REVIEW OF DRAFT NORTHERN IRELAND AMMONIA STRATEGY

Report for: Office for Environmental Protection

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1. INTRODUCTION

The Northern Ireland consultation on ammonia sets out a two-tier approach for reducing the impact of ammonia in Northern Ireland. The two approaches are to reduce ammonia emissions, and to take action to protect and restore natural habitats. The draft strategy includes 21 questions for consideration by consultees.

The strategy covers the following topics:

- Introduction and Background to Ammonia in Northern Ireland
- Addressing the Ammonia Challenge: Actions so far
- The Strategic Approach to Ammonia
- Pillar One: An Ammonia Reduction Programme
- Pillar Two - Conservation Actions to Protect and Restore Nature
- Conclusions and Timelines

Annexes are provided which provide case studies and set out the background to the preceding "Making Ammonia Visible" strategy.

Ricardo was commissioned by the Office for Environmental Protection (OEP) to review the scope and content of this consultation document, and this report provides feedback addressing the following high-level questions. The views and opinions expressed in this report are those of Ricardo, and do not represent the opinion or position of OEP. This report is designed to support OEP in its mission to "*protect and improve the environment by holding government and other public authorities to account*". This review aims to answer the following questions:

- Does the consultation cover all the relevant issues for mitigation of the impacts of ammonia in Northern Ireland – are there any apparent gaps?
- Are the conclusions and proposals supported by the data presented in the report?
- Are the proposed actions reasonable, sufficient, and achievable?

We have also provided specific feedback on the following questions included in the consultation document.:

- Q1: What are your views on the Northern Ireland wide 2030 targets outlined in the 3.1 Targets section?
- Q4 to Q13: Request for views on 10 specific agricultural ammonia mitigation techniques
- Q16: What are your views on the proposals for spatially targeted measures around designated sites?
- Q17. What are your views on the proposed conservation actions to restore habitats and support sustainable development?

2. HIGH LEVEL QUESTIONS

2.1 TOPIC COVERAGE

The question for consideration here is whether the consultation covers all the relevant issues for mitigation of the impacts of ammonia in Northern Ireland, and to identify any apparent gaps.

The current consultation focuses exclusively on ammonia emissions from agriculture as it is the dominant source of ammonia emissions in the UK. Agriculture accounted for 87% of total UK emissions in 2020, and 97% of ammonia emissions from Northern Ireland. The focus on ammonia is appropriate.

Other potentially relevant sources of ammonia include waste management and road traffic. These each accounted for about 0.5% of emissions from Northern Ireland in 2020.

2.1.1 Waste sector

While minor at present, emissions from the waste sector could potentially grow in the future if there is significant investment in waste treatment infrastructure such as composting and anaerobic digestion of wastes.[1] This could be an important component of a move towards a circular bioeconomy in Northern Ireland (for example, for anaerobic digestion, see item 17 in Reference 2).

While minor at present, we consider that the strategy should re-emphasise the importance of avoiding adverse impacts from waste infrastructure at sensitive habitat sites. At the same time, the growing use of anaerobic digestion for treatment of agricultural wastes as part of a strategic move towards a circular economy could potentially reduce ammonia emissions from the spreading of agricultural wastes on fields near to nature conservation sites.

This can be managed through the waste planning process, to ensure that new infrastructure is located close enough to handle agricultural wastes from farms close to or within nature conservation sites, but far enough away from designated sites to avoid any significant contribution to ammonia levels and nitrogen deposition at these sites. The planning and (where applicable) permitting process must ensure that strategic planning allows for benefits to be optimised and impacts to be avoided and must ensure that suitable assessment and control of potential impacts of proposed new facilities is carried out.

2.1.2 Road traffic

Even though road traffic is a relatively minor source of ammonia in Northern Ireland, road traffic can have a significant near-field effect on levels of airborne ammonia close to roads. For example, Chatain *et al*.[3] found that levels of ammonia measured close to an urban road between 2019 and 2021 were elevated by between 1 and 10 µg/m^3. This would correspond to an increment of between 30% and 1000% of the Critical Levels for airborne ammonia, highlighting the potential importance of road traffic emissions in the near vicinity of major roads.

Emissions of ammonia from road traffic could potentially increase if there is more widespread deployment of additives such as “AdBlue”, used to reduce NOx emissions from diesel-engine vehicles. Projected emission estimates of ammonia emissions from road transport in the UK were obtained from the National Atmospheric Emissions Inventory. Total road transport ammonia emissions increased by 41% from 2020 to 2030 and by a further 1.4% from 2030 to 2040 (see Figure 1).[4]

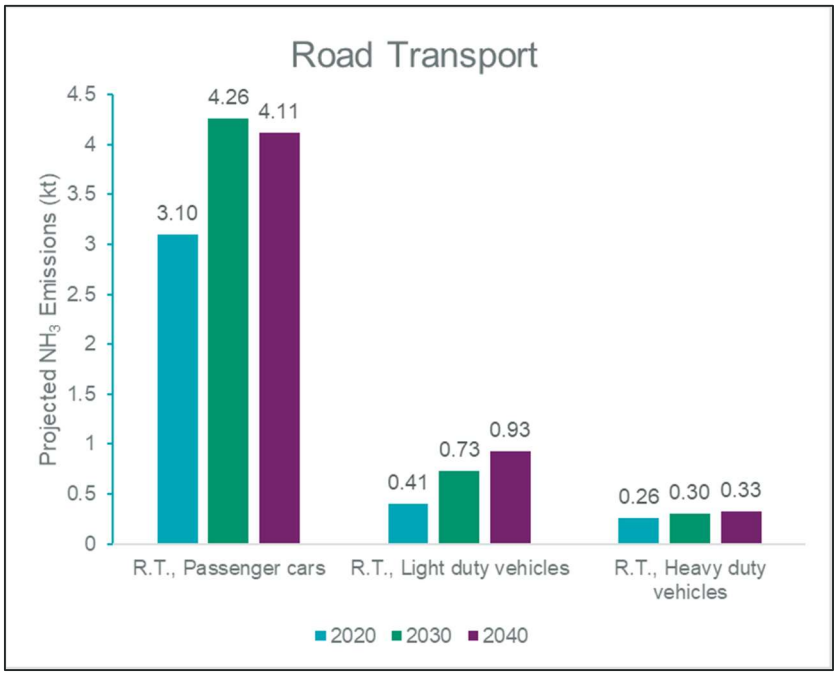
[1] https://naei.beis.gov.uk/data/ (data for NFR Categories 5B1 and 5B2.

