required a septic tank system.



The Agency promoted the use of soakaways for the site. These would remove the need to construct a considerable length of oversized sewer and a controlling outfall to the river. As a result discharge consent for the septic system was not required. Ground conditions proved satisfactory and two separate soakaways were installed. One for the septic tank discharge and one to serve the surface water system.

The soakaways provided a sustainable drainage system and, at the same time, a considerable saving to the developer. The septic tank soakaway dramatically reduces the possibility of the system polluting the river.

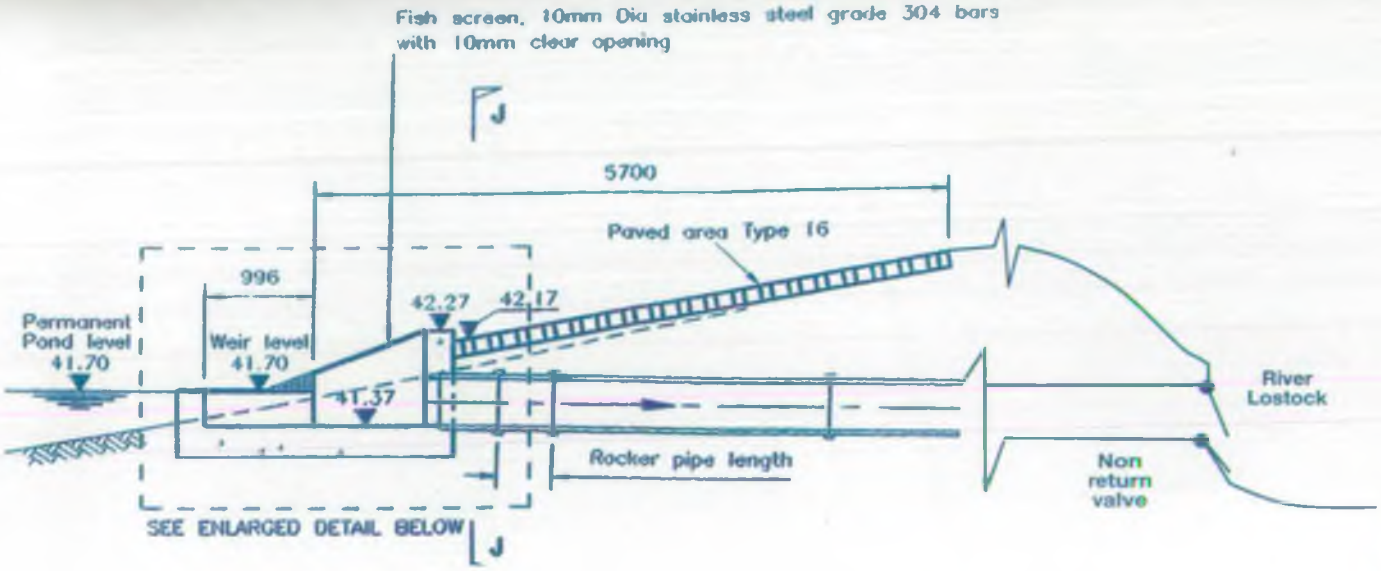
M65 Motorway – South Preston

CASE STUDY 8

Flood storage basin
Grid Reference SD567 246

The River Lostock has existing capacity and flooding problems. The large impermeable area of the new M65, a good part of which drains to the river, could have made these problems more pronounced.

Extensive negotiations with the Highways Agency and Howard Humphries, their consultants, resulted in the construction of the large flood storage basin pictured below. The basin is set in a triangle of land between the M6 and M65, not accessible by the public. In addition to providing the appropriate volume of flood storage the site provides valuable habitat.



