the NATURAL STEP™

ENVIRONMENT AGENCY

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Putting Sustainable Drainage Systems (SUDS) into Practice

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Putting Sustainable Drainage Systems (SUDS) into Practice

Summary

1. Introduction 1

2. Background Issues 2

2.1 Floodwater management in the UK 2

2.2 The benefits of SUDS 3

2.3 The importance of good design 4

2.4 Duties to promote sustainable water management 4

2.5 The opportunity for landowners and managers 5

2.6 The opportunity for water service providers 6

3. Technical Support to Facilitate Practical Decision-making 7

3.1 The benefits of a decision framework 7

3.2 The decision flowchart and supporting information 7

3.3 Field-testing the decision flowchart 12

4. Making SUDS Happen: Conclusions and Recommendations 13

4.1 SUDS as 'stepping stones' 13

4.2 Conclusions about making SUDS happen 14

4.3 Recommendations for further work 15

Annex 1: About this *2020 Vision* Project i

Annex 2: Responsibilities for Storm Water Management in the UK iii

Annex 3: Duties to Promote Sustainable Water Management v

Annex 4: Liabilities Relating to Potential Pollution of Receiving Waters vi

Annex 5: Adoption of SUDS Schemes During Operational Life ix

EA-Sustainable Development

Summary

The need for Sustainable Drainage Systems (SUDS) has never been greater, and their benefits are clear. However, traditional unsustainable drainage methods for rainwater remain the *de facto* norm favoured by developers and planners. This *2020 Vision* consensus-based study by The Natural Step (TNS) in the UK, in collaboration with the Environment Agency and many other key players in this debate, investigates perceived obstacles to SUDS implementation, develops practical guidance on decision-making about SUDS, and identifies relevant sources of technical information to support design. A decision flowchart, with supporting information, is central to the report.

Although this study covers similar ground to some of the work of the National SUDS Working Group, it endeavours to bring a fresh view to the issues and to apply The Natural Step's systems-based approach. It does not replicate excellent work being done elsewhere on ensuring good SUDS design, but provides practical guidance on decision-making about SUDS. The emphasis of this report is on the provision of clear messages and practical guidance. The main body of the report is therefore relatively short, with supporting information provided for those needing it in a series of Annexes.

The study comes to a range of conclusions, some of which support the direction taken by the National SUDS Working Group. These include the importance of focusing on the systems perspective to deliver the maximum benefits of SUDS, and confirmation of the need to address the six key sustainability challenges identified in the first TNS *2020 Vision* project *Sustainable Drainage Systems (SuDS): An Evaluation Using The Natural Step Framework.* It also concludes that many perceived pollution risks associated with SUDS are largely unfounded. A key conclusion is that the policy environment is today attuned to traditional piped schemes and, whilst committed individuals and organisations can meets its requirements when installing SUDS, their wide-scale implementation and adoptions will depend upon revision of the regulatory framework. The same principle applies to economic signals provided by those regulations, which may be at odds with the requirements of the EU Water Framework Directive. It is clear that SUDS need to become a higher priority planning issue, and awareness, more attuned regulation and improved networking between all interested organisations all have a part to play.

Three recommendations for priority research to drive forwards sustainable drainage emerge from this work:

1. **Review of legislation from a systems perspective**. This report exposes the ways in which current regulations restrict the free implementation and adoption of SUDS, and provide a good foundation from which to research necessary revisions to policy. The National SUDS Working Group is currently undertaking a review of legislation to promote and secure ownership and maintenance of SUDS, which is welcomed. However, a review from a systems perspective necessarily considers longer time scales, and is not constrained by today's organisation boundaries and responsibilities.

2. **Review of economic incentives for SUDS**. This partnership-based research would comprise two levels: (1) the economic signals stemming from appropriate regulatory review; and (2) collation of more data on life cycle costs that make a case for the multiple benefits of SUDS relative to traditional piped schemes.

3. **Review of organisational collaboration**. This would help decision-makers better understand the networks that need to be developed to deliver the full benefits of SUDS to society. (The National SUDS Working Group is currently developing an 'Adoption Matrix' of SUDS techniques which will make it clear which organisation will be responsible for adoption.)

This is a fast moving area of work, and some of these recommendations are already the subject of projects being undertaken by the National SUDS Working Group, the Environment Agency and UKWIR. TNS is grateful to the Environment Agency for funding this project through its R&D Project No.P2-261/14, for which this report forms the Project Note.

The Environment Agency has contributed to this project through its R&D programme to help explore and develop consensus about a number of the more contentious sustainability-related issues connected with the development and adoption of SUDS. This document does NOT reflect Environment Agency policy, but presents the consensus of an independent 'think-tank' process that may be helpful at a later stage as a contribution to policy development.

1. Introduction

The need for Sustainable Drainage Systems (SUDS) has never been greater, and their benefits are clear. However, traditional unsustainable drainage methods for rainwater remain the *de facto* norm favoured by developers and planners. It is therefore essential that we make serious progress with unblocking perceived obstacles to their more widespread implementation. The network of partners involved in a previous study[1] by The Natural Step (TNS) identified some key obstacles to selection of SUDS.

The Natural Step (TNS) in the UK has therefore, in collaboration with the Environment Agency, instigated this subsequent *2020 Vision* study. Using the consensus building and system perspective approach championed by The Natural Step, it seeks to investigate and overcome false perceptions that may have presented obstacles, develop practical guidance on decision-making about SUDS, and identify relevant sources of technical information to support design.

Although this study covers similar ground to some of the work the National SUDS Working Group[2], it endeavours to bring a fresh view to the issues and to apply The Natural Step's system based approach. It does not replicate excellent work being done elsewhere on ensuring good SUDS design[3]. The major emphasis of this study is on providing practical guidance on decision-making about SUDS, a major part of which is to help break down the perceived barriers to the practical application of SUDS. The findings address problems faced by the water industry, as well as non-water industry applications of SUDS. The emphasis of this report is on the provision of clear messages and practical guidance. The main body of the report is therefore relatively short, with supporting information provided for those needing it in a series of Annexes.

This study has been undertaken with an active network of involved participants from a wide range of organisations. It is also being developed in close co-operation with the National SUDS Working Group to ensure that the overview generated by our systems thinking approach benefits their work, and that the outputs from this project are relevant to policy development.

TNS is grateful to the Environment Agency for funding this project through its R&D Project No. P2-261/14, for which this report forms the Project Note. This study forms part of the TNS *2020 Vision* consensus-building programme. Further details of the process of, and the participants in, this project are provided at Annex 1. Copies of this summary report are available from The Natural Step in hardcopy form, or can be downloaded from the TNS website: www.naturalstep.org.uk. (Contact details on back cover.)

The Environment Agency has contributed to this project through its R&D programme to help explore and develop consensus about a number of the more contentious sustainability-related issues connected with the development and adoption of SUDS. **This document does NOT reflect Environment Agency policy**, but presents the consensus of an independent 'think-tank' process that may be helpful at a later stage as a contribution to policy development.

Note on SUDS Terminology: In it's early days, the acronym SUDS was used to define 'sustainable urban drainage systems'. However, the philosophy of natural drainage applies beyond the urban environment, and so the generally-accepted standard changed to SuDS, standing for 'sustainable drainage systems'. Today, the acronym SUDS has been reinstated by general consensus, led by the Environment Agency and the National SUDS Working Group (standing for the more generic 'sustainable drainage systems'), to avoid any further confusion of terms. This protocol is used throughout this TNS *2020 Vision* report.

[1] *Sustainable Drainage Systems (SuDS): An Evaluation Using The Natural Step Framework*, available from the TNS office in the UK using the contact details on the back cover of this report.

[2] The National SUDS Working Group was set up and is run by the Environment Agency. It addresses potentially problematic aspects of SUDS implementation, including necessary legislative change, and is supported by DEFRA.

[3] See for example, CIRIA manuals 521, 522 and 523 (CIRIA, 6 Storey's Gate, London SW1P 3AU, UK, www.ciria.org.uk; Tel: 020-7222-8891), or the *SuDS Accreditation Checklist* being developed for the Environment Agency.

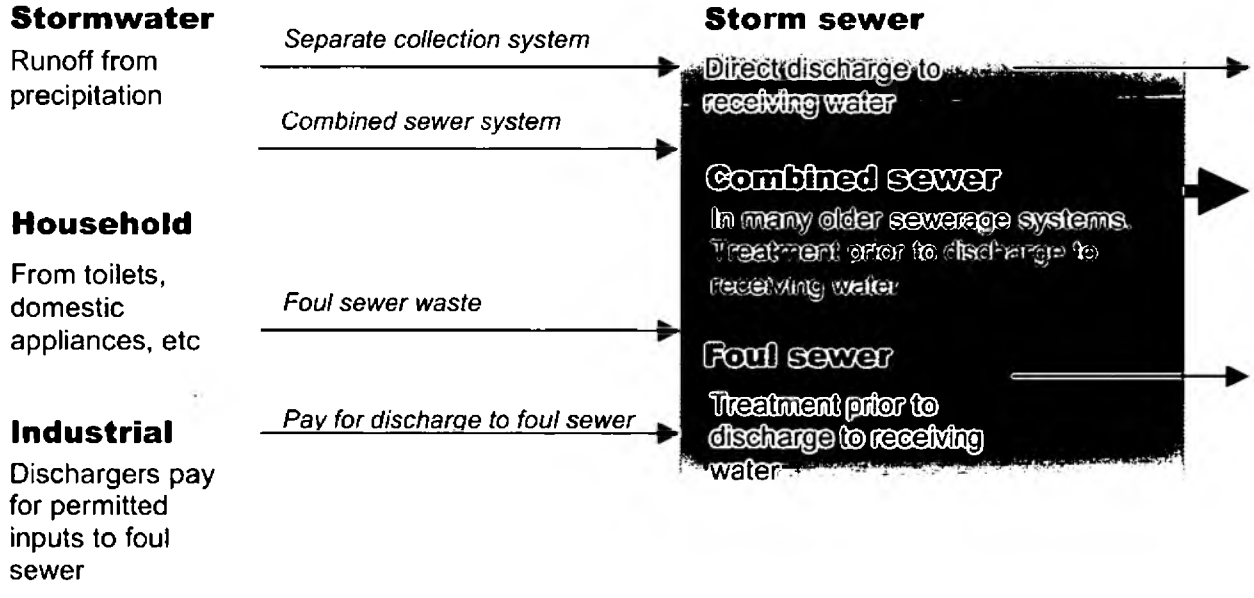
2. Background Issues

This *2020 Vision* SUDS project clarifies current responsibilities for storm water management in the UK, as well as highlighting a number of statutory and other factors which would encourage the promotion and adoption of SUDS by the different players currently involved in or affected by storm water management. SUDS are no solution to massive flooding of the kind witnessed across the UK in the winter of 2000/2001. However, they are demonstrably effective in helping improve or maintain water quality, and addressing some types of local flash flooding. They do so by replicating natural drainage and other ecosystem functions, which are the reference point of good and sustainable drainage design. Flooding events are predicted to increase as a consequence of climate change, exacerbating the need for tenable and more sustainable new approaches.