[2] Northern Ireland Executive, “Energy Strategy for Northern Ireland: the path to Net Zero Energy: Action Plan 2022”

[3] Mélodie Chatain Eve Chretien,Sabine Crunaire and Emmanuel Jantzem, Road Traffic and Its Influence on Urban Ammonia Concentrations (France)”, Atmosphere 2022, 13(7), 1032; https://doi.org/10.3390/atmos13071032

[4] Derived from “Reporting table for the UNECE/EMEP 2014 Guidelines for Reporting Emissions and Projects Data under Convention on Long-Range Transboundary Air Pollution, Country: GB,” 28 June 2022, version 1.0

Figure 1: Projected UK emission estimates for ammonia from the road transport sector.



We reflect that the Ammonia Strategy should consider the potential influence of road traffic on nature conservation sites in the vicinity of the roads. The strategy should consider whether specific measures are required to ensure that the impacts of these emissions do not worsen in the future.

The strategy should also consider whether further measures are needed to reduce the impact of traffic from the existing road network and any new planned roads, in view of the likely increase in ammonia emissions from this source between the present day and 2030. If required, measures that aim to reduce the use of higher emitting vehicles could be developed and implemented. For example, accelerated deployment of low-emitting options such as hydrogen or electric vehicles could be facilitated, most likely as part of a wider strategy to move to low-emitting road transport in Northern Ireland and the UK as a whole. This could potentially have wider benefits for sustainable transport, mobility, and road safety. If required, such national-scale measures could potentially be supplemented by spatially targeted measures such as:

- Low emission zones, which could potentially be implemented to reduce the numbers of higher polluting vehicles on roads near designated sites.
- Tree belts located between road links and sensitive areas, subject to space and other constraints (for example, potential shading, potential effects on species and predator behaviours)
- Speed management for major roads near sensitive receptors

We reflect that these matters should be considered in the final Northern Ireland Ammonia Strategy.

Robustness of Supporting Evidence

The evidence provided in the draft Ammonia Strategy underlines the importance of dealing with Northern Ireland's ammonia emissions:

- Northern Ireland has 6% of the UK land area and 3% of the population, but is responsible for 12% of UK ammonia emissions, a disproportionately large proportion reflecting the importance of livestock agriculture in Northern Ireland
- Agriculture accounts for 97% of ammonia emissions from Northern Ireland
- Between 2009 and 2019, ammonia emissions from agriculture in Northern Ireland increased by almost 19%
- Northern Ireland has 394 sites of high nature conservation value designated for their protection. Almost 250 of these are sensitive to the impacts of ammonia and nitrogen.

- 98% of Special Areas of Conservation (SACs) and 83.3% of Special Protection Areas (SPA) had nitrogen deposition rates exceeding their Critical Load. These are Northern Ireland's most important habitats.
- 95.7% of Areas of Special Scientific Interest (ASSI) which are nationally important sites had nitrogen deposition rates exceeding their Critical Load for at least one feature.
- 100% of SACs, 100% of SPAs and 99.7% of ASSIs in Northern Ireland had ammonia concentrations greater than 1 μg/m^3 (the long term annual average Critical Level for lichens and mosses and for ecosystems in which they are important).
- 27.8% of SACs, 21.4% of SPAs and 24.6% of ASSIs in Northern Ireland had ammonia concentrations greater than 3 μg/m^3 (the long term annual average Critical Level for higher plants including heathland, semi-natural grassland, and forest ground flora).
- Most Northern Ireland habitats continue to be in 'unfavourable-bad' conservation status, with one out of the 49 priority habitats in favourable condition. Northern Ireland priority species (those species which require conservation action) are faring somewhat better at this stage but only 12 out of 28 are deemed to be at favourable conservation status.
- Specific objectives to maintain or, where necessary, restore concentrations and deposition of air pollutants to at or below the site-relevant Critical Load and Level are now listed in the site conservation objectives for each of the Special Areas of Conservation in Northern Ireland.
- The Clean Air Strategy for Northern Ireland - Public Discussion Document highlighted a report published by Public Health England which estimated that in 2010, 553 deaths in over-25s in Northern Ireland were attributable to exposure to anthropogenic air pollution ($PM_{2.5}$). To add to this, at a global level, nitrogen (ammonia and oxides of nitrogen) was estimated to account for 39% of $PM_{2.5}$ in the atmosphere, highlighting the importance of controlling ammonia to avoid impacts due to $PM_{2.5}$.[5]
- The fraction of mortality due to anthropogenic air pollution in Northern Ireland district council areas ranged from 5.2% in Belfast to 2.5% in Fermanagh with an average for Northern Ireland being 3.8%. Taking account of the annual numbers of deaths in Northern Ireland,[6] this would correspond to approximately 600 deaths per year linked to air pollution, consistent with the figure of 553 deaths per year in the Public Health England report.
- In 2020 cattle accounted for 66% of agricultural ammonia emissions from Northern Ireland, with the dairy sector producing 37% and beef 29%. The poultry sector was responsible for 12% while pigs accounted for 8% of total agricultural ammonia emissions. Sheep produced 3% of agricultural ammonia emissions, 7% of emissions were from fertiliser and digestate to land accounted for 4% of emissions.

The contextual information presented in the draft Ammonia Strategy is robust and consistent with the national and Northern Ireland datasets that we have access to.

The key questions therefore relate to the effectiveness of proposed actions, discussed in the next section.

2.2 PROPOSED ACTIONS

In this section, we consider whether the proposed actions are reasonable, sufficient and achievable.

2.2.1 DAERA Emissions Reduction target

DAERA has proposed a target to reduce Northern Ireland's total agricultural ammonia emissions by at least 30% from 2020 levels.

[5] Gu et al., "Abating ammonia is more cost-effective than nitrogen oxides for mitigating $PM_{2.5}$ air pollution," Science 4 Nov 2021, Vol 374, Issue 6568, pp. 758-76

[6] Office for National Statistics, Deaths in Northern Ireland 2000 to 2020," https://www.ons.gov.uk/aboutus/transparencyandgovernance/freedomofinformationfoi/deathsinnorthernireland2000to2020

The UK national target is to reduce ammonia emissions by 8% by 2020 and by 16% by 2030, based on 2005 levels. UK national total emissions were above the 2020 target, although the adjusted "Compliance Total" emissions complied with the 2020 target.[7]

The UK national targets correspond to a reduction of approximately 9% between 2020 and 2030. Achieving the target to reduce Northern Ireland's emissions by 30% over this period would be sufficient to make a proportionate contribution to the UK target. Without any reduction in emissions by Northern Ireland, the rest of the UK would need to reduce its emissions by 10% between 2020 and 2030.

