

Title: Implementation of the Nitrates Directive in England 2013-2016 IA No: Defra1407 Lead department or agency: Defra Other departments or agencies: Environment Agency	Impact Assessment (IA)		
	Date: 18/10/11		
	Stage: Consultation		
	Source of intervention: EU		
	Type of measure: Secondary Legislation		
Contact for enquiries: Alex Bowness (alex.bowness@defra.gsi.gov.uk) Tel: 02072386710			
Summary: Intervention and Options			RPC Opinion: RPC Opinion Status

Cost of Preferred (or more likely) Option			
Total Net Present Value	Business Net Present Value	Net cost to business per year (EANCB on 2009 prices)	In scope of One-In, Measure qualifies as One-Out?
£8m	£8m	£0m	No
			NA

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

The Nitrates Directive is aimed at reducing water pollution from agriculture and requires the Government to review both our designation of Nitrate Vulnerable Zones, and the Action Programme of measures that applies inside them, every four years. Any new designations and measures must be in place by 1 January 2013 to help reduce nitrate pollution from agriculture to water. The shape of the Action Programme will depend on not only the responses to this consultation but also on negotiations with the European Commission.

What are the policy objectives and the intended effects?

The objective is to support agriculture and reduce the burden of reporting for farmers, improve the environment, and fulfil our obligations under the Directive. The Nitrates Directive seeks measures that reduce water pollution from agriculture. The proposed measures within the Consultation are aimed at reducing nitrate pollution from agriculture that are cost-effective and will gain Commission approval. Government will be looking to improve the efficiency with which all sources of nitrogen are used on farms, minimising pollution swapping (i.e. reducing losses of one pollutant that results in increased losses of another pollutant).

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

Four options are considered in the IA:

Option 1 – ‘Doing Nothing’ - maintain the existing Action programme within discrete zones (this poses EU Infraction risks) and is not considered as a preferred option.

Option 2- A package of proposals focusing on reporting requirements that reduce and simplify NVZ regulation but maintains current targeted approach.

Option 3- As in Option 2 –but also includes proposals on closed period is extended by 2 weeks and cover crops are required.

Option 4- As in Option 2 but assumes that these are applied to whole of England i.e a Whole England Approach (WEA) is adopted.

Will the policy be reviewed? It will be reviewed. If applicable, set review date: 2015					
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.	Micro Yes	< 20 Yes	Small Yes	Medium Yes	Large Yes
What is the CO ₂ equivalent change in greenhouse gas emissions? (Million tonnes CO ₂ equivalent)			Traded: Zero		Non-traded: Zero

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 SELECT SIGNATORY: _____ Chris Ryder _____ Date: _____ 19/10/11 _____

Summary: Analysis & Evidence

Policy Option 1

Description: Do nothing Option – Extend the current Nitrate Vulnerable Zones arrangements through to 2016

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2011	Time Period Years 5	Net Benefit (Present Value (PV)) (£m)		
			Low: Optional	High: Optional	Best Estimate: £8

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional	Optional	Optional
High	Optional	Optional	Optional
Best Estimate	£0		£0

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

This is the 'do nothing option' and has no additional costs above those of the current NVZ programme. The effectiveness of the existing programme has been previously assessed.

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

None

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional	Optional	Optional
High	Optional	Optional	Optional
Best Estimate	£0	£0	£0

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

There are no additional benefits with 'do nothing option'

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

None

Key assumptions/sensitivities/risks

Risk of Infraction. Potential cost have not been assessed due to uncertainties.

Discount rate (%) 3.5%

BUSINESS ASSESSMENT (Option 1)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: £0	Benefits: £0	Net: £0	No	NA

Summary: Analysis & Evidence

Policy Option 2

Description: Implement measures that reduce/simplify NVZ regulation

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2011	Time Period Years 5	Net Benefit (Present Value (PV)) (£m)		
			Low: Optional	High: Optional	Best Estimate: £8m

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional	Optional	Optional
High	Optional	Optional	Optional
Best Estimate	£0	£0	£0

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

Simplification option that does not result in additional costs

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

None

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional	Optional	Optional
High	Optional	Optional	Optional
Best Estimate	£0	£1.6	£8

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

Benefits stem from reduced paperwork which result in time savings for farmers.

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

Potentially less stress

Key assumptions/sensitivities/risks

Per hour time saved assumed to be £20/h

Discount rate (%)

3.5%

BUSINESS ASSESSMENT (Option 2)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: £0	Benefits: £1.6	Net: £1.6	No	NA

Summary: Analysis & Evidence

Policy Option 3

Description: Reduce/simplify NVZ regulation + increase closed period + require cover crops

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2011	Time Period Years 5	Net Benefit (Present Value (PV)) (£m)		
			Low: Optional	High: Optional	Best Estimate: -£11.4

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional	Optional	Optional
High	Optional	Optional	Optional
Best Estimate	£0	£4.6	£23

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

Majority of costs result from increased costs for farmers who have to establish cover crops.

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

None

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional	Optional	Optional
High	Optional	Optional	Optional
Best Estimate	£0	£2.3	£11.5

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

Benefits arise mainly from reduced water and air pollution. These account for majority of monetised benefits. Farmers will also benefit from lower fertiliser costs.

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

Reduced phosphate emissions have not been valued.

Key assumptions/sensitivities/risks

Discount rate (%) 3.5%

Results are sensitive to assumption about costs of establishing cover crops. For some farmers these could be less than assumed in the analysis. A lower-range estimate would produce a positive NPV estimate.

BUSINESS ASSESSMENT (Option 3)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: £4.2	Benefits: £1.6	Net: -£2.6	No	NA

Summary: Analysis & Evidence

Policy Option 4

Description: Reduce/simplify NVZ regulation and Whole England Approach is adopted

FULL ECONOMIC ASSESSMENT

Price Base Year 2011	PV Base Year 2011	Time Period Years 5	Net Benefit (Present Value (PV)) (£m)		
			Low: Optional	High: Optional	Best Estimate: -£36.9

COSTS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Cost (Present Value)
Low	Optional	Optional	Optional
High	Optional	Optional	Optional
Best Estimate	£67.6	£0	£67.6

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

Cost results from increased capital costs associated with need to increase slurry storage capacity by farmers currently not in a NVZ area.

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

Potential increase in admin burden which has not been monetised. These will be on going costs.

BENEFITS (£m)	Total Transition (Constant Price) Years	Average Annual (excl. Transition) (Constant Price)	Total Benefit (Present Value)
Low	Optional	Optional	Optional
High	Optional	Optional	Optional
Best Estimate	£0	6.1	£30.7

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

Benefits arise mainly from reduced water and air pollution. These account for majority of monetised benefits. Farmers will also benefit from lower fertiliser costs.

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

Potential reduced phosphate emissions have not been valued.

Key assumptions/sensitivities/risks

Assumption about cost of storage capacity is crucial in driving the results.

Discount rate (%) 3.5%

BUSINESS ASSESSMENT (Option 4)

Direct impact on business (Equivalent Annual) £m:			In scope of OIOO?	Measure qualifies as
Costs: £13.5	Benefits: £1.6	Net: -£11.9	No	NA

Evidence Base (for summary sheets)

Problem under consideration

1. The need to protect water courses through the implementation of control measures to minimise the leaching of nitrates into water courses, that can have an adverse effect upon ecosystem health, including water, biodiversity, climate, as well as human health. The Nitrates Directive has been in force since 1991 and requires Member States to establish a code of good agricultural practice to be applied by farmers on a voluntary basis throughout their national territory. In addition, the Directive requires an Action Programme of measures to be implemented by farmers either within areas of the country draining to nitrate-polluted waters (Nitrate Vulnerable Zones) or across the whole of the country (Whole Territory Approach). These measures are designed to reduce the level of nitrate leaching into water course and thereby protect ecosystems and improve water quality.
2. The Nitrates Directive requires Government to review both the designation of Nitrate Vulnerable Zones (NVZs), and the Action Programme (AP) of measures that applies inside them, every four years. The Government is required to do this for England, and have any new designations and measures in place by 1 January 2013.

