



RP697: SUDS updated guidance on technical design and construction

Briefing paper on requirements for SUDS guidance

April 2004

Version - Final

1. BACKGROUND

CIRIA and HR Wallingford are undertaking CIRIA Project RP697 *SUDS – updated guidance on technical design and construction* to review and update best practice on SUDS, with the aim of producing a SUDS compendium dealing with the design, construction and management of Sustainable Drainage Systems (SUDS). In order to do this it's important to understand the end users requirements for guidance. However, basic research on some of these issues may not be available, and CIRIA has therefore also been tasked with determining what industry believe are gaps in SUDS research so that these can be tackled at a strategic level to help ensure that practitioners have the relevant information to make informed business decisions.

This briefing paper covers the specific requirements for guidance, there is an accompanying briefing paper that covers industry's requirements for research. The process of obtaining feedback from stakeholders on guidance requirements included a consultation exercise and workshops to help determine end-users requirements. A web and paper-based consultation exercise was undertaken as well as a series of consultation workshops in London and Durham with a feedback workshop in Coventry (sponsored by WaPUG). Information from the workshops and consultation will help influence the development of the SUDS guidance and prioritise coverage of topics within the document.

Attendance of the workshops included those primarily involved with the design and management of SUDS. Professionals from local authorities, regulators, consultancies, research organisations and the construction industry were represented at the events.

1.1 Review of previous SUDS guidance

CIRIA's best practice guidance on SUDS has been in circulation since 2000, the guidance documents are typically used by engineers, designers, planners, developers, architects, regulators and professionals working for water utilities.

Both CIRIA (RP663, 2002) and the Scottish Environmental Protection Agency (SEPA), (Wild et al, 2002) have undertaken a review of CIRIA's SUDS guidance. The SEPA research indicated that over 90% of their respondents found *Sustainable urban drainage systems – design manual for Scotland and Northern Ireland* (C521) to be effective. However, both SEPA's research and CIRIA's consultation exercise suggested areas where guidance could be improved, these are detailed below:

- **Design detail** – many respondents require further information on design detail for all SUDS components including inlets and outlets. The SEPA research identified the need to ensure guidance reflects current experience and knowledge. The SEPA research also indicated that the 'Designing SUDS' and 'Selecting SUDS' sections of the manual required the most improvement.
- **Design objectives** – respondents requested the need for objectives/criteria for improving the management of water quality and quantity. Some respondents also stated that guidance lacked any real quantification of the water quality benefits of SUDS.

- **Adoption issues** – respondents from both pieces of research also suggested that the lack of information on adoption and ownership and the necessary standards for SUDS was a deficiency that should be addressed.
- **Risk assessment** – respondents would also welcome the introduction of guidance that dealt with risk assessments for both the performance and safety issues relating to SUDS.

Whilst many of these concerns have been addressed by CIRIA’s latest guidance document *SUDS – hydraulic structural and water quality advice* (C609) there is still a requirement to collate and assess further information to ensure that practitioners have a one-stop shop for best practice guidance on the planning, design, construction and management of SUDS. The consultation and workshops run as part of RP697 will be used to inform the development of guidance to ensure that the guidance is effectively targeted at its target audience.

2. PROCESS

In order to obtain feedback on the development of guidance two main methods were used, web and paper based consultation and regional workshops. The results will potentially help influence the development of the guidance document, although it may not be appropriate or pragmatic to include all of the suggestions.

2.1 Consultation

The consultation exercise was run during December 2003 and January 2004. During the process 89 letters and questionnaires were sent to contacts with an interest in SUDS. From this mail out we received 20 completed questionnaires which represented a return rate of just over 20%. The questionnaire was also replicated on CIRIA’s SUDS website www.ciria.org/suds, over 40 web based questionnaires were completed. In total 61 questionnaires were received and analysed. The breakdown of respondents by sector is represented in the figure 1.