The draft Ammonia Strategy sets out a number of actions which are designed to achieve reductions in ammonia emissions from the agriculture sector. DAERA's Northern Ireland Ammonia Research Programme reached the following conclusions:

- A combination of measures considered to be achievable over a five to 10 year policy cycle could achieve a 25% reduction in emissions.
- Case studies show that significant reductions in emissions are possible at the individual farm level:
    - 40% in dairy and beef sector
    - 40-80% in pig sector
    - 25% in poultry sector
- Agri Food and Biosciences Institute economic analysis found that implementing feasible ammonia reduction measures could achieve 25-28% reduction in emissions.

We conclude that the research provided in the Ammonia Strategy suggests that a 25% overall reduction of agricultural ammonia emissions across Northern Ireland by 2030 is feasible. Greater reductions would be possible in specific locations and livestock sectors.

It is unclear exactly how the figure of a 30% reduction in agricultural ammonia emissions has been identified, but it is plausible that widespread implementation of the ammonia reduction measures described in the Strategy could result in this level of improvement. We consider that a greater challenge would lie in achieving widespread implementation of the Strategy measures in practice.

2.2.2 DAERA Habitat Protection target

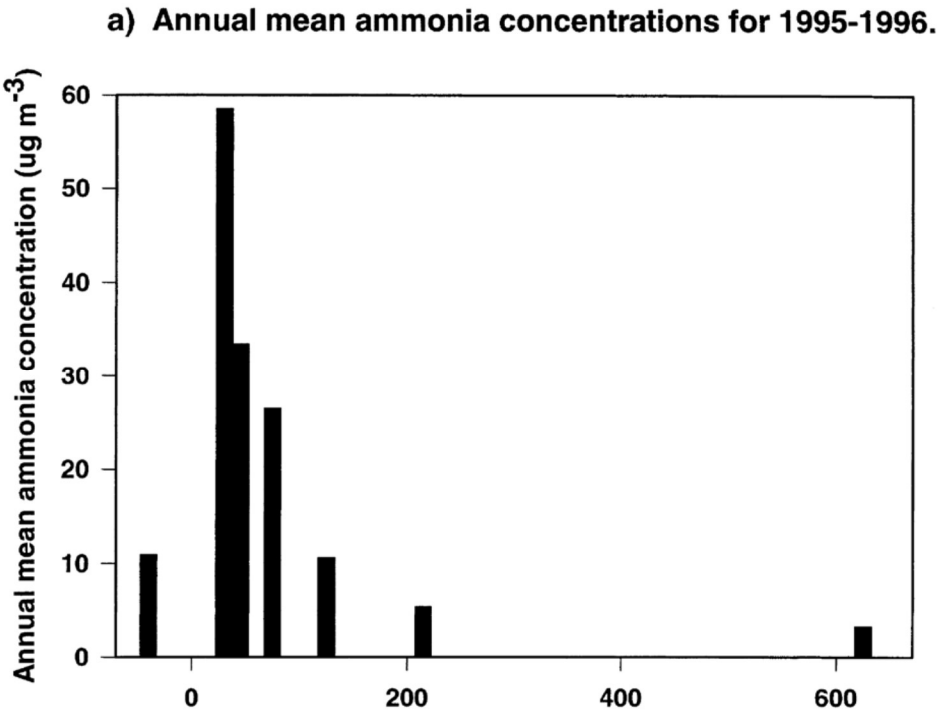
DAERA has set a target to reduce ammonia levels at designated sites to comply with Critical Loads and Critical Levels at habitat sites, or by 40% from 2020 levels. On page 8, the draft strategy indicates that this target would apply to "internationally designated sites," whereas on page 36, the strategy indicates that this target would apply to "all designated sites." This is an important distinction, and we consider that the intention should be clarified. In either case, this represents a challenging target, and additional measures for protection of habitat sites are needed to achieve this target. The proposed measures include:

- A prohibition on spreading of manures within 50 metres of a designated site. Similar rules exist in the Nutrients Action Programme (NAP) which prohibit the spreading of organic manures within 50m of a borehole, well or spring.
- Require slurry to be spread by Low Emission Slurry Spreading Equipment (LESSE) within 1km of a designated site by 2025.
- Focused campaigns to achieve significant adoption of ammonia reduction technologies in existing livestock housing and greater implementation of other ammonia reduction measures.

Information in the draft Strategy show that impacts from farms and agricultural activities can be expected to be very high within the first 150 metres of a source – see Figure 2. Furthermore, ammonia concentrations were found to be at or above the Critical Loads at a distance of 650 metres from a source. This suggests that measures which rely on a 50 metre separation are likely to be inadequate: a much wider margin is needed. The analogy to protection of boreholes, wells and springs is not particularly useful when seeking to protect habitat sites against impacts transmitted via airborne pathways.

[7] https://www.gov.uk/government/statistics/emissions-of-air-pollutants/emissions-of-air-pollutants-in-the-uk-ammonia-nh3

Figure 2: Measured evidence of drop-off in ammonia concentration levels (from draft Northern Ireland Ammonia Strategy Section 1.9)



The draft Ammonia Strategy refers briefly to a long-term target in relation to ammonia emissions:

> "*The long-term target to 2050 is to reduce ammonia emissions to a point where Critical Loads of nitrogen deposition and Critical Levels of ammonia are at a more sustainable and pragmatic place.*"

The draft Ammonia Strategy goes on to say:

> *"This is a 5-year strategy which will set Northern Ireland on a pathway to achieving the 2030 and 2050 targets."*

Therefore, it is important to understand what is meant in relation to the 2050 target. The text describing the 2050 target is written in an unclear way, and we consider that this should be clarified. We understand that the ambition is for exceedances of Critical Loads and Critical Levels are eliminated by 2050. To provide greater clarity around this target, we have investigated whether the proposed measures would be sufficient to eliminate exceedances of Critical Levels and Critical Loads at European designated habitat sites in Northern Ireland. Data for six example sites, selected to represent a range of sensitive habitat types, were taken from the Nature Conservation Agencies' APIS resource, as set out in Table 1.