CASE STUDY 9

Redrow Residential Development – Longton

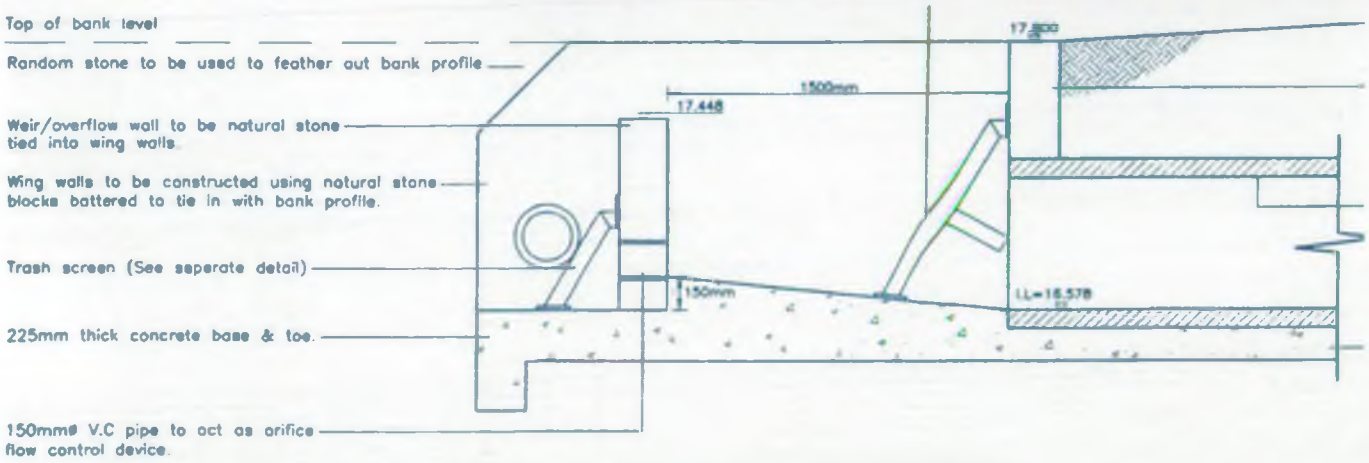
In line storage within retained watercourse
Grid Reference SD485 256

The Redrow Homes site of residential units at School Lane, Longton, drains to Hall Pool. This watercourse causes fairly frequent flooding in Longton Village. In order to ensure the flood risk is not made worse, South Ribble Council conditioned the planning approval to require a surface water regulation system for the residential development.

The site is crossed by two existing watercourses, which drain to Hall Pool. Both watercourses are retained as features of the site with surface water sewers from the development discharging freely to them. In line control structures to each watercourse restrict the rate at which surface water can leave the site to less than the previous greenfield rate. The watercourses within the site have been resectioned to provide the appropriate volume of flood storage. The new channel profile will also provide improved aesthetic and ecological value to the watercourses and development.

By retaining and amending the existing watercourses the need to provide expensive below ground storage tanks and oversized sewers has been removed. This imaginative scheme will provide not only improved environmental value to the site, but also a significant cost benefit to the developer. Restricting run-off from the site to less than the previous rate also provides a small reduction in the flood risk to Longton Village.

CASE STUDY 9


Top of bank level
Random stone to be used to feather out bank profile
Weir/overflow wall to be natural stone tied into wing walls.
Wing walls to be constructed using natural stone blocks battered to tie in with bank profile.
Trash screen (See seperate detail)
225mm thick concrete base & toe.
150mmø V.C pipe to act as orifice flow control device.
17.448
1500mm
150mm
LL=16.578

CASE STUDY 10

Residential Development – adjacent to Carr Brook, Whittle le Woods

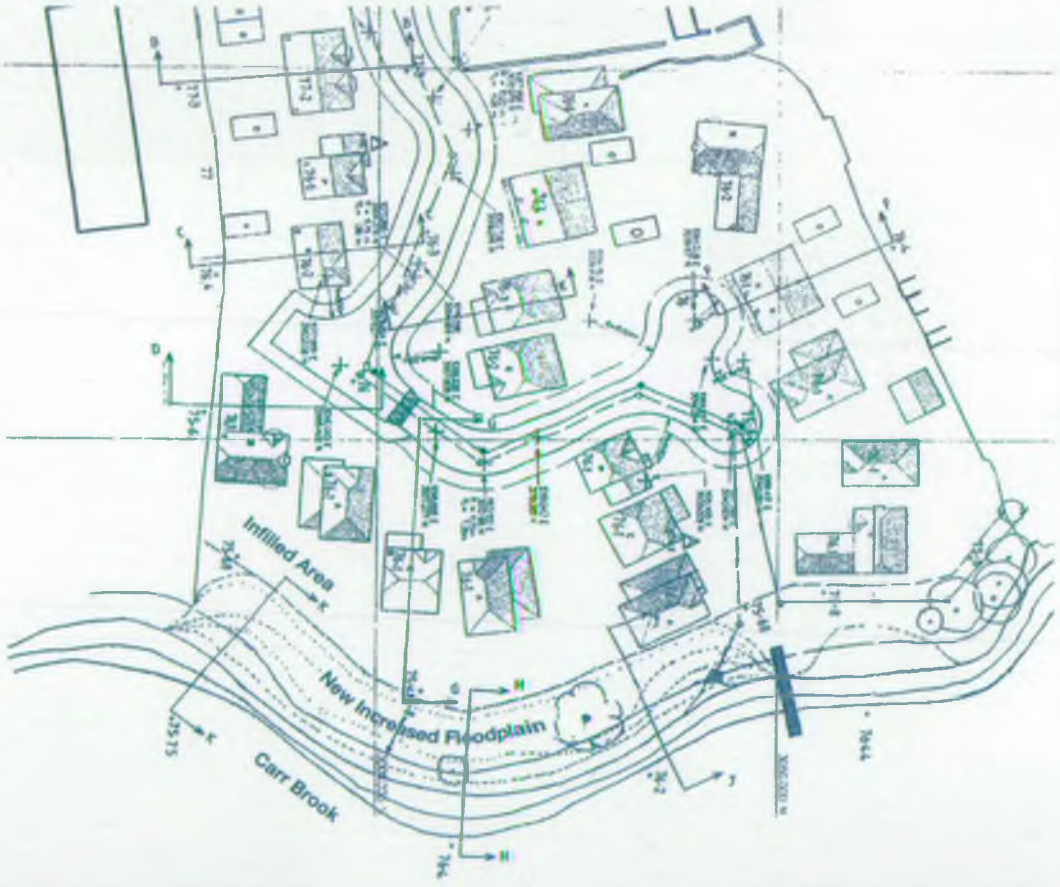
In line flood storage
Grid Reference SD580 255

