

**ESTIMATING THE QUANTITATIVE ENVIRONMENTAL IMPACTS  
OF A PACKAGE OF POTENTIAL OPTIONS TO RECAPTURE  
THE BENEFITS OF SET-ASIDE**

**PHASE 1: REVIEW OF NATURAL ENGLAND BENEFITS ASSESSMENT**

**FINAL REPORT**

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**Nigel Boatman**

**Central Science Laboratory  
Sand Hutton, York, YO41 1LZ**



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## **1. INTRODUCTION AND BACKGROUND**

### **1.1 THE HISTORY AND DEVELOPMENT OF SET-ASIDE**

Set-aside was first introduced in the UK in 1988 (known as the five-year scheme), as an EU control measure to limit over-production of cereals and other arable crops. The original scheme was voluntary but at least 20% of eligible land had to be taken out of production and managed as rotational or non-rotational fallow. In 1992, this scheme was replaced by a measure introduced across the EU, under which 15% of a holding's cereal, oilseeds and protein crops area had to be set aside in order to claim arable area payments. The percentage of land that had to be set aside was adjusted by the European Commission according to perceived need. In 1995 it was reduced to 12%, then 10% in 1996 and 5% in 1997 and 1998, before reverting to 10% for the next five years (Defra, 2007). The set-aside rate was reduced again to 5% in 2004, then as part of the 2005 CAP reform a new system of decoupled payments was introduced. This meant that payments in England were no longer linked to production; instead farmers received a standard subsidy on all eligible land regardless of crop type. Set-aside was retained however, at a rate of 8% of eligible area, which now included a wider range of crop types, i.e. not just cereals, oilseeds and protein crops. However, in the autumn of 2007, the set-aside rate was set at 0% for the 2008 harvest, in order to increase cereals supply to the market and therefore reduce prices following two consecutive lower EU harvests. However, farmers could continue to receive payments on land voluntarily taken out of production provided that it was managed according to the GAEC 12 cross-compliance standard.

Although set-aside was introduced as a supply management tool, set-aside has always been recognised as a potential opportunity for achieving environmental benefits, albeit as a 'side effect' of the production control objective (Evans *et al.*, 1997; Firbank *et al.*, 2003). This recognition was incorporated into UK guidelines for management of set-aside, which sought to maximise the environmental benefits within the constraints of the EU policy framework.

### **1.2 THE END OF SET-ASIDE AND ITS IMPLICATIONS**

In its Communication of November 2007 the European Commission anticipated the permanent abolition of set-aside and noted the need to preserve the environmental benefits as part of the Health Check. The abolition was included in the 'CAP Health Check' proposals published in May 2008, which were adopted by the Council of Ministers in November 2008.

Following the setting of a zero rate in September 2007, the Secretary of State for Environment, Food and Rural Affairs announced a programme of environmental monitoring of set-aside and fallow land. He also announced that Defra would be investigating the potential for recapturing of environmental benefits lost as a result of abolishing set-aside and that he would be prepared to take further action depending on the significance of the environmental impact.

The Secretary of State established a High Level Set-Aside Group under the chairmanship of Sir Don Curry to oversee the monitoring of the environmental impact of the withdrawal of set-aside and, if necessary, to recommend options to recapture the benefits. This group produced an Interim Report in April 2008 and a Final Report was published in July 2008. This summarised the findings from the monitoring programme, which demonstrated that set-aside has delivered significant environmental benefits. Furthermore, monitoring of agricultural land use data has indicated that farmers have already brought a large portion of formerly uncropped land back into production (Defra, 2007; Langton, 2008; Defra 2008).

In response to the findings of the monitoring programme, Natural England produced a set of options for recapturing the environmental benefits of set-aside. After consideration of the options and consultation with stakeholders, the Curry Group recommended that the Secretary of State

pursue option 'XC1', which would require that farmers put a percentage of eligible land into 'environmental management', with top-up options on this land for farmers in Environmental Stewardship. A menu of 'environmental management' options would be available from which farmers could choose, according to their circumstances and preferences. It is intended that measures to recapture the benefits would be in place by the 2009/10 cropping year. Farmers would need to be informed of impending changes by summer 2009 in time for them to plan their cropping for 2009/10.

By December 2008, the constituent options for XC1 had been developed (see Appendix 1), and Natural England had produced an assessment of these options in terms of their relative benefits for birds, plants, other biodiversity and water quality compared to land managed under the former set-aside rules (the 'traffic lights' analysis, see Appendix 2). Details of the proposed management requirements are presented in Appendix 3.

### **1.3 AIMS OF THE PROJECT**

CSL was commissioned by Defra to carry out a two stage project. Stage 1 consists of a 'peer review' of the 'traffic lights' benefits analysis of eight proposed options carried out by Natural England.

The aim of Stage 2 is to provide quantitative estimates of the likely benefits of the options, along with estimates of uncertainty, based on scenarios of likely take-up developed by analogy with currently observed uptake levels for similar options in ELS, plus experience of earlier schemes (e.g. Countryside Stewardship) where relevant. The methodology employed will be by formal expert elicitation.

This report presents the results of Stage 1. the traffic lights analysis scores each option in terms of its benefits relative to set-aside, as greater than, the same as, or less than set-aside, or no/negligible benefit at all. The scores are reviewed in the light of evidence from the literature and expert knowledge, and if it is considered that any of them should be modified, a case is presented in support of modification. It is not intended to be a comprehensive literature review, but key references are provided to indicate likely benefits, and where this assessment differs from that provided by Natural England, supporting references are given where available.

## 2. ASSESSMENT OF ENVIRONMENTAL MANAGEMENT OPTIONS

### 2.1 EM1: GRASS BUFFERS ALONGSIDE TEMPORARY AND PERMANENT WATER COURSES

Under the rules of the former set-aside scheme, land could be set aside in strips between 6 and 10 metres wide alongside watercourses, hedgerows, woods and Sites of Special Scientific Interest (SSSIs), provided the resulting land parcel was no smaller than 0.05 ha. The proposed management rules for EM1 are similar to the former set-aside rules, except that there is no requirement to cut the sward (previously, set-aside margins had to be cut at least once a year, though up to 25% could be left uncut for up to three years). Therefore the environmental benefits are expected to be similar to those accruing under the former set-aside scheme.

Two ELS top-ups are available: EX1 (Wildflower seed mix) and EX2 (Regular cutting and removal of vegetation).

#### 2.1.1 Biodiversity: Birds

Vickery *et al.* (2002) reviewed the value of different types of field margins as foraging habitats for birds. Grass margins provide habitat for invertebrates that are important in the diet of a number of bird species, including circl bunting, corn bunting, grey partridge, yellowhammer and skylark (though skylarks are unlikely to feed in field margins as they avoid field boundaries). Grass seeds are also eaten by several species, including starling, dunnock, house sparrow, tree sparrow and yellowhammer. Field margins are a preferred foraging habitat for yellowhammers (Perkins *et al.*, 2002), and alongside watercourses, if the vegetation is sufficiently tall and dense, may be used for nesting by species such as reed buntings and sedge warblers. However, the density of the sward may hamper foraging by birds.

Grass field margins also provide habitats for small mammals, and hence provide hunting opportunities for predatory birds such as kestrels and barn owls (Askew *et al.*, 2007).

The Natural England (NE) assessment indicates that benefits for birds are likely to be similar to those under set-aside. We concur with this assessment, provided that cutting is not carried out during the nesting season. Regular cutting is recommended during the first 12-24 months to control annual weeds and encourage grasses to tiller. However, this would only be effective if carried out during the growing season, most of which also includes the nesting period for ground-nesting birds. It is suggested that once the vegetation is dense enough to provide cover for nesting birds, cutting should be avoided during the period between April and July inclusive, which is the main nesting season, or that if carried out during this period it should be regular (at least every 3-4 weeks) to discourage birds from nesting. The latter provision is unlikely to be practical on most farms as other tasks will take priority. However, observations by the author indicate that grass seed mixtures will establish in competition with arable weeds even if regular cutting is not carried out, though it may take longer for a dense sward to develop. It is therefore suggested that cutting of dense vegetation should only be carried out outside the nesting season, ideally in late March and then in August and again in the autumn.

#### ELS top-ups

##### **EX1: Wildflower seed mix**

Vickery *et al.* (2002) suggested that grass/wildflower strips are likely to provide food for birds over a longer period of the year than grass-only swards. In the SAFFIE project, over five years birds were more strongly associated with mixtures containing wildflowers than a grass-only mix, though the effect was not strong (Clarke *et al.*, 2007).

## **EX2: Regular cutting and removal of vegetation**

The NE assessment suggests that benefits for birds would be higher with this top-up option. However, this would not be the case if cutting were to be carried out during the nesting season. If the rules do not either prohibit cutting during the nesting season or specify the frequency of cutting, it is likely that nests and, even more importantly, sitting hens, will be destroyed. As it is unlikely that cutting would be carried out sufficiently frequently to maintain a sufficiently short sward to discourage nesting, it is suggested that more specific guidelines are given on the timing of cutting, which prohibit cutting during the main nesting season. Cutting in August or September with removal of vegetation would still be beneficial in terms of reducing fertility levels.

Vickery *et al.* (2002) suggest that cutting in August or September will facilitate foraging by species such as thrushes that feed on ground-dwelling invertebrates, but may reduce the value of the margin for ground-nesting birds. The SAFFIE project found that other methods of opening up the sward, such as scarification and selective herbicide use, were more effective than cutting. Average bird densities were twice as high in scarified and graminicide-treated margins as in cut margins (Potts *et al.*, 2007).

The extent to which cutting of margins is beneficial to birds is not therefore clear. In practice, cutting some of the sward and leaving some uncut, as allowed under the previous set-aside regime, is likely to maximise benefits for birds. It is therefore concluded that this top-up option is not likely to be more beneficial than the former set-aside rules.

### **2.1.2 Biodiversity: Plants**

Impacts of grass buffers on plants are likely to be similar to the former set-aside regime.

#### **ELS top-ups**

##### **EX1: Wildflower seed mix**

Sowing a wildflower mix has been found to increase botanical diversity in comparison with a naturally regenerated sward (Smith *et al.*, 1993) or a grass-only mixture (Potts *et al.*, 2007).

##### **EX2: Regular cutting and removal of vegetation**

Regular cutting and removal of vegetation will reduce the nutrient status of the soil over time, which is likely to be beneficial to plant species diversity (Marrs, 1993). It will also open up the sward, providing potential establishment sites for seedlings. However, where an established tall herb community exists, cutting may be detrimental, at least during the growing season. Plants should be allowed to flower and set seed before any cutting is carried out.

### **2.1.3 Biodiversity: Other**

Field margins provide habitats for butterflies (Pywell *et al.*, 2004) and other invertebrates (Asteraki *et al.*, 2004; Woodcock *et al.*, 2005), and also small mammals (Bence *et al.*, 2003; Askew *et al.*, 2007; MacDonald *et al.*, 2007). Benefits are likely to be similar to set-aside, though they will be affected by the cutting regime adopted (see below under EX2).

#### **ELS top-ups**

##### **EX1: Wildflower seed mix**

Smith *et al.* (1993) found that field margins sown with wild flowers support greater numbers of invertebrates than naturally regenerated swards. Potts *et al.* (2007) concluded that a grass-only mix provides a good resource for invertebrates that are dependent on sward architectural complexity, but is poor for phytophagous species. A tussocky grass mixture including forbs was superior to a fine-leaved grass mixture with forbs. Inclusion of forbs in the seed mixture also resulted in a large increase in abundance and diversity of bumblebees and butterflies.

## **EX2: Regular cutting and removal of vegetation**

Tattersall *et al.* (2001) found that wood mice favoured uncut patches of set-aside and avoided cut patches. Cutting the vegetation is likely to expose small mammals to greater risk of predation (Tew & MacDonald, 1993) and may also directly injure or kill adults and young in the nests. For invertebrates, taxonomic groups differ in their response to cutting; tall grassland supports more species, individuals and a greater diversity than short swards, though some species prefer short grass (Morris, 2000). For invertebrates in general therefore, cutting is not likely to be beneficial. This was demonstrated by Smith *et al.* (1993), who found that mowing significantly reduced numbers of invertebrates, especially if carried out in summer. The effects were particularly severe for spiders and Auchenorrhyncha. They concluded that invertebrates were best conserved by avoiding summer mowing and by mowing once a year or less, preferably rotating the areas that are cut each year.

