STROUD VALLEY EXEMPLAR

LOW COST, 'NATURALLY ENGINEERED' FOUL AND RIVER FLOODING SOLUTIONS

Synopsis

The appended report seeks significant Defra support to solve all the surface flooding problems (foul and river) by adopting naturally engineered wetlands and reed beds/swales in an innovative and holistic way. Whole water cycle benefits will also accrue within the catchment.

The overall cost is estimated at some £500,000 over three years with the highest initial priority and amenity value, costing around £50,000. The ability to verify the benefits and costs during the overall period is a benefit all the partners, see document, see as invaluable. This work builds on some proven elements from elsewhere (Severn Trent Water near Stoke) but needs additional solutions to give whole catchment solutions.

Subsequently applied, nationally the savings and additional benefits for the whole nation going forward are hugely significant which is why we are seeking significant Defra support. Whilst a national exemplar, it also have international benefits for UK Plc.

Stroud Catchment Partners

DEVELOPING AND DEMONSTRATING AN EXEMPLAR OF INNOVATIVE, HOLISTIC, LEAST COST ALLEVIATION OF FLOODING CONSEQUENCES

INTRODUCTION AND CONTEXT

Increased flooding problems are resulting from ever more impervious surfaces and agricultural run off. At the same time, the effects of climate change are becoming more and more evident, with increasing storm ferocity and more frequent droughts. These factors are in conflict with and undermining achievement of the ever tighter needs and expectations of improved river water quality.

Without a significantly different approach to water and catchment management it is predicted that these problems and their impact on the environment, local economies and people's quality of life will noticeably worsen.

Sustainable, much more affordable and less visually intensive 'engineering' solutions are clearly and urgently needed for:

1. Further foul flooding relief
2. Dealing with storm overflows
3. River flooding relief
4. Wetland creation (saving abstraction licences)
5. River quality improvement from reduced agricultural and urban run off
6. Protecting both current and future householder amenity

Solutions to the above are transferable in whole or part to other locations so giving huge national value from this work.

The appended paper on Aston Hall Farm, an exemplar which has already won two prestigious awards, already shows how to address issues 3, 4 and 5 above.

Innovative solutions to these urban environment problems will be applied in the Stroud Valley (learning from certain important developments elsewhere) with partnership involvement of, in no particular order:

- Defra
- Environment Agency
- Severn Trent Water Limited

- Stroud District Council, Gloucestershire County Council and Local Parish Councils
- Local Developers
- Local Environmentalists
- English Nature
- UKWIR
- Royal Agricultural College, Cirencester
- ADAS
- FWAG

OUR HOLISTIC AND INNOVATIVE APPROACH

This proposal offers resolution of flooding problems by acting on the **causes** ahead of, as well as on any residual effects, demonstrating complete, long term solutions. These forward solutions also embrace growing climate uncertainty within this relatively concentrated river catchment which also offers a mixed urban/rural challenge.

Our approach uses water's various interactions with the land as a natural 'blueprint' to provide sustainable solutions through the use of a range of natural "soft", as well as "conventionally" engineered functioning landscapes.

By using the focus of moderating flooding, within related aspects of land management, this pilot will demonstrate much lower cost, mutually inclusive solutions. High social benefit, significant agricultural diversification, new resource creation and a global relevance reinforce the holistic nature of the approach.

This pilot offers methods of sustainable water management that in addition address moderation of drought, additional economic benefits for the rural economy and new possibilities for further sustainable housing and social development, all while also creating leisure, important social welfare and biodiversity opportunities.

THE DETAILED PROPOSAL - Why Stroud?

The District of Stroud and its environs (with a population of some 100,000 persons) is in Gloucestershire on the scarp slopes of the Cotswold Hills adjacent to the fast flowing River Frome.

There are a number of key considerations that focus Stroud as a location for development of dispersed wetlands for both wastewater and water management. Stroud is known for its concern in making our future more ecologically sustainable. This is reflected in the forward thinking of Stroud District Council (SDC), which has recently conducted a series of 'Water Summits' involving many stakeholders. The conclusion of this inclusive process has been the decision to prepare a Sustainable Water Management Strategy for the District.

SOLUTIONS - A NEW 'COMMUNITY PARTERSHIP' FOR WATER RESOURCES

Perhaps of all industries and infrastructure providers, the Water Industry seeks sustainable, responsible, collaboration with all its stakeholders. Whilst rarely openly discussed, tacit support of customers is also required for instance in terms of what they may seek to dispose of into the sewers as well as a realistic attitude to the needs within the community for its waste water treatment works, infrastructure and their maintenance.

