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|---|---|
| <b>Title:</b><br>Water Quality and Agriculture: Basic Measures<br><b>IA No:</b> Defra1819<br><br><b>Lead department or agency:</b><br>Department for Environment, Food and Rural Affairs<br><br><b>Other departments or agencies:</b><br>Environment Agency | <b>Impact Assessment (IA)</b>                 |
|   | <b>Date:</b> 16 June 2016                     |
|   | <b>Stage:</b> Post Consultation               |
|   | <b>Source of intervention:</b> EU             |
|   | <b>Type of measure:</b> Secondary legislation |
| <b>Contact for enquiries:</b> Matthew Hampshire<br>(matthew.hampshire@defra.gsi.gov.uk, 0208 02 63647)  |   |
| <b>Summary: Intervention and Options</b>  | <b>RPC Opinion:</b> Green at pre-consultation |

| Cost of Preferred (or more likely) Option |                            |  |   |
|---|----------------------------|--|---|
| Total Net Present Value                   | Business Net Present Value | Net cost to business per year (EANCB on 2014 prices) | In scope of One-In, Three-Out? Measure qualifies as |
| £440m                                     | £230m                      | -£24.9m  | No NA   |

**What is the problem under consideration? Why is government intervention necessary?**

Water pollution from agriculture is a significant external cost to other parties such as water companies, recreational users of watercourses and members of the public. This is a market failure; in a free market there are limited incentives for farming businesses to adopt practices which would reduce water pollution. Government intervention is necessary to correct this market failure. Effectively tackling water pollution requires a mix of regulation, voluntary action and financial incentives. The Water Framework Directive (WFD) introduced in 2000 requires us to establish basic measures to control or prevent agricultural diffuse pollution. The current measures in England appear not to meet this requirement in full. In particular there is evidence of widespread agricultural diffuse pollution by phosphorus but no mandatory controls in place to tackle it. The European Commission is increasing its pressure on Member States to address such gaps and issued a pilot letter against England and Wales in March 2015.

**What are the policy objectives and the intended effects?**

Our aims are :

1. To establish a basic standard of good practice through the introduction of new basic rules to meet the requirements of the Water Framework Directive (WFD). If government sets and enforces a clear good practice standard this will give it a stronger negotiating position when putting pressure on others (such as water companies and NGOs) to contribute further funds to incentivise additional actions to reduce diffuse water pollution from agriculture. Our aim is to reduce diffuse water pollution from agriculture, focusing on phosphorus, in a way that minimises costs to the farming sector while delivering appreciable economic and environmental benefits.
2. To support a world-leading food and farming industry, and a cleaner, healthier environment, benefitting people and the economy.
3. To maintain agricultural land in optimum condition, reducing nutrient losses and soil erosion, improving our water environment and water quality by reducing diffuse pollution from agriculture.

**What policy options have been considered, including any alternatives to regulation? Please justify preferred option (further details in Evidence Base)**

We are proposing a final option that consists of 8 basic rules for farmers to prevent and control diffuse water pollution from agriculture. The rules do this in a way that minimises costs to the farming sector by focusing on resource efficiency in relation to nutrient and soil management. These new rules would set a clear basic level of good practice for consistent agricultural land management across England, meet the requirements of the Water Framework Directive without gold plating, and complement the range of incentives, advice and voluntary measures which make up the package of measures to tackle water pollution from agriculture.

This has been amended from the pre-consultation IA by dropping 2 rules from our consultation option 2 (feed planning and accurate fertiliser spreading). For these rules concerns were expressed that, whilst shown to be cost beneficial in our analysis, they might not be practical for regulatory control in the short term. These have been replaced by one rule from our alternative, option 3. This received a strong level of support and now aligns the rules more closely with existing requirements, in line with stakeholder feedback. NB the final number of new rules is now 8 due to the way they have been regrouped and defined for ease of understanding. This final option represents a compromise between the two consultation options sitting between them in terms of costs and benefits to the industry and the environmental benefits.

The purpose of these rules is to increase uptake of basic good practice and to reach those farmers who have not responded to the voluntary approaches employed to date.

**Will the policy be reviewed?** It will be reviewed. **If applicable, set review date:** 3 years

|   |                     |                       |                     |  |                     |
|---|---------------------|-----------------------|---------------------|--|---------------------|
| Does implementation go beyond minimum EU requirements?  |                     |                       | No                  |  |                     |
| Are any of these organisations in scope? If Micros not exempted set out reason in Evidence Base.                          | <b>Micro</b><br>Yes | <b>&lt; 20</b><br>Yes | <b>Small</b><br>Yes | <b>Medium</b><br>Yes                     | <b>Large</b><br>Yes |
| What is the CO <sub>2</sub> equivalent change in greenhouse gas emissions?<br>(Million tonnes CO <sub>2</sub> equivalent) |                     |                       | <b>Traded:</b><br>0 | <b>Non-traded:</b><br>-0.25 <sup>1</sup> |                     |

***I have read the Impact Assessment and I am satisfied that, given the available evidence, it represents a reasonable view of the likely costs, benefits and impact of the leading options.***

Signed by the responsible Minister \_\_\_\_\_ Thérèse Coffey \_\_\_\_\_ Date: 5th February 2018 \_\_\_\_\_

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<sup>1</sup> This value was derived using an EPA Greenhouse Gas Equivalencies Calculator: <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

# Summary: Analysis & Evidence

# Final Policy Proposal

**Description:** Regulation - package of 8 basic rules with net benefits to farm income. Preferred Option.

## FULL ECONOMIC ASSESSMENT

|                             |                          |                             |  |                  |                           |
|-----------------------------|--------------------------|-----------------------------|--|------------------|---------------------------|
| <b>Price Base Year</b> 2014 | <b>PV Base Year</b> 2017 | <b>Time Period Years</b> 10 | <b>Net Benefit (Present Value (PV)) (£m)</b> |                  |                           |
|                             |                          |                             | <b>Low:</b> 292                              | <b>High:</b> 581 | <b>Best Estimate:</b> 440 |

| <b>COSTS (£m)</b>    | <b>Total Transition (Constant Price) Years</b> |   | <b>Average Annual (excl. Transition) (Constant Price)</b> | <b>Total Cost (Present Value)</b> |
|----------------------|--|---|---|-----------------------------------|
| <b>Low</b>           | 12   | 1 | 9   | <b>91</b>                         |
| <b>High</b>          | 12   |   | 11  | <b>102</b>                        |
| <b>Best Estimate</b> | 12   |   | 10  | <b>96</b>                         |

### Description and scale of key monetised costs by 'main affected groups'

Farm Businesses: cost of capital investment (mainly in facilities to store animal manures) for some farmers with insufficient storage who chose not to manage their slurry in other ways e.g. tankering off farm, to comply with new rules (PV of £54.2m). Also costs of administration and familiarisation with the new rules (PV of £40.3m).  
Government: Costs of publicising, monitoring and enforcing new rules (PV of £1.2m)

### Other key non-monetised costs by 'main affected groups'

None.

| <b>BENEFITS (£m)</b> | <b>Total Transition (Constant Price) Years</b> |   | <b>Average Annual (excl. Transition) (Constant Price)</b> | <b>Total Benefit (Present Value)</b> |
|----------------------|--|---|---|--------------------------------------|
| <b>Low</b>           | 0  | - | <b>46</b>   | <b>395</b>                           |
| <b>High</b>          | 0  |   | <b>78</b>   | <b>672</b>                           |
| <b>Best Estimate</b> | 0  |   | <b>62</b>   | <b>536</b>                           |

### Description and scale of key monetised benefits by 'main affected groups'

Farm Businesses: Net operational cost savings from more efficient use of inputs, though there are increased operational costs from implementing some rules (PV net benefit of £324.6m).  
Environmental: the aggregated value of environmental benefits is £211m, in part some of these are passed on to water companies as improvements in water quality benefit them through savings in the cost of treating water for drinking (PV £7m). The environmental benefits include recreational use and amenity value of watercourses, as well as perception values (e.g. by taking pleasure in the knowledge that the water ecosystem is being protected). Some of the increased recreational benefit would lead to increased sales for the leisure industry, but these benefits have not been estimated separately.

### Other key non-monetised benefits by 'main affected groups'

The environmental benefits of rules 6 and 7 have not been quantified due to a lack of available data. The basic rules as a whole are likely to lead to unquantifiable improvements in biodiversity on land, in addition to the benefits in the water system included above.

### Key assumptions/sensitivities/risks

**Discount rate (%)**

3.5

Uptake: Central assumption of 80% uptake for basic rules involving a net cost to farmers, high scenario assumption is 90% uptake of rules that benefit farm income. Analysis includes scenarios of different levels of uptake. These assumptions were tested at consultation. Methodology: The modelling approach is based on average farms from each English agricultural sector to estimate net impacts of measures on farm income and the environment. Analysis includes ranges of costs and benefits to reflect uncertainty.

## BUSINESS ASSESSMENT (Final Option)

|  |                       |                  |                          |                             |
|--|-----------------------|------------------|--------------------------|-----------------------------|
| <b>Direct impact on business (Equivalent Annual) £m:</b> |                       |                  | <b>In scope of OITO?</b> | <b>Measure qualifies as</b> |
| <b>Costs:</b> 10.3                                       | <b>Benefits:</b> 35.2 | <b>Net:</b> 24.9 | No                       | NA                          |

# Evidence Base

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# 1. Introduction

## 1a. Policy Background - Diffuse Water Pollution from Agriculture

Inevitably farming has some negative impacts on the water environment through losses of chemical fertiliser, animal manure, soil and agro-chemicals into the environment. The majority of land in England is used for farming, so pollution from agriculture is a widespread problem across the country. Current levels of pollution are higher than they need to be because not all farmers are aware of or carry out basic good practice. This impact assessment considers a small set of actions that farmers can carry out to prevent or to help mitigate the negative impacts. In many cases these actions have a positive impact on the farm business as well as the environment.

Many farmers already take steps on a voluntary basis to safeguard the water environment and keep their soils and nutrients as far as possible on the fields. However, for a variety of reasons others do not. It is now appropriate to engage those farmers who simply have not responded to the voluntary approaches employed to date.

This impact assessment considers a proposal to introduce a set of basic rules to prevent and reduce diffuse water pollution from agriculture in a way that minimises costs to the farming sector and delivers appreciable economic and environmental benefits.

Subject to the outcome of this IA, any regulation would be laid in early 2017 with commencement later in 2017. Although the rules would apply from commencement there would be an advice led approach to implementation, allowing businesses time to familiarise themselves with the requirements and adapt their farming practices.

## 1b. Policy driver - The Water Framework Directive

The Water Framework Directive (WFD) established an integrated process for managing pressures on the water environment in order to safeguard our water resources. Its six-yearly cycle of River Basin Management Plans sets out the measures required to improve water quality. These proposed new basic rules for farmers provide the detail on how some of these measures would be delivered in practice.

Article 11 of the WFD specifies that Member States should establish a programme of measures for each River Basin District within its territory (comprising basic measures and where necessary supplementary measures) to meet the environmental objectives of the Directive. Supplementary measures can include voluntary approaches and incentives; the combined impact of basic and supplementary measures should deliver 'good status' for all water bodies unless it is technically infeasible, disproportionately expensive or where natural conditions prevail. Failure to

comply with WFD requirements and to have basic measures as required by article 11.3 would risk infraction proceedings against the UK.

The Commission considers that we currently do not have measures in place that are sufficient in scope to fully transpose the WFD requirements in relation to agricultural diffuse pollution in England. The basic rules will help to meet these objectives of the WFD.

Following consultation a final option is now proposed, which is exempt from One-In-Three-Out requirements as it is required to complete transposition and implementation of the Water Framework Directive without gold-plating

### **1c. What is the Problem?**

Diffuse water pollution from agriculture arises from multiple small scale pollution losses from farms across the country. Cumulatively it results in a deterioration in water quality and places costs on all water users including water companies, tourism and our shellfish industry. The Water Framework Directive requires us to meet 'good status' for all our water bodies which provides a framework for addressing this issue.

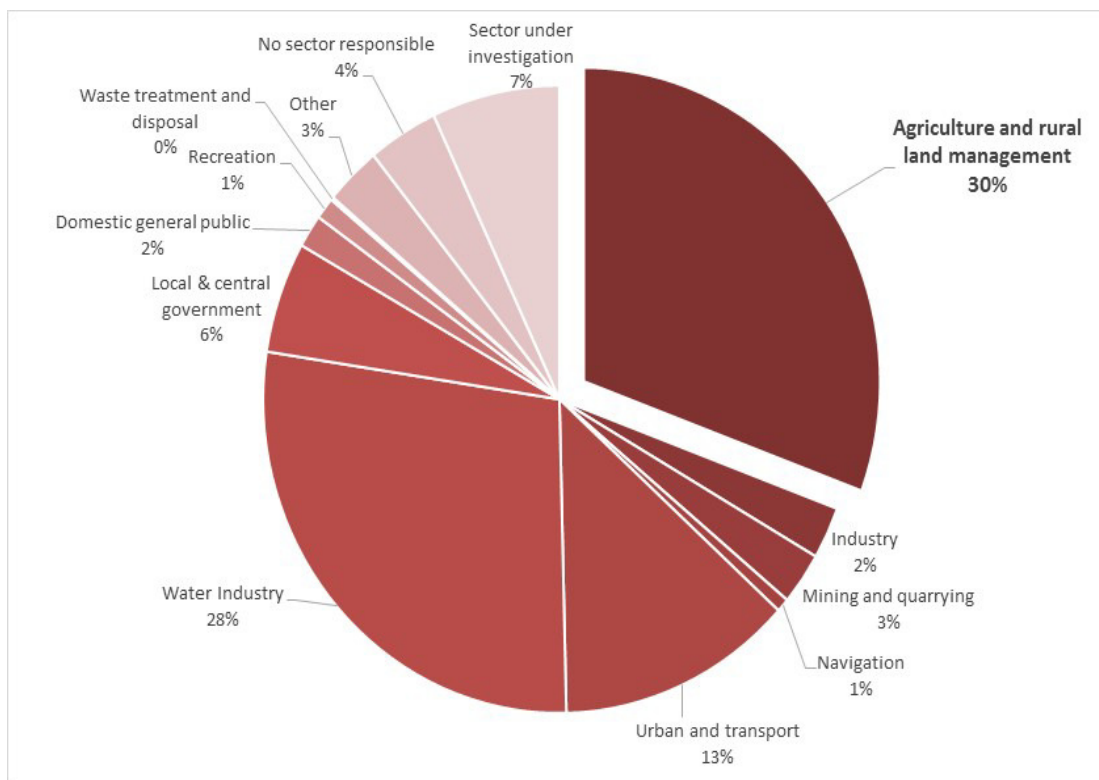
In England, 17% of our 4,950 individual water bodies (917 water bodies) are currently at good or better overall WFD status<sup>2</sup>. The agriculture and rural land management sector is responsible for 30% of those water bodies failing to meet their WFD objectives<sup>3</sup>.

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<sup>2</sup> National RBMP Evidence and Data Report - December 2015, Table 30. This figure covers all surface waters (rivers, canals, surface water transfers, lakes, estuaries and coastal waters) and ground waters, and is based on Cycle 2 water bodies and the New Building Block classification (note: % of water bodies at good or better overall status reflects the one-out-all-out approach to classification). These changes reflect: improvements to biological classification methods; improvements to environmental standards; refreshed designations of heavily modified water bodies; and adjustments to the number and shape of water bodies.

<sup>3</sup> National RBMP Evidence and Data Report - December 2015, Table 32. WFD Reasons for Not Achieving Good Status (RNAGs) data, August 2015 i.e. reasons for water bodies predicted to be not achieving WFD good status objectives in England in 2015 and only includes data where the level of certainty assigned to the sector and pressure is probable or confirmed. Individual water bodies can have more than one reason for failure.

**Figure 1: Sectors preventing waters reaching WFD good status in England**  
 (note that these are counts of reasons for not achieving good status within water bodies not the number of individual waterbodies)



## Phosphorus

Phosphorus is a key nutrient, present in organic (animal wastes) and inorganic (manufactured) fertilisers. It typically enters the water environment as a pollutant when applied on land in quantities exceeding plant uptake. The most recent national source apportionment estimates indicate that agriculture contributes around 25%<sup>4</sup> of the total phosphorus load to waters in England.

Phosphorus pollution can result in eutrophication (excessive plant growth due to the addition of large quantities of nutrients, mainly phosphorus in freshwater), killing aquatic organisms, affecting drinking water supplies, clogging waterways and disrupting flood defences, e.g. by plants blocking culverts and flood defence pump inlets. There would be significant potential benefits from avoiding such damages from agricultural losses of phosphorus for which Defra analysis estimates costs of £16-134m each year to the natural environment<sup>5</sup>. We have not used these figures to conduct our analysis, these are simply used to provide an estimate of the costs accruing from water pollution. The Environment Agency estimates that English

<sup>4</sup> Update to River Basin Management Plans, supporting information. Pressure Narrative. Phosphorus and freshwater eutrophication Environment Agency October 2014.