2.1 Floodwater management in the UK

Approximately 96% of properties in the UK are connected to the public sewer network. Much of the storm runoff from properties and urban areas enters the sewerage system. This storm water may discharge directly to surface waters or, in many cases in urban areas, be combined with waterborne wastes from homes, businesses and factories and conveyed to wastewater treatment plants (Fig 1).

Fig 1: Primary inflows to sewerage systems in the UK



Ownership and management of the various components of this floodwater management system is divided between a range of players, including water service companies, the Highways Agency, local authorities and developers. Specific aspects of these arrangements are outlined in Annex 2. Nationally, it is estimated that 10-30% of the sewerage network is in private ownership outside of these bodies. These private sewers give rise to significant concern about maintenance and liabilities.

2.2 The benefits of SUDS

A previous report by TNS, *Sustainable Drainage Systems (SuDS): An Evaluation Using The Natural Step Framework*[4], explored the contribution of SUDS to sustainable development. It also outlined remaining challenges, both to their widespread application and the achievement of full sustainability.

Traditional approaches to drainage, reliant upon ever-increasing pipework and associated infrastructure, are widely-acknowledged as being unsustainable. SUDS offer a well-established set of alternative, more sustainable approaches that replicate natural drainage functions of the catchment ecosystem. SUDS are primarily concerned with clean water, and its infiltration to groundwater or discharge as near to 'greenfield' rates to surface waters. Some forms of contaminated water are also amenable to treatment via SUDS mechanisms, including silt and other substances often overlooked by traditional drainage systems. In addition to their primary functions of storm water detention and pollution control at source, they also incorporate water resource, amenity and wildlife benefits. As a means to restore ecosystem services lost through the unsympathetic management and development of land-water catchment systems, SUDS offer a strategic step towards restoring the natural functioning and the carrying capacity of catchments. It also creates a possibility to increase the habitat available for wildlife, particularly restoring small ponds. This is entirely consistent with both the spirit and the requirements of the EU Water Framework Directive 2000.

There is a strong case for requiring, within development planning and regulation of the water industry, a presumption in favour of SUDS in all new greenfield or brownfield developments and in retrofit. A clear justification is also necessary explaining exemptions from this presumption, recognising that not all developments are amenable to a full SUDS approach without disproportionate societal cost. It is acknowledged that wholesale replacement of existing infrastructure is unrealistic. However, SUDS solutions can complement existing infrastructure where currently intractable difficulties arise, providing a useful 'migration strategy' towards widespread application of more sustainable approaches in the longer term. The SUDS elements of these hybrid systems will contribute immediately to reducing surcharging of existing floodwater drainage systems, as well as to source control of potential pollutants and the provision of amenity and wildlife benefits.

There may be practical restrictions to using SUDS in densely populated urban environments, although novel approaches such as rainwater harvesting, or the use of underground box storage systems permitting infiltration to groundwater, can effectively replicate certain hydrological functions (as well as providing a substitute for mains water) where the available space is small[5]. In all cases, the economic and social costs and benefits should be evaluated in the light of best available (and fast-evolving) technology, before making too rapid a decision in favour of traditional piped systems.

[4] Available from the UK office of The Natural Step, using contact details on the back cover of this report.

[5] There are many such technologies available. See, for example:

- Andoh, RYG., Faram, MG., Stephenson, A. and Kane, A.S. (2001). *A novel integrated system for stormwater management*, Novatech 2001, 4th international conference on innovative technologies in urban drainage, Lyon, France 25-27 June, pp 433-440.
- Andoh, RYG., Stephenson, A. and Kane, A.S. (2001). *Sustainable Urban Drainage using the Hydro Stormcell™ Storage System*'.

2.3 The importance of good design

SUDS is a design approach which incorporates an evolving suite of existing and new technologies. Effective SUDS schemes need to be well thought through from first principles to ensure that the benefits – natural drainage, detention or treatment of potential pollutants, water resource improvement, wildlife habitat, and amenity – are integral design components. This approach comprises far more than token 'greenery', such as reedbeds within largely traditional drainage schemes, which have been sometimes advanced as 'SUDS'. Effective maintenance is also essential to maintain performance of SUDS schemes, just as it is for traditional piped systems, and this emphasises the importance of correct maintenance planning and the placement of maintenance contracts only with competent companies. Good design of a SUDS scheme will:

- manage out duplication of solutions (for example, there may be little point in installing and maintaining grit or oil interceptors where a SUDS-based swale system will do the same job);
- manage out maintenance problems (such as the interceptors cited above, or elimination of gully pots, or landscaping that reduces requirements for mowing) reducing ongoing costs substantially;
- be accredited, for example through the *SUDS Accreditation Checklist* being developed by the Environment Agency, and their design checked by regulators to ensure that all safeguards are addressed[6]; and
- be subject to formal management agreements, with the responsibilities of all players clearly articulated.

Good design will not only ensure efficacy, but will also avert excessive maintenance costs and will increase acceptance by the public. (Perhaps inevitably, the case studies of some bad SUDS designs have attracted the most attention in the past rather than the many good schemes. However, by differentiating the good from the bad SUDS schemes, this demonstrates the point about needing good design.)

2.4 Duties to promote sustainable water management

Various of the bodies responsible for decision-making about water service infrastructure are charged with duties to promote sustainable development. Given the sustainability benefits of SUDS, there is a clear case for organisations such as the Environment Agency and SEPA (Scottish Environment Protection Agency), DEFRA (the Department of Environment, Food and Rural Affairs), ODPM (the Office of the Deputy Prime Minister), the National Assembly for Wales, and local authorities to promote the benefits of the SUDS approach over traditional 'hard' engineering solutions. Further details of these various duties and powers are provided in Annex 3.

Commercial considerations are an important part of the 'jig-saw' of decision-making. However, it is important that this study and our vision of SUDS recognises the benefit to society of restoring natural drainage processes, and the contribution that they may make to reversing biodiversity loss, reducing the risk of flash-flooding, and creating amenity areas. It is from this systems perspective that the benefits of SUDS are most apparent, over and above the interests of any individual organisations. The Environment Agency and SEPA, central government departments and local authorities in particular should have a keen eye to deliver the maximum benefits to society at that systems level. This will require them to identify

[6] The Accreditation Checklist is currently being updated and simplified, and will form the basis of a training programme by Sustainable Drainage Associates (SDA).

conflicts of interest between commercial interests and potential environmental problems, and make their judgements with a presumption in favour of maximising the benefits to society from protection or restoration of natural processes.

2.5 The opportunity for landowners and managers

There are many opportunities for private landowners and those responsible for public open spaces (or their devolved managers) to reduce management costs through the use of SUDS. This is due to:

- Minimisation of storm water run-off, approaching 'greenfield' rates;
- Designing out excessive or unnecessary maintenance;
- Potential reduction in fees payable to drainage undertakers;
- Maximisation of landscape, amenity and wildlife benefits; and
- Maximisation of property values, which may be enhanced by open water SUDS[7].

In practice, with sensitive SUDS design, there can be significant cost savings relative to traditional maintenance of 'hard' engineering solutions as shown by case studies at Oxford, Stroud College and Hopwood Park (see Box 1, Section 3). Since 'hard engineering' solutions, such as gully pots and oil interceptors, are often required to pre-treat run-off before it enters traditional storm or combined sewers, the application of SUDS techniques by landowners and managers can result in financial savings through elimination of these less sustainable solutions. These savings may be significant, and include capital and maintenance costs, as well as charges for discharge to sewer.

There are also benefits to land managers in terms of the provision of biodiversity and amenity opportunities. In the example of West Stevenage (Section 3 of this report), the Borough Council recognises the amenity value of public open spaces that are also designed to act as infiltration basins, and willingly assumes maintenance requirements (principally periodic mowing).

Because the SUDS approach will generally result in a simplified approach to drainage, the resultant system will probably be maintained by operatives who will be visiting the site to undertake landscape maintenance. Specialist plant, such as gully suckers, will not be required. The self-interest benefits for landowners or managers to assume management responsibility for SUDS reverses the tendency in the UK towards divesting responsibility to water service companies for often substantial fees. These people will also assume some of the presently-devolved risks. However, the economic self-benefit of effective SUDS may be significant. The benefit to the functions of the wider ecosystem may be substantial.

[7] Open water BMPs (Best Management Practices, the US term for SUDS) are widely believed to boost property prices. Two sources for this information are:

- Nuttall, P.M., Boon, A.G. and Rowell, M.R. (1997). *Review of the Design and Management of Constructed Wetlands*. CIRIA Report 180, London.
- The video *Nature's Way: Designing for Pollution Prevention*, International Association on Water Quality (IAWQ), Alliance House, 12 Caxton Street, London SW1H 0QS, T: 020-7654-5500, W: www.iwahq.org.uk.

2.6 The opportunity for water service providers

The Asset Management Planning (AMP) framework establishes agreements on investment by water service companies in England and Wales, and the charges passed on to their customer. In the third round of AMP, know as AMP3 (running from 2000-2005), there was agreement on an investment of £1.7 billion by the water industry to address 4,682 unsatisfactory CSO (combined sewer overflow) schemes, due for delivery by 2005. In Scotland, under the 'Quality and Standards II' framework, the former East of Scotland Water is committed to spending £27.5 million on upgrading CSOs for the period 2000-2005.

