



Post-Chernobyl Monitoring and Controls

Report of Cumbrian De-Restriction Survey

2006

Emergency Planning, Radiation and Incidents Division
Food Standards Agency

May 2007

Post-Chernobyl Monitoring and Controls

Cumbrian De-Restriction Survey 2006

Summary

1. Following the Chernobyl accident in 1986, restrictions under the Food and Environment Protection Act 1985 were placed on the movement, sale and supply of sheep in areas of the United Kingdom where contamination levels in sheep meat could potentially cause a risk to public health.
2. Surveys of sheep placed under restrictions following the Chernobyl accident are conducted in order to assess the possibility of de-restricting farms. De-Restriction Surveys were conducted in 2006 at farms remaining under restriction in Cumbria.
3. The decision to lift restrictions affecting a particular farm is usually based on the results of two consecutive years monitoring. Therefore the 2005 De-Restriction Survey results are also used when considering whether any farms could potentially be de-restricted.
4. Of the nine farms remaining under restriction, flocks from six farms were monitored in 2006; totalling 6196 sheep. The results are presented on a farm by farm basis, with conclusions given for each farm. Data of radiocaesium contamination from the 2006 De-Restriction Survey are presented and compared with the data from previous De-Restriction Surveys conducted since 1995.
5. This report recommends that no farms in Cumbria be de-restricted on the basis of the 2006 De-Restriction Survey results. Four out of the six surveyed farms held sheep which were found to exceed the Working Action Level (see Glossary of Terms at the end of this report) for radiocaesium contamination. Neither of the two remaining farms is currently suitable for de-restriction as they do not fulfil the requirement of having two consecutive years of reliable monitoring results showing that all sheep are below the Working Action Level. Further monitoring is recommended to be carried out in 2007 before de-restriction of farms can be considered.

Background

6. Following the Chernobyl accident in 1986, restrictions, under the Food and Environment Protection Act 1985, were placed on the movement, sale and supply of sheep in areas of the United Kingdom where contamination levels in sheep meat could potentially cause a risk to public health. At the time, 1,670 sheep farms in Cumbria were placed

under restriction. Over the last 20 years, the level of Chernobyl radiocaesium contamination in the United Kingdom has reduced, and now only nine farms in Cumbria remain under restriction. Eight of these are clustered in the south west of Cumbria and one is located towards central western Cumbria.

7. Since 1986, surveys of radiocaesium contamination levels in sheep on affected farms have been carried out to investigate whether the restrictions are still required. These surveys are carried out during the summer, when the sheep are grazing the contaminated land, and radiocaesium levels will be at their highest. If all of the sheep on a farm are shown to be below a value of 645 Becquerels per kilogramme (Bq/kg), for two consecutive years, a farm may be judged suitable for restrictions to be lifted.
8. The limit for Chernobyl contamination in sheep meat is 1,000 Bq/kg of radiocaesium. To assess the levels of contamination in sheep muscle tissue without having to kill the animals first, live monitoring is used. This uses a detector to estimate the level of radiocaesium in the sheep muscle tissue. In practice, to ensure that estimates of radiocaesium levels are safely within the 1,000 Bq/kg limit, those sheep estimated by live monitoring to exceed 645 Bq/kg are prevented from entering the food chain. This value is known as the Working Action Level (WAL).
9. Radiocaesium contamination levels within sheep muscle can vary year on year, sometimes quite widely. This is due to differences in environmental conditions between years, such as the amount of rainfall, which affects the uptake of radiocaesium from the soil into grass and then from the grass in to the sheep muscle tissue. This is why two consecutive years of survey data are required to free a farm from restrictions. If restrictions are then removed from a farm, the farm will be re-surveyed in the following year to ensure that the activity concentrations remain below the Working Action Level. If the levels have increased above 645 Bq/kg in a single sheep, the restrictions will be reintroduced on the farm.
10. Previous surveys of contamination levels in Cumbria were conducted up to 2000. In 2001, the Foot and Mouth outbreak prevented a survey being performed and the repercussions following Foot and Mouth meant that it was not practical for further surveys to be conducted until 2004. Surveys were also undertaken in 2005.
11. In 2006, De-Restriction Surveys took place at six of the nine farms currently under sheep farming restrictions. The results from these surveys will help the Food Standards Agency to assess changes in contamination levels on these farms since 2000, and to identify any farms where the potential may exist to remove restrictions. Since the 2000 survey, a new monitor was introduced for use in Cumbria.