Rowland Homes proposed a residential development of a greenfield site adjacent to Carr Brook. There are existing flooding problems on Carr Brook which cause the Agency concern, and the site is partly within the brook's flood plain.

At the Agency's request Chorley Borough Council placed a condition on the planning approval which required surface water run-off to be restricted to greenfield rates, and any infilling of the flood plain fully compensated for. As is usual in these instances the Council's Planning Officer consulted the Agency on the developers scheme to comply with the condition requested by the Environment Agency.

An inadequate culvert downstream permitted both the run-off restriction and flood storage mitigation to be achieved by creating a low-level area adjacent to the brook. The flood storage volume finally agreed was considerably in excess of actual requirements thereby creating a real reduction in the flood risk frequency downstream. The ecological and aesthetic value of the brook has also been enhanced.

All the new homes are set outside the revised 100-year event floodplain. To reduce the flood risk even further, ground floor levels are set at least 600mm above the level of such an extreme event.



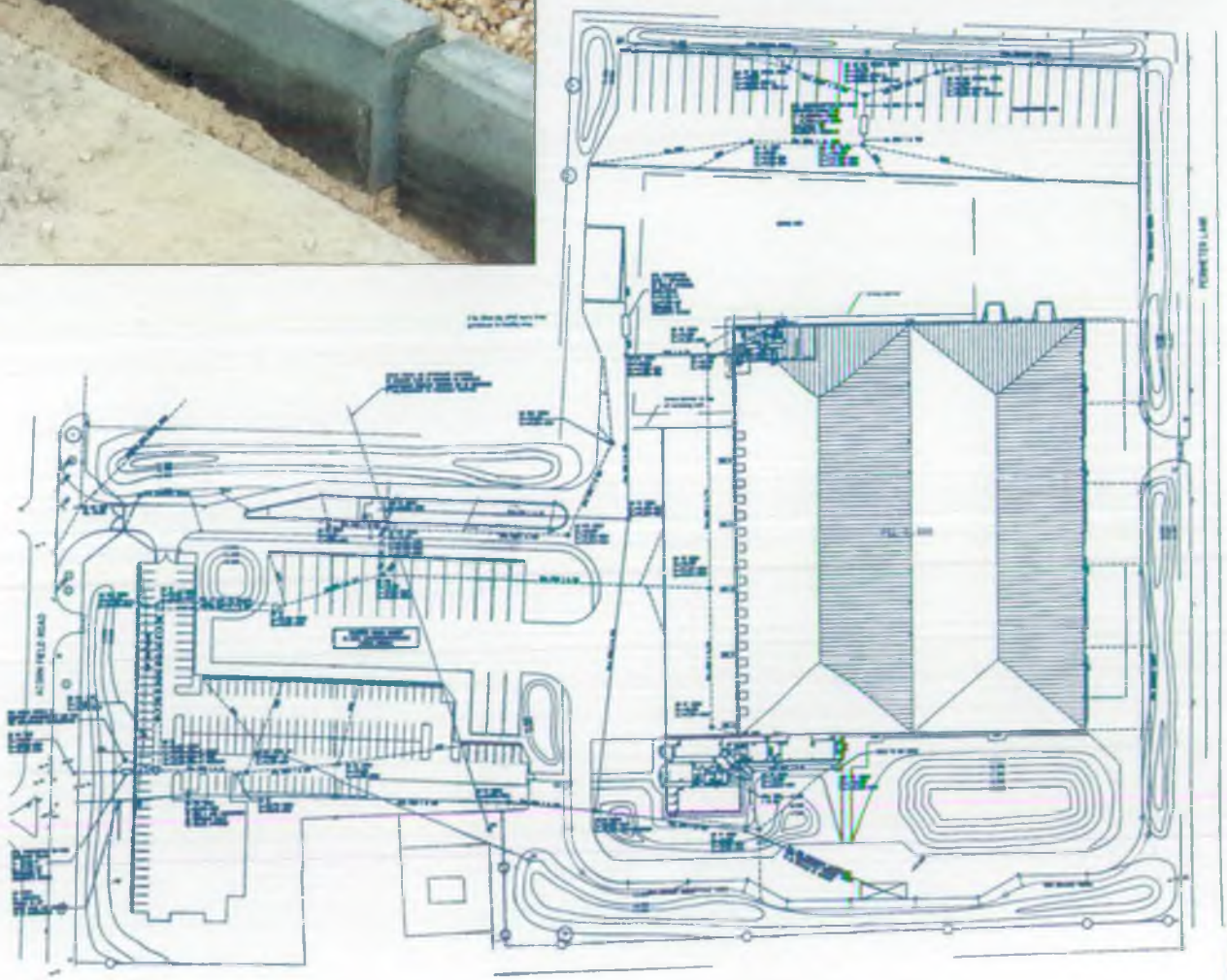
Industrial Site – Tradeteam Ltd, Acornfield Road, Knowsley Industrial Park