The traditional approach to addressing CSO issues has been to increase capacity in piped (unsustainable) systems. However, in many cases, unsatisfactory CSOs may be fixed by reducing the rates at which floodwater enters combined sewer systems during heavy rainfall. SUDS effectively replicate natural drainage functions 'upstream' of sewerage infrastructure, providing water service companies with a direct interest in SUDS as a means to address surcharging of sewers by preventing excessive run-off entering them in the first place. There are some regulatory difficulties to be overcome with the making of these adoption arrangements[8]. However, appropriately sited and well-designed SUDS schemes offer a feasible alternative to the more common but unsustainable approach of merely increasing the capacity of pipework and, with it, loads to treatment works and the risk of flooding further downstream. According to Ofwat (the Office of Water Regulation), the number of properties at risk from internal flooding '*...due to the incapacity of the sewerage system...*' contained in their Level of Services report is 20,368 for one-in-ten year flooding events and 5,644 for two-in-ten year events. SUDS can help alleviate that pressure on the sewerage system by restoring or protecting natural catchment hydrology, simultaneously providing source control of potential pollutants, and wildlife and amenity benefits. SUDS may also be more acceptable to customers than traditional piped schemes, and indeed many economic studies demonstrate that proximity to open spaces and water bodies can increase property values significantly. The SUDS approach may also reduce the need for disruptive sewer replacement in streets, which can generate severe local disruption and opposition. All of these compound benefits, including reduction in pollutant loads for treatment, reduced pumping and treatment costs as reduced volumes are passed forward for treatment, and greater consistency of sewage arriving at treatment works, increase the economic benefits to water companies arising from the promotion of SUDS schemes.

[8] There are restrictions in the legislation of what constitutes a sewer, and what can therefore be adopted by a water company (see Annex 5), for which there are present solutions though in the long term there is a need for legislative revision.

3. Technical Support to Facilitate Practical Decision-making

The diverse benefits of SUDS, and the associated risks of poor design or inadequate maintenance and/or lifetime ownership, highlights the need for a clear and robust decision framework.

3.1 The benefits of a decision framework

Such a framework would:

- help overcome several perceived obstacles to adopting SUDS;
- frame decision-making within the whole system perspective, over and above the interests of any one organisation;
- streamline the decision-making process;
- make it transparent to all involved in SUDS approval;
- offer clear (non-statutory) policy guidance and management structure relating to acceptable forms of SUDS schemes and their location;
- clarify issues relating to potential pollution of receiving waters;
- recognise and maximise all potential benefits of the SUDS scheme;
- identify practicalities of adoption through the operational life of SUDS; and
- refer users to existing resources to inform decision-making.

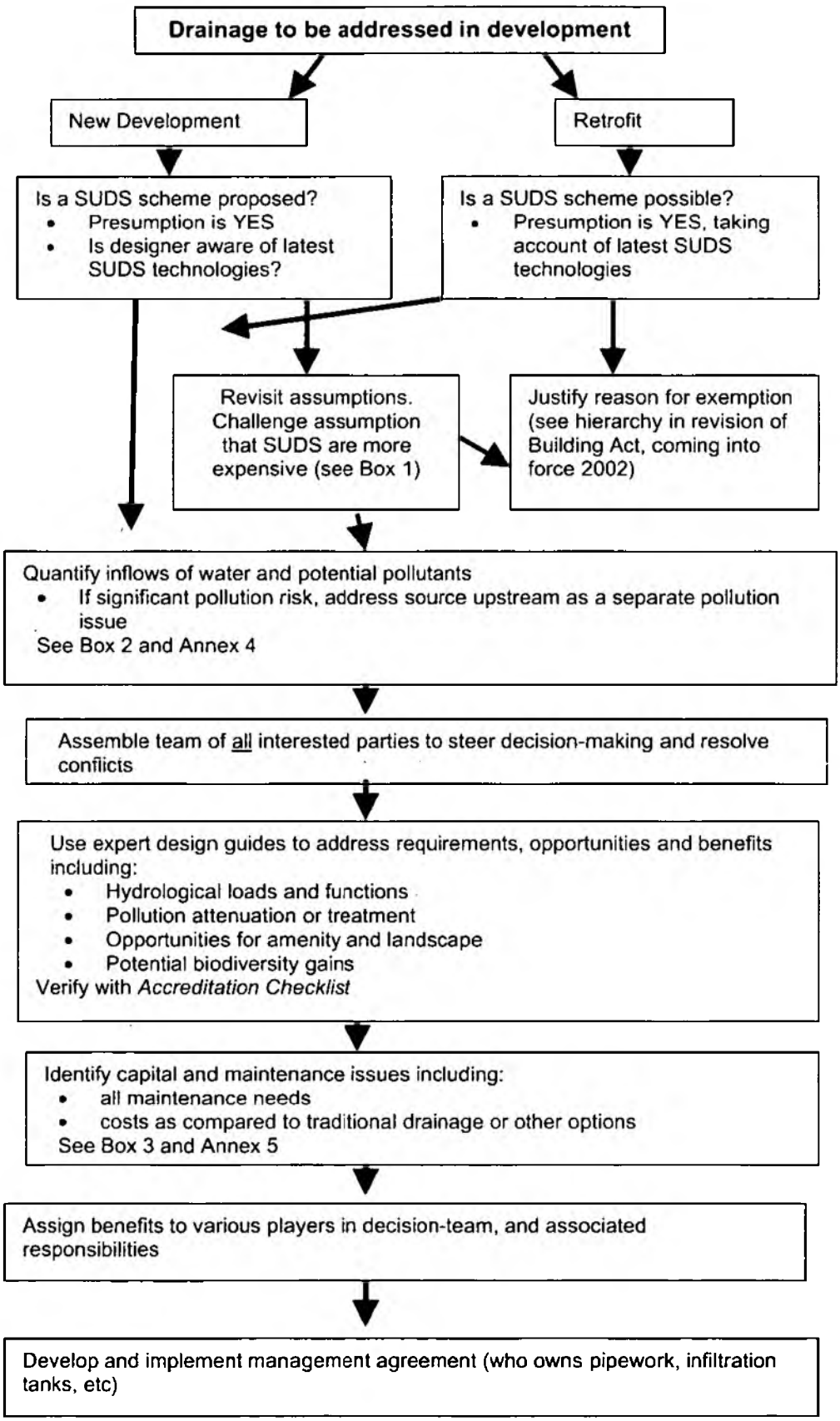
It is critically important that *good design* is ensured (i.e. that the scheme is genuinely a SUDS system, rather than assumed to address all functions and benefits because of incorporation of 'green' features in an otherwise poorly-integrated scheme). Also, that ongoing maintenance needs are established. For this reason, amongst the resources suggested is the *SUDS Accreditation Checklist* being developed for the Environment Agency. The latest technologies should also be assessed, as novel approaches address many of the real or perceived shortcomings of earlier SUDS implementations. These include, for example, technical fixes to address a range of issues, such as underground gravel trenches to detain grit and absorb oil (see reference to Hopwood Park case study in Box 1 later in this Section).

Facilitating practical decision-making in this way enables practical progress with sustainable development in the short term, if not completing the necessarily long journey to full sustainability. It relates particularly to Challenge 6 (Overcome the technological shortcomings of SuDS) from the previous TNS *2020 Vision* project *Sustainable Drainage Systems (SuDS): An Evaluation Using The Natural Step Framework*.

3.2 The decision flowchart and supporting information

A flowchart setting out the decision framework is shown in Figure 2 below.

Fig 2: Decision framework for the adoption of SUDS



Resources

Policy guidance on SUDS should be steered by PPG25 as well as self-interest

For latest research and technologies:
- Eg Building product catalogues produced by RIBA, Barbour Index and Entec (www.endat.com)
- Also the CIRIA web site www.ciria.org.uk

Drainage hierarchy in revision to Building Act, coming into force 2002

Use design guides cited below

Contact Environment Agency or SEPA in the event of potential pollution upstream

Use design guides, the best of which available today are CIRIA Manuals:
- C521 (Scotland & Northern Ireland)
- C522 (England & Wales)
- C523 (best practice)

Guidance on designing SUDS that are good wildlife habitats is provided in the SEPA manual *Ponds, Pools and Lochans*, available from www.sepa.org.uk

See case studies of maintenance and financial arrangements (Box 1)

Accreditation Checklist for Sustainable Drainage Systems (SuDS) Proposals, currently under development in consultation with a range of players. (Contact Robert Bray Associates, Stroud, T: 01453 764885).

Box 1: SUDS Maintenance Costs

The costs of maintaining SUDS schemes will depend on the type of SUDS. There is a perception that SUDS schemes are more expensive than traditional drainage systems. However, there is growing evidence that SUDS are in fact cheaper to maintain. (This probably also applies to capital costs as SUDS are generally simpler technologies. This contributes significantly to potential benefits in terms of whole life costs.) If well-designed, to eliminate duplication of functions and to minimise maintenance needs, an increasing body of case studies demonstrates substantially reduced maintenance costs (many backed up with details of financial agreements). For example:

- R.J. Bray. (2001). *Maintenance of Sustainable Drainage — Experience on two Environment Agency Demonstration Sites in England* and *Environmental Monitoring of Sustainable Drainage at Hopwood Park Motorway Service Area M42 Junction 2*, papers presented at the First National Conference on Sustainable Drainage, Coventry University, 2001. These case studies of SUDS schemes at Oxford, Stroud and Hopwood Park motorway service area provide a clear indication of the financial advantage of SUDS schemes, with annual savings on maintenance of approximately £900-1,200.

- CIRIA is showcasing case studies at www.ciria.org.uk/suds/case_studies.htm.

- Further examples are available on Sustainable Water Environment in Lancashire s website at www.waterambassador.org/SWEL/case.html.

- The video *Nature s Way* includes commentary from Peter Stahre (Malmo Water & Wastewater Works, Malmo, Sweden), stating that that SUDS are always cheaper than conventional methods. Sometimes, this may be as much as half the cost, but savings range from this to 10% cheaper®.