Table 1: Status of example habitat sites in Northern Ireland and improvements required to achieve compliance with Critical Levels/Critical Loads

Site Name	Site ID	Site Designation	Nitrogen Critical load Class(es)	Range of Critical Loads for N (kg N/ha/yr)	Range of N deposition at site (kg N/ha/yr)	% N deposition reduction needed	Ammonia Critical Levels (µg m^{-3})	Ammonia Concentration at site (µg m^{-3})	% Ammonia concentration reduction needed
Upper Lough Erne	UK0016614	SAC	Acidophilous Quercus-dominated woodland	10-15	30.7-43.8	51-77%	1-3	2.6-4	0-75%
Cuilcagh Mountain	UK0016603	SAC	Arctic, alpine and subalpine scrub habitats Raised and blanket bogs Dry heaths	5-20	13.3-15	0-66%	1	1.5-1.9	33-47%
Eastern Mournes	UK0016615	SAC	Arctic, alpine and subalpine scrub habitats Raised and blanket bogs Dry heaths	5-20	21.1-28.5	5-82%	1	1.3-2.3	23-57%
Carn - Glenshane Pass	UK0030110	SAC	Raised and blanket bogs	5-10	17.5-22.2	43-77%	1	1.4-2.4	29-58%
Pettigoe Plateau	UK9020051	SPA	Raised and blanket bogs Northern wet heath: Calluna-dominated wet heath (upland moorland) Moss and lichen dominated mountain summits	5-20	9.7-10.9	0-54%	3	1.4-1.5	0%
Antrim Hills	UK9020301	SPA	Northern wet heath: Calluna-dominated wet heath (upland moorland)	10-20	12.2-25.4	0-61%	3	1-2.8	0%

The information in Table 1 shows that reductions in ammonia levels and nitrogen deposition of up to 75% would be needed to achieve the relevant Critical Loads and Critical Levels at the example sites analysed. The ranges of figures provided in Table 1 represents the extent of reduction that would be needed at different locations within each example site to achieve the Critical Level or minimum Critical Load. The most efficient way to achieve these reductions is likely to be a combination of broad scale national measures to deliver wide-ranging reductions, combined with targeted measures to address areas where ammonia levels and nitrogen deposition rates are higher as a proportion of the Critical Loads or Levels. This is described in the Joint Nature Conservation Committee Nitrogen Futures report as "smart targeting" of measures.[8] This may result in targeted measures where agriculture is particularly intensive and/or particularly close to or within a designated site. Targeted measures may also be appropriate for designated sites which are particularly sensitive to ammonia and/or nitrogen deposition, and where, as a result, particularly demanding Critical Levels or Critical Loads apply.

It is possible that further reductions may be needed at sites which are affected by cross-border ammonia emissions if similar reductions in ammonia emissions are not achieved in the northern counties of the Republic of Ireland. The Ireland Environmental Protection Agency reports[9] "*Further research is required to establish the contribution of intensive point sources, such as Industrial Emission Directive facilities, to long-range particulate ammonium pollution and their subsequent contribution to wet deposition of nitrogen. This would probably require the creation of detailed dispersion and transformation models of ammonia from intensive units, which should be integrated into national concentration and deposition models of nitrogen in Ireland. The AmmoniaN2K project focused on predicting impacts from ammonia, not ammonium. This is likely to have transboundary impacts because of the density of poultry houses in County Monaghan and prevailing south-westerly winds.*" The Republic of Ireland is required to achieve a 5% reduction in ammonia emissions by 2030 compared to 2005.[10] This corresponds to a reduction of approximately 8% from 2020 emissions. This scale of reduction would not be sufficient to eliminate a significant cross-border contribution to ammonia levels and nitrogen deposition at nature conservation sites in Northern Ireland.

From the information in Table 1, it is concluded that the proposed target to reduce levels of ammonia at internationally designated sites by 40% would not be adequate to eliminate adverse impacts due to ammonia and nitrogen deposition at all internationally designated nature conservation sites. The steps needed to achieve this level of improvement are not considered in the draft Ammonia Strategy, even though the strategy states unambiguously:

> *"Unless specific measures are designed and implemented to address the excessive pollution above Critical Levels and loads, then the habitat cannot be considered to be under 'favourable management' or hope to recover fully."* (Draft Northern Ireland Ammonia Strategy page 61)

Clearly, achieving a reduction in ammonia levels of 75% would be much more demanding than achieving the proposed improvement of 40%. This would have potentially far-reaching implications for the agricultural industry in Northern Ireland. We consider that these implications should be considered in the final Ammonia Strategy, in order to allow proper consideration of the costs and benefits.

It is possible that the proposed improvements in farming practices set out in the Strategy may not be sufficient to deliver compliance with Critical Loads and Critical Levels at all international sites. This seems quite likely based on the information on potential effectiveness of measures given in the draft Ammonia Strategy. Delivering improvements on this scale could potentially require the implementation of further measures.

A set of measures for reducing ammonia emissions is set out in a report entitled "*Rapid Evidence Assessment of Interventions to Improve Ambient Air Quality*" produced for Public Health England by a team led by Institute of Occupational Medicine (IOM) in 2018.[11], The measures considered in the Public Health England report are set out in Table 2. We consider that the final Ammonia Strategy should consider the full range of measures set out in the Public Health England report, where relevant to Northern Ireland.

