Appendix 7. Cost-effectiveness assessments – supplemental information
Appendix A7.1 Cost of field wetlands

Table A7.1.1 Summary of field wetlands cost

Site	Name (Abbreviation)	Design	Approx. Area (m^2)	Construction Cost £	Excavation Cost £	Pipework £	Fencing £	Other £	Maintenance £
Loddington, Leicestershire	Upper Ponds (LDUP Ditch)	SS	100.0	1175	800	-	-	375[2]	-
	Paradise (LDPD Drain)	DS	20.0	1470	1215	160	-	95[3]	-
	Little Owl (LDLO Surface)	S	22.0	460	435	-	-	25[3]	-
Crake Trees, Cumbria	Bill & Ted (CTBT Surface)	SS	200.0	1010	355	240	415	-	-
	William (CTW Drain)	S	50.0	1540	1180	70	290	-	-
	India (CTI Stream)	S	125.0	2850	1375	480	875	120[4]	-
Whinton Hill, Cumbria	Shelduck (WHSD Drain)	DS	320.0	3145	1700	390	1000[1]	55[3]	-
	Yellowhammer (WHYH Ditch)	S	50.0	500	500	-	-	-	-
	Gully Trap (WHGT Surface)	SS	7.5	280	280	-	-	-	180
Newton Rigg, Cumbria	Willow Coppice (NRWC Surface)	DS	5.0	515	425	90	-	-	-

Note: SS=Shallow paired ponds; DS=Deep and shallow paired ponds; S=Single shallow pond. [1]Estimate of £1000 for fencing, as actual area fenced enclosed much wider area than wetland at farmer's request. [2]In this wetland wooden boards are being used within the feature to increase the flow path length. [3]Represents cost of wildflower seed mix. At other sites grass seed was used; that cost is not shown here. Similarly, the cost of transplanting wetland vegetation from the surrounding area has not been included. This was undertaken for all sites except WHGT and NRWC. [4]Land drainage consent (£50) and crayfish survey (£70)

Appendix 7.2 Cost effectiveness of mitigation options in spring cropping, potatoes

Table A7.2.1 Cropping area and overall crop rotation margin per hectare, 2010-1012

Site	Harvest Year	Cropping area (%)					Overall crop rotation margin (£ ha^{-1})
		Winter Wheat	Winter Oats	Spring Barley	Winter Oilseed Rape	Potatoes	
West Midlands	2010	63	6	6	6	19	£823
Rosemaund	2010	60	0	0	20	20	£1373
	2011	40	0	20	20	20	£933
Wistaston[1]	2012	58	0	0	31	11	£932
Tern	2010	38	24	17	0	21	£1612
	2011	38	24	17	0	21	£985
	2012	38	24	17	0	21	£1287

[1]The rotation at Wistaston comprised two years of herbage seed covering 6% of the land area. This crop has not been included in the analysis for reasons of simplicity and to allow comparability to the rotation at Rosemaund in previous years

Table A7.2.2 Cost of the mitigation options and impact on the overall crop rotation margin

Mitigation option[1] (harvest year)	Impact on individual crop margin (£ ha^{-1})	Impact on overall crop rotation margin (£ ha^{-1})	Resultant overall crop rotation margin (£ha^{-1})
West Midlands			
Cover crop	120.00-167.00	22.00-31.00	792-801
Tramline cultivation	2.50-3.00	1.00	822
Stone row cultivation: tied ridger	30.00	6.00	817
Stone row cultivation: angled tine	23.50-47.00	4.00-9.00	814-819
Stone row cultivation: vertical tine	23.50	4.00	819
Stone row cultivation: rotary harrow	19.50	4.00	819
Autumn deep cultivation	49.00	9.00	814
Autumn shallow cultivation	37.00	7.00	816
Autumn cultivation and winter cereal	-	-	823
Autumn up and down cultivation	30.00	6.00	817
Autumn wide contour cultivation	45.00	8.00	815
Autumn narrow contour cultivation	60.00	11.00	812
Rosemaund (2010)			
Cover crop	167.00	28.00	1339
Tramline cultivation	3.00	1.00	1372
Autumn deep cultivation	49.00	10.00	1293
Autumn shallow cultivation	37.00	8.00	1295
Autumn cultivation and winter cereal	-	-	1375
Wistaston (2012)			
Stone row cultivation: tied ridger	30.00	3.00	929
Stone row cultivation: angled tine	47.00	5.00	927
Stone row cultivation: rotary harrow	19.50	2.00	930
Tern			
Cover crop (2010)	120.00	23.00	1581
Tramline cultivation (2010)	2.50	1.00	1611
Stone row cultivation: tied ridger (2011)	30.00	6.00	979
Stone row cultivation: angled tine (2011)	23.50	5.00	980
Stone row cultivation: vertical tine (2011)	23.50	5.00	980
Autumn up and down (2011)	30.00	6.00	979
Autumn wide contour cultivation (2011)	45.00	9.00	976
Autumn narrow contour cultivation (2011)	60.00	12.00	973