Case for Government Intervention

3. Reactive nitrogen has both positive and negative outcomes. In the agricultural context it can increase soil fertility and productivity and thus increase crop yields. It can also impact negatively on ecosystems, particularly water, and on human health. One way in which reactive nitrogen is formed is through the production of Ammonia by the Haber–Bosch process and then used in agriculture to increase food, feed and fuel production. While the use of nitrogen as a fertilizer and chemical product has brought enormous benefits, losses of fertilizer nitrogen to the environment lead to many side effects on ecosystem health, including water, biodiversity, climate, as well as human health.
4. Nitrogen is an essential nutrient for plant growth and is therefore vital in food production. However, the use of nitrogen in manures and manufactured fertilisers poses risks to water quality (nitrate, ammonium), air quality (Ammonia and nitrous oxide – a greenhouse gas), biodiversity and soil quality. Over application and application during wet periods of organic fertilizers results in leaching of reactive nitrogen which harms water courses, biodiversity and reduces water quality.
5. The Water Framework Directive requires Member States to achieve ‘good status’ in all water bodies (surface and groundwater) by 2015 or such later date or such lower objective as may be justified in River Basin Management Plans adopted under that Directive. The Nitrates Directive (1991) and the Urban Waste Water Treatment Directive were confirmed as basic (obligatory) measures to implement the objectives of the Water Framework Directive. England faces a series of problems affecting the quality of its rivers, lakes, estuaries, coastal and marine waters, and ground waters.
6. Work is progressing to define the scale of the problem and the reasons for failure of water bodies. What we do know is that sensitive areas that have to be specially protected because they provide vital services to society are particularly affected (Nitrates from agriculture is the primary reason for 70% of Groundwater Drinking Water Protected Area failures, Faecal Indicator Organisms from agriculture are the cause of 80% of Bathing Water failures against the revised standards and 25% of the Phosphate that causes Surface Water failures is from farming). Analysis by the Environment Agency indicates that the greatest agricultural pressure is diffuse pollution (number of small sources) but it is also noteworthy that inappropriate management of slurry is reported to be responsible for over 60% of the serious pollution incidents caused by agriculture. Agriculture as a sector has been responsible for between 15- 20% of serious water pollution incidents over the past 5 years.

Introduction

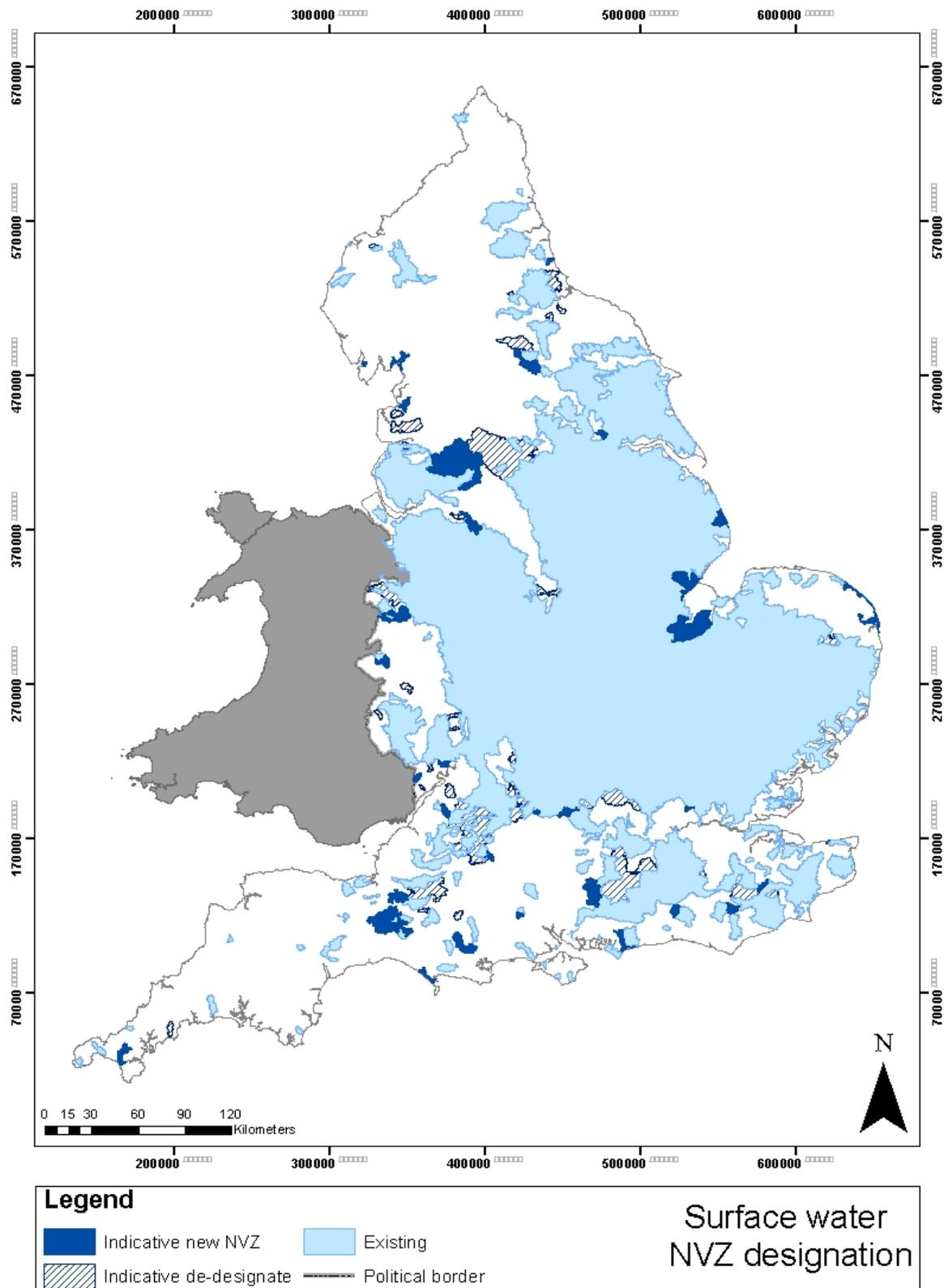
7. This document accompanies the Consultation 'The Protection of Waters against Pollution from Agriculture: Consultation on Implementation of the Nitrates Directive in England 2013-2016', hereafter 'the Consultation'. It provides an assessment of the costs and benefits of the different proposals set out in the Consultation.
8. The Nitrates Directive requires, as a minimum, that Member States designate discrete Nitrate Vulnerable Zones (NVZs) that drain into polluted waters and within which an Action Programme of measures is implemented by farmers. As an alternative, Member States may apply Action Programmes across the whole of their national territory. Ten EU countries have opted for the latter approach, including the UK in respect of Northern Ireland.
9. To date, in England the Government have opted to take a targeted approach and designate NVZs which currently cover approximately 62% of agricultural land in England. This is consistent with the objective of the Directive, which aims to reduce pollution where it occurs and ensure that those who contribute to it take action to reduce the pollution. This approach encapsulates the polluter pays principle. It also ensures that burdens are not imposed on those whose land does not drain to nitrate-polluted waters and therefore ensures the minimum of additional costs associated with implementation of the Directive
10. As set out above, because the Government has opted to take a target approach for England, the Nitrates Directive requires the Government to review the designation of NVZs, and the AP of measures that apply within them, every four years. This IA assesses the impact of proposals for the new Action Programme being consulted on.
11. In addition to proposals for the AP, the Consultation includes whether the current targeted approach of NVZ areas should be replaced by a move to a Whole England Approach (WEA) where the AP is applicable to the whole of England. The existing AP has been in place since January 2009 and many of the most recent surface and ground water monitoring results have shown a reduction in nitrate concentrations. This improvement can in part be attributed to the effect of the current and previous APs.
12. The complete set of proposed changes to the AP is set out in the Consultation document. In selecting the final package of measures to meet the obligations under the Nitrates Directive the Government will look for the best proposals for achieving the following goals:
 - Improving the efficiency with which all sources of nitrogen are used on farms
 - Achieving as cost-effectively as possible reductions in losses of nitrogen from agriculture (with associated benefits of improving water and air quality, and enhancing biodiversity)
 - Minimising pollution swapping (i.e. reducing losses of one pollutant that results in increasing the losses of another pollutant)
 - Delivering coherent interventions on Defra's two main priorities – supporting agriculture and improving the environment
 - Reducing the burden of reporting for farmers

