SEPA
Scottish Environment Protection Agency

WORKING TOGETHER
TO IMPROVE OUR
WATER ENVIRONMENT

Restoration and Flood Management Project

River South Esk

Summary Report

JBA consulting

1 Introduction

1.1 Key objective

The aim of this study is to identify and assess possible options for improving the quality of the river channel and habitats in the River South Esk catchment whilst helping to reduce flood risk. This continues earlier work undertaken by Sniffer (2011)[1] which identified potential river restoration options within the catchment.

Addressing the quality of the river channel, habitats and flood risk issues at the same time should help Scotland deliver its responsibilities in relation to European and domestic water legislation[2] in a more cost effective and efficient way, whilst also addressing the river catchment as a whole.

The project findings will inform future development of river basin management and flood risk management plans and also the introduction of natural flood management measures across Scotland.

The project is being delivered in four phases. This report summarises Phase 1.

Table 1: Description of the project phases

Project phase	Summary
Pre-work	Catchment selection and Sniffer (2011) work
Phase 1	Scoping opportunities for measures delivery
Phase 2	Detailed design of measures and preparation for Phase 3
Phase 3	Implementation of measures

1.2 Why the South Esk

The River South Esk project is one of four catchments which have been selected across Scotland. The key reason for selecting the South Esk was the extent of physical modifications to the river habitats, particularly within the lower catchment, together with the degree of flood risk throughout the catchment.

In addition, the opportunity existed to expand the earlier Sniffer work to consider natural flood management alongside measures to address physical modifications to river habitat – measures which could improve the quality of the habitat and / or provide benefits to fresh water pearl mussels and water quality through reducing fine sediments within the catchment.

The project identifies options that landowners in the catchment could be supported to undertake. SEPA is looking at ways to use the Water Environment Fund to progress the restoration options chosen.

[1] http://www.sniffer.org.uk/knowledge-hubs/resilient-catchments/river-restoration-partnerships/physical-restoration-priority-catchments-scoping/

[2] The European Water Framework Directive (2000)
Water Environment and Water Services (Scotland) Act (2003)
Flood Risk Management (Scotland) Act (2009)
European Floods Directive (2007) Directive 20117/60/EC

1.3 What are natural flood management measures

These measures involve restoring or changing the natural features of the area to help slow the flow of water and help reduce the risk of flooding either in the immediate locality or downstream.

Improvements may be instream or riparian (river bank). Restoration of river channels through re-meandering, reconnecting the river with the floodplain through embankment removal, the creation wetlands or bankside woodland planting are all examples of natural flood management measures. These measures are very different to traditional flood defence measures which use hard engineering solutions such as flood walls and embankments.

It is important to note that this study has focused on river and floodplain restoration at a river reach level, and that there are further opportunities for natural flood management or improved land management at other locations in the catchment. For example, opportunities for expanding this work include gully planting and tree planting along contours within the upper catchment.

2 The South Esk

2.1 Catchment description

The River South Esk lies to the south of the Grampian Mountains in the Angus Glens (Glen Clova and Glen Prosen). The catchment is long and narrow and flows west to east towards the North Sea, with a maximum elevation of 1012 m above sea level on Cairn Bannoch. The catchment drains an approximate area of 564 km^2 to the Bridge of Dun. The upper two-thirds of the catchment are generally steeply sloping and respond rapidly to rainfall. Land use in the upper catchment is a mix of rough grazing on open moorland and forestry. The upper moorland is degraded habitat which also suffers from overgrazing. Heather moorland, bog and peat cover around 44% of the catchment. In the lower catchment most of the land is used for agriculture and includes some of the most productive arable land in Scotland. Figure 2-1 summarises the main issues in the catchment.