<sup>5</sup> Defra analysis of environmental benefits from improved water quality – see Annex B for more details.



farmers are losing 2,300 tonnes of phosphorus (at a value of £0.06 per kg<sup>2</sup>) every year that would otherwise help sustain farming. These estimates are not counted as benefits for the purpose of this IA.

### ***Other pollutants***

Nitrogen, pesticides, sediment and faecal bacterial are pollutants that can also impact on the water environment. These rules will contribute towards reducing the amount and impact of these pollutants and complement the existing regulations to cover them whilst extending coverage to the whole country. Such benefits were not estimated in monetary terms.

### ***Future pressures***

The agricultural industry is under ever increasing pressure to increase food production to meet the needs of a growing global population. At the same time we are increasingly feeling the impacts of climate change giving us hotter, drier summers and milder, wetter winters with more extreme weather events such as storms, flooding and droughts. These will increase the risk of soil erosion, water pollution and damage to farm infrastructure, stock and crops<sup>6</sup>. There will be less water available for crops and livestock at critical times, and with less water for dilution pollution levels can be expected to rise. If not managed carefully these changes have the potential for significant negative impacts upon the natural environment and the farming sector. Whilst it is hard to predict future conditions it is expected that such changes will be seen within the next decades<sup>7</sup> and therefore more sustainable agricultural practices are required.

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<sup>6</sup> See The Climate Change Risk Assessment Summary: Agriculture for more details, available here: <http://randd.defra.gov.uk/Default.aspx?Module=More&Location=None&ProjectID=15747>

<sup>7</sup> Agriculture and Climate change House of Commons Information Note 2012 <http://researchbriefings.files.parliament.uk/documents/SN03763/SN03763.pdf>

## 2. Policy Objective

**Our aim is to establish a basic standard of mandatory good practice through the introduction of new basic rules that meet the requirements of the Water Framework Directive without gold-plating.** These good practice rules will provide a foundation for water companies, NGOs, voluntary actions and government incentives to build upon to contribute to better farming practices and deliver further reductions in agricultural pollution. Our aim is to reduce diffuse water pollution from agriculture, in a way that minimises costs to the farming sector. These ambitions are reflected in the following objectives:

### 2a. A Healthy Water Environment

Our policy objectives under the Water Framework Directive are to:

1. avoid deterioration in our water bodies;
2. focus action on our protected areas (such as bathing waters, shellfish waters<sup>8</sup>, Drinking Water Protected Areas and Natura 2000 areas); and to
3. aim for good status.

These proposals should establish basic on-farm actions to deliver the first objective, avoiding deterioration of our watercourses over the current river basin management planning cycle (2015-21). In doing so, they should also facilitate progress towards achieving the protected area and 'good status' objectives under the Water Framework Directive. These outcomes should deliver significant cost savings from avoiding diffuse pollution to tourism, bathing beaches and the shellfish industry.

### 2b. A World Leading Food and Farming Industry

These policy proposals will support a world leading food and farming industry. This means an industry that increases its productivity and competitiveness, exploits market opportunities at home and abroad and enhances its long-term resilience. Specifically, the policy proposals aim to increase the resource efficiency of farm businesses securing savings for farmers by avoiding nutrients losses. They will also aim to increase farm business resilience, including future challenges such as climate change, and boost its reputation at home and abroad. Government will do so in a way that keeps regulatory burdens on business to a minimum. Section 5 examines the net benefits of these proposals to the farming industry.

### 2c. Wider Environmental Objectives

Within the scope of objectives 2a and b, our final policy proposals seek to deliver multiple environmental benefits, including tackling biodiversity loss, soil loss and flooding. For example, reductions in water pollution help improve aquatic habitats (including water dependent Sites of Special Scientific Interest, Special Areas of

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<sup>8</sup> Also an objective under the Marine Strategy Framework Directive

Conservation, Special Protection Areas and Natura 2000 sites). Minimising soil losses to watercourses reduces the need to clear channels, improves water quality and reduces the need or cost of water treatment.

## **2d. Provide Proportionate Enforcement Tools**

The proposed new rules would be enforced through a proportionate and advice led approach in line with the Environment Agency's Enforcement and Sanctions Policy<sup>9</sup>. Any checks against the basic rules would be included within the Environment Agency's existing risk based, targeted farm inspections, and within catchment investigations and pollution incident investigations.

In line with government policy the Environment Agency would make best use of the data and technology available to them to build upon and refine their risk based targeting, focusing on catchments where agricultural pollution is having a detrimental environmental impact. We will work with stakeholders to complement the work of the Environment Agency to provide advice to farmers on what they need to do to comply. This advice led approach is similar to the successful implementation in Scotland of their General Binding Rules (equivalent basic measures for agriculture)<sup>10</sup>.

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<sup>9</sup> See <https://www.gov.uk/government/publications/environment-agency-enforcement-and-sanctions-statement>

<sup>10</sup> [http://www.sruc.ac.uk/homepage/680/know\\_the\\_rules](http://www.sruc.ac.uk/homepage/680/know_the_rules)

### 3. Rationale for Intervention

This section sets out the case for Government intervention due to the occurrence of market failure through negative externalities and imperfect information. It also notes the wider benefits for agriculture and the environment.

#### 3a. Negative Externalities

Chemical fertilisers, animal manure and agro-chemicals used in the farming sector contain phosphates, ammonia, nitrates and faecal indicator organisms (FIOs). These substances may seep into and pollute water bodies where they can have a damaging effect on aquatic flora and fauna, which are valued in their own right by the general public. Additionally, such pollution imposes an appreciable cost on other industries and members of the public that make use of the water. The value of the damage caused by agricultural water pollution has been estimated in a Defra research project (WT0706)<sup>11</sup> to be between £750m and £1,300m a year. Phosphorus accounts for 15.7% of the total damage, i.e. £118m to £205m. Table 1 shows the breakdown of the total annual damage costs according to the type of impact involved. The figures below are indicative estimates of the spillover costs accruing from agriculture but are not included in the cost benefit analysis.

**Table 1: Spillover Costs from Agricultural Water Pollution**

| <b>Spillover effect of agricultural water pollution</b> | <b>Annual cost to third parties (£m, 2014 prices)</b> |
|---|---|
| Drinking water quality (surface and groundwater)        | 16-86   |
| Lost recreational value due to worse water quality      | 18-46   |
| Poorer fishing  | 18-45   |
| Freshwater eutrophication                               | 203-399   |
| Marine eutrophication                                   | Not available   |
| Bathing water quality                                   | 30-54   |
| River ecosystems and natural habitat impacts            | 447-626   |
| Wetland ecosystems and natural habitat impacts          | 16-51   |
| Total   | 748-1307  |

These spillover effects or negative externalities are not accounted for by farmers. In some cases farmers may not be aware of the damage caused by their farming practices. These spillover effects constitute market failure and can be corrected to some degree through government intervention. By requiring farmers to use the

<sup>11</sup> The report is available here - <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=13653&FromSearch=Y&Publisher=1&SearchText=wt0706&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

proposed rules to reduce water pollution from agriculture the government can ensure benefits for business, the water-using public and those who value the environment.

In many other situations, requiring polluters to reduce the costs they impose on others can only be done by imposing some costs on the polluters, meaning there is a trade-off to be made. However in this case, the proposed rules have been designed both to reduce the damage costs and at the same time on average to benefit the polluting farms. The rules are expected to involve some capital costs for farm businesses but these will be outweighed by operational cost savings. This means that while reducing the diffuse pollution produced by the farming sector the farms can simultaneously benefit from increased efficiency and generate savings.

### **3b. Imperfect information**

The potential benefits to farmers from adopting the practices specified under the proposed rules include:

- More efficient use of the nutrients in animal manures and artificial fertiliser, reducing costs and/or improving crop and grass yields
- Increased business resilience to future challenges such as climate change by reducing soil erosion risk
- Increased long term crop yield by maintaining long term soil productivity
- Improved reputation both locally and wider marketing benefits

Many farmers do in fact already follow the practices set out in the proposed rules. However some farmers may not be implementing income beneficial practices for several reasons:

They may not be aware of these farming practices or their potential to benefit the business. They may be unable to estimate the potential benefits of implementing such rules. Information on the benefits of the proposed rules is difficult to anticipate with a high degree of confidence because farm income is highly variable due to the weather and market prices, so it is difficult to obtain clear information on the comparatively small benefits of practices on the bottom line.

Many farmers are the sole worker in the business, meaning that their time is dominated by day-to-day operations and that they have little time to consider changes to the farm business in a strategic way. Government intervention with the help of existing farm advisors has the potential to help address this issue.

The factors set out above are not in themselves a sufficient rationale for Government regulation but they build a case for the provision of additional information to farmers. This is envisaged in the proposed policy. However, the presence of environmental externalities establishes the rationale for government to intervene through regulation to increase uptake of farm practices which are environmentally beneficial and are expected to deliver improved business performance for the farmers themselves.

## 4. Description of Options Considered

### 4a. Consequences of doing nothing and options considered

Before describing the final proposed option it is important to understand the consequences of the baseline, if we were to do nothing more, i.e. not introduce any basic rules, and to set out why the other options considered prior to consultation were rejected.

If we were to do nothing more (Option 1) we would not be fulfilling the WFD requirement to have basic measures as required by article 11.3. It would also put at risk our prospect of meeting WFD objectives for 'good status' water bodies by 2021 as we would not sufficiently address diffuse water pollution from agriculture. We might also be accused of acting unjustly as other sources of pollution such as water companies have had to invest to improve water quality whereas farmers would not be changing their practices.

The pre-consultation impact assessment considered a range of options for tackling diffuse water pollution from agriculture some of which were rejected. This was primarily because they would not meet certain WFD requirements. Details of those options and why they were rejected are set out below:

Options 2 and 3 (the two consultation options) were a set of 7 and 11 proposed new basic rules, with option 2 being cost beneficial to the agricultural industry as a whole and option 3 providing greater benefits to the water environment. Following consultation the proposed rules were adapted into a final proposed set of rules which mostly closely match option 2 in terms of costs and benefits. The final proposed option is a proportionate, risk based approach to tackling diffuse pollution in a way that minimises burdens to farmers.

In terms of options that were rejected prior to consultation, options 4 and 6 were an improved voluntary approach and farm assurance schemes; these were considered to be non-binding or voluntary actions. Basic measures are required to prevent or control the input of pollutants, such as prior authorisation or general binding rules. The non-binding or voluntary actions considered in these options would not satisfy the Commission's concerns that there are insufficient basic measures in place.

Option 5 considered applying maximum regulatory measures to cover all agricultural pollutants everywhere. This would meet the requirements of the directive, however it would place significant impacts on the industry whilst delivering the maximum benefit to the environment. However, the extra benefit is considered disproportionate to the large costs imposed on the industry.

Option 7 considered incentives to drive action, this option was rejected on the basis that it would not be fair, appropriate or affordable to incentivise basic good practice to meet WFD requirements, given the high levels of existing voluntary uptake of these actions. In addition this would be contrary to the polluter pays principle which underpins EU and UK legislation. This principle means that the party responsible for

producing the pollution should be responsible for paying for the damage done to the natural environment.

Option 8 considered targeted regulation, the extent of diffuse pollution varies across the country due to differing farming practices, soils and rainfall amongst other variables. However since the WFD requires us to 'prevent or control the input of pollutants' it would not be appropriate to target regulations aimed only to reduce pollution in certain areas.

Option 9 considered introducing general binding rules as part of the cross compliance regime. However, this would firstly not allow for full coverage as not all farmers claim the Basic Payment Scheme and the Commission would be likely to consider that there were still gaps in our compliance. Secondly, cross compliance is not a binding measure as take up of the scheme is voluntary and therefore would not constitute a basic measure in this context.

Having rejected the options that would not meet Water Framework Directive requirements we consulted on two options, a package of 7 (option 2) or 11 (option 3) proposed basic rules for all farmers. Feedback from the consultation provided overall support for the approach but challenged some of the rules that some consultees thought too complex or costly for certain farms or farming sectors. The final proposed option is described below and section 4c, stakeholder support, explains how the final rules have been shaped by the responses to the consultation.

#### **4b. The Final Proposed Option**

We are proposing a final option that consists of 8 basic rules for farmers focusing on nutrient and soil management. This has been amended from the pre-consultation IA by dropping 2 rules from our consultation option 2 (feed planning and accurate spreading). For those rules concerns were expressed that, whilst shown to be cost beneficial in our analysis, they might not be practical for regulatory control in the short term. This was due to the complexity (in the case of feed planning) which might require training or advisor time to bring farmers into compliance. These have been replaced by one rule from our alternative, option 3 (avoiding spreading at high risk times and in high risk places). This received significant support and now aligns the rules more closely with existing requirements, in line with stakeholder feedback.

Overall we have, as far as possible, retained those rules which are cost beneficial to farmers and dropped those with considerable costs attached. This has meant that the environmental benefits are not as significant as option 3 but by setting an achievable baseline of good practice we can expect others to contribute further funds to incentivise additional actions to reduce diffuse water pollution from agriculture. However, the final option is still estimated to achieve a 4.6% reduction in phosphorus originating from agricultural diffuse pollution as opposed to 2.4% under option 2.

Note the final number of proposed new rules (8) is due to the rules being regrouped to improve clarity.

Our final proposed option comprises the following two categories of rules:

### **1. Inorganic and organic fertiliser planning, storage and application**

These rules support careful planning, storage and application of organic and inorganic fertilisers to maximise crop uptake and minimise unwanted losses to air and water. These fertiliser rules are the least cost solution and should contribute to a 4.5 percent reduction in P losses.

### **2. Soil management**

These rules target agricultural practices and livestock management to ensure that erosion and poaching<sup>12</sup> is minimised to safeguard soils on fields and prevent soil erosion and run off to watercourses. Two of the three measures in soil management could not be modelled so the estimated reductions are likely to be understated.

These rules would apply to all farms in England although only to the extent that they are relevant to the activities carried out on a particular farm. So for example organic fertiliser planning might not be relevant on a farm that does not produce or import such material. The final set of proposed rules are set out in table 2, below.

**Note:** All farms in Nitrate Vulnerable Zones (NVZs cover 58% of England) will already be required to carry out these actions on manures and fertilisers (rules 1 – 5) (see table 2, below), as will farmers entering agri-environment schemes (30 – 40% of farm holdings). Rules 4 - 7 are required as scheme entry requirements for the Basic Payment scheme (cross compliance) (approx. 95% of farm holdings).

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<sup>12</sup> Poaching is the trampling of soil by livestock causing compaction and soil erosion.



**Table 2. Preferred option – final proposed set of rules**

Note – the proposed rules defined here describe the intention but the final wording may be adjusted to align with related legislation.

| Issue   | Proposed Rule   |
|---|---|
| <b>Organic manures and manufactured fertiliser planning, storage and application, storage</b> | <p>1. A person who has custody or control of agricultural land must ensure that when organic manures and manufactured fertilisers are applied to that land that all reasonable precautions are taken to prevent causing environmental pollution from significant soil erosion or runoff. That person must also ensure that:</p> <p>a) application of organic manures and manufactured fertilisers must be planned in advance to meet and not exceed soil and crop needs, and</p> <p>b) soil testing must be carried out for Phosphorus, Potassium, Magnesium and pH, and Nitrogen levels assessed, at least every 5 years, for cultivated land.</p> |
|   | <p>2. Organic manures must not be stored on land:</p> <p>a) within 10 metres of inland freshwaters or coastal waters,</p> <p>b) where there is significant risk of runoff* entering inland freshwaters or coastal waters</p> <p>c) within 50 metres of a spring, well or borehole</p>   |
|   | <p>3. A person must not apply organic manures or manufactured fertilisers:</p> <p>a) if the soil is water logged, flooded, or snow covered</p> <p>b) if the soil has been frozen for more than 12 hours in the previous 24 hours</p> <p>c) if there is significant risk of causing pollution from soil erosion and run-off</p>  |
|   | <p>4. A person must not apply organic manures:</p> <p>a) within 10 metres of - inland freshwaters or coastal waters<sup>13</sup></p> <p>b) within 50 metres of a spring, well or borehole.</p>  |
|   | <p>5. A person must not apply manufactured fertiliser within 2 metres of inland freshwaters or coastal waters.</p>  |
| <b>Soil management</b>  | <p>6. A person who has custody or control of agricultural land must take all reasonable precautions to prevent significant soil erosion and or muddy runoff that could enter inland freshwaters</p>   |

<sup>13</sup> a. except if precision equipment is used, then organic manure must not be applied closer than 6 metres from inland freshwaters or coastal waters (precision equipment means a trailing hose band spreader or a trailing shoe band spreader, or a shallow injector which injects the organic manure no deeper than 10 centimetres below the surface, or a dribble bar applicator, or other equipment designed to apply organic manures or manufactured fertilisers in an accurate manner.)

b. except livestock manure which can be applied within 10 metres of inland freshwaters or coastal waters if the agricultural land is managed for breeding wader birds or as a species-rich semi-natural grassland under certain restrictions. These are:

- i. the agricultural land must be in an agri-environment scheme, or notified as a Site of Special Scientific Interest (SSSI)
- ii. the manure is not applied directly onto surface water, and
- iii. the total annual amount applied is not more than 12.5 tonnes per hectare.

|  |  |
|--|--|
|  | <p>or coastal waters especially from:</p> <p>a) seedbeds, tramlines, rows, beds, stubbles (including harvested land with haulm), polytunnels and irrigation</p> <p>b) poaching by livestock</p>  |
|  | <p>7. Any land within 5 metres of inland freshwaters or coastal waters must be protected from significant soil erosion (including bankside erosion) or significant runoff by preventing poaching by livestock.</p>   |
|  | <p>8. Livestock feeders must not be positioned:</p> <p>a) within 10 metres of inland freshwaters or coastal waters,</p> <p>b) where there is significant risk of runoff* from poaching around the feeder entering any inland freshwaters or coastal waters</p> |

\*In assessing whether there is “significant risk of runoff” a person must take into account: the slope of the agricultural land, especially if the slope is greater than 12 degrees; any ground cover; the proximity to inland fresh waters and coastal waters, proximity to wetlands; the weather conditions [and weather forecasts]; the soil type and condition; and the presence and condition of agricultural land drains.

