Stroud Rural SuDS, Stroud

SuDS used

- *Leaky dams*
- *Coarse woody debris (CWD) structures*
- *Off-line field bunds*
- *Culverts & soakaways*
- *Large scarp erosion drainage channels filled with timber*
- *Track drainage, dry ponds and silt traps*
- *Tree planting, fencing and installation of drinking troughs for cattle to prevent erosion*

Benefits

- *achieving natural flood management through attenuation and infiltration*
- *enhancing biodiversity*
- *improving water quality*

1. Location

Stroud Rural SuDS stretches over the river Frome catchment area in five valleys around Stroud, Gloucestershire, an area of 250km^2. 52.5 km^2 (21%) of the Frome catchment now drain through rural SuDS structures.

2. Description

In 2007 catastrophic floods in the Stroud area flooded 200 homes. High water flow and debris lead to a culverted part of the Slad Brook being blocked, setting the lower end of Slad Road under 5 feet of water. The Environment Agency has since identified the Slad Valley as a Rapid Response Catchment, at risk of

destructive flash flooding similar to the event that destroyed parts of Boscastle in Cornwall. Several neighbourhood flood action groups started up after these floods which commissioned a study to look into sustainable drainage. This resulted in a collaborative partnership between Gloucestershire County Council, The Environment Agency, the RFCC (Severn and Wye Regional Flood and Coastal Committee) and Stroud District Council to fund the project and a project manager for three years. Stroud Rural SuDS are now a showcase of partnership work in practice, involving local community flood groups, land owners, farmers and partner organisations.

Stroud, being surrounded by areas of outstanding natural beauty and small steep wooded valleys, did not lend itself to hard engineering solutions. Instead, the solution turned out to be many small interventions in all of the Stroud Valleys maintaining the beauty of the area whilst also creating biodiversity habitats and improving water quality.

Stroud SuDS implement a range of measures that reduce flood risk in a cost- effective way in the wider River Frome catchment, an area of over 250 km^2.

Between 2014 and 2018 the project has constructed or implemented over 400 interventions (leaky dams, coarse woody structures (CWD), culverts & soakaways, off-line field bunds, large scarp erosion/drainage channels filled with timber tree planting and installing cattle troughs to prevent streamside erosion) to slow peak flows and reduce floods in the valleys.

These low key natural flood prevention measures now form part of the natural environment and are non -intrusive on the beauty of the Stroud surroundings.

Stroud Rural SuDS, now in its fourth of six years, aspires

> *'To create a river catchment where water management is fully integrated into land management practices. Where public bodies, private companies and local communities work together to manage water within the landscape, creating valuable habitat for wildlife and people, and limiting flood risk downstream.*'

3. Main SuDS components used

- in-stream structures of a range of sizes, designed to slow down peak flood flows, divert and attenuate water (leaky dams, timber filled gullies),
- attenuation & deflection structures within seasonal high flow channels, (shallow in field dams, leaky dams, timber filled gullies)
- culvert crossings with soakaways and flow restrictions downstream
- erosion prevention (timber filled gullies, tree planting, cattle drinking troughs)
- track drainage, dry ponds and silt traps

4. How it works

Stroud Rural SuDS aim to reduce the downstream maximum water height of a flood (the flood peak) or to delay the arrival of the flood peak downstream, increasing the time available to prepare for floods. It works by restricting the progress of water through a catchment by making the catchment rougher and more difficult for water to flow quickly over land and in stream. Stroud Rural SuDS rely on one, or a combination, of the following underlying mechanisms:

a. Attenuating water by using, and maintaining the capacity of, ponds, ditches, embanked reservoirs, channels or land

b. Increasing soil infiltration. Allowing water to soakaway can reduce surface runoff. Free-draining soil will make saturation less likely, and evaporation from soil can also make space for water.

c. Slowing water by increasing resistance to flow. For example, by planting floodplain or riverside woods or constructing large woody debris dams in channels & gulleys or on flood plains.

d. Reducing silt being washed downstream by reducing the flow rate.

e. **Creating new habitat** for crayfish and trout as well as insects and birds.

Leaky dams use felled trees that allow water to pass through in normal water conditions and slow the water flow in high water conditions by diverting it away from the water channel to allow it to infiltrate the soil. All trees used are felled on site as part of existing woodland management.

Gully filling fills in the spring flow gullies with small branches, or brash, from the tops of the trees that had been used for the larger structures. The brash traps silt and sediment, reducing the amount reaching the stream.

Soakaways create areas where water can soak away rather than being allowed to follow the main channel.

Shallow dams on fields near the tributaries means water can be diverted out of the main channel in high water conditions and held in shallow dips, thus reducing the flow going down stream.