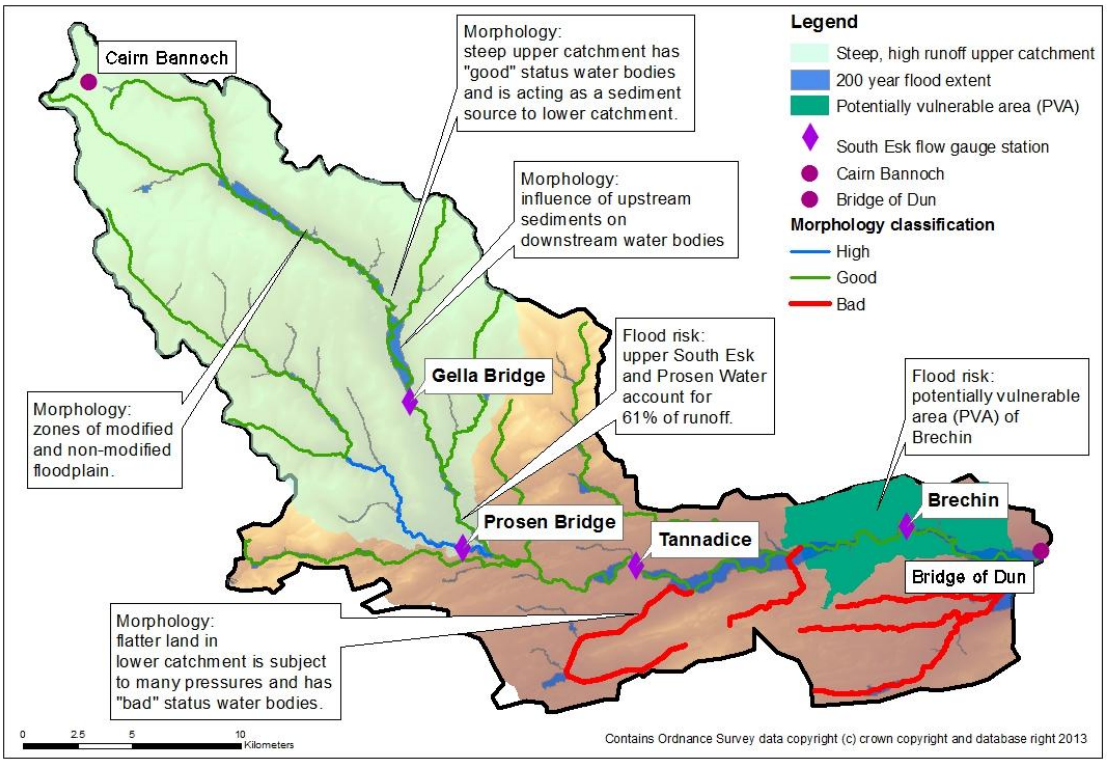

Figure 2: The River South Esk catchment showing the main locations of the river and flood risk issues[3]

2.2 Flooding

The catchment has a high risk of flooding. The largest recorded flood events (such as the flood in November 2002) occurred as a result of very high rainfall in the upper catchment. However, flooding can also occur in the lower catchment when flows in the upper catchment are low or when rainfall is high for a prolonged period of time in the lower catchment only. For example, the April 1998 flood was generated largely over the lower catchment during an easterly driven rainfall event. Flooding at Brechin (which has been identified as a potentially vulnerable area for flooding by SEPA)[4] is well documented and isolated properties outside of the potentially vulnerable area have also been identified as being at risk. The Lemno Burn and Prosen Water sub-catchments are estimated to have among the highest numbers of isolated properties at risk.

2.3 Morphology

The morphology of a river refers to its physical shape and structure. Over the years the River South Esk and its tributaries have been subject to a range of man-made modifications, reflecting the way land use has evolved, and so now we no longer have a river system that is near-natural, but one that in some cases is actually quite heavily modified.

[3] Water body – A defined section of the water environment. This could be a river, loch, stretch of river, groundwater or part of a coastal or transitional area. SEPA has divided the water environment into these units defined by their characteristics.

[4] SEPA's description of the Flood Risk Management (Scotland) Act (2009) http://www.sepa.org.uk/flooding/flood_risk_management/flood_risk_management_act.aspx

In the lower catchment, the Pow, Lemno and Melgund Burn tributaries have been extensively modified (primarily straightening) over several 100 years to maximise land productivity for agriculture. The result is that these water bodies are classified as bad under the Water Framework Directive.

In the upper catchment, the morphology is less impacted and these water bodies are currently classified at good ecological status. However, the upper catchment has issues with naturally eroding banks and is a significant source of fine sediment (in Glen Prosen and Glen Clova) which may be contributing to the diffuse pollution pressure in the lower catchment. This is an important issue because the River South Esk is a designated Special Area of Conservation and the transfer of sediment may pose a risk to the population of freshwater pearl mussels in the catchment.

A summary of the main catchment issues and photographic examples of flood risk and morphological pressures on the river are shown in the accompanying figure (Figure 3).