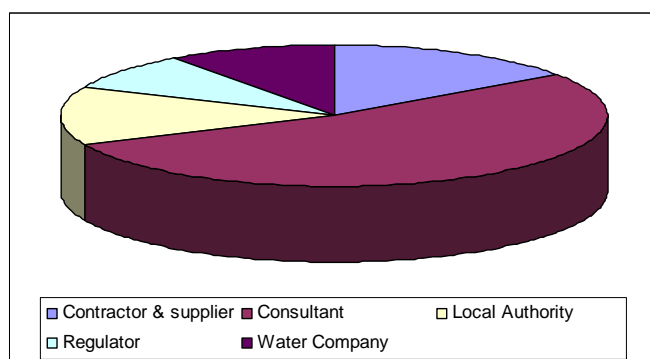


Figure 1: Breakdown of consultation respondents by sector

The questionnaires asked respondents to indicate the SUDS components they wished to be covered by the guidance, as well as indicating the importance of elements of the guidance, eg planning, design and construction of SUDS. The main guidance sections that respondents were asked to consider included:

- Impacts of urban land use on runoff
- Stakeholders
- SUDS fundamentals
- SUDS performance
- Development master-planning
- SUDS sizing and design criteria
- Detailed design guidance
- Construction of SUDS
- Operation and maintenance of SUDS
- Monitoring SUDS
- Public awareness and education
- Costs

Respondents were also asked to suggest possible case studies, the use of which will depend on the value that they add to the guidance document.

2.2

Workshops

Three workshops were run in January 2004, these consisted of two consultation/brainstorming workshops run in London and Durham and a feedback workshop in Coventry (sponsored by WaPUG). Seventy people attended the consultation workshops and nearly thirty delegates attended the feedback workshop. The breakdown of delegates by sector is represented in figure 2.

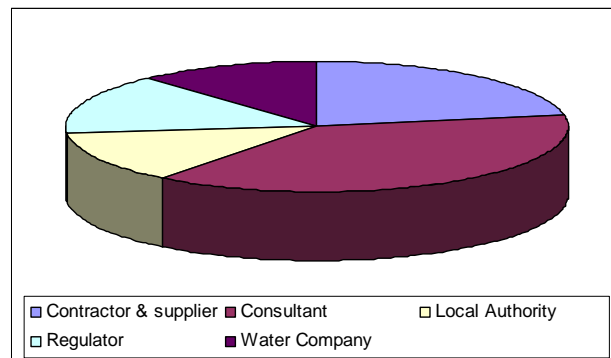


Figure 2: Breakdown of delegates' attendance by sector

The workshops were split into two sessions, the morning session covered specific guidance requirements to help influence the development of the guidance document from RP697, the afternoon session focused more on the identifying gaps in general research.

The workshop session focussing on guidance requirements utilised a 'goals grid' that provides a framework for delegates to identify the elements of guidance they wish to *achieve* and *preserve* or, conversely, *avoid* and *eliminate*. Delegates were asked to populate a goals grid with post it notes to identify how they wished the guidance to be developed. Figure 3 and Table 1 shows how the goals grid was represented to the delegates.

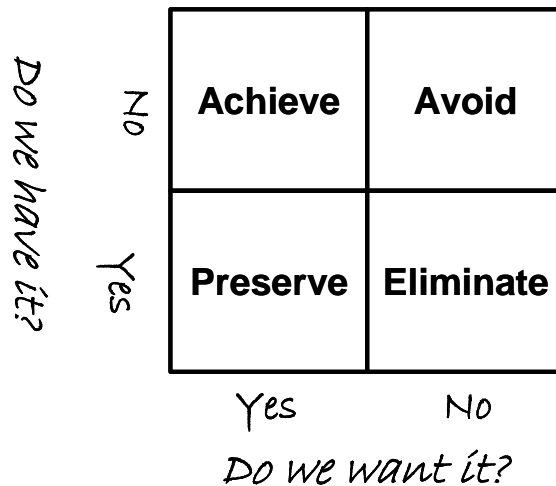


Figure 3: Example goals grid

Achieve	What do you want that you don't have?
Preserve	What do you want that you already have?
Avoid	What don't you have that you don't want?
Eliminate	What do you have now that you don't want?

Table 1: Explanation of goals grid

After the two consultation workshops the suggestions were analysed and presented to delegates at the feedback workshop. Key areas of interest and questions were relayed to the delegates and they were asked some questions to help with potential conflicts or ambiguities in the information provided at the consultation workshops.