CASE STUDY 11

Peripheral soakaways
Grid Reference SD439 990

This site drains to the River Alt in Knowsley, which has existing capacity problems. Therefore the planning permission for this greenfield site is conditioned so surface water run-off will be restricted to no more than existing rates. WSP, the consultant working for Tradeteam, agreed to install french drain type soakaways throughout the site in order to reduce considerably the volume of attenuation storage required.

One concern where industrial sites use soakaways is the effect on groundwater. Clearly any areas where contaminants are stored or where potential spillage may occur must not be permitted to soakaway. In this case the site is to be used as a warehouse distribution centre with the loading and wagon parking areas discharging to a surface water sewer via an interceptor. The Agency was content for soakaways to be used as no industrial processes are proposed.



CASE STUDY 12

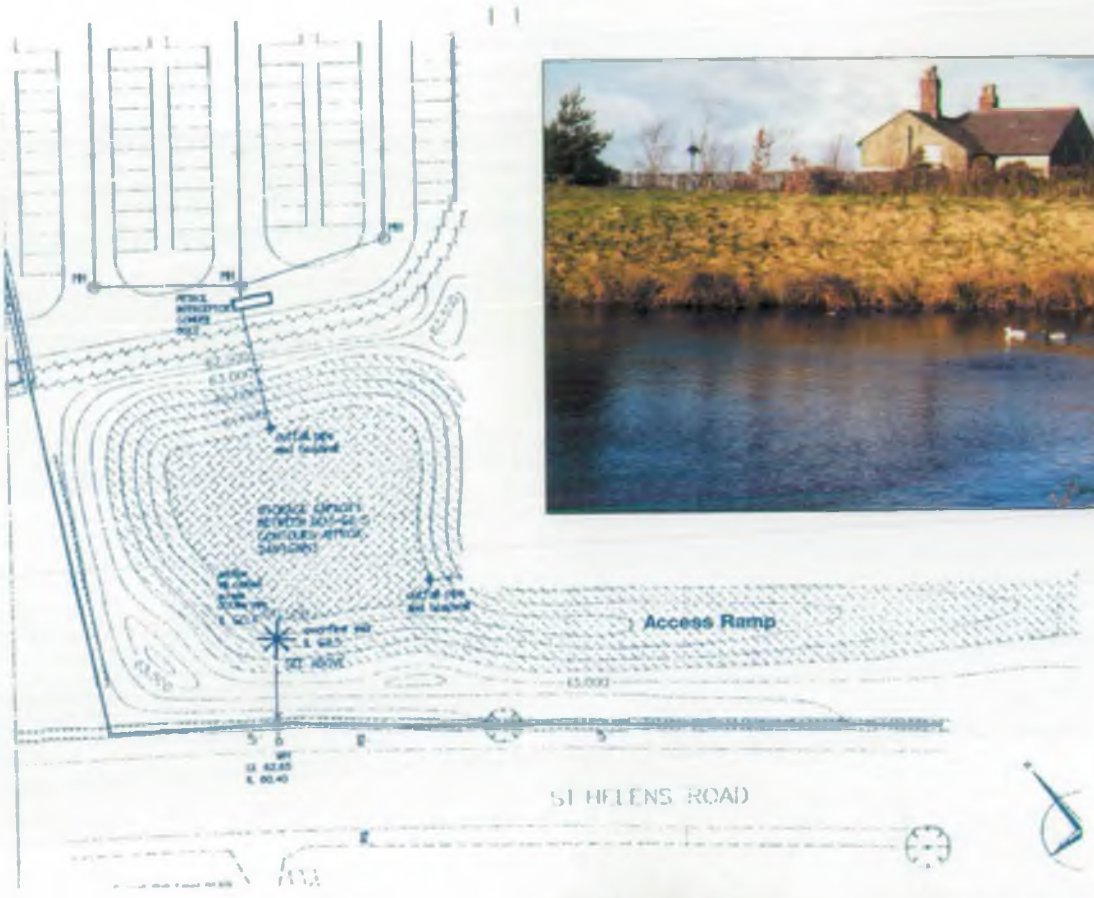
Edge Hill College – Ormskirk Campus

Balancing pond
Grid Reference SD422 071

A substantial extension to buildings and impermeable sports areas at Edge Hill College had the potential to generate a very significant increased rate of surface water run-off to Hurlston Brook. This main river watercourse runs through the centre of Ormskirk and has existing capacity problems which has resulted in several severe flooding events in the past.

The Agency promoted the use of a balancing pond designed to attenuate run-off to somewhat less than existing rates. The photographs show the established pond. One feature clearly shown in the photograph is the gentle access ramp designed to increase the storage volume and provide machine access for desilting and maintenance purposes.