Current Water Pollution Levels

13. Much has happened since the last review, In broad terms nitrate pollution has fallen, though there have been some areas where it has increased. It is difficult to ascribe causes with certainty, though one important factor in addition to the effect of the Nitrates Action Programme is likely to have been the continuing reduction in the use of manufactured nitrogen fertilisers.
14. One aspect of enhancing the environment is the implementation of the Water Framework Directive, and the size of this task is becoming increasingly clear. At present only about 28% of water bodies meet the Directive's objective of good status. To raise this figure, the Government announced on 22 March 2011 its intention to take a catchment-based approach (working with local people to find local solutions to local challenges) to meeting the Directive's aims more widely. This was an approach that the Task Force on Farming Regulation strongly endorsed in its report to the Government, published in May.

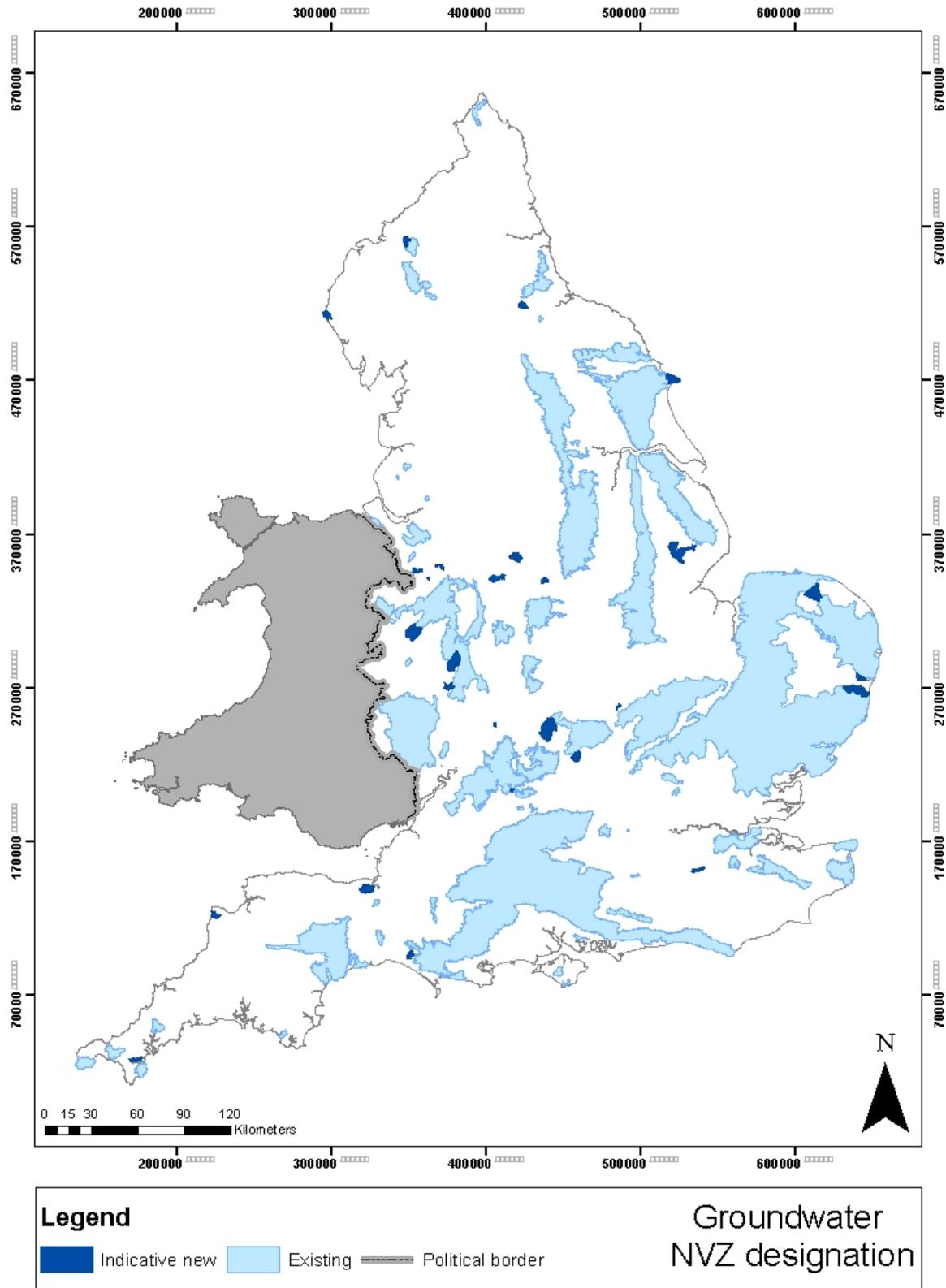
15. Figure 1 below shows the land identified as draining to polluted surface water. Surface water NVZs would cover 50.1% of England, compared with 48.1% (for surface waters only) in the 2008 round of designations. For surface water NVZs there have been small areas removed and other areas added as shown on the indicative map. Note that some of this land may remain designated because of polluted groundwater or eutrophication and therefore the percentage figures of the three indicative maps are not cumulative.

Figure 1: Indicative Surface Water NVZ Designation



16. Figure 2 below shows the land identified as draining to polluted groundwater. Groundwater NVZs would cover 25% of England, compared with 24.4% in the 2008 round of designations.

