

Summary of progress in implementation of Rural Sustainable Drainage Measures (SUDS) in the upper Lunan Water Catchment, Angus, Scotland, and some lessons for future schemes.



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1. Introduction

Diffuse pollution is one of the most significant pressures leading to failure of lochs and rivers to achieve objectives set out in the Water Framework Directive. The Lunan Diffuse Pollution Monitored Catchment Project was launched as a joint initiative between SEPA, MLURI (now JHI) and SAC (now SRUC) in 2006, as a platform which enabled practical assessment of diffuse pollution strategy in response to the requirements of the Water Framework Directive. Activities included (a) long term monitoring of the water chemistry and discharge in 5 sub-catchments of the Lunan Water, Angus; (b) farm diffuse pollution audits to develop diffuse pollution plans at farm level, focusing on implementation of the Regulatory General Binding Rules; (c) farmer focus meetings on diffuse pollution mitigation both within the catchment and elsewhere; (d), from 2010, implementation of targeted measures to reduce the impact of hotspots of pollution. Sources of further information for the 2006-2016 period are summarised in table 1.

2. Implementation of rural SUDS

Measures with some impact on water quality were included in Scotland Rural Development Plan (SRDP 2007-2013), for example through Land Manager Options. However, nationally, uptake of funded measures was not strongly focused on water quality improvement. The emphasis of SEPA and Scottish Government was on the development, implementation and monitoring of regulatory measures, such as the General Binding Rules. Nonetheless some non-regulatory measures were implemented in the Lunan Water catchment. Examples of implementation and proposals for diffuse pollution mitigation measures are shown in Table 1. These included two sediment retention installations on Mains of Balgavies Farm, two sediment retention fences on Baldardo Farm and 6m buffer strips on Wemyss and Mains of Balgavies Farms (Figure 1).

With the development of the new Agri-environment and Climate scheme (AECS, 2014-2020), it was anticipated that more uptake of funded voluntary measures directed at water quality issues would occur. Water quality measures appropriate for arable land in this scheme included the following headings: Establish and maintain rural sustainable drainage systems (rural SUDS ie. ponds, sediment traps and bunds, wetlands and swales); Convert arable land at risk for erosion or flooding to low-input grassland; Create and manage hedgerows; Remove, lower or breach embankments to restore floodplains; Retain winter stubbles until early spring; Establish water margins in arable and grassland fields; Establish grass strips within or at the edges of arable fields; Restoring (Protecting) River Banks.

Scottish Government called for applications for funds to promote the uptake of measures under the Environmental Co-operation Action Fund (ECAAF, 2016). A proposal was prepared by James Hutton Institute in the Lunan Water

catchment, with local consultants carrying out the promotion events, but although the proposal was successful, the funding scheme was subsequently withdrawn nationally. Following this, Scottish Natural Heritage, promoting an interest in protecting local wetland habitats from the impact of sediment and nutrients, have supported an ongoing programme of diffuse pollution mitigation plans for specific farms draining into the protected wetlands in the upper catchment, including Restenneth Moss, Fonah Bog, and Chapel Mires. Diffuse pollution plans have been drawn up by Lockett Agri-Environmental for at least 3 farms (Greenhead Farm, Newmills Farm, Lunanhead Farm) in the upper catchment (to the end of 2018) and at least one further plan is under way.

A key group of measures attracting funding was Rural SUDS, and a guide was published in Dec 2016 (CREW, 2017 - see Table 2). This report summarises the progress in uptake of mainly rural SUDS in the Lunan Water catchment. The diffuse pollution plans were necessary pre-requisites to developing plans and funding proposals for Rural SUDS measures at specific sites, on the basis that sediment and nutrients runoff should be mitigated at source as much as possible, before implementation of edge-of-field or downstream retention measures. However, in the meantime, discussion meetings were held, and pilot topographic surveys and draft plans for rural SUDS measures were drawn up by Moir Environmental, with input from Lockett Agri-Environmental and James Hutton Institute (Andrew Vinten), where possible. Figure 1 shows the sites of actual or potential rural SUDS in the upper catchment of the Lunan Water, as of January 2019. The progress with implementation is summarised in table 2. The details of these measures are the subject of reports to farmers, and in some cases have formed part of wider AECS applications. Some of these measures have been approved, and some are pending.