Severn Trent Water, the water services provider for Stroud District, has maintained significant interest in achieving higher environmental standards. Soon after Water Privatisation, Avening Wastewater Treatment Works (local to Stroud) was rebuilt, innovatively featuring some of the earliest reed beds to enable a high quality discharge to the sensitive receiving watercourse at this location.

Severn Trent also has supporting experience of creating a wet grazing marsh, agricultural field margins for pollution protection and management of flood meadows to gain multiple benefits to the economy and overall water cycle. The lessons learned, including the engagement of the local community and the effective acquisition and utilisation of funding through the Stroud local partnership created, provide the overall template which may usefully be proven from the urban context of Stroud as the national exemplar, for replication and great costs savings.

The District Council's declared intent is to develop a sustainable water strategy that can now also be 'partnered' by Defra and Severn Trent Water to the mutual benefit of all. The local MP, David Drew is also particularly supportive.

LOCAL CONTEXT – METHODS OF MODERATING FLOOD RISKS

A Complex and Difficult Hydrology

Stroud is central within the catchment of the River Frome, near to the confluences of five valleys. Joining the main Frome valley from Chalford are the Slad and Painswick Brooks within the town, whilst just below the town, the Nailsworth and Ruscombe Brooks merge.

These watercourses are fed by springs which issue from rock horizons in the Cotswold Scarp slopes. Due to the porosity of the limestone rocks, these streams used to be notable for their very constant flows. This situation has presently been lost but can now also be remedied as a further benefit of this work.

Note: Poor aquifer recharge should also be recognised as a contributing sign of increased flood risk.

SOLUTIONS - Moderating River Flood Risks

It is estimated that 1,000 acres (400 hectares) of millponds and reservoirs have been lost through their abandonment and development in Stroud district during the last 100 years. This is typical of comparable locations throughout the UK. The loss of this water storage and the **flood water buffering** it provided has also been significant. Risk of major flooding is locally perceived to be high. However, a number of low cost, sustainable structures are proposed to significantly address this risk. They are:-

- Upstream retention of floodwater within simple keyed ‘natural’ bunded earth impoundments planted with coarse grass, so providing temporary water storage in areas of farmland upstream of the main urban areas.

- Basic flow restriction (with overspill) to retain water, on an opportunity basis, in areas of typically 5 – 10 hectares area at depths of 1metre, at multiple locations as required, on each of the 5 sub catchments described earlier.

- Creation of seasonal ‘water meadow’ features that will not only improve infiltration for groundwater recharge but also improve summertime grass growth for grazing and haymaking.

- The ‘soft’ engineered approach follows an ‘agriculturally engineered’, as opposed to a ‘civil engineered’, method of construction. Civil Engineers

continue to have a vital role in robustness of design and overall context. The local construction provides further support to the rural economy by placing that earth construction, where appropriate, with local agricultural contractors.

SOLUTIONS - Capture and Control of Urban Run-off

Typical of many conurbations, much of Stroud's urban surface water run-off is combined within the urban sewer network. During storms, the increased volume of water frequently exceeds the capacity of the drains and sewers and these surcharge into streams and onto the land. These problems are already being exacerbated by both climate change and also the substantial local urban growth in recent decades (increasing the area of paved catchment for rainfall).

The comparative steepness of Stroud's valley further amplifies any problems with the sewerage system. The undulating topography (there is a total head differential approaching 200m over the sewerage catchment) provides a difficult landform on which to optimise any centralised sewerage system.