[1]Autumn cultivation refers to cultivations undertaken after the potato harvest and, unless otherwise stated, left overwinter and followed with a spring crop (barley), the cost of which is assigned to the spring crop and hence differing impact on the overall crop rotation margin compared to that of other options.

Figure A7.2.3. Summary results showing percentage reductions in total runoff volumes and derived cost-effectiveness estimates for different mitigation treatments, sites and years[1]

	Runoff	
	Effectiveness (% reduction)	Cost-effectiveness (% reduction per £ spent)
Rosemaund (2010)		
Cover crop	33.5	1.20
Autumn deep cultivation	99.3	9.93
Autumn shallow cultivation	96.9	12.11
Autumn cultivation and winter cereal	99.4	-
Wistanton (2012)		
Stone row cultivation: tied ridger	89.0	29.67
Stone row cultivation: angled tine	50.2	10.04
Stone row cultivation: rotary harrow	97.9	48.95
Tern		
Cover crop (2010)	38.7	1.68
Stone row cultivation: tied ridger (2011)	63.9	10.65
Stone row cultivation: angled tine (2011)	83.5	16.70
Stone row cultivation: vertical tine (2011)	97.7	19.54

[1] Cost-effectiveness calculations are based on the percentage reduction in runoff divided by the cost (the overall rotation margin in £/ha from Table A7.2.2).

Appendix 7.3 Potential uptake: results from the focus groups and survey

A7.3.1 Farmer perceptions: focus groups

Focus groups were used in this study to gauge attitudes and opinions of farmers and their advisors to sediment and phosphorus loss and their assessment of the practicality and viability of options undertaken in the current project and its predecessor (PE0206). There were three key areas of discussion as follows: (i) understanding of soil erosion, its causes and impacts; (ii) practices to address soil erosion; and (iii) discussion of the mitigation options trialled within the MOPs projects, including the barriers to their adoption and the ways in which these barriers could be overcome. Two focus groups for the farmer perception work took place in January 2012. The first focus group at Tern focused on winter cereals and potatoes. The second focus group at Loddington encompassed a broader discussion reflecting the mixed farming systems that the participants came from, but with additional emphasis on the role of wetlands in controlling diffuse water pollution. These fed into the design of the subsequent postal survey which took place in spring 2013. Two further focus group discussions took place in January and February 2013 as part of two Catchment Sensitive Farming workshops, which combined a morning field visit and talks, with the focus group discussion taking place in the afternoon. The January workshop took place in Cumbria and focused on wetlands with a visit to the Whinton Hill site. The February workshop took place in Hereford and focused on potatoes with a visit to the Wistaston site. A summary of the key points made about the MOPS projects options are given in Table A7.3.1 at the end of this discussion.

