



Sussex Flow Initiative Powdermill Catchment Natural Flood Management Project



End of Year Report 2018/19



Summary

Sussex Flow Initiative (SFI) – Powdermill is a Natural Flood Management (NFM) project formed in 2017, as a partnership between Sussex Wildlife Trust and the Environment Agency. SFI works with landowners, local Flood Action Groups and others to create natural features designed to slow and store water in the landscape, creating drought resilience and helping to reduce flood peaks. We deliver multiple benefits for people and wildlife, as well as showing how NFM can be used to support traditional flood management methods to help reduce flooding.

SFI has also helped develop and implement new approaches to NFM across a 672 km² area and 1220 km of river in the Ouse catchment since 2012. The success of SFI – Ouse led to the extension of the NFM approach to include the Powdermill Catchment, covering around 1,770 hectares; including 6.3km of main river, 4.2 km of secondary stream and 26.5 km of tertiary (head)stream in East Sussex.

Sussex Flow Initiative's NFM delivery has taken place upstream of 15 properties considered by the Environment Agency to be at 'very significant risk' of flooding. By working closely with landowners, local communities, and local authorities, SFI has influenced and delivered NFM throughout the Powdermill Stream catchment. This report highlights the project's achievements. This year we have :-

- Advised 9 landowner this year, covering 593 acres of land
- Supported the planting of over 1.5 km of hedgerow
- Helped to install 45 natural leaky dams to slow the flow
- Planned and consented a further 28 leaky dams.
- Created additional water storage created of an estimated 80 m³ per flood event¹
- Once mature, hedges are estimated to store approx. 3,000 m³ of water during rainfall events².
- Hedgerow planting is estimated to sequester up to 13.7 tonnes of carbon per hectare per year³.
- Our NFM message has potentially reached audiences of > 200,000 people.
- We have trained at least 26 people directly in the installation of leaky dams.

In addition to the delivery of NFM, SFI helps others to use and understand the approach, by sharing case studies, knowledge and experiences with other organisations and individuals considering NFM. By utilising best practice and disseminating our findings using a wide range of media, we try to positively influence the uptake of NFM throughout England and further afield. We do this through a combination of print (e.g. 'Wildlife' Sussex Wildlife Trust's magazine) and digital (websites, blogs, Twitter, YouTube, Facebook) media, as well as producing [Case Studies](#) of our major projects.

Following the launch of the Environment Agency's national 'Working with Natural Processes' programme in 2017, there is a new impetus to deliver NFM as a priority throughout England. SFI will continue to deliver ambitious targets and to build new partnerships with the shared goal of increasing the resilience of local communities to flooding.

¹This is a conservative figure based on features that are 0.3m high, however many of the leaky dams in this catchment are much larger and are holding water back across quite large floodplains so the actual figure could be a lot higher than this.

²Hedgelink, <https://bit.ly/2lIPKRJ> [accessed 2018] - A 50m hedgerow at the bottom of a 1ha field can store between 150 and 375 cubic metres of water during rainy periods. Additional woodland infiltration from leaky dams has not been included. We assume approximately 100 cubic m of water per 50 metres is stored in each rainfall event.

³Crossland, M (2015), The carbon sequestration potential of hedges managed for woodfuel, The Organic Research Centre. Available at http://www.organicresearchcentre.com/manage/authincludes/article_uploads/project_outputs/TWECOM%20ORC%20Carbon%20report%20v1.0.pdf



Partnership working © D Morrison

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Introduction and project background

The Sussex Flow Initiative is an innovative project which shows how catchment-wide natural flood interventions can help to reduce flood peaks in areas vulnerable to flooding, whilst increasing biodiversity and providing multiple benefits at a landscape scale. SFI works with Catchment Partnerships and others to install natural flood management (NFM) measures, and to recommend how and where to target them in partnership with communities and landowners. Our NFM measures create local community resilience to drought, as well as to flooding.

Trees, in-stream wood and other low cost NFM measures can reduce flood risk in lowland catchments, working alongside traditional flood risk management in rural and urban areas. Although the effects of NFM such as tree planting can take time to show their benefits, multiple actions taken now can provide positive natural capital benefits far into the future. A range of NFM techniques can be used to reduce landscape scale flood risk including: -

- Re-wooding and re-hedging hill slopes, and planting floodplain woodlands
- Restoring / re-activating river channels, meanders and floodplain washlands
- Providing advice on land use and controlling excessive run-off and erosion
- De-gripping (reversing drainage) of heathland, woodland and other land
- Using and managing Large Wood in watercourses
- Increasing surface water storage i.e. in ponds and seasonal scrapes
- Using leaky dams and walls to slow down peak floods
- Using swales, permeable surfaces & rain gardens to capture & store run off

Different NFM can be applied in different parts of the catchment. NFM measures also provide multiple benefits to people and wildlife including carbon storage, pollination services, water purification and local climate regulation.



Figure 1: Waterfall and ghyll stream at Rackwell Woods, Crowhurst

Flooding in Crowhurst

The Powdermill stream runs between historic Battle to the north and Crowhurst village to the south. Undulating hills, wild flower meadows, ancient and ghyll woodlands are familiar characteristics of this landscape. The catchment is naturally steep and fast flowing and localized flooding to properties in Crowhurst has occurred regularly in recent years. Flooding is caused by storm and surface water run-off from the road network and urban surfaces, flooding from rivers and streams, and water backing up behind high tides at Combe haven. During times of high rainfall, too much water flows down the river too quickly, and creates flood surges which cause risks to people and property.