5. Specific project details

Stroud rural SuDS are implemented throughout the catchment area of the river Frome and all its tributaries, including the Slad Brook, Painswick Stream, Nailsworth Stream, Ruscombe Brook and all their named and unnamed tributaries, all together an area of 250km^2. Many case studies have been published from different parts of the catchment area. Examples are

1. Snows Farm Nature Reserve
2. Buckholt and Cranham Woods
3. Workmans Wood
4. Wick Street Farm
5. Overton Farm
6. Miserden Estate
7. Stroud Slad Farm, The Reddings, Hazel Mill, Wades Farm, Slad Valley (I)

In all areas the Project Manager works with landowners to implement at source rural sustainable drainage measures and restore natural drainage where it is safe and feasible to do so. It was brought about and continues to work with local community flood groups, land owners, farmers and partner organisations to implement a range of measures that will reduce flood risk but also improve water quality and enhance the biodiversity of the streams, brooks and the wider River Frome catchment.

In 2012, the Environment Agency, at the request of Cllr Sarah Lunnon, chair of the Slad Brook Action Group, commissioned a report into the feasibility and potential benefits of implementing Rural Sustainable Drainage (RSuDS) throughout the catchment of the Frome and associated tributaries. Acting on the findings of the study, the Severn and Wye Regional Flood and Coastal Committee (RFCC) agreed to fund a project officer to implement and promote rural sustainable drainage in the Frome catchment. A formal partnership between Gloucestershire County Council, The Environment Agency, the RFCC and Stroud District Council was established to implement the work, and under a collaborative agreement, Stroud District Council agreed to employ the project officer for three years.

Now in his fourth year the Project Officer, Chris Uttley has built up partnership working between communities, land managers, farmers and local authorities enabling help and assistance from owners of wooded and agricultural land to start implementing Rural Sustainable Drainage measures, so reducing

flood risk for downstream communities. To date he has worked on four sites owned by NGO's (Wildlife Trust, National Trust, Butterfly Conservation as well as nine privately owned areas).

Stroud SuDS have moved the understanding of sustainable drainage measures at source along to a level where it can be used to provide good standardised guidance on different techniques for Rural SuDS. Many groups have visited the area to learn from this example and to start their own rural SuDS. In 2017 Gloucestershire University together with Stroud District Council hosted an event on Natural Flood Management: Enabling Partnerships and Action.

It has tested good and effective structures and how to maximise benefits for flood risk, for water quality and biodiversity.

Stroud Rural SuDS shows that it is possible to use SuDS principles in situations where hard engineering options are not feasible, and it helps to make Rural SuDS an accepted part of the mix of measures available to flood risk managers in every catchment.

In January 2017 the following structures had been put in place:

- 270 Large woody debris leaky dams in four tributaries,
- 9 culverts & soakaways
- 12 off-line field bunds (no watercourse)
- 7 large 'scarp erosion/drainage channels filled with timber (>2km erosion channel)

Since then another 100 features have been installed across the five Stroud Valleys.

Large woody debris leaky dams form a main part of Stroud SuDS simply because there is a good coverage of existing woodland (see Pictures Case Study 7 Slad Farm). They also provide multiple benefits, including the natural re-engineering of stream morphology and function. Slight differences in construction can be used to achieve different results, such as to deal with incision, cause deflection onto flood plain, create scour, reduce scour, attenuate large volumes, speed water up and slow water down. Large dams are usually held in place by long metal pins drilled into the ground. Leaky dams also create new habitat for trout, crayfish and many invertebrates.

In field bunds are shallow structures that allow the farmers to still farm the land whilst providing a barrier for runoff slowing the water flow and allowing infiltration into the ground (see Pictures Case Study 5 Overton Farm).

Drainage channels filled with timber ensure in high water flows that the channel does not get further eroded and moves the flood water out of the drainage channel, widening the area over which the water will flow (see Picture Case Study 1 Snows Farm).

Tree planting can stop erosion along streams (see Picture Case Study 4 Wick Farm).

6. Maintenance & operation

Maintenance is minimal and replacement may be required once logs have rotted away or if smaller branches have broken down. This can be incorporated into land management practices by the landowners.

7. Monitoring and evaluation

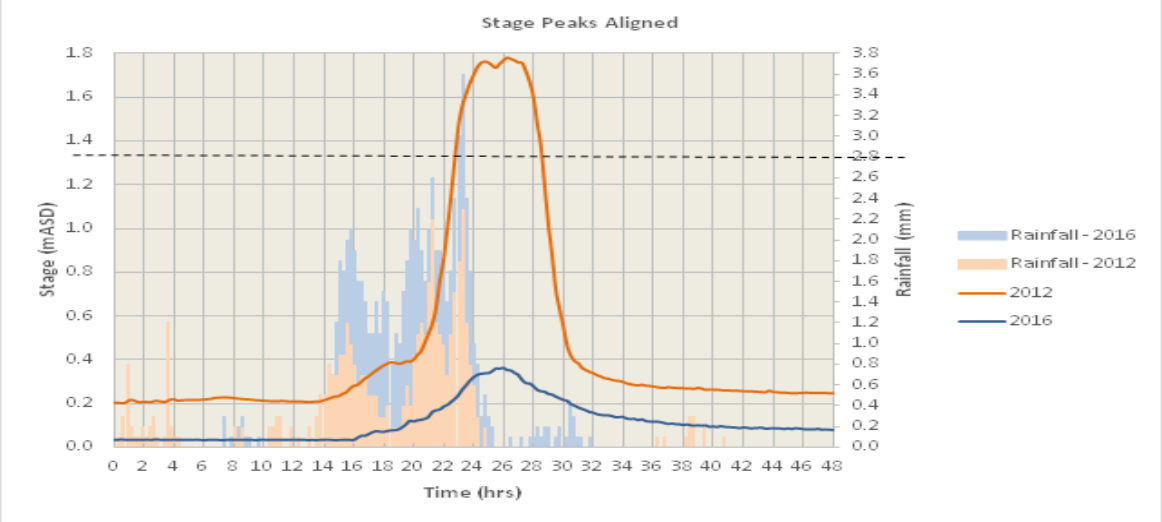
One of the challenges of Stroud SuDS is to calculate exact volumes or providing assurances to 1:100yr standard or model the benefits for many small structures without a formal budget.