- Today the sustainable approach to storm drainage is generally accepted in Malmo, although this is the result of a long process. The city's decision to adopt an official policy framework for storm drainage based on the ideas of sustainability marked an important milestone. This entailed getting several technical city departments to work together in the planning of SUDS, as an active interest from the different departments is of utmost importance for a successful outcome. Involving developers and the public in the planning process is of equally high importance, and this has been facilitated by the adoption of the policy framework by the city.

  The fact that the water and wastewater systems in Sweden is publicly owned and operated could very well have contributed to Malmo's achievements, as this results in a closer relationship between water service undertakers and other local authorities (city planning, park and recreation, etc) than in England and Wales. This makes it much easier to optimise the whole water cycle, and presents fewer potential legal obstacles. It may also explain at least some of the reason why Scandinavia, the Netherlands and parts of Switzerland - all with a publicly owned and operated water industry - has taken the lead in the development of SUDS.

  - Stahre P. (1999). 10 years experiences of sustainable stormwater management in Malmo, Sweden. Proceedings of ICUD — International Conference on Urban Drainage, Sydney, Australia.

  - Stahre P. (2001). Recent experiences in the use of BMP in Malmo, Sweden. Proceedings of the Engineering Foundation Conference, Snowmass, Colorado, US.

- Various examples in the USA demonstrate benefits of SUDS (or BMPs [Best Management Practices] as they are known there). However, few of the documented case studies include the costs and benefits of BMPs. A wide variety of case studies and information is available. Readers wishing to seek more information are directed to:

- *The national menu of best management practices for stormwater phase II* (www.epa.gov/npdes/menuofbmps.htm); and

- *Preliminary data summary of urban stormwater best management practices* (www.epa.gov/OST/stormwater).

- Research has been commissioned from Binnie, Black and Veatch by Water UK to gauge how SUDS perform in terms of hydraulics and water quality, and to determine real costs. When complete, this research will be a valuable contribution to the debate.

Further monetised case studies are needed to help demonstrate to decision-makers the implications of well-designed SUDS schemes relative to their traditional piped alternatives in a range of applications[2]. Furthermore, there is a need to ensure that these case studies recognise the full extent of the multiple benefits — hydrological, pollution control, amenity and wildlife — including lists of all beneficiaries[3].

[1] The video *Nature s Way: Designing for Pollution Prevention*, International Association on Water Quality (IAWQ), Alliance House, 12 Caxton Street, London SW1H 0QS, T: 020-7654-5500, W: www.iwahq.org.uk. The Malmo case studies do not appear to be documented elsewhere, but details may be available from Mr Peter STAHRE, Malmo Water & Wastewater Works, S- 205 80 Malmo, Sweden (T:*+46-40-34.16.23, F:*+46-40-34.14.48, E: peter.stahre@malmo.se

[2,3] Relating respectively to Challenge 1 (develop clear life cycle costings of SuDS and traditional drainage systems) and Challenge 2 (Increase awareness about multiple benefits of SuDS) of the previous TNS *2020 Vision* project *Sustainable Drainage Systems (SuDS): An Evaluation Using The Natural Step Framework.*

Box 2: Potential Pollution of Receiving Waters

Liabilities relating to potential pollution of receiving waters are an issue for both traditional and SUDS systems. However, there is a perception that such liabilities will be more of an issue for SUDS systems as, by their nature, they do not generally feed into water treatment plants. The reality, of course, is that the same issue applies to traditional storm drainage systems, which have the further problem of higher loads of water and associated mixed pollutants arising from larger catchments. Because we have relied on piped solutions for many years, we tend to overlook their associated pollution risks. SUDS will reduce the risk of liability by either treating or retaining polluting materials rather than dispersing them generally into the environment, where they could be far more costly to remediate.

A key issue for SUDS is that they should be recognised for what they are: systems that replicate and enhance natural drainage processes, whilst bringing about amenity, ecological and financial benefits. They are not automatically part of the sewerage system, though their design intent (to intercept close to source and treat water and pollutants liable to enter surface waters) benefits sewerage undertakers. They seek to detain problem metals, and also to trap and treat persistent organic substances. However, the fact remains that SUDS do not create pollution. This happens due to other activities or conditions upstream, that should themselves be the focus of regulatory controls. Thus, where there are concerns about these substances, we need to go upstream to the source of the pollution, not to point to SUDS as the source of the problem. Further discussion of the particular concerns around potential liabilities relating to pollution of receiving waters is summarised in Annex 4.

There are obviously practical ways through these potential liabilities, clearing the way for SUDS implementation as widely as possible. These must address reasonable concerns whilst acknowledging the wider range of benefits that they can offer and the contribution that they can make to increasing sustainability, decreasing flooding, and lowering inputs to sewerage systems. A growing number of case studies is available which can provide support for this stance (some included in Box 1).

Box 3: Adoption of SUDS During Operational Life

A number of options are available for adoption and maintenance of SUDS. The network established for this *2020 Vision* project identified the need for a flexible approach which is dependent on issues such as the type of SUDS, its location, the recipients of any associated benefits, etc. Detailed discussion of adoption issues is shown in Annex 5. Key points are summarised below.

- ***Implementation and adoption by landowners, managers and water companies***. Since SUDS basically replicate natural drainage, ownership and management would tend to rest with the landowner or devolved manager, or the local authority associated with a public open space. Under current arrangements, water companies would only be involved if the water enters the sewerage system. Where outflowing water from SUDS schemes must enter a sewer, they contribute relatively clean water at a controlled rate (a third best option to complete infiltration or greenfield flows to watercourses under the revised Building Regulations which came into force in April 2002). It is therefore in the water industry s interest to contribute to the wider-scale adoption of SUDS, as this will enable them to receive storm water at greenfield run-off rates or, for less severe floods, not to have to accept storm water peaks at all.

  The Water Industry Act 1991 is the primary legislation relating to sewerage infrastructure, investment and management in England and Wales. Section 94 in particular provides a case for the inclusion of SUDS within the responsibilities of sewerage undertakers (see Annex 5), though the basis of the legislation in traditional piped schemes does create unintended obstacles to be addressed.

- ***Financial aspects of adoption and maintenance***. A perceived problem for water companies is the lack of an income stream for supporting SUDS schemes. Water companies can only levy charges where there is a discharge from a pipe to a sewer. Local authorities currently do not currently pay for rainwater or storm water discharges to sewer in their locality, so are currently not empowered by legislation to ring fence money to support SUDS schemes. The legislation creates an obstacle, though one that may be addressed by looking at the wider benefits of SUDS to a local community.

  If there was a mechanism for charging for drainage — instead of just the current system of charging for discharges to sewer — then this could help divert funds to support SUDS. In new housing developments, for example, where there is a maintenance charge, LAs could charge for drainage . Other mechanisms might include community partnerships or the use of Section 106 Agreements[9]. In the West Stevenage example later in this Section, the amenity value of public open spaces designed also to act as infiltration basins provides a vehicle for utilisation of Parks and Amenities service budgets for ongoing maintenance activities.

  Section 97 of the Water Industry Act 1991 (discussed in greater detail in Annex 5) covers financial aspects relating to sewerage infrastructure and management, including investment by government, local authorities and water service companies. There are shortfalls in the Act with regard to investment in management of SUDS schemes.

- ***Concerns about access for soakaway maintenance***. Soakaways generally require replacement after a 20 year period. There are potential obstacles due to the need for someone who owns the soakaway to be able to enter land to make any improvements. Entry onto private land is becoming a major issue to customers as well as a high cost area for drainage operators.

- ***Implications for adoption***. It appears that there is a need for the integration of drainage responsibilities, and an explicit inclusion of sustainable development within that duty. In terms of ownership, one possibility would be to centralise that responsibility within local authorities. Services associated with the SUDS could then be delegated to private water businesses (water service

companies, developers, residents associations, etc). This would provide a dual incentive for water companies to become involved — not only would it limit floodwater entering the piped system, but would provide them with a revenue stream associated with drainage.

Adoption options are being explored by the National SUDS Working Group (comprising the Environment Agency, ODPM, DEFRA, NAW, Ofwat, Water UK, LGA and others), which is looking to develop a national agreement on the adoption and maintenance of SUDS. A consultation draft on a framework for SUDS in England and Wales is expected to be circulated by the autumn 2002.

[6] Section 106 of the Town & Country Planning Act 1990 allows the drafting of agreements (Section 106 agreements) between local authorities and developers. These are discussed in further detail in Annex 5.

3.3 Field-testing the decision flowchart

Stevenage Borough Council was represented on the network established by TNS to develop this *2020 Vision* project. The West Stevenage development provided an opportunity to field test this approach. This falls short of a full case study, which would be a longer partnership-based approach. However, many elements of the approach already taken by the developer and the Council had already been broadly along those lines.

Field Testing the Flowchart: West Stevenage

In summary, the West Stevenage development is intended to deliver a sustainable new neighbourhood of 5,000 homes, of which 3,600 would be built by 2011. An outline planning application has, at the time of writing, been submitted by The West Stevenage Consortium (comprising Persimmon Homes plc, Taywood Homes plc, Leach, Redrow and Wilcon, the latter three making up The Garden Village Partnership). The proposal includes various SUDS implementations, including roadside swales and open spaces that act as infiltration basins, many with overflows leading to storm drains. Thames Water will provide sewerage, with potable water supplied by Three Valleys Water. At the time of writing, the planning application is still being considered.

The flowchart was applied by TNS and staff at the Council to the available outline plans, including roads infrastructure. It was found to be helpful in guiding decision-making, and determining the partnerships that would be useful to enable the project to proceed. It also helped identify duplication in drainage technologies (gully pots and swales in road drainage, both of which serve similar purposes in trapping grit and oil), providing opportunities to rethink design to remove unnecessary hard drainage technologies and cut construction and long-term operating costs (i.e. benefits in terms of whole life costs of the SUDS scheme).

All partners in the development are happy with the principle and design of the SUDS scheme, although the Heads of Terms of legal agreements for adoption had not yet been determined at the time of writing. The County Council has a policy of promoting the use of SUDS, but is not prepared to adopt all drainage. However, it is prepared to adopt and maintain those parts of the SUDS that handle drainage from roads. Since the infiltration basins comprise public open spaces and serve clear amenity purposes in the development, the Borough Council s *Parks and Amenities* service will undertake basic maintenance (including mowing, etc). However, developers are willing to pay for ongoing maintenance agreements via commuted sums. (The developer naturally pays for capital works.)