CASE STUDY 12



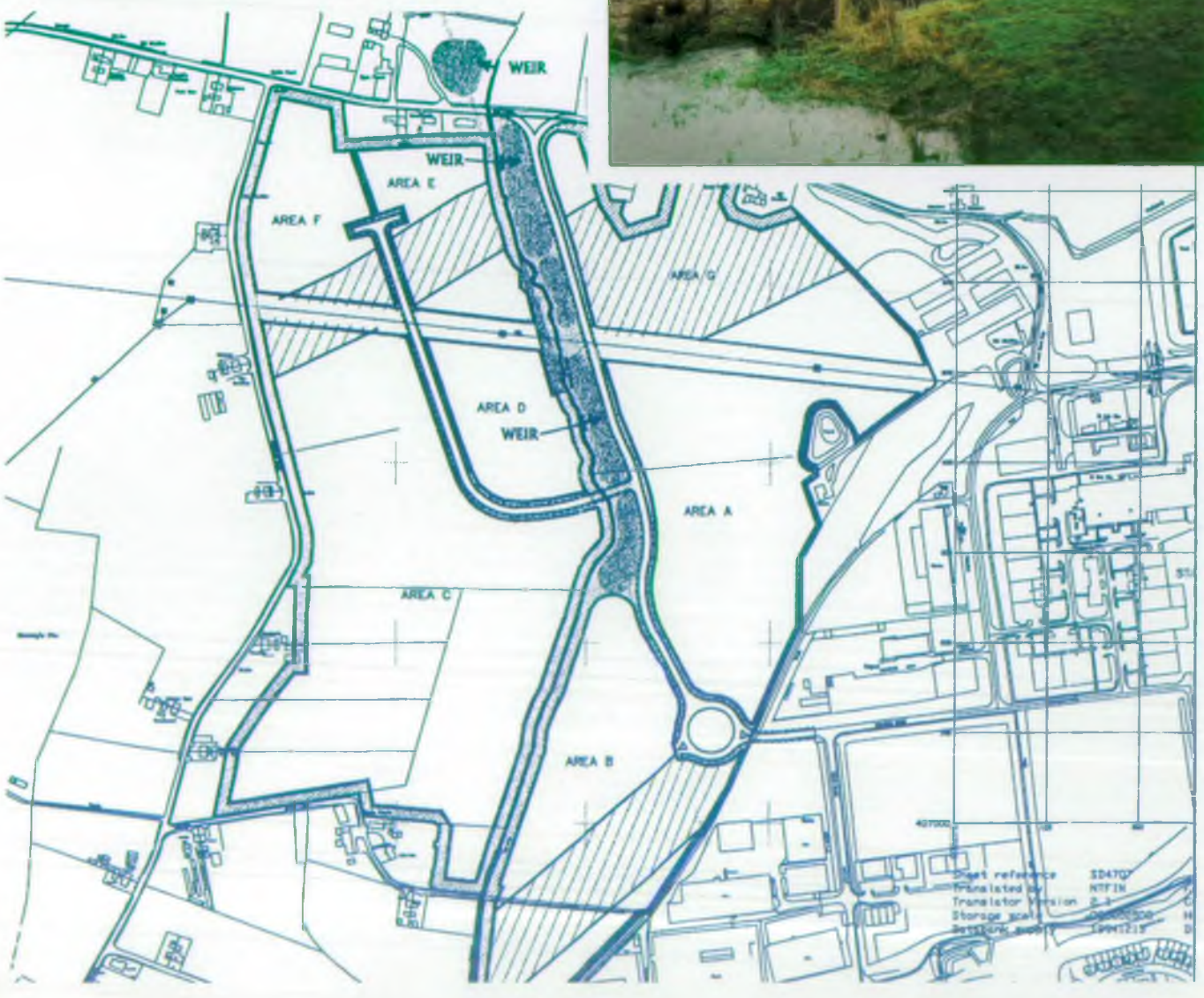
CASE STUDY 13

Slate Farm Industrial Development – Skelmersdale

Off line balancing ponds
Grid Reference SD465 073

A large industrial site on the north west edge of Skelmersdale is in the early planning stage. The main river watercourse, Slate Brook, runs through the centre of the site. This brook is a tributary of the River Douglas, which suffers existing capacity and flooding problems. The Agency is anxious to prevent an increased flood risk downstream and have asked the Council to ensure surface water run-off from this large development site is restricted to no more than existing rates. The use of a large balancing pond to serve the whole site was suggested.

In the Development Brief, West Lancashire District Council support the use of SuDS for the site. The plan shows an example of how this could be arranged. The system should include reed beds to improve water quality. With careful design the pond system will provide significant aesthetic and ecological benefit to the area.



Sustainable Road Drainage System – Perimeter Road, Kirkby

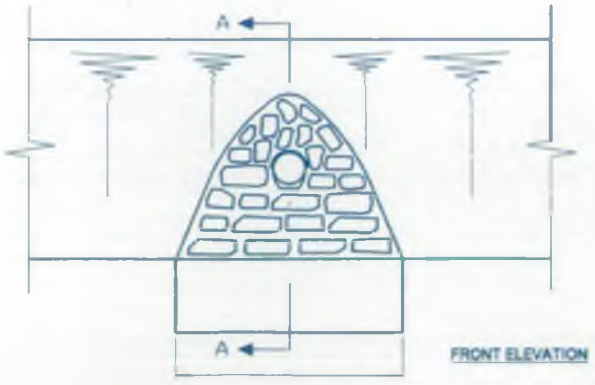
CASE STUDY 14

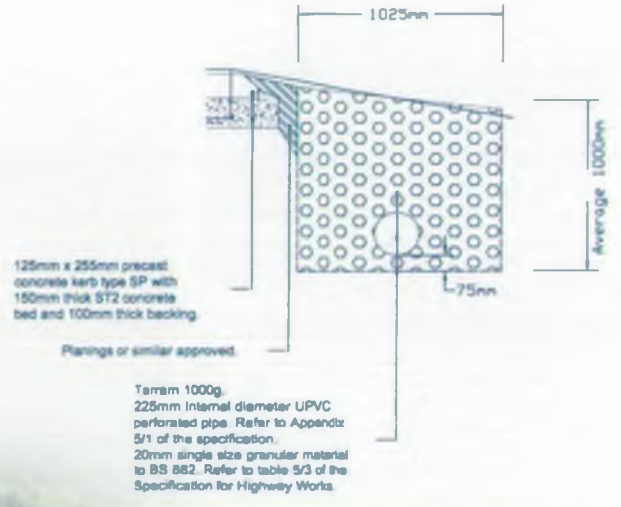
Conveying soakaways
Grid Reference SJ440 995

The northern section of Perimeter Road in Kirkby suffered from poor drainage and localised flooding. Traditional improvements to bring the poor road drainage up to standard would have increased surface water run-off rates to the receiving watercourse system, which has existing capacity problems.

Discussions between the Agency and Knowsley Council resulted in the use of a soakaway system for the road. Concern regarding potential flooding during extreme rainfall was reduced by constructing high level overflows from the linear soakaways to the watercourse.

Another advantage of the system is that the quality of run-off from the road is improved. Contaminates such as silt, oil, rubber, combustion residuals and minor spillages accumulate on road surfaces to be normally washed into the watercourse when it rains. These contaminates, which are referred to as 'non point source pollutants', can significantly reduce the quality of the watercourse. At Perimeter Road, these pollutants infiltrate the ground adjacent to the soakaways where they will degrade over time. Should a major spillage occur then there would be much more chance that it can be safely contained within the system, from where it can be removed fairly readily.