#### 4c. Stakeholder Support

We consulted between October and November 2015 on a list of between 7 and 11 proposed rules for farmers. In total 183 responses were received, the main groups were as follows:

- Agricultural interest: 47
- Environmental organisations 40
- Fisheries interest 22
- Water and sewerage industry 11
- Local authorities 10
- Academics/researchers 10

Overall, there was a positive response to introducing a small set of new basic rules for farmers. Whilst consultees did not necessarily support all the individual measures proposed, about 76% thought that at least half the rules should become mandatory. We therefore dropped some of the proposed rules that responses to the consultation felt might impose significant costs on farmers.

There was little dispute that agriculture did have an impact upon the water environment placing costs on third parties, or that the proposed rules represented basic good practice already carried out by many farmers. However opinions were divided on how we go about reducing this impact and increasing the uptake of good practice actions.

Industry organisations generally felt that advice and incentives were more effective whereas environmental organisations felt that this approach had been tried and tougher rules and regulations were needed.

There was widespread support for clear simple communications to accompany roll out so that farmers understood clearly what was expected. Environmental organisations felt that this should be backed up by tough sanctions for persistent offenders.

Of the small number of farmers who replied to the consultation, more than two-thirds agreed with the introduction of at least 50% of the rules.

The key issues raised by consultees that have been addressed in the final proposed option include:

- Taking account of the intensity and location of farmers – relevant rules have been amended to reduce the impact on small famers. The EA will monitor compliance through its risk based targeting framework and adopt a proportionate enforcement response taking into account mitigating factors where appropriate.
- Aligning the rules with existing ones and provide more clarity – we have aligned the rules to the scheme entry requirements for the Basic Payment Scheme (cross compliance) and clarified meanings.
- Consider paperwork burdens – have worked with EA to ensure that inspections are visual and as advice based as possible, with minimised focus on paperwork.
- Advice led approach must be agreed with industry and align with existing advice for clarity and consistency – initial stakeholder meeting held seeking input on advice led roll out. We will continue to engage with industry to improve understanding of the basic rules, what to expect during inspections and where advice on compliance can be found.
- Impact on dairy and livestock farmers – we will take a proportionate and risk based approach to compliance, working with industry to make improvements and help them achieve compliance. The measures are mainly outcome focussed and less prescriptive about how compliance can be met. This should give farmers choices on the actions they take to achieve compliance.

The change in rules from the pre-consultation option 2 to the final proposed option and the impact on our analysis is highlighted in table 3. The final option is estimated to achieve (for all 8 rules) a 4.6% reduction in phosphorus originating from agricultural diffuse pollution as opposed to 2.4% under option 2.

There remain wider environmental benefits (£211m) from the basic rules but these are not as great as the original proposal as some measures that benefited air quality have been dropped. If these benefits were excluded the proposal would still be justified.

For some farmers who have insufficient slurry storage or who chose not to manage slurry in other ways such as tankering off farm, there will remain some capital costs associated with slurry storage (£54.2m). This would mainly impact upon dairy and livestock farmers. These capital costs have been included in the analysis as private

costs to farmers. For the purposes of the impact assessment we have assumed that farmers will choose to upgrade storage where necessary to comply with the restrictions on spreading at high risk times. However some farmers may choose alternatives (such as tankering off farm) which will have a much lower capital impact.

Table 3 sets out for each rule the level of support from the consultation, the rationale for keeping or dropping it and the impact on the final analysis.

**Table 3. Consultation feedback informing changes to the rules and impact on the analysis**

Note that the impact of the proposed final option, in terms of the number of farm businesses affected, compared with the do nothing more baseline is shown in table 5.

| Proposed Rule at consultation stage                                   | Consultation response<br>% support as a new rule  | Whether in final option | Rationale for changes to the rules   | Pre-consultation option | Difference from pre-consultation Option 2 (preferred) analysis   |
|---|---|-------------------------|--|-------------------------|--|
| Take action to prevent soil erosion and run-off.                      | <b>129 (81%)</b><br>Widely supported by consultees.   | ✓ <b>included</b>       | Risk factors revised to include polytunnels  | 2                       | No change.   |
| Field manure storage at least 10m from a watercourse.                 | <b>127 (80%)</b><br>Strongly supported with many suggesting greater separation from boreholes and springs | ✓ <b>included</b>       | Revised to include separation distances from key water features such as boreholes and springs.   | 2                       | No change.   |
| Spread fertilisers accurately, e.g. calibrate and maintain machinery. | <b>125 (78%)</b><br>Concern about high costs to some farmers although many are voluntarily improving.     | <b>X excluded</b>       | Given the potential high costs if this rule became mandatory but recognising that voluntary calibration and testing of spreaders is now increasing, will be promoted as good | 2                       | Annual costs of calibration not incurred but significant benefits for cereals, horticulture and general cropping not realised so reduces overall net operational cost savings. |

|   |   |   |  |  |   |   |   |
|---|---|---|--|--|---|---|---|
|   |   |   |  |  | practice rather than a new rule.  |   |   |
| Avoid severe poaching where likely to pollute a watercourse.                                | <b>125 (78%)</b><br>This proposed rule was widely supported   | <b>✓ included</b>   |  |  | Widely supported, rule clarified to apply within 5m of a watercourse  | 2 | No change.  |
| Do not spread manufactured fertiliser or manures at high risk times or in high risk places. | <b>124 (78%)</b><br>Widely supported but concern that needs clear definitions and guidance.                                 | <b>✓ included</b><br><b>Split into 3 rules to provide clarity</b> |  |  | Revised rule more clearly defines a range of risk factors that are not suitable for fertiliser or manure application.   | 3 | Increases capital costs but delivers increased operational cost benefits. |
| Livestock feeder positioning.   | <b>118 (74%)</b><br>Many consultees supported this rule noting small costs in relocating feeders.                           | <b>✓ included</b>   |  |  | Rule retained and grouped into the soils rule as its primary outcome is to reduce soil erosion  | 2 | No change.  |
| Spreading limits for slurry and manure between 15 October and February                      | <b>109 (68%)</b><br>Reasonable support for the rule but concern about inflexibility of specific dates for spreading limits. | <b>X excluded</b>   |  |  | Rule not adopted. Revised version focuses on high risk times and places putting the onus on farmers to determine these as a component of whole farm planning. | 3 | Not preferred option in previous analysis so no change.                   |

|   |  |                          |  |          |  |
|---|--|--------------------------|--|----------|--|
| <p>Use a fertiliser recommendation system</p>       | <p><b>105 (66%)</b><br/>Good support for this rule although many farmers already adopt this good practice and less relevant for grassland and low intensity livestock farms.</p> | <p><b>✓ included</b></p> | <p>Rule amended to make more outcome focused and less prescriptive. Rather than a recommendation system the revised rule requires soil nutrient testing.</p> | <p>2</p> | <p>No change.</p>  |
| <p>Exclude livestock from watercourses</p>          | <p><b>101 (64%)</b><br/>Concern about cost of fencing, providing alternative water and loss of bank grazing vs strong advocates given environmental benefits.</p>                | <p><b>X excluded</b></p> | <p>This rule has been dropped in favour of good practice. The risk of poaching is tackled through a separate rule.</p>                                       | <p>3</p> | <p>Not preferred option in previous analysis so no change.</p> |
| <p>Incorporate manures, within 24h of spreading</p> | <p><b>91 (57%)</b><br/>Many consultees were concerned that it would not always be practical to incorporate within 24 hours and it might be difficult to monitor compliance.</p>  | <p><b>X excluded</b></p> | <p>Rule has been dropped in favour of promoting this as good practice instead.</p>   | <p>3</p> | <p>Not preferred option in previous analysis so no change.</p> |

|                            |   |  |   |          |   |
|----------------------------|---|--|---|----------|---|
| Use a feed planning system | <p><b>79 (50%)</b></p> <p>Considered by many to be too complex or costly for many farmers</p> | <p><b>X</b></p> <p><b>excluded</b></p> | <p>Rule has been dropped in favour of promoting this as good practice instead. Avoids potential additional paperwork.</p> | <p>2</p> | <p>Reduces capital costs for livestock farmers (not grazing). However net operational cost benefits not realised.</p> |
|----------------------------|---|--|---|----------|---|



#### 4d. Slurry Storage

Proposed rule 3 sets out details of when farmers may not apply manures or manufactured fertilisers (e.g. when ground is frozen, snow covered or water logged) to prevent diffuse pollution. Many farmers including those in NVZs will already have made provision for storing or tankering slurry off farm during these periods. However, some farmers may need to improve their arrangements for managing, storing or transporting their slurry and manures throughout the year. For most, this will mean having sufficient storage capacity for their slurry and manure to support their business operation, making best use of the nutrients available and not spreading fertilisers and manures during inappropriate conditions.

At present the Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010 (or SSAFO regulations) require all farmers who upgrade their slurry storage facilities or have built new storage to ensure that they have at least 4 months' capacity, and that stores meet construction standards. The capacity of older stores built before 1991 may count toward the storage capacity of the holding, if they remain fit for purpose. The Environment Agency can require stores in poor condition to be upgraded or replaced. Those who have not upgraded their facilities since 1991 do not have to comply with these rules unless served with a notice to do so by the Environment Agency. In Nitrate Vulnerable Zones (58% of land) farmers are required by the Nitrate Pollution Prevention Regulations 2015 to have at least 5 months' slurry storage capacity for cattle and 6 months storage capacity for pigs slurry.

The joint industry and government Slurry Working Group concluded in 2012/13 that 5 months' storage was required to follow good practice guidelines and avoid spreading during inappropriate conditions. Amendments to the SSAFO regulations to align with this recommendation are currently under consideration.

For the purpose of this IA we have assumed that for those farmers wishing to store their slurry at least 5 months' storage would be required to be able to comply with the final option of proposed basic rules. These costs are included in the capital cost estimates for the purpose of this analysis. We expect to work with the industry to help farmers achieve compliance and improve resilience to wetter and more extreme weather patterns.

## 5. Estimated Costs and Benefits of the Proposed Option

This section explains the analysis for estimating the net present value of the final preferred policy option. Table 4 summarises the key results.

**Table 4: Main results of analysis (present value over 10 years, rounded to the nearest £m)**

|  | <b>Present Value</b> |
|--|----------------------|
| Environmental Benefits <sup>14</sup>                           | +£211m               |
| Net Operational Cost Savings for Farm Businesses <sup>15</sup> | +£324m               |
| Capital Costs for Farm Businesses                              | -£54m                |
| Administration and familiarisation costs                       | -£40m                |
| Government cost of Enforcement                                 | -£1.2m               |
| <b>Net Present Value</b> (may not sum due to rounding)         | <b>+£440m</b>        |

### 5a. Methodology

The impacts of the proposed rules were analysed using a modelling framework called FARMSCOPER (FARM SCAle Optimisation of Pollutant Emissions Reduction). FARMSCOPER is a peer reviewed model that allows the user to estimate the impacts of environmentally beneficial farming practices on air and diffuse water pollution. The model amalgamates the results from multiple models<sup>16</sup> simultaneously allowing the user to assess the impact of changes on a number of pollutants such as phosphates nitrates, ammonia, Green House Gasses (GHGs) and FIOs. Using these models individually would not provide a holistic view of the impacts of the proposed rules on the environment as they tend to focus only on one or two pollutants. Additionally the model takes into account the interactive effects between farming practices themselves i.e. it allows the user to estimate the impact of a combination of changes on the environment when implemented together. The model also provides an estimate of the impact of changed practices on farm income by calculating the capital and net operational costs stemming from implementing them. These financial results use well-established standard values widely used in farm management analysis. The model works by representing the impacts on individual representative farms for each of the main farm types, and then scaling these impacts up to a national level. For this impact assessment, we used the model to simulate the changes in farming practice that farm management experts considered would be required for each farm type to comply with the proposed basic rules.

In order to use the model we first created a baseline by calibrating it to reflect the effects of existing regulation. The proposed rules were then layered on to the baseline to estimate the resultant incremental costs and benefits to both the farming industry and the environment. Annex B provides a detailed discussion of the analysis methodology used in this impact assessment. This includes a full description of the FARMSCOPER decision support tool and a discussion on the approach for valuing improvements in water quality.

<sup>14</sup> The environmental benefits comprise of the monetised values of benefits accruing from the reduction in a myriad of pollutants (including phosphorus) due to the implementation of the rules

<sup>15</sup> The net operational cost savings are savings accruing from the implementation of the proposed rules less extra operational costs caused. FARMSCOPER reports the net figures but it is not possible to identify the gross savings and gross costs separately.

<sup>16</sup> FARMSCOPER comprises of peer reviewed models such as PSYCHIC (Phosphorus and Sediment Yield Characterisation In Catchments) model, NEAP-N (The National Environment and Agricultural Pollution. Nitrate), NARSES and MANNER Models, (National Ammonia Reduction Strategy Evaluation System) , NT26AE model

## 5b. Uptake of Rules

This section explains the assumptions in the analysis pertaining to the baseline levels of uptake of mitigation methods and then discusses assumptions on final uptake of the methods after implementation of the proposed rules.

### ***Baseline of Uptake***

In our analysis we have simulated a baseline of full compliance with existing regulation such as the Nitrate Pollution Prevention Regulations or scheme entry requirements for the Basic Payment Scheme (Cross Compliance). This means that where a measure is already part of regulation in Nitrate Vulnerable Zones (as designated under the Nitrate Pollution Prevention Regulations), we have simulated 100% adoption of this measure in NVZ areas. Furthermore, farm businesses entering agri-environment schemes are required to follow good practice actions on fertiliser management as an entry requirement of their agreement. We have simulated full implementation of these rules on these farms.<sup>17</sup> Where there are no regulations or current uptake exceeds the regulatory requirements, we have used our evidence of current levels of uptake as our baseline for the main scenario.

In some cases, our evidence base suggests that current levels of uptake are less than the regulatory requirements (i.e. some farmers do not comply fully with existing regulation or agri-environment obligations). However, we have used a baseline of full compliance so that we can assess the incremental effects of an increase in regulation which is the subject of this impact assessment. This is a feature of the model used; it does not consider actions to improve compliance with existing regulation or include any such actions in the appraisal. The impacts of existing regulation have already been assessed in previous impact assessments<sup>18</sup> and therefore to prevent 'double counting' when assessing the overall burden of business on regulation we do not include the impacts of improving compliance with previous regulation.

### ***Adoption of rules under final preferred option***

We have analysed the impacts of adopting the proposed rules under the final option in a range of scenarios. The low and high scenarios assume 60% and 100% uptake of the proposed rules, and we use 80% uptake of the rules as our central scenario. Where practices to comply with the rules are cost-beneficial or cost-neutral for farmers we assume slightly higher uptake in the low and central-uptake scenarios. We assume 80% compliance in the central scenario because there are cases where sections of the farming industry do not comply with existing regulation. However, rates of compliance with future regulation are uncertain, and therefore we analyse the impacts of regulation at both 60% and 100% adoption rates to assess how this uncertainty affects the analysis of the options.

These assumptions recognise that farmers complying with NVZ and cross compliance rules will already meet most of the basic rules requirements in the do nothing more baseline. 58% of land is within NVZs so the minimum existing compliance rate for those rules which are similar to NVZ requirements would be 58% although some other farmers may also have adopted such practice voluntarily. So given this assumption of full compliance with existing regulations, the selected three scenarios of adoption rates are appropriate.

Although the consultation did not seek feedback specifically on the assumed compliance rates, it did draw comments on compliance with existing regulations. Consultees were concerned that compliance can be poor where there is a lack of enforcement, and that this puts farmers who do comply with rules at a competitive disadvantage. So a robust yet proportionate approach to enforcement would be needed for the proposed basic rules.

Table 5 shows the assumed rates of compliance across the three scenarios described above.

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<sup>17</sup> It is expected that the proportion of agricultural area covered by agri-environment schemes will fall to about 40% by 2020 – we have used this as the baseline for estimating the proportion of farms which are already covered by these regulations as part of their agri-environment agreement.