3. Lessons drawn for the Payments for Ecosystem Services – Lessons (PESLES) project

The objective of the Scottish Government funded research project entitled PESLES (Payments for Ecosystem Services: Lessons) is to build understanding of what incentives or arrangements could be considered appropriate and effective in enabling and encouraging stakeholders to adopt measures that will improve water quality and/or manage water levels and flows. It aims to provide research support for the planning, development, implementation and appraisal of measures and mechanisms to improve water management in selected catchments. The work will give an opportunity to understand how new arrangements actually play out in practice and to monitor their impact. What lessons on the funding and implementation of the sediment mitigation methods described above can be drawn from the processes in the Lunan Water catchment?

- Farmers were receptive to carrying out diffuse pollution audits of activities, both during the Focus Farm project that SRUC led (2006-2011), and through the SNH funded plans led by Lockett Agri-Environmental (2016-present).
- During the early part of the Lunan Water Diffuse Pollution project (2006-2011), Agri-Environment funding was not particularly well aligned with water quality goals, but in some cases, farmers were ready to fund innovative solutions (eg sediment traps and ponds) from their own resources. However, this meant the design element was somewhat lacking. This issue has to some extent been resolved by the publication of the rural SUDS guide.
- Farmers in the catchment were sometimes ready to host experimental and demonstration innovative solutions (eg sediment fences), during the research phase of the project (2011-2016), but there was also some resistance. One farmer wanted a signed agreement concerning activities and re-instatement costs before agreeing to host a pilot sediment retention pond.
- At the Lunan catchment science group meeting in June 2013 (minutes available), there was a feeling from farmers that not many people in the lower catchment are involved in environmental SRDP schemes. The issue is that most measures involve removing land from production, and the land there is simply too profitable for that to be economic. It's a different story in the upper catchment.
- Funding is an issue for some. Rates for SRDP land haven't changed much over the last ~20 years, whilst the return off the land has increased. So whilst it was once clearly economical in places to opt for SRDP, now it may not be so clear cut.
- Discussions between land-users in the current phase of the project (2016-present) have highlighted the question of responsibility for receiving /treating and managing sediment from upstream neighbours. It is a legal responsibility to receive the upstream neighbour's water, but what about their sediment? At several points, the Fonah Bog (part of the SWT run Balgavies Loch SSSI) receives sediment from upstream neighbours. This sediment also blocks culverts under the road between Fonah bog and upstream neighbours, leading to

requirement for maintenance of the culverts and the immediate area downstream for prevention of flood risk, on Scottish Wildlife Trust (SWT) land.

- A verbal agreement in principle was reached, if rural SUDS are installed on SWT land, to be responsible for recovery of the sediment. It may be that formal agreement is needed in some cases.
- SWT are unable to resource application for funds for measures on their land, highlighting the administrative burden of seeking AECS support for small organisations. It has not proved possible to agree input to such works from upstream neighbours.
- It is difficult to agree setting aside adequate ground for sediment traps or ponds funded by AECS to deliver the rural SUDS guideline of 0.25% of the catchment area. It has been easier to agree funded and area set-aside for swales and buffer strips, and this probably reflects more generous funding and ease of implementation within existing management of fields.
- At a very local level, there has been increased dialogue between upstream producers of sediment and downstream receivers. This occurs both on a 1:1 basis (eg for Fonah Bog) and through standing committees, such as the Balgavies Loch committee (chaired by SWT), Rescobie Loch Development Association and Community Councils. JHI researchers have been regularly invited to provide updates at some, but not all of these local bodies (such as Rescobie Loch Development Association).
- The new AECS funding for Water Quality measures have achieved some uptake for grant applications and implementation has begun in the upper Lunan catchment. However, the overall impact of measures currently implemented, compared to the level of mitigation required, as outlined in Balana et al., and Vinten et al., is quite small.
- The co-ordinated input of Environmental consultants (SRUC (in 2006-2011) Lockett-Environmental, Moir Environmental (in 2016-present)), Agencies (SEPA and SNH) and Research scientists (JHI) has helped facilitate the progress in implementation of sediment mitigation measures.
- The progress of the sediment mitigation approaches outlined in this summary have been reported to the Lunan Catchment Management Group (previous minutes available at <https://www.hutton.ac.uk/research/projects/payments-ecosystem-services-lessons#Water> for all)
- It would be valuable to review this progress, including possible funding of measures on SWT land at Fonah Bog as well as another potential site adjacent to Balgavies Loch (sites G and C in Figure 1). This would complement those rural SUDS agreed on upstream sections draining into Fonah Bog.
- Technical assessment of the operation, maintenance and performance of the measures described here is beyond the scope of this report. Adaptive management is generally needed once measures are installed, and would benefit from ongoing financial support.