3. RESULTS

Results are broken down into those obtained from the consultation and workshops. The information from the workshops have been filtered to ensure that they remain pertinent to guidance issues and not general SUDS practices.

3.1 Consultation

We received 61 completed questionnaires from those with an interest in SUDS. The questionnaires were split to cover the SUDS components that should be covered, suggestions for case studies and the importance of certain sections.

Coverage of SUDS components

Figure 4 represents the proportion of delegates that believe the components should be included in the guidance. Generally speaking there was good agreement about the inclusion of all SUDS components, with the strongest agreement being found on the inclusion of filter drains, filter strips, infiltration devices and swales, while only half of the respondents agreed with the inclusion of greenroofs and infiltration basins. This response possibly reflects the different types of SUDS components currently in use.

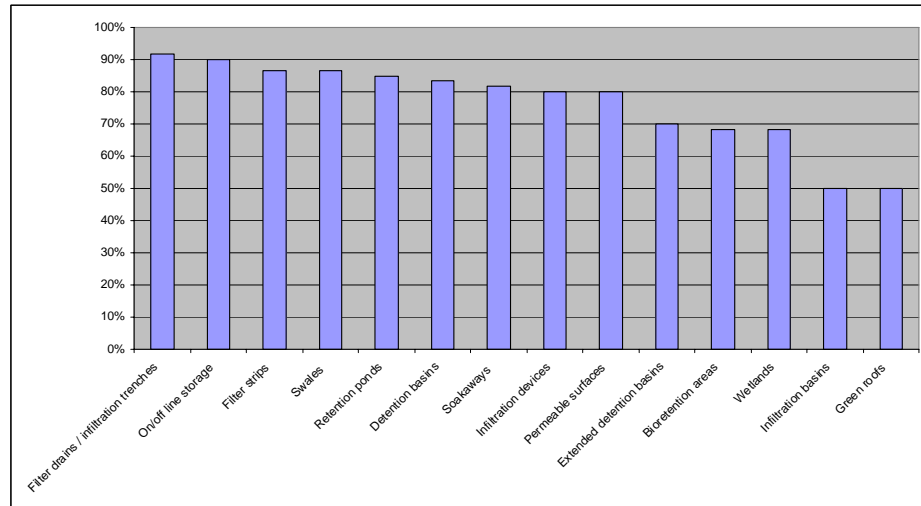


Figure 4: Inclusion of SUDS components within guidance

Detailed content for guidance document

Respondents were asked to identify elements of the guidance that they considered more important and the issues that should be covered. Figure 5 below represents the sections of the document they believe to be the most important.

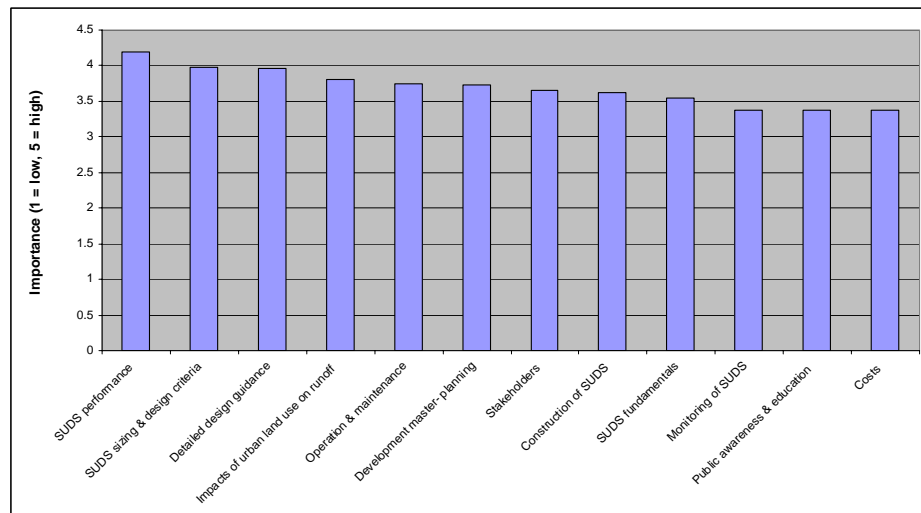


Figure 5: Importance of guidance sections

Respondents thought that information on SUDS performance (maximising the hydraulic and water quality performance as well as information on managing risk) was the most important. This was closely followed by guidance on SUDS sizing and design criteria and then detailed design guidance. Information on public awareness and costs were considered to be of a lesser importance. Delegates were also asked to provide feedback on the key issues that they believe the guidance should address. The main issues are discussed below:

Impacts of urban land use on runoff

Guidance needs to be focused on solutions rather than highlighting problems, this section should provide value by linking to the selection and application of SUDS to performance. It was thought that the impact of urbanisation needs to be put in context of the Water Framework Directive (WFD), as this will become an increasingly powerful driver. It was also thought important that guidance should consider changing land use and the impact of runoff on flood risk management.

Stakeholders

There was some contrasting opinion with regards to the usefulness of this section. Many thought this could potential repeat the information that is currently already known, others believed this provided an opportunity to reinforce the benefits of SUDS and educate planners.

SUDS fundamentals

Again there was some contrasting opinion about the level of coverage to be provided. It was thought that this information is best left in other guidance and RP697 should progress this to provide design guidance. However, many respondents believed it was still important to ensure that the guidance included some information about the drivers (including PPG25, WFD and other policies) and aims of SUDS and explain how SUDS has progressed and can contribute to the implementation of WFD.

SUDS performance

It would be useful if some empirical information on the long term performance and maintenance requirements was presented. Other respondents also thought it would be useful to provide guidance about proprietary products. Guidance was thought to be useful in terms of setting the performance and risk managements procedures relative to the requirements of the site.

Development master planning

Respondents indicated that this section should highlight the need for sensible site layout and the consideration of other strategic issues such as transport and biodiversity (although only relevant to large developments). It was also thought necessary that the general planning approach should be mapped to ensure early consideration of SUDS, this may be facilitated by referring to the availability of Supplementary Planning Guidance (eg SPG produced by South Gloucestershire).

SUDS sizing and design criteria

Respondents thought that designing for maintenance, as well as good hydraulic and water quality performance was essential. Many of the respondents required consistency between the approaches for designing piped systems and SUDS. The respondents also felt that appropriate reference should be made to managing extreme events and exceedance.

Detailed design guidance

It was thought that information on adapting designs for climate change would be useful, including information on prevention (eg rainwater harvesting/greenroofs). It was also thought useful to provide information on specifying materials etc. Guidance should promote the primary purpose to manage runoff and then consider ecological issues. Many respondents suggested that inlet and outlet design should also be covered in detail.

Construction of SUDS

This was thought to be a useful addition to the suite of SUDS guidance to help facilitate the implementation of robust systems. There was also support for a separate document on the construction process for on site contractors.

Operation and maintenance

This was thought by many respondents to be a useful section, many believe that detailed schedules for SUDS components would be welcome. Some respondents also thought it would be useful to provide case study information on successful maintenance.

Monitoring of SUDS

Information about methods of monitoring to facilitate good maintenance and operation was thought to be useful. Many respondents also believe that a common methodology/protocol for monitoring should be introduced.

Public awareness and education

In relative terms this was thought to be a low priority by the respondents, although some respondents felt this was an effective way to ensure that amenity value of SUDS was maximised. It was thought that technical guidance might not necessarily be the best place for this information.

Costs

Many respondents believed it would be useful to have details about capital costs comparison for SUDS and piped drainage systems. Respondents also believe that information on Whole Life Costing may also help facilitate the calculation of commuted sums. There was also concern about the usefulness of absolute costs as these would become dated.

3.2

Workshops

The tables below summarise the main points that came out from the completion of the goals grid. The key points and most common comments have been captured and have been presented below, the responses obtained from delegates exceed over a thousand, some of the suggestions were related more to practices rather than the content of the guidance document. There were some conflicting and ambiguous suggestions, where this was the case the feedback workshop helped to provide some further clarity. The points in *italics* were elements that required further explanation.