Stevenage Borough Council is also considering an approach from a private company to take on the management and the liability of the SUDS schemes. This approach has worked in Scotland in the past, though at this early stage the revenue streams have not been identified.

4. Making SUDS Happen: Conclusions and Recommendations

From a systems perspective, the contribution of technologies such as SUDS that protect or restore natural processes can only contribute to a more sustainable society. SUDS therefore make a positive contribution to sustainable development, provided:

- they are well designed to maximise all benefits, eliminate duplication and minimise maintenance needs;
- maintenance requirements are clearly understood and agreed; and
- ownership of SUDS schemes is clearly agreed, with management shared by beneficiaries.

This report has sought to systematise decision-making to deliver the most sustainable outcomes, on the basis of consensus-between its participants.

4.1 SUDS as 'stepping stones'

SUDS, in their current state of development and application, are not the final solution to sustainable water management. To be fully sustainable, we need to address all four System Conditions of The Natural Step's integrated science-based model of sustainability. This includes eliminating the potential for the accumulation of chemicals in nature, be they mined or man-made substances, as well as physical degradation of natural resources, whilst at the same time ensuring an equal share of resource across society. The elimination of pollutants is best tackled as far 'upstream' as possible, eliminating them or at least containing them within the processes and applications for which society uses them. This is a long journey, entailing society at large realising that there is a price to be paid for a sustainable, clean, safe and biodiverse world.

SUDS approaches nevertheless represent an important interim position between managing potential problems at source versus 'downstream' dispersal or treatment. They certainly have a key place in a sustainable future in which we realise that protecting or restoring the ecosystem functions that provide for our needs, including our economic activities and 'quality of life', is the only really sound investment we can make in our future.

The journey of sustainable development is one of continuous change, as a fully sustainable water management system can only take place within a society that has taken more widespread and committed action with sustainable development. The further action entailed in making this longer journey is well beyond the scope of the present *2020 Vision* project, which nevertheless seeks to establish critically important 'stepping stones' to further progress.

4.2 Conclusions about making SUDS happen

This study confirms or develops a range of conclusions:

- From the **systems perspective**, the benefits of SUDS to society are clear. Successful implementation on the ground will depend upon overcoming a wide range of narrower interest, and is therefore best achieved in partnerships. This is essential to define problems of drainage and source control of potential pollutants at an adequately large scale, from which systemic rather than parochial decisions may emerge. It will also be a key to ensuring that all benefits from SUDS are maximised in the design, and that acceptability is assured.

- The **six key sustainability challenges**, that were identified in the first TNS *2020 Vision* project *Sustainable Drainage Systems (SuDS): An Evaluation Using The Natural Step Framework*, remain highly relevant. These six key sustainability challenges are outlined here. (Five of these are at the heart of work being undertaken by the National SUDS Working Group.) This *2020 Vision* project has made further progress with most of these challenges.

The Six Key Sustainability Challenges for SUDS

1. Develop clear life-cycle costings of SUDS and traditional drainage systems
2. Increase awareness about multiple benefits of SUDS
3. Embody SUDS within appropriate legislation
4. Establish protocols for the adoption and maintenance of SUDS
5. Divert funding to SUDS from other areas of public expenditure
6. Overcome the technical shortcomings of SUDS

- In most cases, **perceived pollution risks associated with SUDS** are largely unfounded, as outlined in Box 2 (Section 3). SUDS are in essence clean water systems, replicating natural processes. Perceived risks for SUDS are generally based on an implicit, yet flawed, assumption that traditional piped systems (whether combined or storm) have no risks. For both SUDS and traditional systems, contamination of storm run off signals an 'upstream' pollution issue requiring direct and discrete regulatory attention.

- It is also apparent that **the policy framework needs to be revised**, as today it is geared towards traditional piped systems. SUDS implementation is possible, but is not supported proactively by the network of legislation. Novel regulatory instruments such as PPG25 are moving towards more sustainable approaches (see Annex 5). However, many organisational responsibilities create little or no economic incentive to manage drainage in any way other than traditional piped (unsustainable) systems. Until SUDS requirements are the subject to an approach agreed by all parties on a voluntary basis, or else adequately legislated, implementation of SUDS is open very much to individual interpretation and the foresight and knowledge of individuals in Local Authorities and other bodies.

- Although those who have delved into the numerous case studies may have a different view of the benefits of SUDS, for many the **economic signals** still create an incentive for paying for drainage through traditional means. The convenience of paying for storm water removal within a water bill, and the delegations of liabilities to water service providers, enforces unsustainable practices founded upon dealing with problems 'downstream' where flows have and pollutants have accumulated. This should be addressed to a certain extent by Article 9 of the EU Water Framework Directive (relating to the true costs of water services – see Annex 5). However, it does endorse the need to regulatory review from a systemic basis, fully consistent with sustainable development.

- **SUDS need to be seen as a planning issue** as, if more partnerships were formed around new developments as well as redevelopments, the many benefits to society apparent from the systems perspective would be more readily realised. This calls for a new form of *organisational intelligence* in determining planning issues, ensuring that narrow interests of organisation do not create a barrier to delivery of the best outcome for society at large. This is particularly so in areas where development pressure or risk of flooding is high.

4.3 Recommendations for further work

Three areas present themselves as priority recommendations to drive forward sustainable drainage.

1. **Review of legislation from a systems perspective**[9]. In order to make significant progress towards sustainable drainage (or, in other words, to avoid perpetuating the *de facto* norm of unsustainable solutions), the policy environment needs to be reviewed from the systems and whole-catchment perspective. This systems perspective necessarily considers longer timescales, and is not constrained by today's organisation boundaries and responsibilities, but seeks to address how best to deliver protection or restoration of the natural functions of the water cycle upon which society depends. It is from this perspective that the benefits to society are most apparent, over and above the narrower interests of individual organisations. The mechanisms by which current regulations restrict the free implementation and adoption of SUDS have been made apparent throughout this report. (The National SUDS Working Group is undertaking a review of necessary legislative changes to promote SUDS and to secure their ongoing ownership and maintenance. Their work is welcomed, although it falls short of the full systems-based review recommended here.)

2. **Review of economic incentives for SUDS**. This partnership-based research would comprise two levels: (1) the economic signals stemming from appropriate regulatory review; and (2) collation of more data on life cycle costs that make a case for the multiple benefits of SUDS relative to traditional piped schemes. For Local Authorities, this focus on life cycle costs would be consistent with the requirements of Best Value requirements, in sustainability as well as hard economic terms.

3. **Review of organisational collaboration**. This would help decision-makers better understand the networks that need to be developed to provide the *organisational intelligence* from which the maximum benefits from SUDS can be delivered and maintained. The goal should be identification of the organisational networks most appropriate for the delivery of the benefits apparent from the systems perspective. This in turn will feed back into refinement of the decision flowchart in this report. (The National SUDS Working Group is currently developing an 'Adoption Matrix' of SUDS techniques which will make it clear which organisation will be responsible for adoption.)

[9] This is in turn consistent with addressing Challenge 3 (Embody SuDS within appropriate legislation) from the TNS *2020 Vision* project *Sustainable Drainage Systems (SuDS):An Evaluation Using The Natural Step Framework.*

Annex 1: About this *2020 Vision* Project

There are many contentious issues around developing and adopting more sustainable forms of drainage of urban areas. Such issues relate to technical, social, ecological and economic issues, and present a number of challenges to those responsible for urban drainage systems. The aim of this *2020 Vision* project was to involve a wide range of participants in sharing information and building consensus about how to make practical progress with the delivery of SUDS as part of an increasingly sustainable world. The following people were involved in the development of this project

Attending the *2020 Vision* Seminar

From The Natural Step
Dr Mark Everard
Penny Street (TNS Facilitator)

From the Environment Agency
Chris Chubb
David Griffiths
Prosper Paul
Jackie Vale

From the Scottish Environment Protection Agency (SEPA)
Brian D'Arcy

From Water Service Companies
Morag Garden (East of Scotland Water)
Dan Green (Wessex Water)
Phil Reaney (Yorkshire Water)

Other Invited Guests
Jeremy Biggs (Ponds for People)
Bob Bray (Robert Bray Associates)
Carole Bond (Carbon Data)
Robert Cunningham (Wiltshire Wildlife Trust)
Heidi Smith (University of Bradford)
Simon Taylor (WS Atkins)
Norman Walker (White Young Green)
Chris Williams (Hydro International plc)

Corresponding members of the *2020 Vision* Project

From The Natural Step
Lorna Berry
David Cook
Dr Sandy Muirhead
Jonathon Porritt (Chairman)
Peter Price-Thomas

From the Environment Agency
John Batty
Mervyn Bromley
Paul Bryson
Colin Candish
Jonathan Chapman
Phil Chatfield
Ian Davey
Mark Diamond
Geoff Mance
Ian Preston
Dr Andrew Skinner
Jenny Thomas
Martin Townsend

From Water Services Companies
Brian Crathorne (Thames Water)
Tony Harrington (Yorkshire Water Services)
Perry Hobbs (Anglian Water)
Deborah Pedley (Yorkshire Water)
Adrian Rees (Yorkshire water)
Julie Robinson (Severn Trent Water)
John Wilkes (Yorkshire Water Services)

Other Participants
Jane Anderson (Building Research Establishment)
Bob Andoh, (Hydro International)
Prof. Richard Ashley (University of Bradford)
Dave Brook (ODPM)
David Brownless (Bryant Homes Northern Ltd)
Pamela Castle (United Utilities plc)
Nigel Cartwright (DEFRA)
Dr Stewart Clarke (English Nature)
Sue Cosgrove (Tesco)
Jas Dhami (Carillion plc)
Alison Duffy
Bill Duley (WHD Pathways)
Suzy Edwards (Building Research Establishment)
Cliff Elliot (United Utilities plc)
John Griggs (Building Research Establishment)
Tony Harrington (Yorkshire Water Services)
Colin Hygate (the Environmental Solutions company)
Chris James (Carillion plc)
Tim Lawrence (Bryant Homes Ltd)
Tracey McMahon
Prof. Quentin Leiper (Carillion plc)
Phil Reaney (Yorkshire Water Services)
Hugh Roberts (Ponds for People)
Chris Seeley (Just Business)
Mike Smith (Quest Futures Solutions)
Dr Heidi Smith (University of Bradford)
Julie Spinks (United Utilities plc)
Mr Peter Stahre (Malmo Water & Wastewater Works, Sweden)
Rob Stoneham (Sheffield Wildlife Trust)
Roger Sweeting (Fresh Biological Association)
Simon Taylor (WS Atkins)
Jacob Tompkins (Water UK)
Alex Turner (Stevenage Borough Council)
Mike Waddington (Water UK)
Simon Walster (OFWAT)
Rebecca White (Building Research Establishment)
Penny Williams (Oxford Brookes)

End of Annex 1

Annex 2. Responsibilities for Storm Water Management in the UK

In this Annex, we summarise key responsibilities for storm water drainage.