4. Conclusions

A number of rural SUDS have been implemented in the upper Lunan catchment over the past 12 years.

The cumulative impact of these at a catchment scale is quite small compared with what would have an influence on soluble P or sediment loads. Monitoring of these impacts is probably best done by periodic measurement of sediment depth, prior to excavation as part of a management plan.

The focus of several of the recent measures on sediment input to Fonah Bog, a Site of Special Scientific Interest, is more significant to protecting this individual wetland.

The willingness of farmers to participate has in some cases been influenced by the level of funding available, but in other cases, farmers have been willing to contribute from their own resources to developing sediment control measures.

There has been some evidence of a “joined up” approach, with responsibility for example, with sediment accumulating in Fonah Bog being recognised by upstream farmers.

The overall process of (1) identification of sites for sediment control, (2) initial survey and drawings, (3) making grant application, (3) funding approval, (4) detailed design, and (5) implementation is taking more than two years. A more streamlined approach, perhaps through a locally administered fund associated with the Lunan Catchment

Management Group with more flexibility to design and implement on a site specific basis, would enable a more rapid uptake of rural SUDS, and other water quality measures.

The SNH funded diffuse pollution control plans developed in the upper Lunan Water catchment could prove a useful model for a scheme in which implementation of rural SUDS is also funded through local administrative arrangements.

Date	Activity	Contributors	Funding	Links to reports
2007	Lunan Water diffuse pollution monitored catchment project started.	SRUC/SEPA/JHI	SG Research project/ SEPA WFD	http://www.programme3.ac.uk/images/Firstyearreport7.doc
2007-present	Monitoring of Lunan, Baldardo, Balgavies, Burnside, Newmills subcatchments for water quality	JHI/SEPA	SG research	https://www.hutton.ac.uk/research/projects/lunan-water-diffuse-pollution-monitoring-project-first-10-years
2007-2010	Farmer focus group meetings about General Binding Rules and Diffuse Pollution mitigation	SRUC/SEPA/JHI	SG advisory	http://www.programme3.ac.uk/water/Lunathirdyearreport3.pdf
2007-2008	Farm environmental audits on Mains of Balgavies and Wemyss Farms	SRUC	SG advisory	
2008	Sediment trap/bund installed on Greens Burn at Wester Gospetry, Fife	SRUC/JHI	SG Research	https://www.sniffer.org.uk/wfd13-pdf
2010	Farmer group visit Wester Gospetry, Loch Leven catchment from Lunan Water	JHI/SRUC/Leven CMG	farmer/SG advisory	See pictures on p1 of this report. http://www.fwr.org/waterq/wfd13.htm
2011	Installation of sediment trap/bund and pond on Mains of Balgavies Farm, Lunan Water	SRUC	farmer	See Figure 2
2011	Installation of sediment trap/bund and trees on Mains of Balgavies Farm, Lunan Water	Farmer	farmer/SRDP	See Figure 2
2011-2015	Catchment science group meetings and stakeholder interviews	JHI/SEPA/SNH	SG Research	http://www.programme3.ac.uk/water/Report090211.pdf https://www.hutton.ac.uk/sites/default/files/files/Leaflet%20output%20LR%20work.pdf
2010-2012	Trials of sediment fences at Baldardo Farm	JHI/farmer	SG Research project	https://www.thecourier.co.uk/business/farming/farming-news/61579/special-fences-used-to-tackle-soil-erosion/
2014	Paper on trends in Water quality in Lunan Water	JHI/SEPA	SG Research project	https://pubs.rsc.org/en/Content/ArticleLanding/2014/EM/c3em00698k#!divAbstract
2014	Paper on sediment fences	JHI/farmer	SG Research project	https://www.sciencedirect.com/science/article/pii/S0048969713011947
2016	Paper on cost-effectiveness of diffuse pollution measures	JHI	SG Research project	https://www.sciencedirect.com/science/article/pii/S0048969717302759?via%3Dihub

Table 1. Progress highlights in Lunan Diffuse Pollution Monitoring Catchment project.