Figure 2: Past flooding in Crowhurst village has affected many properties



Powdermill Catchment Properties at Risk of Flooding

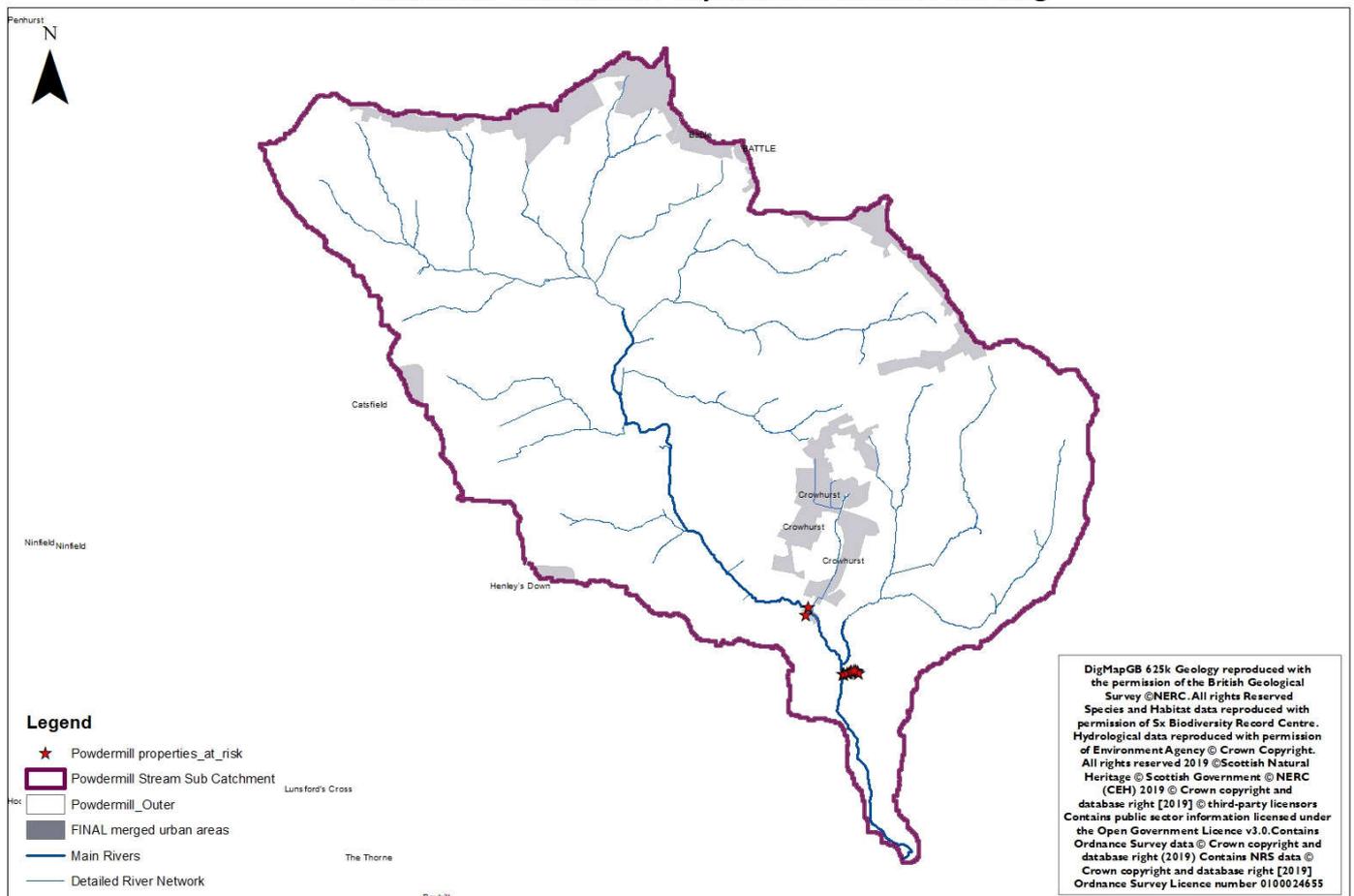


Figure 3: 15 Properties are at risk from flooding in the Powdermill Stream Catchment

Project achievements 2018 – 2019

The Sussex Flow Initiative provides working examples of NFM techniques and best practice Natural Flood Management demonstration projects. We promote a landscape scale approach to reducing flood risk and water shortages, and to promoting the wider uptake of NFM in other suitable catchments.

