An Assessment of Radiocaesium Activity Concentrations in Sheep in Restricted Areas of England and Wales and Potential Consumer Doses

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(UK Post-Chernobyl Monitoring Programme)

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Executive Summary

The Food Standards Agency (FSA) manages restrictions on the movement, sale and slaughter of sheep on farms in North Wales and in Cumbria, which remain affected by radiocaesium fallout from the Chernobyl accident. The restrictions are enforced using powers under the Food and Environment Protection Act (FEPA) 1985. A live sheep monitoring programme, known as 'Mark and Release', operates to ensure that sheep exceeding 1,000 Bq/kg of radiocaesium do not enter the food chain.

The FSA has been reviewing its policy of restrictions and monitoring controls and is planning to go out to public consultation on whether to remove them. To inform the consultation process an assessment has been made of the levels of radiocaesium in sheep within the restricted areas and the potential consumer doses if control measures were to be lifted.

Sheep were monitored directly following upland grazing during the summers of 2010 and 2011. The summer period ensured the radiocaesium activity concentrations in the sheep were at their peak. In addition, by monitoring directly following upland grazing, it meant that farming practices (e.g., fattening on lowland pasture) would not lower the radiocaesium levels. This allowed the maximum consumer doses to be established.

A probabilistic dose model (Wells, 2011a) was developed to use the sheep monitoring data to estimate the distribution of annual effective dose in millisieverts per year (mSv/y), to a Representative Person (ICRP 2006). This Representative Person corresponds to a more highly exposed individual consumer of sheep meat from each restricted farm, whose habits are realistic and not outside the range of what people encounter in their day to day life.

The distribution of annual effective dose to a range of additional consumers has also been modelled to demonstrate a robust understanding of potential doses in different scenarios (including extreme scenarios).

The doses to the representative person from consuming sheep meat from each monitored farm range from <0.05mSv to 0.21mSv per year with a mean of <0.09mSv per year. The doses are considerably below the 1mSv per year limit established underArticle 48 of Council Directive 96/29/Euratom for members of the public exposed to radiation from routine *planned* exposures and the 1mSv per year reference level typically used in *existing* exposure situations (ICRP, 2006 & 2007). Doses are also well below 0.26mSv, the dose the Representative Person would receive, if they consumed all their meat at the 1,000 Bq/kg limit.

The mean radiocaesium activity concentration in sheep on each restricted farm ranged from <160 Bq/kg to 739 Bq/kg and the maximum from <160 Bq/kg to 1433 Bq/kg. Only 4 out of 78 farms recorded sheep above 1,000 Bq/kg. No more than 2.5% percent of sheep on each of these four farms exceeded this limit.

Although low levels of radiocaesium persist throughout the restricted areas of Cumbria and North Wales, the level of consumer risk, if control measures were removed, is considered to be very low. With very few sheep exceeding the 1,000 Bq/kg limit when activity concentrations are at their peak, the Mark and Release monitoring programme is having a negligible impact on reducing consumer doses.

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1. Introduction

1.1. Background

The Food Standards Agency (FSA) manages restrictions on the movement, sale and slaughter of sheep in parts of the United Kingdom affected by radiocaesium fallout from the Chernobyl accident. Restrictions remain in place on 334 farms in North Wales (283 of which are active) and 8 farms in Cumbria. This represents less than 5% of the original total. The restrictions are enforced using powers under the Food and Environment Protection Act (FEPA) 1985.

A live sheep-monitoring programme, known as 'Mark and Release', operates to ensure that sheep exceeding 1,000 Bq/kg of radiocaesium do not enter the food chain. This limit was set in 1986, based on recommendations from a group of experts established under Article 31 of the Euratom Treaty.

The FSA has been reviewing its policy of restrictions and monitoring controls, in response to the International Commission on Radiological Protections' latest recommendations (ICRP, 2006, 2007, 2009a & 2009b) and queries from stakeholders questioning the continuing need for controls. A public consultation on whether to change the policy and remove control measures is planned for the latter part of 2011.

A probabilistic dose model has been developed (Wells, 2011a) to better understand the risks to consumers, were control measures to be lifted from the remaining restricted farms in Cumbria and North Wales.

This report discusses the need to change the way that decisions on removing control measures has previously been made, and presents the results of a sheep-monitoring survey, carried out over two years, to assess the levels of radiocaesium in sheep on farms throughout the restricted areas. It also presents the results of a dose assessment, using the probabilistic dose model and data collected from the survey, to model the doses that different consumers would receive, were they to consume sheep meat from each individual monitored farm.

A range of doses to a representative person (ICRP, 2006), who represents the more highly exposed consumers, is compared to international dose limits and reference levels, to put the level of risk into context. These doses are also compared to the dose that the representative person would receive under the current policy (i.e. the dose they would receive from consuming all their sheep meat at the 1,000 Bq/kg limit). The aim is to allow an informed decision to be made, following public consultation on whether control measures can be lifted.

1.2. The Current Policy

The current policy of intervention has become less proportionate to the risks, as levels of radiocaesium in the environment have declined over the years. No sheep in Cumbria have failed the Mark and Release monitoring criteria for several years and less than 0.5% of the 75,000 sheep monitored annually in North Wales fail. The criteria are set so that a sheep has no more than a 1 in

40 chance of exceeding 1,000Bq/kg of radiocaesium. This means that the majority of sheep that fail are still unlikely to exceed the 1,000Bq/kg limit.

The Mark and Release programme generally monitors sheep just before they go to market, when the levels of radiocaesium tend to be at their lowest. This is because the majority of farmers tend to fatten (or finish) their sheep on improved or partially improved pasture, a practice that can significantly reduce the levels of radiocaesium in the sheep. For this reason, monitoring data from the Mark and Release programme has tended not to be used when making decisions on the need for control measures.

A separate programme of monitoring, commonly known as 'summer' or 'de-restriction' monitoring, is undertaken for this purpose. Summer monitoring takes place when levels of radiocaesium in sheep are at their peak (June to October), and immediately after sheep have been removed from grazing upland pastures and prior to grazing on improved pastures. The peaty nature of the soil in upland pasture allows plants to take up radiocaesium more efficiently. This causes it to accumulate to a higher concentration in grazing sheep. Summer monitoring therefore ensures that the levels of radiocaesium in sheep are at the maximum they could enter the food chain, were controls to be lifted and famers to send their sheep directly to slaughter without grazing on improved pasture.

The criteria for removing control measures following summer monitoring have remained largely unchanged since they were first introduced. Restrictions have only been considered for removal where a farm's entire flock has been monitored to be at, or below the monitoring pass mark for 2 consecutive years. The pass mark is the same as that used in the Mark and Release programme, i.e., no more than a 1 in 40 chance of a sheep exceeding 1,000Bqkg of radiocaesium.

1.3. The Need for Change

The above approach to de-restriction has been a cautious and successful way of ensuring that sheep exceeding 1,000Bq/kg of radiocaesium are unlikely to enter the food chain. It has gained general acceptance from stakeholders, including members of the public, but has placed a significant burden on farmers who have to present their entire flock for monitoring. For a large flock, monitoring can take a several days. Notwithstanding the burden to farmers, there are other reasons why the current approach to de-restriction is no longer considered the best:

1. It does not consider the radiation dose (or detriment) that the radiocaesium imposes on consumers, (particularly those most exposed). As such it is no longer considered in line with current best practice, which is to assess consumer dose by taking account of their characteristics and habits.

2. The 1000 Bq/kg limit gives the impression that there is a step-change in risk above 1000 Bq/kg, and that consuming any amount of sheep meat containing radiocaesium above this limit is 'unsafe'. In fact, a distinction between 'safe' and 'unsafe' cannot be made in this way for two reasons. Firstly, any amount of radioactivity is considered to present a risk, however small, which increases in proportion to the exposure (ICRP, 2007). Secondly the activity concentration in the sheep meat is not the only factor that determines the dose a

consumer receives. For example, consumption rates and purchasing habits (e.g., where and how often the meat is purchased) can significantly influence consumer dose.

3. The 1000 Bq/kg limit does constrain consumer dose. However, it does not allow the actual doses below the constraint to be understood and put into context with established dose limits and reference levels. The current approach therefore makes decisions on control measures that are not entirely risk-based.

   Furthermore, the assumption that farms with sheep that exceed the limit always present the greater consumer risk is not always true. This is because individuals are very unlikely to consume their annual supply of sheep meat from a single sheep. They are more likely instead, to consume their meat from a number of different sheep over the course of a year. This pushes their radiocaesium intake closer to the mean of the radiocaesium distribution in the sheep (rather than the upper end).

   Consumers can therefore receive a higher dose from consuming sheep meat from farms with a higher mean radiocaesium activity concentration in their sheep, but where no sheep exceed the limit, compared to a farm that has a few sheep exceeding the limit, but where the mean radiocaesium activity concentration is lower.