### **2.1.4 Resource Protection**

Buffer strips play an important role in filtering sediment and associated phosphorus (P) and pesticides. There is strong evidence that buffer strips can reduce the quantity of pesticides reaching water (e.g. Zande *et al.*, 2001; Porskamp *et al.*, 1995). However, it should not be ignored that there is also evidence to demonstrate that buffers are not always effective at reducing nitrate leaching (Muscutt *et al.*, 1993; Sabater *et al.*, 2003), weakly sorbing pesticides (Reichenberger *et al.*, 2007), or soluble reactive P (Borin *et al.*, 2005; Uusi-Kamppa *et al.*, 2000) and their effectiveness is highly variable. It is the size and location of the buffer in relation to the risk that determines their effectiveness, thus a reduction in pollutants contained in runoff and throughflow is more likely to occur where they are appropriately sited. Moreover, buffer strips do require some management in order to remain effective (e.g. by removing accumulated sediment) hence they should not be left undisturbed indefinitely. There is the potential for the accumulated nutrients to be released if there is a change in land use. Nevertheless, avoiding agro-chemical and manure inputs in the proximity of a watercourse is likely to be beneficial regardless of any other limitations.

The proposal to create 5–9m grass strips along the GAEC14 strips (1-2m) effectively creates a buffer of 6–11m, which is very similar to set-aside (6–10m). It can therefore be expected that the benefits of EM1 will not be less than that for set-aside. It is possible that the benefits could be greater for the reason that set-aside allowed the spreading of manure and organic wastes, whereas EM1 does not. Although manure should not be spread within 10m from a watercourse to comply with SMR4 and the Water Code (thus set-aside along watercourses, on the whole, should not have received any organic manure), this may not have always been adhered to and the clear prescription to disallow the spreading of organic manure on grass buffers is likely to be beneficial to water quality.

### **ELS top-ups**

#### **EX1: Wildflower seed mix**

It is unlikely that the wildflower seed mix would be of benefit to resource protection, and it is assumed that the benefit of the Top Up Options relates solely to EX2 Regular cutting and removal of vegetation.

#### **EX2: Regular cutting and removal of vegetation**

It is difficult to comment on the impact of 'regular cutting and removal' without knowing what is meant by 'regular' cutting. Cutting was already part of the set-aside regime, although only once a year and there was no prescription to remove the cut vegetation. Bedard-Haughn *et al.* (2005) have demonstrated that cutting vegetation on a monthly basis (approximately) and removing the cut vegetation between June and October can reduce the amount of nitrate in runoff, although differences were only apparent after around two months. De Cauwer *et al.*, (2006) have also demonstrated that cutting and removal in June and September can reduce soil mineral nitrogen. However, these studies did not consider the effect of removing vegetation on the trapping

efficiency of sediment, and associated pollutants (pesticides and phosphorus), which could be reduced.

There is therefore some evidence that would indicate that cutting and removal of vegetation could assist in reducing N losses to ground and surface water. However, regular cutting could increase the frequency of machinery on the land compared to set-aside, thus there is a greater potential for compaction and inadvertently creating pathways for runoff which would increase the connectivity with the stream (as the buffers are alongside watercourses), thus negating their intended purpose. The prescription does state that compaction should be avoided and tracks should not be made, but it may be beneficial to clearly state that this is of greater importance than cutting *regularly*, as long as some cuts are made.

### 2.1.5 Conclusion

The benefits arising from EM1 are likely to be broadly similar to those arising from margins managed under the former set-aside rules, as indicated by the NE assessment. However, the effects of the top-ups are not beneficial for all measures of environmental benefit, particularly in the case of EX2, which is likely to be detrimental for invertebrates and small mammals, and may have mixed effects on birds. Cutting part of the margin and leaving part uncut would optimise environmental impacts overall.

**Table 1 Revised assessment for EM1**

Environmental benefits	Original assessment		Revised assessment		
	EM only	With top-ups	EM only	With EX1	With EX2
Biodiversity: birds	same	greater	same	greater	same? <sup>1</sup>
Biodiversity: plants	same	greater	same	greater	greater? <sup>2</sup>
Biodiversity: other	same	greater	same	greater	less
Resource protection	same	greater	same/greater?	same	greater?

<sup>1</sup> Provided cutting is not carried out during the nesting season.

<sup>2</sup> Depending on the soil and vegetation type present, and time of cutting.

## 2.2 EM2: REVERTED ARABLE PLOTS OR STRIPS ALONGSIDE WOODLANDS OR HEDGES

The proposed management rules for EM2 are identical to EM1 and are similar to the former set-aside rules, except that there is no requirement to cut the sward (previously, set-aside margins had to be cut at least once a year, though up to 25% could be left uncut for up to three years and up to two metres next to a hedgerow or wood could be left permanently uncut). Therefore the environmental benefits are expected to be similar to those accruing under the former set-aside scheme.

Two ELS top-ups are available: EX1 (Wildflower seed mix) and EX2 (Regular cutting and removal of vegetation).

In general, the comments made above for EM1 also apply here. Where habitat use may differ due to the proximity of woody vegetation, this is noted below.

### 2.2.1 Biodiversity: Birds

Effects are likely to be similar to the former set-aside regime.

## **ELS top-ups**

### ***EX1: Wildflower seed mix***

As EM1.

### ***EX2: Regular cutting and removal of vegetation***

These areas are likely to be used by birds that nest in hedgerows or herbaceous vegetation adjacent to hedgerows, e.g. yellowhammer and whitethroat (Stoate, 1999; Stoate *et al.*, 1998). These species will be negatively affected by cutting. Vickery *et al.* (2002) propose leaving the part of the strip next to the hedge uncut, as this is likely to increase the attractiveness of the vegetation for these species.

### ***EX3: Limited grazing***

Under this top-up option, livestock are excluded between the end of September and the end of April, but no guidelines are given on stocking rate. Grazing can improve the suitability of grassland for foraging birds, both in terms of vegetation structure and availability of invertebrate prey (Vickery *et al.*, 2001). However, grazing also has detrimental effects in terms of predation and trampling of nests. These impacts are likely to increase with stocking rate. Limits on the permitted stocking rate could improve suitability for ground-nesting birds.

## **2.2.2 Biodiversity: Plants**

Effects on plants are likely to be similar to the former set-aside regime, as for EM1.

## **ELS top-ups**

### ***EX1: Wildflower seed mix***

As EM1, provided that a species-rich vegetation is not already present, in which case sowing could be detrimental.

### ***EX2: Regular cutting and removal of vegetation***

As EM1, but ideally the 2m or so next to the hedge should be left uncut or only cut once a year where necessary to prevent scrub encroachment (e.g. when blackthorn is present) to allow the development of a tall herb community. This is especially relevant where a species-rich tall herb or relict woodland flora is present adjacent to the hedgerow or wood edge.

### ***EX3: Limited grazing***

Grazing will alter the botanical composition of the sward, favouring those plants that are tolerant of defoliation and inhibiting or eliminating those that are intolerant. Moderate grazing, especially by cattle, may increase the heterogeneity of the sward and thus the range of niches available for plants. However, intensive grazing, especially by sheep, reduces botanical diversity (Vickery *et al.* (2001), affecting especially annual and biennial species through prevention of seed set (Crofts & Jefferson, 1999). Exceptions may occur in situations where the soil type and seed sources permit the development of species-rich plant communities typical of grazed swards, as found for example on chalk grassland.

## **2.2.3 Biodiversity: Other**

Effects on other biodiversity are likely to be similar to the former set-aside regime, as for EM1.

## **ELS top-ups**

### ***EX1: Wildflower seed mix***

As EM1.

### ***EX2: Regular cutting and removal of vegetation***

As EM1. Leaving an uncut strip next to the hedge would benefit those species that require a complex vegetation architecture, such as spiders (Baines *et al.*, 1998) and harvest mice (Bence *et al.*, 2003).

### ***EX3: Limited grazing***

The effects of grazing on invertebrates are complex, and related to the timing, duration and intensity of grazing as well as the type of grazing stock (Morris, 2000; Vickery *et al.*, 2001). Grazing is clearly beneficial to dung-feeding invertebrates, provided avermectin wormers are not used (Vickery *et al.*, 2001), and increases organic matter, thus benefiting earthworms and other soil-dwelling detritivores. Selective light or moderate grazing can increase the structural heterogeneity of vegetation, which may be beneficial for some invertebrates such as carabids (Morris, 2000) and grasshoppers (Tscharntke & Greiler, 1995), but intensive grazing is damaging to phytophagous invertebrates especially if carried out in spring or summer (Vickery *et al.*, 2001).

The abundance of small mammals is likely to be inversely related to grazing intensity because of the reduction in amounts of cover.

In summary, this top-up option is likely to be detrimental compared to the former set-aside scheme, unless limits are imposed on stocking density.

## **2.2.4 Resource Protection**

Other permanent areas managed as EM2 without top-ups are unlikely to have any measurable benefits above that offered by set-aside. The issue of spreading organic manure is of less importance to resource protection when it is not spread in the proximity of a watercourse, though it would still be detrimental to the vegetation.

### **ELS top-ups**

### ***EX2: Regular cutting and removal of vegetation***

There is the potential for some enhanced benefit through regular cutting and removal of vegetation (although this must be carefully managed to counteract the increase in frequency of traffic compared to set-aside). These buffers could have additional benefit in reducing nitrate losses if they coincide with overland flow zones or footslope seepage zones (Blackwell *et al.*, 1999), as these areas are effectively 'in-field buffers' rather than riparian buffers.

### ***EX3: Limited grazing***

Set-aside regulations did not generally allow grazing. If the top up option 'limited grazing' is included this has the potential to reduce the resource protection benefits compared to set-aside, due to the potential for poaching, compaction (and hence soil erosion) and a source of nutrients, veterinary medicines and faecal organisms, as contained in excreta.

## **2.2.5 Conclusion**

EM2 is likely to provide similar benefits to those arising from long term set-aside under the previous scheme. EX1 will be generally be beneficial for biodiversity so long as it does not replace an existing species-rich vegetation.

The impact of EX2 will depend on the existing vegetation and when cutting is carried out. Cutting during the spring (April onwards) and summer will be damaging to flowering and seeding plants, phytophagous invertebrates and ground-nesting birds, but cutting in autumn may have some benefits in terms of opening up the sward and providing establishment sites for seedlings and feeding opportunities for birds. Removal of cut vegetation will lower fertility over time, thus potentially increasing plant diversity. However, there is a strong case for leaving a strip at least 2m

wide next to the hedge uncut, or at least cut infrequently where necessary to prevent scrub formation. This will provide a refuge for plants and invertebrates that are intolerant of defoliation as well as small mammals, and increase the quality of the habitat for nesting birds.

EX3 is only likely to be beneficial in comparison with former set-aside if limits are introduced on stocking rates. Low or moderate grazing will increase foraging opportunities for insectivorous birds, and may provide conditions suitable for some ground-nesting birds. Impacts on plants will depend on soil type, community present and seed sources. Heavy grazing will be detrimental for all environmental attributes, especially if grazing occurs right up to the hedge or woodland edge.

**Table 2 Revised assessment for EM2**

Environmental benefits	Original assessment		Revised assessment			
	EM only	With top-ups	EM only	With EX1	With EX2	With EX3
Biodiversity: birds	same	greater	same	greater	same? <sup>1</sup>	mixed <sup>3</sup>
Biodiversity: plants	same	greater	same	greater	greater? <sup>2</sup>	less <sup>4</sup>
Biodiversity: other	same	greater	same	greater	less	same/less <sup>3</sup>
Resource protection	same	greater	same/greater?	same	greater?	less

<sup>1</sup> Provided cutting is not carried out during the nesting season and an uncut strip is left next to the hedge or wood.

<sup>2</sup> Depending on the soil and vegetation type present, and time of cutting. Detrimental if cut right up to the hedge or wood.

<sup>3</sup> Effects depend on stocking rate, always detrimental if intensive.

<sup>4</sup> Detrimental especially if intensive, except in situations where there is potential for species-rich communities characteristic of grazed swards to develop.

### **2.3 EM3: PREVIOUSLY CULTIVATED LAND ROTATIONALLY TAKEN OUT OF PRODUCTION**

This option is similar to land managed as rotational set-aside under the former scheme, except that herbicide use is not permitted until 1 June.