Hedgerow planting

Woodland and hedgerow planting forms a key part of our NFM delivery. We use trees and hedgerows to slow and intercept the flow of water across hill sides and floodplains, and to encourage greater infiltration and percolation of water into soils and groundwater. In the last year we have planted hedgerows or are planning to plant them at the following sites : -

Completed:

- Church Farm, Church Road, Henley Down – 323 m of new hedge and 330 m of hedge laid and re-fenced via HWAONB
- Sampson’s Farm, Sampsons Farm, Crowhurst – 250 m hedgerow planted February 2019

In progress:

- Hillside Farm – 524 m of laid or coppiced hedge plus fencing and 120 m of new hedge via HWAONB

Totalling 1,547 m of hedgerow



Figure 4: Completed hedgerows at Church Farm

Leaky dams

By using strategically placed natural wood in streams and ditches, floodwater can be interrupted during high rainfall events. Leaky dams help to slow the speed of water, temporarily backing it up and encouraging it out onto small floodplains, where greater surface roughness results in slower flows, as well as more percolation of water into soil and groundwater. Leaky dams can also help to remove sediment and other debris and pollution transported in water during floods.

The Sussex Flow Initiative uses a range of leaky dam techniques. In 2018/19 we installed 55 natural leaky dams, estimated to be storing around 1 m³ (1,000 litres) of water per structure during each rainfall event – or at least 55,000 litres of water.