4. Finally, on a practical level it is very resource intensive to monitor all sheep on all restricted farms twice in two consecutive years. It would take many years with current resourcing levels to achieve this, and many farms would stay unnecessarily restricted for many years while they waited for the surveys to be done. It was therefore felt necessary to develop a new decision-making process based on consumer dose, (and therefore risk) for determining the need for restrictions.

1.4. The FSA's Response

Having recognised the need for change, the FSA commissioned the development of a probabilistic dose model (Wells, 2011a). The model was to be in line with current best practice and based on the principles and methodologies described in ICRP Publication 101, *'Assessing Dose of the Representative Person for the Purpose of Radiological Protection'* (ICRP, 2006). The brief was to:

- Determine the characteristics including consumption rates and habits of an identified representative person (or persons);
- Construct a model to determine the relationship between the estimated average radiocaesium activity concentration in sheep and the estimated dose to the representative person(s);
- Construct a model, using the above relationships, to predict the chances of the dose to the representative person(s) exceeding appropriate limits;
- Use sheep monitoring data collected from hand-held radiation monitors during summer surveys;

- Allow prospective assessments of dose to be made.

The following sections describe the sheep-monitoring survey that took place during 2010 and 2011, and the estimates of consumer doses using the probabilistic model.

2. Survey Design

2.1. General

The aims of the sheep monitoring survey were as follows:

- To provide sufficient data to allow a statistically robust assessment of the levels of radiocaesium in sheep to be made in the restricted areas in North Wales.
- To provide sufficient data from full-flock monitoring on the few remaining restricted farms in Cumbria, to allow a robust assessment of the levels of radiocaesium in sheep to be made.
- To allow a good understanding of the spatial distribution of radiocaesium in sheep throughout the restricted areas in both regions.
- To allow a robust assessment of the range of potential doses consumers could receive, if they consumed all their meat from individual restricted farms.

The monitoring took place during the summers of 2010 and 2011, on farms throughout the restricted areas of North Wales and Cumbria. The vast majority of the monitoring was carried out between late spring and late summer, when levels of radiocaesium in sheep tend to be at their peak (Ministry of Agriculture, Fisheries and Food, 1994 and Nisbet and Woodman, 1999).

The sheep were monitored within 24 to 48 hours of being gathered off the worst-affected upland pasture, and prior to grazing on improved or partially improved lowland pasture. Grazing on improved or partially improved pasture is undertaken by the majority of farmers, to fatten sheep prior to sale or slaughter. It is a practice known to substantially reduce the levels of radiocaesium in the sheep, which has a biological half-life of approximately 10-12 days for lambs and 20 days for ewes (Howard *et al*., 1987). This was a deliberate decision to ensure a robust understanding of the *maximum* levels of radiocaesium in the sheep, and to put an upper bound on potential consumer doses.

In North Wales, due to the large number of restricted farms it was not possible to monitor all sheep on all farms. The survey was therefore designed to be representative of all the working sheep farms within the restricted area and to ensure that no more than 5% of these farms were likely to exceed the highest levels of radiocaesium found at the monitored farms. A minimum of 54 farms was calculated as being required to achieve this degree of confidence (see Annex 1 for details), although a good response from farmers meant monitoring was able to be carried out on 72 farms. In Cumbria, monitoring was carried out on six of the eight restricted farms.

2.2. Farm Selection

2.2.1. North Wales

At the time the survey began, there were 334 sheep farms in North Wales registered as Restricted (under control measures) or Under Direction (exempt from control measures, as long as certain grazing conditions were complied with). Seven of the restricted farms had previously been 'Fully

Consented', exempting them from all control measures. Checks on the Animal Movement License System (AMLS) database, showed that a further forty four farms had not moved sheep for several years. It is believed these farms had either stopped stocking sheep, been merged with adjacent farms or changed their use. As such, there were a total of 283 working sheep farms under restriction in North Wales at the time of the survey.

For the 2010 survey, 213 farms were considered eligible to take part in the survey. A decision was made to exclude 27 farms, which were Under Direction. A further forty three farms were also excluded as their contact details were unavailable at the time. Due to the limited resource available, a maximum of 23 farms were targeted for monitoring. The farms were selected from a simple randomised list of the 213 eligible farms. They were then contacted and asked whether they were able to take part in the survey. Twelve farms initially agreed to take part but 11 felt unable to do so. Where farms were unable to take part, neighbouring farms were contacted and a further 4 farms were recruited in this way. In total, 16 farms were monitored between the 9th July and the 2nd November 2010. All but two farms were completed by the end of September.

In 2011, the resources became available to carry out a larger monitoring campaign and communication with farmers was improved to ensure a sufficient number of farms were recruited. Two hundred and sixty seven farms were considered eligible to take part in the 2011 survey. The 16 farms monitored in 2010 were excluded. However, the 27 farms originally excluded because they were 'Under Direction' were included as they were technically still under restriction. The 43 farms originally excluded because contact details were unavailable at the time were also included in 2011.

In 2011, monitoring was carried out on 54 randomly selected farms out of a target of 54 farms. The farms were also chosen from a simple randomised list, this time of the 267 eligible farms. They were contacted as before and asked to take part in the survey. For those farms that were unable to take part, a replacement was sought in the order they appeared in the randomised list to ensure a representative sample. Monitoring took place between the 25th May and the 2nd September. In total, 72 randomly selected farms were monitored in North Wales during 2010 and 2011.

2.2.2. Cumbria

In Cumbria, there are eight farms under restriction. Due to the small number of farms and the resource available to carry out the monitoring, all eight farms were asked if they would take part in the survey. Five farms agreed to be monitored in 2010 and one in 2011. In total, 6 of the 8 farms were monitored in Cumbria during 2010 and 2011.

It is worth noting that the two farms which were unable to take part in the survey lie adjacent to two of the farms that did take part.

2.3. Sheep Selection

In North Wales, forty sheep or 10% of the flock (whichever was the greater) were monitored on each farm. The monitoring was timed to coincide with when farmers were gathering their sheep (e.g., for clipping, sorting or dipping). This reduced the inconvenience to the farmers and allowed access to

their whole flock. The sheep chosen for monitoring were randomly selected from each flock, to ensure they were representative.

In Cumbria, as the resources were available, a decision was made to ask the farmers if they would consent to full-flock monitoring. Five farms agreed and were monitored in 2010. Representative monitoring on an additional farm, using the same criteria as for the Welsh survey was carried out in the summer of 2011.

2.4. Questions to farmers about Fattening Sheep

The 57 famers in North Wales that took part in the 2011 survey were asked three questions about their grazing practices for fattening/finishing their sheep. These were as follows:

- Do you fatten/finish your sheep before they go to market?
- If yes, for how long do you fatten/finish your sheep?
- On what type of pasture do you fatten/finish your sheep?

The questions were asked to get an indication of the extent to which additional grazing practices were likely to further reduce the levels of radiocaesium in sheep meat, before entering the food chain. The answers are discussed in Section 7 (Results).

3. Sheep Monitoring

3.1. Monitoring Equipment

The sheep were monitored using a Redeem PRM 85C gamma monitor manufactured by Corus Northern Engineering Services (Figure 1). The monitor consists of a separate ratemeter and probe, containing an 85 mm x 41mm thallium-activated caesium iodide crystal. The ratemeter which displays a count-rate in counts per second (cps), was set up with an energy window of 400 keV to 800 keV to ensure the Cs-137 peak (662 keV) was incorporated, and to reduce the influence of background radiation.

Figure 1 - The Redeem PRM 85C gamma monitor

3.2. Monitoring Procedure

The sheep from each farm were placed in a pen where they were segregated, restrained and monitored (Figure 2). A static monitoring location was chosen inside the pen away from the influence of other sheep or brick or granite walls. A background count-rate measurement was taken with the probe held against the inspector's body at sheep height, to approximate the background measurement of an uncontaminated sheep. This accounts for the naturally occurring radioisotope potassium-40 present in all animals. Each sheep was then brought to the monitor in turn, and three 10-second count-rate readings were recorded with the probe held firmly against the animal's rump in a horizontal position (Figure 2). The background count-rate was subtracted from the mean of the three gross count-rate measurements, to give the mean net count-rate in counts per second (cps).

The majority of sheep were monitored in single batches, with a single background count-rate applied to the batch. In some cases sheep were monitored in multiple batches, producing several datasets per farm. Multiple batches were generally produced where new background radiation measurements were required, for example, were the surveyor suspected the jostling of sheep had caused the monitoring location to move or where monitoring took more than a couple of hours.

In Cumbria, where full-flock monitoring was carried out, the sheep were monitored in multiple batches sometimes over several days. In these instances the batches were defined as above, but also by grazing location where possible. This was to allow differences in the activity concentration in sheep between different grazing locations to be examined.

Figure 2 - Sheep are gathered in a pen (left) and monitored on the rump (right)

3.3. Reducing measurement uncertainties

A number of factors can interfere with the accuracy of the radioactivity measurements during the live-monitoring of sheep. In order to ensure confidence in the results, procedures were put in place to ensure the fleet of monitors were calibrated, set up identically and response-checked before they were taken out to the farms. The surveyors also underwent refresher training in the monitoring procedures to ensure they applied a consistent approach on each farm.