#### **2.3.1 Biodiversity: Birds**

Rotational set-aside was used as a foraging and nesting habitat by birds. Defra project BD1640<sup>1</sup> reported densities of declining Farmland Bird Index species ten times higher on set-aside than on winter cereals in summer, and almost 90 times higher in winter (rotational and non-rotational combined) (British Trust for Ornithology (BTO), 2008). EM3 is likely to provide similar benefits in winter, but in summer the benefits will be considerably greater, because under the previous set-aside regime, broad-spectrum herbicides could be applied from 15 April, and it was common practice to apply herbicide (almost invariably glyphosate) to prevent seeding of annual weeds, usually in April or May. The resulting destruction of the vegetation cover exposed existing nests to greater predation risk, and curtailed further breeding attempts. Rotational set-aside is a particularly attractive breeding habitat for skylarks, and BD1640 reported an average number of 1.89 fledglings per breeding attempt on set-aside compared to 1.44 on conventional crops. Recent research by

<sup>1</sup><http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=15950&FromSearch=Y&Publisher=1&SearchText=BD1640&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

the BTO has demonstrated increased skylark territory densities where spraying was delayed until June; in years when spraying was delayed until early June, set-aside supported the highest densities of breeding skylarks as well as foraging finches and buntings, and numbers of grey partridge<sup>2</sup>.

## **ELS top-ups**

### ***EX4: Wild bird seed mixture***

Seed densities in wild bird seed mixtures are likely to be much higher than in naturally regenerated set-aside following conventional crops. BD1640 estimated that 0.13 ha of wild bird seed mixture was equivalent to 1ha of naturally regenerated set-aside, based on densities of seed-eating birds in the two habitats.

Under the former set-aside rules, wild bird seed mixtures could be sown as 'wild bird cover', but the rules were slightly different. At least two crop groups were specified, but these had to be sown in an intimate mixture which often meant that one of the crops was dominant and out-competed the other. In contrast, EX4 allows sowing of component crops in separate drill widths or strips, thus avoiding competition and aiding the achievement of the correct drilling depth for each crop. Also, no fertiliser or insecticide was permitted under the set-aside rules (except under derogation in the case of the latter), so establishment and growth was often poor. For example, brassicas and linseed may be severely damaged by flea beetles at the seedling stage, and exhibit poor growth where nitrogen levels are low. EX4, which permits fertiliser use and seed treatments is likely to result in higher seed production. It is likely therefore that on average, the production of seed food for birds will be greater under EX4 than in wild bird cover on former set-aside land.

### ***EX5: Nectar mix***

It is difficult to assess the value of this option for birds, as there are no relevant data. It may provide some seed food for birds, but the vegetation may be too dense for some species which may prefer the more open foraging conditions of naturally regenerated set-aside. Nectar mix will be less valuable than wild bird cover for birds. On balance, it is probably less useful than other forms of set-aside.

### ***EX6: Uncropped cultivated margins***

Cultivation stimulates the germination of annual plants, and once established these margins are likely to have a higher seed production than conventional rotational set-aside, and so provide more foraging for granivorous birds. The greater plant diversity may also increase insect abundance, providing greater resources for insectivorous birds.

### ***EX7: Unharvested cereal headlands***

During the growing season this option will be effectively similar to a conservation headland in a cereal crop. Conservation headlands were originally designed to provide foraging areas for grey partridges, and have been shown to improve chick survival (Rands 1985, 1986). Although food resources have been shown to be higher, benefits for other bird species in the breeding season have not been clearly demonstrated. However, in the winter, the unharvested crop will provide an abundant source of food for granivorous species such as corn bunting and yellowhammer that favour cereal seeds (Boatman & Stoate, 2002; Henderson *et al.*, 2004).

### ***EX8: Rotational fallow (false seed bed in spring)***

This option will provide nesting habitat for birds that favour open areas for nesting, such as lapwing and stone curlew. It is likely to be more valuable than rotational set-aside that is sprayed with herbicide due to the lack of disturbance and retention of some vegetative cover from germination following cultivations.

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<sup>2</sup> <http://www.farmwildlife.info/Forums/forums/754/ShowPost.aspx>

### **2.3.2 Biodiversity: Plants**

Delaying the spraying date until 1 June may give a limited number of early flowering species an opportunity to flower and set seed. This could be advantageous where rare arable flora are present. However, for most species, seed set is unlikely to be completed before 1 June.

#### **ELS top-ups**

##### ***EX4: Wild bird seed mixture***

Herbicides are not permitted on EX4. Because it is retained for a whole season, it will provide opportunities for plants germinating from the seed bank to set seed, and therefore have higher value than rotational set-aside. However, the permitted use of fertilisers and seed treatments is likely to improve establishment of the seed crops, thus offering greater competition to wild plants, so the benefits may be less than in wild bird cover sown on former set-aside land. The relative benefits therefore depend on the comparison adopted.

##### ***EX5: Nectar mix***

As the mixture will be dominated by the sown components, wild plants will have limited opportunities for establishment. However the option will be retained for long enough to permit seed set, so this option is likely to be more beneficial than standard rotational set-aside if sprayed off with herbicide, though not as advantageous as wild bird cover.

##### ***EX6: Uncropped cultivated margins***

Uncropped cultivated margins are designed to encourage annual plants, and have been found to be the most effective option for the conservation of rare arable flora (Walker *et al.*, 2007). They will therefore have a higher value than conventional rotational set-aside.

##### ***EX7: Unharvested cereal headlands***

These headlands are equivalent to conservation headlands, which contain higher densities and diversity of annual plants than conventional crops, but direct comparisons have not been made with rotational set-aside. The wild flora will have to compete with the cereal crop which would tend to reduce growth and seed set in comparison with uncropped set-aside, on the other hand the cultivations prior to establishment of the cereal will stimulate germination of annual plant seeds so a greater diversity may occur in the cereal headlands. More importantly, the cereal headlands will be retained for a whole year, so plants will have an opportunity to set seed which they would not in conventional rotational set-aside that is sprayed off in spring.

##### ***EX8: Rotational fallow (false seed bed in spring)***

EX8 is likely to be more valuable than rotational set-aside that is sprayed with herbicide as plants germinating following cultivations will have opportunities to flower and set seed.

### **2.3.3 Biodiversity: Other**

Delaying the spraying date will extend the period for which the habitat is suitable for non-avian fauna, but destroying the vegetation on 1 June will still curtail the life cycles of many phytophagous insects and force mobile species to seek alternative habitats and resources elsewhere.

#### **ELS top-ups**

##### ***EX4: Wild bird seed mixture***

In addition to birds, seeds also provide food for small mammals (e.g. Tew *et al.*, 2000) and invertebrates (e.g. Tooley & Brust, 2002). As indicated above, seed production from the sown crops is likely to be higher than from wild bird cover on former set-aside, though the seed production from associated naturally occurring species may be lower because of competition from the sown crops.

Parish & Sotherton (2004) found that butterflies and bumblebees were 15 and 40 times more abundant respectively in game crops in Scotland than in conventional crops. Although these were not specifically managed under agri-environment prescriptions, the results suggest that wildlife seed mixture-type prescriptions are likely to provide good habitat for pollinators in summer as well as providing seed sources for birds in winter. Pywell *et al.* (2005) found that wildlife seed mixtures provided good foraging habitat for bumblebees providing suitable forage species were included.

#### **EX5: Nectar mix**

This option has a high value for insects, especially bumble bees (Pywell *et al.* 2006) and other pollen and nectar feeders such as butterflies (Pywell *et al.*, 2004).

#### **EX6: Uncropped cultivated margins**

These margins will provide habitat for phytophagous insects and foraging for pollen and nectar feeding insects. Hassall *et al.* (1992) showed that abundance and species richness of spiders, carabid beetles and Heteroptera were higher in uncropped cultivated margins than conservation headlands or conventionally managed headlands. Six metre wide uncropped field margins have been shown to support ten times as many foraging bumblebees as cropped margins (Kells *et al.*, 2001). Although comparisons with rotational set-aside have not been reported, it is likely that EX6 will be more beneficial for invertebrates.

#### **EX7: Unharvested cereal headlands**

As noted above, Hassall *et al.* (1992) showed that abundance and species richness of spiders, carabid beetles and Heteroptera were higher in uncropped cultivated margins than conservation headlands. However, as headlands are retained all year, the overall benefits are likely to be greater for invertebrates than rotational set-aside. It is not possible to compare with other forms of set-aside as data are not available.

Wood mice feed in conservation headlands (Tew *et al.*, 1992), and seed sources were found to be major determinants of habitat use (Tew *et al.*, 2000). In summer, mice will feed on weed seeds and in winter the crop grain itself will provide an abundant source of food. EX7 headlands will therefore provide an abundant source of food for this species, and may also be used by other small mammals.

#### **EX8: Rotational fallow (false seed bed in spring).**

Spring cultivations will have a negative impact on invertebrates, but the longer retention period (until 31 July) may provide benefits. This option seems unlikely to provide greater benefits overall than rotational set-aside for invertebrates or other non-avian fauna.

### **2.3.4 Resource Protection**

EM3 is largely the same as rotational set-aside with the primary difference being that there is no requirement to establish a green cover; it is assumed that if the land is left to stubble some natural regeneration will occur. Defra (2007) reported that around 10% of land going into rotational set-aside following cereal crops was sown for green cover, 85% was left to regenerate naturally and 5% went to wild bird cover. It is therefore unlikely that there will be any measurable differences in resource protection.

#### **ELS top-ups**

It is unclear why the top-up options are perceived to be beneficial to resource protection over and above that already provided by the land taken out of production. Indeed, EX6 and EX8 may increase nutrient losses, if wet weather follows cultivation.

### **2.3.5 Conclusion**

In most cases the biodiversity assessment concurs with the NE analysis. The value of EX5 for birds is not known but may be less than rotational set-aside, and EX8 may not provide any additional benefits for non-avian fauna. For resource protection however, there is no apparent reason why the top-up options should be more beneficial than conventional set-aside, and those options involving cultivation (EX6 and EX8) may be less beneficial in certain circumstances.

## **2.4 EM4: GAME STRIPS (USING COMMERCIALLY AVAILABLE MIXTURES OR GAME AND/OR WILD BIRD MANAGEMENT)**

This option is similar to the wild bird cover option under the former set-aside scheme, but has greater flexibility as there are no restrictions on herbicide or fertiliser inputs, seed treatments may be used, and the only restriction on crops sown is that maize is excluded.

### **2.4.1 Biodiversity: Birds**

The lack of restrictions on inputs is likely to result in better establishment, growth and seed production than in wild bird cover on set-aside, thus providing higher seed yields and more resources for birds. BD1640 estimated that 0.13 ha of wild bird seed mixture was equivalent to 1ha of naturally regenerated set-aside, based on densities of seed-eating birds in the two habitats.

### **2.4.2 Biodiversity: Plants**

Herbicides may be used in EM4; whilst this will assist establishment of the sown crops, where they are used they will obviously suppress the naturally regenerating flora. It is concluded therefore that EM4 will be less beneficial than land set aside under the former rules.

### **2.4.3 Biodiversity: Other**

As indicated for EX4, these game strips may also be beneficial for small mammals and nectar-feeding insects, though if naturally occurring species are suppressed the attractiveness to insects will depend on the species sown. The benefits are not therefore likely to be greater than for wild bird cover, and could be less.

### **2.4.4 Resource Protection**

No additional benefit is expected compared to wild bird cover on set-aside.

**Table 3**      **Revised assessment for EM3**

<b>Environmental benefits</b>	<b>Original assessment</b>		<b>Revised assessment</b>					
	<b>EM only</b>	<b>With top-ups</b>	<b>EM only</b>	<b>With EX4</b>	<b>With EX5</b>	<b>With EX6</b>	<b>With EX7</b>	<b>With EX8</b>
Biodiversity: birds	greater	greater	greater	greater	less	greater	greater	greater
Biodiversity: plants	same	greater	same	greater	greater?	greater	greater	greater
Biodiversity: other	greater	greater	slightly greater	greater	greater	greater	greater	same
Resource protection	same	greater	same	same	same	less	same	less

## 2.4.5 Conclusion

EM4 is likely to be more beneficial to birds than wild bird cover on set-aside, but less beneficial to plants and possibly non-avian fauna. Impacts on resource protection will be similar to set-aside.