In total there were 44 participants, the majority of whom were farmers (33), advisors (6) or both (3). Of the farmers, the majority were owners (40.6%) or owned and additionally rented (37.5%), with the remainder being tenants (9.4%) or managers (12.5%). More than half were over 50 (58%), with majority of those being between 50 and 59 (46%). Three quarters (76%) had also received some form of formal agricultural education although not all necessarily beyond school leaving age. In terms of farm type, the majority had mixed farming systems (70%), followed by arable (11%), but with beef, sheep and dairy also represented. A range of crops (cereals, oilseeds, pulses, root crops) and livestock (beef breeding, stores and finishing, sheep breeding, stores and fat, dairy and pigs) were evident. Just under one third of farms (28%) were less than 100 ha, with the majority between 100 ha and 500 ha (48%), the remainder (24%) being greater than 500 ha, with 10% being over 1000ha.

All of the farmers who attended carried out a soil protection review (SPR) under cross compliance and in terms of good farming practice suggested as part of cross compliance, more than half incorporated crop residues (65%) and undertook minimum tillage and contour cultivation (55% and 52% respectively), whilst a small proportion also did direct drilling (14%). Participation in ELS was also evident (55%). The most popular option was low input grassland (41%), followed by 2m buffer strips on cultivated land and overwintered stubble (both 28%). Less favoured options were those linked to intensive/improved grassland.

In terms of the understanding of soil erosion, reference in all discussions was made to the role of the natural environment, particularly climatic effects, mainly rainfall but also wind and topography (slope) of the land and soil type. Of equal concern was the role of farm practice, particularly cultivations, size of machinery and livestock management. It was also felt a lot of farmers, those not present, do not realise what they should do, and why they should do it. In addition one group mentioned the wider landscape encompassing features such as hedges and ditches and how they were managed. In the two groups focused on potatoes one of the key causes of erosion identified was that of irrigation.

Regarding the impacts of soil erosion a key area of concern was the loss of topsoil with subsequent financial impact for the farm business. The problem of loss of sediment into water courses and onto roads was also mentioned, alongside the issues associated with pollution, from both sediment and nutrients. The key concern, however, was the business impact, with the environmental impact being of concern where there is both a 'pathway' and 'receptor' to consider.

A range of mitigation methods were discussed covering both in-field and edge of field options. Financial evaluation of each option was important for the participants, as farms are first and foremost businesses. Participants also felt that solutions should focus on the causes of soil erosion, rather than dealing with the impacts that arise. A wide range of practices were undertaken by the focus group participants, with a positive response from participants to additional or new measures they could adopt. Some options, however, both existing and new, were not seen as

practical. There was general consensus that different options worked differently according to the individual situation e.g. soil type and climate. Furthermore, what worked well in one year would not necessarily work well in the following year, and what worked well on one farm would not always work well on another due to, for example, differences in slope, exposure and soil type. The main options adopted were practices related to cultivations and livestock management within fields, and buffers at the edge of fields. Reference was also made to cropping choice and, within the potato group, the need to increase water infiltration.

The barriers to adoption that were mentioned included practicality of the options, particularly timing, and availability of staff and machinery. With fewer people working on farms combined with farm size increasing there is continuous pressure to meet deadlines. Cost is also a key issue with some options also requiring investment into machinery. It was recognised that you needed the right machinery for a specific job at that particular time under those circumstances; however, in reality you could not have every piece of machinery available for every potential circumstance. A further barrier was lack of awareness and knowledge; participants felt that certain existing options, such as those linked to cross compliance and/or ELS, are still not fully understood by all of the farming population.

Key Quotes

Soil Erosion and the Causes
"I think the biggest issue is whether we get 36 inches of rain, or 18 inches of rain in a year".
"The natural features tend to be the problem; if you are ploughing up and down a steep slope it tends to disappear straight".
"Presence of bare ground, if you have not got bare ground you do not get erosion".
"I know of one particular farm where they always plough the headlands downhill, and there is a now a four foot step at the top end of the field to the hedgerow".

Issues as a Result of Erosion
"I suppose, because there will be a loss of yield, so obviously you are trying to protect the crop"
"It is only polluting if it gets somewhere where it does some damage."
"I would put the farm business side higher than the environment."

Barriers regarding uptake of options to educe DWPA
"The trouble is every year is different and every field is different. It is not one size fits all".
"You cannot have a portfolio of machinery that suits everything".
"If you are pressed to do larger acreages, you have not got as much flexibility in terms of timing".