Table 2: Site appraisal & SUDS selection (Planning)

Achieve/preserve		Avoid/eliminate	
Selection	<ul style="list-style-type: none"> Guidance on geology and topography Presentation of selection tool Use of SUDS in high density developments Linkages to dual/multi purpose, ie amenity and water resources 	Process	<ul style="list-style-type: none"> Exclusion of piped solutions Over complexity Conflicts with planning guidance <i>SUDS management train?</i>
Process	<ul style="list-style-type: none"> Details of information required to facilitate selection Guidance on who and when to consult Guidance on risk assessment Guidance on modelling techniques Development of risk assessments <i>Achieve balance between quality, quantity and amenity?</i> <i>SUDS management train?</i> <i>Guidance for assessing impact on receiving waters?</i> <i>Determine impact on water quality?</i> 	Presentation	<ul style="list-style-type: none"> <i>Lengthy introductory text?</i> Negativity
Presentation	<ul style="list-style-type: none"> Use of decision trees List of pros/cons associated with each component Worked examples 		

Table 3: Designing SUDS

Achieve/preserve		Avoid/eliminate	
Process	<ul style="list-style-type: none"> Detailed guidance on components Guidance on integrating SUDS and rainwater harvesting Guidance on the use of 'prevention' techniques (eg greenroofs and rainwater harvesting). Guidance on retrofitting SUDS Guidance on designing for buildability, maintenance, safety and amenity Guidance on balancing quality, quantity and amenity <i>Guidance on suitability of materials?</i> <i>Information on generalities?</i> 	Process	<ul style="list-style-type: none"> Over prescriptive guidance. Over duplication of information Inconsistent design criteria Conflicting terminology Imbalance between quality, quantity and amenity Imbalance between attenuation, conveyance and infiltration <i>Information on generalities?</i>
Technical	<ul style="list-style-type: none"> Guidance on the design of control structures Guidance on accommodating flood paths Guidance on implications for pollution control <i>Guidance on agreed hydraulic and water quality design criteria?</i> <i>Extensive guidance on designing all components?</i> 	Presentation	<ul style="list-style-type: none"> Confusing diagrams Jargon Over complicated calculations without worked examples
Presentation	<ul style="list-style-type: none"> Use of Information checklists Use of flow charts Use of relevant case studies 		

Table 4: Constructing SUDS

Achieve/preserve		Avoid/eliminate	
Process	<ul style="list-style-type: none"> Guidance on programming/phasing Guidance on protecting site <ul style="list-style-type: none"> Compaction Pollution Sediment Guidance on site rehabilitation Guidance on drafting method statements Checklist for inspection Guidance on materials and sustainability 	Process	<ul style="list-style-type: none"> Over complicating construction of SUDS Prescriptive over specification
Presentation	<ul style="list-style-type: none"> Clear and simple guidance Flow chart on process Separate leaflet/pamphlet <i>Use of case studies (good and bad practice)?</i> 		

Table 5: Managing and maintaining SUDS

Achieve/preserve		Avoid/eliminate	
Process	<ul style="list-style-type: none"> • Need to link to good design • Provide information for maintenance method and frequency • Development of example maintenance schedules • Guidance on assessing failure • Guidance on waste management issues • Guidance on using risk based approach to maintenance 	Process	<ul style="list-style-type: none"> • Over complicated guidance • Misconception that SUDS are more costly to maintain than conventional systems • Reference to adoption/responsibilities • Over prescriptive and negative guidance
Cost information	<ul style="list-style-type: none"> • <i>Whole Life Costing application to SUDS to facilitate funding</i> • Guidance on design lives for SUDS • Costs for maintenance regimes • <i>Guidance on calculating commuted sums</i> 		
Presentation	<ul style="list-style-type: none"> • Clear simple guidance • Use of case studies 		

Table 6: Maximising amenity and ecological value of SUDS

Achieve/preserve		Avoid/eliminate	
Process	<ul style="list-style-type: none"> • <i>Guidance on balancing amenity with other functions?</i> • <i>Guidance on H&S risk assessment?</i> • Guidance on impact of O&M on amenity • Guidance on the integration of wildlife corridors. • Guidance on the composition of an 'appropriate' team 	Process	<ul style="list-style-type: none"> • Over emphasis of habitat creation at expense of other functions • Over cautious approach to safety.