**Table 4 Revised assessment for EM4**

Environmental benefits	Original assessment		Revised assessment	
	EM only	With top-ups	EM only	With top-ups
Biodiversity: birds	greater	N/A	greater	N/A
Biodiversity: plants	same	N/A	less	N/A
Biodiversity: other	same	N/A	same/less?	N/A
Resource protection	same	N/A	same	N/A

## 2.5 EM5: MINIMUM ROW WIDTH WINTER OR SPRING CEREAL

This is one of several options for the manipulation of commercial crops. The taller and denser structure of modern winter wheat crops makes them unsuitable for ground-nesting birds, such as lapwing and skylark (Hudson *et al.* 1994, Donald *et al.* 2001). Any option to provide a more open structure might potentially be beneficial.

### 2.5.1 Biodiversity: Birds

The effect of sowing wheat in wide spaced rows (WSR), compared to conventional row spacing and undrilled patches (UP), (equivalent to EM6), on plants, invertebrates and birds, was studied in the SAFFIE project (Morris *et al.* (2007). Skylark breeding productivity was higher in the WSR treatment but effects were not as consistent or as pronounced as for the UP treatment. No direct comparison is available with set-aside. Rotational set-aside was an attractive breeding habitat for skylarks, but breeding was generally curtailed when the land that was to be returned to cropping received an application of glyphosate herbicide in April or May. In contrast, a cereal crop with WSR would remain throughout the summer. The SAFFIE project reported that chick production per nest with wide spaced rows was 0.4 chicks per nesting attempt higher than in a conventional crop, but 0.25 chicks per attempt less than with UP. Territory densities were 0.91 in conventional crops, 1.04 in WSR and 1.22 in UP. In contrast, BD1640 reported that average skylark densities were over five times higher on set-aside than on winter cereals, and that 0.45 more chicks were produced per breeding attempt on set-aside compared to cereals. Overall, it seems likely that productivity in cereals with wide spaced rows would be less than that in rotational set-aside sprayed with herbicide.

### ELS top-up

#### **EX11: Skylark plots**

Project BD1640 concluded that 2.5ha of winter wheat with undrilled patches (skylark plots) would be needed to support the equivalent number of breeding skylarks to one hectare of set-aside. However, this does not take into account the curtailed breeding season that was commonplace on rotational set-aside as a result of herbicide application, and therefore probably underestimates the value of wheat with undrilled patches.

## 2.5.2 Biodiversity: Plants

In the SAFFIE project, there was little difference in vegetation cover between the wide-spaced rows treatment and the conventional spacing (Morris *et al.* (2007); Jones & Smith (2007).

### ELS top-up

#### ***EX11: Skylark plots***

In the SAFFIE project, there were often marked differences in vegetation cover, structure and seed production within undrilled patches compared to the surrounding crop, but in view of the relatively tiny area covered by the undrilled patches (around 0.3% of the field as a whole), differences were insignificant at a field scale (Clarke *et al.*, 2007). The value of EX11 for plants is likely to be less than for land managed as set-aside overall.

## 2.5.3 Biodiversity: Other

In the SAFFIE project, there was little difference in invertebrate numbers between the wide-spaced rows treatment and the conventional spacing (Morris *et al.* (2007); Jones & Smith (2007).

### ELS top-up

#### ***EX11: Skylark plots***

A few invertebrate species were more abundant in undrilled patches than in the surrounding cereal crop, but at a field scale the differences were insignificant. Skylark plots are likely to have less value for invertebrates than set-aside overall.

Where skylark plots become weedy, they could provide feeding areas for wood mice, however management generally aims to avoid weed infestations occurring in the plots.

## 2.5.4 Resource Protection

The NE assessment suggests no impact on resource protection. If the seed rate is held constant, there is likely to be little effect, but it is possible that nutrient uptake by a crop with wide-spaced rows would be less efficient, especially earlier in the season when the roots had not fully explored the soil between the rows. This could lead to greater potential for nutrient losses compared to a conventional crop, but the differences are likely to be slight.

Because the use of pesticides, fertilisers, and manures on cropped land provides a greater source of pollutants, the impact of cereal crops is likely to be negative compared to set-aside. The presence of tractor wheelings is also a significant pathway for runoff (PE0206<sup>3</sup>) and can therefore increase the connectivity of the pollutant source with surface waters (Lancaster Environment Centre, 2005).

### ELS top-up

#### ***EX11: Skylark plots***

Although bare areas could have a detrimental impact on nitrate leaching, the relatively small area involved is likely to have little impact on resource protection overall compared to a conventional cereal.

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<sup>3</sup><http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=11500&FromSearch=Y&Publisher=1&SearchText=PE0206&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

## 2.5.5 Conclusion

The NE assessment suggests a lower benefit than set-aside for birds, plants and no benefit for resource protection from this option. The SAFFIE results suggest some increase in breeding productivity for skylarks.

No significant impact on plants or invertebrates was observed in the SAFFIE project. Any impact on resource protection is likely to be negative.

A yield decrease in the WSR treatment compared to the conventional treatment was noted on some sites in the SAFFIE project. Similarly, Welsh *et al.* (2002) found that increasing wheat row spacing from normal practice to wide rows can result in a significant reduction in yield of the order 5–10 %.

The ELS top-up option EX11 appears to be equivalent to EM6. The benefits of farmland bird plots in wide-spaced rows compared to conventionally drilled crops have not been tested experimentally, but as the plots produce good results in conventional crops there does not seem to be any advantage in undergoing the additional inconvenience, expense and potential yield penalty of drilling in wider rows.

**Table 5 Revised assessment for EM5**

Environmental benefits	Original assessment		Revised assessment	
	EM only	With top-ups	EM only	With top-ups
Biodiversity: birds	less	same	less?	same?
Biodiversity: plants	less	less	none/negligible	none/negligible
Biodiversity: other	less	less	none/negligible	none/negligible
Resource protection	none/negligible	none/negligible	none/negligible	none/negligible

## 2.6 EM6: FARMLAND BIRD PLOTS IN WINTER CEREALS

EM6 appears to be effectively identical to EX11, and the same comments therefore apply. The assessment is therefore as below:

**Table 6 Revised assessment for EM6**

Environmental benefits	Original assessment		Revised assessment	
	EM only	With top-ups	EM only	With top-ups
Biodiversity: birds	less	N/A	same?	N/A
Biodiversity: plants	none/negligible	N/A	none/negligible	N/A
Biodiversity: other	none/negligible	N/A	none/negligible	N/A
Resource protection	none/negligible	N/A	none/negligible	N/A

## **2.7 EM7: REDUCED NITROGEN WINTER OR SPRING CEREAL CROP**

### **2.7.1 Biodiversity: Birds**

There is evidence that the high density of winter cereals inhibits breeding by ground nesting birds such as skylark and yellow wagtail later in the season (Vickery *et al.*, 2008). The less dense crop canopy resulting from reduced nitrogen use could therefore be beneficial to birds compared to conventional cereals, but there is little evidence on which to base an assessment. Wilson *et al.* (1997) found that skylark densities were higher on organic cereals than conventional cereals, but attributed this only partly to sparser and slower growing crops, as territory densities were higher early in the season when vegetation structure was unlikely to be a limiting factor. More abundant invertebrate food supplies as a result of the withholding of synthetic fertilisers and pesticides were considered also to play a role. Densities on organic cereals were similar to those found on non-organic set-aside.

#### **ELS top-up**

##### ***EX11: Skylark plots***

As for EM5.

### **2.7.2 Biodiversity: Plants**

Grundy *et al.* (1993) found that weed density, biomass and species richness were higher at low nitrogen rates in wheat but this was in the absence of herbicide. Where herbicide is used, it is likely that there would be little difference in the levels of non-crop plants present between cereals with reduced nitrogen levels and conventional cereal crops, except for the most herbicide tolerant species such as black-grass and cleavers. Set-aside is therefore likely to be of greater value.

#### **ELS top-up**

##### ***EX11: Skylark plots***

As for EM5.

### **2.7.3 Biodiversity: Other**

Evidence is lacking as to the effect of reduced nitrogen rates on other fauna. A number of studies have been carried out comparing organic or integrated farming systems with conventional systems, but these rarely separated the effects of different inputs. Set-aside is likely to have a greater habitat value than reduced nitrogen cereal over winter and spring, until it is sprayed off (where this occurs).

#### **ELS top-up**

##### ***EX11: Skylark plots***

As for EM5.

### **2.7.4 Resource Protection**

Reduced nitrogen inputs are likely to be beneficial compared to conventional cereals, but set-aside is likely to have greater benefits in terms of resource protection.

#### **ELS top-up**

##### ***EX11: Skylark plots***

As for EM5.

## 2.7.5 Conclusion

EM7 is likely to have limited value compared to set-aside.

**Table 7 Revised assessment for EM7**

Environmental benefits	Original assessment		Revised assessment	
	EM only	With top-ups	EM only	With top-ups
Biodiversity: birds	less	same	less	same?
Biodiversity: plants	less	less	less	less
Biodiversity: other	less	less	less	less
Resource protection	less	less	less	less

## 2.8 EM8: REDUCED SEED-RATE WINTER OR SPRING CEREAL CROP

Once again there is little evidence on which to assess this option. In general, the effects are likely to be similar to EM7, and the assessment is the same.

## 2.9 EM9: WINTER STUBBLE (LEFT FROM CROP HARVEST UNTIL THE END OF FEBRUARY IN THE FOLLOWING YEAR)

This option is similar to the overwinter period under the former set-aside rules, except that straw is chopped and baled or removed, and a light cultivation *may* be carried out to encourage weed germination and loosen any surface compaction or capping (however this is not required).

### ***EX12: Low input regime for spring crop***

It is assumed that this applies to spring cereals. It would be more valuable if this preceded the stubble, so that the surviving weeds could provide food for seed-eating birds over the following winter. Note: tri-alleate has now been withdrawn from use.

### 2.9.1 Biodiversity: Birds

Defra project BD1610<sup>4</sup> investigated the effects of different crop stubbles and straw disposal methods on wintering birds and arable plants (BTO, 2002). Most stubble fields were found to support no birds at all. Most of the variation in the number of granivorous species using stubbles was explained by the seed densities of Chenopodiaceae and Polygonaceae, and the number of chemicals used on the previous crop. Cultivations, if carried out, would stimulate weed germination but these weeds would have to reach maturity and set seed before the end of February to provide food for seed eating birds. This is unlikely, except perhaps for very short lived species such as annual meadow-grass and chickweed. Cultivations will bring some seeds and invertebrates to the surface and temporarily increase food availability in the autumn, but food supplies are generally not limiting at this time of year and the effect will only be temporary. Return of the stubble to cropping from the end of February will reduce its value compared to set-aside.

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<sup>4</sup><http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=8410&FromSearch=Y&Publisher=1&SearchText=BD1610&SortString=ProjectCode&SortOrder=Asc&Paging=10#Description>

## **ELS top-ups**

### ***EX9: Enhanced winter stubble option***

Herbicide use in the previous crop, and particularly the use of pre-harvest glyphosate, were found to be important factors influencing seed availability for birds in stubbles in project BD1610. The prohibition of pre-harvest desiccants and post-harvest herbicides is likely therefore to increase the value of these stubbles in comparison with former set-aside stubbles. Leaving the field undisturbed until 31 July will maximise benefits for breeding birds. This option should be of very high value for birds.

### ***EX12: Low input regime for spring crop***

EX12 will allow survival of some weeds in the crop, leading to increased insect densities, equivalent to a conservation headland (Sotherton, 1991). This will benefit birds foraging in the crop, such as grey partridge (Rands, 1985) and corn bunting (Brickle *et al.*, 2000). As the option will last until harvest, it would be more beneficial than rotational set-aside that is treated with glyphosate.

## **2.9.2 Biodiversity: Plants**

The early date at which the stubble can be destroyed means that EM9 is likely to have lower benefits for plants than set-aside, as even if the soil is cultivated, few plants germinating in the autumn will have set seed before the end of February.

## **ELS top-ups**

### ***EX9: Enhanced winter stubble option***

EX9 will allow annual plants to germinate and complete their life cycle and so will be more valuable than conventional rotational set-aside, and also potentially more valuable than long-term set-aside in its first year, as this would not normally be cultivated to stimulate germination. This option will be especially valuable where rare arable plants are found.