<sup>18</sup> See the impact assessment on nitrate vulnerable zones, which is available here:  
[https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/82417/20111220nitrates-directive-consult-ia.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/82417/20111220nitrates-directive-consult-ia.pdf)

**Table 5: Assumed adoption of rules in final option**

| Proposed new regulation   | Covered by existing legislation  | Uptake in Final Option (%)  |   |  | Number of farm businesses affected in central uptake scenario <sup>19</sup>                           |
|---|--|---|---|--|---|
|   |  | Low   | Central   | High   |   |
| <p><b>1. Organic Manures and Manufactured Fertilisers</b></p> <p>a) Application of organic manures and manufactured fertilisers must be planned in advance to meet soil and crop nutrient needs and does not exceed these levels</p> <p>b) Soil testing must be carried out for Phosphorus, Potassium, Magnesium and pH, and Nitrogen levels assessed, at least every 5 years, for cultivated land.</p> <p>2 Organic manures must not be stored on land:</p> <p>a) within 10 metres of inland freshwaters or coastal waters,</p> <p>b) where there is significant risk of runoff entering inland freshwaters or coastal waters</p> <p>c) within 50 metres of a spring, well or borehole used for drinking water or food production purposes</p> <p>3. Organic manures or manufactured fertilisers must not be applied:</p> <p>a) if the soil is water logged, flooded, or snow covered</p> <p>b) if the soil has been frozen for more 12 hours in the previous 24 hours</p> <p>c) if there is significant risk of causing environmental pollution from soil erosion and run-off</p> <p>4. Organic manures must not be applied:</p> <p>a) within 10 metres of any inland freshwaters or coastal waters, except, if precision equipment is used within 6 metres of inland freshwaters or coastal waters</p> <p>b) within 50 metres of a spring, well or borehole used for drinking water or food production purposes</p> <p>5. Manufactured fertiliser must not be applied within 2 metres of inland freshwaters or coastal waters</p> <p>6. Take all reasonable precautions to prevent significant soil erosion and runoff from:</p> <p>a) seedbeds, tramlines, rows, beds, stubbles (including harvested land with haulm), polytunnels and irrigation b) poaching by livestock</p> <p>7. Any land within 5 metres of an inland freshwaters and coastal waters must be protected from significant soil erosion by preventing poaching by livestock</p> <p>8. Livestock feeders must not be positioned:</p> <p>a) within 10 metres of any inland freshwaters or coastal waters,</p> <p>b) where there is significant risk of runoff from poaching around the feeder entering any inland freshwaters or coastal waters</p> | <p>NVZ (in part)</p> <p>NVZ</p> <p>NVZ</p> <p>Cross compliance</p> <p>Cross Compliance</p> <p>Cross Compliance</p> <p>Cross Compliance</p> | <p>75</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> <p>60</p> | <p>90</p> <p>90</p> <p>80</p> <p>80</p> <p>80</p> <p>80</p> <p>80</p> <p>80</p> <p>80</p> <p>80</p> <p>80</p> <p>80</p> <p>80</p> | <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> <p>100</p> | <p>14,400</p> <p>1,800</p> <p>27,000</p> <p>515</p> <p>2,250</p> <p>5000</p> <p>5000</p> <p>18000</p> |

<sup>19</sup> The numbers were derived through two steps. Step 1 involved assessing the numbers of farms each rule would apply to. Step 2 subtracted the number of farms that were already adhering to the rule which are those covered under cross compliance and NVZs, to arrive at the number of farms that will be impacted by the proposed rules..

## 5c. Costs

This section discusses the costs of implementing the final policy option. Three types of costs arise and are covered in turn: capital costs required for some farm businesses to comply with the proposed rules; costs of administration and familiarisation for all farm businesses; and costs to government. Any ongoing operational costs of implementing rules are considered in the net operational cost savings section in Section 5d, Benefits.

When estimating both the present value of costs and benefits of policy options, we have used a standard ten-year appraisal period and applied a 3.5% discount rate, in line with Green Book appraisal guidance.<sup>20</sup> The price base year used is 2014.

### ***Private Capital Costs to farm businesses***

The only rule that might require capital expenditure for some farmers who have insufficient slurry storage and who chose not to manage their slurry in other ways such as tankering off farm, is rule 3. This rule restricts the timing of application of manures and so some farmers might need to increase the capacity of their slurry storage. For the purpose of this analysis we estimated that 5 months' storage would be required. Table 6 shows the estimated capital costs of implementing the final policy option for different farm types. We cannot estimate exactly how many farms will be undertaking the costs as the model does not allow us to identify the number of farms under each farm type that will need to adopt each rule.

**Table 6: Required Capital Expenditure for Final Option (2014 prices, discounted over 10 years)**

| <b>Farm Type</b>                                  | <b>Capital Costs</b> |
|---|----------------------|
| Cereals   | Nil                  |
| Dairy   | £40.5m               |
| General Cropping                                  | Nil                  |
| Horticulture                                      | Nil                  |
| Indoor Pigs                                       | £1m                  |
| LFA Grazing Livestock                             | £2m                  |
| Lowland Grazing Livestock                         | £3.5m                |
| Mixed   | £6m                  |
| Outdoor Pigs                                      | Nil                  |
| Poultry   | Nil                  |
| <b>Total</b> (figures are rounded so may not sum) | £54m                 |

As shown above, the capital cost associated with the final option may be incurred by dairy and livestock farms. For those farmers with insufficient storage who choose not to manage their slurry in other ways such as tankering, this cost of constructing additional slurry storage capacity may arise to comply with Rule 3. This is already a requirement for farms in Nitrate Vulnerable Zones, a baseline requirement for agri-environment agreements and for all farms except those that are currently covered by the pre-1991 SSAFO exemption.

In order to reflect that many farmers will borrow in order to spread the costs of capital items, in this analysis we have estimated the repayments of the expected capital costs over ten years

<sup>20</sup> See here - [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/220541/green\\_book\\_complete.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf)

using an interest rate of 7%. This shows the annual impacts on farm businesses of required capital expenditure and has been used when calculating the net present value of the final option. Table 7 shows the estimated annual costs to farm businesses from repayments on required capital expenditure.

**Table 7: Annual Costs of repayments for required capital expenditure (2014 prices). Figures may not sum due to rounding.**

| Farm type                 | Annualised Capital Cost |
|---------------------------|-------------------------|
| Cereals                   | Nil                     |
| Dairy                     | £4.7m                   |
| General Cropping          | Nil                     |
| Horticulture              | Nil                     |
| Indoor Pigs               | £0.1m                   |
| LFA Grazing Livestock     | £0.2m                   |
| Lowland Grazing Livestock | £0.4m                   |
| Mixed                     | £0.7m                   |
| Outdoor Pigs              | Nil                     |
| Poultry                   | Nil                     |
| <b>Total</b>              | <b>£6.3 m</b>           |

To help understand the financial impact on businesses, we have compared the capital costs (including finance costs) against the expected savings in operational costs to calculate the average payback period. The results in table 8 show that for most farm types the capital cost is quickly recovered. The exception is dairy farms, where the payback period is 5.5 years. This more prolonged period of potential net negative impact on business cash flow is something that will be taken into account when helping dairy farmers come into compliance. The approach to compliance management will take into account evidence of a farmer's efforts to comply with the rules and where pollution risk has been minimised.

**Table 8: Estimated time taken to recover capital costs through operational cost savings**

| Farm type                 | Time period |
|---------------------------|-------------|
| Dairy                     | 5 ½ years   |
| Indoor Pigs               | 9 months    |
| LFA Grazing Livestock     | 4 months    |
| Lowland Grazing Livestock | 5 months    |
| Mixed                     | 11 months   |

### ***Familiarisation and Administration Costs to farm businesses***

As well as the cost of implementing the final set of rules, there will be business costs in familiarising and adjusting to the new requirements, managing farm implementation and dealing with the administrative burdens of compliance.

For the final option we have identified the following initial costs of familiarisation and administration:

- Time for reading the rules and any guidance and planning farm practices to comply
- Additional time spent planning on non-intensive livestock farms, as more rules (for example those on manures) apply to these farms

We also identified the following annual ongoing costs of implementation:

- Time spent monitoring compliance and implementing practices
- Time evaluating field nutrients and inherent risk of nutrient and soil losses to water to determine appropriate land use, choice of crop and timing of fertiliser applications

Table 9 shows the assumptions made in calculating time requirements for a typical farmer to carry out these activities. These are similar to the estimates made by Defra when appraising the impacts of changes to the NVZ rules<sup>21</sup>, but will be additional to the administrative burden imposed by those regulations on farms outside NVZs.

**Table 9: Estimated time requirements for a typical farmer (hours) under the final policy option**

| Task  | Initial  |          |                                   | Annual     |
|-------|----------|----------|-----------------------------------|------------|
|       | Guidance | Planning | Additional planning for livestock | Monitoring |
| Hours | 2        | 4        | 2                                 | 2          |

We have valued these time requirements using the Annual Survey of Hours and Earnings<sup>22</sup> for farm manager time, giving an hourly rate of £20 per hour (including non-wage costs of employment). The full costs of implementation for the final option are shown below in table 10. These estimates have been discounted at the social time preference rate of 3.5% and summed over the ten year-period to show the present value of familiarisation and administrative costs in table 10. The range shown in the tables below includes uncertainty in levels of uptake, while the central value is based on the central uptake scenario.

**Table 10: Private Familiarisation and Administrative Costs to farmers of the Final Option (2014 prices, range in brackets)**

| Final option         |                     |   |
|----------------------|---------------------|---|
| Initial              | Ongoing (pa)        | Present value of familiarisation and administrative costs |
| £12.1m<br>(£9m-£15m) | £3.3m<br>(£2.4-£4m) | £40.3m<br>(£29m - £49m)                                   |

### ***Public Costs to government: Communications, monitoring and enforcement***

As well as costs to industry, there will also be costs to government agencies of interventions. We describe the approach for implementation more broadly in Section 9.

A regulatory approach will place public costs on government for communications, advice, monitoring and enforcement activities. The present value of costs to government for each option is shown in table 11. These reflect both initial start-up costs and annual operation costs.

<sup>21</sup> See here for the initial report to Defra for the NVZ rules: <http://www.defra.gov.uk/consult/files/20111220nitrates-directive-consult-evid3.pdf>

<sup>22</sup> Available in Table 14.5 here - <http://www.ons.gov.uk/ons/publications/re-reference-tables.html?edition=tcm%3A77-328216>

**Table 11: Present Value of Total Costs to Government (2014 prices).**

| <b>Cost</b>    | <b>Final Option</b> |
|----------------|---------------------|
| Communications | £0.3m               |
| Monitoring     | £0.3m               |
| Enforcement    | £0.6m               |
| <b>Total</b>   | <b>£1.2m</b>        |

The key assumptions underpinning these costs are shown in table 12. Although we do not have precise estimates of number of farms affected our analysis assumes that compliance improves over time and that enforcement costs rise per case investigated as more time consuming actions, e.g. prosecution, become necessary.

**Table 12. Key Assumptions in estimating costs to Government of implementing basic rules**

|                                  |  |
|----------------------------------|--|
| <b>Communications and advice</b> | Based on integration of requirements to Farming Advice Service and Environment Agency advice and communications. Includes transitional communications plus ongoing provision of a national programme of events, helpline and website.  |
| <b>Surveillance</b>              | Based on integration of requirements into existing inspections, with 1.5-2 additional hours per inspection at £33 per hour.<br><br>Training costs of £120 per staff member (80 staff in first year, then 30 staff p.a. thereafter).<br><br>Negligible cost of integration of requirements into existing programme of catchment walkovers. Negligible increase in costs of incident reporting as diffuse pollution events can already be reported.  |
| <b>Enforcement</b>               | Based on achievement of projected compliance levels (table 5) by Year 5 of implementation.<br><br>Includes enforcement actions from all forms of surveillance (inspections, incident reporting, and catchment walkovers).<br><br>Assumes that the average cost of enforcement actions (excluding letters) is £228 per farm in Year 1, arising primarily from advice and guidance. By Year 6, this rises to £435 as formal enforcement tools (e.g. cautions, works notices, prosecutions) are used as a last resort for the small number of businesses (<20 per annum) which do not undertake agreed rules. |



## Small and Micro Business Assessment

We have assessed the impact of each option on small and micro businesses. As almost all farming businesses are small businesses<sup>23</sup>, this policy would not be viable and would not implement the Water Framework Directive if these businesses were deemed exempt. However, in recognition of the difficulties of adapting to new regulation as a small business, we are adopting a proportionate advice led approach. This is described in Section 9.

The vast majority of farm businesses are either small or micro businesses. Table 13 below shows the proportion of employers and employment in agriculture, fishing and forestry<sup>24</sup> with low levels of employment.

**Table 13: Structure of Agriculture (2015)<sup>25</sup>**

| Size band           | 2013                       |                               | 2014                       |                               |
|---------------------|----------------------------|-------------------------------|----------------------------|-------------------------------|
|                     | Percentage of all holdings | Percentage of all farm labour | Percentage of all holdings | Percentage of all farm labour |
| 0 to 4 workers      | 89%                        | 60%                           | 89%                        | 60%                           |
| 5 to 9 workers      | 8%                         | 18%                           | 8%                         | 18%                           |
| 10 to 19 workers    | 1%                         | 6%                            | 2%                         | 7%                            |
| 20 to 49 workers    | 1%                         | 5%                            | 1%                         | 5%                            |
| 50 to 99 workers    | 0%                         | 3%                            | 0%                         | 3%                            |
| 100 to 249 workers  | 0%                         | 4%                            | 0%                         | 4%                            |
| 250+ workers        | 0%                         | 4%                            | 0%                         | 4%                            |
| <b>Total number</b> | 98 881                     | 295 563                       | 99 631                     | 301 760                       |

## 5d. Benefits

There are two areas of benefits of the final option compared to the baseline: ongoing net cost savings to farm businesses from implementing the proposed rules, and environmental benefits from implementation. These are discussed in turn below.

### **Net Operational Cost Savings to Farm Businesses**

As well as the capital costs discussed in Section 5c, there will also be ongoing impacts from implementing farm practices to comply with the proposed rules. As discussed in Section 5a, the FARMSCOPER tool estimates a net ongoing impact from implementing practices which includes both positive and negative impacts on farm income, however it is not possible to split out the positive and negative operational impacts. As the ongoing positive impacts of implementing the rules outweigh the ongoing negative impacts for most farm types, we have considered these impacts as net benefits to farm businesses. Table 15 shows the estimated aggregated net operational cost savings of implementing the final policy option for different farm types. This includes rules which have been analysed within the FARMSCOPER tool. A positive number in table 14 implies a net cost saving and negative numbers mean that there would be a net cost to the sector from implementing the rules. Note that due to limitations in the FARMSCOPER model we are unable to split out operational costs and savings.

<sup>23</sup> More than 99% of businesses in Agriculture, Fishing and Forestry in England employ fewer than 50 people. Source: UK Commission on Employment and Skills' Employer Skills Survey 2013.

<sup>24</sup> June Agricultural and Horticultural Survey, Defra 2015

<sup>25</sup> Source: UK Commission for Employment and Skills' Employer Skills Survey 2013.

**Table 14: Net Operational Cost Savings per year from the final policy option (2014 prices)**

Figures are rounded so might not sum.

| Farm type                 | Final Option |
|---------------------------|--------------|
| Cereals                   | £ 3m         |
| Dairy                     | £ 7.6m       |
| General Cropping          | -£1m         |
| Horticulture              | £0           |
| Indoor Pigs               | £1.5m        |
| LFA Grazing Livestock     | £6m          |
| Lowland Grazing Livestock | £ 8m         |
| Mixed                     | £7m          |
| Outdoor Pigs              | £0           |
| Poultry                   | £ 5m         |
| <b>Total</b>              | <b>£ 38m</b> |

The final option has net operational cost savings for all but two farm types. Unfortunately due to the limitations of the FARMSCOPER model we cannot say exactly how many farms will incur these operational costs. Cost savings arise from reduced application of fertiliser and increased output due to more efficient use of fertilisers. Particularly significant are reduced usage of manufactured fertiliser on phosphorus rich soils and on farms that have access to organic manure. Operational costs stem from the potential yield reductions due to not applying manures and fertilisers at high risk times and high risk areas. Table A1 in Annex A provides additional details on the positive and negative impacts of the rules on farm income. These assumptions have been reviewed by agronomists at ADAS. The two farm types that incur net annual operational costs are horticulture and general cropping.

Table 15 shows the Present Value of the net operational cost savings for the central uptake scenario of the final option. The range in this table captures uncertainty in the operational costs or cost savings for a single farm of implementing the rules and uncertainty in uptake.

**Table 15: Present Value of Net Operational Cost savings (2014 prices, central uptake scenario, range in brackets)**

| Final Option             |
|--------------------------|
| £324m<br>(£288m - £357m) |

### ***Environmental Benefits***

The proposed rules would result in improvements to the environment, benefits to relevant sectors of the economy, such as water companies and tourism, and to other groups within society such as anglers and other recreational users of watercourses. The environmental benefits are listed below:

- Improvements in water quality due to reductions in concentrations of nitrates, phosphorus, sediment and Faecal Indicator Organisms (FIOs)
- Improvements in biodiversity and the natural environment.
- Benefits to protected sites helping us to meet domestic targets for SSSIs (Sites of Special Scientific Interest) within the England Biodiversity 2020 Strategy and conservation objectives for Natura 2000 sites under the Habitats Directive.