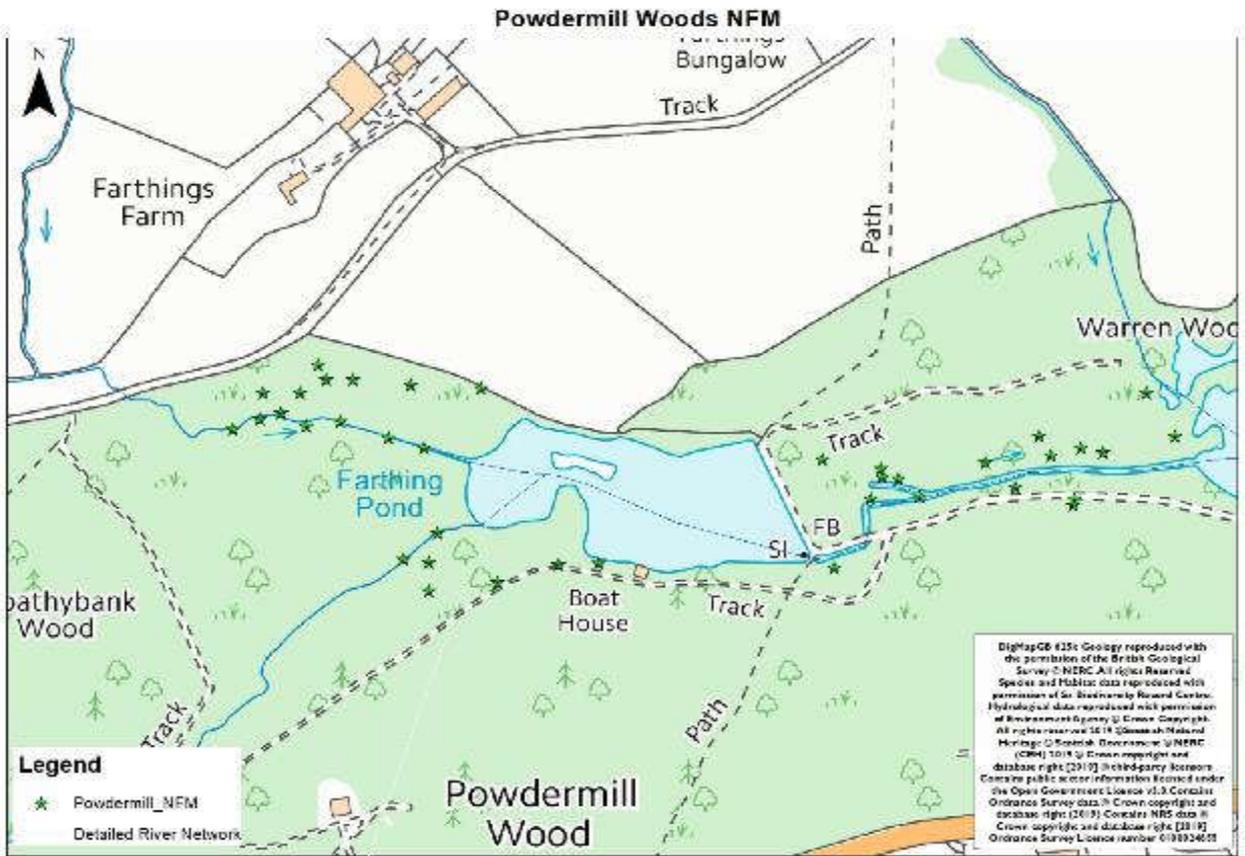


Figure 5: Leaky dam at Sampsons

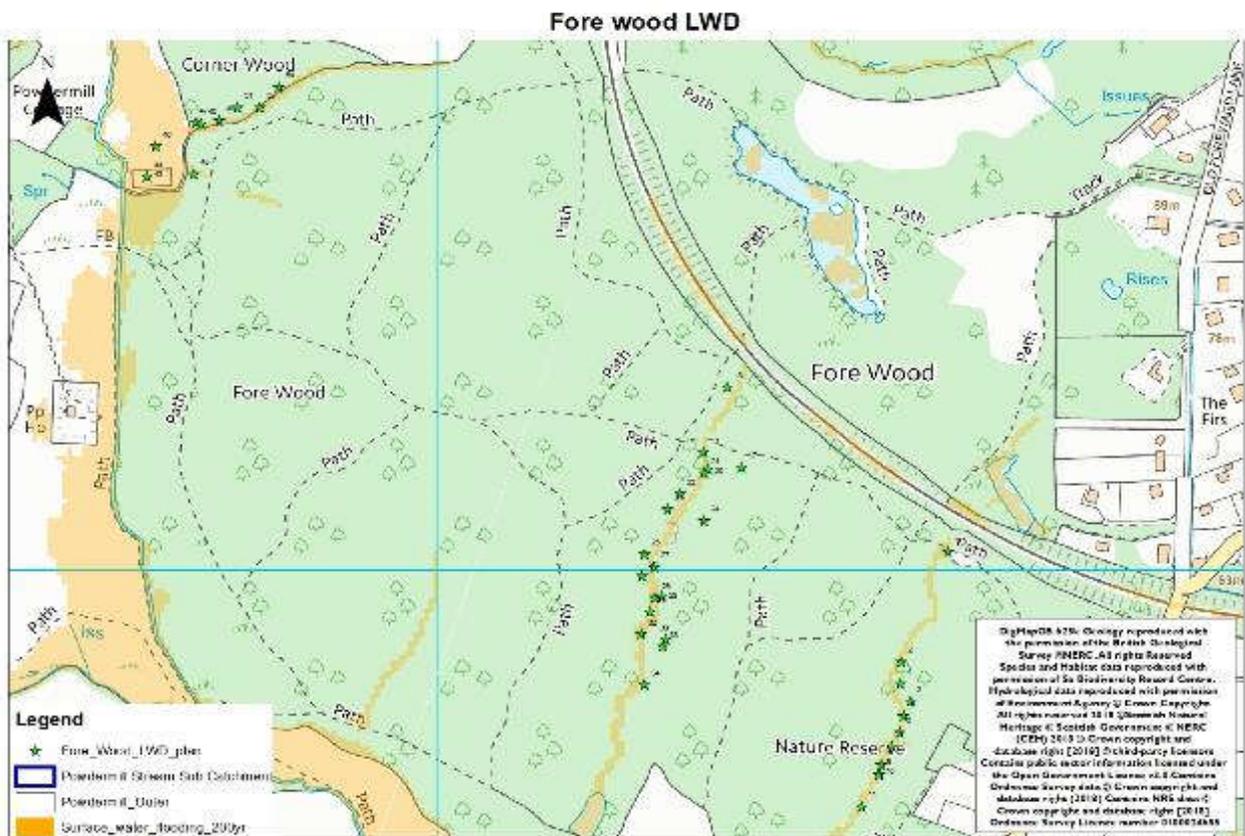
In the last year we have advised on a number of sites to install woody debris dams as follows :-

- Fore Wood, 56 hectare site – approximately 40 woody debris dams completed in February 2019
- Powdermill Wood, 6 hectare site – approximately 25 woody debris dams, to be completed in autumn 2019
- Sampsons Farm, 5 hectare site – approximately 15 woody debris dams, completed in February 2019
- Squirrel Farm, 41 hectare site – site recommendations being made, to be installed in in autumn 2019
- Rackwell Wood, Court Lodge Farm 116 hectare – approximately 13 leaky dams and other site recommendations being made, to be installed in in autumn 2019

Total leaky dams – 45 leaky dams installed, 38 leaky dams advised and planned for 2019-20



a)



b)

Figure 6: Location of leaky dams at a) Powdermill Wood (proposed) & b) Fore Wood (completed)

'Working with Natural Processes' targeting

The Environment Agency recently developed a 'Working with Natural Processes' (WwNP) evidence base for NFM, using a series of maps to target a range of NFM delivery types i.e. floodplain washland restoration. SFI uses these maps to assist with the targeting of our NFM work.

Comparing SFI's delivery of Natural Flood Management in 2018-19 to the WwNP layers, shows that our delivery of tree planting and leaky dams aligns partially with these layers. For example 120 m of hedgerow is planted in areas identified as a WwNP target area for riparian planting. In addition, approximately 31 leaky dams are located within a WwNP target area of RAF 1 (25 dams) and RAF 3.3 zones (31 dams).

The WwNP layers are a useful tool for helping to target NFM work. However SFI also works opportunistically outside of WwNP target areas. Using our Surface Water Flow Paths model, staff expertise and other evidence, we can ground-truth WwNP evidence to ensure that local opportunities are not being missed or wrongly identified.

The multiple benefits of Natural Flood Management have been highlighted in the Environment Agency's 'Working with Natural Processes' evidence base, which includes 'benefit wheels' for a wide range of techniques. Examples of these are shown in Figure 8.

Leaky Barriers

Introduction

What is it?
Leaky barriers are usually formed of wood and they are either formed naturally or are installed across watercourses and floodplains.

They reduce flood risk by intercepting the flow of water in a river, this can help restore river-floodplain connectivity which can reduce flood peaks, slow water velocities and attenuate flow by storing water on the floodplain.

Examples
Observed data collected during the Boxing Day floods (2015) in **Pickering** found the flood risk scheme reduced flood peaks by approx. 15-20%. Half this reduction was due to upstream NFM measures and the other half the engineered storage area in the town.

Modelling by Odoni and Lane (2010) found installing 100 leaky barriers could reduce flood flows by 7.5% (from 29.5m³/s to 27.3m³/s).