To overcome these barriers, the first step suggested was to provide more education and guidance, but also to highlight the benefits and value of certain options so that farmers would make the time to gain the understanding and knowledge. There was some discussion on who would be best placed to provide the advice. Reference was made to organisations such as the Potato Council and initiatives such as Catchment Sensitive Farming and similar which focus on providing one to one advice, on-farm events, discussion groups and workshops. A pro-active lead/champion farmer as a first adopter and promoter of mitigation options was also suggested as key to encourage uptake of options amongst the farming population. Participants felt that to implement some options some kind of incentive would be required. In one group, it was suggested that this funding need not necessarily be through ELS or HLS, as alternative initiatives and funding routes could be just as valuable. In another group, it was suggested that more ELS options should be aimed at soil management practices and ways to reduce pollution, rather than the current emphasis on birds and wildlife conservation. What came out from most groups was the need to focus options and tailor them and any associated incentive to each individual situation.

Table A4.3.1 Specific comments on MOPS options

Option	Comment
Straw incorporation	There was divergence amongst participants partly dependent on farming system. *"We need every bale of straw we can get"* *"If you are all arable and you want to get on, you chop it and get rid of it"* On a positive note it *"Improves organic matter and soil structure"* Conversely *"Incorporated straw … that can be an issue with slugs"*
Minimum tillage	The benefits of minimum tillage were recognised. *"Get your ground ready quicker using non inverted tillage"* But there were also issues associated with the rotation and agronomic factors. *"Ploughing is really good for the control of blackgrass"* *"The ground conditions have got to be right whatever you decide to do"* *"Real issue of timing"*
Contour cultivation	This was seen as possible in some but not all circumstances and heavily dependent on slope. *"If it's not too steep its fine",* but *"A lot of our fields go two ways"* *"More of when and where you can"* It was also seen as dependent on soil type and crop *"With sufficient rain, it will break through and will just go down the slope"*
Vegetative barriers	There was concern that this would take too much land out of production and that it needs large fields to make it worthwhile. Reference was made to Australia*, "The fields were bigger so there was more room to do it"* and *"Cambridgeshire… I'm sure they could do it there"*
Tramline disruption	There is interest in this option particular if it is part of an existing operation, although some participants were not convinced *"Effectiveness of the tramline disruption I found hard to believe"* *"Not going to be taken up in a big way"*
Cover crop	The benefits of having a crop or crop residue on the land over winter were recognised but there were many negatives *"Not sure whether cover crop would give anything more than a good stubble"* *"Cover crops means wire worm trouble in potatoes"* *"More slug issues"*
Stone row cultivation	There was interest in the various options on the basis of the potential for increased water retention and infiltration, particularly if it could be part of an existing operation. "*Motivation is water conservation"* One group suggested it would not be possible on all land, dependent on how stony the soil was, *"There is a threshold beyond which you can't do it"*
Tied ridger	"*Valuable operation in dry years when irrigate"* *"Cannot justify the cost of a separate operation"* *"Structure does not last in lighter soils"*
Vertical tine	*"Something would look into"* *"Does it actually direct water to crop"* *"A concept that works"* *"Waste of time"*
Angled tine	*"Does it direct water better to the crop"* *"Could damage potatoes in the bed"* *"Not easy to implement"* *"Has to be extremely precise"*
Rotary harrow	Seen as very effective at reducing run-off losses. *"Would looks into"* *"Seems very effective"* *"Must be reasonably priced"* and *"combined with another operation"*
Wetlands	*"Really should focus on in-field options"* *"A last resort (to deal with) one-off, non-routine events"*

	"Would only consider if erosion a real issue" *"Could be part of the solution"* *"I actually suspect that they could be very effective"* "*To be effective you would need so many of them so you could not do it. We'd need too many, it would not be worthwhile".*

A7.3.2 Farmer perceptions: postal survey

Method

The survey of farmers was designed to investigate:

(i) their understanding of diffuse water pollution from agriculture (DWPA);
(ii) what mitigation options they would voluntarily implement and those that they would require a benefit or incentive to carry out;
(iii) which mitigation options they would never implement; and
(iv) the impact on farm businesses that current legislation has.