- These rules will also contribute towards meeting the Marine Strategy Framework Directive aim of good status.

The environmental benefits of the final option are more uncertain than the impacts on farm businesses, and therefore there is a greater range in these benefits than other impacts. The results are likely to undervalue the water quality, biodiversity and air quality benefits but these remain our current best estimates. However the strong level of support for all the rules in the consultation from a wide mix of stakeholders shows a general acknowledgement that these actions would be beneficial for the farming industry, the environment and others.

Table 16 shows the estimated range of reductions in losses of pollutants for each option from the rules as modelled in FARMSOPER. This is based on current levels of agricultural activity; if agriculture were to intensify in the future then the reductions in losses of pollutants would be greater.

**Table 16: Estimated percentage reduction in annual losses of pollutants from agriculture**

| Uptake Level | Nitrogen | Phosphorus | Sediment | Ammonia | Methane | Nitrous Oxide | FIOs |
|--------------|----------|------------|----------|---------|---------|---------------|------|
| Central      | 0.9      | 4.6        | 0.3      | 0.5     | 0.0     | 1.3           | 1.7  |
| Low          | 0.4      | 3.2        | 0.1      | 0.2     | 0.0     | 0.7           | 0.7  |
| High         | 1.3      | 5.8        | 0.5      | 0.8     | 0.0     | 2.0           | 2.8  |

As might be expected, the environmental benefits of the basic rules increase with greater levels of uptake. The most significant impact of the rules is on losses of phosphorus, our key target pollutant. The reductions in losses of sediment and nitrate to water are comparatively low, but environmental benefits on a national scale can be significant even with small percentage reductions. Locally at the catchment scale we are likely to see a variation in the reductions depending upon the farm type and existing practices.

Section 5a and Annex B discuss the methodology for monetising these impacts<sup>26</sup>. This has enabled us to calculate the annual value of environmental benefits from these rules, shown below in table 17. The most significant impacts on water pollution are due to reductions in pollutants of phosphorus and FIOs.

**Table 17: Annual Monetised Benefits from Pollutant Reduction for the Final Option (£m/year, central estimates, 2014 prices)**

| Nitrogen | Phosphorus | Sediment | FIOs   | Ammonia | Nitrous Oxide | Total   |
|----------|------------|----------|--------|---------|---------------|---------|
| £0.79m   | £2.34m     | £0.24m   | £0.57m | £1.71m  | £18.91m       | £24.56m |

The benefits shown in table 18 include estimates for cost savings to water companies from reduced pollution leading to less treatment for clean drinking water. These arise from reduction in losses of nitrogen to water and are worth 46% of the benefit from reductions in levels of nitrate pollution. This is equal to £0.7m per annum.

We have discounted these values across a ten year time period to provide the present value of these benefits for each option, which is shown in table 18. The analysis shows that the value of environmental benefits increase sharply as uptake or the number of methods implemented

<sup>26</sup> The benefits from reductions in water pollution have been monetised as explained in Annex B. The benefits from air pollution have been monetised using established sources –see Table 18

increases. The central values are based on our best estimates of the impact on pollution of implementing an individual method on an individual farm.

The assumptions underlying our valuation of environmental benefits are discussed in Annex A . This is a complex area where monetisation is difficult and uncertain. However these remain our best estimates and most respondents to the consultation who commented did broadly concur with our general view of environmental benefits.

**Table 18: Present Value of Environmental Benefits for the final option (£m, 2014 prices)**

| <b>Level of Uptake</b> | <b>Final Option</b> |
|------------------------|---------------------|
| Low                    | £104m               |
| Medium                 | £211m               |
| High                   | £313m               |

### ***Environmental Benefits from non-modelled rules***

In order to identify the environmental benefits from rules which cannot be modelled in FARMSOPER, Defra engaged expert opinion from stakeholders and the Environment Agency, as well as experts from ADAS and Rothamsted Research<sup>27</sup>. This enabled us to identify the potential environmental benefits from implementing each on-farm measure. This is shown in Annex A.

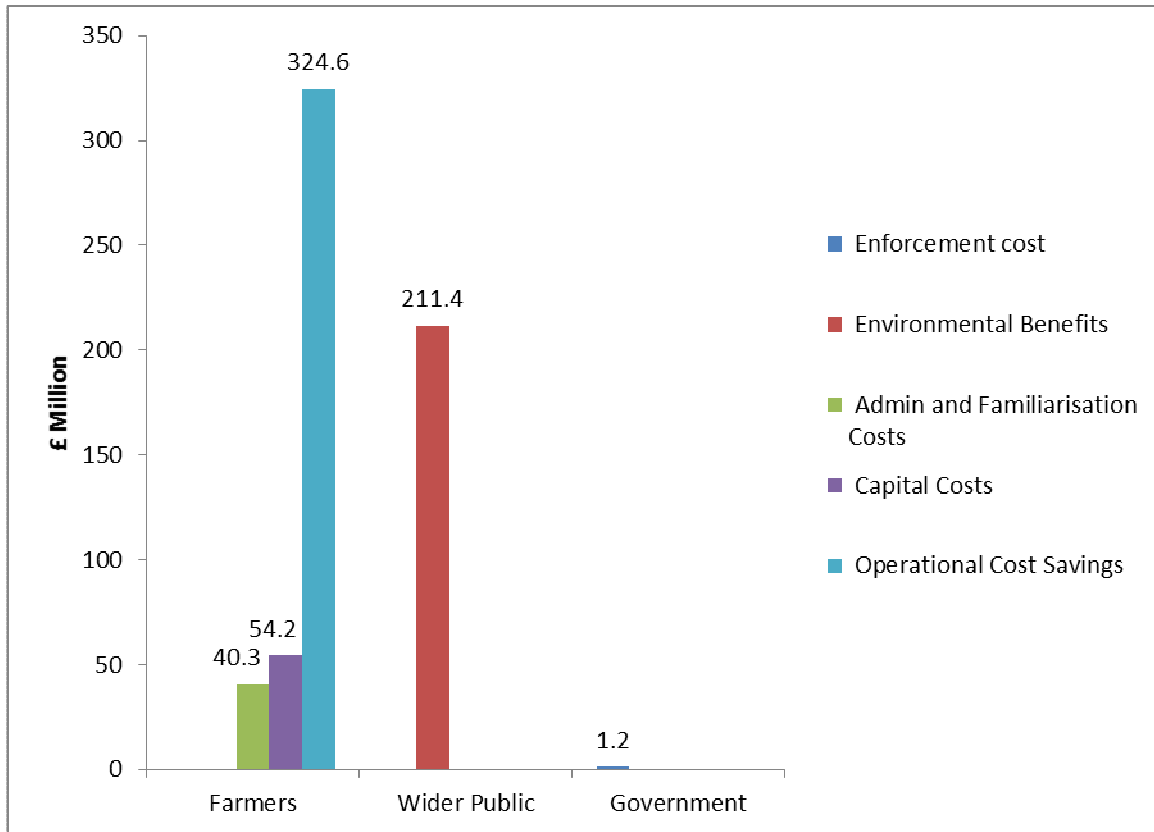
### **5e. Assessment of Net Present Value**

Net Present Values (NPV) are presented overleaf in figure 2. This shows the present values (PV) of environmental benefits, measure impacts on farm income, administration and familiarisation costs and the cost to Government of implementation. These have been combined to show the Net Present Value of the final policy option.

The IA cover sheets only show the range of impacts in the central scenario of 80% uptake. The figure below indicates the spread of these costs and benefits between the farming community, the general population and the Government.

<sup>27</sup> UK-based agricultural research station targeting productive and sustainable agricultural systems

**Figure 2: Net Present Value of final option across stakeholders (£m, 2014 prices)**



### 5f. Sensitivity Testing

We have conducted sensitivity analysis to assess the impacts of the final policy option on the farming sector and the net present value. The full range of testing is set out in annex D. Having run the various sensitivity tests it is concluded that there is a positive net present value associated with the rules proposed in this IA.

## 6. Risks and Assumptions

### 6a. Uptake and Compliance

The assumptions in this impact assessment about uptake and compliance carry a degree of uncertainty. Because the farming industry has many small and geographically isolated businesses, it can be difficult to spread information effectively and change practices either through voluntary or regulatory mechanisms. Managers of farm businesses often operate as the farm's only employee and their time can be stretched in managing the day-to-day running of the business. Therefore even when changes are good practice or cost beneficial, it can be challenging to find the time to assess and implement them.

To address this, we have analysed the impacts of the proposal in three different scenarios with compliance rates of 60%, 80% and 100%. The approach for these scenarios is discussed in Section 5b.

Intensive pig and poultry farms are likely to have already adopted many of the proposed measures as they are subject to strict controls to reduce pollution risk to water. Such farms are subject to farming permits under the Industrial Emissions Directive. Intensive farming has a good level of compliance – 95% are in the higher compliance bands A and B. This existing regulation has been included in the regulatory baseline used in the main analysis.

### 6b. Assumptions in methodology

#### ***Modelled Farms***

A significant assumption in the modelling is the use of 'model' farm enterprises, which are based on the average farm in each sector of agriculture. These are generated from June 2010 Agricultural Census data covering all of England's farming businesses. However, farm businesses are not homogenous within any one individual sector of agriculture, and there is a risk that such variation is not captured within the model farm approach. This may mean that the modelled impact of mitigation measures is inaccurate. For example, this may be the case if a particular segment of agriculture is not currently implementing a practice because this practice would have no environmental impact or because it is less compatible with their farming system. In this case this may mean that the benefits to the environment or the farming industry of increasing uptake of this measure would be overstated by the central estimate of value-for-money.

In order to address this, we have presented ranges for the modelled impacts of uptake of mitigation measures on farm income and losses of pollutants which have informed the estimates of value-for-money. The process for dealing with uncertainty in pollutant impacts and farm income impacts is described in greater detail in Annex B.

#### ***Environmental Benefits***

An important assumption in the methodology is how the environmental benefits have been monetised. The value of environmental benefits for unit reductions in pollutants are shown below in table 19. For the damage costs of ammonia and GHGs, we have used standard established sources.

For the environmental benefits of reductions in water pollution, we have developed our estimates for this piece of analysis. We used willingness to pay (WTP) estimates generated by independent consultant Paul Metcalfe as part of an update to the National Water Environment

Benefits Survey in partnership with the Environment Agency to value improvements in the river environment.<sup>28</sup> This assessment does not include the value of improvements in drinking water and bathing waters as a result of pollutant reductions, which have been sourced from Defra project WT0706. We used preliminary working analysis of the Metcalfe WTP values disaggregated by pressure to generate the total cost of agricultural losses of each water-based pollutant, and were compared to annual losses under the baseline of current practice to obtain the unit environmental benefits shown in table 19. More details on this method can be found in Annex B, Table B5.

This average environmental benefit approach for water-based pollutants covers a large degree of variation, as levels and concentrations of water pollutants vary substantially over different geographical areas and time periods. In addition, the damage caused by an additional unit of water pollution is the result of a complex process which will depend on the size of the water catchment, the degree to which it is used by humans or supports wildlife and the baseline concentration of pollution in the water. Furthermore, the existence of tipping points and non-linear relationships between the level of water pollution and the condition of an ecosystem means that there may be sharp variations in the marginal impact of additional water pollution even within the same water catchment. In this impact assessment, we have used a range of unit environmental benefits shown below to attempt to capture this uncertainty.

**Table 19: Average Environmental Benefits for reductions of each pollutant (£/kg unless otherwise stated, 2014 prices, range in brackets)**

| Pollutant Area | Pollutant                | Value                    | Source  |
|----------------|--------------------------|--------------------------|---|
| Water          | Nitrate                  | £0.33 (£0.0 - £0.48)     | Defra analysis – see Annex C  |
|                | Phosphorus               | £19.80 (£4.29 - £35.06)  |   |
|                | Sediment                 | £0.05 (£0.05 - £0.06)    |   |
|                | FIOs (£ per billion CFU) | £0.08 (£0.06 - £0.11)    |   |
| Air            | Ammonia <sup>29</sup>    | £2.14 (£1.67-£2.43)      | Defra ammonia value <sup>30</sup>                                     |
| GHG            | Nitrous Oxide            | £22.18 (£11.09 - £33.28) | Average DECC non-traded cost of carbon across 2017-2027 <sup>31</sup> |

We are currently working to improve our understanding of how the damage caused by water pollution varies spatially and temporally as well as the marginal impact of water pollution at different pollutant concentrations. In particular, some research led by NERC, the Macronutrients Cycle Programme, will report in June 2016. Although too late for this impact assessment, the programme will quantify the scales (magnitude and spatial/temporal variation) of N and P fluxes and the nature of transformations through the catchment under a changing climate and perturbed C cycle. So the research outputs should inform any future review of this policy.

### ***Wider environmental impacts***

As some of the impacts of this policy cannot be quantified or monetised<sup>32</sup>, there is a risk that estimates of value-for-money understate the environmental benefits which can be achieved. In this impact assessment we have quantified and monetised impacts where possible. Where it

<sup>28</sup> Paul Metcalfe. "Update of CRP WFD Benefit Values – Economic Component", 2012.

<sup>29</sup> Note that this value only includes health impacts of ammonia, and not biodiversity impacts. Biodiversity impacts of ammonia are discussed in Section 8a as unmonetised environmental impacts.

<sup>30</sup> See <http://www.defra.gov.uk/environment/quality/air/air-quality/economic/damage/>

<sup>31</sup> See <https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>

<sup>32</sup> See Table B1 in Annex B.

has not been possible to quantify or monetise impacts, then we have identified impacts and have added appropriate caveats to the assessments of value for money.

### **6c. Costs to the Farming Industry**

There is a generic risk within any estimates of the impact on businesses of new regulation that the impact is under or over-estimated. We have carried out additional work to mitigate this risk in this impact assessment by consulting with agricultural experts within Defra and other stakeholders and then amending both the assumptions for our analysis and the measures included in each option following their feedback. We have used a range for costs to the farming sector to reflect that there may still be factors which we have not considered.

This has been further built upon with feedback from the consultation. Feed planning and spreader calibration were highlighted as having potential costs to livestock and dairy farmers and small non-intensive farms respectively. Having investigated further we have concluded that these rules should not form part of the proposed regulations. We will however work with industry to increase uptake of these good practice actions.

Some consultation responses did challenge the estimates of costs and benefits. In particular highlighting the varied nature of farms and farming in this country mean that costs and benefits could be very localised. We would expect this to be the case, which is why an advice led, proportionate implementation approach is recommended to enable us to tailor it to the type of farm and relative impact of the actions both on the farming business and the environment. See section 4 and Table 3 for further detail on how the consultation responses have helped shape the final set of basic rules.

For modelling impacts on farm income, we have focussed on major impacts such as large changes in nutrient use efficiency. There may be smaller second-order impacts on farm income which have not been considered in the analysis. These impacts could be beneficial if a measure promotes small increases in nutrient use efficiency.

For some farmers with insufficient slurry storage capacity who chose not to manage their slurry by for example tankering there may be costs from the rule that restricts spreading during high risk times. However, investing in greater capacity slurry storage will also allow the farmer to apply manures at more suitable times, reducing losses to watercourses and improving take-up of nutrients by crops, which could lead to improved plant growth or savings from reduced use of manufactured fertiliser. These small second-order impacts have not been modelled due to their complexity.

Those rules pertaining to soils (rules 6 and 7) which are not modelled in FARMSCOPER would apply to less than 5% of farmers. This is because approximately 95% of farmers claim the Basic Payment Scheme and as such already need to comply with Good Agricultural and Environmental Conditions (GAECs) 4 and 5 as a condition of receiving their subsidy payment. The estimated annual costs accruing from these rules are £0.1 million annually. Due to the low cost imposed on the farming sectors they have not been included in the analysis as they have a small impact on the overarching cost and benefit figures. Those sectors most impacted by these rules in terms of costs have a 99 – 100% uptake on the Basic Payment Scheme.



## 7 Direct Costs and Benefits to Business Calculations (following OITO methodology)

This proposal is exempt from One-in, Three-out (OITO) as it is required to complete transposition and implementation of the Water Framework Directive. Article 11 requires Member States to establish a programme of measures to achieve the required improvements in water quality. Article 11.3 requires Member States to implement a set of basic measures as a minimum requirement and Article 11.3h sets specific requirements for diffuse sources of pollution.

There is a trade-off between the cost to business and the need to achieve good status under the Water Framework Directive. Our proposed final option represents what our lawyers consider is the minimum required for basic measures.

This means that supplementary measures, delivered through voluntary approaches advice and incentives, will need to make a significant contribution to reducing the overall estimated pollution from agriculture if we are to achieve good status as required by the Directive.

According to the BIS guidelines, we have calculated the Equivalent Annual Net Cost to Business (EANCB) for the final option in the central scenario below. Note that this includes direct cost savings to farmers from implementing cost-beneficial measures, but does not include any cost savings to water companies from better drinking water quality as this is an indirect cost saving.