### ***EX12: Low input regime for spring crop***

This option will also potentially allow spring-germinating arable plants to set seed, though as some herbicide use is permitted this may kill or reduce the vigour of some species. Benefits may be greater or less than set-aside, depending on how it is managed (assessed as the same).

## **2.9.3 Biodiversity: Other**

Disturbance of the soil is likely to be detrimental to most invertebrates (Holland, 2004) and this, coupled with the early date for return to cultivation, will mean that EM9 will be less beneficial than set-aside.

## **ELS top-ups**

### ***EX9: Enhanced winter stubble option***

The year round vegetation cover and seed production will provide resources for mammals and invertebrates throughout the summer. EX9 is likely therefore to be of greater benefit than set-aside.

### ***EX12: Low input regime for spring crop***

The presence of non-crop plants will provide resources for non-avian fauna, but as for plants, the relative benefits compared with set-aside will depend on the management of the set-aside concerned.

## 2.9.4 Resource Protection

Subsoiling of compacted areas and loosening of compaction or capping, if carried out, will be beneficial in terms of reducing the risks of run-off and erosion. However, from the time the field is returned to cropping the benefits of EM9 are likely to be less than for set-aside.

### ELS top-ups

#### ***EX9: Enhanced winter stubble option***

Subsoiling of compacted areas and loosening of compaction or capping, if carried out, will be beneficial in terms of reducing the risks of run-off and erosion, and provided that the cultivation is not severe enough to destroy any green cover present, leaving the vegetation undisturbed subsequently will reduce risks of nutrient loss relative to conventional rotational set-aside.

#### ***EX12: Low input regime for spring crop***

Spring cultivation (potentially stimulating nitrogen release) and the use of fertiliser inputs mean that this option will be marginally less favourable than set-aside for resource protection.

## 2.9.5 Conclusion

EM9 is likely to be of limited value in most cases, however where EX9 is used, benefits will be high. EX12 will also provide benefits, which are likely to be greater than rotational set-aside treated with herbicide.

**Table 8 Revised assessment for EM9**

Environmental benefits	Original assessment		Revised assessment		
	EM only	With top-ups	EM only	With EX9	With EX12
Biodiversity: birds	less	same	less	greater	greater?
Biodiversity: plants	less	same	less	greater	same
Biodiversity: other	less	same	less	greater	same
Resource protection	less	less	less	same/greater	less

## 2.10 EM10: WINTER STUBBLE FOLLOWED BY SPRING BARLEY OR BEANS, SUGAR BEET AND LINSEED

The main value of this option is that it may introduce spring crops into the rotation. However, it is likely to be taken up mainly by farmers who already grow these crops. The spring crop is managed conventionally, and there are few restrictions on management of the preceding stubble apart from prohibition of pesticides (which presumably includes post-harvest herbicides).

#### ***EX9: Enhanced winter stubble option***

It is not clear how this top-up can be applied, since the stubble is to be left undisturbed until July 31<sup>st</sup>, thus it would not be possible to sow a spring crop. If managed as for EM9, the benefits would be the same.

### 2.10.1 Biodiversity: Birds

The short timescale over which the stubble is present will reduce its value compared to set-aside. Although spring crops are more favourable for nesting and foraging for species such as lapwing and skylark, than winter crops, if conventionally managed they are likely to have lower value than set-aside, at least until it is sprayed off, if this occurs.

#### ELS top-ups

##### **EX9: Enhanced winter stubble option**

See above.

##### **EX12: Low input regime for spring crop**

This option is apparently designed for spring cereals, as the herbicide prescriptions are those used in conservation headlands and previous low input cereal options in agri-environment schemes. It is not likely to be directly applicable to other spring crops. Comments apply as for EM9 in relation to spring cereals. Earlier destruction of the stubble will reduce overwinter feeding value compared to EM9.

### 2.10.2 Biodiversity: Plants

The value of EM10 for plants is likely to be lower than set-aside, as there are no restrictions on herbicide use in the spring crop.

### 2.10.3 Biodiversity: Other

Holland *et al.* (2002) found that chick-food invertebrates were generally present at the highest densities in combinable break crops such as oilseed rape, peas and beans, and lowest in root crops (potatoes, sugar beet), with cereals intermediate. Moreby & Aebischer (1992) reported that numbers of invertebrates important in the diet of grey partridge chicks were three times as high in set-aside as in wheat. On the limited evidence base available, it seems unlikely that this option will be as beneficial as set-aside

### 2.10.4 Resource Protection

Spring cultivation (potentially stimulating nitrogen release) and the use of fertiliser inputs mean that this option will be marginally less favourable than set-aside for resource protection.

### 2.10.5 Conclusion

This option is of limited value compared to set-aside, and will probably be taken up by farmers who grow spring crops anyway, thus achieving little change in relation to current practice.

It is not clear that the top-up options are applicable, except for low-input cereals.

**Table 9 Revised assessment for EM10**

Environmental benefits	Original assessment		Revised assessment		
	EM only	With top-ups	EM only	With EX9 <sup>1</sup>	With EX12 (cereals only)
Biodiversity: birds	less	same	less	greater	same?
Biodiversity: plants	less	same	less	greater	same
Biodiversity: other	less	same	less	greater	same

Resource protection	less	less	less	same/greater	less
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<sup>1</sup> Assuming this replaces the spring crop.

## 2.11 EM11: LOW-INPUT CEREAL OR OILSEED RAPE FOLLOWED BY WINTER STUBBLE

This option is similar to EM9 except that pre-harvest desiccants and post-harvest weed control treatments are specifically prohibited (NB pesticide application to the stubble is not allowed under EM9, which should exclude post-harvest herbicides under the usual definition of pesticides, but this is not explicitly stated).

### ELS top-ups

These are not discussed separately for the different environmental attributes as the comments made previously apply here also, as indicated below.

#### ***EX9: Enhanced winter stubble option***

This effectively replaces EM11 as the conditions relating to herbicide use are the same. The comments made above under EM9 (section 2.9.1) apply.

#### ***EX11: Skylark plots***

EX11 will have similar effects in relation to cereals managed as EM11 as when implemented as EM6. As far as is known, they have not been tested in oilseed rape, so the value is not known.

#### ***EX12: Low input regime for following spring crop***

Comments apply as under EM9.

### 2.11.1 Biodiversity: Birds

As stated above (section 2.9.1), withholding pre-harvest desiccants and post-harvest herbicides is likely to increase seed production by weeds present in the stubbles, and hence substantially increase the amount of seed food available to birds (BD 1610; BTO, 2002). Benefits will be curtailed however when the stubble is ploughed.

### 2.11.2 Biodiversity: Plants

In contrast to EM9, the restriction on herbicide usage should allow any weeds present in the preceding crop which survive harvest to continue to set seed over winter, thus replenishing the seed bank. No herbicides were permitted on set-aside stubbles, but pre-harvest desiccants could be used, so the weed flora in the autumn may be enhanced compared to conventional set-aside.

### 2.11.3 Biodiversity: Other

As for EM9.

### 2.11.4 Resource Protection

As for EM9. Glyphosate is the most common herbicide used for pre- and post-harvest treatment, and as it is inactivated on reaching the soil, its use does not have resource protection implications.

### 2.11.5 Conclusion

This option will provide greater benefits than EM9 for birds; value for other environmental indicators is similar to EM9

### 2.11.6 Conclusion

The benefits will be enhanced for birds and plants compared to EM9. Combinations with top-ups will lead to combined benefits.

**Table 10 Revised assessment for EM11.**

Environmental benefits	Original assessment		Revised assessment			
	EM only	With top-ups	EM only	With EX9	With EX11	With EX12
Biodiversity: birds	same	greater	same <sup>1</sup>	greater	same	greater?
Biodiversity: plants	less	same	greater?	greater	greater?	greater?
Biodiversity: other	less	same	less	greater	less	same
Resource protection	same	less	less	same/greater	less	less

<sup>1</sup> Benefits will be greater until the end of February, then less.

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## APPENDIX 1. OPTIONS PROPOSED FOR INCLUSION XC1 (DRAFT FOR CONSULTATION)