One of the greatest difficulties to overcome when monitoring low levels of radiation in live sheep is controlling the influence of background radiation. Background radiation can vary over relatively small distances due to differences in the underlying geology, natural radon in the air and the close proximity, or not, of granite or brick walls. The presence of radiocaesium in the soil or faeces of sheep can also vary the levels of background radiation. As sheep tend to move about and need to be restrained, it can be difficult to control the monitoring location and geometry. Small changes in either can alter the background levels of radiation, which in turn influences the final net count-rate measurement. By choosing a low background area, keeping the monitoring location static and by bringing the sheep to the monitor (rather than the monitor to the sheep), the monitoring process was controlled.

In addition, as background levels of radiation can change over the course of a day due to the amount of natural Radon-222 in the air, and the surveyor can wander from the monitoring location, new background measurements were taken at regular intervals. This was generally necessary when large numbers of sheep were being monitored. This helped to ensure the correct background count rate was applied when deriving the net count-rate for the sheep. Further information can be found in the FSA's monitoring procedures (Field, 2011).

3.4. Conversion of Net Count-Rate to Radiocaesium Concentration

The net count-rate for each sheep was converted into a radiocaesium concentration using the slope and intercept of a calibration curve, derived from a monitoring exercise undertaken in 2007. The exercise involved live-monitoring sheep from different farms. These were then slaughtered and their muscle tissue analysed by a laboratory. The net count rates in cps from the live-monitoring were then plotted against the laboratory-derived radiocaesium concentrations in Bq/kg. A best fit regression line was then calculated and plotted (Figure 3). The linear regression was weighted to give bias towards those monitor readings least affected by background radiation (i.e. those with higher net count-rates). This was because there is less uncertainty in these measurements. Further details on the calibration curve can be found in (Wells, 2009a).

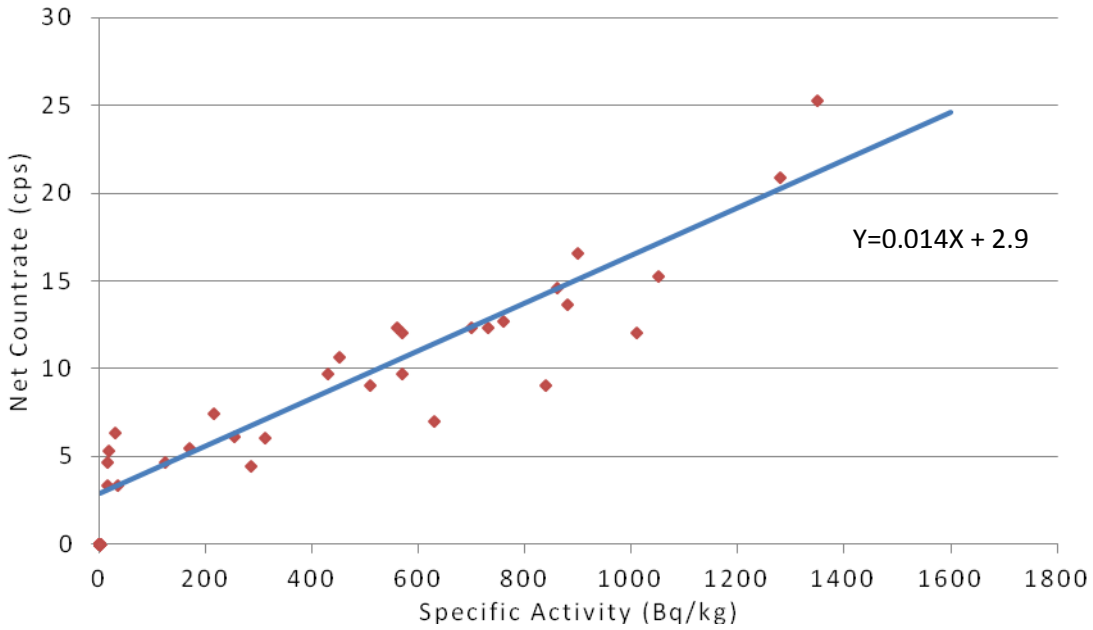


Figure 3 - Best fit regression line through sheep monitoring data

3.5. Estimating the Minimum Detectable Activity (MDA)

The minimum detectable activity (MDA) is the minimum amount of activity (in net counts) we can be confident of detecting in our measurements at the 95% confidence level (or in other words, the level at which the probability of detecting activity, when there is no activity, is less than or equal to 5%), (Wells, 2011b). It is a function of the standard deviation of the background radiation readings measured by the monitor. On the monitored farms the background count-rate varied from 6 cps to 26.3 cps. This means the MDA is different for each monitoring situation.

In order to define a minimum reporting limit for radiocaesium in each batch of sheep monitored, the MDA was calculated using the 'Currie Equation' (see below). This gave the minimum value of net counts above which there was a 95% probability that activity was present. This was then converted

into an activity concentration (in Bq/kg) using the slope and intercept of the calibration curve. The following equations describe the process:

Equation 1 - MDA Concentration

$$MDA\ Concentration = \left(\frac{c_{\min}}{t} - a \right) / b$$

Where:

Equation 2 - Currie Equation

$$c_{\min} = 4.7\ \sigma_{bkg} + 2.7$$

and

σ_{bkg} is the Standard deviation of the background count;

a is the Intercept count-rate of the regression line (= 2.9 cps);

b is the Slope of the regression line (= 0.014 cps/Bq/kg);

c_{min} is the Minimum net count at the 95 % criteria;

t is the Count time (= 30 seconds).

As can be seen in Figure 3 the calibration curve has a positive net count-rate intercept (2.9 cps), which results in a negative minimum detectable activity concentration being calculated at low counts. The positive intercept is the result of the way that background radiation measurements are taken against the surveyor's stomach, as he/she crouches at sheep height to replicate the monitoring geometry. It means a person's stomach is not the best approximation for a clean sheep as it results in the background radiation readings being under-subtracted. This is most likely due to the surveyor's thighs and arms, which shield the radiation from the ground as they crouch down. When sheep are monitored this shielding effect is not present. To deal with this issue, the intercept of the calibration curve was set to zero and the original slope of the regression retained. This provided a more conservative (higher) minimum detectable activity concentration.

Where the measured net count-rate in the sheep gives an activity concentration below the MDA concentration, the activity concentration is reported as less than (<) the MDA concentration. Where this value is used in the estimates of consumer dose, the dose is also reported with a less than. In situations where multiple batches of sheep were monitored on a farm, the highest MDA concentration calculated from the highest background reading is reported.

4. Probabilistic Consumer Dose Model

4.1. General

The dose model uses sheep monitoring data to estimate the distribution of annual effective dose, in mSv per year, to the more highly exposed consumers of sheep meat from each farm in the restricted areas of England and Wales. It provides a more realistic representation of the consumer risks than radiocaesium concentration in single sheep can provide, and is therefore a more valuable approach for determining whether control measures remain justified.

Different consumer characteristics and exposure scenarios were considered to determine the quantity of meat that consumers ingest, its radiocaesium concentration and the dose per unit intake. As there are a large number of characteristics and habits which can influence the level of exposure, a hypothetical consumer was identified to represent the more highly exposed individuals. This consumer is known as the 'representative person'.

The representative person was constructed to represent an individual whose habits are realistic and not outside the range of what people encounter in day to day life. The representative person was also constructed to ensure that the probability was less than approximately 5% that a person drawn at random from the exposed population would receive a greater dose. This is in line with ICRP recommendations for prospective probabilistic dose assessments (ICRP, 2006).

In a large exposed population this can still mean that many individuals could exceed the dose to the representative person. This is only an issue if the level of dose received is considered a concern, and more than a few tens of individuals are exposed. In order to ensure a robust understanding of the range of potential doses consumers could receive, the characteristics of different individuals including those with extreme habits were also considered and their potential doses assessed. The following sections describe how the model was constructed and doses estimated.

4.2. The Representative Person

In constructing the representative person three exposure populations were defined, characterised by their buying habits. The characteristics of consumers within each exposure population were then considered in terms of their age and consumption rates.

The frequency of purchase is an important factor in the probabilistic dose calculations, since a person purchasing their meat on multiple occasions throughout a year, is likely to be purchasing meat from multiple sheep. This means that as the number of different sheep a person consumes their meat from increases, the radiocaesium concentration of their intake will tend towards the mean of the activity distribution in the flock.

4.3. Defining the Exposed Populations

4.3.1. Farmer Group

The first group is defined by people who purchase, or otherwise acquire for personal consumption, their annual supply of sheep meat on a single occasion from a farm, farm shop, local butcher or farmers market, where all the meat is sourced from a single animal from the farm. These people are likely to be closely associated with the farming community and may represent individual farm owners, tenants, operators or other persons living on or close to the farm. In order to consume from a single animal over the course of a year, individuals in this group are likely to store their meat in a freezer. This group is considered to represent a very small minority. It should be noted that the amount of meat that can be sourced from a single animal is finite and in reality a very high consumer would be unable to source all their meat from a single animal.