SOLUTIONS - Costs and Timescale

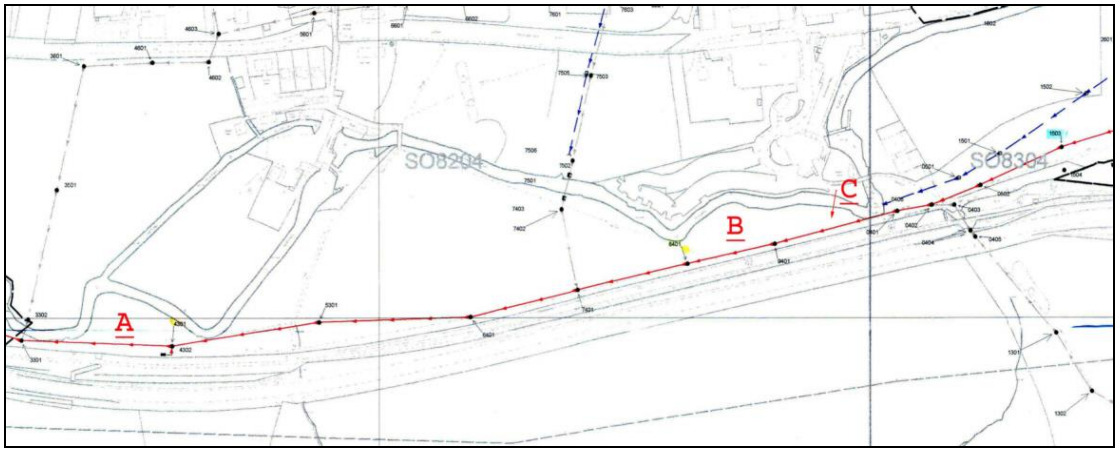
There is a sequence of scheme options and costs for the Stroud pilot proposal. These exclude the cost of land as ownership is intended to be retained by farmers, with long term agreements to allow our seasonal land usage for water management.

The feasibility study (completed late summer 2003 and now updated), includes prioritised costs for meeting the catchments needs from alleviation of all foul flooding, through to the many, wider water cycle benefits from amenity to turbine power generation.

COST ESTIMATES AND TIMESCALES OF WHOLE CATCHMENT - PHASING FROM THE MOST IMPORTANT/BENEFICIAL FIRST

By way of example, a central site at Ebley Meadows in Stroud is described to show the scope and value of this exemplar.

Ebley Meadows



The plans for controlling foul flooding in Ebley Meadows have been costed with a reputable local agricultural groundwork contractor (David Cridland, Commelines Mill Farm, Gloucester) and this estimate is based on his quote.

To construct 2 x Reedbed/Swales (as per plans below, EM001 at A above & EM002 at B above, already supplied & provisionally approved by John Kelly & Charles Tucker, EA). Excavation of sites, installation and supply of vertical flow straining reedbed within tank and all pipework. Connection to main sewer at adjacent manholes. Excavation of swale areas and overflows to river. Landscaping and reseeding, planting with shrubs. Spoil to be landscaped on site. Each site bounded by treated post and rail fence with stocknet/barbed wire and 12ft wooden entrance gates. Cost for supply of materials and installation £20,000 each site, £40,000 total estimate. Planning/supervision of construction costs £3,000 each, £6,000 total estimate.

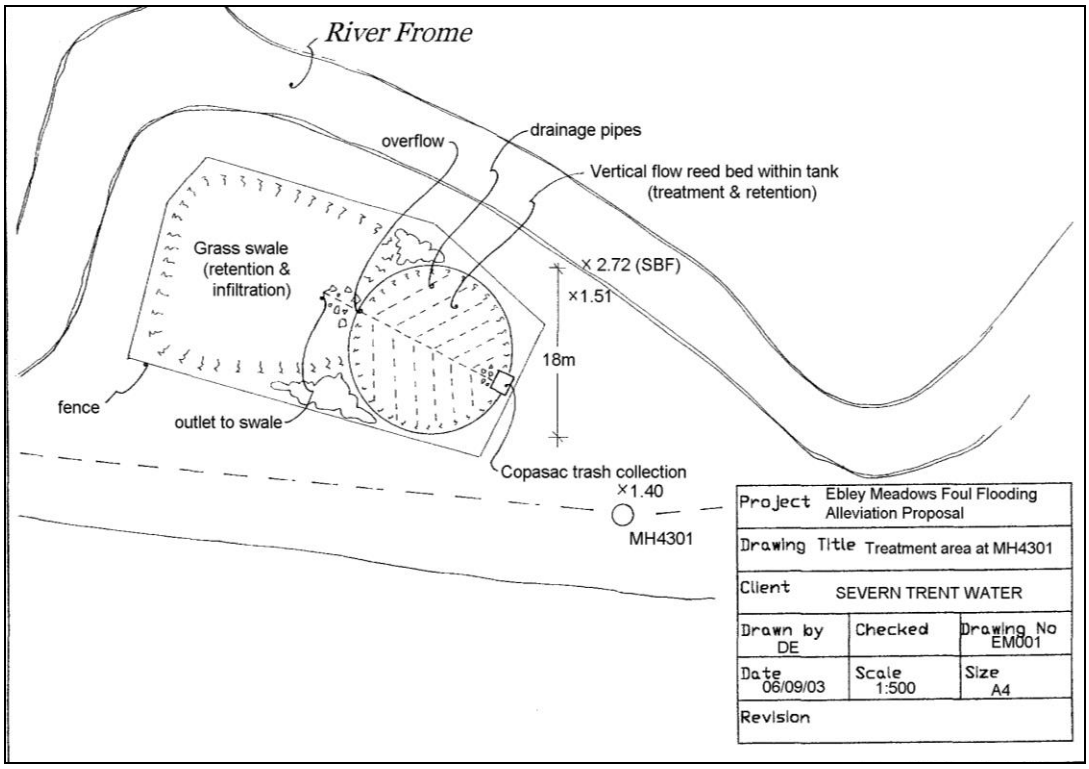
Total anticipated cost for initial phase at Ebley Meadows £46,000.