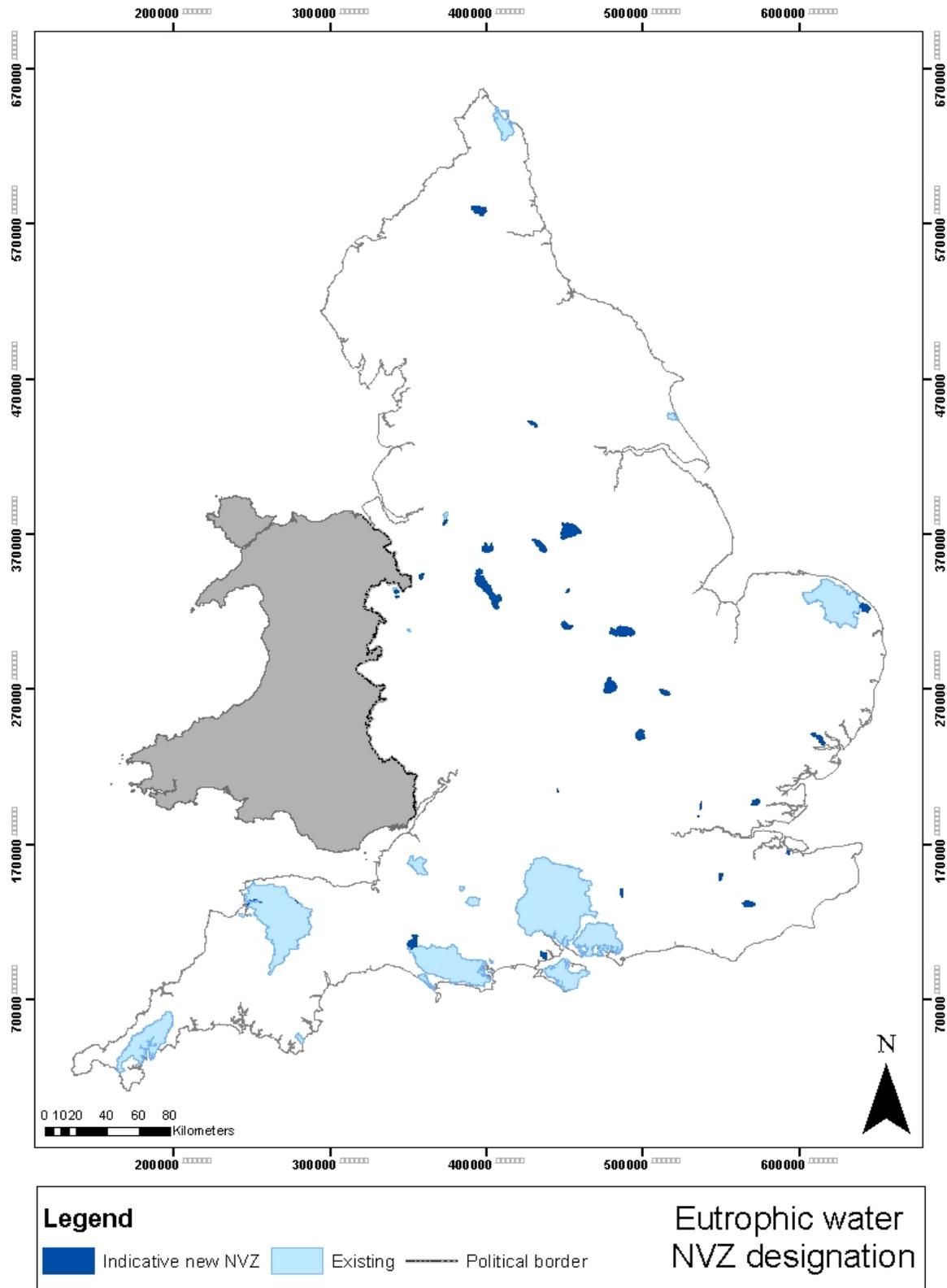
Figure 2: Indicative Groundwater Water NVZ Designation



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17. Figure 3 below shows the land identified as draining to eutrophic water. Eutrophic NVZs would cover 5.1% of England, compared with 4.6% in the 2008 round of designations. This increase in area reflects the inclusion for consideration of a larger number of water bodies, resulting from work done since the 2008 designations on implementing the Water Framework Directive. It does not necessarily mean that there are more waters in England where nitrate was responsible for eutrophication than in the past.

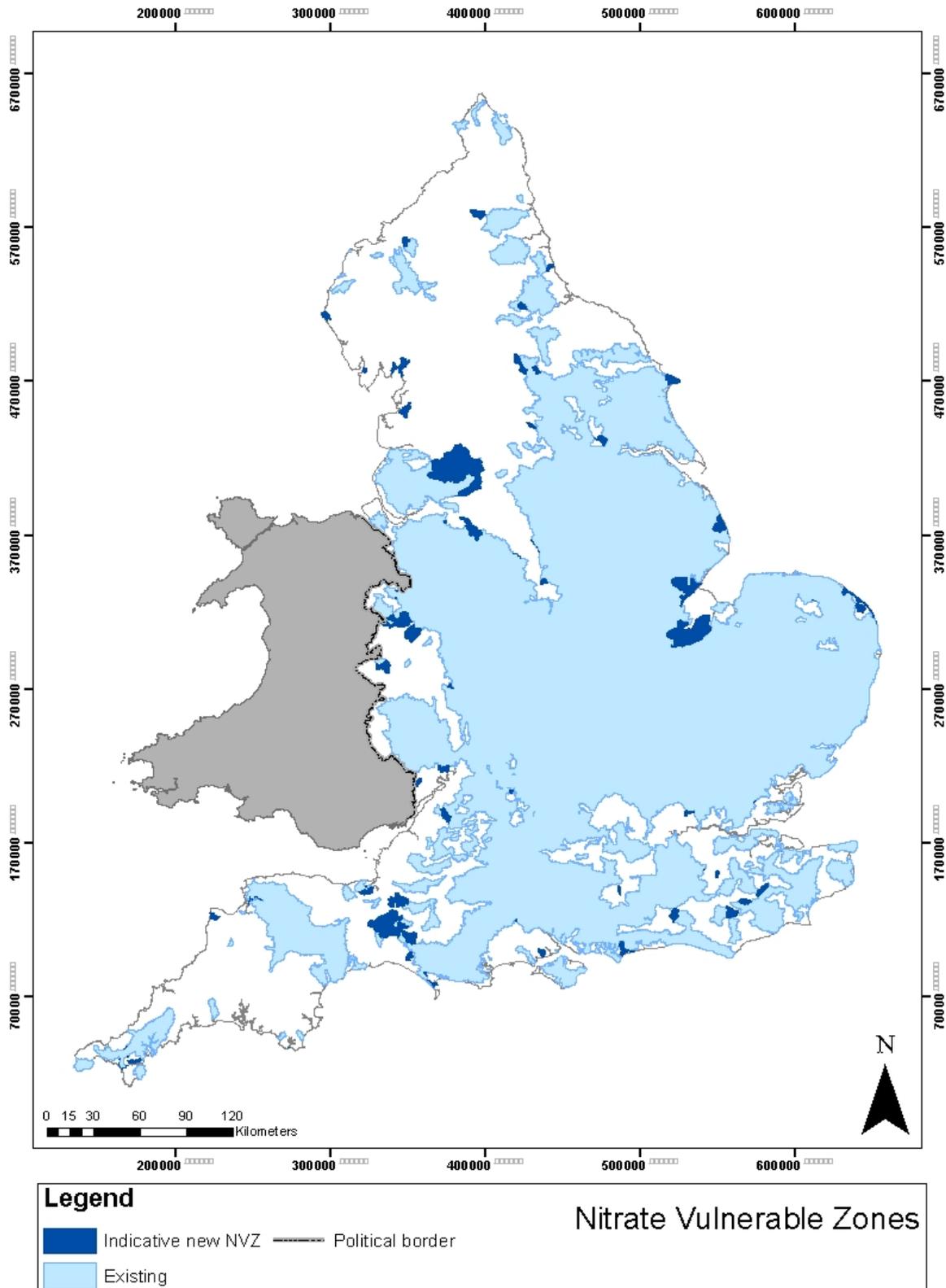
Figure 3: Indicative Eutrophic Water NVZ Designation



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18. Figure 4 combines the three individual maps. It shows all three classifications of NVZ, overlapping where this occurs. In total, taking account of the overlaps, about 61.5% of England would be indicative NVZs using this methodology. This compares with 68% that was identified for designation under the previous methodology, and the 62% which is the current NVZ designated area following the consideration of appeals. The indicative NVZ figure of 61.5% may slightly rise or fall as new water catchment boundaries and as the indicative boundaries are firmed up with field boundaries or other features over the next few months.

Figure 4 Indicative Combined NVZ Designation



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Analysis

19. This section sets out the methodology and assumptions for assessing the impact of proposals in the Consultation and provides, where possible, estimates of the monetary impacts.

Methodology

20. The application of organic manures to agricultural land, in addition to improving soil fertility and productivity, can result in 3 types of pollution: (i) Green House Gas (GhG) emissions to air; (ii) Ammonia emissions to air; and (iii) Nitrate-N emissions to water. Monetised damage costs associated with each of these pollutants from the literature have been used to assess the benefit of mitigation (see table 1 below).
21. Proposals within the Consultation will increase either, or both, capital and operational costs. The benefits from more efficient manure application include potential reduction in GhG emissions, Ammonia emissions to air and nitrate-N emissions to water. There is also the potential benefit to farmers of reduced synthetic fertiliser costs. The full range of variables that are impacted by the different proposals and their monetary value used in the analysis is given in table 1 below.