Important! There is limited evidence of how these measures perform during extreme flood events. Caution is needed when installing leaky barriers to ensure they do not become detached, cause a downstream blockage with consequent impacts on public safety.

What did we find?

We found that
We have a **Mixed** level of confidence in the flood risk benefits of leaky dams. Observed and modelled evidence shows they are effective at reducing flood risk at a local scale for small flood events (**Med** confidence). We have a **High** level of understanding of their effect on sediment and geomorphology. However, there is limited evidence of their flood risk effect for large events at greater catchment scales (**Low** confidence).

We still need

- To understand their effectiveness at mitigating flood peaks at larger catchment scales for larger flood events.
- More floodplain roughness data to calibrate flood models.
- Guidance on how to design and construct them.

Other examples

Catchment size	Flood magnitude	Modelled or observed?	Description
Not provided	Small	Observed	Wenzel et al (2014) found a delay in flood wave propagation over the local reach due to increased channel roughness and a decrease in peak discharge (2.2%) for a 3.5 year return period event.
Medium	Small	Modelled	Kitts (2010) found that leaky barriers in ~12 km ² wooded catchments can slow small flood peak by up to 33%.
Small	Medium	Modelled	Thomas and Nisbet (2012) found that installing 5 leaky barriers reduced flow velocities by 2.1m/s, delaying the flood peak by 15 min over a 0.5 km reach for 1 in 100 year event.

Multiple benefits

Benefits summary
Leaky barriers provide greatest benefits to the environmental services shown in the benefits wheel.

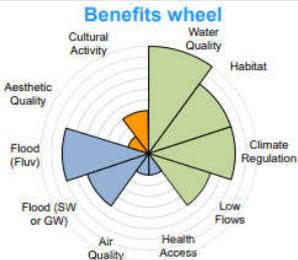
There are limited studies to show cultural, aesthetic, air quality or health access benefits.

Examples

- One study valued the ecosystem services provided by wood placement projects from 1-08 to 1-81 € m⁻¹ year, with the largest economic value for recreational opportunities (Acuña et al., 2013).
- On the Blackbrook 4 engineered log jams have reduced average phosphate concentration by 3.6mg per litre. Nitrate is also reduced. By 2035, it is predicted that 792m³ of sediment will be stored in 3 ponds retained by the jams.
- Wood dams provide increased resilience to climate change by regulating temperature and water level (Wild Trout Trust, undated).




Stroud valley leaky barrier (source: Chris Uttley)



The [Working with Natural Processes website](#) is freely accessible and has set of reference documents providing guidance and background research on a range of NFM methods. This includes one page summaries of the key NFM techniques (Figure 7). The information can be used to help inform and support Local Flood Action Groups, and other community groups who have concerns about local flooding and who would like to be take pro-active steps to reduce localised flooding.

A table summarising the natural capital benefits of key habitats that we help to restore can be found in Appendix A.