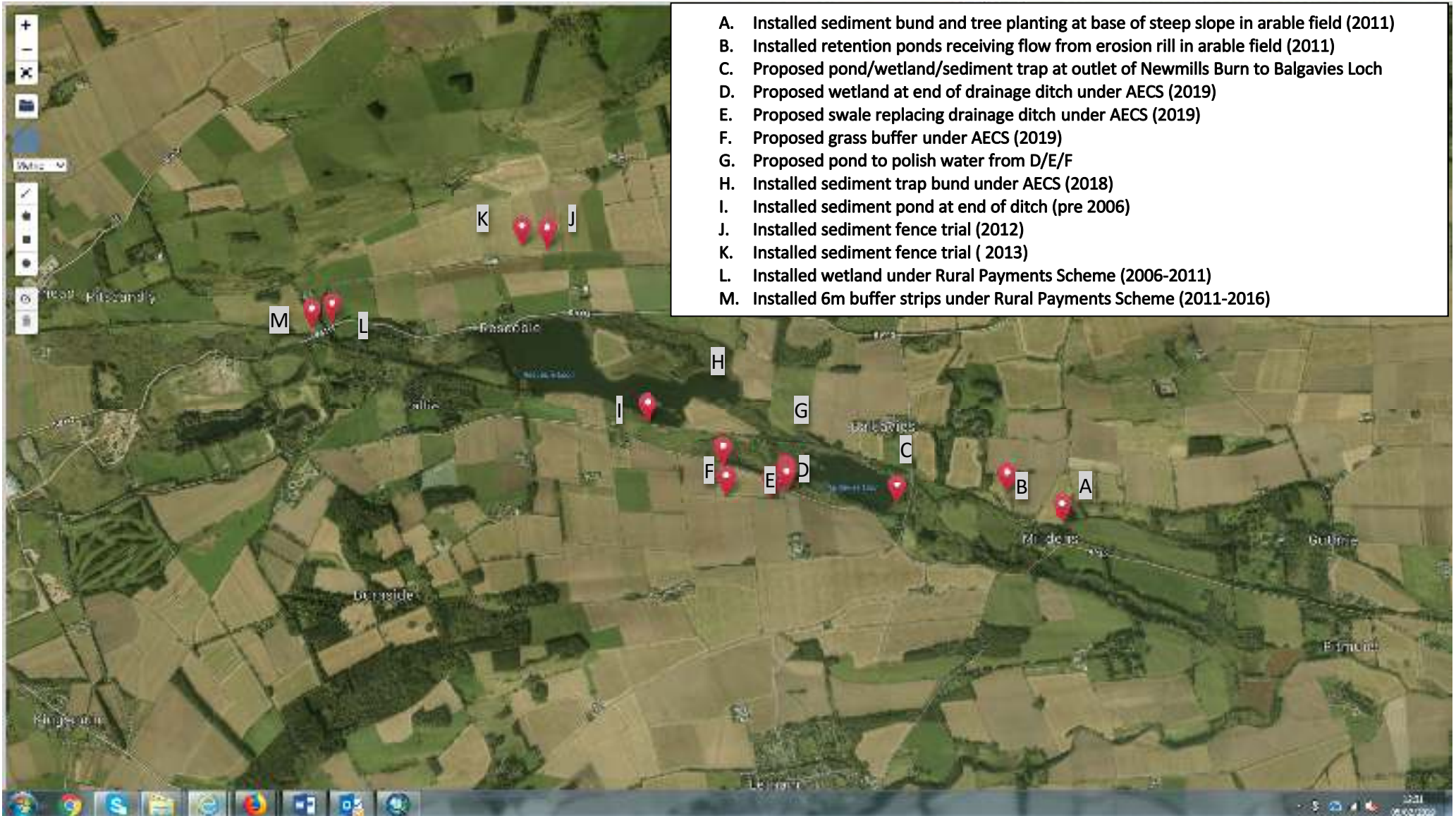


Figure 1. Sites of some rural SUDS and other sediment control measures in the upper Lunan Water catchment (both implemented and proposed).