Table 1 Variable impacted on and their monetary value

Variable	Monetary Value (£)
Capital cost	Will vary by proposal
Operational costs	Will vary by proposal
Fertiliser savings (t)	£345 per tonne of product or £1,000 per tonne of nitrogen
GhG savings (t)	£58 tonne in 2011 prices ¹
Ammonia savings (t)	£2,238/t ²
Nitrate-N savings (t)	£716/t ³

22. Monetary costs/benefits of changes in emissions and fertiliser demand is estimated by change in tonnes multiplied by monetary value per tonne.
23. Four options are set out: Option 1 do nothing and maintain the current AP; Option 2 include a package of proposals that reduce and simplify NVZ regulations and maintains the current targeted approach i.e. NVZ area is not expanded to whole of England; Option 3 as in option 2 plus closed period is extended by 2 weeks and cover crops are required; Option 4 as option 2 but assumes proposals are applied to whole of England, i.e. targeted approach is replaced by Whole of England Approach.
24. The costs and benefits for all the proposals, except Option 1 where there are no additional costs or benefits since the current AP is maintained, are set in table 2 below.

Table 2 Total cost and benefits for Options 2-4 (£m)

Year	Option2			Option3			Option4		
	PVc	PVb	NPV	PVc	PVb	NPV	PVc	PVb	NPV
1	0.0	1.6	1.6	4.9	2.4	-2.6	14.5	6.1	-8.4
2	0.0	1.6	1.6	4.7	2.3	-2.4	14.0	6.3	-7.6
3	0.0	1.6	1.6	4.6	2.3	-2.3	13.5	6.2	-7.3
4	0.0	1.6	1.6	4.4	2.3	-2.1	13.1	6.1	-7.0
5	0.0	1.6	1.6	4.3	2.3	-2.0	12.6	6.0	-6.6
Sum	0.0	8.0	8.0	23.0	11.5	-11.4	67.6	30.7	-36.9

PVc = present value of costs, PVb = present value of benefits, NPV= net present value

Note that due to rounding techniques the figures in the above table do not always add up

¹ Value increases over time.

² Range of £1,745-£2,543/t taken from: <http://archive.defra.gov.uk/environment/quality/air/airquality/panels/igcb/guidance/damagecosts.htm>

³ Estimate taken from Defra project 'Economic benefits of measures to reduce diffuse water pollution from agriculture (DWPA) in England'

25. All options are assessed over 5 years (the AP may be re-assessed after this period). There are no additional costs or benefits for option 1 since this is simply maintaining the current AP. There is however a risk with this option of Infraction. We are unable to quantify the potential cost to the UK if Infraction proceedings were implemented because of the uncertainty around the likelihood that the UK would lose the case and what fines would be imposed. It is likely that any fines could be very significant. However, any fines imposed would be after the lifetime over which this IA assesses i.e. 5 years.
26. Option 2 has a positive NPV of £8m. That is implementing the proposals that reduce and simplify the NVZ regulations would have greater benefits than costs of around £1.6m per annum and £8m over 5 years. The option does not impose any additional costs for farmers as no additional requirements are imposed on them.
27. Option 3, which in addition to simplifying NVZ regulation also increases the closed period by 2 weeks and requires the use of cover crops in appropriate areas, has a negative NPV. The negative NPV results predominately from higher costs than benefits from the cover crops requirement. If this proposal were removed from the package of proposals in this option, the NPV would be positive. Similarly, if we reduced the estimate of the cost of establishing cover crops to the lower end of £20/ha, rather than £50/ha, then Option 3 also has a positive NPV. This sensitivity analysis suggests that extending the closed period and requiring cover crops (along with simplification) may not necessarily result in a high negative NPV.
28. Option 4, which is Option 2 applied to the whole of the UK, has a negative NPV of £36.9m over the lifetime. The negative results stems from the assumption around additional costs of slurry storage for farmers that are currently required to have just 4 months storage capacity. Even if storage costs were reduced by 20%, the NPV would still be negative which suggests that the costs of additional storage are considerably larger than the benefits of reduced emissions under this option.
29. The monetary estimate of the costs and benefits of the individual proposals in the Consultation are set out set out in the next section.

Uncertainty in the Analysis

30. There are a number of uncertainties that characterise the analysis: there is uncertainty around the underlying impact estimates and also the monetary values of damage costs for the different emissions. For example, although the central cost of carbon for non-traded GhG emissions in the UK is estimated to £58tCO₂e in 2014 the full range of the monetary cost estimate is £27-£87 per tonne of CO₂e, a of +- range of 50%. Similarly the damage cost estimate associated with Ammonia emissions fall over a large range. The central estimate used in the analysis is £2, 238 but the full range is £1,745 to £2,543 per tonne, a -22% +14% range. Sensitivity analysis has been carried out but only discussed in the text where it makes a meaningful impact on the outcome of the central analysis i.e. it changes the sign of the NPV. The NPV estimates for the each of the Options set out above is the central estimate and we believe provides a best estimate of the likely total costs and benefits of each Option. Outputs of the analysis have been presented in £m to avoid the impression of spurious accuracy.

Consultation Proposals

This section sets out the individual proposals in the Consultation and begins with estimating the costs and benefits of moving away from a target approach to a Whole England Approach (WEA).

Territory Designation

- 31 Consultation proposal: To move to Whole England Approach (WEA)
32. As set out above in England the Government has followed a targeted approach to meeting the requirements of the Nitrates Directive. Although this enables costs to be minimised and targets those areas where nitrates pollution is a particularly acute problem, there are drawbacks associated with this approach. In particular, the requirement to review the action programme every four years creates uncertainties for farmers and potentially increases costs over what they would be if a longer term framework were developed. A targeted approach also increases costs

for some farmers putting them at a competitive disadvantage compared to farmers outside of NVZs.

33. Moving to a Whole England Approach (WEA) which would avoid the 4 yearly review of boundaries would provide more certainty for farmers to make longer-term decisions on issues like amount of storage capacity or equipment for spreading manures etc. It would also provide benefits in terms of lower pollution and thus less environmental damage. ADAS have estimated the impact of moving to WEA as being:

Table 3

	Change ⁴
Capital cost	+£170m
Operational costs	N/A
Fertiliser savings (t)	1,785
GhG savings (t)	22,000
Ammonia savings (t)	750
Nitrate-N savings (t)	1,100

34. Capital costs are included because moving to whole territory would imply that farmers in England currently outside an NVZ would be required to increase storage capacity. To what extent capital costs for farmers increase will depend on how the move to WEA is implemented. Requiring farmers to meet the Action Programme requirements over time would be a means to minimise capital costs. The £170m estimate is a worst case scenario and assumes that all additional storage capacity is installed in one year. The consultation does seek stakeholder feedback as to transition periods.
35. There are also likely to be some additional operational costs associated with compliance which have not been quantified. The benefits of moving to a WEA approach are the environmental benefits associated with reduced GhG, Ammonia and nitrate-N emissions. Farmers would also benefit from reduced fertiliser costs due to improved soil fertility as a result of more efficient organic fertiliser application.
37. Annex A table 1 sets out the detailed figures. The headline results are presented here.
38. The potential amortised capital cost is estimated to be around £16m assuming an interest rate of 7%. Total annual benefits are expected to be around £4m. Overall, costs exceed benefits and the Net Present Value (NPV) is negative. The cost benefit ratio over a 5 year time period is estimated to be just over 3 i.e. costs are 3 times the value of benefits.
39. The above analysis assumes that the requirements on storage are implemented from when the designation is introduced and that there are no economies of scale. However, it is possible to mitigate the capital costs of requiring additional storage by allowing storage capacity to be built up over time, for example, by enabling the required capacity to be established as part of the natural investment plans for farms. This could reduce costs significantly. It would also mean that benefits would be generated gradually over time.