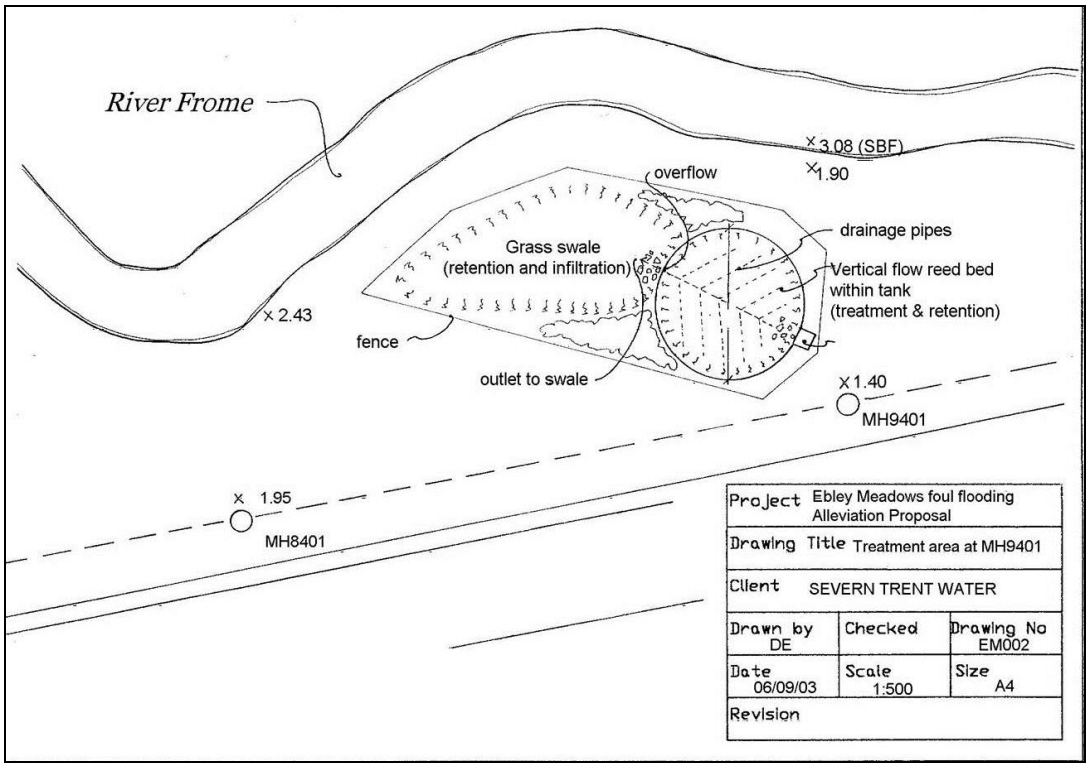
It should also be noted:

20 reedbed/swale sites for foul flooding capture and control and anticipated to be achieved within a £500,000 budget. These will provide for worst ten year foul flooding events on the sewer catchment at/and upstream of Ebley Meadows.

Complete resolution of the worst ten year foul flooding events at Ebley Meadows can only be expected when all upstream sites are installed. This is part of the need to look holistically at the whole catchment and whilst there is of course some likelihood of overspill into the river until such completion, this would be at greatly reduced volumes/frequency than at present and so an immediate great amenity improvement.

The model proposed for resolving foul flooding in Stroud will have useful applications in all other sewer catchments nationally where retention tanks are installed, i.e. virtually all.





Prioritisation of works for 'Defra Pilot'

The complete catchment approach utilising natural 'soft' engineered works envisaged in this pilot offers a very innovative approach to the flood, drought and river water quality problems caused by urban, agricultural and highway runoff. This pilot effectively reverses a long period of low interest /high costs and meets the now increasing public concern for the environment.