CASE STUDY 15

Mixed Use Brownfield Site redeveloped as Buckshaw Village – Former Royal Ordnance Factory, Chorley

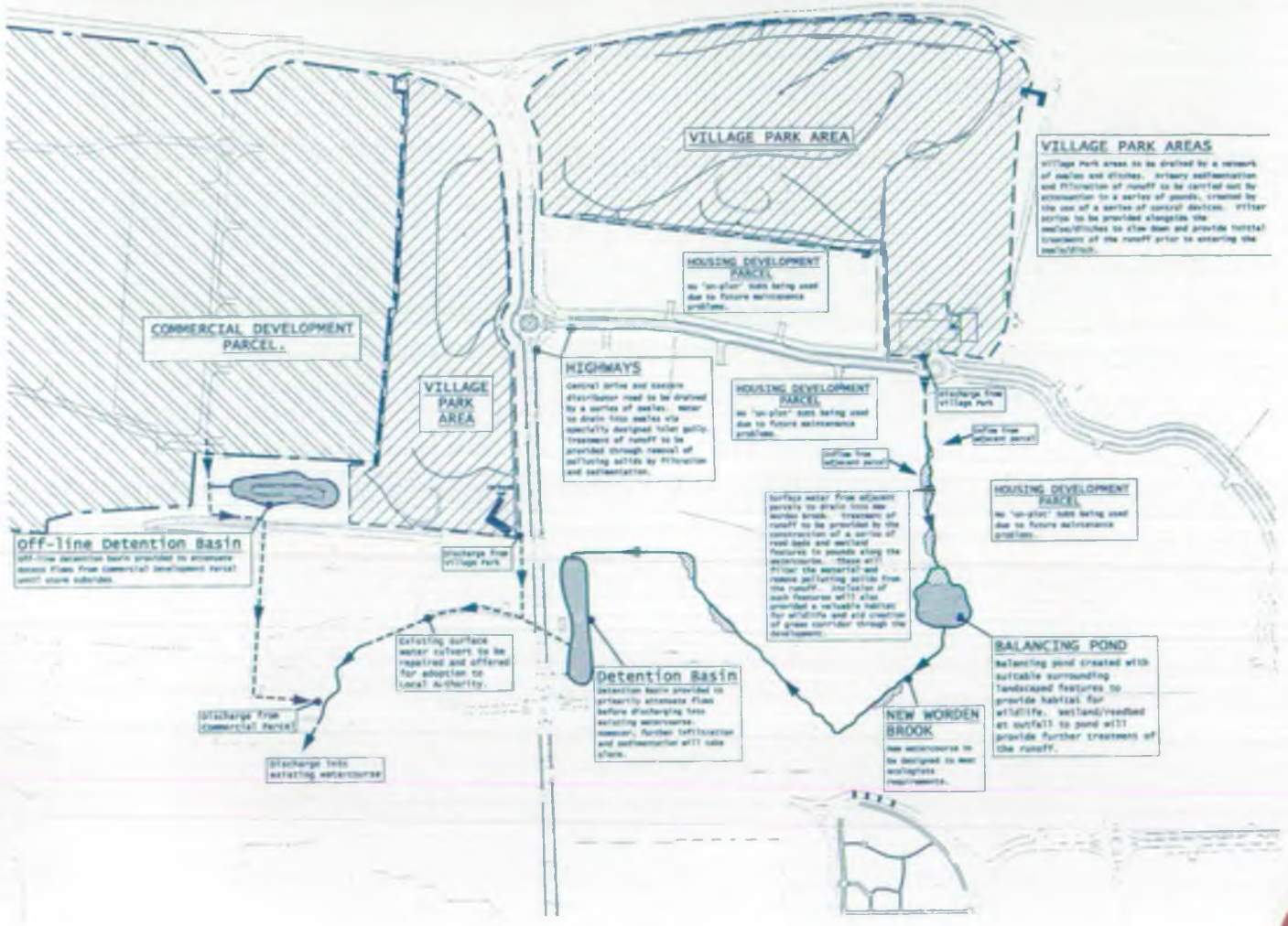
Balancing ponds, swales, reed beds and a regenerated watercourse Grid Reference SD560 209

The former Royal Ordnance Factory at Chorley is being redeveloped to create 'Buckshaw Village'. This major scheme will result in a mix of retail, residential and industrial development. Both South Ribble Borough Council and Chorley Borough Council promoted the use of Sustainable urban Drainage Systems (SuDS) for the site.

The schematic plan shown outlines the various features of the integrated sustainable drainage system for part of the site. The main highways and park areas will drain to an interlinked system of swales designed to not only restrict surface water run-off but to improve the quality of that run-off. The industrial areas will restrict run-off and improve low flow water quality by the use of detention basins and reed beds. These basins also provide the opportunity to incorporate features of ecological interest.

Worden Brook, which disappeared into the sewer system when the factory was first developed, is to be recreated with in line ponds and reed beds. The watercourse and ponds are to become a feature of a residential part of the development and are expected to significantly increase the value of the adjacent housing.