Methods Used

12. Sheep on the farms surveyed in Cumbria were live monitored during July and August. Where possible, the monitoring was performed within 24 hours of the animals leaving the fell (hills), because in-bye (lowland) pasture has little contamination and radiocaesium levels in the sheep decrease rapidly with time.
13. For each sheep, three 10 second live monitor readings were taken. For each monitor used, six background counts were taken (performed by taking a reading against the operator's stomach, whilst crouching to represent the height at which the sheep are monitored), and the mean determined. After deduction of the mean background, the mean live monitor Count Above Background (CAB) was calculated for each sheep. Estimated Activity Concentrations were determined by multiplication of the CAB with a conversion factor, previously derived from laboratory and field calibration tests. This allowed comparisons between the Estimated Activity Concentrations and the 645 Bq/kg Working Action Level.
14. The estimated maximum CAB readings and the estimated mean CAB readings for 2006 were compared to data collected in both 2004 and 2005, and between 1995 and 2000 for each farm. This allows trends in contamination levels over time to be assessed and for recommendations to be made regarding the possible lifting of restrictions, and future surveys, especially in 2007. These are presented in the following paragraphs.

Survey Results

Farm 1		2006	
Number of sheep monitored		374	
Number of sheep above the Working Action Level		7	1.9%
Number of sheep below the Working Action Level		367	98.1%
Estimated maximum activity concentration (Bq/kg)		1134	
Estimated mean activity concentration (Bq/kg)		420	
Standard deviation (σ , Bq/kg)		138	

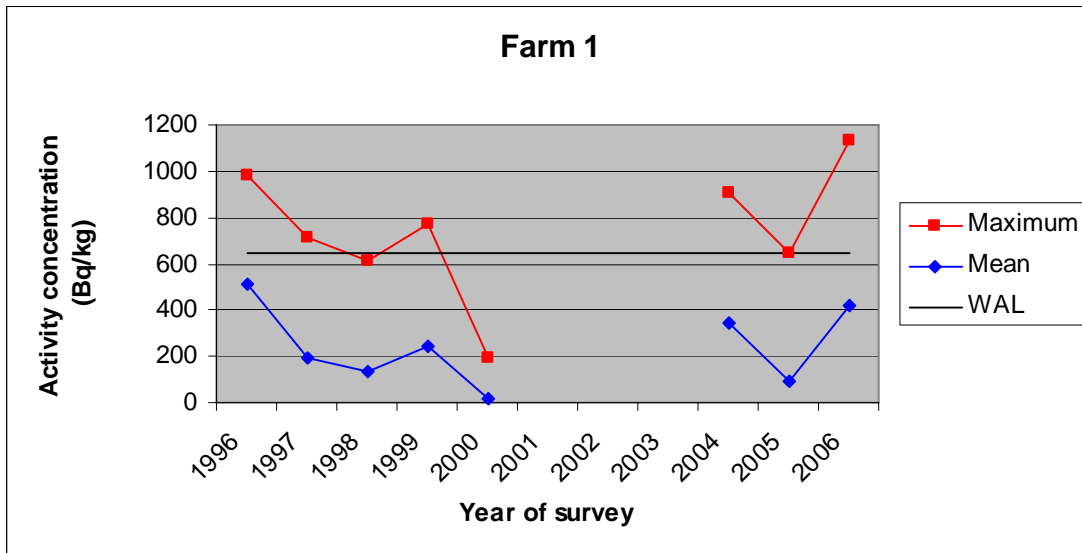


Figure 1: Graph showing estimated activity concentrations on Farm 1 between 1996 and 2006. Note that no surveys were carried out on this farm in 1995 and between 2001 and 2003.

15. The 2006 monitoring results show a marked increase in both the estimated maximum and mean activity concentrations compared with the 2005 survey. Seven sheep exceeded the Working Action Level (WAL) in 2006, compared with none in 2005. The estimated mean activity concentration increased from 92 Bq/kg, in the 2005 survey, to 420 Bq/kg in 2006; both values being below the WAL. However, the estimated maximum value of 1134 Bq/kg is substantially higher than the WAL and, together with the variation in results between the 2004 and 2005 surveys, indicates that this farm is not currently suitable for de-restriction.
16. **Recommendation:** This farm be monitored again in 2007 to assess trends in activity concentration. It is unlikely to be suitable for de-restriction in the near future.