Figure 3: Land management pressures within the catchment

Land management - including grazing

Boulder bank protection

Disconnected floodplain and land drainage

Strong gravel transport and storage

Culverted channel

Degraded river bank

Artificially straightened and lined channel

Build up of silt and fine sediment

Disconnected floodplain via embankment

Active bank erosion

3 Approach taken to identify and prioritise opportunity reaches

In order to prioritise the most suitable locations to direct restoration efforts, it was first important to sub-divide the rivers within the catchment into manageable sections. These sections are discrete lengths of river which have been called 'opportunity reaches'. Forty-six opportunity reaches were identified across the catchment where potential opportunities exist to address physical changes, reduce the inputs of fine sediments and provide natural flood management benefits. The approach taken to the project is summarised in the Figure 4.

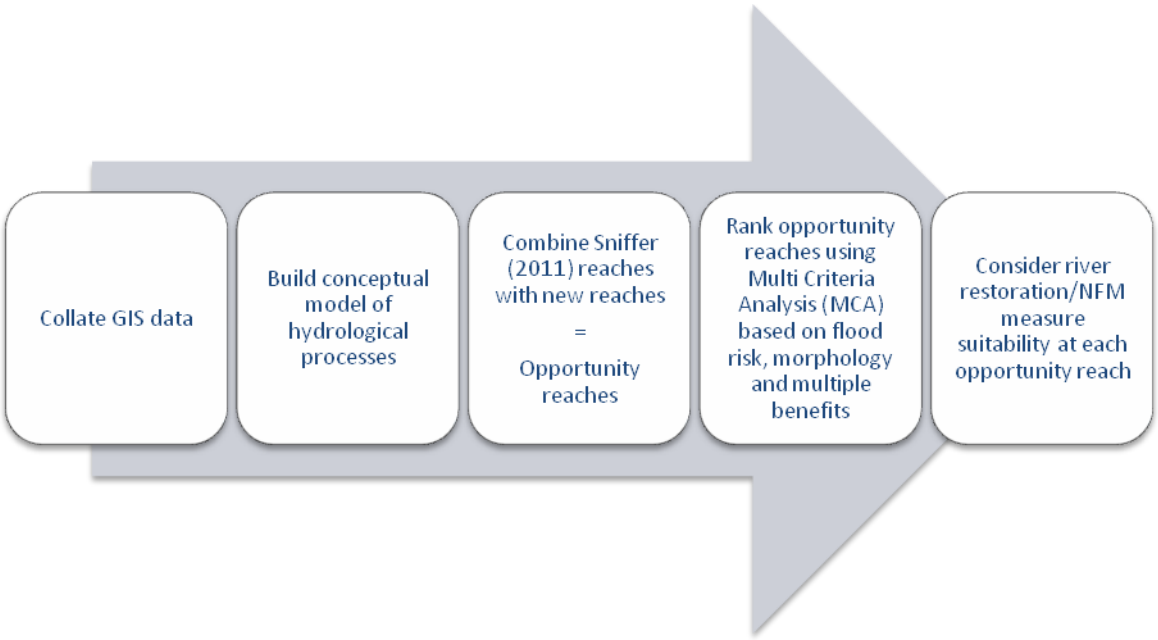

Figure 4: Methodology

In order to prioritise the 46 possible restoration reaches, an assessment of each reach was made using a multiple criteria analysis. The assessment involved assigning a high, medium or low rating for the categories of flood risk, morphology and potential for multiple benefits (such as potential improvements to water quality). These ratings were converted to scores of one, two or three respectively which led to an overall score for each reach.

The multiple criteria analysis also enabled an assessment of the benefits which would result from addressing either flood risk or the morphology of the river alone. A key example of this is that in addition to decreasing flood risk, natural flood management measures could also provide benefits to water quality, recreation or habitat connectivity.

This study has shown that the headwaters of the South Esk in Glen Prosen and Glen Clova do not have poor shape or structure. However, the fact that the reaches in these areas have been identified as a source of fine sediment, which can affect water quality or populations of fresh water pearl mussel, means that they would benefit from river restoration measures.

4 Prioritisation results

The reaches ranked highest by the multiple criteria analysis are located in the lower catchment of the River South Esk where the majority of the pressures on the physical river channel exist (Figure 5). Several of these reaches are upstream of Brechin.

The highest ranking reach is on the Lemno Burn, followed by reaches on the Melgund Burn and Pow Burn. The reach at Melgund Burn (ranked sixth in the multiple criteria analysis) was identified as a strong candidate for restoration through the previous Sniffer project. The top ten rankings are shown in Figure 5. Note that there are some cases of tied rankings.