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[8] Joint Nature Conservation Council, "Nitrogen Futures", JNCC Report 665, October 2020

[9] Environmental Protection Agency, "Assessment of the Impact of Ammonia Emissions from Intensive Agriculture Installations on Special Areas of Conservation and Special Protection Areas," Report No.347, 2020

[10] Environmental Protection Agency, "Ireland's Air Pollutant Emissions 1990-2030," April 2022

[11] Institute of Occupational Medicine, Ricardo Energy & Environment, Rothamsted Research Limited and Aether, "*Rapid Evidence Assessment of Interventions to Improve Ambient Air Quality*," IOM Report 745-4, July 2018

Table 2: Comparison of proposed measures with Public Health England study

IOM Summary	IOM Report Measure	Draft Ammonia Strategy
Intervention 1: Changes in Livestock Housing Design or Management		
Livestock building design	Including building structure, ventilation arrangements, manure removal equipment, etc. There is overlap with other mitigation actions. Some other more specific mitigation actions below are relevant (for example, biofilters, exhaust air scrubbing).	Page 39 - 4.1.1
Out wintering pads	Outdoor area with drainage and often with a woodchip surface; a reduced cost alternative to conventional housing	Page 44 - 4..1.4
Yard Design	Yards are used in livestock management for safe, efficient handling of livestock.	Page 44 - 4..1.4
Shorter housing periods	Livestock may be grazed for more of the year or housed for only part of a 24h period.	Page 44 - 4..1.4
Biofilters	Air is passed through wet filter where pollutants are degraded by microorganisms. There is overlap with exhaust air scrubbing (below).	Page 39 - 4.1.1
Exhaust air scrubbing	Removal of pollutants by filtration. There is overlap with biofilters (above).	Page 39 - 4.1.1
Electrostatic particle ionization (EPI) and Particle separators	Equipment to remove PM from air within livestock housing.	Not relevant to ammonia
In-house fogging	Use of fine liquid droplets to remove pollutants within livestock houses, including oil spraying.	Not relevant to ammonia
Ozonation	Ozone application to reduce internal air pollutant concentrations in livestock buildings. This can influence emissions from buildings.	Potentially harmful, so not for further consideration
Choice of litter material	Litter materials include straw and woodchip, used on the floor of livestock housing.	
Poultry manure removal time	Frequency of manure removal.	
Strategic tree planting	Includes location, planting density, choice of species.	Page 50-51 - 4.1.8
Intervention 2: Change in Diet or Feeding Regime		
Cattle diet change	Better matching of feed nutrients to animal requirements, to limit N excretion; may also include feed additives.	Page 47-49 - 4.1.6
Pig diet change	Better matching of feed nutrients to animal requirements, to limit N excretion; may also include feed additives.	Page 47-49 - 4.1.6
Poultry diet change	Better matching of feed nutrients to animal requirements, to limit N excretion; may also include feed additives.	Page 47-49 - 4.1.6
Feed scheduling	Changing feeding times.	
Intervention 3: Changes in Manure Management/ Storage/ Processing		

IOM Summary	IOM Report Measure	Draft Ammonia Strategy
Anaerobic digestion of manure and composting of digestate		
Manure additives		
Manure composting		
Manure drying (poultry)		
Manure management system / Manure treatment plant	Includes system for removing, processing and storing manure.	
Manure/slurry storage methods	Includes tanks, lagoons, slurry bags, heaps.	Page 51 - 4.1.9
Slurry acidification	Addition of acid such as sulphuric acid to slurry to lower the pH.	Page 40 - 4.1.2
Intervention 4: Low Emission Manure Application to Land		
Rapid incorporation of solid manure		Page 41-43 - 4.1.3
Low emission slurry spreading	Use of equipment to apply slurry to land by injection, or with a low trajectory to the surface.	Page 41-43 - 4.1.3
Intervention 5: Fertiliser Application Change		
Urease inhibitor	Use of a fertiliser additive with urea fertiliser to reduce the hydrolysis of urea to ammonia and carbon dioxide.	Page 46-47 - 4.1.5
Choice of nitrogen fertiliser		
Fertiliser management	Optimisation of application methods, timings and rates.	
Nitrification/denitrification inhibitors	The use of inhibitors of microbial nitrification/ denitrification.	
Intervention 6: Change Land Use/ Consumption/ Productivity/ Genetic Selection/ Other		
Change in consumption	Change in general consumption pattern of agricultural outputs (mainly food).	
Change in land use or livestock species		
Increase productivity		
Local targeting of mitigation	Targeting of mitigation actions in localities where impacts are greatest, as opposed to regional or national implementation	Page 57 – 4.2.3
Genetic selection		Page 49 - 4.1.7
Change in fuel type for glasshouse heating		Not relevant to ammonia

Alongside the benefits for wildlife and the natural environment, some of these measures, such as “Change in consumption” and “Change in land use or livestock species” could have far-reaching practical and economic impacts. We consider that these benefits and impacts should be considered in the final Northern Ireland Ammonia Strategy.

2.2.3 Barriers to implementation of proposed actions

Farms in Northern Ireland produce more manure than can be applied to fields. Northern Ireland does not operate a system of Nitrate Vulnerable Zones, as the rest of the UK does: instead, Northern Ireland has a "whole territory" approach to reducing nutrient pollution from agriculture through the Nutrients Action Programme.[12] This places restrictions on the dates when slurry can be spread on fields.

Additionally, new farm developments in Northern Ireland must demonstrate minimisation of ammonia emissions. The measures typically used to achieve this are included in the mitigation techniques listed in the draft Ammonia Strategy – in particular:

1. Low Emission Livestock Housing
3. Low Emission Slurry Spreading Equipment (LESSE)
9. Covering Above Ground Slurry Stores

The main barriers to wider implementation of ammonia mitigation measures are: (a) the financial costs of implementing measures; (b) lack of awareness of ammonia as a problem for farmers, and (c) resistance to change within the farming community.

Many of the measures set out in the draft Ammonia Strategy have significant associated costs. DAERA operates a Farm Business Improvement Scheme which provides financial support for equipment such as Low Emission Slurry Spreading Equipment (LESSE) needed to implement some of these measures.[13] This Scheme closed for new applications in November 2022, and we are not aware of any information that has been published on a replacement scheme.

Section 4.2.1 of the draft Ammonia Strategy indicates that funding for ongoing improvements will need to come through the draft Green Growth Strategy. However, the draft Green Growth Strategy makes only passing mention of ammonia, and it seems likely that this may not be an effective mechanism for delivery of ammonia improvement measures, particularly where these do not have a clear or quantifiable carbon benefit. We consider that financial support for future improvements in ammonia could be made available, potentially with priority given to measures which contribute to delivering improvements which align with both the Ammonia Strategy and the Green Growth Strategy.

A programme of education, technical support, and peer-to-peer learning (for example, through demonstration farms and/or an expansion of DAERA's Knowledge Advisory Service) would be valuable in enabling farmers to understand the importance of ammonia, and the measures that are potentially relevant to their farming operations. Without this kind of investment, together with funding to support the costs associated with new technology and changing practices, the measures outlined in Section 4.1 of the draft Ammonia Strategy are unlikely to be deployed as widely as needed to achieve the targeted reductions in ammonia emissions.