**Table 20: Equivalent Annual Net Cost to Business (EANCB) (2014 prices, central scenario)**

| <b>Final option</b>             |         |
|---------------------------------|---------|
| <b>EANCB</b>                    | -£24.9m |
| <b>Transition costs</b>         | £1.3m   |
| <b>Capital costs</b>            | £5.9m   |
| <b>Administrative costs</b>     | £3.1m   |
| <b>Operational cost savings</b> | -£35.2m |

NB. Negative numbers indicate an increase in business net income.

## 8. Wider impacts

### 8a. Unquantified and Unmonetised Environmental Impacts

There are some environmental impacts which have not been monetised or quantified. One benefit will be improvements in biodiversity from reducing the risk of further damage or extending the scale of negative impacts, with the potential for habitat and species recovery in some locations. Improvements in aquatic biodiversity resulting from reductions in water pollution have already been included in our valuation of environmental benefits.

These impacts are not quantifiable, but should be considered when assessing the value for money of the proposals especially as there are existing domestic, EU and international policy commitments on biodiversity. In addition we have obligations under the European directives on nature conservation, which, amongst other things, requires Member States to take preventative steps to avoid deterioration within European sites and failure to achieve this risks infringement proceedings and ultimately financial sanction and remedial action.

### 8b. Wider Impacts on the Farming Sector

The most significant impact of the policy options on the economy will be in the agriculture sector. For example the rules that seek to match the addition of nutrients to soil and crop needs will minimise losses of excess nutrients to water and maximise crop yield relative to investment in soil nutrient. So there will be fewer wasted nutrients and better resource efficiency resulting in improved farm productivity.

Table 21 shows the average capital expenditure requirement (over 10 years) and the average annual net operational cost saving per farm in each sector for the preferred option. These are calculated from the total expected capital cost (Table 6) divided by the number of farm businesses in each sector based on the June Agricultural Census. It shows that there are considerable benefits to farm businesses for implementing these measures, and that the benefits to implementing these measures may help to reduce the number of farms making losses. We do not use the average capital cost and average annual operational cost saving values for the purposes of the EANCB analysis as they reflect the average costs and savings per farm by farm type. The analysis draws on information on the aggregated annual capital costs (Table 7) and annual operational cost savings (Table 14).

Where farm businesses are forced by regulation to implement costly measures, this may lead to some businesses exiting the industry in the short term. This is particularly the case where some farm businesses are already reporting a low or negative net income and will therefore struggle to meet extra cost burdens placed upon them. In addition, even though for most farmers there are few barriers to borrowing to spread the cost of new capital equipment required by regulation<sup>33</sup>, a requirement to purchase expensive capital equipment may provide an additional impetus for some businesses to exit the industry. However an advice led, proportionate implementation approach is planned which would give farmers time to consider the options over the long term.

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<sup>33</sup> Farm businesses have low levels of indebtedness compared to other sectors of the economy, suggesting that they can accommodate additional borrowing if necessary. Over the period 2009-2013 liabilities for the average farm were worth 11% of assets and interest payments represented only 6% of Farm Business Income. Sources: Defra Farm Balance Sheet Analysis – available here: <https://www.gov.uk/government/publications/balance-sheet-analysis-and-farming-performance-england-201011-20122013>

**Table 21: Capital Expenditure Requirements for Farm Businesses and % of farming businesses with negative net income (central estimate, 2014 prices)<sup>34</sup>**

| Sector                    | Average annual net operational cost saving | Average Capital Expenditure Requirement over 10 years | % of farms with Farm Business Income (FBI) <£0 |                       |
|---------------------------|--|---|--|-----------------------|
|                           |  |   | 2013/14 <sup>35</sup>                          | 2014/15 <sup>36</sup> |
| Cereals                   | £179                                       | £ 0   | 19   | 18                    |
| Dairy                     | £976                                       | £ 5,201   | 8  | 9                     |
| General Cropping          | -£61                                       | £ 0   | 11   | 17                    |
| Horticulture              | -£11                                       | £ 0   | 16   | 19                    |
| Indoor Pigs               | £1,351                                     | £ 901   | 14   | 25                    |
| LFA Grazing               | £544                                       | £ 181   | 30   | 21                    |
| Lowland Grazing           | £241                                       | £ 105   | 24   | 21                    |
| Mixed                     | £851                                       | £ 729   | 20   | 22                    |
| Outdoor Pigs              | £0   | £ 0   | 15   | 25                    |
| Poultry                   | £2,383                                     | £ 0   | 11   | 21                    |
| <b>All-sector average</b> | <b>£ 645</b>                               | <b>£ 712</b>  | <b>16.8</b>                                    | <b>19.8</b>           |
| <b>Total</b>              | <b>£6,452</b>                              | <b>£7,117</b>   | <b>168</b>                                     | <b>198</b>            |

### 8c. Wider Impacts on the rest of the economy

There are a number of areas in which implementing the Water Framework Directive requirements on basic measures could impact on the wider economy:

- Where regulation leads to cost savings, producers may pass some of the reduction in costs onto market participants further down the supply chain, including consumers. However, the extent to which this is possible is uncertain and is probably unlikely to significantly impact on consumer prices.
- Similarly, where regulation promotes reduced use of inputs such as fertiliser, this may negatively affect agricultural suppliers. On the other hand, businesses may require additional advice in order to comply with the regulation, leading to a benefit for farm advisors.

<sup>34</sup> Data on Farm Business Income 2013/4 available here - <https://www.gov.uk/government/publications/farm-accounts-in-england-201213> . Data for 2011/12 available here - <http://webarchive.nationalarchives.gov.uk/20130315143000/http://www.defra.gov.uk/statistics/foodfarm/farmmanage/fbs/publications/farmaccounts/farm-accounts-in-england-2012/>

<sup>35</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/406669/fbs-businessincome-statsnotice-30oct14.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/406669/fbs-businessincome-statsnotice-30oct14.pdf)

<sup>36</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/471952/fbs-businessincome-statsnotice-29oct15.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/471952/fbs-businessincome-statsnotice-29oct15.pdf)

- The impact on the farming sector of regulation will not have a serious knock-on effect on the rest of the economy as agriculture is only a small proportion of the whole economy.<sup>37</sup>
- There will be economic benefits for the water industry from the reduced cost of removing water pollution which may be passed on as savings to water bill payers. This is included in the estimates of environmental benefits from policy options.
- There will also be economic benefits for businesses in the outdoor recreation and tourism sectors from an improved water environment as more people choose to use watercourses during their leisure time due to an improved natural environment<sup>38</sup>. Some of these have also been included in the amenity value which the public places on better water quality in our estimates of the environmental benefits from policy options, but where improvements relate to reductions in concentrations of faecal indicator organisms, these have not been valued.
- There will also be economic benefits to businesses in the shellfisheries sector due to cleaner water. These have not been included in valuations of the environmental benefits.

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<sup>37</sup> In the first quarter of 2016 agriculture was 0.7% of total GDP of the U.K..

Source:<https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/grossdomesticproductpreliminaryestimate/januarytomarch2016>.

<sup>38</sup> It has been estimated that tourism generates around £14.3bn per year in the Northwest. If all 33 bathing water pass the minimum standard of the new Directive, it is estimated that an increased visitor numbers would lead to an additional £12.7m per year for the North West economy. However should they all fail, the reduced visitor numbers could come at a cost of £1.3bn to the local economy over 15 years.

## 9. Summary and Final Option with Description of Implementation Plan

### 9a. Summary and Final Option

This impact assessment has reviewed the evidence of water pollution from agriculture and has identified phosphorus loss as one of the key pressures that needs to be addressed both to improve the water environment and to implement relevant parts of the Water Framework Directive.

Section two described our policy objective which is to **establish a basic standard of good practice through the introduction of new basic rules that meet the requirements of the Water Framework Directive without gold-plating**. In doing so we will reduce diffuse water pollution from agriculture in a way that minimises costs to the farming sector. In aiming to achieve this objective we also seek to:

- a) Support a healthy water environment
- b) Promote a world leading Food and Farming industry
- c) Secure wider environmental benefits
- d) Provide enforcement tools to the Environment Agency that are effective at addressing diffuse water pollution; i.e. a series of small events.

We considered the full range of mechanisms and measures for addressing these water quality issues and have consulted formally with a wide range of stakeholders. This has resulted in a refined list of basic rules which sits between the two original proposals consulted upon.

Non-regulatory mechanisms such as voluntary initiatives and guidance were considered, however it was recognised that, whilst these form an important and complementary part of the delivery of WFD, on their own they would not implement the WFD requirement for measures to prevent or control pollution or deliver the scale of change required.

As with the previous options we have focused on avoiding significant additional burdens for the farming sector.

### 9b. Implementation Plan

Any regulation would be laid in early 2017 with a common commencement date of April 2017. Although the rules would apply from commencement there would be an advice led approach to implementation, allowing businesses time to familiarise themselves with the requirements and adapt their farming practices. The advice led approach to implementation would form part of the EA's proportionate approach to enforcement explained in section 2d.

#### ***Communications***

As well as the core objective of implementing the Water Framework Directive, the aim of the proposed regulations is to bring about an increase in the standard of farm practice and therefore a reduction in water pollution. As such, communications and advice are central to delivering behaviour change.

Communications to explain the new regulatory requirements will be provided and delivered both directly and in partnership with leading industry bodies. These will be targeted towards farmers and land managers but also those that work with them (e.g. agronomists, suppliers, contractors), to maximise awareness and understanding of the requirements. Messages will be tailored to different industry sectors and take account of existing levels of awareness and uptake.

#### ***Surveillance and Enforcement***

The Environment Agency is the competent authority for implementation of the Water Framework Directive and the regulator for domestic legislation on agricultural water pollution. It will act as

the enforcement agency for any new regulations, adopting an advice-led approach to help farmers meet their legal requirements:

- It will use evidence to help identify where the priority areas, activities and farm businesses are for action and engage farmers to explain how the evidence relates to their farm.
- It will educate farmers on how the activities on farm are contributing to water pollution and enable farmers to take action by identifying the changes required in an action plan (with timescales) and, if needed, signpost them to where they can seek help to implement the changes.
- It will enforce where the actions are not implemented to agreed timescales by using the most appropriate and proportionate enforcement tool.
- It will then evaluate the action taken including behavioural changes, and record and monitor it to show success.

In using these tools, the regulator's approach will be proportionate and outcome-focused, with the aim of bringing businesses up to compliance.

To minimise burdens on businesses, the regulator will limit record-keeping requirements and focus inspection effort on the highest risk activities, areas and farm businesses. Within this, it will use data available to them from wider regulatory regimes and external sources (e.g. farm assurance schemes) to target poor performance, such that where they have evidence that a farmer has a strong track record of good environmental performance farmers will benefit from a reduced probability of inspection (earned recognition). Inspection activity will be complemented by incident reporting and catchment walkovers.

The Rural Payments Agency (RPA) also carries out inspections on farmers to ensure compliance with scheme entry requirements for the Basic Payment Scheme (cross compliance) and agri-environment schemes. In relation to these rules the RPA will check compliance with GAEC 1 on buffer strips and GAECs 4 and 5 on soils and SMR 1 on Nitrates as required under cross compliance. If an EA farm visit detects non-compliance with relevant cross compliance requirements then this may be referred to the RPA.

### ***Monitoring and Evaluation***

The Environment Agency will monitor implementation of the policy. Through its existing surveillance programme, it will collect compliance data to help assess the impact of the policy on farm practices. It will also monitor environmental outcomes through its programme of data collection under the Water Framework Directive (WFD). This includes ongoing measurement of the number of water bodies not achieving WFD objectives due to different agricultural pollutants.

### ***Post Implementation Review***

The proposed intervention will be evaluated within five years of implementation to confirm that it has had its intended effect and has not incurred unintended consequences. This review will seek the views of stakeholders and draw on evidence collected from a number of test catchments during the implementation period. Policy recommendations arising from this evaluation will be considered as part of the six-year cycle of River Basin Management planning.

## Annex A – Impact of Basic rules

This annex contains detailed information on the proposed final set of basic rules, including analysis of the impact on farm income of the measures in each option for different farm types.

### **Impacts of Basic Rules on Farm Income**

Table A1 shows the assumptions which have been used to generate estimates of the impact on farm income, while Table A2 shows additional assumptions which have been used to estimate savings due to accounting for organic manure nutrient supply when using a fertiliser recommendation system. Where implementing a basic rule imposes capital costs on a farm business, this is shown in italics. Estimates of the time costs for administration and familiarisation are discussed separately in section 5c of the main document.

**Table A1: Assumptions used in estimating farm income impacts of basic rules for the Final Option. Sources: FARMSOPER 3 Cost Tool, Nix Farm Management Pocketbook (44<sup>th</sup> edition)**

| Key: Green = positive impact on farm net income, red = negative impact, black = no impact, <i>italics</i> = capital cost  |  |   |
|---|--|---|
| Basic rule  | Do nothing more baseline   | Assumptions for generating estimates of impacts on farm income under proposed rules   |
| <p>1 a) Application of organic manures and manufactured fertilisers must be planned in advance to meet soil and crop nutrient needs and does not exceed these levels</p> <p>b) Soil testing must be carried out for Phosphorus, Potassium, Magnesium and pH, and Nitrogen levels assessed, at least every 5 years, for cultivated land.</p> | <p>Farmers in NVZs will already comply in part with this rule.</p> | <p>Costs of fertiliser applications to arable land are reduced by 5% due to more efficient use of fertiliser.</p> <p>Output of grassland increased by 10% due to more efficient use of fertiliser.</p> <p>In addition, there are savings due to not applying manufactured phosphorus fertiliser to soil with a high phosphorus index 4 or above), as recommended by fertiliser recommendation systems.<sup>39</sup> Around 20% of agricultural land is at P index 4 or above<sup>40</sup>, and for this land there are savings in the form of reduced use of phosphorus fertiliser (see table A2) and one less fertiliser application per annum (saving of £9 per ha which no longer has phosphorus fertiliser applied). There are no yield effects from no longer applying phosphorus to high-P soils.</p> <p>Where a farm has organic manure, there are additional savings from accounting for the nutrient value of manure applied to land. Table A2 separately shows the assumptions used to estimate the benefits to farm income of correctly accounting for the nutrient content of manure.<sup>41</sup></p> <p><b>There will be additional costs of soil testing. It is assumed that a farmer will need to test each field</b></p> |

<sup>39</sup> See p4, <http://www.nutrientmanagement.org/2-nutrient-management-plan/>

<sup>40</sup> See here: <http://www.nutrientmanagement.org/paag-2013-final-dec-2013/>

<sup>41</sup> Where the potential supply of a nutrient from organic manure is greater than total crop demand across the farm, then we assume no further cost savings beyond the total amount of manufactured fertiliser required to cater for total crop demand. This is because high transportation costs mean that it is unlikely that a farmer could sell excess organic manure to another farmer.