<b>EM1:</b>	<b>Grass buffers alongside temporary and permanent water courses</b>
<b>Role:</b>	To provide additional buffering protection alongside existing GAEC14 Protection Zones.
<b>Benefits:</b>	<p><b>Resource protection:</b></p> <p>Reduced inputs being applied to cropped land area.</p> <p>Reduce risk of water pollution by providing a buffer between productive part of the field and the watercourse to:</p> <ul style="list-style-type: none"> <li>• Reduce effects of agri-chemical spray drift.</li> <li>• Trap and filter sediment and associated pollutants (including contaminants bound to sediment such as Phosphate).</li> <li>• Control or prevent erosion of valuable topsoil from fields into watercourses and may help reduce frequency of ditch maintenance through decreased rates of siltation.</li> <li>• Reduce nitrate leaching via nitrogen absorption by vegetation growing on the buffer strip.</li> </ul> <p><b>Biodiversity:</b></p> <p>Provides summer foraging and nesting habitats for a number of declining farmland birds.</p> <p>Provide nesting and feeding areas for many other types of wildlife and game including brown hare and small mammals such as field vole.</p> <p>Provide corridors for wildlife to move between different areas of habitat; and enhances landscapes.</p> <p><b>References</b></p> <p>(Abu-Zreig (2001), Coyne (1995), Daniels and Gilliam (1996), Dillaha <i>et al.</i> (1989), Lalonde (1998), NSRI (2006), Magette <i>et al.</i> (1989), Robinson <i>et al.</i> (1996), Syversen and Bechmann (2004)</p>
<b>Management Requirements:</b>	<p>Natural regeneration or sown mixture.</p> <p>Retained areas of long-term set-aside.</p>
<b>ELS Top-ups</b>	<p>EX1 Wildflower seed mix.</p> <p>EX2 Regular cutting and removal of vegetation.</p>
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM2:</b>	<b>Reverted arable plots or strips alongside woodlands or hedges</b>
<b>Role:</b>	To capture the benefits which larger plots or strips of non-rotational set-aside delivered for feature protection, as well as the longer-term areas that have developed into stable and valuable habitats for plants, invertebrates and soil protection.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Provides foraging and nesting habitats for farmland birds.</p> <p>Retention of rare invertebrate and plant assemblages that have developed in non-rotational areas (5-15 years).</p> <p>Reduced risk of adverse affects of fertiliser and sprays on hedge bottom and basal flora. Generic benefits for species such as voles that benefit from long grass and as a better network of pathways for wildlife movement under climate changes pressures. .</p> <p><b>Resource Protection:</b></p> <p>Benefits from reduced fertiliser or pesticide inputs. In addition, may offer some benefit in situations where such field areas are direct flow paths to watercourses.</p>
<b>Management Requirements:</b>	<p>Natural regeneration or sown mixture.</p> <p>Retained areas of long-term set-aside.</p> <p>Remove of compaction before establishment and regular cutting allowed in first 12 months.</p> <p>No inputs except spot treatment for weed control.</p> <p>No regular vehicular access or storage.</p>
<b>ELS Top-ups</b>	<p>EX1 Wildflower seed mix.</p> <p>EX2 Regular cutting and removal of vegetation.</p> <p>EX3 Limited grazing.</p>
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM3:</b>	<b>Previously cultivated land rotationally taken out of production</b>
<b>Role:</b>	To secure field and part-field areas on an annual basis from harvest until 31 July the following year.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Annual rotational protection for boundary features.</p> <p>Nesting and foraging benefits for birds and mammals associated with open, uncropped land areas.</p> <p><b>Resource Protection:</b></p> <p>Reduced inputs.</p> <p>Where there is risk of runoff and erosion over-wintered stubbles provide more protection through the winter than bare soil, (providing the stubble soil is not capped and compacted).</p> <p>Where there is risk of soil erosion and runoff, significant benefits if, after harvest, any compaction or surface capping is removed to increase surface roughness and infiltration.</p>
<b>Management Requirements:</b>	<p>Restrictions on timings of any herbicide applications for spring weed control. Herbicides can be applied for weed control from 01 June.</p> <p>This option is annual and can be rotated.</p> <p>Different to GAEC12:</p> <p>No requirement for green cover on or after 1 March.</p> <p>No requirement to cut between 1 March and 31 July.</p> <p>Manure can be stored on the field for the next growing season.</p>
<b>ELS Top-ups</b>	<p>EX4 Wild bird seed mixture.</p> <p>EX5 Nectar mix.</p> <p>EX6 Uncropped cultivated margins.</p> <p>EX7 Unharvested cereal headlands.</p> <p>EX8 Rotational fallow (false seed bed in spring).</p>
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM4:</b>	<b>Game strips (using commercially available mixtures for game/wild bird management)</b>
<b>Role:</b>	This measure will capture some of the 15,000 ha of game cover previously grown under derogation on set-aside land.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Provides summer foraging and winter feeding habitats for a number of declining seed-eating farmland birds including yellowhammer, grey partridge and tree sparrow.</p> <p>Provides feeding areas for other types of wildlife and game, and corridors for them to move between different areas of habitat.</p> <p><b>Resource Protection</b></p> <p>None identified.</p>
<b>Management Requirements:</b>	<p>Game strip established as a strip or block to provide winter cover and food.</p> <p>It can contain either an unsprayed unharvested cereal crop (excluding maize) or sown mixture of plants, typical of those which are commercially available and can be annual or biennial. The game strip must be retained until 31 January.</p> <p>Areas should be re-established to maintain reasonable cover and seed production. No restriction on herbicide or fertiliser inputs for sown game mixtures.</p>
<b>ELS Top-ups</b>	None.
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM5:</b>	<b>Minimum alternate row width winter or spring cereal</b>
<b>Role:</b>	To secure field and part-field areas of commercial cereal crops under reduced crop density management on an annual basis.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Should produce a more open crop structure and weedier understorey in commercial cereal crops for foraging and insect provision, but the value to biodiversity will be limited by the agronomic inputs applied.</p> <p><b>Resource Protection:</b></p> <p>There may be a small benefit if reduced inputs are applied in response to a lower potential crop yield.</p>
<b>Management Requirements:</b>	Crop established at minimum 25 cm separation between alternate drill rows to ensure open crop canopy (SAFFIE and MAFF Project CE0614). No other restriction on agronomic inputs.
<b>ELS Top-ups</b>	EX11 Skylark plots.
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM6:</b>	<b>Skylark plots in winter cereals</b>
<b>Role:</b>	To secure small in-field plots in commercial cereal crops on an annual basis.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Produces open in-field areas in commercial cereal crops for skylarks to land, giving better access to nesting and feeding areas (fully supported by SAFFIE project).</p> <p><b>Resource Protection:</b></p> <p>Very minor reduction of inputs on plot areas.</p>
<b>Management Requirements:</b>	<p>Drill conventional crop and spray out skylark plots by end December.</p> <p>10 plots per ha of eligible land to be supplied. The total number of plots can be located on cereal crops on the farm, at minimum of 2 plots per ha. Minimum plot size 4m x 4m.</p>
<b>ELS Top-ups</b>	None.
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM7:</b>	<b>Reduced nitrogen winter or spring cereal crop</b>
<b>Role:</b>	To secure field and part-field areas of commercial cereal crops under reduced nutrient management on an annual basis.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Should produce a more open crop structure and weedier understorey in commercial cereal crops for foraging and insect provision, but the value to biodiversity will be limited by factors such as high soil nitrogen levels and other agronomic inputs applied.</p> <p><b>Resource Protection:</b></p> <p>The reduced nitrogen fertiliser input will help to mitigate nitrate losses to water through in-field drains. On most fields, limiting the amount of N fertiliser applied to crops will reduce the quantity of residual nitrate in the soil after harvest. There will be a slight reduction in the amount of residual soil nitrate available for leaching in the autumn.</p> <p>Research by Cuttle <i>et al.</i> (2006) suggests a 5-10 kg N/ha reduction in leaching per year from a 20% reduction in N application below the fertiliser recommendation; 10-15 kg/ha per year reduction for a 50% reduction in rates (Cuttle S.P., Haygarth P. M., Chadwick D.R. Newell-Price P., Harris D., Shepherd M.A., Chambers B.J., Humphrey R. (2006) An Inventory of Measures to Control Diffuse Water Pollution from Agriculture (DWPA). ADAS/IGER report).</p>
<b>Management Requirements:</b>	<p>Use an appropriate method of assessment (such as Planet or RB209) to determine the optimum nitrogen for the cereal crop.</p> <p>Reduce this optimum nitrogen rate by 50%.</p> <p>Document the nitrogen requirement calculation and reduction on FACTS records/NVZ documentation.</p>
<b>ELS Top-ups</b>	EX11 Skylark plots.
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM8:</b>	<b>Reduced seed-rate winter or spring cereal crop</b>
<b>Role:</b>	To secure field and part-field areas of commercial cereal crops under reduced seed rate management on an annual basis.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Should produce a more open crop structure and weedier understorey in commercial cereal crops for foraging and insect provision, but the value to biodiversity will be limited by factors such as continued use of other agronomic inputs.</p> <p><b>Resource Protection:</b></p> <p>There may be a small benefit if reduced inputs are applied in response to a lower potential crop yield.</p>
<b>Management Requirements:</b>	Maximum seed rate (potentially 60-70% of commercial rate) will be permitted for the range of cereal crops. Growers will need to achieve a maximum plant density per m <sup>2</sup> and keep a record of the seed rate applied.
<b>ELS Top-ups</b>	EX11 Skylark plots.
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM9:</b>	<b>Winter stubble (left from crop harvest until end of Feb in the following year)</b>
<b>Role:</b>	To secure field and part-field areas of arable crop stubbles on an annual basis to complement spring crop production.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Providing over winter food resources for seed-eating birds.</p> <p>Retaining the stubble until <u>end February</u> to cover the hungry gap for some farmland birds.</p> <p>Provision of foraging land for other species including the BAP listed Brown Hare.</p> <p><b>Resource Protection:</b></p> <p>Where there is risk of runoff and erosion, overwinter stubbles provide more protection through the winter than bare soil, (providing the stubble soil is not capped and compacted).</p> <p>Where there is risk of soil erosion and runoff after harvest, any compaction or surface capping is removed to increase surface roughness and infiltration</p>
<b>Management Requirements:</b>	Stubbles must not receive inputs such as pesticides, fertilisers, manures or lime. Stubbles can receive a light surface cultivation to help water infiltration on vulnerable soils/slopes They should not be cut during the cross compliance requirement period. They should be retained until the end of February.
<b>ELS Top-ups</b>	EX9 Enhanced winter stubble option (preceding crop herbicide restrictions) ELS IP 85 to 115.  EX12 Low input regime for spring crop.
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM10:</b>	<b>Winter stubble followed by spring barley or beans, sugar beet and linseed</b>
<b>Role:</b>	To secure field and part-field areas of arable crop stubbles on an annual basis to complement specified spring crop production.
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>These crops can provide valuable breeding habitats for ground-nesting farmland birds, such as skylark and lapwing.</p> <p>Retaining the stubble until <u>mid-January</u> will help to cover the early part of the hungry gap for some farmland birds.</p> <p><b>Resource Protection:</b></p> <p>Where there is risk of runoff and erosion, overwinter stubbles provide more protection through the winter than bare soil, (providing the overwinter stubble soil is not capped and compacted).</p> <p>Where there is risk of soil erosion and runoff after harvest, any compaction or surface capping must be removed to increase surface roughness and infiltration.</p>
<b>Management Requirements:</b>	<u>No</u> restrictions are proposed on input use but the stubbles must be followed by the specified crops.
<b>ELS Top-ups</b>	EX9 Enhanced winter stubble option (preceding crop herbicide restrictions): ELS IP 85 to 115.  EX12 Low input regime for following spring crop.
<b>Land/crop eligibility</b>	Cultivated land receiving SPS entitlement.

<b>EM11:</b>	<b>Low-input cereal or oilseed rape followed by winter stubble</b>
<b>Role:</b>	
<b>Benefits:</b>	<p><b>Biodiversity:</b></p> <p>Stubbles from low input cereal and oilseed rape crops are better in providing over winter food resources for farmland birds than similar conventional crops. They can deliver weeds which shed seeds over the critical 'hungry gap' winter period. Restrictions on herbicide use, fertiliser rate and crop density will all help to provide opportunities for useful populations of beneficial plants and insects to develop to support many farmland birds.</p> <p><b>Resource Protection:</b></p> <p>There may be a small benefit from the reduced inputs applied to the previous crop.</p>
<b>Management Requirements:</b>	Restriction on herbicide type and timing only. Pre-harvest desiccant or post-harvest herbicides are not permitted. Stubble retained until 01 March the following spring.
<b>ELS Top-ups</b>	<p>EX9 Enhanced winter stubble option (preceding crop herbicide restrictions) ELS IP 85 – 115.</p> <p>EF11 Skylark plots 10 (5 per plot).</p> <p>EX12 Low input regime for following spring crop.</p>
<b>Land/crop eligibility</b>	<p>Cultivated land receiving SPS entitlement.</p> <p>Cereal or oilseed rape grown commercially as a low-input crop.</p>

**APPENDIX 2. 'TRAFFIC LIGHTS' ANALYSIS OF THE BENEFITS OF PROPOSED XC1 OPTIONS, COMPARED TO LAND MANAGED UNDER THE FORMER SET-ASIDE RULES.**

**COLOUR CODE KEY**

Environmental benefits **relative** to set-aside (ha for ha);

Greater than set-aside	
Same as set-aside	
Less than set-aside	
No/negligible benefit	

**OPTIONS TABLES**

<b>EM1 Grass buffers</b>			<b>ELS Top Up Options</b>
<b><i>Environmental Benefits</i></b>	<b>EM only</b>	<b>With top ups</b>	
Biodiversity: Birds			EX1 Wildflower seed mix EX2 Regular cutting and removal of vegetation
Biodiversity: Plants			
Biodiversity: Other			
Resource Protection			

<b>EM2 Other permanent areas</b>			<b>ELS Top Up Options</b>
<b><i>Environmental Benefits</i></b>	<b>EM only</b>	<b>With top ups</b>	
Biodiversity: Birds			EX1 Wildflower seed mix EX2 Regular cutting and removal of vegetation EX3 Limited grazing
Biodiversity: Plants			
Biodiversity: Other			
Resource Protection			

<b>EM3 Land rotationally out of production</b>			<b>ELS Top Up Options</b>
<b><i>Environmental Benefits</i></b>	<b>EM only</b>	<b>With top ups</b>	
Biodiversity: Birds			EX4 Wild bird seed mixture EX5 Nectar mix EX6 Uncropped cultivated margins
Biodiversity: Plants			
Biodiversity: Other			

Resource Protection			EX7 Unharvested cereal headlands EX8 Rotational fallow (false seed bed in spring)
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EM4 Game strips			ELS Top Up Options
<i>Environmental Benefits</i>	EM only	With top ups	N/A
Biodiversity: Birds		n/a	
Biodiversity: Plants		n/a	
Biodiversity: Other		n/a	
Resource Protection		n/a	

EM5 Minimum row width cereals			ELS Top Up Options
<i>Environmental Benefits</i>	EM only	With top ups	EX11 Skylark plots
Biodiversity: Birds			
Biodiversity: Plants			
Biodiversity: Other			
Resource Protection			

EM6 Skylark plots in winter cereals			ELS Top Up Options
<i>Environmental Benefits</i>	EM only	With top ups	N/A
Biodiversity: Birds		n/a	
Biodiversity: Plants		n/a	
Biodiversity: Other		n/a	
Resource Protection		n/a	

EM7 Reduced nitrogen cereal			ELS Top Up Options
<i>Environmental Benefits</i>	EM only	With top ups	EX11 Skylark plots
Biodiversity: Birds			
Biodiversity: Plants			
Biodiversity: Other			
Resource Protection			

<b>EM8 Reduced seed rate cereal</b>			<b>ELS Top Up Options</b>
<b><i>Environmental Benefits</i></b>	<b>EM only</b>	<b>With top ups</b>	EX11 Skylark plots
Biodiversity: Birds			
Biodiversity: Plants			
Biodiversity: Other			
Resource Protection			