4.3.2. Bulk Buyer Group

The second group is defined by people who, on average, purchase their annual supply of sheep meat quarterly (4 times per year) from farm shops, local butchers or farmers markets, where all the meat is sourced from the same farm. On each occasion they purchase meat derived from a single animal, probably in the form of a particular cut or joint or even a ¼-lamb pack freezer pack. The meat is most likely stored in a freezer at home and consumed throughout the year. People in this group consume their annual supply of meat from 4 different sheep.

4.3.3. Frequent Buyer Group

The third group is similar to the Bulk Buyer Group but with an important difference. As above, these people purchase their annual supply of sheep meat from farm shops, local butchers or farmers markets, where all the meat is sourced from the same farm. However, these people buy smaller quantities of meat more frequently for immediate personal consumption, rather than longer term storage in a freezer. On each occasion the individual purchases meat derived from a single animal, possibly in the form of a packet of chops or leg steaks. For this group the average frequency of purchases was set to fortnightly, meaning people in this group consume their annual supply of meat from 26 different sheep.

4.4. Age categories

Having defined three exposure populations the ages of different consumers were then considered. This is because the dose per unit exposure to radiocaesium and the consumption rate varies with age. The ICRP recommends that the annual dose for the representative person should be defined by three age categories (ICRP, 2006). These categories are 0–5 years (infant), 6–15 years (child), and 16–70 years (adult). The ICRP further recommend that a 1-year-old infant, a 10-year-old child and an adult are used to represent the three age ranges.

It should be noted that doses to foetuses and breast feeding infants are represented by the 1-year-old infant, since the differences in dose to these different age groups from radiocaesium are very small (ICRP, 2006).

4.5. Consumption Rates

To calculate the dose to an individual within each exposure population, their sheep meat consumption rates must be known. For this assessment, published national consumption rates for the three representative ages were used (Byrom, *et al.*, 1995). These are summarised in Table 1.

Table 1 - National sheep meat consumption rates with percentile projections

Name of Age Category	*Age of Representative Person*	*Mean Consumption Rate (Kg person^{-1} y^{-1})*	*Consumption Rate at 95th Percentile (Kg person^{-1} y^{-1})*	*Consumption Rate at 97.5th Percentile (Kg person^{-1} y^{-1})*
Infant	1 year old	0.8	2	3
Child	10 year old	4	10	10
Adult	Adult	8	20	25

Byrom, *et al.*, 1995

To better understand the above consumption rates, 20 kg of meat per year could equate to two hundred 100-gram portions, or about 3.8 portions per week.

Consideration was given to using unpublished national consumption rates derived from the FSA's National Dietary and Nutrition Survey (NDNS). However, comparable consumption rates were only available for two of the three ICRP-recommended age groups (adults and 10-year olds), and were slightly lower than those used. As the assessment is prospective and it is possible that consumption rates will increase in the future, it was felt appropriate to use the higher consumption rates published by Byrom *et al*., 1995.

The national consumption data shows three different percentiles of the distribution of consumption across the nation. This allows a basic sensitivity analysis to be carried out between average consumption rates and highly conservative estimates within the exposure populations. Three levels of consumer were therefore defined namely an average consumer, a high-level consumer and a very-high level consumer, representing the mean, the 95th percentile and the 97.5th percentile of the national consumption rates respectively.

Consolidating the above, we defined three exposure populations each with nine sub-groups as follows:

1) Farmer Group
    a. Adult
        i. Average-Level Consumer;
        ii. High-Level Consumer;
        iii. Very High-Level Consumer.

    b. Child
        i. Average-Level Consumer;
        ii. High-Level Consumer;
        iii. Very High-Level Consumer.

c. Infant

i. Average-Level Consumer;
ii. High-Level Consumer;
iii. Very High-Level Consumer.

2) Bulk-Buyer Group

a. Adult

i. Average-Level Consumer;
ii. High-Level Consumer;
iii. Very High-Level Consumer.

b. Child

i. Average-Level Consumer;
ii. High-Level Consumer;
iii. Very High-Level Consumer.

c. Infant

i. Average-Level Consumer;
ii. High-Level Consumer;
iii. Very High-Level Consumer.

3) Frequent Buyer Group

a. Adult

i. Average-Level Consumer;
ii. High-Level Consumer;
iii. Very High-Level Consumer.

b. Child

i. Average-Level Consumer;
ii. High-Level Consumer;
iii. Very High-Level Consumer.

c. Infant

i. Average-Level Consumer;
ii. High-Level Consumer;
iii. Very High-Level Consumer.

This list of consumers is large and a further reduction was required in order to define the representative person. The following two sections describe how a further reduction was made by considering the doses to each of these consumers.

4.6. Ingestion Dose Coefficients

In order to determine the dose received by each consumer, the remaining factor to consider is the Ingestion Dose Coefficient. Ingestion Dose Coefficients are a measure of the hazard radioactive substances have on the body, and are derived from various radiation and tissue weighting factors as well as metabolic and biokinetic information. Ingestion Dose Coefficients are defined as the dose

per unit intake of a radioactive substance and are measured in Sieverts per Bequerel (Sv/Bq). They are age-specific meaning that people of different ages can receive different doses from consuming the same amount of radiocaesium. For this reason the consumer age needs to be considered. Ingestion dose coefficients are published by the ICRP (ICRP, 1996).

Table 2 - Dose coefficients for selected age categories

Name of Age Category	***Age of Representative Person***	***Cs-137 Ingestion Dose Coefficient e(τ) (Sv Bq-1)***
Infant	1 year old	1.20E-08
Child	10 year old	1.00E-08
Adult	Adult	1.30E-08

Table 2 shows the ingestion dose coefficients for the selected consumer age groups. It should be noted that the Cs-137 dose coefficients do not follow the usual trend of increasing with younger age groups. The following equations allow the ingestion dose to different aged consumers to be calculated.

Equation 3 - Age-related Ingestion Dose

$$H_{ingest,age} = r_{age} \times e(\tau)_{age} \times s \times f$$

Where:

$H_{ingest\ age}$ is the age-related annual Ingestion Dose (Sv/year);

r_{age} is the age-related Consumption Rate (kg/year);

$e(\tau)_{age}$ is the age related Ingestion Dose Coefficient (Sv/Bq);

s is the sheep meat Activity Concentration (Bq/kg); and

f is the Fraction of sheep meat consumed from the affected farm.

For the simplicity of calculation, **f** can be set to 1. This pessimistic assumption equates to the consumer eating all their sheep meat from the farm under assessment. The activity concentration ***s*** was calculated using sheep monitor readings as follows:

Equation 4 - Activity Concentration

$$s = (c_{rate} - a)/b$$

Where:

a is the Intercept count-rate of the regression line (= 2.9 cps);

b is the Slope of the regression line (= 0.014 cps/Bq/kg);

c_{rate} is the instrument Count-rate (cps).

4.7. Consolidation

Use of the above equations demonstrates that the dose to children and infants never exceeds that of adults. This is because the consumption rates and dose coefficients are lower in all cases. As such there is no longer a need to consider child and infant consumers for our representative person. It should be pointed out that assessments to child and infant consumers were carried out to demonstrate this is the case.

The Representative Person may now be defined from the exposure groups described in Section 4.2, minus the child and infant groups. The remaining nine groups are listed below:

1) Adult Farmer
a. Average-Level Consumer;
b. High-Level Consumer;
c. Very High-Level Consumer.

2) Adult Bulk-Buyer
a. Average-Level Consumer;
b. High-Level Consumer;
c. Very High-Level Consumer.

3) Adult Frequent Buyer
a. Average-Level Consumer;
b. High-Level Consumer;
c. Very High-Level Consumer.

These nine groups can further be refined by considering consumption rate. As half of the exposed population would exceed the mean consumption rate, average level consumers are not considered appropriate for defining the representative person. It was felt that the representative person should be a high-level consumer with an intake at the 95^{th} percentile of the national consumption rate (20 kg/person/year). This was considered cautious (but not extreme) and is in line with ICRP recommendations (ICRP, 2006).

All three purchasing scenarios relate to consumers that source all their lamb from a single restricted farm. Therefore, they all represent the more highly exposed consumers. In considering the three exposure populations, it was decided that the farmer group represented an extreme habit, which although plausible, was possibly unrealistic and probably represented only a small number of people at best. The bulk buyer group was considered more plausible and realistic, but likely to represent a minority of consumers. It was decided that the frequent buyer group represented the scenario for the majority of these consumers and that the representative person should therefore be drawn from this group.