Figure 7: Leaky dam summary

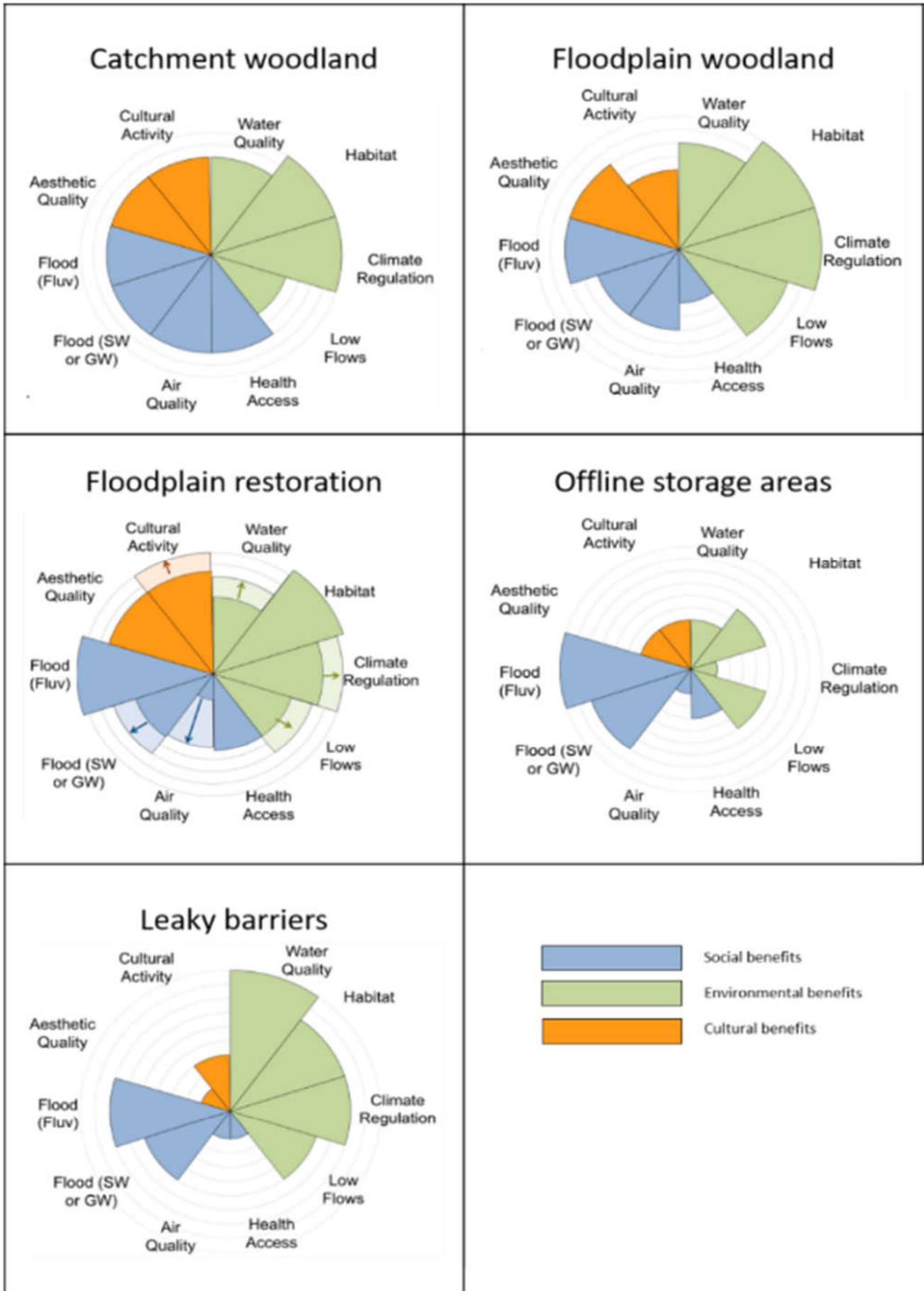


Figure 8: Multiple benefits provided by Natural Flood Management techniques (EA, 2017)

Advocacy

A core role of the Sussex Flow Initiative is to advocate the use of best practice Natural Flood Management, and to provide support and to upskill those wishing to use NFM techniques. This advocacy involves engaging with a whole range of stakeholders including landowners, local district, parish and county councils, the Environment Agency, eNGO's and many more.

Landowners

In the first year of the Powdermill SFI project, we visited 9 landowners, covering approximately 240 hectares (593 acres) of land. Advice included whole farm wildlife plans as well as NFM reports.