As explained above and to help the design of a postal questionnaire for farmers, four focus groups of 44 farmers in total were held in study areas in January and February 2012 and 2013 to explore attitudes to soil erosion, current mitigation practices and perceived barriers to implementing such measures. The discussions were audio-taped and transcribed to help in the design of the questionnaire. A draft questionnaire resulted in four main sections: questions about the farm; questions about participation and membership of conservation bodies; questions about soil erosion and DWPA including current practice and whether, in the future, they would adopt practices with or without incentives; and questions about the occupier and their business. Following a pre-pilot exercise of known farmers to the research team, the final questionnaire was produced. The sample of farmers was provided by Defra from their database of addresses used in the June Survey of Agriculture.

All holdings surveyed were over 20 ha in size, stratified for an equal split between arable, livestock and dairy farming in each of the four areas where experiments had been carried out in the MOPS1 and MOPS2 projects – Cumbria, Leicestershire and Rutland, Herefordshire, and Shropshire; 300 names and addresses for each of these areas were provided to Defra's approved mailing provider who arranged the posting of the covering letter, a coloured information sheet explaining various mitigation options to reduce DWPA and the four-page A4 sized black and white questionnaire.

The survey went to 1200 occupiers on 15 March 2013 with a reply-paid envelope for return; a 'reminder' postcard was sent out on 26 April 2013 and the final questionnaire used was returned on 15 July 2013. Only seven spoilt, partly completed or refusals were sent back, and 17 replies were received stating that the addressee had either 'gone away', 'died' or was 'no longer farming'. A final total of 119 completed questionnaires received represents a response of 10%.

It is important for the validity of the results to make an assessment of whether the survey respondents are nationally representative. The mean total agricultural area of the respondents was 152 ha; this compares closely with the figure from Defra (2013b) of 129 ha for all holdings of 20 ha or over in England in 2012. Some 24% of the respondents were 50 or under which can very loosely be compared with Defra (2013b) showing that 39% of the holders of commercial holdings in the UK in 2010 are 54 years old or under. The mean area owned by the respondents was 84 ha and that rented was 59 ha. The national picture was very similar to this tenurial split.

The possibility of non-response bias was also tested by analysing the first third of those responding to the survey against the last third. It was found that there was no bias in terms of total agricultural area ($t = 0.82$; $P \leq 0.4126$), years worked in farming ($t = 0.10$; $P \leq 0.9207$), number of full-time equivalent staff working on the farm ($t = 0.67$; $P \leq 0.5038$), proportion of the area farmed that was owner-occupied ($t = 0.05$; $P \leq 0.9616$) and age category (Wilcoxon 1605.00; $P \leq 0.5987$). Put another way, in terms of these characteristics of the respondents and their businesses, there is no evidence that the response is biased by those who did not reply at all.

Results

(i) Characteristics of the farmer and the farm business

As stated previously, the mean farm size was 152 ha. The most common farm type was dairy (33% of total) followed by lowland livestock (30%). Around 37% of the respondents were owner-occupiers, 12% tenants and 51% had mixed tenure.

Most respondents (89%) were male and 78% were 51 years old or over and their average length of time working in farming was 40 years. The mean FTE workforce (including the respondent and paid and unpaid family members) was 2.5 and 80 % of the respondents were working exclusively on the farm; 69% had 'definitely' or 'possibly' identified a successor. Some 7% had experienced agriculture-related further education and a further 45% had further education. Almost 69% of respondents had an average farm income in the last two financial years of: a loss and up to £50,000; 17% from £50,001-100,000; and 14% of over £100,000.

Of the 119 responding businesses, 66% had land in a NVZ. Of these, 30% said that the introduction of this designation had had a negative or financial cost to their businesses. Typical comments illustrating this were: 'more paper work and record keeping'; 'had to reduce herd to reduce slurry production in closed period'; and 'limitation on N application has affected grassland output'. When respondents were separated into two groups - those with animals and those without - it was found that there was a significant ($\chi^2 = 4.59$; $P \leq 0.0300$) relationship between the NVZ having a negative impact on the business or not with livestock farmers less likely to view the NVZ as having a negative impact than farmers with crops. However, there was not a significant relationship between those affected by the introduction of NVZs and their willingness to voluntarily implement steps or practices to reduce nitrate pollution ($\chi^2 = 0.1121$; $P \leq 0.7378$).