The Action Programme

40. This section sets out in detail estimates of costs and benefits of the proposals for the AP in the Consultation. The Consultation sets out proposals for the following areas of the AP:
- A. Rates and limits on the field application of organic manures and manufactured nitrogen fertilisers**
 - B. Closed spreading periods**
 - C. Restrictions on spreading**
 - D. Storage of organic manures**
 - E. Planning nutrient use and keeping records**
 - F. Cover crops**

⁴ Based on estimates produced by ADAS in NITRATES ACTION PROGRAMME: IMPACTS ON GREENHOUSE GAS EMISSIONS

41. The costs and benefits of relevant measures under each category are set out below.
42. There is some uncertainty around the underlying estimates that are used to carry out the cost/benefit assessment due to a lack of precise data on, for example, the take-up of current measures, the extent to which farmers already comply with the directive and the extent to which any proposed change will impact on emissions. The analysis within this IA is based on published research and more recent research carried out for Defra by ADAS that will be published during the Consultation period. Given the uncertainties the estimates presented in this IA are best estimates based on the current best available data and we believe provide a good indication of the direction of costs and benefits.
43. The baseline, or do nothing, against which each proposal is assessed assumes that the existing Action Programme (AP) is implemented in the current NVZ area. Where costs/benefits are expected to be marginal but their values are not known, no quantification is provided. Each proposal is assessed under the two options: Option A: the AP proposal applies to the current NVZ area; Option B: the AP proposal applies under WEA.

A. Rates and limits on the field application of organic manures and manufactured nitrogen fertilisers

44. Consultation proposal: (i) Crop available nitrogen from all types of organic manures to be used for estimating compliance with maximum Nitrogen (N) limits (N Max limits).
45. The Nitrates Directive sets a number of fertiliser allocation limits: Organic Manure N Field Limit of 250kg/ha in any 12 months; the Livestock Manure N Farm Limit of 170kg/ha/calendar year of nitrogen produced by farm livestock averaged across the agricultural area of the whole farm, and the Nmax limits.
46. There are no proposals to change these limit levels. However, a technical change to the nitrogen-containing materials that must be included in the calculations of the nitrogen contributions to the Nmax calculation is proposed. At present the only materials that the Nitrates Regulations require farmers to count towards Nmax are farm livestock manures and manufactured nitrogen fertilisers. Any nitrogen derived from sewage sludge (biosolids), compost or other organic manures that do not originate from farm livestock are simply ignored. We propose to remove this anomaly because it increases the risk of pollution through underestimating nitrogen applied to the crop. The Government believes that all N in all organic manures should be counted in the Nmax calculation. This would increase the accuracy of estimates of crop available N and therefore reduce the risk of over applying N.
47. Crop yields would not be harmed as a result of this change as it is still possible to apply the optimum level of N. Farmer costs could be reduced as the need to apply additional synthetic fertiliser could be reduced. However, any costs or benefits to the farmer are not expected to be significant. There is of course the benefit to the environment of reduced risk of N pollution (and potentially other pollutions such as phosphate). We do not have sufficient detailed information to be able to estimate these potential benefits and attempting to ascertain the necessary detail is likely to involve disproportionate cost. However, we do not expect these potential environmental benefits to be very large.
48. The cost benefit impacts are not expected to be significantly different whether the current targeted approach is followed or whether a WEA is taken.

B. Closed spreading periods

49. Consultation Proposal: (i) keep current closed periods; (ii) extend closed period by 2 weeks for medium/heavy soils; (iii) extend closed period by 1 month for medium/heavy soils.
50. The Nitrates Directive requires the establishment of 'closed periods' that prohibit the spreading of organic manures that contain high readily available nitrogen (e.g. slurry, poultry manure and liquid digested sludge) to land at times of the year when the risk of nitrate loss is high, that is when the ground is generally wet and crop growth, and therefore nitrate demand, low. The 'current closed' period is 4 months for grassland with sandy/shallow soil but just 3 months for all

other soils. For tilled land with sandy/shallow soils the closed period is 5 months. For all other soils the tilled land closed period is 3½ months.

51. The existing AP does not prohibit all manure spreading within closed periods (e.g. farm yard manure) but does prohibit the spreading to land of organic manures with a high readily available N content (i.e. more than 30% of the total N content is in a form that can be readily taken up by the crop – these manures are pig and cattle slurry and poultry manure) in the following periods, i.e. the closed period:

Table 4

	Grassland	Tillage land
Sandy or shallow soils	1 Sept to 31 Dec (4mths)	1 Aug to 31 Dec (5mths)
All other soils	15 Oct to 15 Jan (3mths)	1 Oct to 15 Jan (3½mths)

52. In addition to the closed period, all farms within NVZs are expected to have some spare storage capacity to allow for weather or ground conditions that prevent spreading immediately after the end of the closed period. Pig and poultry farms are expected to have 6 months manure storage capacity and dairy and beef farms 5 months. There is no need to extend this requirement, because the proposals on extending the closed period imply that farmers should still have spare capacity, although it will be reduced. Requiring farmers to increase storage capacity above the current AP requirements could have significant cost implications.
53. Research to investigate the effect on nitrogen pollution of extending the closed period was undertaken by ADAS/Rothamsted Research on behalf of Defra (2011). The research demonstrated that the later in the winter slurry is applied, the lower nitrate leaching is. On sandy/shallow soils, leaching from slurry applied after mid-late January is negligible. On medium/heavy soils, leaching is considerably reduced at this time compared with slurry applied in November. However, about 10% of what is applied can still be lost to water under average rainfall conditions due to rapid drainage through soil cracks or by surface runoff. These results show that closed periods are important in reducing the risk of nitrate leaching in high risk areas.
54. In the absence of any other considerations, the evidence might suggest longer closed periods on medium/heavy soils and also, although to a lesser extent, on sandy/shallow soils. However it is difficult to set mandatory closed periods that eliminate the risk of leaching yet allow practical beneficial application of manures to agricultural land. There is already a limited time in spring for the application of slurry if growing crops are not to be damaged or grass is to be suitable (uncontaminated) for grazing or silage making. Moreover, if more slurry is applied in summer, Ammonia losses are likely to increase. There is therefore a balance to be struck between minimising nitrate losses by spreading manures later and keeping Ammonia losses down by spreading before it gets too warm. The policy goal is to encourage manure application in spring and summer to meet the period of high crop N requirement and to achieve a more integrated approach to minimise potential pollution.
55. Government wants to avoid farmers needing to increase storage above that required under the existing AP. The Consultation therefore proposes three options on closed periods for organic manures: (i) keep to the current periods; or (ii) extend by 2 weeks for medium/heavy soils; or (iii) extend by one month for medium/heavy soils. Option (ii) and (iii) are set out below:

Table 5

Option II Extend by 2 weeks for medium/heavy soils	Grassland	Tillage land
Sandy or shallow soils	1 Sept to 31 Dec (SAME)	1 Aug to 31 Dec (SAME)
All other soils	15 Oct to 31 Jan (CHANGE)	1 Oct to 31 Jan (CHANGE)

Option III Extend by 1 month for medium/heavy soils	Grassland	Tillage land
Sandy or shallow soils	1 Sept to 31 Dec (SAME)	1 Aug to 31 Dec (SAME)
All other soils	15 Oct to 15 Feb (CHANGE)	1 Oct to 15 Feb (CHANGE)

56. Extending the closed period for medium/heavy soils will have costs and benefits (option (i) has no additional costs or benefits as it maintains the status quo). There are costs associated with increasing storage capacity, if this is necessary. However, even under option (iii) storage capacity will still exceed 2 weeks (for cattle farms) and 6 weeks (for pig farms). The analysis thus assumes no increase in spare storage capacity over and above that currently required.
57. Ammonia emissions are also likely to rise if the closed period were to be significantly extended as it would mean more manure being applied when it is warmer. Synthetic fertiliser costs could also rise as more may need to be applied due to the shorter period when organic fertilisers can be applied, although this effect is expected to be small.
58. The benefits of extending the closed period arise due to a reduction in GhG emissions and reduced nitrate-N leaching to water.
59. The analysis below assumes that there is full compliance with both the current and proposed AP. Should compliance be less than that assumed in the baseline then costs and benefits will both be less but the net monetary effect will be in the same direction.