The proposed three year programme is:

<u>Ebley Meadows</u>

- The quantitative increase in relative foul flooding (partly also due to increasing development) during 2003 indicates the construction of the already planned and costed trial reedbeds/swales in Ebley Meadows should be the starting point. The EA have also strongly indicated their wish to commence here.

  A linked refinement of the methods proposed would be a further site upstream on one of the branch sewers – perhaps here also in association with a local parish level group who are interested.

- Other activities during year one would comprise co-ordination of organisational plans, commencement of wider detailed modelling, auditing, surveying and development of planned works.

Year Two

Completion of refined designs and planning and commencement of other works.

Year Three

Completion of all proposed works (urban, agricultural and highway flood relief and infiltration structures) and confirmation of benefits.

- Alleviating the consequences of further sewer surcharging in Stroud provides the opportunity to demonstrate an exemplar in a dispersed approach to managing foul flooding. It will use 'straining' wetlands at multiple locations (estimated between 8 – 12) as the innovative solution to capture and safely alleviate this problem.

- We envisage a two stage approach namely surface flooded vertical flow straining reedbed for treatment combined with a retention and/or infiltration intermittent wetland where appropriate.

- This has huge applicability throughout the UK.

- A concurrent benefit is further relief to any nearby Unsatisfactory Intermittent Discharges (UIDs) from storm overflows.

- Sizing of dispersed treatment/retention structures at any individual location are typically less than 0.5 hectare each.

- Either gravel or soil/humus planting media options will be offered for reed beds. Humus offers improved reed nutrition and protection against drying out for this intermittent use application. (The humus itself is provided by composted sewage sludge with domestic waste).

- Segregation and separation of highway drainage runoff from the sewer system also significantly helps reduce foul flooding and surcharging. A variety of 'soft' treatment, retention and infiltration options will be used according to location.

Capture and Control of Agricultural Run-off

Changes in agricultural land use around Stroud during the second half of the 20th century have had significant adverse effects, both qualitative and quantitative, on the local water cycle. A large increase in land area used for intensive arable (mainly cereals) production on often shallow 'Cotswold Brash' soils on the higher ground surrounding the River Frome catchment has of itself caused:

- Increased surface run-off of rainfall and top soil (silt), this reduces aquifer recharge, causes siltation, amplifies peak flows and reduces base flows in watercourses.

- Some nitrate (also pesticide and herbicide) accumulation in ground water.

- At some locations, fine top soil material (silt) is now issuing in spring water, apparently from intensive land cultivation practices on nearby land causing this material to percolate through the limestone.

- Loss of topsoil and humus material from the land creates a general accelerating and cumulative general deterioration of land water retention and infiltration properties.

Large areas of Stroud District farmland are already designated by Defra as an Environmentally Sensitive Area (ESA); this requires reduced artificial agricultural inputs and other careful consideration of aspects of land management. Severn Trent also has extensive experience of farming in this environmentally sensitive way at its own sites.

A range of further land and water management measures are also proposed as a part of this pilot to protect the local water resource. Soil water retention can be cumulatively improved by return of silt from watercourses:

- Construction of silt traps within those mainly smaller water courses that are affected by agricultural silt, at (subject to further survey) upwards of 100 locations, typically spaced at 500 metre distance throughout those affected upper reaches of the catchment.

- Simple excavated unlined ponds, typically 20 metres x 5 metres x 2 metres deep, graded to settle silt with keyed and bunded earth impoundments with normal flow restriction (and overspill) planted with coarse grass, to enable capture of silt for subsequent removal, typically every 2 years, for return to adjacent land via a simple rotary muck spreader.

- Silt traps/ponds provide additional temporary floodwater storage/infiltration in areas of farmland upstream of the main urban areas.

- Full implementation of agricultural field margins as buffers along all watercourses to protect from surface run-off products, arising from both arable and livestock farming activity.

- Strategic consideration of set-aside land placement to secure further benefits such as those 'extras' detailed at Severn Trent's Aston Hall Farm.

VALUE - GENERAL BENEFITS OF THIS CATCHMENT WIDE APPROACH

This full scale national exemplar utilises an array of sympathetic techniques and approaches deployed across an entire catchment to address the whole range of specific urban and agricultural flood related issues.

Each specific aspect produces a clear and particular benefit.

However, the total catchment benefit is significantly greater than the sum of its individual parts, across many areas (economic, biodiversity, leisure, employment etc) and most importantly in operational terms.