Total land advised 593 acres / 9 landowners

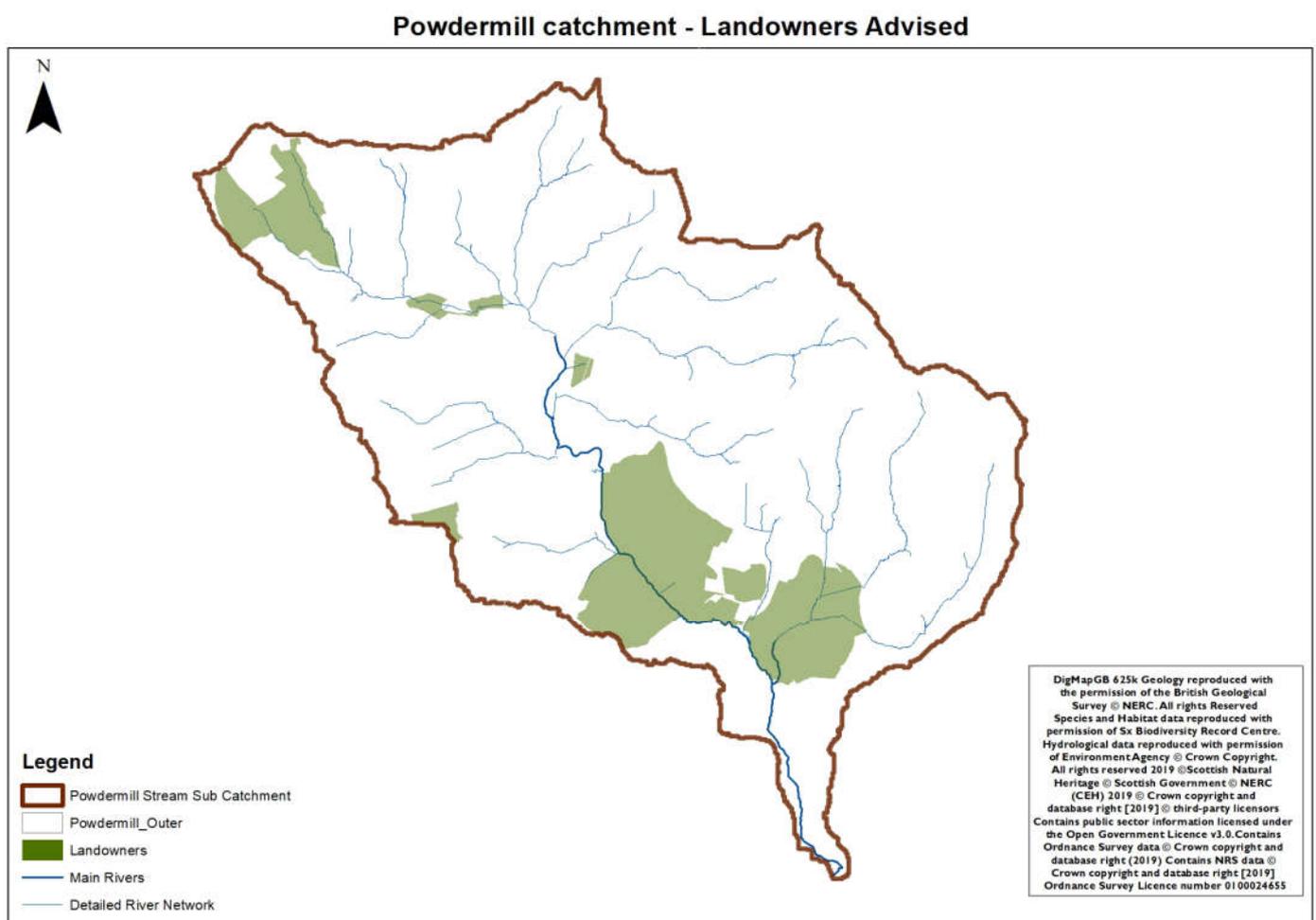


Figure 9: Landowners advised in the Powdermill Stream Catchment

Volunteers & local communities

An important aspect of NFM is the ability to empower communities to actively increase their resilience to flooding. Without the support from local communities, landowners and volunteers, the delivery of NFM would be significantly reduced. In 2018/19 we received huge support from a team of dedicated and enthusiastic volunteers from local community groups. This included :-

- More than 155 volunteer hours from more than 20 volunteers and staff of local groups and organisations, six of which had chainsaw licences with an approximate value of £3,600¹
- Support from local Crowhurst Flood Action Officer, of approximately 32 hours with an approximate value of £600¹
- Support from local Crowhurst Environment Group, of approximately 24 hours with an approximate value of £450¹

Total volunteer time - £4,650



Figure 10: RSPB volunteers installing woody debris dams in Fore Wood

Working in partnership

Over the last year we have worked with a range of local and national groups and stakeholders including :-

- Charities (RSPB, Woodland Trust, Powdermill Trust, South East Rivers Trust, National Trust)
- Local Environment Groups and Flood Action Groups
- Statutory agencies including Natural England and the Environment Agency
- Landowners and land managers
- Local Councils (East Sussex County Council & Rother District Council)

¹ Based on £150 per day for volunteers and £250 for those with chainsaw licenses based on eight-hour days

- Water Level Management Board (Pevensey and Cuckmere)
- Catchment Partnerships
- High Weald Area of Outstanding Natural Beauty
- Universities and academic institutions

Total ‘in kind’ value provided by volunteers and other organisations = minimum £8,250.

Flood risk agencies and organisations

We work closely with Lead Local Flood Authorities (LLFA) and others who have a statutory duty to prevent flooding of residential properties, businesses, and infrastructure. East Sussex County Council has made two site visits to the catchment and has offered advice and support for the project. By engaging with these groups, SFI is directly influencing the future of flood management in the area.

It has been an interesting and educational process for all involved, navigating the vagaries of [Ordinary Watercourse Consent](#) so that we can satisfy legal flood risk management requirements, whilst still providing Natural Flood Management benefits to local communities. We think we’ve cracked it this year! And we now have a smooth and efficient system of paying for, and reporting on NFM works in Ordinary Watercourses.

We have also engaged with the following flood authorities and groups over the last year :-

- Lead Local Flood Authorities, East Sussex County Council
- Crowhurst Local Flood Action Group
- Cuckmere and Pevensey Levels Catchment partnership
- Environment Agency

The Environment Agency local Operations team also helped us to create leaky dams in Sampsons quarry, just upstream of Crowhurst.



Figure 11: Environment Agency staff helping to install leaky dams at Sampsons Farm

Local communities



An important benefit of SFI is its ability to empower local people to increase the resilience of their communities to flooding. Through volunteer days installing leaky dams in the RSPB's Fore Wood site, SFI has connected with local people giving them an opportunity to take positive action to reduce flood risk, providing information on the projects objectives and the theory behind NFM.

We are working with Crowhurst Environment Group, Crowhurst Flood Action Group and others to encourage wider uptake of NFM across the catchment.

River Habitat Workshops

We aim to support, inform and upskill as many people as possible in the techniques and technicalities of how to install and implement Natural Flood Management measures. This year, our volunteer work parties and Leaky dam days have helped to upskill at least 26 people in NFM techniques.

Total – Minimum 26 people upskilled in NFM techniques

Events

To inform others about NFM and the work of the SFI project, we have lead, and presented at local and regional events including :-

- Farm Cluster Group Funding event
- Cuckmere and Pevensey Levels Catchment partnership
- Crowhurst Environment Group NFM talk
- Fore wood best practice site visit for stakeholders

Total audience reached by events = at least 80 people.



Figure 12: Catchment Partnership meeting held at Fore Wood © C Laburn

Websites and social media

The Sussex Flow Initiative continues to build its online presence by maintaining a comprehensive website and [blog](#), as well as a Sussex Wildlife Trust SFI page, and social media/networking accounts. Sussex Wildlife Trust pages attracted over 1000 views throughout the year, and the [SFI twitter](#) account and tweets resulted in more than 141,000 ‘impressions’ (views) with an audience of 229 followers.



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Powdermill catchment



The Powdermill Stream is a tributary of the Combe Haven catchment in East Sussex, set in rural countryside with historic Battle to the north and the village of Crowhurst to the South. A large proportion of the Powdermill catchment is within the High Weald Area of Outstanding Natural Beauty (HW AONB) which is a nationally protected landscape.