Table 6 below sets out the annual impact on costs and emissions of option (ii) and (iii) relative to option (i). The NPV is assessed over a 5 year period as the AP could be reassessed after 5 years.

Table 6 Impact on costs and emissions of option (ii) and (iii) over option (i)

	Option II: Increase Closed Period by Two Weeks	Option III: Increase Closed Period by One Month
Year	1	1
Capital costs of extra slurry storage (£)	Zero	Zero
Annual amortised costs (£)	Zero	Zero
Additional operation costs	0	0
Synthetic fertiliser usage (t)	Neg	+100
GHG emissions (tCO₂e)	-2,500	-5,000
Ammonia-N emissions (t)	+200	+400
Nitrate-N emissions (t)	-200	-400

60. The impact of option (iii) is twice that of option (ii), i.e. the analysis assumes that the impact on emissions is linear. The detail analysis is in Annex A tables 2-5.
61. The NPV of option (ii) is -£0.7m, i.e. a net loss to society of just under £0.7m over the lifetime (5 years). This is a relatively low cost and equates to around £0.1m annual cost. As no capital costs are associated with increased storage capacity, the loss results from the estimate of damage costs associated with Ammonia emissions. These are estimated to be £0.4m in 2014. Thus, although the annual increase in Ammonia emissions is expected to be very minor as a result of increasing the closed period by two weeks, the high estimate of damage costs makes these costs significant.
62. Given the uncertainties around some of the estimates, for example estimates of damage costs of Ammonia emissions or the extent to which Ammonia emissions would in fact increase as a result of this change; it would not be unreasonable to conclude that the net effect of the proposed change will in fact be negligible. If we apply the lower estimate for Ammonia damage costs (£1745 rather than £2238) then NPV falls to a loss of less than £0.3m over the lifetime of the policy.
63. The net impact of option (iii) is a net loss to society of over £1.5m over the lifetime, i.e. double those for option (ii). This equates to an annual average loss of just over £0.3m. The driver of this loss is again the increase in Ammonia emissions. The cost/benefit ratio is 1.5 over the lifetime, i.e. costs are 1.5 times benefits.

64. Sensitivity analysis around some of the key variables does not alter this picture greatly and costs are still greater than benefits. However, as with option (II) neither cost or benefits are expected to be very high.

Whole England Approach (WEA)

65. The proposals do not change under a WEA, however, the area impacted does and so do the estimates of costs and benefits. The costs and benefits of comparing a WEA where the closed period is extended as in option (ii) and (iii) above with a WEA where the current closed period is maintained are set out in table 7 below.

Table 7 Impact on costs and emissions of option (ii) and (iii) over option (i) (WEA)

	Option II: Increase Closed Period by Two Weeks	Option III: Increase Closed Period by One Month
Year	1	1
Capital costs of extra slurry storage (£)	Zero	Zero
Annual amortised costs (£)	Zero	Zero
Additional operation costs	0	0
Synthetic fertiliser usage (t)	+70	+140
GHG emissions (tCO₂e)	-7,000	-14,000
Ammonia-N emissions (t)	+250 ⁵	+500
Nitrate-N emissions (t)	-450	-900

66. The impacts of increasing to 1 month are assessed to be twice that of increasing by 2 weeks. The NPV assessed over a 5 year period is estimated to be +£0.6m from increasing the closed period by 2 weeks and +£1.3m when increasing by 1 month. Overall benefits exceed costs by a factor of 1.3. The net impact is positive because GhG savings are proportionally greater than the increase in Ammonia emissions, relative to the under the current NVZ. This is due to the fact that territory currently not in an NVZ is generally wetter than territory in NVZ and thus negative impact of closing the closed period on Ammonia emissions is relatively small but positive impact on GhG and nitrate-N emissions is quite large. The net impact is that benefits are greater than costs.
67. Detailed figures for the above options can be found in Annex A tables 2 and 3

C. Restrictions on spreading

68. Consultation proposal: Allowing farmers using precision spreading techniques to spread manures closer to watercourse.
69. Precision slurry spreading techniques such as band-spreading and shallow injection reduce the risk of pollution, particularly Ammonia, as these techniques enable slurry to be spread much more precisely and thus effectively. They also significantly increase manure N use efficiency. The Consultation proposes to encourage the use of these techniques by allowing farmers using these methods to spread manures closer to watercourses. Allowing farmers to do this should increase their productive area and also reduce their fertiliser costs.
70. Although precision slurry spreading techniques minimise the risk of pollution and improve efficiency of manure spreading, the cost of the equipment (contractor) is considerably higher than that of conventional spreading. However, the Consultation does not propose to impose the use of precision spreading techniques and thus we would expect those farmers who already use, or plan to use, such equipment to take-up this opportunity in some cases. Therefore, the proposal is not assessed to impose any costs. There will be some environmental benefits, and cost

⁵ Ammonia emissions are up only marginally relative to current NVZ but GhG savings are significant. This due to the territory currently out of NVZ area being wetter than that in NVZ and thus impact of increasing closed period on Ammonia emissions is only marginal.

savings for the farmer, should farmers choose to take-up this opportunity. These are not expected to be large given that the option could only be applied in limited circumstances. Given this, and the fact that we do have an estimate of the likely take-up, no benefit estimate is made.

71. There would be no additional cost even under a WEA (since this is a voluntary option) and again we do not have sufficient information to estimate benefits. However, these are expected to be only marginal.

D. Storage of organic manures

72. Consultation proposals on: (i) Methodology to calculate the capacity of storage vessels, (ii) on field storage of solid livestock manures.
73. The first proposal is about simplifying the rules around how storage capacity is calculated and does not imply any additional costs. There may be some very small administration benefits due to reduced rules but these are not assessed. The second proposal is to keep the existing rules around storage of solid manure in fields. No change is proposed relative to the existing AP and thus there are no additional costs/benefits even under WEA.

E. Planning nutrient use and keeping records

74. Consultation Proposal: (i) Reduce 'Nutrient Management Planning' record keeping, (ii) Reduce 'general' record keeping burden, (iii) Remove duplication: certified organic farms do not have to demonstrate compliance with NVZ.
75. The aim of the proposals on record keeping is to reduce the administrative burden on farmers and reduce 'red tape'. The Task Force suggested that government could take a number of steps to reduce the administrative burden on farmers and the proposals aim to do this while also maintaining environmental standards.
76. Taken all together, the proposals are expected to reduce the administrative cost for farmers by around £1.6m p.a. This estimate is based on reduced time savings for farmers using a cost saving rate of £20 per hour. Reduced nutrient planning is expected to generate an annual saving of around £0.7m, record keeping- general burden £0.3m, and recording keeping- avoiding duplication £1m. The figures do not sum to £1.6m since some farmers will qualify for the same admin saving under the different categories. This impact (overlaps) is estimated to be around £0.4m.

Whole England Approach

77. Administration costs would be reduced under the WEA as a result of the recording keeping proposals in the Consultation relative to the status quo on recording keeping. However, overall administration costs would be higher by moving to WEA since farmers currently not expected to keep records would be expected to do so. In this section we only assess the benefits/costs of the proposals on reducing recording keeping rather than the impact on farmer's total admin costs as a result of a move to WEA.
78. More farmers will be affected by the proposals to reduce admin burden under the WEA than the current NVZ. Overall, the impact of the proposals on a WEA approach is expected to be around £2.2m p.a. Individually the benefits are expected to be £1.0m, £0.4m and £1.4m respectively, with overlaps estimated to be around £0.6m.