Some examples:

- The latent risk of submerging of foul or sewer surcharge control reedbeds (which by necessity will be adjacent to watercourses) from rising river flood levels (peak flows) is significantly reduced by the other proposed upstream flood retention measures.

- Maximised infiltration of rainwater to improve base flows will maintain self-cleansing of river beds for longer periods.

- Improved public awareness of the local watercourses usage, value and function is expected to improve public self-policing.

BENEFITS AND COSTS

The currently engineered high capital and ongoing maintenance costs of dealing with flooding, agricultural run off, conventional flood defence and rainwater

disposal systems can be collectively, significantly reduced by the mutually inclusive, naturalistic solutions described in this proposal.

There are a wide range of beneficiaries, particularly the **Local Council**, as land hitherto incapable of development can now become both revenue earning (Council Tax) and a social asset. Similarly, **Developers** gain, as does the **Wider Community** directly from the further facilities and environmental improvements that this exemplar pilot provides.

Defra, on behalf of the Government, benefits from enabling the farming, food, landscape, CAP modulation etc. elements to be combined in this urban/rural pilot. Improving the quality of and reducing the huge variability inflow from run off is a major catchment benefit.

The successful implementation and demonstration of the methods outlined in this proposal will allow, in the longer term, widespread national usage of these and potential annual cost savings of £billions against less innovative approaches. This is in addition to the potential flood damage costs and the value of the other benefits.

Solutions refined, combined and demonstrated in Stroud will allow extensive possible application at the majority of other catchments and conurbations.

This exemplar will also provide useful new strategies and experience for the **EA** to consider in their further development of wetlands for flood control and possibly, in applying their Restoring Sustainable Abstraction (RSA) Programme and aspects of Catchment Abstraction Management Strategies (CAMS). The required Regulatory arrangements will also be signalled and thus development work can be developed on a just in time basis to help sustain the more holistic solutions described in this work.

The 'natural' construction and general approach comprises an effective re-evaluation of traditional concepts of 'downstream' flood defence. It may thus also encourage some re-evaluation of some existing principles to allow 'upstream' flood interception. This could then herald a further wider, attitudinal change from 'disposal' of flood waters to seeing them as utilisable resource and opportunity rather than a hinder.

There are important national implications to the successful demonstration of the dispersed method of controlling foul flooding and accompanying benefits for all sewerage undertakes moderating UIDs from storm overflows.

CONCLUSION

The most significant life enhancing efforts of modern, perhaps all time, have been the Victorian provision of safe water and wastewater services. These are deeply embedded in the fabric of our personal and economic well being. Our urban centres are fundamentally dependent on these networks – and as we are unlikely to physiologically alter too greatly, will still be required, in the very long term.

However, in the urban edges of even the biggest conurbations, the land/water interface offers many excellent reasons to how carefully reappraise applying sustainable much lower cost 'soft' engineered approaches. These offer a secondary tier of huge functional and perceived value to buttress the existing conventional water infrastructure against the new quantity and quality challenges amplified by climate change and the wider consequences of modern living.

This innovative proposal outlines an important and valuable method of properly quantifying this approach, to demonstrate and prove the engineering as well as defining and testing any required new regulatory principles. The exemplar's context is set within a much higher value (lower costs/higher outputs) proposition which maximises sustainable, naturalistic engineering solutions.

Whilst focused to be developed at Stroud because of a number of unique opportunities, the outputs apply not only throughout the UK but also internationally. This global relevance helps underline the world class nature of the UK Water Industry in also innovatively developing increased availability of sustainable water services.

Prof. Gerald P Noone MBE
Executive Director
Severn Trent Water Limited

In consultation with Julian Jones (Environmental Consultant)

TABLE 1

KEY PARTNERS, BENEFICIARIES, BENEFITS AND COSTS

PARTNERS/BENEFICIARIES	BENEFITS	OVERALL COSTS TO BE ALLOCATED
Defra	Sustainable land/water management with CAP modulations	
Stroud District Council	Removal of development restrictions and improved environment	
Developers	Without these initiatives, building will have to be curtailed - this thus enables wider growth	
Environment Agency	Articulate EA's vision re wetlands etc but on whole catchment basis	
Severn Trent Water Limited	Future proofing services in ever more efficient, effective and sustainable ways	
Gloucester County Council	Meet highway drainage and wider county plan needs	
English Nature	Sustainable, biodiverse solutions replacing problems	
Local Environmentalists and Population	Replace local "complaints" with local "pride"	
UKWIR	Significant practical demonstration project for UK	

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