2.2.4 Technical audit

We have audited the information provided in the draft Ammonia Strategy against the source material to check whether the presentation of potential effectiveness of the measures under consideration is appropriate. The findings of this evaluation are set out in Table 3.

[12] https://www.daera-ni.gov.uk/nutrientsactionprogramme2019-2022

[13] https://www.daera-ni.gov.uk/sites/default/files/publications/daera/Guidance%20Documentation%201%20-%20FBIS%20C%20Tier%201%20Tranche%204%20Explanatory%20Booklet%20v.4.pdf

Table 3: Technical audit of proposed measures

Item	Reference	Reference text	Conclusion
Page 39: "*For example, scientific evidence has shown that installation of appropriate slat mats with scrapers in cattle housing can reduce housing emissions by up to 49%.*"	Annex AFBI Beef Case Studies - within Strategy text	Mitigations Applied in Beef Case Study Scenarios: Installation of Slat Mats with scrapers (achieving c. up to 49% reduction).	NARSES UK national inventory model was used for this study to create scenarios completed by Rothamsted and AFBI. Overall, the beef case studies showed between 34 - 42% reduction in annual ammonia reductions when modelled. Based on this model, the information in the strategy appears reasonable
Page 41: "*Low emission slurry spreading is one of the most effective ammonia reduction techniques. Based on existing emission factors, implementation of low emission slurry spreading techniques would achieve by itself a 5 to 10% reduction in total ammonia emissions across Northern Ireland agriculture.*"	Frost (2007) Occasional publication No. 38, British Grassland Society. Methods of spreading slurry to improve N efficiency on grassland	This article was not readily available online, but an reference was found with the data below: Benefits of Low Emission Slurry Application Technology AFBI Hillsborough Research – Quantifiable Benefits: Traditional Splash Plate vs Trailing Shoe/Band Spreading (results from 23 harvests over 3 years) Application method/Trailing shoe/Band spreading *Available N utilisation change (%) / 25 / 10 https://meetings.eaap.org/wp-content/uploads/2016/S64_05_Mulholland.pdf	This independent reference validates the view that trailing shoe is most effective at reducing ammonia emissions but have been unable to consult the paper referenced in the Strategy
"*Results from a study by AFBI and Teagasc have shown considerable benefit from using urea in combination with the urease inhibitor NBPT (N-(n-butyl) thiophosphoric triamide). Urea + NBPT offered a reduction in ammonia losses of 78.5% compared with straight urea, whilst maintaining similar agronomic yields to CAN.*"	https://www.afbini.gov.uk/news/balancing-greenhouse-gas-and-agricultural-production-targets-irish-farms	This reference states: *"Treating urea fertiliser with NBPT also reduced ammonia losses by up to 78.5%.*"	This is backed up by the reference, but the original reference refers to reductions of "*up to"* 78.5%, so this is a maximum figure, not necessarily an expected figure.
Whilst urea use is not widespread throughout Northern Ireland and	https://www.daera-ni.gov.uk/publications/fertiliser-	This page could not be found. The reference could be updated to: https://www.daera-	The new reference does not include the statistic relating to urea use in Northern Ireland or the UK as a whole

Item	Reference	Reference text	Conclusion
represents only 8% of all fertiliser use	statistics-2009-2021	ni.gov.uk/publications/fertiliser-statistics-2009-2022	
Scientific evidence shows that ammonia emissions are reduced by 8 -10% for every 1% fall in crude protein in pig diets	The impact of diet and 'flushing' on ammonia and odour emissions from pig housing; AFBI	Page 26 https://www.afbini.gov.uk/sites/afbini.gov.uk/files/publications/ammonia_and_odour_creation_and_abatement_2015_0.pdf	This is backed up by the reference
Across the livestock sectors, including cattle, reducing crude protein in all livestock diets can achieve an industry wide reduction in ammonia of around 9%	Estimated costs of ammonia mitigation measures for Northern Ireland Agriculture; AFBI	This article could not be found	No verification
Tree cover can also capture 60% of ammonia released from livestock ranging under the tree canopy	https://farmtreestoair.ceh.ac.uk/sites/default/guidance/index.html	Ammonia capture ranged from 15-25% for housing emissions, 10-20% for slurry lagoons and up to 60% recapture for livestock ranging under the trees. The national potential for tree shelterbelts approaches was modelled in Bealey *et al*. (2016) and it was shown to be cost effective when taking into account the social costs of ammonia pollution.	This is backed up by the reference, but the original reference refers to capture of "*up to"* 60%, so this is a maximum figure, not necessarily an expected figure.
Across Northern Ireland, covering all slurry stores would reduce total manure storage emissions by 16% and overall agricultural emissions by 1.3%.	Tom Misselbrook, Rothamsted Research.	This article could not be found	No verification
targeted within 1km of designated sites are on average 4.6 to 5.8 times more effective at reducing ammonia concentrations in the air. On average they are also approximately 4 times more effective at reducing dry deposition of ammonia at designated sites when compared to applying enhanced measures across the whole of NI.39	Scenario modelling - spatial targeting of ammonia mitigation measures in Northern Ireland.	This article could not be found	No verification

Additionally, as highlighted above, some potentially relevant measures were identified in the 2018 Public Health England study,[11] but are not explored in the draft Northern Ireland Ammonia Strategy. The full list of measures is provided Table 2. We consider that the Public Health England report should be reviewed, and any further potentially relevant measures included in the Northern Ireland Ammonia Strategy.

3. QUESTIONS RAISED IN CONSULTATION DOCUMENT

This section provides specific feedback on the following consultation questions identified in the consultation document:

3.1 Q1: WHAT ARE YOUR VIEWS ON THE NORTHERN IRELAND WIDE 2030 TARGETS OUTLINED IN THE 3.1 TARGETS SECTION?

As described in Section 2, we consider that achieving the Northern Ireland wide target for 2030 (30% reduction in ammonia emissions) would be sufficient to enable Northern Ireland to play its part in achieving national commitments for ammonia emissions reductions. We consider that there are significant challenges with implementing the measures to the extent required to achieve the Northern Ireland wide target for 2030.

We consider that a reduction in ammonia impacts of approximately 75% would be needed to achieve the 2050 target of eliminating exceedances of the Critical Levels and Critical Loads at Northern Ireland's nature conservation sites. This would not be achieved by a 30% reduction in ammonia emissions. A combination of national-scale and locally targeted measures would be needed to eliminate exceedances of Critical Levels and Critical Loads at nature conservation sites.