For probabilistic assessments the ICRP recommends that the representative person should be defined such that the probability is less than about 5% that a person drawn at random from the population will receive a greater dose. This can be achieved by assuming that the representative person consumes at no less than the 95^{th} percentile of the radiocaesium distribution in the sheep meat intake of a frequent buyer. For the purpose of this assessment the more conservative 97.5^{th} percentile was chosen, to demonstrate a robust understanding of the highest consumer doses.

The representative person is therefore defined as '*an adult frequent buyer who sources all their meat from the monitored farm and who consumes a high level (20kg) of sheep meat per year at the 97.5th percentile of the radiocaesium distribution in their sheep meat intake'.*

Due to the lack of specific data on purchasing habits and a firm understanding of the proportion of consumers represented by each exposure population, assessments were carried out on each adult consumer in each exposure population. This was to demonstrate robustness in our understanding of the range of potential consumer doses, and to allow a basic sensitivity analysis to be carried out within each exposure population (based on consumption rate and consumer age).

5. Estimating Consumer Dose

To assess the potential doses to different consumers including the representative person, the fixed parameters of age, purchasing habit and consumption rate that define each individual were combined with the probability distribution of radiocaesium activity concentration in sheep meat.

When uncertainty is considered in the estimates of consumer dose derived from radiocaesium measurements in the sheep, a percentile of the dose distribution can be interpreted as a probability. When related to dose this allows statements like the following to be made:

'The probability that the annual effective dose to the specified individual does not exceed 0.3 mSv is 97.5 %'

The main advantage of a probability distribution is that it does not require every sheep to be monitored. Representative monitoring provides sufficient information about the distribution of radiocaesium in the whole flock.

5.1. Components of the Probability Distribution

The estimates of dose incorporate two categories of variability. The first incorporates the variability of the radiocaesium concentration in the flock. The second incorporates the variability in the consumer characteristics (i.e., purchasing habits, age and consumption rates).

In the first category, the variability of radiocaesium concentrations in sheep within the flock can be observed as the variability of the monitoring results over the probability distribution. The variability between sheep is represented in the assessment by using the 97.5^{th} percentile of the radiocaesium activity concentration. This is representative of the highest radiocaesium activity concentrations in the flock.

The second category includes variability in the consumption rates and purchasing frequencies. Consumption rates were fixed at three levels: the mean, 95^{th} percentile and 97.5^{th} percentile of national consumption rates. These relate to the average -level, high-level and very-high level consumers respectively. Purchasing frequencies were also fixed at three levels, namely annual, quarterly and fortnightly. These relate to the number of different sheep the consumers consume their meat from and correspond to the farmer, bulk-buyer and frequent-buyer exposure populations.

It is important to note that the purchasing frequency does not affect the total amount of sheep meat consumed in a year. Rather it represents how the total consumption is divided up in terms of purchasing habit. The consumption rate and purchasing frequency are therefore independent parameters and cannot be integrated within a single probability distribution. In order to carry out a sensitivity analysis of the potential doses to each exposure group, multiple dose distributions are required.

It should also be noted that measurement uncertainties associated with the sheep monitoring are not quantified in the assessment, although they do influence the dose estimates. These include the random errors resulting from the probabilistic nature of radioactive decay, and the systematic errors

resulting from variations in how different monitors respond to the radiation and how well the surveyor was able to control the monitoring process. These uncertainties were addressed by ensuring the monitors were set up identically and the monitoring process was kept consistent on each farm. See Section 3 for further details and Field, 2011.

5.2. Probabilistic Dose Assessment Methodology

The monitoring data was first checked to ensure a sufficient number of sheep were monitored and that there were no obvious signs of systematic errors. The monitoring data in counts per second was then converted to radiocaesium activity concentration in Bq/kg using a calibration curve derived from a previous monitoring exercise.

For consumers in the 'extreme' farmer population it was assumed that annual consumption came from a single sheep (i.e., n=1). The data was tested to see if it fitted a normal or lognormal distribution. The distribution with the best fit was then used to estimate the 97.5th percentile of the radiocaesium activity concentration. Where neither distribution was a good fit, an empirical estimate of the 97.5th percentile was made using the actual observed distribution of the monitoring data. The doses were then calculated using the specific parameters (consumption rate and age-related dose coefficient) that defined the particular consumer being assessed.

For consumers in the bulk-buyer and frequent-buyer populations it was assumed that annual consumption came from 4 sheep and 26 sheep respectively (i.e., n=4 and n=26), which relates to the quarterly and fortnightly purchasing habit. Equal quantities of meat were assumed to have been consumed from each sheep. An estimate was then made of the mean and standard deviation of the radiocaesium activity concentration averaged over n sheep.

For both the bulk-buyer and frequent-buyer consumer assessments a normal distribution was assumed in all cases. Following the Central Limit Theorem, the average radiocaesium activity concentration of a large enough number of randomly selected sheep will also approximately follow a normal distribution, irrespective of the radiocaesium distribution. The normal approximation will therefore usually provide a reasonable estimate for consumers that purchase fortnightly (where n=26). It is not so good an estimate for consumers that purchase quarterly (where n=4), but as this group's purchasing habit falls between those of the farmer and frequent buyer populations, it was considered that a greater uncertainty in the estimates was tolerable. In addition, the frequent buyer habit for which the normal approximation is best is considered to represent the majority of consumers.

6. Understanding Acceptable Levels of Dose

The model allows statements to be made about the doses that each assessed individual, including the representative person, would receive if they consumed all their sheep meat from individual monitored farms. This means a range of doses can be established for the representative person.

In order for these doses to be put into context, and to allow an understanding of whether or not they represent an unacceptable risk, they need to be compared to a reference level. In the UK there are no legal limits for the dose a consumer can receive from radioactivity following a nuclear accident, and radiation protection principles assume there is no level of radiation dose, however small, that can be considered entirely risk-free (ICRP, 2007). However, Article 48 of Council Directive 96/29/Euratom lays down basic safety standards, which specifies that members of the public exposed to radiation from routine *planned* exposures, (e.g., from authorised discharges from nuclear power stations), should not exceed a dose limit of 1 mSv per year.

The 1mSv limit is also supported by the ICRP, who recommend constraining doses to the lower part of the 1 to 20 mSv per year band for people living in contaminated areas (ICRP 2007). They further state that levels close or equal to 1 mSv per year are typically used by authorities to manage such situations (ICRP, 2009b).

To help understand what this means we can compare it to the average dose of 2.7 mSv that people in the UK are exposed to each year (Health Protection Agency, 2011). This comes mainly from natural sources of radiation in homes, places of work and in the food people eat. In Cornwall, the average dose people receive from natural Radon is 7.8 mSv per year (Health Protection Agency, 2011).

For the past 25 years a limit of 1,000Bq/kg radiocaesium in sheep meat has been considered acceptable for constraining the doses that consumers receive. If the representative person were to consume their entire annual supply of sheep meat at the 1,000Bq/kg level, they would receive a dose of 0.26mSv per year, which is well below the 1mSv per year level previously mentioned.

Therefore, if doses to our representative person are below 0.26mSv, this demonstrates that the level of risk to consumers is less than that allowed under the existing control measures. The converse is also true.

Note:

1. *It should be noted that the 1mSv per year level relates to total exposure from all pathways, and that this assessment deals with the exposure from the consumption of sheep meat only. Exposure from other pathways related to Chernobyl contamination cannot be entirely ruled out, such as from direct radiation shine to those living in the restricted areas, and from the consumption of other local produce. However, there is good evidence to suggest these exposure pathways are minor, and that the consumption of sheep meat is the dominant pathway for the majority of exposed people. The restricted areas are sparsely populated with little in the way of other food production. Extensive monitoring of foodstuffs in the immediate aftermath of the Chernobyl accident showed levels of radiocaesium in other food groups were very low (much lower than in sheep) and mostly below the limits of detection (Ministry of Agriculture, Fisheries and Food / Welsh Office, 1987 and Ministry of Agriculture, Fisheries and Food, 1994).*

2. *The ICRP recommend that radiation doses should be 'optimised'. This means they should be kept as low as reasonable achievable (ALARA), taking account of economic and social factors, as well as the distribution of doses and the benefits resulting from the implementation of protection strategies (ICRP, 2009b). The optimisation of dose is not considered in this report, but is fully discussed in the Impact Assessment which accompanies this report (Thomas, 2011). The impact assessment considers two policy options, namely keeping the existing Mark and Release monitoring controls and removing all control measures. The impact assessment also discusses other policy options, which have been discounted because they could not be shown to reduce consumer doses.*

7. Results

7.1. Radiocaesium Concentrations in Sheep

7.1.1. Wales

In Wales, representative monitoring of sheep was carried out on 72 randomly selected farms out of a total of 283. The mean radiocaesium concentration in sheep on each of these farms ranged from <160 Bq/kg to 739 Bq/kg, and the maximum ranged from <160 Bq/kg to 1050 Bq/kg (Table 3). Only 2 of the 72 farms monitored had sheep that exceeded 1,000 Bq/kg. In both cases only a single sheep exceeded this level.