Farm 2	2006	
Number of sheep monitored	781	
Number of sheep above the Working Action Level	0	0.0%
Number of sheep below the Working Action Level	781	100%
Estimated maximum activity concentration (Bq/kg)	618	
Estimated mean activity concentration (Bq/kg)	-30	
Standard deviation (σ , Bq/kg)	323	

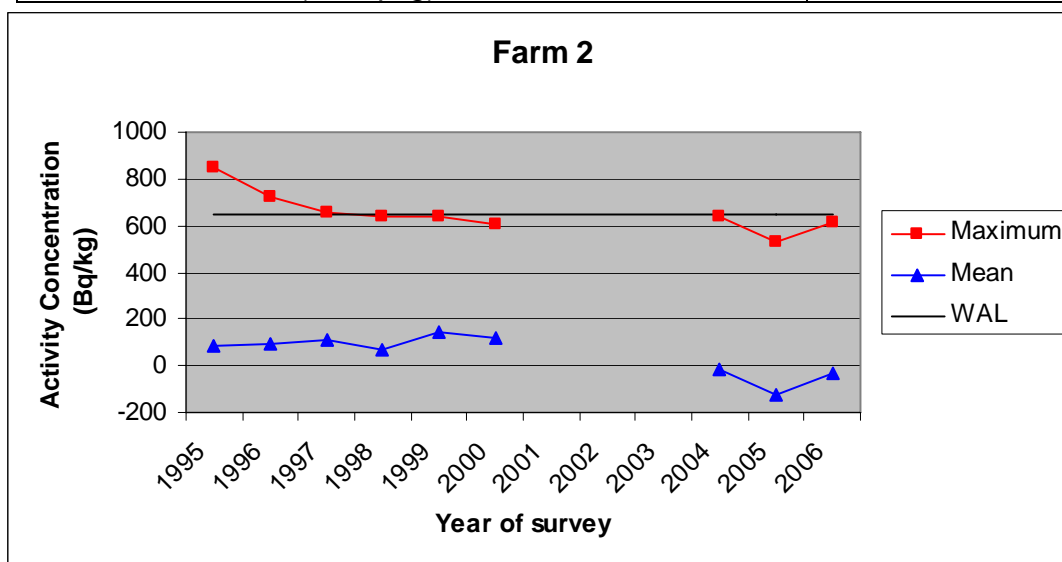


Figure 2: Graph showing estimated activity concentrations on Farm 2 between 1995 and 2006. Note that no surveys were carried out on this farm between 2001 and 2003.

17. The 2006 survey results show that the maximum estimated activity concentration of 618 Bq/kg remains close to the Working Action Level, and the estimated mean activity concentration is significantly below it at -30 Bq/kg. The estimated mean activity concentration level in 2006 is slightly negative, and well within statistical limits, and implies that for most sheep there was little or no contamination above background.
18. The very low estimated mean activity concentration of -127 Bq/kg in the 2005 survey suggested that there was an under measurement of background radiation levels which skewed the dataset to provide lower activity concentration results than actually existed. The unreliability of the 2005 results, coupled with the close proximity of both the estimated mean activity concentration to background levels, and the maximum activity concentration to the WAL, means that further monitoring is necessary to obtain clear evidence that this farm is suitable for de-restriction.
19. **Recommendation:** This farm be monitored again in 2007 to further assess the extent of variation in contamination levels.

Farm 3		2006	
Number of sheep monitored		962	
Number of sheep above the Working Action Level		27	2.8%
Number of sheep below the Working Action Level		935	97.2%
Estimated maximum activity concentration (Bq/kg)		2376	
Estimated mean activity concentration (Bq/kg)		164	
Standard deviation (σ , Bq/kg)		253	