Site A



Site A after storm Frank, Jan 2017



Site B



Site B after storm Frank



Site J

Figure 2. Sediment retention systems previously implemented in the catchment (Labels refer to Figure 1).



Figure 3. Swale and sediment trap installed at Greenhead Farm, upstream of Fonah Bog with AECS funding (2018).(a) prior to installation (b) ditch capturing burst drain (c) swale inlet from ditch (at back of picture) and sediment trap (water filled after storm event) with outlet to culvert under road. Site H in Figure 1.

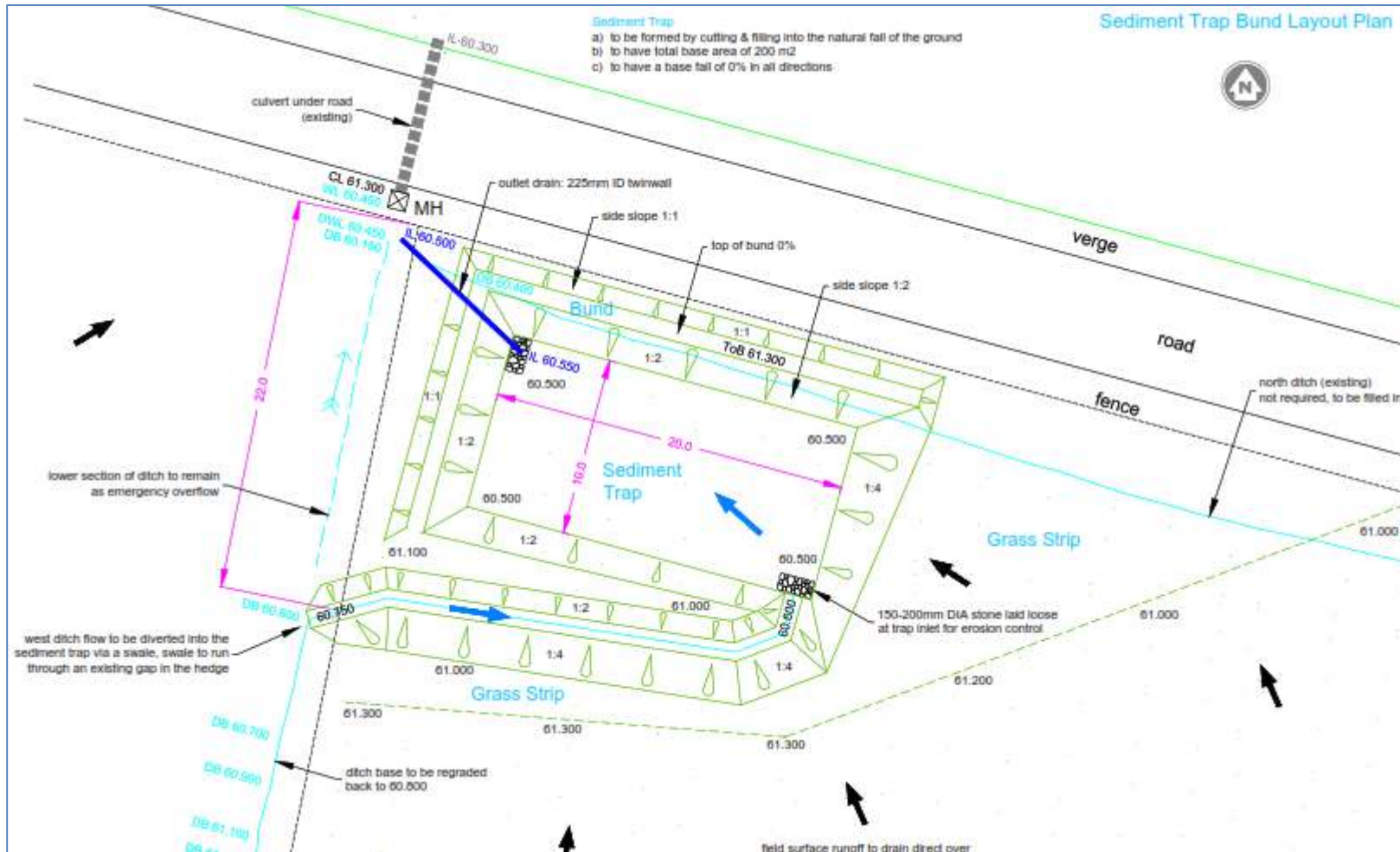


Figure 4. Screenshot of design detail for sediment trap and pond shown in Figure 3 (courtesy of Moir Environmental)