Table 7: Management of runoff & extreme events

Achieve/preserve		Avoid/eliminate	
Process	<ul style="list-style-type: none"> • Guidance on 'prevention' and source control • Guidance on designing for system exceedance • Provide clarity on return periods • Appropriate consideration of climate change • Use of simple design tools 	Process	<ul style="list-style-type: none"> • Protracted consideration of climate change • Ambiguity when discussing events • Misconception that flooding means failure • Inappropriate differentiation between SUDS and piped sewers. • Over emphasising of SUDS
Runoff mgt	<ul style="list-style-type: none"> • Guidance on development of a management plan for all return periods • Guidance on the maintenance required for extreme events • Guidance on design of outlets for extreme events • Consistent standards with Sewers for Adoption 		
Presentation	<ul style="list-style-type: none"> • Checklist for consideration of source control • Case studies 		

Table 8: Liability and insurance issues

Achieve/preserve		Avoid/eliminate	
Process	<ul style="list-style-type: none"> • Health and safety considerations for each component • Designing for safety • List SUDS in order of risk in terms of sensitivity, risk to people etc 	Process	<ul style="list-style-type: none"> • Over prescriptive approach to safety • Bias towards flooding control
Technical	<ul style="list-style-type: none"> • Guidance on risk management to cover: <ul style="list-style-type: none"> ○ Risk of adoption (future maintenance) ○ Risks to design performance ○ Risks of exceedance • Guidance on constructing SUDS on brownfield sites. 	Presentation	<ul style="list-style-type: none"> • Confusing and non representative statements • Overuse of complicated legal terminology

3.3

Clarification of points

During the detailed analysis of responses on the goals grids a number of issues and potential conflicts arose that the Project Team thought might be useful to obtain further clarification from potential end users. The feedback workshop was used to discuss some of the findings and seek resolution to some of those issues.

Site appraisal & SUDS selection (Planning)

Queries that arose from the analysis of the goal grids related to the level of information that should be provided on the overall SUDS philosophy and the downstream impact of drainage in terms of flood risk and water quality.

Inclusion of background information on philosophy – The target audience for the guidance is likely to be broad and therefore guidance needs to be useful to a variety of organisations and disciplines. Information on the background and philosophy should be included, but this should be brief, add value to the existing guidance and provide useful ‘hooks’ and snippets on SUDS. Background information should consider regulatory, planning and where appropriate adoption issues. The guidance should also include the SUDS triangle, water management/treatment train and emphasise that SUDS is a philosophy, rather than a ‘one answer suits all’ solution.

Impact on receiving waters and catchment - Guidance should encourage the reduction of flows and volumes and that guidance provided in this section should be consistent with EA guidance on water quality and flood management. Guidance should be provided on measures that relate to the size and sensitivity of the site and/or catchment. The potential impact of the Water Framework Directive should be discussed and that where possible systems should be designed so they do not require consents.

Flood risk - This should be related to the level of urbanisation, making linkages with Catchment Flood Management Plans should help provide further clarity. Guidance should also primarily focus on greenfield sites and major development projects.

Designing SUDS

Further clarification on the level and design information required was thought to be useful. The Goals Grid also indicated that delegates would appreciate further information on specific components, namely permeable pavements and greenroofs (information on greenroofs was in contrast to the consultation!).

Inclusion of design criteria – Clarity is required on what ‘design criteria’ means as it can refer to technical design criteria, relevant to specific SUDS components, or site planning criteria that may include information on balancing quantity, quality and amenity on a site or local scale. There was consensus that hydraulic design criteria (flow and volume) would be easier to agree than criteria for Water Quality. Hydraulic design criteria can be based on design return periods and the Greenfield run-off methodology. Water quality design criteria was difficult to tie down, and should relate to the quality of the receiving water. However, the adoption of the Treatment Train would help ensure a consistent approach to water quality.