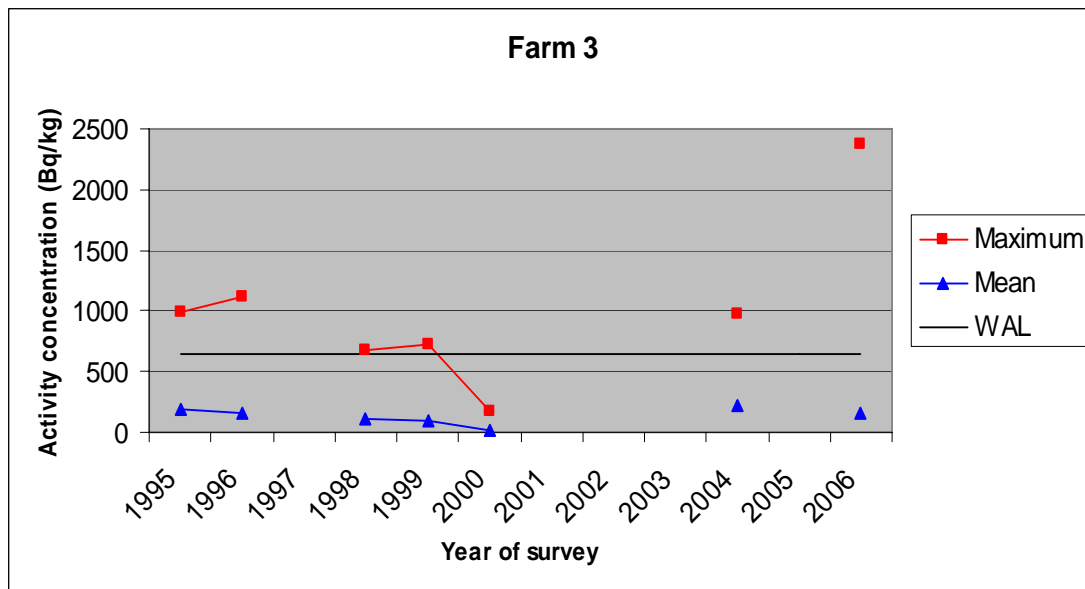


Figure 3: Graph showing estimated activity concentrations on Farm 3 between 1995 and 2006. Note that no surveys were carried out on this farm in 1997, between 2001 and 2003 and in 2005.

20. The 2006 survey has demonstrated a significant increase in the estimated maximum activity concentration compared with that in the 2004 survey (no survey was undertaken in 2005). The estimated maximum activity concentration was found to be 2376 Bq/kg in 2006; over three times the WAL of 645 Bq/kg. This elevation in the estimated maximum activity concentration level between 2004 and 2006 may partly be due to temporal changes in the availability of radiocaesium in the environment. However, conversely, a slight decrease was observed in the estimated mean activity concentrations; from 214 Bq/kg in the 2004 survey to 164 Bq/kg in 2006. Nearly three per cent of monitored sheep were found to exceed the WAL. Further monitoring will need to be undertaken before this farm can be considered for de-restriction, although de-restriction is unlikely to be possible in the near future.
21. **Recommendation:** This farm be monitored again in 2007 to assess trends in activity concentration. It is unlikely to be suitable for de-restriction in the near future.

Farm 4		2006	
Number of sheep monitored	815		
Number of sheep above the Working Action Level	5	0.1%	
Number of sheep below the Working Action Level	810	99.9%	
Estimated maximum activity concentration (Bq/kg)	983		
Estimated mean activity concentration (Bq/kg)	109		
Standard deviation (σ , Bq/kg)	161		