The total catchment area above Crowhurst is around 1,770 ha, and the Powdermill stream sub-catchment comprises around 6.3 km of main river, 4.2 km of secondary stream and 26.5 km of tertiary (head)stream. Much of the landscape is farmed with arable and agriculturally improved grasslands, but there are also large areas of important meadow and ancient and ghyll woodlands.

The Powdermill catchment is naturally steep and fast flowing. Localized flooding to properties in Crowhurst has occurred regularly in recent years. Flooding has been caused by storm and surface water run-off from the road network and urban surfaces, flooding from rivers and streams, and water backing up behind high tides at Combe haven. During times of high rainfall, too much water flows down the river too quickly, and creates flood surges which cause risks to people and property.

Print Media

A number of articles and blog posts have been published as follows :-

Slowing the flow in the ancient ghyll streams of the Weald

14/1/2019

0 Comments



On Thursday 6th December 18 enthusiastic volunteers gathered in Fore Wood to start work on Natural Flood Management (NFM) as part of the Sussex Flow Initiative (SFI) project in the Powdermill Catchment. This semi-natural ancient, 52-acre woodland has a SSSI designation and falls within the Area of Outstanding Natural Beauty of the High Weald. The site is situated on the edge of Crowhurst village, 1.5 miles south of Battle and is owned and managed by RSPB.

The Powdermill catchment is naturally steep and fast flowing. Localized flooding to properties in Crowhurst has occurred regularly in recent years. During times of high rainfall, too much water flows down the river too quickly, and creates flood surges which cause risks to people and property.

SFI is working in this catchment to slow down this flow of water.

- Sussex Wildlife Trust ‘Wildlife’ magazine (readership of > 32,000),
- Crowhurst parish magazine
- SWT website
- SFI website, FaceBook and Twitter

Case studies

As part of our ongoing work to share best practice, we are publishing a series of case studies on our SFI web pages. These case studies help to document the costs, benefits, partnerships and methods used to help reduce flood risk in local communities. Each case study is tailored to an individual site, giving those who use them an opportunity to evaluate the implementation of NFM in a range of different scenarios.

Downloadable case studies can be found [here](#).

What's next?

The Powdermill SFI project is run as a partnership between Sussex Wildlife Trust and the Environment Agency. The project has been running for just over a year, and we have already helped to raise awareness about flood issues, train numerous people in natural flood management, and reduce the flows of water rushing downstream to Crowhurst.

We have a range of NFM works scheduled in including leaky dams and hedges within the Powdermill catchment, there are also many more landowners to engage with. NFM benefits are cumulative over a number of years, and we hope that the NFM work in this catchment will continue for a number of years. In the year to come, subject to funding, we also hope to upscale the project to include the wider Combe Haven and Cuckmere catchments.

Sussex Flow Initiative case study:
Leaky dams at Fore Wood, Crowhurst
Rina Quinlan and Fran Southgate



Project summary

Fore Wood is a 21.5 hectares (52.6 acre) woodland in East Sussex, which includes a Site of Special Scientific Interest (SSSI). Its steep gully woodland streams and sandstone ravines, where rare ferns and bryophytes grow, offer a great opportunity to create natural leaky dams that slow the flow of water and hold it back in times of high rainfall. Footpaths through the woodland flood regularly in winter, and there are opportunities to increase winter access through Natural Flood Management (NFM).

At least 50 opportunities to install NFM measures were identified in Fore Wood. These include:

- Creating 'leaky dams' in gullies and ditches, including tree heads, gully stuffing and ditch top diverters
- De-silting ponds
- Blocking surface water flow paths with brush bundles and other natural woody material
- Improving flow flow into minor **washbowl** storage areas

Site & catchment characteristics

Approximate Grid Ref	TQ 79637 12036
Catchment	Crooked Stream, Coombe Haven
Land use	Ancient Woodland
Soil type	Ashdown beds with an overlay of Walden Clay



Figure 1. Location - Fore Wood, Crowhurst



Floodplain in the Coombe Haven

Appendix A.

UK NEA services provided by the 3 main strands of SFI Project work

Ecosystem service	ES from SFI Semi Nat Grasslands / Washlands	ES from SFI Woodland	ES from SFI Fresh & Openwaters, Wetlands & Floodplains
Food	•	•	•
Water	•	•	•
Timber		•	•
Woodfuel		•	
Biofuel (incl Peat)			
Bioenergy			
Health Products			
Fibre			•
Species Diversity	•	•	•
Genetic Reserves	•	•	•
Disease and Pest Control			
Climate Regulation	•	•	•
Erosion Control	•	•	•
Water Regulation	•	•	•
Flood Regulation	•	•	•
Fire Hazard Regulation			
Air Quality Regulation	•	•	
Water Quality Regulation	•	•	•
Soil Quality Regulation	•	•	•
Noise Regulation		•	
Recreation	•	•	•
Tourism	•		
Aesthetic Values	•	•	•
Cultural Heritage	•	•	•
Employment	•	•	•
Spiritual Values	•		
Education	•	•	•
Sense of Place	•	•	•
Health Benefits	•	•	
Navigation			
	20	21	18