<b>EM9 Winter stubble (to end Feb)</b>			<b>ELS Top Up Options</b>
<b><i>Environmental Benefits</i></b>	<b>EM only</b>	<b>With top ups</b>	EX9 Enhanced winter stubble option (preceding crop herbicide restrictions) EX12 Low input regime for following spring crop
Biodiversity: Birds			
Biodiversity: Plants			
Biodiversity: Other			
Resource Protection			

<b>EM10 Winter stubble (restricted spring crops)</b>			<b>ELS Top Up Options</b>
<b><i>Environmental Benefits</i></b>	<b>EM only</b>	<b>With top ups</b>	EX9 Enhanced winter stubble option (preceding crop herbicide restrictions) EX12 Low input regime for following spring crop
Biodiversity: Birds			
Biodiversity: Plants			
Biodiversity: Other			
Resource Protection			

<b>EM11 Low input cereal/osr followed by stubble</b>			<b>ELS Top Up Options</b>
<b><i>Environmental Benefits</i></b>	<b>EM only</b>	<b>With top ups</b>	EX9 Enhanced winter stubble option (preceding crop herbicide restrictions) EF11 Skylark plots EX12 Low input regime for following spring crop
Biodiversity: Birds			
Biodiversity: Plants			
Biodiversity: Other			
Resource Protection			

## **APPENDIX 3. IMPLEMENTATION DETAIL FOR ENVIRONMENTAL MANAGEMENT (EM) AND ELS TOP-UP (EX) OPTIONS**

### **ENVIRONMENTAL MANAGEMENT (EM) OPTIONS**

#### **The following rules apply across all EM Conditions:**

- Access onto and across EM land for essential hedge and ditch maintenance is permitted, provided no damage to EM habitats occurs and activities comply with other GAEC conditions. Any permanent crossing points for access into crops and links between fields should not be counted towards your XC requirement.
- Areas of habitat likely to be damaged by farmed or wild animals may be fenced off.
- Control of injurious and invasive weeds is permitted in accordance with the Weeds Act 1959 and GAEC11.
- Force majeure may be enacted in exceptional circumstance as specified for limited duration for extreme weather preventing compliance with GAEC, grazing by migratory birds such as geese, restrictions imposed on animal movements from a notified disease outbreak.
- Any drainage or fencing works, whether temporary or permanent is not permitted unless specified in an individual EM option.
- Nutrient status management including applications of lime and gypsum to change pH are not permitted on EM land during the compliance period.
- Land cultivation to prevent access onto and across EM land is not permitted. Care should be taken to site EM land away from these risks.
- Temporary storage of machinery, farm auctions, car parking, horse riding, walking, charity events, access for hunting, shooting or fishing over the land are not permitted.
- Land currently under organic management and entered into environmental management options should not be cultivated for weed control during the compliance period.

(Background note. NFU said “It is important to note that under SPS and pre-SPS set-aside rules those organic farmers who were not 100% organic were allowed to cultivate their set-aside land from 1st May for weed control - this should still be allowed under the non-crop EM options”. However, XC1 is not set-aside and needs undisturbed land management to ensure environmental delivery is possible on a smaller land area than former set-aside. Therefore this concession has not been included in the proposals.)

Bioenergy and biomass crops such as short rotation coppice and cereals for biofuel are not eligible as crops for Environmental Management options as they do not offer the same level and intensity of biodiversity benefits accrued under set aside.

<b>EM1:</b>	<b>Grass buffers alongside temporary and permanent water courses</b>
<b>Management Requirements:</b>	<p>Locate on areas of cultivated land where production has ceased or on retained areas of long-term set-aside. These buffers will generally be permanently but can be re-located if necessary to meet agronomic or land use change.</p> <p>Establish or maintain a grassy strip of a minimum width between 5m and 9m in addition to existing 1m protection zones.</p> <p>Use either natural regeneration or sowing grass to achieve this (especially if there is insufficient green cover from natural regeneration).</p> <p>If you already have land with an acceptable green cover or temporary grass, you may leave these covers in place.</p> <p>Remove any compaction in the topsoil if you need to prepare a seedbed, except on archaeological features.</p> <p>Regular cutting in the first 12–24 months may be needed to control annual weeds and encourage grasses to tiller. Avoid cutting when the soil is moist, to prevent further compaction.</p> <p>Do not use buffer strips for regular vehicular access, turning or storage of manure, machinery or bales. There should be no tracks, compacted areas or poaching.</p> <p>Do not cultivate the buffer area after the grassy strip has been established.</p> <p>Do not apply any fertilisers or manure to these strips.</p> <p>Only apply herbicides to spot treat or weed wipe for the control of injurious weeds (ie creeping and spear thistles, curled and broadleaved docks, or common ragwort) or invasive alien species (eg Himalayan balsam, rhododendron or Japanese knotweed).</p> <p>Grazing is not permitted.</p> <p>Mole draining across grass buffers is not permitted.</p>

<b>EM2:</b>	<b>Reverted arable plots or strips alongside woodlands or hedges</b>
<b>Management Requirements:</b>	<p>Locate on areas of cultivated land where production has ceased or on retained areas of long-term set-aside. These buffers will generally be permanently but can be re-located if necessary to meet agronomic or land use change.</p> <p>Establish or maintain a grassy strip of a minimum width between 5m and 9m in addition to existing 1m protection zones.</p> <p>Use either natural regeneration or sowing grass to achieve this (especially if there is insufficient green cover from natural regeneration).</p> <p>If you already have land with an acceptable green cover or temporary grass, you may leave these covers in place.</p> <p>Remove any compaction in the topsoil if you need to prepare a seedbed, except on archaeological features.</p> <p>Regular cutting in the first 12–24 months may be needed to control annual weeds and encourage grasses to tiller. Avoid cutting when the soil is moist, to prevent further compaction.</p> <p>Do not use buffer strips for regular vehicular access, turning or storage of manure, machinery or bales. There should be no tracks, compacted areas or poaching.</p> <p>Do not cultivate the buffer area after the grassy strip has been established.</p> <p>Do not apply any fertilisers or manure to these strips.</p> <p>Only apply herbicides to spot treat or weed wipe for the control of injurious weeds (ie creeping and spear thistles, curled and broadleaved docks, or common ragwort) or invasive alien species (eg Himalayan balsam, rhododendron or Japanese knotweed).</p> <p>Mole draining across grass buffers is not permitted.</p>

<b>EM3:</b>	<b>Previously cultivated land rotationally taken out of production</b>
<b>Management Requirements:</b>	<p>Locate on areas of cultivated land where production has ceased following harvest until 31st July in the following year.</p> <p>No fertiliser inputs can be applied during this time.</p> <p>This option is annual and can be rotated.</p> <p>Herbicides can be applied for weed control from 01 June. If you use a non-selective herbicide, leave the residue of the cover in place for as long as possible to provide cover from predators for young birds in the nest. Wherever possible, treat only the area where the weed problems are present.</p> <p>You must avoid any agricultural operations such as cutting which are known to harm biodiversity using the green cover such as nesting birds (particularly between March and mid-July), overwintering insects (up to mid-May) and wild flowers that have not yet set seed.</p> <p>You may cultivate land to control weeds from 1 June on organic fields in environmental management without having to replace the green cover afterwards. You may not cultivate for any other purposes before 31 July.</p> <p>If you have specific plant health or other problems and wish to use herbicides to destroy the green cover before end May, you should write to RPA requesting an exemption and explaining what you want to do and why you need to do it. You should not take any action to destroy the cover until you have received a written authorisation.</p> <p>If you intend to graze the green cover after the end of the cross compliance period, you can only use herbicides approved for use on grazed land.</p> <p>Organic waste may be stored on this land prior to spreading on the field for the next growing season but it must not be used to store larger quantities of waste than are to be applied to the field on which they are being stored.</p> <p>Do not use buffer strips for regular vehicular access, turning or storage of manure, machinery or bales. There should be no tracks, compacted areas or poaching.</p> <p>This land must not be used as a storage, disposal or dumping ground for any other form of waste.</p>

<b>EM4:</b>	<b>Game strips (using commercially available mixtures for game/wild bird management)</b>
<b>Management Requirements:</b>	<p>Game strip established as a strip or block to provide winter cover and food.</p> <p>It can contain either an unsprayed unharvested cereal crop (excluding maize) or sown mixture of plants, typical of those which are commercially available and can be annual or biennial. The game strip must be retained until mid Feb in the year that the area is returned to crop production.</p> <p>No restriction on herbicide or fertiliser inputs for sown game mixtures.</p> <p>Areas should be re-established to maintain reasonable cover and seed production.</p> <p>More benefit is gained where these blocks and/or strips are at least 6 m wide at the edges of fields and between 0.4 ha and 2 ha in size. Try to ensure that they are well distributed across your farm which makes sure food is always available for seed-eating birds.</p> <p>Avoid sowing mixtures too early in the spring, when seedbeds may be dry, cold and of poor quality.</p> <p>Fertilisers, manures (but not within 10 m of watercourses) and seed treatments may be used to aid establishment, minimise impact to non-target invertebrates and ensure sufficient seed production to deliver the option aim.</p> <p>Non-residual, non-selective herbicides may be used prior to sowing, to help re-establishment.</p> <p>Do not use the area for access, turning or storage.</p> <p>Do not graze.</p>

<b>EM5:</b>	<b>Minimum alternate row width winter or spring cereal</b>
<b>Management Requirements:</b>	<p>Establish a conventional cereal crop with a minimum 25cm separation between seeded drill rows to ensure an open crop canopy develops.</p> <p>There are no other restrictions on agronomic inputs to these crops.</p>

<b>EM6:</b>	<b>Farmland bird plots in winter cereals</b>
<b>Management Requirements:</b>	<p>Drill conventional winter cereal crops and spray out farmland bird plots in them by end January.</p> <p>The total number of plots can be located on cereal crops on eligible land within the farm, at a minimum of 2 plots per ha to ensure they offer value across the landscape.</p> <p>Placing plots in fields more than 5 ha in area and with an open aspect unbounded by trees will deliver greater benefits.</p> <p>Locate the plots away from tramlines (a middle spot between two sets of tramlines is best) and field boundaries/margins (at least 50 m into the field), to minimise nest predation for skylarks.</p> <p>After drilling, there is no requirement to manage plots differently to the remainder of the field (they can be oversprayed and can be fertilised).</p> <p>You are not required to keep the plots weed-free.</p> <p>There must be no mechanical weeding of plots.</p>

<b>EM7:</b>	<b>Reduced nitrogen winter or spring cereal crop</b>
<b>Management Requirements:</b>	<p>Drill and manage a conventional winter or spring cereal crop.</p> <p>Reduce the nitrogen rate applied to the cereal crop by 50%.</p> <p>This reduction should be based on an appropriate method of assessment such as Planet, RB209 or another verification method.</p> <p>You must document the nitrogen requirement calculation and reduction and keep this information safe to present if required at inspection.</p> <p>There are no other restrictions on agronomic inputs to these crops.</p>

<b>EM8:</b>	<b>Reduced seed-rate winter or spring cereal crop</b>
<b>Management Requirements:</b>	<p>Calculate the optimum seed rate for the cereal crop you are sowing, taking into account known agronomic factors such as time of year, soil type and condition, seed size, germination % and % emergence expected.</p> <p>Reduce this optimum rate by 30% and use this as the rate to drill the winter or spring cereal crop.</p> <p>You must document the optimum seed rate calculation and reduction and keep this information safe to present if required at inspection.</p> <p>There are no other restrictions on agronomic inputs to these crops.</p>

<b>EM9:</b>	<b>Winter stubble (left from crop harvest until end of Feb in the following year)</b>
<b>Management Requirements:</b>	<p>Locate on areas of cultivated land.</p> <p>Bale (or chop and spread) straw after harvest.</p> <p>Where the stubble is predominantly clean after harvest, a light surface cultivation can be made before the end of September or within the first month following harvest if later, to encourage weed germination and loosen any surface compaction or capping.</p> <p>On sloping fields, tramlines and other areas of severe compaction should always be subsoiled following harvest (except where there are archaeological features or when conditions are wet), to reduce the risk of run-off and erosion.</p> <p>If the stubble is already weedy, do not cultivate.</p> <p>Stubbles must not receive inputs such as pesticides, fertilisers, manures or lime.</p> <p>They should not be cut during the cross compliance requirement period.</p> <p>Stubbles should be retained until the end of February.</p> <p>Do not graze.</p> <p>From 01 March, the stubble can be returned to the farm rotation.</p>