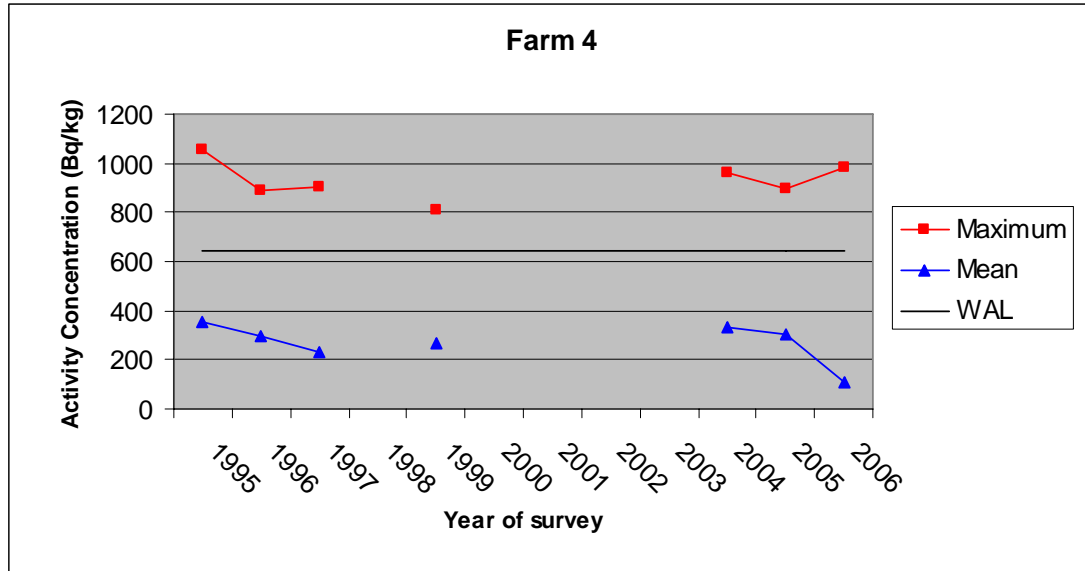


Figure 4: Graph showing estimated activity concentrations on Farm 4 between 1995 and 2006. Note that no surveys were carried out on this farm in 1998 or between 2000 and 2003.

22. The survey results show a slight increase in the estimated maximum activity concentrations between the 2005 result of 894 Bq/kg and that of 983 Bq/kg observed in 2006. A decrease in estimated mean activity concentration was seen, from 304 Bq/kg in the 2005 survey, to 109 Bq/kg in 2006. Out of the 815 sheep monitored in the 2006 survey, 5 were found to exceed the WAL. Further monitoring is required before this farm is considered for de-restriction.
23. **Recommendation:** This farm be monitored again in 2007 to assess trends in activity concentration. It is unlikely to be suitable for de-restriction in the near future.

Farm 5		2006	
Number of sheep monitored	906		
Number of sheep above the Working Action Level	0	0.0%	
Number of sheep below the Working Action Level	906	100%	
Estimated maximum activity concentration (Bq/kg)	205		
Estimated mean activity concentration (Bq/kg)	-255		
Standard deviation (σ , Bq/kg)	187		

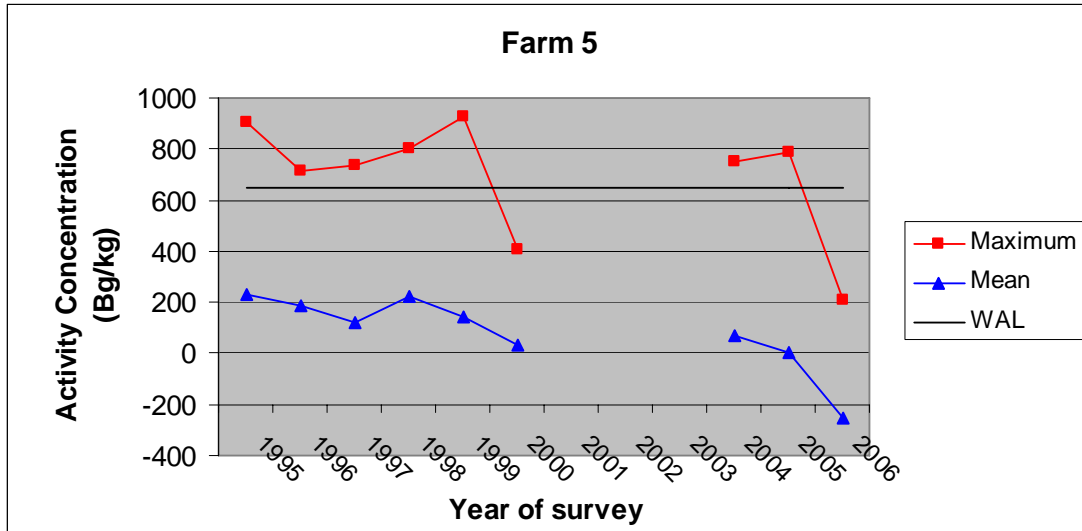


Figure 5: Graph showing estimated activity concentrations on Farm 5 between 1995 and 2006. Note that no surveys were carried out on this farm between 2001 and 2003.