On 38 farms (53%) the mean radiocaesium concentration was below the estimated minimum detectable activity concentrations. The mean radiocaesium concentration was below 300Bq/kg on 48 farms (66%) of farms and below 500 Bq/kg on 65 farms (90%), (Figure 4). The mean radiocaesium concentration in sheep on all the monitored farms in the restricted area of North Wales was <289 Bq/kg.

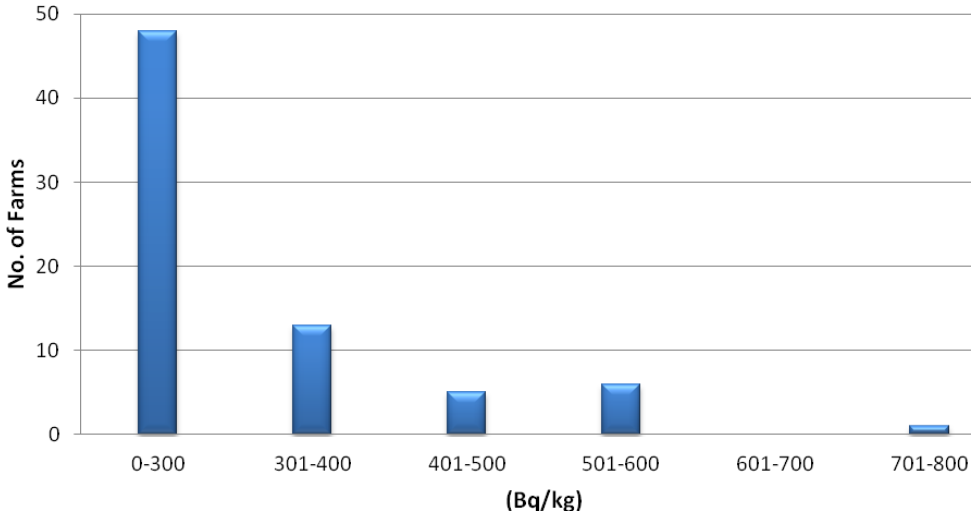


Figure 4 - Mean radiocaesium activity concentration in sheep on monitored farms in North Wales

A map showing the mean radiocaesium activity concentration in sheep for each farm, by their approximate grazing locations within the restricted area is given in Annex 2. It should be noted that some farms graze sheep in areas bordering the restricted area and that sheep may wander in and out. In these cases the grazing location has been placed just inside the restricted area.

The map shows that the activity concentration of radiocaesium in sheep varies by grazing location and is patchy rather than homogenous within the restricted area. The centre of the restricted area to the west and southwest of Betws-y-Coed and to the North of Blaenau Ffestiniog is the largest area where the mean radiocaesium activity concentrations in sheep are elevated above 300 Bq/kg. Two

smaller areas lie approximately 7 miles to the Northwest of Betws-y-Coed and in an area to the east of Trawsfynydd.

The lowest levels of radiocaesium in sheep are found in the northern-most parts of the restricted area and to the east and southeast of Blaenau Ffestiniog. With a few isolated exceptions, the farms grazing in these areas had a mean radiocaesium activity concentration in their sheep below 300 Bq/kg. The majority of these were below the minimum detectable activity concentration.

The survey was designed to be representative of all the working sheep farms within the restricted area, and to ensure that no more than 5% of these farms were likely to exceed the highest levels of radiocaesium found at the monitored farms. A minimum of 54 farms was initially calculated as being required to achieve this degree of confidence. However, a good response from farmers meant monitoring was carried out on 72 farms. This allows us to estimate that no more than 4% (11/283) of restricted working sheep farms in North Wales, are likely to have higher mean radiocaesium activity concentrations in their sheep, than the maximum observed of 739 Bq/kg, (see Annex 1 for details).

7.1.2. Cumbria

In Cumbria, full flock monitoring was carried out on 5 farms and representative monitoring was carried out on 1 farm. Six farms were monitored out of a total of eight. Of the two farms that were not monitored, one lies between Farm C and Farm F, and the other borders Farm F. Historic monitoring has shown there is little difference between these farms in terms of radiocaesium activity concentration in sheep. The mean radiocaesium activity concentration in sheep on each of the monitored farms ranged from <230 Bq/kg to 331 Bq/kg, and the maximum ranged from 339 Bq/kg to 1433 Bq/kg (see Table 4 and maps in Annex 2).

Two of the farms monitored (Farm A and B) had sheep that exceeded 1,000 Bq/kg. On Farm A, 24 sheep out of a total 643 fell-grazed sheep exceeded this level. On Farm B a single animal out of 372 exceeded this level by a small margin.

On five farms the mean radiocaesium activity concentration was below the estimated minimum detectable activity concentrations, and only Farm A was slightly above. The mean radiocaesium activity concentration in sheep on all six monitored farms in the restricted area of Cumbria was <266 Bq/kg.

On five farms full-flock monitoring was undertaken in multiple batches, with each batch being defined by the grazing location and a new background radiation measurement. The results show that sheep grazed on in-bye pasture for up to 3 months (Farm A1) had demonstrably lower levels of radiocaesium than those that had recently grazed the fells (Farm A). This can be seen by comparing the percentage of sheep over 350 Bq/kg in each dataset. This shows that <0.5% of sheep grazed on in-bye pasture had a radiocaesium concentration over 350 Bq/kg compared to 53% of those grazed on the fells. All restricted farms in Cumbria are known to improve the quality of their sheep by grazing them on in-bye pasture. There have been no Mark and Release monitoring failures in Cumbria for a number of years.

It should be noted that on Farm A, the majority of monitoring results for sheep grazed on in-bye pasture (6 out of 8 batches) had systematic monitoring errors. These were manifested by each batch having a large percentage (>55%) of negative net count-rates. For a batch of sheep containing no radiocaesium you would expect about 50% of readings to be slightly positive and 50% slightly negative, due to the probabilistic nature of radioactivity. Where greater than 55% of sheep in a batch returned negative net count-rates, the monitoring failed the quality control requirements that were set for the survey. For this reason the results of these datasets have not been included in the dose assessment, (although they are very likely to represent sheep containing low levels of radiocaesium). The monitoring conditions on FARM A are known to be difficult due to high and locally variable background radiation, which is likely to have contributed to these systematic errors.

7.2. Consumer Doses (England and Wales)

The representative person has previously been defined as '*an adult frequent buyer who sources all their meat from the monitored farm and who consumes a high level (20kg) of sheep meat per year at the 97.5th percentile of the radiocaesium distribution in their sheep meat intake'.*

The doses that the representative person receives from consuming their annual supply of sheep meat from each monitored farm in Cumbria ranges from <0.07mSv to 0.14mSv per year with a mean of <0.09mSv per year. The individual doses to the representative person for each Cumbrian farm are given in Annex 3.

The doses that the representative person receives from consuming their annual supply of sheep meat from each monitored farm in North Wales ranges from <0.05mSv to 0.21mSv per year with a mean of <0.09mSv per year. The individual doses to the representative person for each Welsh farm are also given in Annex 3.

Figure 5 gives the distribution of doses to the representative person from consuming their annual supply of sheep meat from each monitored farm in Cumbria and North Wales. This demonstrates that the majority of doses are at the lower end of the range.

The doses to other consumers, including children and infants, in the three defined exposure groups have also been calculated to demonstrate how different characteristics and consumption patterns affect consumer dose. The results of these assessments are also included in Annex 3. The doses to children and infants are always less than the doses to adults. We can demonstrate this by considering the following scenario: '*a child of a frequent buyer who sources all their meat from the monitored farm and who consumes a high level (10kg) of sheep meat per year at the 97.5th percentile of the radiocaesium distribution in their sheep meat intake'.* The dose that this child consumer receives ranges from <0.02 mSv to 0.08m Sv per year. The dose an infant in the same group would receive from consuming 2 kg per year ranges from <0.01 to 0.02 mSv per year.

Figure 6 shows a comparison of the distribution of doses an adult high consumer from each of the three exposure groups would receive, were they to consume their annual supply of sheep meat from each monitored farm in Cumbria and North Wales. This demonstrates how doses increase as you go from the frequent buyer group to the farmer group.