Date	Activity	Contributors	Funding	Links to reports
Jan-16	ECAF funding application to SG. Project approved, but funding for whole programme withdrawn	JHI/Lockett/Moir /SRUC	SG advisory	
Apr-16	Start of Payments for ecosystem services - Lessons - project	JHI	SG research project	
Dec-16	Manual: Rural Sustainable Drainage Systems: A practical design and build guide for Scotland's farmers and landowners	Abertay/Moir Environmental	CREW	https://www.crew.ac.uk/publication/rural-sustainable-drainage-systems-practical-design-and-build-guide-scotlands-farmers
ongoing	Awareness raising and discussion at Lunan Catchment Management Group meetings and Rescobie Loch Development Association AGMs.	JHI, Angus Council, ERFT, SEPA, SNH, Rescobie Loch riparian owners	SG research project	https://www.hutton.ac.uk/research/projects/payments-ecosystem-services-lessons#Water for all
Oct-Dec 2016	Management plan and advice for Greenhead farm	Lockett/Moir/JHI	SNH	Moir/Lockett reports
Mar-17	Sediment trap included in AECS application for Greenhead farm	Lockett	farmer	
Dec-17	<i>Application approved by RPID</i>			
Oct-Dec 2017	Management plan and advice for Newmill farm	Lockett/Moir/JHI	SNH	Moir/Lockett reports
Oct-Dec 2017	Visits to Fonah Bog (SWT property) d/s Newmills runoff to agree responsibility for sediment removal from potential sediment trap/pond on edge of fonah bog	Lockett/Moir/JHI	?	
Mar-18	Filter strip/Swale/wetland included in Newmill farm AECS application	Moir	Farmer/AECS	
Dec-18	<i>Application approved by RPID</i>			

Date	Activity	Contributors	Funding	Links to reports
Oct-Dec 18	Management plan and advice for Mains of Balgavies farm and/or Balmadies farm	Lockett/Moir/JHI	SNH	
	Potential AECS application to include treatment system for Newmills Burn sediment at entry into Balgavies Loch - March 2019	Lockett	Farmer/AECS	

Table 2. Summary of progress of implementation and planning of rural SUDS measures in the upper Lunan Water catchment, 2016-present.



Figure 4. Proposed sites of further rural SUDS implementation. (Labels refer to Figure 1).

Reports and links for further information.

PESLES project

[https://www.hutton.ac.uk/research/projects/payments-ecosystem-services-lessons#Water for all](https://www.hutton.ac.uk/research/projects/payments-ecosystem-services-lessons#Water%20for%20all)

Lunan Water diffuse pollution mitigation project

<https://www.hutton.ac.uk/research/projects/lunan-water-diffuse-pollution-monitoring-project-first-10-years>

Vinten,A., Sample, J. Ibiyemi, A. Abdul-Salam, Y. & Stutter, M. (2017). A tool for cost-effectiveness analysis of field scale sediment-bound phosphorus mitigation measures and application to analysis of spatial and temporal targeting in the Lunan Water catchment, Scotland. Science of The Total Environment,586, 631-641, <https://doi.org/10.1016/j.scitotenv.2017.02.034>.

Consultant reports providing support for AECS applications (not for circulation)

Lockett Agri-Environmental. 2016. Rescobie and Balgavies Lochs SSSI Greenhead Farm Diffuse Pollution Plan, December 2016

Moir Environmental. 2017. Newmills of Balgavies proposed Rural SUDS design. September 2017.

Moir Environmental. 2017. Greenhead Farm proposed Rural SUDS design. December 2017.

Rural SUDS design guide

CREW (2017). <https://www.crew.ac.uk/publication/rural-sustainable-drainage-systems-practical-design-and-build-guide-scotlands-farmers>

Agri-environment schemes

SRDP (2007-13). Scotland Rural Development Fund (2014-2020). <https://www2.gov.scot/Topics/farmingrural/SRDP>

ECAF (2016). <https://www.ruralnetwork.scot/news-and-events/news/environmental-cooperation-action-fund-opens-applications>

AECS (2014-2020).<https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/agri-environment-climate-scheme-full-guidance-menu/>