24. The estimated mean activity concentration of -255 Bq/kg suggests an under measurement of background radiation levels which has skewed the dataset and indicates a lower degree of contamination than actually exists. This invalidates the 2006 survey results and dictates that further monitoring be undertaken.
25. **Recommendation:** This farm be monitored again in 2007 to assess trends in activity concentrations.

Farm 6		2006	
Number of sheep monitored	2358		
Number of sheep above the Working Action Level	190	8.1%	
Number of sheep below the Working Action Level	2168	91.9%	
Estimated maximum activity concentration (Bq/kg)	3869		
Estimated mean activity concentration (Bq/kg)	83		
Standard deviation (σ , Bq/kg)	368		

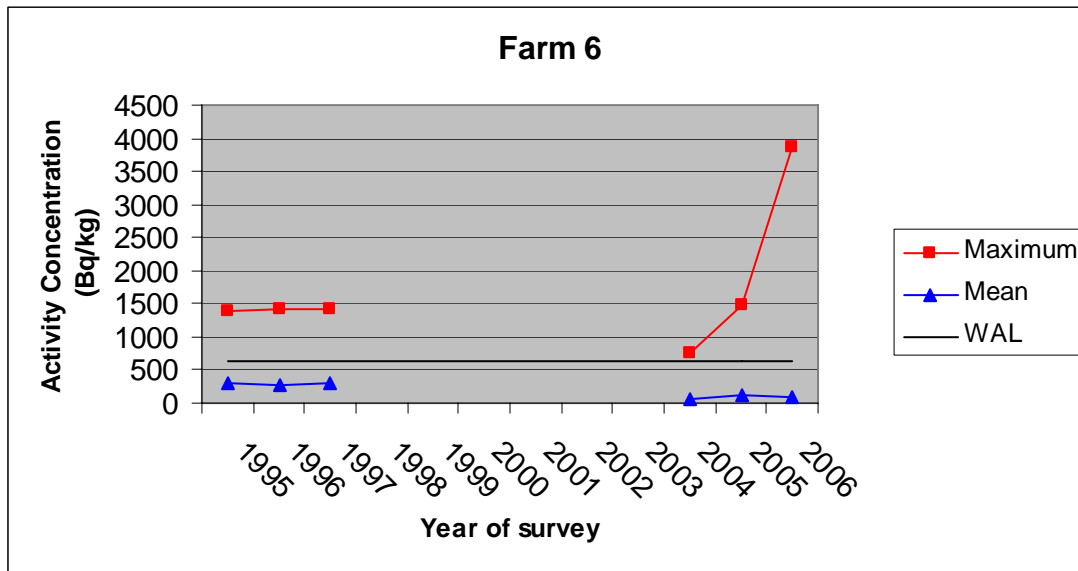


Figure 6: Graph showing estimated activity concentrations on Farm 6 between 1995 and 2006. Note that no surveys were carried out on this farm between 1998 and 2003. An additional 57 sheep were monitored in 2004, but have not been included in the results as there was no corresponding background measurement (but based on the recorded monitor readings, it is not believed that any of these sheep would have exceeded the Working Action Level).

26. The survey results show a sharp increase in the estimated maximum activity concentrations, reaching 3869 Bq/kg in 2006; more than twice the value of 1469 Bq/kg observed in 2005. This high variation in estimated maximum levels of contamination between years may partly be due to temporal changes in the availability of radiocaesium in the environment. Less variation was seen in the estimated mean activity concentrations of 72 Bq/kg, 110 Bq/kg and 83 Bq/kg in years 2004, 2005 and 2006 respectively; all of which fall below the WAL. However, of all the sheep monitored, 8.1% were found to exceed the WAL. Therefore further monitoring needs to be undertaken before this farm can be considered for de-restriction, although de-restriction is unlikely to be possible in the near future.
27. **Recommendation:** This farm be monitored again in 2007 to assess trends in activity concentration. It is unlikely to be suitable for de-restriction in the near future.

Farm 7

28. It was not possible to survey this farm in 2006. The farm was monitored in 2004 and 2005, and had shown decreases in estimated maximum (from 1226 Bq/kg to 643 Bq/kg), and estimated mean (from 427 Bq/kg to 205 Bq/kg), activity concentrations between those years.
29. **Recommendation:** This farm be monitored in 2007 to investigate current activity concentrations in sheep.