F. Cover crops

79. The Consultation also proposes the inclusion of cover crops in the new AP. Specifically the proposal is to require cover crops on sandy soils over areas designated as groundwater NVZs, where the ground would otherwise be left bare over winter. In these circumstances landowners/farmers would be required to establish or maintain a cover crop if the land would otherwise be bare for a significant period between 1st September and 15th January (i.e. crop harvested before 1st Sept and following crop not planted until after 15th Jan). In such cases the cover crop would have to be planted (or achieved in part through volunteers) by 15th September and not destroyed until after 15th December. Bare soil would be defined as a "soil without a growing crop".

80. Evidence from ADAS suggests establishment of cover crops in the above circumstances can reduce nitrate leaching into ground water by as much as 10%. This would have environmental benefits for water as a result of reduced N leaching because the cover crop takes up N and releases it in the spring when the cover crop is destroyed. These benefits are likely to be greatest on nitrate 'leaky' sand and shallow soils.
81. This is not a cost free option. The establishment and destruction of cover crops will have cost implications for farmers. ADAS estimate that the cost of these activities are likely to be in the region of between £20-£115/ha depending on the type of activity the farmer engages in, and that around 100,000 ha of land would meet the requirement of needing to establish cover crops. The IA analysis assumes that the average cost is £50 ha per annum and that this cost is applicable to all 100,000 ha. The benefits of the measure are reduced nitrate-N emissions of 10% p.a. The annual cost benefits are:

Table 8

	£	Total (£)
Cost to establish and remove cover crop	£50/ha	£5m
Avoided Damage cost of nitrate-N emissions	£716/t	£0.6m
Per annum net impact		-£4.4m

82. Per annum total costs are estimated to be higher than total benefits by around £4.4m. The NPV of the measure over a 5 year period is therefore negative and around -£19m. As indicated above, the range of costs that farmers will face varies considerably. The above analysis assumes that the weighted average cost is £50/ha. However, the distribution of costs may mean a lower average cost. If average cost were £20/ha then the per annum net impact, although not positive, would much smaller at around -£1m p.a. The NPV over the life-time (5 years) would in this case be around -£6m.
83. Assuming that nitrate-N savings are lower than the 10% assumed above does not alter the analysis to any significant extent. For example, in the above analysis under a per ha cost of establishment of £50 the life-time NPV is -£19m. Assuming that nitrate-N savings are only 5% changes this figure -£20m, and increase of £1m over the figure years or just £0.2m p.a.

Whole England Approach

84. Moving to a WEA would not produce an outcome very different from that assessed above. This is due to limited land where cover crops would be assessed to be applicable outside the current NVZ territory.

Annex A

Table 1 Cost and benefits of moving to Whole England Approach

Costs/benefits of moving to Whole England Approach (WEA) (£m)⁶					
Year	1	2	3	4	5
Capital cost (amortised)	16.0	16.0	16.0	16.0	16.0
Value of fertiliser savings	0.6	0.6	0.6	0.6	0.6
Value of GHG savings	1.2	1.2	1.2	1.3	1.3
Value of Ammonia N savings	1.7	1.7	1.7	1.7	1.7
Value of nitrate-N savings	0.8	1.2	1.2	1.2	1.2
Discount factor	1.1	1.1	1.2	1.2	1.3
Total costs	16	16	16	16	16
Total benefits	4.3	5	5	5	5
PV costs	14.5	14.0	13.5	13.1	12.6
PV benefits	3.9	4.1	4.0	3.9	3.8
Total PV costs	68				
Total PV benefits	20				
NPV	-48				

Table 2 Cost and benefits of increasing closed period by two weeks (Current NVZ)

Option 2: Increase Closed Period by Two Weeks (£)					
Year	1	2	3	4	5
Amortised Capital cost	0	0	0	0	0
fertiliser savings	0	0	0	0	0
GHG savings societal benefit (£)	0.1	0.1	0.1	0.2	0.2
Ammonia N savings societal benefit (£)	-0.4	-0.4	-0.4	-0.4	-0.4
Nitrate-N savings societal benefit (£)	0.1	0.1	0.1	0.1	0.1
Total costs	0.4	0.4	0.4	0.4	0.4
Total benefits	0.3	0.3	0.3	0.3	0.3
Discount factor	1.1	1.1	1.2	1.2	1.3
PV Costs	0.4	0.4	0.4	0.4	0.4
PV benefits	0.3	0.3	0.2	0.2	0.2
PV total costs	1.9				
PV total benefits	1.2				
NPV total costs/benefits	-0.7				

⁶ Figures may not sum due to rounding

Table 3 Cost and benefits of increasing closed period by one month (current NVZ)

Option 3: Increase Closed Period by One Month (£m)					
Year	1	2	3	4	5
Amortised Capital cost	0	0	0	0	0
fertiliser cost savings	-0.03	-0.03	-0.03	-0.03	-0.03
GHG savings societal benefit	0.3	0.3	0.3	0.3	0.3
Ammonia N savings societal benefit	-0.9	-0.9	-0.9	-0.9	-0.9
Nitrate-N savings societal benefit	0.3	0.3	0.3	0.3	0.3
Total costs	0.9	0.9	0.9	0.9	0.9
Total benefits	0.6	0.6	0.6	0.6	0.6
Discount factor	1.1	1.1	1.2	1.2	1.3
PV Costs	0.8	0.8	0.8	0.8	0.7
PV benefits	0.5	0.5	0.5	0.5	0.5
PV total costs	3.9				
PV total benefits	2.5				
NPV total costs/benefits	-1.4				

Table 4 Cost and benefits of increasing closed period by two weeks (WEA)

Option 2: Increase Closed Period by Two Weeks (WEA) (£m)					
Year	1	2	3	4	5
Amortised Capital cost	0	0	0	0	0
fertiliser cost savings	-0.02	-0.02	-0.02	-0.02	-0.02
GHG savings societal benefit	0.4	0.4	0.4	0.4	0.4
Ammonia N savings societal benefit	-0.6	-0.6	-0.6	-0.6	-0.6
Nitrate-N savings societal benefit	0.3	0.3	0.3	0.3	0.3
Total costs	0.6	0.6	0.6	0.6	0.6
Total benefits	0.7	0.7	0.7	0.7	0.7
Discount factor	1.1	1.1	1.2	1.2	1.3
PV Costs	0.5	0.5	0.5	0.5	0.5
PV benefits	0.7	0.6	0.6	0.6	0.6
PV total costs	2.5				
PV total benefits	3.1				
NPV total costs/benefits	0.6				

Table 5 Cost and benefits of increasing closed period by one month (WEA)

Option 3: Increase Closed Period by One Month (WEA) (£m)					
Year	1	2	3	4	5
Amortised Capital cost	0	0	0	0	0
fertiliser cost savings	-0.05	-0.05	-0.05	-0.05	-0.05
GHG savings societal benefit	0.8	0.8	0.8	0.9	0.9
Ammonia N savings societal benefit	-1.1	-1.1	-1.1	-1.1	-1.1
Nitrate-N savings societal benefit	0.6	0.6	0.6	0.6	0.6
Total costs	1.2	1.2	1.2	1.2	1.2
Total benefits	1.5	1.5	1.5	1.5	1.5
Discount factor	1.1	1.1	1.2	1.2	1.3
PV Costs	1.1	1.0	1.0	0.9	0.9
PV benefits	1.3	1.3	1.2	1.2	1.2
PV total costs	4.9				
PV total benefits	6.2				
NPV total costs/benefits	1.3				