|  |  |  |
|--|--|--|
|  |  | every 5 years at a cost of £11.50 per test.  |
| <p>2. Organic manures must not be stored on land:</p> <p>a) within 10 metres of inland freshwaters or coastal waters,</p> <p>b) where there is significant risk of runoff entering inland freshwaters or coastal waters</p> <p>c) within 50 metres of a spring, well or borehole used for drinking water or food production purposes</p> | Farmers in NVZs will already comply with this rule.                            | No additional costs to farm businesses of directly implementing this measure.  |
| <p>3. Organic manures or manufactured fertilisers must not be applied:</p> <p>a) if the soil is water logged, flooded, or snow covered</p> <p>b) if the soil has been frozen for more 12 hours in the previous 24 hours</p> <p>c) if there is significant risk of causing environmental pollution from soil erosion and run-off</p>      | Farmers in NVZs will already comply with this rule.                            | <p>Not applying fertiliser at high-risk times will lead to a 10% chance of yield reductions of 10% in any field in any year on both grassland and arable land for winter-sown crops.</p> <p>There are assumed to be no direct costs of not applying organic manures at high risk times.</p> <p><i>However, the industry-led Slurry Working Group estimated that farmers who manage their manures as slurry will require at least 5 months of slurry storage capacity in order to avoid applying slurry at high-risk times. Costs of increasing storage capacity may arise for some farmers, from this rule, if they do not have sufficient storage or chose not to manage the slurry in other ways i.e. tankering. We have therefore included the costs of upgrading slurry storage capacity to 5 months in this analysis. It is assumed that as part of the baseline farmers who do not currently 5 months storage have an average of 4 months' worth of storage, and upgrading storage has an initial capital cost of £60.5 per m<sup>3</sup> of storage required.</i></p> |
| <p>4. Organic manures must not be applied:</p> <p>a) within 10 metres of any</p>   | Farmers claiming the Basic Payment Scheme will comply through cross compliance | There are assumed to be no direct costs of not applying organic manures in high risk areas.  |



|   |  |  |
|---|--|--|
| <p>inland freshwaters or coastal waters, except, if precision equipment is used within 6 metres of inland freshwaters or coastal waters</p> <p>b) within 50 metres of a spring, well or borehole used for drinking water or food production purposes</p>  | <p>requirements</p>  |  |
| <p>5. Manufactured fertiliser must not be applied within 2 metres of inland freshwaters or coastal waters</p>   | <p>Farmers claiming the Basic Payment Scheme will comply through cross compliance requirements</p> | <p>It is assumed that high-risk areas make up 5% of total farmland. Not applying fertiliser to these areas leads to 30% yield reductions in high-risk grassland areas and 50% yield reductions in high-risk arable areas.</p> <p>Not applying fertiliser to high-risk areas does save on fertiliser costs of manufactured nitrogen and phosphorus fertiliser and on fertiliser applications (£9 per ha of high-risk area).</p> |
| <p>6. Take all reasonable precautions to prevent significant soil erosion and runoff from:</p> <p>a) seedbeds, tramlines, rows, beds, stubbles (including harvested land with haulm), polytunnels and irrigation, and</p> <p>b) poaching by livestock</p> | <p>Farmers claiming the Basic Payment Scheme will comply through cross compliance requirements</p> | <p>Not modelled in FARMSCOOPER</p>   |
| <p>7. Any land within 5 metres of inland freshwaters or coastal waters must be protected from significant soil erosion by preventing poaching by livestock.</p>   | <p>Farmers claiming the Basic Payment Scheme will comply through cross compliance requirements</p> | <p>Not modelled in FARMSCOOPER</p>   |
| <p>8. Livestock feeders must not be positioned:</p>   | <p>New rule for all farmers</p>  | <p>This will impose costs on farmers for moving livestock feeders, estimated at 15 minutes per feeder, with a cost of £34 per hour for a tractor and</p>   |

|   |  |           |
|---|--|-----------|
| <p>a) within 10 metres of any inland freshwaters or coastal waters,</p> <p>b) where there is significant risk of runoff from poaching around the feeder entering any inland freshwaters or coastal waters</p> |  | a driver. |
| Additional Costs of Nutrient Management Planning  | Where a business does not already have a nutrient management plan, it will need to create one to implement measure 1. The costs of this are included in the FARMSCOPER analysis and is assumed to occupy 8 hours of farm manager time at £20 per hour.                         |           |
| Additional Costs of Manure Management Planning  | For farms with livestock, where a business does not already have a manure management plan, it will need to create one to implement measure 1. The costs of this are included in the FARMSCOPER analysis and is assumed to occupy 8 hours of farm manager time at £20 per hour. |           |

**Table A2: Assumptions used for estimating farm income impacts of accounting for organic manure nutrient supply when using a fertiliser recommendation system. Source: FARMSCOPER 3 Cost Tool.**

| Nutrient  | Nitrogen | Phosphorus | Potash |
|---|----------|------------|--------|
| Cost of manufactured fertiliser (£/kg)                          | £0.90    | £0.85      | £0.57  |
| Nutrient content (kg nutrient/tonne animal waste) <sup>42</sup> |          |            |        |
| Slurry  | 0.9      | 1.2        | 3.2    |
| Farmyard Manure   | 0.6      | 3.2        | 8      |
| Poultry Muck  | 6.3      | 25         | 18     |
| Saving of manufactured fertiliser (£/tonne of animal waste)     |          |            |        |
| Slurry  | £0.81    | £1.02      | £1.82  |
| Farmyard Manure   | £0.54    | £2.72      | £4.56  |
| Poultry Muck  | £5.67    | £21.25     | £10.26 |

The assumptions in tables A1, A2 and A3 about the impact of the proposed new basic rules on farm income were tested during consultation. Whilst this did not produce any alternative suggestions, many respondents commented on the likely impact of specific rules on farm incomes. For example, some respondents were concerned about the significant cost to smaller farms of introducing a feed planning system and purchasing more accurate spreading equipment and as a result these rules have been dropped. Within the limits of the responses provided this has allowed us to cross check these assumptions.

<sup>42</sup> For nitrogen, this measures available nitrogen within animal waste as opposed to total nitrogen, as a large portion of the nutrient content of animal waste is not immediately available for plant uptake.

Table A3 below shows our central estimate of the capital cost requirement for the individual measure in the final policy option on the average lowland grazing, dairy and cereals farm assuming that the farm was not previously enacting this measure. The impact of any of the measures is likely to vary according to the characteristics of each farm such as size, intensity of production, geographical characteristics and adoption of other practices. As the baseline adoption of each of these measures varies substantially, summing the values below will not give an accurate representation of the total capital cost requirement of each option on each farm type; this can be found in Section 5c.

**Table A3: Capital Cost Impact of basic rules on Farm Income**

| Basic rule   | User Guide Coding | Impact on Average Farm Income |       |         |
|--|-------------------|-------------------------------|-------|---------|
|  |                   | Lowland Grazing               | Dairy | Cereals |
| 3. Organic manures or manufactured fertilisers must not be applied: a) if the soil is water logged, flooded, snow covered, b) frozen for 12 hours in the previous 24 hours or c) if there is significant risk of causing environmental pollution from soil erosion or run-off. | 52                | 0.03% <sup>43</sup>           | 2%    | N/A     |
| None of the other measures require capital expenditure   |                   |                               |       |         |

Table A4 below indicates whether the proposed measures result in a net operational cost or saving for the average lowland grazing, dairy and cereals farm, assuming that the farm was not previously adopting this rule. The '+' sign indicates cost savings while the '-' sign indicates operational costs for a certain farm type under a combination of measures. The impact of any of the basic rules is likely to vary according to the characteristics of each farm such as size, intensity of production, geographical characteristics and adoption of other practices. As discussed in Section 5a, while it is possible to estimate this for individual rules at an individual farm level, it is not possible to separately identify these impacts at a national level for each group of rules.

**Table A4: Operational Cost Impact of final proposed basic rules on Farm Income**

| Basic rule   | User Guide Coding | Impact on Average Farm Income |       |                 |
|--|-------------------|-------------------------------|-------|-----------------|
|  |                   | Lowland Grazing               | Dairy | Cereals         |
| 1a) Application of organic manures and manufactured fertilisers must be planned in advance to meet soil and crop nutrient needs and does not exceed these levels.<br>b) Soil testing must be carried out for Phosphorus, Potassium, Magnesium and pH, and Nitrogen levels assessed, at least every 5 years, for cultivated land. | 22, 23, 32        | +                             | +     | + <sup>44</sup> |
| 2. Organic manures must not be stored on land:<br>a) within 10 metres of inland freshwaters  | 60                | -                             | -     | N/A             |

<sup>44</sup> Even though the average cereals farm uses more fertiliser than the average dairy farm, the benefits from using a fertiliser recommendation system are greater for the dairy farm where it can utilise the nutrient content of manures more efficiently to reduce fertiliser use by a greater amount.

|   |                   |              |              |              |
|---|-------------------|--------------|--------------|--------------|
| <p>or coastal waters</p> <p>b) where there is significant risk of runoff entering inland freshwaters or coastal waters</p> <p>c) within 50 metres of a spring, well or borehole used for drinking water or food production purposes</p>   |                   |              |              |              |
| <p>3. Organic manures or manufactured fertilisers must not be applied:</p> <p>a) if the soil is water logged, flooded, or snow covered</p> <p>b) if the soil has been frozen for more 12 hours in the previous 24 hours</p> <p>c) if there is significant risk of causing environmental pollution from soil erosion and run-off</p> | 26,52,69,72       | -            | -            | -            |
| <p>4. Organic manures must not be applied:</p> <p>a) within 10 metres of any inland freshwaters or coastal waters, except, if precision equipment is used within 6 metres of inland freshwaters or coastal waters</p> <p>b) within 50 metres of a spring, well or borehole used for drinking water or food production purposes</p>  | 68                | Cost neutral | Cost neutral | Cost neutral |
| <p>5. Manufactured fertiliser must not be applied within 2 metres of inland freshwaters or coastal waters</p>   | 25                | -            | -            | -            |
| <p>6. Take all reasonable precautions to prevent significant soil erosion and runoff from:</p> <p>a) seedbeds, tramlines, rows, beds, stubbles (including harvested land with haulm), polytunnels and irrigation</p> <p>b) poaching by livestock</p>  | Not in user guide | -            | -            | -            |
| <p>7. Any land within 5 metres of an inland freshwaters and coastal waters must be protected from significant soil erosion by preventing poaching by livestock</p>  | Not in user guide | -            | -            | N/A          |
| <p>8. Livestock feeders must not be positioned:</p> <p>a) within 10 metres of any inland freshwaters or coastal waters</p> <p>b) where there is significant risk of runoff from poaching around the feeder entering any inland freshwaters or coastal waters</p>  | 38                | -            | -            | N/A          |

### **Description of Basic Rules**

For most of the basic rules, detailed descriptions can be found in the "Mitigation Methods User Guide", which was developed in conjunction with the FARMSCOPER decision support tool as part of Defra project WQ0106. The user guide is based on a mix of scientific studies and expert judgement and provides a detailed definition of the mitigation methods, as well as likely directions of changes in pollutant losses to air and water following implementation of the measures. The user guide also estimated the impacts on farm income of each of the measures.

Table A4 shows which mitigation method in the user guide corresponds to each basic rule. Note that in some cases a basic rule encompasses more than one mitigation method, so more than one mitigation method in the user guide should be referred to.

The full user guide can be found here -

<http://www.adas.co.uk/LinkClick.aspx?fileticket=vUJ2vIDHBjc%3d&tabid=345>

Some of the basic rules are not included in the User Guide. In order to understand more about the impacts of each of these individual measures, we asked ADAS to provide detailed definitions in a similar manner for the pre-consultation IA.

## Annex B – Methodology

FARMSCOOPER uses model farms to assess the impact of mitigation methods on different farm types for given assumptions about the impact on pollution and on farm income after implementing the methods.

For this analysis we've used average farms across 10 farm types in England as model farms; the average farms have been based on data from the 2010 June Agricultural Census. The tool can then upscale the results for individual model farms across England to present an overall net impact of the methods.

### ***Introduction to FARMSCOOPER***

The FARMSCOOPER (FARM SCAle Optimisation of Pollutant Emissions Reduction) modelling tool was developed from 2006 as part of Defra project WQ0106 as a means to model on-farm losses of pollutants from agriculture to surface water and the atmosphere, and to model the effects of various mitigation methods in reducing such losses.<sup>45</sup> This includes modelling reductions in losses of phosphorus and sediment to water.

For the analysis in this impact assessment, we used the latest of version of the tool, version three. This version contains updated information on the cost of mitigation methods and baseline of current uptake of methods. FARMSCOOPER uses Microsoft Excel as the user interface, and consists of three principal tools. The first is the ability to 'create' a model farm. This involves specifying the geographical conditions of the farm, details of the enterprises carried out on-farm and the practices used on-farm. The outputs of this tool are details of the annual losses of pollutants to air and water from the model farm based on evidence about the drivers on agricultural losses of pollutants from a suite of existing models. For this analysis, we have used model farms based on 2010 June Agricultural Census data, which provides data for the average farms across 10 farm types and a range of different soil types and rainfall levels.

**Table B2: The 10 Farm Types considered in FARMSCOOPER**

|                  |                           |
|------------------|---------------------------|
| Cereals          | Dairy                     |
| General Cropping | LFA Grazing Livestock     |
| Indoor Pigs      | Lowland Grazing Livestock |
| Outdoor Pigs     | Mixed                     |
| Horticulture     | Poultry                   |

The second tool is used to model the impact of different mitigation methods on losses of pollutants from a given model farm. The program now contains 110 mitigation methods, but a user can add further methods if they have sufficient data. The tool allows a user to specify a level of current practice as prior implementation of different methods, and also to vary the extent to which a method is adopted. It then compares the losses of pollutants after the implementation of a single method or a group of methods with losses of pollutants under current practice. This is based on a series of evidence-based assumptions as to the efficacy of on-farm mitigation

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<sup>45</sup> FARMSCOOPER has previously been used for analysis in other contexts. This includes work on prioritising method selection in Demonstration Test Catchments and a Defra 2012 review of the voluntary approach in tackling agricultural emissions of GHGs. It is also currently being used as part of the modelling in the ongoing Defra project WQ0223. It has also been used in academic research; see: Zhang, Y., et al., Application of the FARMSCOOPER tool for assessing agricultural diffuse pollution mitigation methods across the Hampshire Avon Demonstration Test Catchment, UK. *Environ. Sci. Policy* (2012), <http://dx.doi.org/10.1016/j.envsci.2012.08.003>

methods<sup>46</sup>. In addition, the tool also shows the impacts on farm income by modelling the likely cost and revenue implications of each of the mitigation methods<sup>47</sup>. Results are presented in terms of the loads (i.e. the mass) of pollutants lost from the farm, as opposed to concentrations (the mass of a specific pollutant for a given volume of water) in watercourses. Details of the methods which have been modelled in this analysis and the levels of prior and post implementation assumed can be found in Section 5b.

The final tool combines the outputs of the first two tools to estimate the effects of implementing a single method or a group of methods across a given geographical area. As such, it estimates the impact of the methods across each model farm and upscales the results according to the number of farms of each farm type, soil type and rainfall level. This means that the tool can be used to assess the impact across a geographical area if methods are implemented universally.

FARMSCOOPER is a powerful modelling tool which can estimate the impact of a large number of mitigation methods across a wide area. However, while the use of average farms across the different sectors of agriculture is necessary in order to keep the data and resource requirements of analysis proportionate, it means that the final results of analysis are an average figure and hide a significant level of variation between different farm businesses and in different geographical areas with different conditions. Our approach to modelling uncertainty in outputs is discussed below.

### **Measures modelled in FARMSCOOPER**

Table B3 below shows which of the basic rules have been modelled in FARMSCOOPER and which mitigation methods they correspond to. In some cases a basic rule encompasses more than one mitigation method in FARMSCOOPER.

Table B3 also highlights where the fit between basic rule and mitigation methods in FARMSCOOPER is not exact and explains where this may result in bias in the modelling results. We have used expert opinion from within Defra and outside bodies to check that the mitigation methods in FARMSCOOPER correspond sufficiently to the basic measures.

**Table B3: Mitigation Methods in FARMSCOOPER**

| <b>Basic Rule</b>   | <b>FARMSCOOPER Measure(s)</b>                                    |
|---|--|
| <b>Organic Manures and Manufactured Fertilisers</b><br>1 a) Application of organic manures and manufactured fertilisers must be planned in advance to meet soil and crop nutrient needs and does not exceed these levels<br>b) Soil testing must be carried out for Phosphorus, Potassium, Magnesium and pH, and Nitrogen levels assessed, at least every 5 years, for cultivated land. | 22 – Use a fertiliser recommendation system                      |
|   | 23 – Integrate fertiliser and manure nutrient supply             |
|   | 32 – Do not apply P fertiliser to high-P soils                   |
| 2. Organic manures must not be stored on land:<br>a) within 10 metres of inland freshwaters or coastal waters,<br>b) where there is significant risk of runoff entering inland freshwaters or coastal waters<br>c) within 50 metres of a spring, well or borehole used for drinking water or food production purposes   | 60 - Site solid manure heaps away from watercourses/field drains |

<sup>46</sup> More detail on these assumptions can be found in the 'Mitigation Methods User Guide', which is available here - <http://www.adas.co.uk/LinkClick.aspx?fileticket=vUJ2vIDHBjc%3d&tabid=345>

<sup>47</sup> The relevant assumptions regarding the impacts of mitigation methods on net farm income are shown in Annex A

|   |   |
|---|---|
| <p>3. Organic manures or manufactured fertilisers must not be applied:</p> <p>a) if the soil is water logged, flooded, or snow covered</p> <p>b) if the soil has been frozen for more 12 hours in the previous 24 hours</p> <p>c) if there is significant risk of causing environmental pollution from soil erosion and run-off</p> | 26 - Do not spread manufactured fertiliser to fields at high-risk times                   |
|   | 52 - Increase the capacity of farm slurry stores to improve timing of slurry applications |
|   | 69 - Do not spread slurry or poultry manure at high-risk times                            |
|   | 72 - Do not spread FYM to fields at high-risk times                                       |
| <p>4. Organic manures must not be applied:</p> <p>a) within 10 metres of any inland freshwaters or coastal waters, except, if precision equipment is used within 6 metres of inland freshwaters or coastal waters</p> <p>b) within 50 metres of a spring, well or borehole used for drinking water or food production purposes</p>  | 68 - Do not apply manure to high-risk areas   |
| <p>5. Manufactured fertiliser must not be applied within 2 metres of inland freshwaters or coastal waters</p>   | 25 - Do not apply fertiliser to high-risk areas   |
| <p><b>Soil management</b></p> <p>6. Take all reasonable precautions to prevent significant soil erosion and runoff from:</p> <p>a) seedbeds, tramlines, rows, beds, stubbles (including harvested land with haulm), polytunnels and irrigation</p> <p>b) poaching by livestock</p>  | Not modelled in FARMSOPER   |
| <p>7. Any land within 5 metres of an inland freshwaters and coastal waters must be protected from significant soil erosion by preventing poaching by livestock</p>  | Not modelled in FARMSOPER   |
| <p>8. Livestock feeders must not be positioned:</p> <p>a) within 10 metres of any inland freshwaters or coastal waters,</p> <p>b) where there is significant risk of runoff from poaching around the feeder entering any inland freshwaters or coastal waters</p>   | 38 – Move feeders at regular intervals <sup>48</sup>                                      |

Table B4 shows the baseline levels of uptake which were assumed for each method in the main scenario. The final rates of implementation of the measures under regulation are shown in table 5.