Farm 8

30. This farm was not monitored in 2000 as it was not considered a candidate for de-restriction, due to consistently high historical readings. Nor was not possible to survey this farm in 2004, 2005 or 2006. It would be useful to consider monitoring this farm in 2007 to investigate trends in activity concentration on the holding.
31. **Recommendation:** This farm be monitored in 2007 to investigate current activity concentrations in sheep.

Farm 9

32. This farm is no longer used to graze sheep. However, it remains covered by the restrictions, and should be considered for monitoring if sheep are to be kept on this farm in future.

Conclusion

33. There are currently nine farms still subject to sheep farming restrictions in Cumbria, of which six took part in the Food Standards Agency 2006 De-Restriction Survey. A total of 6196 sheep were monitored, with 229 found to exceed the Working Action Level for radiocaesium contamination. The 2006 results were generally higher than in 2004 and 2005, particularly the estimated maximum activity concentrations which had risen in five of the six farms. Farm 5 was the exception, for which an inaccurate background measurement was responsible for invalidating the monitoring results. There is a significant gap in data between the years 2001 and 2004 due to an inability to undertake surveys in these years resulting from the Foot and Mouth outbreak.
34. Four out of the six surveyed farms were found to hold sheep which were contaminated above the Working Action Level (Farms 1, 3, 4, and 6). These are unlikely to be suitable for de-restriction in the near future. Farm 2 results indicate that no sheep have exceeded the Working Action Level since monitoring resumed in 2004 and, therefore, that the farm is a possible candidate for de-restriction. However, the 2005 survey results were particularly low due to an inaccurate background measurement which invalidated the findings for that year. Nonetheless, the 2006 results for Farm 2 are encouraging, and seem to confirm the trend in low estimated maximum and mean activity concentrations and all sheep being below the Working Action Level. Further monitoring is required to determine whether this farm is indeed suitable for de-restriction.
35. It is not possible to de-restrict any of the Cumbrian farms as a result of the 2006 survey. In order to be considered for de-restriction, a farm must have two consecutive years in which all sheep are shown to be below the Working Action Level. Unfortunately, none of the farms have achieved this.
36. A further survey of the farms remaining under restriction in Cumbria is recommended in 2007, in order to collect further data on the trends in radiocaesium concentrations in sheep meat, before consideration to de-restriction can be given.

Glossary of Terms

Activity Concentration	The amount of radioactivity within a fixed volume. This is the scientific unit used to measure radioactivity in food. Generally recorded in units of Becquerels per kilogramme (Bq/kg) or Becquerels per litre (Bq/l).
Becquerel	The scientific unit of radioactivity, defined as the activity of a quantity of radioactive material in which one nucleus decays per second. The short-hand for Becquerel is Bq.
Consent	A consent is the lifting of restriction on sheep movement from a farm in the restricted zone in which all sheep have been shown to have activity concentration levels below the working action level for two consecutive years, but which have no hard defined boundaries. This lack of boundaries means that it is not possible to amend the restriction order and de-restrict the farm. However, a consent allows animals to be moved from the farm without controls.
De-restriction	The lifting of restrictions imposed on a farm as part of the Chernobyl Mark and Release scheme. De-restriction can be granted if all sheep monitored on the farm for two consecutive years are below the Working Action Level.
In-bye	Low level (valley) pasture. Levels of radiocaesium are usually very much lower in the in-bye land compared to that found on the fells (hills). Sheep are brought to in-bye for clipping during the summer and for fattening prior to being sold at market.
Limit	The maximum concentration of radiocaesium allowed in UK sheep meat raised in Chernobyl-affected areas. The limit is 1000 Bq/kg and was set in 1986, following advice from the European Commission's Article 31 Group of Experts.
Restriction	The limits put on sheep movements from farms affected by the Chernobyl disaster. These restriction require sheep to be monitored before they are allowed to leave the farm, with only sheep with a radioactivity level lower than the working action level allowed to be consumed. This system is called the Mark and Release scheme.
Working Action Level	The practical limit for radiocaesium in UK sheep meat. The Working Action Level (WAL) takes into account any inherent variability in monitoring results to ensure that sheep with activity concentrations above the limit do not enter the food chain. Statistically, the Working Action Level (currently 645 Bq/kg) was set so that there is only a 1 in 40 chance of a sheep that is over the limit seeming to be under the limit and, therefore, entering the food chain.