- **Where storm sewers are separate from foul sewer systems**, the majority of these storm sewers are owned (at least in England and Wales) by water service companies. (This does not include private sewers or highways drains.)

- In this context, **to be classified as a 'sewer'**, a piped system must have an outlet to a receiving water. There are some instances of SUDS buffering inputs to piped sewerage systems falling within this definition, and being adopted by water companies. OFWAT has confirmed that SUDS schemes will be included as part of the asset base of water companies where these conditions are met. (For example, Yorkshire Water Services have adopted pipework associated with ponds with pipes running into and out of them, such that they can then be classified as sewers, and thereby transferred ownership of the ponds as an asset that is required to make the sewerage system function. This enables YWS to charge for the SUDS-related services they provide.)

- **Where the sewer system is combined**, water service companies also own most of the infrastructure, but not the connecting laterals from individual properties or private developments.

- **Water service companies charge homeowners** for inputs of rainfall to storm or combined sewer, but are not able to charge Highways Authorities or Local Authorities for such inputs. Drainage services for public open spaces and highways are funded by a standing charge on all customers in the area.

- Connection of drains from premises to the storm, foul or combined sewerage system is a **matter for the individual developer**. The developer only pays the water service company for the sewerage infrastructure service, both foul and surface water, and therefore a foul only connection would attract the same charge. The general trend is for the developer or site owner to pay the water service company for the service of storm water disposal (albeit by unsustainable piped means), divesting risk for a set fee. This amounts to approximately 20-25% of the average domestic water bill (£12-35 per property at current charges), a figure derived by an estimate of the cost split between disposal costs for foul and storm effluent. If the developer opts not to request adoption of the sewerage system by the sewerage undertaker, the developer has no risk as the sewers would be the responsibility of the property owners.

- **Water utilities and local authorities** are required, under PPG25, Part H of the Building Regulations and other related planning guidance (Annex 5) to favour SUDS in new developments. However, the refusal of water service companies to adopt them is forcing developers instead to keep to the tradition of installing piped drainage systems[10].

- The Water Industry Act 1991 allows for **discharge from highways to sewers**, although there is no 'right to discharge', there is an 'understanding' that water from roads and public open spaces may be discharged to sewer without payment by local authorities or others. In Scotland, this is covered under Section 7 of the Sewerage (Scotland) Act 1968. There is also Scottish Water Bill under development, which may influence wider UK policy regarding responsibility for SUDS maintenance.

[10] New Civil Engineer. (2002). Water companies reject sustainable drain systems. *New Civil Engineer*, **18 April 2002**, p.5.

- **Highways Drains are exempt from the need for a discharge consent.**

- **Highway drains may also be owned privately,** by Local Authorities or by the Highways Agency. It is accepted, but not necessarily required, that all new sewers should be designed for a 1 in 1 year event and checked to ensure that no flooding of properties or surface area occurs from a 1 in 30 year event. There is however no such requirement upon highway drains.

- The Environment Agency makes no charge for **discharge of uncontaminated storm run-off** to receiving waters from separate systems. However, storm run-off which becomes contaminated (for example by passing through a lorry park) is treated as trade effluent and might become subject to a charge.

- **Some stormwater schemes use control structures** (such as detention basins with restricted outflow orifaces) to control the rate of discharge. This can apply to both SUDS and piped systems. Where this is to a receiving water, there is no charge. However, inputs to storm drains or combined sewerage systems are charged by the water service company.

- Local Authorities are not charged by the Environment Agency for **run-off from public open spaces direct to controlled waters**. These discharges would not automatically be accepted to sewer.

End of Annex 2

Annex 3. Duties to Promote Sustainable Water Management

This Annex contains a summary of the duties of key organisations to promote sustainable water management.

- The **Environment Agency** (England and Wales) and the **Scottish Environmental Protection Agency** (SEPA) each have a core duty, defined by Section 4 of the Environment Act 1995, to exercise all of their powers and duties "*...so as to protect or enhance the environment taken as a whole as to make the contribution towards attaining the objective of achieving sustainable development...*". The same duty is shared by **Land Drainage Authorities.**[11]

- In England, the **Department of Environment, Food and Rural Affairs** (DEFRA) also has a general instruction to contribute to sustainable development. This is shared north of the border by the **Scottish Executive**. The **National Assembly for Wales** also has an obligation to deliver sustainable development through its actions.

- Under Section 51 of the Water Industry (Scotland) Act 2002, **Scottish Water** has a duty in terms of sustainable development. (Water service companies in England and Wales have no such duty.)

- **Local Authorities** across Great Britain are granted sweeping powers under the Local Government Act 2000 to ensure that the challenge of sustainable development is addressed, and also have duties under Best Value requirements to look at whole life cycle costs of options when making investment decisions.

- **The Office of Water Regulation** (Ofwat) is to be given a specific sustainable development duty under the provisions of the new Water Bill, and this has been welcomed by the Director General of Ofwat[12].

- **Building or planning regulations** are highly relevant here. For example, revisions to the Building Regulations for England, which came into force in April 2002, will include a presumption for SUDS for rainwater drainage from buildings[13]. These revised Regulations include a hierarchy requiring a presumption in favour of: (1) infiltration; (2) storage; (3) discharge to watercourse; or, if the preceding are not possible or economic, (4) discharge to sewer. In Scotland, the revised Building Regulation guidance provide that a drainage system designed in accordance with the CIRIA SUDS Design Manual for Scotland and Northern Ireland shall be deemed to comply with the requirements of Part M on drainage and sanitary provisions.

End of Annex 3

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[11] In addition to the Environment Agency and SEPA, the authorities or boards that have responsibilities for land drainage include the Department for the Environment, Food and Rural Affairs (DEFRA), Internal Drainage Boards, Flood Defence Committees and Local Authorities.

[12] The Environment Sub-committee of the Select Committee on Environment, Transport and Regional Affairs carried out an inquiry on the draft water Bill in Jan-Feb 2001 (published 3 April 2001). The government supported the Committee's recommendation that the Director General should be given an explicit sustainable development duty.

[13] The Building Act 1984. Review of Part H (drainage and solid waste) of the Building Regulations 1991 and associated legislation.

Annex 4. Liabilities Relating to Potential Pollution of Receiving Waters

The potential for liabilities arising from pollution of receiving waters was perceived by some, as inhibiting wider uptake and adoption of SUDS. From the perspective of sustainability, as conceptualised by The Natural Step Framework, there is a clear need to eliminate the potential for the accumulation of chemicals in nature, be they mined or man-made substances. This is best tackled as far 'upstream' in the process as possible, ideally by eliminating problematic substances in applications, or at least ensuring that they do not 'leak out' from use by society into natural systems.

In the context of preventing potential pollution of groundwater and surface water by contaminated stormwater, traditional drainage systems operate on an 'end-of-pipe' management basis. That is, they are treating symptoms and not problems. SUDS approaches operate in an interim position between managing potential sources and their 'downstream' treatment. They do this by immobilising or treating potential pollutants as close to source as possible before they have the opportunity to concentrate and mix with other contaminated sources. The same principle applies to minimising surges of floodwater by ensuring retention, or percolation into groundwater, as close to source as possible, at the same time delivering ecological and amenity value.

A4.1 Reasons for concern about legal liabilities

Long-term sustainability will include the elimination or containment of polluting substances, rendering stormwater clean. However, in the absence of control of all potential sources of substances of concern in the short-term, stormwater may potentially be polluted. This in turn gives rise to concerns about potential liabilities stemming from legal requirements to eliminate the entry of such pollutants into receiving waters.

Any such liabilities are of course an issue for any form of stormwater management, whether traditional piped systems or SUDS. The Environment Agency is concerned about polluting substances entering either type of drainage system, and would aim to look upstream to investigate the source of such pollution.

The major potential for liabilities, perceived particularly by water industry representatives within the TNS SUDS network, relate particularly from List I and List II substances under both the EU Dangerous Substances Directive 76/464 (Surface Waters) and the EU Groundwater Directive 80/68/EEC. (List I and List II differ in detail between the two Directives but the principles are similar.) The Groundwater Directive calls for zero emission of List I substances to groundwater and no pollution arising from List II substances, and requires *prior investigation* in each case, whereas the Dangerous Substances Directive calls for no pollution from either List I or List II substances. List I substances of most concern include:

- **List I metals** (cadmium and mercury) may be present in road run-off, although the evidence is that polluting loads are declining; and
- **List I organic substances**, principally herbicides and pesticides, that are present in run-off from roads, recreational land, agricultural land, and general urban areas.

These Directives are not reproduced here in the interests of space. The requirements of all Directives are transposed into relevant UK Regulations. EU Directives and UK Regulations and guidance are accessible on websites as follows:

- www.europa.eu-int/eur-lex/en/lif/dat/1976/en_376L0464.html
- www.europa.eu-int/eur-lex/em/lif/dat/1980/en_380L0068.html
- www.defra.gov.uk/environment/water/ground/guidance.htm

A4.2 Implications for SUDS

There is a perception that liabilities are more of an issue for SUDS systems as, by their nature, they do not generally feed into water treatment plants. However, as described above, the reality is that the same issue applies equally to traditional storm drainage systems, which have the further problem of higher loads of water and associated mixed pollutants arising from a much bigger catchment. The issue is therefore one of perception, with an implicit assumption that risks are associated with new SUDS technologies but that today's unsustainable norms are without risk.