CASE STUDY 15



Glossary

Attenuation	To reduce the force of a flow through a system, which has the effect of reducing the peak flow and increasing the duration of a flow event
Balancing Pond	A pond designed to attenuate flows by storing run-off during peak periods and releasing it after the flow has passed
Basin	Flow control or water treatment structure that is normally dry
Catchment	The area contributing flow to a point on a drainage system
Combined Sewer	A sewer designed to carry foul sewage and surface run-off in the same pipe
CSO (Combined Sewer Overflow)	An outfall from a combined sewer designed to prevent the capacity of sewage treatment works from being exceeded under storm flow conditions by allowing the discharge of excess diluted sewage to a watercourse
Detention Basin	A basin constructed to store water temporarily to attenuate flows
Floodplain	Land adjacent to a river that is subject to regular flooding
French Drain	A stone filled trench, usually with a perforated conveying pipe in the base
Infiltration - to the ground	The passage of surface water through the surface of the ground
Infiltration - to a sewer	The entry of groundwater to a sewer
Infiltration Basin	A dry basin designed to promote infiltration of surface water to the ground
Infiltration Trench	A trench, usually filled with stone, designed to promote infiltration of surface water to the ground
Lagoon	A pond designed for the settlement of suspended solids and/or flood storage
Main River	Main arterial watercourse as designated by DEFRA and controlled under the Water Resources Act 1991
Non Main River	Other ordinary watercourses which are controlled under the Land Drainage Act 1991
Pond	Flow control or water treatment structure that is wet
Retention Pond	A pond where run-off is detained (eg. for several days) to allow settlement and biological treatment of some pollutants
Runoff	Water that flows over the ground surface to the drainage system. This occurs if the ground is impermeable or if permeable ground is saturated
Separate Sewer	A sewer for surface water or foul sewage, but not a combination of both
Soakaway	A sub-surface structure designed to promote the infiltration of surface water
Source Control	The control of run-off or pollution at or near its source
SuDS	Sustainable urban Drainage Systems: a sequence of management practices and control structures designed to drain surface water in a more sustainable fashion than some conventional techniques (may also be referred to as sustainable drainage systems SuDS)
Swale	A grass-lined channel designed to control the flow rate and quality of water as it drains from a site
Watercourse	Any natural or artificial channel that conveys surface water
Wetland	A pond that has a high proportion of emergent vegetation in relation to open water

References

CIRIA/Department for the Environment, Transport and Regions, Sustainable urban Drainage Systems: design manual for England and Wales (2000)

CIRIA/Department for the Environment, Transport and Regions, Sustainable urban Drainage Systems: best practice manual (2001)

Department for Transport, Local Government and the Regions, Planning Policy Guidance Note 25: Development and Flood Risk (July 2001)

English Nature, Water level requirements of wetland plants and animals (1997)

Environment Agency, Policy and practice for the protection of floodplains (1997)

Environment Agency, Policy and practice for the protection of groundwater (1998)

Environment Agency, Pollution Prevention Guideline 3: Use and design of oil separator in surface water drainage system

Environment Agency & North West Water Ltd (now United Utilities), Memorandum of Understanding on Urban Drainage (1998)

Environment Agency, Urban Rivers Our Inheritance and Future (2002)

Institute of Hydrology, Flood Estimation Handbook (1999)

Royal Society for the Protection of Birds, The new rivers and wildlife handbook (1994)

The Stationary Office, Land Drainage Acts (1991, 1994)

The Stationary Office, Water Resources Act (1991)

The Stationary Office, Environment Act (1995)

The Stationary Office, Groundwater Regulation (1998)

NORTH WEST REGION ADDRESSES

REGIONAL OFFICE
Environment Agency
PO Box 12
Richard Fairclough House
Knutsford Road
Warrington WA4 1HG
Tel: 01925 653 999
Fax: 01925 415 961

NORTH AREA
Environment Agency
Ghyll Mount
Gillan Way
Penrith 40 Business Park
Penrith
Cumbria CA11 9BP
Tel: 01768 866 666
Fax: 01768 865 606

CENTRAL AREA
Environment Agency
Lutra House
PO Box 519
South Preston
Lancashire PR5 8GD
Tel: 01772 339 882
Fax: 01772 627 730

SOUTH AREA
Environment Agency
Appleton House
430 Birchwood Boulevard
Warrington WA3 7WD
Tel: 01925 840 000
Fax: 01925 852 260

For general enquiries please call your local Environment Agency office. If you are unsure who to contact, or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY GENERAL ENQUIRY LINE

0845 933 3111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY EMERGENCY HOTLINE

0800 80 70 60

ENVIRONMENT AGENCY

NW 07/01.1k.CI.BGUZ. Printed on 100% recycled paper.