(ii) Participation in agri-environment schemes and membership of conservation bodies

Overall, 114 participants answered this question with 74% taking part in agri-environment schemes and 26% not taking part. The majority of those taking part in such schemes were positive (57%), either 'agreeing' or 'strongly agreeing' that there was an improvement in environmental quality by being in a scheme. However, there was a near significant ($P \leq 0.0571$) relationship between the different types of scheme and whether it was felt there was an improvement in environmental quality with ELS participants less positive about benefits than HLS participants. There was some evidence that those who participated in agri-environmental schemes were more willing to implement mitigation options with incentives.

Conversely, around 76% of respondents had not taken part in, or benefitted from, an advisory Government funded scheme (such as Catchment Sensitive Farming). Some 31% of respondents were members of a conservation body or pressure group: the most common body/group belonged to was FWAG followed by the RSPB.

(iii) Soil erosion and diffuse water pollution

A series of questions were posed to try to identify soil erosion issues on respondents' farms and their understanding of DWPA. It should be remembered that participants all received a coloured information sheet explaining various mitigation options as a form of briefing, before asking the questions. When respondents were asked whether they understood the term 'diffuse pollution' and the potential impacts that it can have on the environment, 74% answered either 'Yes, definitely' or 'Yes, a little'. When asked whether they thought soil erosion is an issue on their farms, 3% said it was a big issue and 50% thought it was not an issue at all or did not know. A series of statistical tests were carried out to examine whether the level of understanding of DWPA was related to various farm and farmer characteristics such as age, level of education, farm size, level of soil erosion issues and type of farm. They found that age ($\chi^2 = 5.7902$; $P \leq 0.1223$), level of erosion on their farm ($\chi^2 = 0.3488$; $P \leq 0.8400$) and farm type ($\chi^2 = 4.2002$; $P \leq 0.6496$) were not significant. However, those with further (non-agricultural) education and a university (non-agricultural) degree had a significantly higher level of understanding of DWPA ($\chi^2 = 15.6068$; $P \leq 0.0036$) as did those with larger farms ($t = -1.31$; $P \leq 0.0019$).

The survey respondents, on average, applied 38 kg ha^{-1} of phosphate across their farm each year. The average highest amount of phosphate applied to a single field in any one year was 56 kg ha^{-1}.

(iv) Mitigation options to reduce DWPA

A table presented to those surveyed consisted of a list of 30 various mitigation options to reduce diffuse pollution together with known data for most of these options on percentage effectiveness at reducing phosphate loss and the annual financial impact per ha of implementing these measures (excluding capital costs). Respondents were asked to indicate which of these mitigation options they currently carried out on a typical field and, if so, whether they carried them out under the requirements of a Soil Protection Review or an agri-environment or other scheme or initiative.

Table A7.3.2 summarises respondents' current pollution reduction mitigation options and whether they are carried out under any scheme requirements. It can be seen that the most commonly carried out option is to maintain drainage (by 74% of respondents) followed by options related to both stock and manure management (ranging from 63% to 72%). The two least commonly carried out options were contour minimum tillage with beetle bank (2%) and contour plough with beetle bank (3%). In many cases, but certainly not the majority, the options were undertaken in response to the Soil Protection Review. Even less respondents undertook the options as part of an incentive scheme.