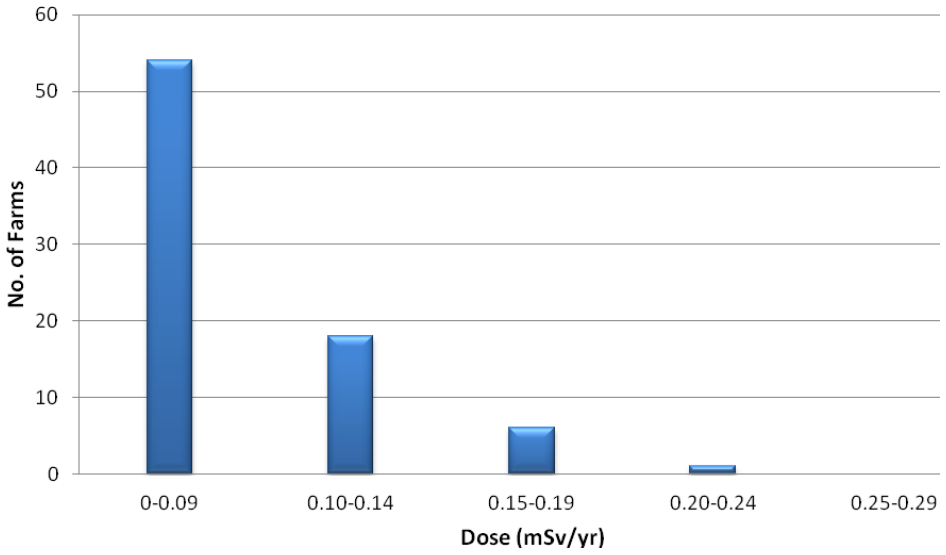


Figure 5 –Distribution of doses to the representative person from consuming sheep meat from each monitored farm in Cumbria and North Wales

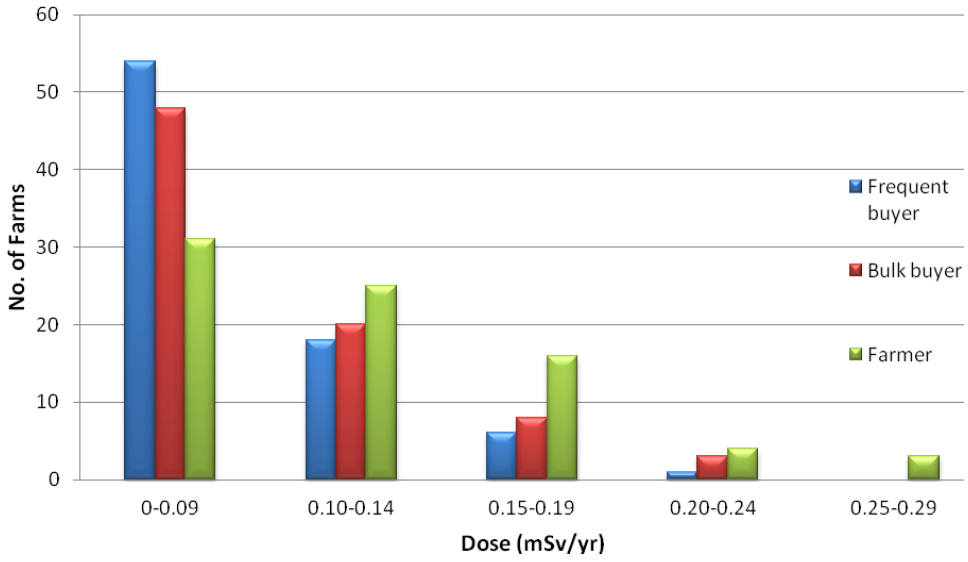


Figure 6 – Comparison of dose to an adult high consumer from each exposure group

The most extreme consumer assessed was defined as: '*an adult from the Farmer Group who sources all their meat from a single sheep from the monitored farm and who consumes a very high level (25kg) of sheep meat per year at the 97.5th percentile of the radiocaesium distribution in the sheep meat intake'.* The doses that this consumer receives from consuming their annual supply of sheep meat from each monitored farm in all restricted areas ranges from <0.06 to 0.35 mSv per year. However, it is unlikely that such a consumer would be able to source all their meat (25 kg) from a single animal. This scenario is therefore considered unrealistic.

7.3. Questions to Welsh Farmers on Grazing Habits

The 57 famers in North Wales that took part in the 2011 survey were asked the following questions:

- Do you fatten/finish your sheep before they go to market?
- If yes, for how long do you fatten/finish your sheep?
- On what type of pasture do you fatten/finish your sheep?

The questions were asked to get an indication of whether farming practice is likely to reduce the levels of radiocaesium in sheep meat entering the food chain. It is known that grazing on improved or partially improved pasture, which has been ploughed and often seeded, can significantly reduce the levels of radiocaesium uptake in sheep. The answers to the questions are given in Figure 7.

Sixty-seven percent of farmers indicated they fatten their sheep before they go to market. Of these 79% indicated that they graze their sheep for at least 1 month, and 87% that they grazed on improved or partially improved pasture.

Table 3 - Radiocaesium activity concentration in sheep on monitored farms in North Wales

FARM REF.	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	Do any sheep exceed 1,000 Bq/kg?
1	590	1026	*Yes*
2	301	560	No
3	<214	302	No
4	366	572	No
5	207	425	No
6	266	523	No
7	352	584	No
8	739	1050	*Yes*
9	<209	241	No
10	<198	290	No
11	<233	240	No
12	259	547	No
13	298	474	No
14	319	572	No
15	<243	376	No
16	<160	<160	No
17	528	829	No
18	<212	268	No
19	<200	577	No
20	<223	474	No
21	427	685	No
22	<185	197	No
23	<240	<240	No
24	<175	<175	No
25	<230	439	No
26	<217	403	No
27	506	896	No
28	238	417	No
29	<189	216	No
30	<251	476	No
31	300	439	No
32	<223	327	No
33	<240	<240	No
34	<194	327	No
35	377	687	No
36	<212	341	No
37	<283	511	No
38	290	685	No
39	<230	390	No
40	<223	547	No
41	<224	246	No

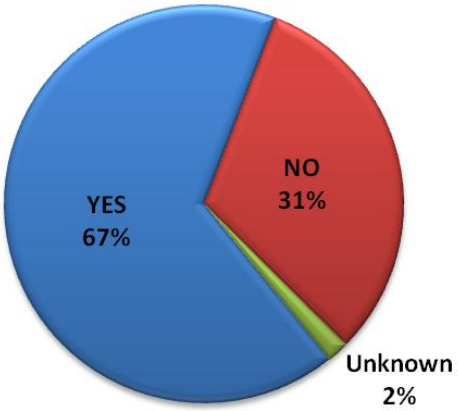
Table 3 (cont) - Radiocaesium activity concentration in sheep on monitored farms in North Wales

FARM REF.	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	Do any sheep exceed 1,000 Bq/kg?
42	400	697	No
43	309	552	No
44	<189	<189	No
45	<204	<204	No
46	241	461	No
47	<202	268	No
48	361	609	No
49	<181	243	No
50	533	744	No
51	369	621	No
52	<183	<183	No
53	<215	295	No
54	271	474	No
55	476	638	No
56	<185	246	No
57	243	339	No
58	295	427	No
59	507	783	No
60	<205	<205	No
61	516	707	No
62	<223	302	No
63	311	572	No
64	308	650	No
65	<280	393	No
66	435	685	No
67	305	758	No
68	<219	381	No
69	<185	<185	No
70	422	650	No
71	<190	381	No
72	346	498	No

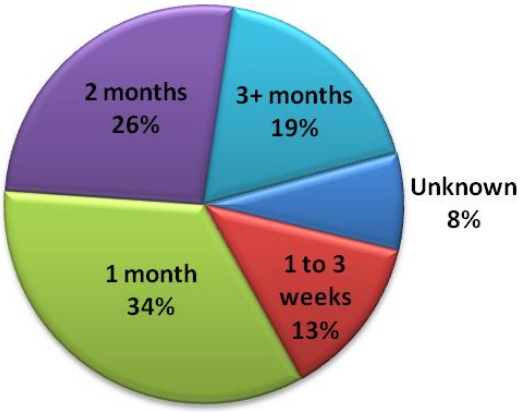
Table 4 - Radiocaesium activity concentration in sheep on monitored farms in Cumbria, England

FARM REF.	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	Do any sheep exceed 1,000 Bq/kg?
A (Fell grazing)	331	1433	*Yes*
A1 (In-bye grazing)	<314	354	No
B	<262	1060	*Yes*
C	<236	339	No
D	<234	498	No
E	<279	584	No
F	<285	486	No

Question1. Do you fatten/finish your sheep before they go to market?



Question 2. If yes, for how long do you fatten/finish your sheep?



Question 3. On what type of pasture do you fatten/finish your sheep?

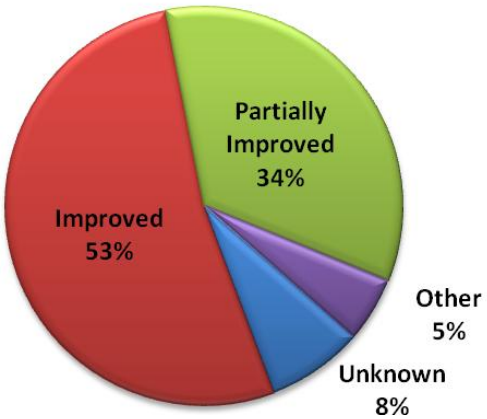


Figure 7- Farmers' Response to Questions About Fattening/Finishing Sheep

8. Discussion

8.1. General

Since 1986, restrictions have been considered for removal where a farm's entire flock is monitored to be at, or below the monitoring pass mark for two consecutive years. The passmark is set so that a sheep has no more than a 1 in 40 chance of exceeding 1000 Bq/kg radiocaesium. This approach to 'de-restriction' has been a cautious and successful way of ensuring that sheep exceeding the 1000 Bq/kg limit are unlikely to enter the food chain.