3.2 Q4 TO Q13: REQUEST FOR VIEWS ON 10 SPECIFIC AGRICULTURAL AMMONIA MITIGATION TECHNIQUES

In the sections below, we provide specific feedback on the nine measures proposed to achieve the 2030 target, in response to questions Q4 to Q13 in the Consultation document. A common theme with all these measures is that a robust source of funding will be needed to facilitate the implementation of these measures. It is not clear that sufficient funding will be available via the Green Growth Strategy, or that many of these measures would be eligible for funding under this strategy.

3.2.1 Q4: Do you have any comments on the proposals for low emission livestock housing?

Low emission livestock housing includes a range of well-established and more innovative techniques for reducing ammonia emissions from livestock. It includes options such as slatted floors with underfloor slurry storage. This has the benefit of separating out faeces and urine, which is an effective way of reducing ammonia formation and release. Underfloor storage of manure also enables ammonia releases to be contained and, if necessary, treated before release.

More frequent cleaning can also be effective in reducing ammonia emissions from livestock housing. This also enables separation of solid and liquid wastes to minimise ammonia formation. The use of robotic scrapers is one way to increase the frequency of cleaning.

Underfloor slurry storage can be readily incorporated into the design of new agricultural buildings but is much less practicable to retrofit to existing buildings. The strategy should explain how appropriate ammonia mitigation techniques would be applied to existing buildings, what the benefits of this would be, and how the costs for upgrading existing buildings would be shared between farmers and other funding agencies. The draft Ammonia Strategy refers to section 4.2.1 which highlights the proposed funding strategy via the Green Growth financial package (the Green Growth strategy is currently at draft stage[14]). However, it is unclear which of the key ammonia mitigation measures would qualify for funding under the draft Green Growth strategy.

3.2.2 Q5: Do you have any comments on the proposals for emerging technologies?

Proposals for emerging technologies are welcome, but there will always be a reluctance to adopt emerging technologies, with the risk of unforeseen consequences for "early adopters". The best means of optimising

[14] https://www.daera-ni.gov.uk/publications/green-growth-strategy-consultation-report

update of emerging technologies is to support peer-to-peer learning using demonstration farms on which new technologies can be seen in action.

As regards the specific measures listed in this section, acidification of slurry is an effective means of retaining ammonium ions in the slurry and avoiding release to the atmosphere. Acidification using sulphuric acid is widely used in Scandinavia.[15] Our experience is that the use of acid dosing is unfamiliar to farmers and can be perceived as a health and safety risk, even though automated systems mean that farmers do not handle slurry at any point in the process. Demonstration of safe systems for acidification would be helpful to facilitate uptake of this approach. Our understanding is that plasma treatment of slurry is not currently being carried out commercially.

3.2.3 Q6 and Q7: comments on the requirement for use of LESSE in 2025 and 2026

The use of Low Emission Slurry Spreading Equipment (LESSE) is likely to be limited in the future. There are already restrictions on the dates and weather conditions when slurry can be spread. The legislation limits the timing and quantity of organic manure application, to ensure the manure is applied in accordance with its crop and soil need at the time of application.[16] Manure can only be added to land with a low risk of leaching and run-off, an application rate that allows no more than 50m^3 /ha (4500 gal/ac) or 50 tonnes/ha (20t/ac) of organic manures to be applied at one time, with a minimum of 3 weeks between applications, and when the weather and ground conditions allow.[17] As a result, farmers typically seek the most rapid means of spreading slurry when there is the opportunity.

Work rates are lower when using trailing shoe low emission spreading equipment. Discharging a load can take 50% longer through a trailing shoe applicator.[18] This could potentially impact the uptake of low emission spreading equipment.[19] Farmers have had to use additional machines to ensure the muck can be spread during seasonal windows. Farmers have enquired about high-capacity machines due to the short window of time for the muck to be spread and have also made enquiries about ex-hire machines as the cost of a new spreader is out of reach of small family businesses which are widespread in the farming sector in Northern Ireland.

This leads to high demand in machines used for spreading, as farmers need extra capacity to comply with regulations. Moreover, difficulties arise when booking machines because of uncertainty in days in which slurry can be spread. LESSE is less effective on stony ground and needs a consistent low viscosity slurry.

Reliable and effective funding sources would therefore be needed to support widespread deployment of LESSE. The Ulster Farmers' Union said farmers would need a considerable financial support to reduce ammonia emissions, in the timeframe suggested by the government.[20] [21]

In view of these constraints, the requirement for all slurry to be spread by LESSE in less than 4 years from the date of this consultation appears to be out of reach at present.

3.2.4 Q8: Do you have any comments on the proposals to encourage implementation of longer grazing seasons?

Longer grazing seasons are potentially attractive as a mitigation measure because outdoor grazing enables the separation of urine and solid wastes. This measure is also likely to be beneficial for animal welfare. Longer grazing will require sufficient infrastructure such as water troughs, and management such as ensuring animals

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[15] European Commission, "Eco-innovation for air quality," 21st European Forum on Eco-innovation, February 2018

[16] https://www.fginsight.com/news/new-rules-put-pressure-on-spreading-124811

[17] DAERA, Nutrients Action Programme 2019-2022 Regulations, summary document, 2019, Nutrients Action Programme (NAP) 2019-2022 | Dairying Technical Support - CAFRE

[18] DAERA 2020 (https://www.daera-ni.gov.uk/news/trailing-shoes-can-reduce-chemical-fertiliser-use-and-smell); Farmers Weekly 2012 (https://www.fwi.co.uk/machinery/trailing-shoe-application-strikes-a-good-balance)

[19] https://www.theguardian.com/environment/2017/aug/21/serious-farm-pollution-breaches-increase-many-go-unprosecuted
https://www.theguardian.com/environment/2019/jan/14/muck-spreading-could-be-banned-to-reduce-air-pollution
https://www.fwi.co.uk/machinery/trailing-shoe-application-strikes-a-good-balance

[20] The Fermanagh Herald, Ammonia plan could cost our farmers tens of thousands - The Fermanagh Herald, January 2023

[21] Farming UK News, Designated sites 'a major worry' in NI draft ammonia strategy - FarmingUK News, February 2023

have access to sufficient grazing. However, extended grazing will be highly depend on soil type and so will be limited by wet soils in many areas

3.2.5 Q9: Do you have any comments on how to reduce ammonia emissions from chemical fertiliser.

Moving to stabilised urea fertiliser is potentially attractive, but at present, calcium ammonium nitrate is more widely used. There are also mixed messages on the use of urea-based fertilisers, which suggest that there could be a risk of harm to soils. At this stage, it is unlikely that the use of stabilised urea would make a significant contribution to reducing ammonia emissions during the period up to 2030.