Yet, although there is currently no budget for formal monitoring of any of the works installed as part of the project, in some areas of the catchment it was possible to compare historical flows under a given rainfall event with flows and levels now experienced after the installation of natural flood management

measures. The Slad valley in particular provides a good opportunity for comparison because it has a number of flow gauges that have been collecting data over a reasonable time period before the SUDS work was carried out.

On March 9th 2016, the Stroud Valleys had approximately 35-40mm of rain over 12 hours. This is roughly half the monthly total expected for March. The Environment Agency were able to compare this event with a similar one that occurred in November 2012, before the RSuDS project started. The compared rainfall events had to have a similar magnitude and intensity, but importantly, also a similar ground saturation before the rainfall occurred.

The comparison of the two events is shown on the graph below:



The graph shows the two peaks aligned in the 10 hours over the event and shows a very substantial reduction in peak level. The gauges were checked to ensure that there were no technical errors or problems and the 2012 data was compared with other events pre-construction The November 2012 graph is a consistent level of response. The data for both events is reliable.

As with any comparison it is important to bear in mind that no two events will ever be identical, but the two rain events were closely comparable in terms of total rainfall, duration, intensity, preceding conditions and seasonality as well as ground saturation levels. In both cases, the soil moisture deficit is zero, indicating full saturation in both cases. It is important to note that the base flow level for 2012 was higher, indicating greater preceding ground saturation, and therefore potential run-off. However, it is also important to note that the total rainfall over the 10 hours prior to the peak was higher in the 2016 event.

8. Benefits and achievements

- No further flashfloods in the Stroud Valleys despite high rainfall events
- No homes flooded since 2014.
- Excellent Partnership work, drawing on a range of skills from different organisations.
- Using local labour.
- Creating 0ver 20km of improved instream habitat for trout and crayfish.
- Creating a showcase for other flood managers (Over 500 people have visited the work sites from other LLFA, EA, Forestry Commission and community flood groups).

9. Lessons learnt

- Keep it local and community lead
- Build capacity in landowners local contractors and volunteer groups
- Build small and many rather than few and large structures
- Start as upstream as possible
- Don't wait for perfect data before building. Focus on low risk and certain wins to gain confidence
- Don't focus on volumes, heights and measurements.

10. Interaction with local authority

The commissioned report from the Environment Agency in 2012 and the commitment from (then) District Councillor Sarah Lunnon resulted in a collaborative partnership between Gloucestershire County Council, The Environment Agency, the RFCC and Stroud District Council to fund the project and a project manager for three years. Stroud District Council has been supportive of the project throughout and is providing the office for the Stroud SuDS Project Manager.

11. Project details

Construction completed: Construction is ongoing. To date around 400 structures are in place and in the following two years many more will follow.

- **Cost:** £430 ,000 (£315 ,000 project officer and £ 115 ,000 capital project costs)
- **Extent:** SuDS measures so far have been implemented in 52 km^2 (21%) of the 250km^2 catchment area.

12. Project team

Funders	• Severn and Wye Regional Flood and Coastal Committee
Clients	• 16 Private landowners/ farmers • Gloucestershire Wildlife Trust • National Trust • Butterfly Conservation
Designers	• Chris Uttley
Contractors	• Local contractors • Wildlife Trust and National Trust volunteers • Landowners
Project Manager	• Chris Uttley
Local SuDS Champion	• Sarah Lunnon

13. Site photographs / images

Fig 1: Stroud (Slad Road) during the floods in 2007

Fig 2: Project Manager Chris Uttley showing one of many community groups and groups from organisations the Stroud SuDS. So far more than 500 people have visited Stroud rural SuDS.

Case Study 1: Snows Farm

Fig 3: 6th Jan 2016 stuffing erosion gullys with wood in the Upper Slad valley

Case Study 4 Wick Street Farm

Fig 4: Willow stakes used on the Painswick Stream at Wick Street Farm to help reduce bank erosion.

Case Study 5 Overton Farm

Figs 5 and 6: Attenuation behind field bunds on the Ebworth Estate, Painswick Valley (low and peak flow)

Case Study 7:Slad Farm

Figs 7 and 8: Leaky dam on Stroud Slad Farm, Slad Valley (low and peak flow):