The top reaches ranked using the flood risk category alone are shown in Figure 6. All of these reaches are located in the upper catchment where much of the flood production occurs. Sources of fine sediment are located in many of these reaches.

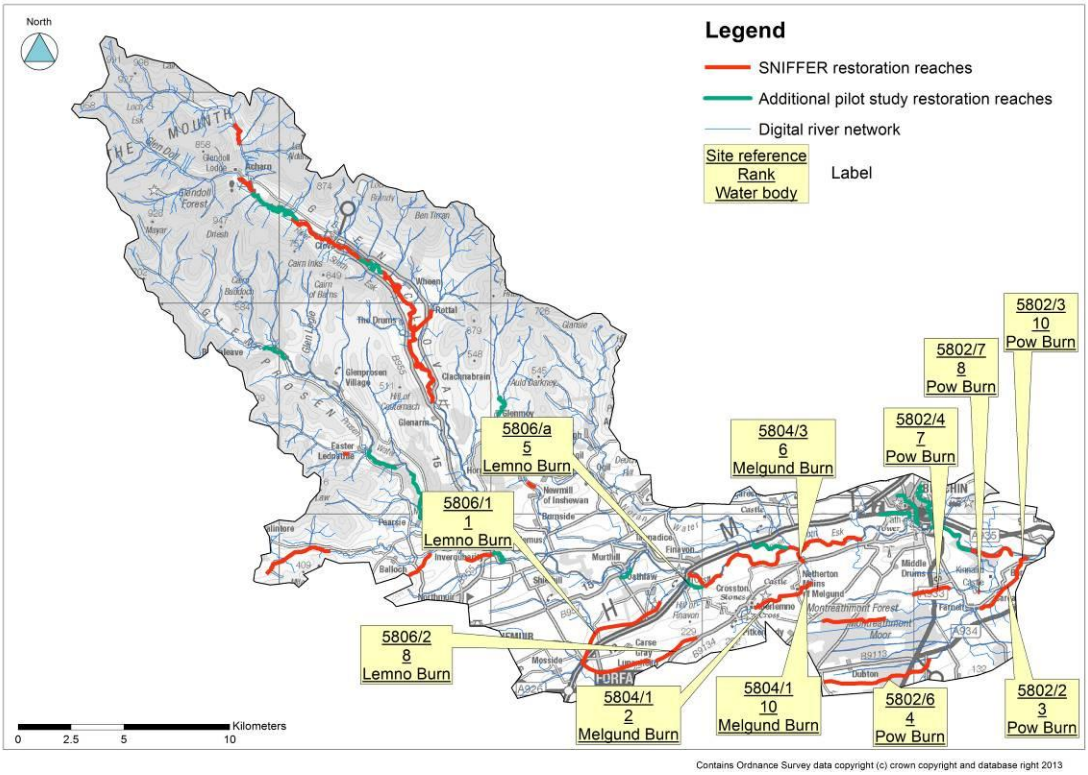

Figure 5: Location of the top ranked reaches according to the results of the criteria from the full multi-criteria analysis