SUDS should be recognised for what they are: systems that replicate and enhance natural drainage processes, whilst bringing about amenity and financial benefits. They are not necessarily part of the sewerage system. However, well-designed SUDS intercept and treat water and pollutants liable to enter surface waters. They seek to attenuate problem metals, and also to trap and treat persistent organics. However, SUDS do not create pollution. This happens due to activities or conditions upstream. Thus, where there are concerns about these substances, regulatory action is required to control the upstream source of pollution, not to point to SUDS as the problem.

SUDS are designed to eliminate cross-connection of storm water to wastewater sewerage systems (unless specifically designed to receive treated effluent), and thus pathogenic microbes should not enter SUDS systems. Members of the SUDS TNS network did not express concerns about risks to public health through the transmission of pathogenic micro-organisms.

Three factors relating to potential liabilities associated with traditional stormwater drainage systems could actually support the case for more SUDS:

- The requirement in the Urban Waste Water Treatment Directive that pollution from CSOs "*..should be limited...*", and that the design of wastewater systems should use BAT (Best Available Technology). This could act as a driver for SUDS, since well-designed SUDS schemes not only reduce surcharging of combined sewerage systems but also attenuate or treat pollutants closer to source;

- There is also the issue that a gradual accumulation of toxins could be harder to detect with conventional systems than with SUDS, and thus lead to greater pollution potential; and

- SUDS schemes can be gated to isolate accidental spills, or other local pollution incidents, or for periodic removal of chronic levels of accumulated pollutants, whereas traditional piped drainage systems are generally not gated. SUDS schemes also slow water movement, increasing the time window for responding to incidents.

Far from creating liabilities, SUDS therefore offer the potential to avoid the build-up of pollutants, and are better adapted for the management of accidental releases. The risks associated with traditional piped drainage systems are, though largely overlooked in planning, as great or greater than those associated with SUDS. The root of the problem actually lies in the 'upstream' release of pollutants into surface and waste water systems, which should be subject to separate pollution control action.

A4.3 Lessons from other SUDS schemes

Practical progress has been made in the UK, particularly in Scotland, with the implementation of SUDS schemes in industrial, residential and retail developments, road schemes, service stations, hard standing, etc. All of these successful implementations face the same issue of potentially contaminated water polluting groundwater. In some instances, this is achieved via simple precautions such as source control of pollutants (e.g. grass swales to precipitate pollutant-bearing solids) or measures to contain water in the event of spills.

There is a range of experience with SUDS schemes outside the UK. In Malmo, Sweden, the use of swales, water detention ponds and other SUDS techniques have become the norm – rather than the exception – for developers. (See previous reference to the *Nature's Way* video). This practice is now being taken up across Sweden. Experience with Best Management Practices (BMPs) across the United States is brought together in a range of publications and databases by the Environmental Protection Agency (EPA). (See www.epa.gov/npdes/menuofbmps.htm and www.epa.gov/OST/stormwater.)

There are obviously practical ways through these potential liabilities, clearing the way for SUDS implementation as widely as possible. These solutions help deliver the wider range of benefits that SUDS offer and the contribution that they can make to increasing sustainability, decreasing flooding, and lowering inputs to sewerage systems. A growing number of case studies are available which can provide support for this stance (see Box 1, Section 3).

The key to this issue is to develop an appropriate management structure for developing SUDS, which addresses the requirements of the relevant Directives (discussed above). The request for *prior investigation* in the Directives appears to be one of the keys to the process of developing a management structure. A formula is being developed by consensus through this *2020 Vision* process, acknowledging the need to address elimination of pollutants at source and ensuring that pursuit of this goal does not present an insurmountable obstacle to the practical implementation of SUDS[14]. This flow of concepts is expanded within a bigger decision-support framework outlined in Section 3 of this report.

End of Annex 4

[14] This is drawing and building on other work being carried out on SuDS design – eg CIRIA SuDS design manuals for England and Wales (C522) and Scotland and Northern Ireland (C523) – and accreditation of SuDS schemes (an *Accreditation Checklist for Sustainable Drainage Systems (SuDS) Proposals* is currently under development by the Environment Agency, in consultation with a range of players – contact Robert Bray Associates, Stroud, T: 01453-764885).

Annex 5: Adoption of SUDS Schemes During Operational Life

By the term adoption, we are referring to formal agreements as to ownership and ongoing management responsibilities. Adoption of SUDS is addressed in the flowchart in Section 3, critically including the bringing together of key beneficiaries of the SUDS scheme. These action relate particularly to sustainability Challenge 4 (Establish protocols for the adoption and maintenance of SuDS) and Challenge 5 (Divert funding to SuDS from other areas of public expenditure) of the previous TNS *2020 Vision* project *Sustainable Drainage Systems (SuDS): An Evaluation Using The Natural Step Framework.*

A5.1 Implementation and adoption by landowners and managers

There are a number of options for adoption and maintenance of SUDS. The TNS SUDS network identified the need for a flexible approach which is dependent on issues such as the type of SUDS, its location, the recipients of any associated benefits, etc.

In view of the fact that SUDS basically replicate natural drainage, ownership and management would tend to rest with the landowner or devolved manager, or the local authority associated with a public open space. As indicated in Section 2, land managers can cut costs by eliminating charges and maintenance of pre-treatment infrastructure. Local authorities can also use SUDS as a way of fulfilling wider obligations to promote sustainability and better quality of life (for example, contributing to objectives relating to Biodiversity Action Plans or the provision of public open spaces).

Recognition of the wider benefits, over and above basic drainage functions, enables other streams of public expenditure to be diverted to SUDS maintenance activities such as periodic mowing.

A5.2 The role of water companies

Under current arrangements, water companies would only be involved if the water enters the sewer system. Where SUDS systems must enter a sewer, then they should be seen as contributing clean water at a controlled rate; a 'second best' option to complete natural drainage but a significant improvement on conventional piped drainage.

It is therefore in the water industry's interest to contribute to the wider-scale adoption of SUDS, as this will enable them to receive storm water at 'greenfield' run-off rates, or better still not to have to accept storm water peaks at all. Advantages to the water industry include:

- Reduction or elimination of requirement for new sewers to deal with increasing loads;
- Cheaper capital and operating costs, as well as those associated with disruption to society due to road works, etc., for sewerage capacity in new SUDS-loaded sites;
- Cheaper solution to CSO problems; and
- Delivery of rainfall run off water at close to 'greenfield' rates, and carrying lower loads of pollutants, reducing the variability of incoming sewage to treatment and helping the treatment process.

The Water Industry Act 1991 is the primary legislation relating to sewerage infrastructure, investment and management in England and Wales. Section 94 is of particular relevance to the position of water companies with regard to SUDS, as it imposes a general duty for the provision of sewage infrastructure, and essentially defines what a sewer is. It certainly provides a case for the inclusion of SUDS within the responsibilities of sewerage undertakers, as outlined in Box 4.

Box 4: Section 94 of the Water Industry Act 1991 and the Promotion of SUDS

- S.94(1)(a) clearly states the duty of every sewerage undertaker *to ensure that that area is and continues to be effectually drained*. Historically, effectual drainage may have automatically been interpreted as investment in increasing amounts of (unsustainable) pipework and infrastructure. Today, we recognise the efficacy and multiple benefits of SUDS for achieving that same end.

- S.94(1)(b) also clearly states that the duty of every sewerage undertaker is *effectually dealing, by means of sewage disposal works or otherwise, with the contents of those sewers*. Given the problems of diffuse inputs of polluted stormwater, compromising the predictability of sewerage system load and content, SUDS offer an excellent way of effectually dealing with the contents of the sewer through effective source control.

Section 106 of the Water Industry Act indicates the rights of individuals to discharge foul and surface water from their premises through a private sewer to a public sewer. It makes it clear that they may not discharge any prohibited substances. It also provides a case for the inclusion of SUDS, as outlined in Box 5.

Box 5: Section 106 of the Water Industry Act 1991 and the Promotion of SUDS

- S.106(1)(a) states that owners or occupiers of any premises in the area of a sewerage undertaker *shall be entitled to have his drains or sewer communicate with the public sewers of that undertaker and thereby to discharge foul water and surface water from those premises or that private sewer*.

- S.106(2) clearly prohibits the discharge directly or indirectly of *any liquid or other matter the discharge of which into the public sewer is prohibited by or under any enactment*. This gives a clear indication that any polluted surface or floodwater should be prevented from entering drainage systems (traditional or SUDS).

- S.106(4) allows the sewerage undertaker to refuse the connection if the *construction or condition of the of the drain or sewer is such that the making of the connection would be prejudicial to the undertaker s sewerage system*. Sewerage operators therefore have grounds to refuse connection of surface water into their combined systems. Unacceptable loads of water and potential diffuse pollutants may be reduced by the strategic positioning of SUDS upstream, making a direct contribution to the sustainability and economic efficiency of the sewerage network, and maximising the value and availability of existing sewerage infrastructure by controlling loads from new developments.

A5.3 Financial Aspects of Adoption and Maintenance

One of the key issues in developing a framework for adoption and maintenance is establishing financial responsibilities. The costs of maintaining SUDS schemes will depend on the type of SUDS. For example, depending upon scheme design, it could comprise the cost of cleaning gullys, keeping swales free of debris, or maintaining ponds. There is a perception that SUDS schemes are more expensive than

traditional drainage systems. However, there is growing evidence that SUDS are in fact cheaper to maintain (see Box 1, Section 3).

A perceived problem for water companies is the lack of an income stream for supporting SUDS schemes. Water companies can only levy charges where there is a discharge from a pipe to a sewer. However, the costs of drainage of highways and public open spaces, for which no direct charges may be levied, are covered by service charges to the customers of water service companies. Local authorities currently do not currently pay for rainwater or floodwater discharges to sewer in their locality. Similarly, local authorities are not able to 'ring fence' money to support SUDS schemes.