Table A7.3.3 summarises the respondents' views on whether they would implement the same list of mitigation options if they were not already doing so either: voluntarily; with an incentive; or not at all. In many cases, there were more respondents that would voluntarily implement a mitigation option than currently do so. Notable exceptions were 'reduce dietary N and P', 'site solid manure heaps on concrete and collect effluent', 'fence off rivers and streams from livestock', establish riverside buffer strips', and 'establish and maintain artificial wetlands'. The most common voluntarily implemented option was 'reduce field stocking rates when soils wet' (81%), followed by 'shepherd the stock to prevent localised overgrazing', 'avoid damage to riverbanks' and 'don't apply manure at high risk times' (all at 80%). No one would voluntarily adopt 'contour minimum tillage with beetle bank'. The most common option that would be implemented with an incentive would be to 'establish riverside buffer strips' (by 61%). Other options that would be implemented with an incentive (between 45% to 52% of respondents) relate to those listed above as not being voluntarily implemented, i.e. 'reduce dietary N and P', 'site solid manure heaps on concrete and collect effluent', 'fence off rivers and streams from livestock', establish riverside buffer strips', and 'establish and maintain artificial wetlands'. Options that would not be implemented either voluntarily or with an incentive include, 'contour minimum tillage with beetle bank' (70% of respondents) and 'contour plough with beetle bank' (59%). In addition to the options involving tillage across the contour, the other less popular option was 'reduce dietary N and P' (where 41% of respondents would not implement).

Of the options trialled within the MOPS projects and based upon established farming practices, the following points emerge: (i) 50% or more of respondents would not consider tillage practices across the contour, (ii) around one third would not consider crop residue incorporation, and (iii) 25% would not establish cover crops in the autumn. Of the two more novel options, respondents are equally split (i) between those who would implement 'tramline disruption' voluntarily (33%), those who would implement it with an incentive (38%), and those who would not implement it (29%), and (ii) those who would 'establish and maintain artificial wetlands with an incentive (49%) and those who would not establish wetlands (44%).

An analysis to see if there were any links between the number of mitigation options carried out and various sub-groups of the respondents was carried out. This revealed that there was no significant link between number of options carried out and farm business tenure: the severity of erosion on-farm ($f = 1.03$; $P \leq 0.3806$); farm income ($f = 1.12$; $P \leq 0.3562$); farmer age ($f = 1.26$; $P \leq 0.2909$); years in farming ($Rho = 0.124$; $P \leq 0.1861$); and whether the farm had livestock or not ($t = 0.09$; $P \leq 0.9297$). However, three statistically significant links were found. These were that: if the farm was in a NVZ more options were taken than if it was not ($t = 2.42$; $P \leq 0.0172$); farms in an agri-environment scheme took more options than those not in one ($t = -1.91$; $P \leq 0.0498$); and the bigger the farm in area, the more options were undertaken ($Rho = 0.323$; $P \leq 0.0004$).

A7.3.3 Farmer perceptions: summary

What is evident from the focus groups and survey responses is that a significant number of respondents are, and perhaps would be, undertaking many mitigation practices as part of routine farming practice, particularly where they relate to cultivations and field management. This is with the exception of contour cultivations which may not be appropriate for many farming situations. Options linked to farm infrastructure (concrete bases, fencing,

gateways) which require some form of investment, however small, and those which could be seen as limiting production (reduce dietary N and P) are less likely to be adopted without an incentive, whether that be monetary or awareness creation. The disruption of tramlines (winter cereals) and stone rows (potatoes) both have the potential for adoption, with and without incentive, particularly in the latter case where cost savings linked to water retention could be realised. Establishment of wetlands is also feasible, but in this case, would almost certainly require some form of incentive payment.

Table A7.3.2 The proportion (%) of respondents currently carrying out a series of pollution reducing mitigation options