Information on components – A consistent approach to the level of detail on components should be achieved. However, it was acknowledged that currently there is a shortfall of research on the hydraulic properties of greenroofs. In circumstances where there is currently a shortage of information the concepts and benefits of components should be mentioned. With regards to additional information on permeable pavements, it was considered that CIRIA report C582 provided the majority of information although more guidance on hydraulics maybe useful.

Information on materials – Information on specific materials, or proprietary products should not be included as this could stifle innovation. However, information on performance criteria (eg tensile strength, permeability) for certain system components was thought to be useful.

Constructing SUDS

Further clarification on the best way to encourage good practice during the construction of SUDS was required, this focused on the value of case studies and guidance on ensuring contractors construct as designed.

Inclusion of case studies – Case study information on construction issues were likely to be too site specific for inclusion in the guidance. Negative case studies are likely to have greatest impact, although these are difficult to come by. It was thought that balance was required and that diagrams and processes should identify some problems during construction.

Contractor education – Simple education and guidance for contractors should include information key principles, tolerances of materials and systems as well as seasonal and timing issues.

Managing and maintaining SUDS

A number of delegates raised issues about costs and funding mechanisms for undertaking management practices. It was thought useful to explore ways in which information on financial implications could be presented.

Provision of information on costs – Linkages with ongoing work should be made, case studies could also usefully provide some further information. Specific information on costs should be avoided, but guidance should facilitate the production of sensible maintenance schedules/specification that can assist with financial estimates. Guidance should also be provided on ways to reduce the cost of maintenance, ie through good design.

Provision of information on deriving Commuted Sums and funding – It may not be appropriate to include guidance on funding and derivation of commuted sums in RP697. However, it might be useful to provide a conceptual method of calculating costs.

Maximising amenity and ecological value of SUDS

Response from the consultation workshops highlighted challenges in promoting the amenity value of SUDS, many believed that it was important to obtain balance between the functions. However, amenity should not impact on the primary function to reduce pollution and flooding risk downstream. Concern about health and safety was also raised as a consideration for guidance.

Obtaining balance between amenity, quality and quantity functions –

Quantity issues cannot be compromised, however quality improvements are likely to be dependent on regulator input, although could be made relevant to the quality of the receiving water. Maximising amenity needs to be considered at the initial planning stage, as it is only at this stage that systems can be specifically designed to improve amenity. Guidance should demonstrate how SUDS can contribute to improved quality of life, sustainability and achieve the aspirations of PPG3 Housing and PPG25 Development and flood risk.

Level of information required on safety issues –

Dialogue with ROSPA should be achieved to ensure that the correct messages on risks are communicated. Guidance should be provided on the development of a framework for risk assessment and the communication of risk.

Management of runoff and extreme events

There is still considerable debate amongst practitioners about methodology for calculating hydrological information. There is also interest in the development of drainage impact assessments and drainage systems that can accommodate exceedance.

Drainage assessment and exceedance – The inclusion of information on drainage impact assessments would be useful, this can be facilitated by the provision of case studies, checklists and decision trees. Guidance on drainage exceedance should include information on the potential impact of a range of return periods and should be compatible with sewers for adoption. It would also be useful for guidance on the capacity of drainage components.

Source information – The Flood Estimation Handbook (FEH) should be encouraged rather than the Flood Studies Report (FSR). Both the FEH and FSR are appropriate for larger catchments (>20 km²) guidance is required on applying a similar approach to smaller catchments.

Liability and insurance

Points of clarification mainly focussed on the need to develop dialogue with insurance organisations and the impact that adoption may have on the development of guidance.

Involvement of Association of British Insurers – Insurers should be involved in the process, but insurance companies should appreciate that SUDS can only provide site drainage not protection from fluvial flooding. It would be helpful if insurance companies could be clear and consistent on the levels of protection they require so that SUDS practitioners can design to these criteria.

Discussing liability and avoiding adoption issues – Reference to the SUDS management/treatment train should help assist with reducing liabilities. Guidance on maintenance (frequency and costs determination) can facilitate the adoption process however, adoption issues should be avoided. Risk analysis would be useful to determine risks to public and corporate and private liability.