This raises a range of options of managing the ongoing maintenance of SUDS:

1. Water companies assume responsibility as discussed elsewhere in this report;

2. Local Authorities may take on aspects of maintenance, as for example the *Parks and Amenities* service in West Stevenage (see Section 3);

3. A community partnership could take responsibility for SUDS as part of a maintenance agreement, as for example in Sheffield;

4. Again referring to West Stevenage, as well as to management arrangements already in place in Scotland, private operators may be interested in taking on management of SUDS (see Section 3);

5. Any combinations of the above may be operable today.

In addition to the above potential arrangements, other options that may be considered in a legislative review might include

6. Expansion of the remit of water service companies, with appropriate revenue streams;

7. A separate drainage authority, with appropriate revenue streams (many transferred from other bodies);

8. The ring fencing of money for drainage within Council Tax to empower Local Authorities with effectual drainage. This might be brought above, for example, in new housing or industrial developments which may then be subject to a maintenance charge;

9. Other mechanisms for diverting finance or charging schemes from water service companies to local authorities should be investigated. One possibility is through 'Section 106 Agreements'[15]. The agreements are used to regulate developments where the use of a planning condition would not be relevant, for example where highway works are required on land which is outside the planning application site and outside the developer's control (see below). These agreements may require proponents to mitigate (planning gain), for example by provision of a nature reserve at Hopwood Services and of the financing of an alternative pond for newts as Stroud in the case studies cited previously. The view of the TNS SUDS *2020 Vision* network is that these can not currently be used to cover the costs of SUDS. However, the National SUDS Working Group is currently looking at the possibility of withdrawing this legislation.

[15] Section 106 of the Town & Country Planning Act 1990 allows the drafting of agreements ('Section 106 agreements') between local authorities and developers.

Separate mechanisms for charging for drainage, instead of just the current system of charging for discharges to sewer, would certainly support SUDS and also internalise some of the costs of more sustainable forms of drainage.

As indicated above, although SUDS can be classified as lying outside the sewerage system in view of their primary role as an addition to natural drainage, there are benefits to clarifying and building links with water service companies and the wider sewerage system. Such benefits would accrue to all players, in terms of helping reduce overload and potential pollution associated with conventional systems, as well as enabling the diversion of funds from traditional schemes to SUDS. In terms of the legislation, The Water Industry Act 1991 allows for delegation from the sewerage undertaker to other bodies of its sewerage function (Section 94, above), although not its liabilities (see Section 97(2), below). The Council or other body to whom sewerage functions are delegated cannot receive a direct income from what is a water service company responsibility, though the water service company can pay the District Council for that activity.

Section 97 of the Water Industry Act 1991 covers financial aspects relating to sewerage infrastructure and management, including investment by government, local authorities and water service companies. There are some shortfalls in the Act with regard to investment in a management of SUDS schemes. Again, this is an area wherein consensus is required to establish a clear framework of understanding as the basis for planning consents and adoption protocols. Relevant parts of Section 97 are reproduced in Box 6 below.

Box 6: Section 97 of the Water Industry Act 1991 and the Promotion of SUDS

- S.97(1) states that *A relevant authority may carry out sewerage functions on that undertaker s behalf in relation to such area comprising the whole or any part of that authority s relevant area*
- S.97(2) states that *Arrangements entered into for the purposes of this section may contain any such provision as may be agreed between the relevant authority and the sewerage undertaker*
- However, S.97(2) continues *but shall not affect the availability to any person, other than the relevant authority, of any remedy against the undertaker in respect of the carrying duty of the undertaker s sewerage functions or of any failure to carry them out .*
- S.97(3) substantiates the view that adoption by authorities other than water service providers should present no legal obstacle by stating that *if arrangements entered into for the purposes of this section so provide, a relevant authority shall be entitled to exercise on behalf of a sewerage undertaker any power which by or under any enactment is exercisable by the undertaker for the purposes of, or in connection with, the carrying out of the undertaker s sewerage functions .*
- S.97(4) explicitly mentions that a local authority may *carry out the sewerage functions of a sewerage undertaker on the undertaker s behalf .*

A5.4 Planning policy

Planning policy in the UK is guided by the Town and Country Planning Act (various revisions) and steered by a series of Policy Planning Guidance (PPG) notes. Two of these are of particular importance: PPG3 and PPG25, relevant sections of which are noted in Boxes 7 and 8 below.

Box 7. PPG3 (Policy Planning Guidance Note 3: Housing)

PPG3 is about Widening Housing Opportunity and Choice . It is concerned with providing sufficient

housing, including the creation of mixed communities, meeting local housing needs, and delivering affordable housing. This includes re-using urban land and buildings, for which there is guidance on determining planning applications and on working in constructive partnership. Rural housing and new developments are also addressed. Mixed-used developments are promoted, as are links with public transport.

The emphasis on quality of the built environment, as well as maximisation of social value from land use, should lead to development that is sympathetic with natural carrying capacity and therefore favouring SUDS schemes about infrastructure-heavy traditional piped systems.

A specific concern is the requirement in PPG3 to maximise redevelopment of brownfield sites. However, many derelict sites are of older developments put in place before the planning system was established, many of which may be low-lying and prone to flooding.

Box 8. PPG25 (Policy Planning Guidance Note 25: Development and Flood Risk)

This PPG was published in July 2001, and presently applies only to England. The Office of the Deputy Prime Minister (ODPM) will be revising PPG25 commencing in 2003. It explains how flood risk should be considered at all stages of the planning and development process in order to reduce future damage to property and loss of life. It guides all parties involved in the planning and development process. PPG25 requires a precautionary approach to ensure that any development is safe and not exposed unnecessarily to flooding. The guidance also requires that run-off from development should not increase flood risk elsewhere in the catchment, and that development must not constrain the natural function of the flood plain, either by impeding flood flow or reducing storage capacity. New development should therefore be located in zones of little or no flood risk wherever possible.

New building works within areas of flood risk are only permitted in exceptional cases where the risks are managed and adequate flood defence measures and/or flood resistant construction techniques are adopted. Developments should also incorporate SUDS where practicable and other mitigation measures to avoid increasing the risk of flooding further downstream. The guidance within PPG25 takes a sequential risk-based approach.

In Scotland, guidance is provided by *National Planning Policy Guideline NPPG7 - Planning and Flooding* which was published in 1995. It provides guidance to planning authorities, developers and the public so that flood risk can be properly taken into account in development plans and development control. Separate advice on SUDS is given in *Planning Advice Note 61 - Planning Sustainable Drainage Systems*. In Wales, new policy on development and flood risk is emerging through *Draft Planning Policy Wales (PPW)* and the revision of *Technical Advice Note 15 Development and Flood Risk (TAN 15)*. Both documents, currently under review, will be issued in final form during 2002.

A5.5 The EU Water Framework Directive

Although well beyond the scope of this project, the EU Water Framework Directive will bring about wholesale changes in regulation of land-water interactions. Article 9, which relates to the principle of recovery of costs of water services (Box 9).

Box 9. Article 9 of the EU Water Framework Directive (WFD)

Article 9 of the WFD states that Member States must take account of the principle of recovery of costs of water services *including environmental and resource costs*. The clear implication is that many costs

currently externalised from water management activities, including environmental implications, will have to be reflected in pricing. This will have implications for SUDS in terms both of their multi-benefit and life cycle value and the funding mechanisms for their implementation and adoption.

Other parts of the WFD are of significance to SUDS, particularly those relating to natural hydrological processes and ecological quality, but are outside of this scope of this study.

A5.6 Implications for adoption

It appears that there is a need for the integration of drainage responsibilities, and an explicit inclusion of sustainable development within that duty. In terms of ownership, one possibility would be to centralise that responsibility within local authorities. Services associated with the SUDS could then be delegated to private water businesses (water service companies, developers, residents associations, etc). This would provide a dual incentive for water companies to become involved. Not only would it limit floodwater entering the piped system, but would provide them with a revenue stream associated with drainage.

End of Annex 5

About the *2020 Vision* Series

The ***2020 Vision*** **Series** of publications aims to provide information about a range of contentious issues, many of which have featured in the media. The Natural Step office in the UK, together with SATIS (the Scientific and Technical Information Service of the Environment Agency), runs a series of ***2020 Vision*** **Seminars**. These seminars involve invited participants in the sharing of information and debate about the place of specific contentious issues in a future more sustainable world. This document is the *2020 Vision* Series report *Putting Sustainable Drainage Systems (SUDS) into Practice*, and is available from The Natural Step office in the UK priced £20 to cover production and handling costs. On The Natural Step's UK website *http:\\www.naturalstep.org.uk*, you can find a summary of this document. (On the same website, you can also find other TNS *2020 Vision* reports addressing GMOs, PVC, SuDS, Resource Use, Biosolids (Sewage Sludge) and Bulk Printing.)

About The Natural Step

The Natural Step (TNS) Framework is a science-based learning and decision-making programme aimed at helping organisations to understand and apply the concept of sustainable development. It was developed in Sweden in the late 1980s. The Natural Step office in the UK has been operating as a charity, chaired by the well-known environmentalist Jonathon Porritt, since the beginning of 1997. It has already been successful in helping a range of large companies[16] address sustainable development as a strategic issue. The science-based model of a sustainable world, which lies at the heart of TNS, together with a range of other specialist TNS tools, provides an 'intellectual round table' for the building of consensus about various social, environmental and economic aspects of contentious issues and their place in a future more sustainable world. The Natural Step office in the UK, which is supported by the Environment Agency, is a partner of the Agency in the *2020 Vision* series of seminars and publications.

About the Environment Agency

The Environment Agency has wide-ranging powers and duties relating to water management, environmental protection and pollution control across England and Wales. Its principal aim is to exercise them so as to contribute to sustainable development. The Agency therefore has strong interests in the application of science to decision-making – both its own and that of other sectors of society – as an important part of its contribution towards the achievement of sustainable development. Involvement in the *2020 Vision* series of seminars and publications has stemmed from the Agency's aspiration to envisage the kind of environment that it wishes to work towards. *2020 Vision* provides an expert analysis of the place that a range of contentious issues occupy in a future sustainable world.

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[16] Pathfinder partners of TNS in the UK comprise: Air BP and BP Scotland, Carillion, Crest Nicholson, the Co-operative Bank, Interface, Nike Europe, Sainsbury's, Sun Microsystems and HP Bulmers

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In addition to being a technical partner in this SUDS project, the Environment Agency has also been a strategic partner of TNS in the ***2020 Vision*** **Series** of seminars and publications