**Table B4: Baseline of uptake of measures in main scenario**

| Measure                                 | Existing regulatory mechanism | Percentage of farmers adopting each measure |         |
|---|-------------------------------|---|---------|
|   |                               | NVZ   | Non-NVZ |
| 1 a) Application of organic manures and | NVZ (in                       | 90  | 90      |

<sup>48</sup> This measure includes the impacts of keeping feeders away from watercourses and moving them frequently. The analysis is therefore likely to overstate both the costs and benefits of the basic measure, which only includes keeping feeders away from watercourses. The bias will be more serious for the environmental benefits than the costs to farm businesses, which have been downscaled to reflect the costs of moving feeders annually as opposed to more frequently.



|  |                  |     |    |
|--|------------------|-----|----|
| manufactured fertilisers must be planned in advance to meet soil and crop nutrient needs and does not exceed these levels<br>1 b) Soil testing must be carried out for Phosphorus, Potassium, Magnesium and pH, and Nitrogen levels assessed, at least every 5 years, for cultivated land.                           | part)            |     |    |
| 2 Organic manures must not be stored on land:<br>a) within 10 metres of inland freshwaters or coastal waters,<br>b) where there is significant risk of runoff entering inland freshwaters or coastal waters<br>c) within 50 metres of a spring, well or borehole used for drinking water or food production purposes | NVZ              | 100 | 90 |
| 3. Organic manures or manufactured fertilisers must not be applied:<br>d) if the soil is water logged, flooded, or snow covered<br>e) if the soil has been frozen for more 12 hours in the previous 24 hours<br>f) if there is significant risk of causing environmental pollution from soil erosion and run-off     | NVZ              | 100 | 80 |
| 4. Organic manures must not be applied:<br>c) within 10 metres of any inland freshwaters or coastal waters<br>d) within 50 metres of a spring, well or borehole used for drinking water or food production purposes  | Cross Compliance | 100 | 80 |
| 5. Manufactured fertiliser must not be applied within 2 metres of inland freshwaters or coastal waters   | Cross compliance | 100 | 80 |
| 6. Take all reasonable precautions to prevent significant soil erosion and runoff from:<br>a) seedbeds, tramlines, rows, beds, stubbles (including harvested land with haulm), polytunnels and irrigation<br>b) poaching by livestock  | Cross Compliance | 95  | 95 |
| 7. Any land within 5 metres of an inland freshwaters and coastal waters must be protected from significant soil erosion by preventing poaching by livestock  | Cross Compliance | 95  | 95 |
| 8. Livestock feeders must not be positioned:<br>c) within 10 metres of any inland freshwaters or coastal waters,<br>d) where there is significant risk of runoff   | None             | 80  | 80 |

|   |  |  |  |
|---|--|--|--|
| from poaching around the feeder entering any inland freshwaters or coastal waters |  |  |  |
|---|--|--|--|

**Monetising impacts under FARMSCOPER**

Table B1 below shows which impacts we have been able to identify, quantify and monetise in this impact assessment. The analysis has focussed on use of the FARMSCOPER modelling framework. This tool is described in more detail below. This section also considers the method for monetising environmental benefits and the method used to analyse measures which cannot be modelled in the FARMSCOPER tool.

**Table B1: Level of analysis for different impacts for final option**

| Impact                        | Example Impacts   | Measures                | Identified? | Quantified? | Monetised? |
|-------------------------------|---|-------------------------|-------------|-------------|------------|
| Farm Business Impacts         | Impacts on farm income, costs, cost savings                               | FARMSCOPER Measures     | Y           | Y           | Y          |
|                               |   | Non-FARMSCOPER measures | Y           | Y           | Y          |
| Water Quality and Air Quality | Nitrates, Phosphorus, Sediment, Faecal Indicator Organisms, Ammonia, GHGs | FARMSCOPER Measures     | Y           | Y           | Y          |
| Wider Environmental Impacts   | Biodiversity, soil organic carbon   | FARMSCOPER Measures     | Y           | N           | N          |

**Uncertainty**

Impacts on the environment and on farm businesses of adopting mitigation measures are subject to a large degree of uncertainty and depend on a wide range of factors. Central estimates of the value for money of the policy options reflect our current understanding of these impacts, but we have estimated ranges for these values to reflect both the inherent uncertainty of these impacts and gaps in our current understanding.

For uncertainty in farm costs, the results from core modelling in the FARMSCOPER tool only include a central estimate of the costs of measures. However, the tool does estimate a minimum and maximum impact on the farm business for each individual mitigation method. These are based on expert judgement from ADAS as to the uncertainty of the impact of a measure on the farm business – for example uncertainty in the unit cost of an item which must be purchased. When estimating the impacts on farm economics of groups of measures within the policy options, Defra economists have combined the FARMSCOPER estimates of minimum and maximum value for the measures within a group to produce a scaling factor. The central estimates of cost have then been adjusted using this scaling factor to present estimates for the minimum and maximum impact on farm businesses of a measure.

The FARMSCOPER modelling tool does present a distribution of expected impacts on pollutants from implementing a group of measures, but this is obtained at an individual farm level as opposed to at a national level. We have used a number of ‘typical’ farms from each farming sector to generate estimates of the minimum and maximum impact on pollutants for each sector from implementing each group of measures. The minimum and maximum points were estimated at the fifth and ninety-fifth percentile points along the cumulative probability distribution of expected pollutant reductions. These maximum and minimum values for the typical farms in the sector were then used to generate scaling factors for the pollutant reductions for each sector. We used ‘typical’ farms from each sector in order to reduce resource time spent running the model and in adherence to the principle of proportionality in analysis. However, this may lead to small biases in the range of expected pollutant reductions where the range of pollutant reductions varies between different geographical conditions such as soil type or levels of rainfall.

### **Valuation**

In order to monetise the impact of policy options on the water environment, we have used estimates for environmental benefits for improvements in water quality. The main source for these estimates is analysis of the total willingness to pay for improvements to river environments generated through updates to the National Water Environment Benefits Survey (NWEBS) by independent consultant Paul Metcalfe.<sup>49</sup> As Metcalfe’s study did not capture the value of benefits to drinking water and bathing waters, we used separate sources which are summarised in Defra project WT0706<sup>50</sup> to supplement the Metcalfe estimates. By assuming symmetry between the benefits from mitigation and the damage caused by pollution, these estimates are used as a proxy for the damage cost from all agricultural pollution. No further evidence was provided on these assumptions during consultation. The total contribution from agriculture across benefits to the river environment, drinking water and bathing waters and different pressures were then estimated using preliminary working analysis of WTP values disaggregated by pressure. The results for the total damage caused by agricultural losses of each pollutant are shown below in Table B5.

**Table B5: Total Annual Environmental benefits from elimination of all agricultural losses of water-based pollutants (range in brackets)**

| <b>Pollutant</b> | <b>Total damage cost</b> |
|------------------|--------------------------|
| Nitrate          | £92m (£53m - £133m)      |
| Phosphorus       | £81m (£18m - £143m)      |
| Sediment         | £92m (£80m - £103m)      |
| FIOs             | £46m (£33m - £59m)       |

In order to find a unit environmental benefits, the total damage caused by emissions of each pollutant were then divided by the total annual losses of that pollutant from agriculture as sourced from estimates of losses modelled in FARMSCOPER using a baseline of current

<sup>49</sup> Paul Metcalfe. “Update of CRP WFD Benefit Values – Economic Component”, 2012.

<sup>50</sup> The report is available here -

<http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=13653&FromSearch=Y&Publisher=1&SearchText=wt0706&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

practice. The unit environmental benefits (with appropriate allowances for uncertainty) are shown in table 19.

The use of the update to the National Water Environment Benefits Survey means that this approach is consistent with that used by the Environment Agency in the next cycle of the River Basin Management Plans. As that analysis is concerned with valuing step changes in river quality in order to achieve targets under the Water Framework Directive, the NWEBS values can be used directly. In this case, as improvements in the water environment are more marginal and focussed on specific pollutants, we have estimated unit environmental benefits based on the willingness to pay for improvements to the river environment (through NWEBS) and to drinking and bathing waters (WT0706).

These damage cost estimates have a serious limitation where they do not sufficiently capture the degree of variation in the damage caused by an additional unit of pollution. The damage caused by an extra unit of pollutant in a watercourse will vary significantly depending on the amount of water in the watercourse, the existing concentration of pollutants, the extent to which humans or wildlife use the watercourse and a large number of other factors. These factors will vary spatially, temporally and even within different points of the same watercourse at the same time. In particular, due to the existence of tipping points and non-linear relationships between the level of pollution and the damage caused the pollution, it is likely that an additional unit of pollutant added to an already heavily polluted watercourse will have a larger impact than in a watercourse that has small concentrations of pollution. Furthermore, there are significant time lags between the loss of pollutants from a farm and the pollutant causing damage in a watercourse if the pollutant is lost to groundwater.

As the environmental benefits are an average value across England, they do not allow for this high degree of variation. We are developing the evidence on the damage caused by water pollution with a view to being able to model the impacts of reducing water pollution in a more sophisticated manner in the future. However, for this analysis we are using a range of values in order to capture the uncertainty in the environmental benefits of improved water quality, as shown in table 19. For valuing improvements in air quality we used established damage costs. These are also shown in table 19.

## Annex C - Stakeholder Engagement Timeline

|                     |  |
|---------------------|--|
| <b>Jan 2013</b>     | EA commissioned <b>Report</b> to develop set of basic measures.  |
| <b>March 2013</b>   | <b>Stakeholder workshop</b> as part of report to consider a short list of basic measures and get views on uptake, acceptability, practicability and applicability.                         |
| <b>July 2013</b>    | Final report published. <sup>51</sup>  |
| <b>July 2013</b>    | <b>Stakeholder workshop</b> – developed guiding principles for any potential list of basic measures.   |
| <b>Nov 2013</b>     | <b>Stakeholder workshop</b> – covered the drivers for an increased regulatory requirements and considered which regulatory mechanisms would work best and how to make them more effective. |
| <b>Feb 2014</b>     | <b>Technical Working group</b> - measures and approach to implementation discussed with smaller core group of stakeholders.  |
| <b>June 2014</b>    | <b>Technical Working group</b> - ran through detail of the proposed shortlist of measures.   |
| <b>July 2015</b>    | <b>Internal peer review</b> – Environment Agency, Natural England, Catchment Sensitive Farming, wider Defra.   |
| <b>Sep-Nov 2015</b> | <b>Consultation</b> from 29 September to 24 November 2015  |
| <b>Oct 2015</b>     | <b>Consultation workshop</b> – discussion about how any new basic rules might be successfully implemented  |
| <b>March 2016</b>   | <b>Stakeholder meeting update</b> – considered methods for effective communication and providing advice on any new basic rules to farmers  |

### Range of stakeholders included in the above conversations:

| Sector | Organisation (Division)   |
|--------|---------------------------|
| ENGOS  | Angling Trust             |
|        | Wildlife Trust            |
|        | The Rivers Trust          |
|        | West Country Rivers Trust |
|        | Soil Association          |
|        | WWF UK                    |
|        | RSPB                      |

<sup>51</sup> ADAS UK Ltd and Halcrow Group Limited. Report to the Environment Agency: "Identification of basic measures to address agriculture's impact on water", 2013. See Appendix I "Outputs of Stakeholder Workshop on Delivery Potential".

|  |  |
|--|--|
|  | Farming and Wildlife Advisory Group South West       |
| <b>Water companies</b>                         | Northumbrian and Essex and Suffolk Water             |
|  | Thames Water   |
|  | South West Water                                     |
|  | Anglian Water  |
|  | South West Water                                     |
|  | Wessex Water   |
|  | South East Water                                     |
|  | Essex and Suffolk Water                              |
| <b>Research and educational establishments</b> | ADAS UK Ltd  |
|  | Ricardo-AEA  |
|  | SOAS, University of London                           |
|  | Rothamstead Research                                 |
| <b>Farming industry representatives</b>        | National Farmers' Union                              |
|  | CLA  |
|  | Agricultural Industries Confederation                |
|  | National Pig Association                             |
|  | Central Association of Agricultural Valuers          |
|  | Agriculture and Horticulture Development Board       |
|  | BPEX, Agriculture and Horticulture Development Board |
|  | Red Tractor  |
|  | Linking Environment and Farming (LEAF)               |
|  | Pesticides Voluntary Initiative                      |
|  | Metaldehyde Stewardship Group                        |
|  | GrowHow UK Ltd                                       |
|  | <b>Government, NDPBs</b>                             |
| Defra (soils)                                  |  |
| Defra Water Quality Farmers' Panel             |  |
| Environment Agency                             |  |
| Natural England                                |  |
| Forestry Commission                            |  |

## Annex D. Sensitivity testing

### ***Uptake of Proposed Rules***

We take into account the variation in operational costs, capital costs and environmental benefits accruing from the central, low and high levels of uptake of the proposed rules. The environmental benefits are subject to a larger level of uncertainty as the unit values attributed to a unit reduction in pollution are subject to variation as well. Table E1 indicates that variation in different levels of uptake continues to result in positive net present values.

**Table E1: Net present value for different levels of uptake (£m, 2014 prices)**

| <b>Value</b>  | <b>High</b> | <b>Central</b> | <b>Low</b>  |
|---|-------------|----------------|-------------|
| Present Value of Environmental Benefits*                          | +£456.28    | +£211.22       | +£53.73     |
| Present Value of Net Operational Cost Savings for Farm Businesses | +£369.61    | +£324.6        | +£220       |
| Present Value of Capital Costs for Farm Businesses                | -£89.24     | -£54.2         | -£17.85     |
| Present Value of administration and familiarisation costs         | -£49.25     | -£40.2         | -£29.5      |
| Present Value of cost to Government of Enforcement                | -£1.2       | -£1.2          | -£1.2       |
| <b>Net Present Value</b>  | <b>£686</b> | <b>£440</b>    | <b>£225</b> |

\*the values in the scenarios represent pollution values accruing from the level of uptake in that scenario multiplied by the corresponding value of benefits i.e. value of benefits in the high scenario equals the reduction in pollutants under the highest level of uptake times highest unit values (£/kg) corresponding the pollutants considered.

### ***Variations in Costs and Savings***

In this section we assess whether an increase or decrease in capital and operational cost savings impacts the net present values. Table E2 indicates that even a 25 percent fluctuation in capital and operational cost saving does not result in an unfavourable net present value.

**Table E2: Net present value accruing from 25% increase and decrease in capital costs and operational cost savings for all three scenarios (£m)**

|                                     | <b>Uptake</b> |                |            |
|-------------------------------------|---------------|----------------|------------|
| <b>Capital Cost</b>                 | <b>High</b>   | <b>Central</b> | <b>Low</b> |
| Net present value with 25% increase | £663.09       | £420.28        | £219.92    |
| Net present value with 25% decrease | £707.71       | £447.06        | £228.84    |
| <b>Operational Cost Savings</b>     | <b>High</b>   | <b>Central</b> | <b>Low</b> |
| Net present value with 25% increase | £777.80       | £513.02        | £279.38    |
| Net present value with 25% decrease | £592.99       | £354.32        | £169.38    |

### ***Variations in Benefits***

The sensitivity analysis for the impact on the lowest level of pollution and lowest unit values indicates that these do not adversely impact the net present values. For the purpose of the analysis we held all values apart from the one being manipulated a central value.

**Table E3: Net present value accruing from changes in unit values and pollution reduction (central uptake, £m, 2014 prices)**

|                   | Lowest unit value |               | Lowest level of pollution reduction |            |          |         |         |
|-------------------|-------------------|---------------|-------------------------------------|------------|----------|---------|---------|
| Pollutant         | Phosphorus        | Nitrous Oxide | Nitrates                            | Phosphorus | Sediment | FIOs    | Ammonia |
| Net present value | £424.00           | £358.60       | £436.10                             | £433.80    | £438.40  | £436.80 | £431.20 |

### ***Impact of Measures on Farm Businesses***

In order to assess the extent to which estimates of value-for-money are vulnerable to uncertainty in the impacts on farm businesses, we also conducted sensitivity testing on the impacts of implementing measures on farm businesses.

We firstly estimated the change in the central estimate of NPV across the range of estimated impacts on farm business income. Table E4 shows how NPV changes when we assume the most beneficial and the least beneficial values in the range of impacts on Farm Business Income.

**Table E4: Net Present Value estimates for the projected range of impacts on farm income from implementing measures (central estimates, central uptake, 2014 prices)**

| Impact of measures on farm business income | Net Present Value under Final Option |
|--|--------------------------------------|
| Least Beneficial                           | £307.2m                              |
| Central                                    | £440m                                |
| Most Beneficial                            | £570.0m                              |