<b>EM10:</b>	<b>Winter stubble followed by spring barley or beans, sugar beet and linseed</b>
<b>Management Requirements:</b>	<p>Locate on areas of cultivated land.</p> <p>Bale (or chop and spread) straw after harvest.</p> <p>Where the stubble is predominantly clean after harvest, a light surface cultivation can be made before the end of September or within the first month following harvest if later, to encourage weed germination and loosen any surface compaction or capping.</p> <p>On sloping fields, tramlines and other areas of severe compaction should always be subsoiled following harvest (except where there are archaeological features or when conditions are wet), to reduce the risk of run-off and erosion.</p> <p>If the stubble is already weedy, do not cultivate.</p> <p>Stubbles must not receive inputs such as pesticides, fertilisers, manures or lime.</p> <p>They should not be cut during the cross compliance requirement period.</p> <p>Stubbles should be retained until mid January.</p> <p>Do not graze.</p> <p>From mid January, the stubble must be followed by spring barley, spring beans, sugar beet or linseed only. Other following crops are not permitted.</p>

<b>EM11:</b>	<b>Low-input cereal or oilseed rape followed by winter stubble</b>
<b>Management Requirements:</b>	<p>Locate on areas of cultivated land in cereal or oilseed rape crops.</p> <p>Do not apply any pre-harvest desiccants or post-harvest weed control treatments before harvest.</p> <p>Bale (or chop and spread) straw after harvest.</p> <p>Where the stubble is predominantly clean after harvest, a light surface cultivation can be made before the end of September or within the first month following harvest if later, to encourage weed germination and loosen any surface compaction or capping.</p> <p>On sloping fields, tramlines and other areas of severe compaction should always be subsoiled following harvest (except where there are archaeological features or when conditions are wet), to reduce the risk of run-off and erosion.</p> <p>If the stubble is already weedy, do not cultivate.</p> <p>Stubbles must not receive inputs such as pesticides, fertilisers, manures or lime.</p> <p>They should not be cut during the cross compliance requirement period.</p> <p>Stubbles should be retained until end February.</p> <p>Do not graze.</p> <p>From 01 March, the stubble can be returned to the farm rotation.</p>

## ENVIRONMENTAL STEWARDSHIP “TOP-UP” OPTIONS

### **EX1 Wildflower seed mix**

Establish all or part of the margin by sowing a mix of fine-leaved grasses and flowers, such as knapweed, bird’s-foot-trefoil, self-heal, oxeye daisy and yarrow.

Remove any areas of soil compaction prior to establishment.

Do not subsoil areas on sites of archaeological interest.

Cutting regularly in the first year of establishment may be needed to control coarse vegetation and encourage tillering.

Cut each year in August or September.

If excess vegetation threatens to suppress the flowers, cut again in the following March or April.

Cuttings should be removed to benefit flower production and survival.

Do not apply fertilisers, organic manures or waste materials (including sewage sludge) on the wildflower margin area.

Treatments to, or management of adjacent land, must not affect or encroach onto the area under management.

### **EX2 Regular cutting and removal of vegetation**

Cut and remove vegetation on a regular basis to generate a dense sward.

Remove any cuttings within one week to avoid loss of green cover and nutrient leaching.

Grazing is not permitted under this option.

Field operations must not damage the soil structure or cause heavy poaching. Small areas of bare ground on up to 5% of the field are acceptable. Take particular care when the land is waterlogged.

### **EX3 Limited grazing**

Exclude all livestock from the grazing area from end September to end April.

Grazing or field operations must not damage the soil structure or cause heavy poaching.

#### **EX4 Wild bird seed mixture**

Sow a balanced combination of at least three small-seed bearing crops chosen from barley, triticale, kale, quinoa, linseed, millet, mustard, fodder radish, and sunflower. No single species should make up more than 70 per cent by weight of the mix, and always make sure they cover a range of crop groups, to minimise any pest and disease impacts. Large-seeded crops (such as maize) and game covers (such as giant sorghum or sweet clover) are not allowed.

Sow in blocks and/or strips at least 6 m wide at the edges of fields. Both should be between 0.4 ha and 2 ha in size, and there should be no more than 3 ha in total per 100 ha of arable land. This will ensure that they are well distributed across your farm and that food is always available for seed-eating birds.

In the first year, sow at the optimum time for the chosen species mixture, which may be autumn or spring, ensuring that any areas of soil compaction are removed prior to establishment, except on sites of archaeological interest. Avoid sowing too early in the spring, when seedbeds may be dry, cold and of poor quality.

To help with weed and pest management, the seed can be sown in separate drill widths or as strips within the option area. On sandy soils, strips must be sown along contours.

Retain the crop mixture until at least 1 March before re-establishment in spring, which could be annually or every other year (biennial crops), to maintain seed production.

Fertilisers, manures (but not within 10 m of watercourses) or seed treatments may be used to aid establishment, minimise impact to non-target invertebrates and ensure sufficient seed production to deliver the option aim.

Only apply herbicides to spot-treat or weed-wipe for the control of injurious weeds (ie creeping and spear thistles, curled and broad-leaved docks or common ragwort) or invasive alien species (eg Himalayan balsam, rhododendron or Japanese knotweed). Non-residual products may be used prior to re-sowing to facilitate re-establishment.

Only apply environmentally sympathetic insecticides – and then only during establishment – where there is a strong risk of crop failure due to severe pest attack (identified through monitoring and use of thresholds). Advice must be taken from a BASIS professional before any insecticides are used.

Do not use the area for access, turning or storage.

Do not graze.

## **EX5 Nectar mix**

Remove any compaction in the topsoil if you need to establish a seedbed, except on archaeological features.

Sow a mixture of at least four nectar-rich plants (e.g. red clover, alsike clover, bird's-foot-trefoil, sanfoin, musk mallow, common knapweed), with no single species making up more than 50 per cent of the mix by weight.

Sow in blocks and/or strips at least 6 m wide at the edges of fields, in early spring or late summer.

Individual areas must not exceed 1 ha in size, and there should be no more than 3 ha per 100 ha of arable land.

This is to ensure that they are well distributed across your farm, so there is always food available for the nectar feeding insects. Re-establish the mix as necessary, to maintain a sustained nectar supply.

Only apply herbicides to spot-treat or weed-wipe for the control of injurious weeds (ie creeping and spear thistles, curled and broad-leaved docks or common ragwort) or invasive alien species (eg Himalayan balsam, rhododendron or Japanese knotweed). Non-residual, non-selective herbicides may be applied prior to sowing to help re-establishment.

Do not apply any other pesticides, fertiliser, manure or lime.

To stimulate valuable late flowering to meet the peak demand from bees, cut half the area to 20 cm between mid-June and the end of the first week of July.

Cut the whole area to 10 cm between 15 September and 31 October, removing or shredding cuttings to avoid patches of dead material developing.

Do not graze in the spring or summer. Late autumn/early winter grazing of areas is allowed and will benefit legumes, but take care to avoid poaching damage and compaction, particularly when conditions are wet.

Do not use the area for access, turning or storage.

## **EX6 Uncropped cultivated margins**

Cultivate an arable field margin annually in either spring or autumn to a depth of about 15 cm (6 inches).

Varying the depth and time of cultivation may help prevent the build-up of undesirable weeds, but should always be managed according to the requirements of the target species.

Margins should be 3–6 m wide. They can be relocated within the same field to avoid the build up of pernicious weeds but should be located on the target species site at least one year in three to benefit the target species.

Do not apply any fertilisers or manures.

Where a severe pernicious weed burden has developed, targeted broad-spectrum herbicides can be used, once annual species have set seed (typically in September).

Only apply herbicides to spot-treat or weed-wipe for the control of injurious weeds (ie creeping and spear thistles, curled and broad-leaved docks or common ragwort), or invasive alien species (eg Himalayan balsam, rhododendron or Japanese knotweed).

## **EX7 Unharvested cereal headlands**

Do not apply fertiliser or manure to the headland between harvest of the previous crop and resuming normal management.

Sow and manage a 3–6 m wide cereal headland along the edge of any arable crop.

You can sow the headland in either autumn or spring (if stubble, manage it as EF6) and leave it unharvested until the following spring (1 March), before resuming normal management.

Sow a cereal or cereal mixture at a reduced seed rate, to encourage a more open headland structure. On more difficult or weedy sites, conventional seed rates can be used.

Take action to remove any surface compaction in tramlines within the headland, if they are causing run-off.

Do not apply insecticides between 15 March and the following harvest.

Only the following herbicides can be applied to control problem grass and broad-leaved weeds:

– for broad-leaved weeds, only use amidosulfuron, and only between 1 February and 31 March.

– for grass weeds, use the following active ingredients only: tri-allate, fenoxaprop-P-ethyl, diclofop-methyl +fenoxaprop-P-ethyl, tralkoxydim, clodinafop-propargyl or pinoxaden/cloquintocet-mexyl.

## **EX8 Rotational fallow (false seed bed in spring):**

The fallow area/plot should be located on level or slightly sloping ground in fields larger than 2ha.

Undesirable weed species such as blackgrass, sterile brome and wild oats should be controlled prior to creating the rough fallow, by spraying off these areas with a non-selective herbicide.

Produce the rough fallow between 1 February and 20 March to make sure it is in place in time for the first breeding attempts of the farmland birds we are trying to help. Avoid cultivating in wet conditions and on historic features.

The plots must be sited carefully to make sure they do not generate erosion and provide runoff pathways for sediment.

The fallow plots must be retained until 31 July

Injurious weeds covered by the Weeds Act (ragwort, thistles and docks) should be controlled by spot spray or weed wiper.

The area must not be used for regular vehicular access, turning or storage.

Do not apply fertilisers, organic manures or waste materials (including sewage sludge).

### **EX9 Enhanced winter stubble option (preceding crop herbicide restrictions)**

Do not apply pre-harvest desiccants or post-harvest herbicides.

Bale (or chop and spread) straw after harvest.

Where the stubble is predominately clean after harvest, a light surface cultivation can be made before the end of September or within the first month of harvest if later, to encourage weed germination and loosen any surface compaction or capping. If the stubble is already weedy, do not cultivate.

You may subsoil tramlines following harvest to remove compaction, except where there are archaeological remains. This is recommended when there is a risk of soil run-off.

Do not apply any pesticides, fertilisers, manure (including manure heaps), waste materials (including sewage sludge) or lime to the stubble.

Beneficial seed and nectar producing plants such as mustard, fodder radish or rape can be broadcast or sown on small areas (no more than 0.5ha per 10ha stubble) in either autumn or spring, to enhance the feeding and foraging value.

Do not top or graze.

The stubble and any subsequent natural regeneration must be left undisturbed until the 31 July in the year following harvest.

From the 1 August in that year you may apply herbicides to destroy the green cover.

From the 15 August, the option area is returned to normal farm management.

### **EX11 Farmland bird plots**

Select a field that is more than 5 ha in area, has an open aspect and will be drilled with winter cereals. A good guide is the presence of skylarks singing over the field in previous years.

Avoid fields bounded by tree lines or adjacent to woods, unless the field is greater than 10 ha.

Create the plots either by turning off the drill during sowing to leave an unsown plot, or by sowing the crop as normal and spraying out the plots by 31 December with an appropriate herbicide.

The plots should be a minimum of 4 m x 4 m.

Locate the plots away from tramlines (a middle spot between two sets of tramlines is best) and field boundaries/margins (at least 50 m into the field), to minimise nest predation.

Space skylark plots across the field at a minimum density of two plots per ha.

After drilling, there is no requirement to manage plots differently to the remainder of the field (they can be oversprayed and can be fertilised).

You are not required to keep the plots weed-free.

There must be no mechanical weeding of plots.

## **EX12 Low input regime for spring crop**

Do not apply insecticides between 15 March and the following harvest.

Only the following herbicides can be applied to control problem grass and broad-leaved weeds:

– for broad-leaved weeds, only use amidosulfuron, and only between 1 February and 31 March.

– for grass weeds, use the following active ingredients only: tri-allate, fenoxaprop-P-ethyl, diclofop-methyl + fenoxaprop-P-ethyl, tralkoxydim, clodinafop-propargyl or pinoxaden/cloquintocet-mexyl.

Where weed growth threatens harvest, you may use a pre-harvest desiccant, unless you plan to use this area as overwintered stubble.