3.2.6 Q10: Do you have any comments on the proposals to reduce crude protein levels in livestock diets?

Reducing crude protein in livestock diets is already widely practised throughout the industry and is an effective way of minimising nitrogen releases from animal wastes. The main concern is that making untested changes to animal diets could potentially put animal health and wellbeing at risk, and so farmers should have access to specialist advice from a nutritionist.

3.2.7 Q11: What are your views on the proposals relating to improving feed efficiency through genetic improvement?

Farmers have been improving the genetic quality of their livestock for generations, usually through informal decisions. A more formal programme to improve feed efficiency through genetic improvement would be a step change for many farmers and would require technical advice and support. This is likely to be a long-term measure.

3.2.8 Q12: What are your views on the proposals to encourage tree plantations around livestock housing?

The use of tree plantations of sufficient width and density around livestock housing can be an effective means of mitigating local scale impacts due to ammonia emissions, subject to spatial constraints and other potential concerns (for example, tree belts can harbour predator species, reducing the attractiveness of nature conservation sites for protected species).

It is important to be aware that tree belts will typically take years or even decades to become established, and so this is only likely to be effective in the long term.

3.2.9 Q13: What are your views on how to encourage the safe covering of existing above ground slurry stores and lagoons?

Covering slurry stores and lagoons is in principle a good way to reduce ammonia emissions. This provides a restriction on the release of ammonia to the atmosphere and encourages reabsorption of ammonia into the slurry. Rigid impermeable coverings can be expensive and difficult to retrofit but are nevertheless reasonably widespread. As an interim measure where rigid covers are not effective, a flexible cover such as plastic sheeting can be used, or alternatively impermeable covers such as straw or plastic balls can provide some reduction in ammonia emissions.

3.3 Q16: WHAT ARE YOUR VIEWS ON THE PROPOSALS FOR SPATIALLY TARGETED MEASURES AROUND DESIGNATED SITES?

Information in the draft Strategy show that impacts from farms and agricultural activities can be expected to be very high within the first 150 metres of a source – see Figure 2. Furthermore, ammonia concentrations were found to be at or above the Critical Loads at a distance of 650 metres from a source. This suggests that measures which rely on a 50 metre separation are likely to be inadequate: a much wider margin is needed.

The information in Table 1 shows that reductions in ammonia levels of up to 75% would be needed to achieve the relevant Critical Loads and Critical Levels at the example sites analysed, in line with the 2050 target described in the draft Ammonia Strategy. The most effective means to achieve this would be a combination of national-scale emissions reductions, combined with local measures to address areas with the greatest exceedances of Critical Loads and Critical Levels.

Achieving a reduction in ammonia levels of up to 75% would be more demanding than achieving an improvement of 40%. This would have potentially far-reaching implications for the agricultural industry in Northern Ireland. We consider that these implications should be considered in the Ammonia Strategy, to allow proper consideration of the costs and benefits.

It is likely that the improvements in farming practices envisaged in the draft Ammonia Strategy will not be sufficient to deliver compliance with Critical Loads and Critical Levels at designated sites (either internationally designated sites as indicated on page 8 of the draft Ammonia Strategy, or all sites, as indicated on page 36 of the Strategy). Delivering improvements on this scale could potentially require far-reaching changes in agricultural practices and activities in Northern Ireland, such as those highlighted in Table 2.

Alongside the benefits for wildlife and the natural environment, some of these measures, such as "Change in consumption" and "Change in land use or livestock species" could have far-reaching practical and economic impacts. We consider that these benefits and impacts should be considered in the Northern Ireland Ammonia Strategy.

The strategy refers to "*reducing local ammonia emission sources, as well as those required to afford greater protection to the site features, such as support for traditional farming practices or nature buffers (habitat creation or nature recovery areas) in the immediate vicinity of the site.*" The reference to "*traditional farming practices*" should be clarified. This could potentially refer to low-intensity practices with longer grazing seasons, which would be lower polluting than intensive indoor livestock management. However, traditional practices could potentially be relatively highly polluting, and should not be encouraged as a component of this strategy.

The draft Ammonia Strategy states that "*CMPs for the full suite of terrestrial SACs (58) are to be prepared by December 2022.*" This does not appear to have been achieved as of February 2023: the DAERA website says, "*With that in mind, we are preparing individual Conservation Management Plans for 57 of our SACs.*"[22] No such plans could be found for the four SACs or the two SPAs listed in Table 1. It will be important to ensure that these CMPs fulfil the following commitment in the draft Ammonia Strategy: "*Where ammonia/nitrogen deposition is identified as a pressure, the key conservation measure will be to reduce emissions at the site level, particularly the more damaging local ammonia sources.*" The examples given in the table on pages 61-62 of the draft Ammonia Strategy do not all topics relevant to ammonia sources, although it is possible that some of the "management recommendations" could be relevant to mitigating impacts due to ammonia.

3.4 Q17. WHAT ARE YOUR VIEWS ON THE PROPOSED CONSERVATION ACTIONS TO RESTORE HABITATS AND SUPPORT SUSTAINABLE DEVELOPMENT?

Conservation actions to restore habitats and support sustainable development are welcome, but the first step should be prevention of impacts due to excessive levels of ammonia. This is highlighted in the draft Ammonia Strategy, which states: *"Unless specific measures are designed and implemented to address the excessive pollution above Critical Levels and loads, then the habitat cannot be considered to be under 'favourable management' or hope to recover fully."* Once this problem has been largely addressed, management measures could be a valuable means of addressing localised residual problems.

The strategy outlines a number of measures and programmes aimed at restoring habitats. It is not clear whether these measures would be sufficient to offset the impacts that would be expected to arise from the high levels of airborne ammonia and nitrogen deposition currently being experienced at nature conservation sites in Northern Ireland, or the impacts that would be expected to arise even if a 40% reduction of impacts is achieved by 2030 as envisaged in the draft Strategy.

[22] https://www.daera-ni.gov.uk/articles/conservation-management-plans-northern-irelands-special-areas-conservation

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