Other impacts on SUDS operation should also be considered and mitigated against.

4. CONCLUSIONS

From the exercise and analysis of the goal grids there are a number of key elements that the potential target audience wish RP697 to preserve or achieve as well as elements they would like the project to avoid or eliminate, these are summarised in the table below.

Achieve/preserve	Avoid/Eliminate
<ul style="list-style-type: none"> • Useful case studies • Simple and clear diagrams • Flow charts • Checklists • Consistent treatment of SUDS and conventional drainage • Balance of functions between quality, quantity and amenity 	<ul style="list-style-type: none"> • Negativity • Needless over sophistication • Jargon • Over emphasis that SUDS is the only solution • Over prescriptive advice • Inconsistencies • Unnecessary duplication

5. CASE STUDIES

As part of the consultation process and management of the workshop, respondents and delegates were asked if they had any suitable case studies. Details of the case studies are provided below, it may not be appropriate to include all of these case studies as each case study will have to be assessed on the value it adds to the overall project. It is also not clear whether case study information will be included in the guidance document or CIRIA's SUDS website.

Case studies originally provided for *Sustainable urban drainage systems – best practice manual (C523)* may also be revisited. ***CIRIA would welcome any additional case study information***

Type	Netlon Advanced turf filter
Location	Cummins, in White Bear
Contact	Glen Rehbein
<i>Details</i>	
The use of two Netlon Advanced Turf filter/infiltration basins.	

Type	Infiltration basin
Location	Angmering
Contact	Peter Brett Associates
<i>Details</i>	
This is a completed scheme	

Type	Hybrid system
Location	West Durrington
Contact	Peter Brett Associates
<i>Details</i>	
Residential development 40 ha (875 homes). This project is currently at concept stage. Within development piped systems discharge to strategic swales, ditches and balancing ponds within the overall site. Swales are large, designed mainly for storage.	

Type	Off line attenuation pond
Location	Wychwood Village
Contact	Countryside Properties
<i>Details</i>	

Type	Off line detention pond
Location	Buckshaw Village
Contact	Redraw Manes
<i>Details</i>	
Entering into 'trial' mgt. Agreement with Redraw Homes/Barratts on this site.	

Type	Filter drain/ balancing pond
Location	Ayrshire
Contact	Atkins
<i>Details</i>	
At least two SUDS retrofit schemes will be complete by March/April 04. Scottish Water should be monitoring performance.	

Type	Wetlands
Location	Newbury by pass
Contact	Middlesex
<i>Details</i>	
Series of wetlands (varying plants/geometries/configurations) for storage and treatment of highway runoff	

Type	Permeable pavement swales wetland
Location	East Midlands Airport
Contact	
<i>Details</i>	
This is at design stage but should be constructed mid 2004. The client is very pro SUDS and would be happy for monitoring to be undertaken	

Type	Bio treatment and infiltration
Location	Derby
Contact	Clear Ltd
<i>Details</i>	

Type	Detention basin
Location	Gosforth Valley
Contact	Yorkshire Water
<i>Details</i>	
Detention basin in large housing estate - built 1970 - part of the public sewerage network	

Type	Basins + infiltration
Location	Lightmoor Telford
Contact	Borough of Telford and Wrekin
<i>Details</i>	

Type	Mainly surface ponds
Location	Newcastle Great Park
Contact	Newcastle City Council
<i>Details</i>	

Type:	Permeable paving
Location	Corbridge (Nr Hexham)
Contact	RMC Concrete
<i>Details</i>	
2,000 m ² permeable paving laid at Corbridge.	

Type:	Swales
Location	Site at Bodmin (St Lawrence's)
Contact	Cornwall CC
<i>Details</i>	
Roads without gullies direct to swales	

Type:	French drains
Location	Nancemere Farm
Contact	Cornwall CC
<i>Details</i>	
Drainage into 'french' drains	

REFERENCES

- Wild, T.C., McKissock G, and D'Arcy BJ (2002). Evaluation of SUDS and urban pollution guidance (SEPA version)
- S, Wilson, B, Bray, P, Cooper, CIRIA (2002). RP663 Paper 9, Summary to consultation exercise