Mitigation options	Currently carry out	Currently undertake under the following	
		Soil Protection Review	Agri-environment scheme or other scheme initiative
Maintain drainage	74	24	4
Cultivate compacted tillage soils	43	20	2
Early drilling	27	8	1
Contour plough	18	6	0
Contour plough with beetle bank	3	1	0
Minimum tillage	29	6	1
Contour minimum tillage	7	2	0
Contour minimum tillage with beetle bank	2	1	0
Leave autumn seedbeds rough	25	5	4
Tramline disruption	17	5	1
Application of organic matter	60	12	4
Crop residue incorporation	34	6	2
Establish cover crops in autumn	15	2	2
Use low ground pressure tyres/machinery	53	13	2
Loosen compacted soil layers in grass field	36	10	3
Reduce field stocking rates when soils wet	66	20	7
Shepherd the stock to prevent localised overgrazing	64	13	4
Move feed and water troughs regularly	46	16	1
Reduce dietary N and P	13	0	1
Use well drained tracks for vehicles and livestock	53	11	3
Use fertilizer recommendation system	53	13	2
Site solid manure heaps away from water courses and field drains	72	13	2
Site solid manure heaps on concrete and collect effluent	24	8	1
Don't apply manure to high risk areas	63	13	2
Don't apply manure at high risk times	66	15	2
Avoid damage to riverbanks	48	5	5
Fence off rivers and streams from livestock	38	3	4
Re-site gate ways from high risk areas	21	2	1
Establish riverside buffer strips (beyond cross compliance)	24	1	11
Establish and maintain artificial wetlands	14	0	6

Table A7.3.3 The proportion (%) of respondents not currently carrying out a series of pollution reducing mitigation options that would or would not carry them out in the future

Mitigation options	Would implement		Would not implement
	Voluntarily	With incentive	
Maintain drainage	73	27	0
Cultivate compacted tillage soils	65	22	13
Early drilling	62	17	21
Contour plough	23	23	54
Contour plough with beetle bank	8	33	59
Minimum tillage	24	28	48
Contour minimum tillage	17	33	50
Contour minimum tillage with beetle bank	0	30	70
Leave autumn seedbeds rough	38	31	31
Tramline disruption	33	38	29
Application of organic matter	64	16	20
Crop residue incorporation	50	12	38
Establish cover crops in autumn	33	42	25
Use low ground pressure tyres/machinery	62	21	17
Loosen compacted soil layers in grass field	50	41	9
Reduce field stocking rates when soils wet	81	15	4
Shepherd the stock to prevent localised overgrazing	80	12	8
Move feed and water troughs regularly	62	12	26
Reduce dietary N and P	7	52	41
Use well drained tracks for vehicles and livestock	58	33	9
Use fertilizer recommendation system	63	25	12
Site solid manure heaps away from water courses and field drains	75	20	5
Site solid manure heaps on concrete and collect effluent	16	51	33
Don’t apply manure to high risk areas	78	22	0
Don’t apply manure at high risk times	80	15	5
Avoid damage to riverbanks	80	20	0
Fence off rivers and streams from livestock	34	45	21
Re-site gate ways from high risk areas	37	49	14
Establish riverside buffer strips (beyond cross compliance)	16	61	23
Establish and maintain artificial wetlands	7	49	44

A7.4 References

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A7.5 Dissemination of results and knowledge exchange activities

7.5.1. Journal papers

Bailey, A. P., Deasy, C., Quinton, J. N., Silgram, M, Jackson, R. J. and Stevens, C. J. (2013) Determining the cost of in-field mitigation options to reduce sediment and phosphorus loss. *Land Use Policy,* 30, pp.234-242.

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7.5.2. Journal papers

Bailey, A. P., Silgram, M, et al (2013) Determining the cost-effectiveness of reducing run-off, sediment and nutrient loss from irrigated potato enterprises.

Bailey, A. P., Tranter, R. B., Jones, P. J. (2013) Controlling diffuse pollution: farmer attitude and uptake of within and edge of field mitigation options across farming systems

Bailey, A., Deasy, C., Quinton, J., Silgram, M., Jackson, B. and Stevens, C. 2013. Determining the cost of in-field mitigation options to reduce sediment and phosphorus loss. *Land Use Policy* 30(1), 234-242.

7.5.3. Meetings and events

MOPS2 focus group (8 participants), Tern Farm, Shropshire, 18 January 2012

MOPS2 focus group (6 participants), Loddington, Leicestershire, 25 January 2012

Catchment Sensitive Farming workshop, including Whinton Hill site visit and MOPS2 focus group (11 participants), Penrith, Cumbria, 23 January 2013

Catchment Sensitive Farming workshop, including Wistaston Farm site visit and MOPS2 discussion (19 participants, Weobley, Herefordshire, 14 February 2013