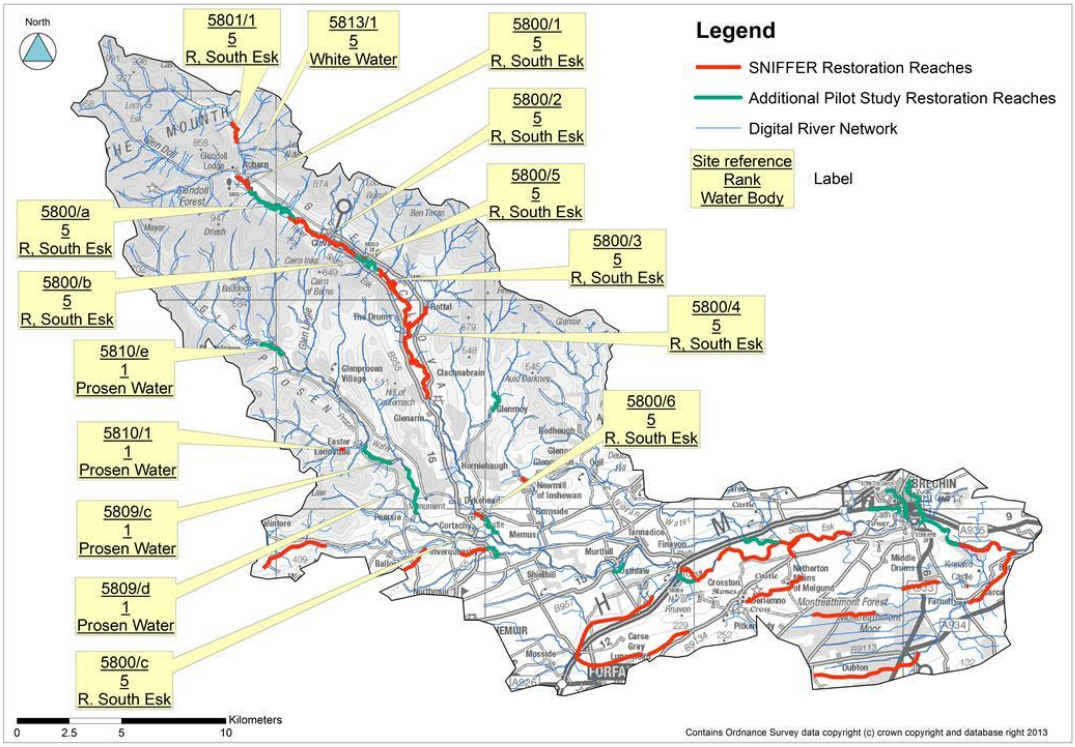

Figure 6: Location of the top ranked reaches according to the results of the flood risk category from the multi-criteria analysis

5 Restoration and natural flood management measures

River restoration and natural flood management options most suitable for each reach were identified (Table 2). Practical information about the catchment was then considered; for example whether additional land was required to undertake restoration, land capability for agriculture and prospective costs. This information suggested that there may be practical obstacles to overcome at some locations and that high quality data which builds on existing data is required to make the best decisions about each potential restoration opportunity.

Where a water body is designated as heavily modified (HMWB[5]), for rural land drainage, as is the case for the Lemno Burn, the water body could not be returned to good ecological status without a significant impact on the benefits accorded by the modifications to allow agricultural use. In this case the objective is to reach good ecological potential which means as good as it can be without compromising the economic use. Restoration in this case may mean small-scale morphological improvements within the existing river corridor, appropriate sediment management and provision of adequate buffer strips.

[5] Heavily modified water bodies (HMWBs) are water bodies which, as a result of physical alterations by human activity, are substantially changed in character and cannot be restored without compromising these modifications, which may be for flood defence, storage of water for hydropower or drinking water or land drainage.

Table 2: Measures to address flooding and morphological pressures

Increased vegetation cover	Working within and on the banks of the channel	Land management	Runoff (pathway) management
• Woodland planting (conifer, native and broadleaf) • Gully woodland planting • Creation of cross slope tree shelter belts • River bank woodland	• Placing of large woody debris and boulders • In-channel barriers • Bank restoration / erosion protection • Managing channel instabilities i.e. fencing • Reach restoration and floodplain reconnection • Reach restoration – removal of objects which restrict the flow of the river	• Soil & bare earth improvements • Changing agricultural field drainage • Upland drain blocking	• Overland flow interception • Offline ponds • Farm wetlands • Sediment traps

6 Modelling flood risk

A model of the catchment was developed to assess the potential for measures to contribute to reducing flooding at Brechin.

Looking at the top 10 reaches, the modelling results indicate that measures on these reaches will have a localised positive effect on flooding. To achieve benefit to the downstream potentially vulnerable area at Brechin, it is likely that multiple measures would be required. The top ranked reach from the multiple criteria analysis (reach 5806/1 on the Lemno Burn) was estimated to be the most effective reach at reducing flooding.

7 Conclusions and recommendations

This project has examined potential opportunities for river channel restoration and natural flood management within the River South Esk catchment. Forty-six opportunity reaches were identified and then ranked using multiple criteria analysis.

The top ranked reaches are located in the lower catchment. Restoration measures in these reaches are likely to benefit the physical shape, flow of water and quality of the river as well as reducing flood risk at individual properties.

It is recommended that the following three reaches should be the priority for restoration and natural flood management:

1. 5806/1 (Lemno Burn)
2. 5804/1 (Melgund Burn)
3. 5802/6 (Pow Burn)

Fundamental to progressing any river restoration project is obtaining landowner support and this is a key next step for the overall project.

Further information

Information on the project can be found on the SEPA website:
http://www.sepa.org.uk/implementingRBMP/

For further technical enquiries please contact:
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References

Sniffer (2011) Physical restoration options for priority catchments – Phase 1 River South Esk catchment restoration scoping study

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