However, the assumption that farms with sheep exceeding the limit result in the highest consumer doses is not always correct. This is because consumers are most likely to consume their meat from a number of different sheep over the course of a year. This pushes their intake closer to the mean of the radiocaesium activity concentration distribution rather than the top end.

It is therefore possible for consumers to receive higher doses from consuming sheep meat from a farm where no sheep exceed the limit, but where the mean radiocaesium level is relatively high, compared with a farm with a low mean radiocaesium concentration, but where a few sheep exceed the limit. An assessment of dose therefore provides a better approach for determining consumer risks and for making decisions about whether control measures are necessary.

8.2. Consumer Doses

The results of the dose assessment show that doses to the representative person, who represents the more highly exposed individuals, range from <0.05 to 0.21 mSv per year with an average of <0.09mSv per year. This is significantly below the 1 mSv per year limit for members of the public exposed to radiation from routine *planned* exposures, and the 1mSv per year reference level typically used in *existing* exposure situations (ICRP, 2006 & 2007).

The doses to the representative person are also below 0.26mSv per year, which represents the dose that the representative person would receive if they consumed all their sheep meat at the 1,000Bq/kg radiocaesium limit. This demonstrates that the level of dose to consumers, were control measures to be removed, is less than the level of dose tolerated by the current control measures.

The dose assessment is conservative and in the majority of cases the doses that consumers actually receive is likely to be much lower than those calculated. This is because the surveys measured the radiocaesium activity concentration in sheep during the summer months when levels tend to be at their highest. The assessment assumes that the sheep meat is consumed on average at fortnightly intervals throughout the year and it is known that sheep are sent to slaughter throughout the year. As such the consumer intake of radiocaesium is unlikely to come entirely from sheep at their peak radiocaesium activity concentration.

In addition, the dose assessment assumes the meat is consumed without the sheep having been fattened (or 'finished') on improved, partially-improved or lowland pasture. This practice, which is sometimes referred to as 'clean-grazing', is known to reduce the levels of radiocaesium in sheep. An estimated 67% of restricted farmers in Wales (see Section 7.3 and Figure 4) and all restricted farmers in Cumbria (from personal knowledge) graze their sheep on such pasture. In 87% of such cases in Wales, it is estimated that at least one or two biological half-lives will pass before these sheep enter

the market. This equates to a reduction in both the radiocaesium activity concentration in sheep and the consumer doses of a half to a quarter of those modelled. The annual dose from the consumption of sheep meat from restricted farms, for the majority of high consumers, is therefore likely to be a few tens of microsieverts (μSv) at most. Consequently the consumer risks are very low.

Consideration was also given to the annual doses that other consumers, including children and infants and those with extreme habits could receive. Doses for children and infants are always less than those for adults and the maximum dose for the most extreme adult scenario modelled (an adult from the farmer group consuming 25 kg per year) was 0.35 mSv per year.

It is unlikely that the most extreme consumers would receive doses much in excess of this, because for extremely high consumption rates, it would be unlikely that an individual could source all their meat from a single animal. As such the radiocaesium intake would tend towards the mean of the radiocaesium distribution in the sheep and be more comparable to that of the bulk buyer scenario.

However, it is possible that an extreme consumer could consume more than 25 kg of sheep meat per year. Such a consumer could be represented by the following scenario: '*an adult from the Bulk Buyer Group who sources all their meat from the Welsh farm with the highest mean activity concentration in its sheep (Farm 8,) and who consumes an extremely high level (50 kg) of sheep meat per year at the 97.5th percentile of the radiocaesium distribution in their sheep meat intake'.* The annual dose that this consumer receives is 0.56 mSv. This is very unrealistic but still well below the recommended and often used 1 mSv level. In fact, this consumer would have to consume 89 kg per year (or 17.1 portions per week) to receive a dose of 1mSv.

Finally it is worth noting that the model does not account for temporal averaging of dose. Over a period of years, the mean consumption of radiocaesium will tend towards the mean of the activity concentration distribution in sheep. This means consumer doses averaged over a number of years will be lower than those modelled over a single year.

8.3. Radiocaesium in Sheep (a link to the existing policy)

The results of the survey show that the maximum observed levels of radiocaesium in sheep did not exceed 1,000 Bq/kg on over 97% of monitored Welsh farms. On the two Welsh farms that did have sheep over 1,000 Bq/kg (Farm 1 and Farm 8), only 2.5% of sheep on each farm exceeded this level. It is therefore likely that only a small percentage of sheep on a small percentage of restricted Welsh farms have the potential to exceed the 1,000 Bq/kg limit. The evidence suggests that any exceedances will most likely be small, as the highest measured concentration of radiocaesium was 1050 Bq/kg.

In Cumbria, the maximum observed levels of radiocaesium in sheep did not exceed 1,000Bq/kg on all but two farms. On Farm A less than 4% of fell-grazed sheep exceeded 1,000Bq/kg, and on Farm B it was less than 0.3%. Of the two restricted farms that have sheep that exceed 1,000Bq/kg of radiocaesium, the farmers are known to fatten them on improved or partially improved 'in-bye' pasture as part of their normal farming practice.

The Mark and Release programme is now largely redundant in preventing sheep exceeding 1,000Bq/kg of radiocaesium from entering the food chain and is having a negligible impact on reducing consumer dose. Furthermore, the results demonstrate that if the existing decision-making process for removing control measures were kept (see Section 1.2), the vast majority of farms would remain restricted for many more years than necessary, until the resources became available to undertake the required full-flock monitoring. This is despite the farms not having sheep that exceed 1,000Bq/kg of radiocaesium.

It should be noted that the current control measures may influence the length of time that some farmers graze their sheep on improved pasture, or even if they graze them at all. The degree to which changes in farming practices might increase the levels of radiocaesium in sheep were controls to be lifted, is difficult to determine. Any increase would be difficult to measure once monitoring uncertainties are taken into account. However, the effect on consumer dose would be negligible.

It is also worth mentioning that no sheep have failed the mark and release monitoring in Cumbria for a number of years and less than 0.4% of sheep failed the mark and release monitoring in Wales in 2010. Of the 14 farms that recorded failures in 2010, only one had sheep predicted to exceed 1,000 Bq/kg. This is because the pass/fail criterion for the Mark and Release programme is conservatively set at a 1 in 40 chance of exceeding the 1,000 Bq/kg limit. For this reason most sheep that fail the mark and release criteria (and most only just fail) are unlikely to exceed 1,000 Bq/kg.

In addition, the Mark and Release monitoring technique is prone to greater uncertainty as practical compromises are made to allow for large volumes of sheep to be monitored. Poorer control over the monitoring process could lead to false positive readings. This has been seen by the author.

9. Conclusions

1. The results of the sheep monitoring survey and the consumer dose assessment demonstrate that although low levels of radiocaesium persist in sheep throughout the restricted areas of Cumbria and North Wales, the consumer risks are very low.

2. The doses to the representative person (representing more highly exposed consumers) range from <0.05mSv to 0.21mSv per year with a mean of <0.09mSv per year. These doses are considerably below the 1mSv per year limit established underArticle 48 of Council Directive 96/29/Euratom for members of the public exposed to radiation from routine *planned* exposures and the 1mSv per year reference level typically used in *existing* exposure situations (ICRP, 2006 & 2007).

3. The maximum observed radiocaesium activity concentration in sheep does not exceed 1,000 Bq/kg on over 97% of monitored Welsh farms. On the small number of Welsh farms where sheep have the potential to exceed 1,000 Bq/kg of radiocaesium, only a very small percentage of sheep (no more than 2.5%) are ever likely to do so. Furthermore, the common practice of fattening sheep on improved or partially improved pasture, prior to slaughter, would reduce the radiocaesium activity concentration to well below 1,000 Bq/kg in the majority of instances.

4. Only two farms monitored in Cumbria had a very small percentage of sheep that exceeded 1,000 Bq/kg of radiocaesium. The standard practice of fattening sheep on improved pasture (in-bye grazing) is likely to ensure that very few sheep, if any, exceeding 1,000 Bq/kg of radiocaesium will enter the food chain in Cumbria. No sheep in Cumbria has failed the Mark and Release monitoring criterion for a number of years.

5. The existing criterion of 1,000 Bq/kg, which is enforced by the Mark and Release programme, is equivalent to permitting a dose of 0.26 mSv per year to the Representative Person. The highest modelled dose to the Representative Person is lower than this at 0.21 mSv per year. Monitoring against the 1,000 Bq/kg limit is therefore having a negligible impact on reducing consumer doses.

6. The level of consumer risk, if control measures were to be removed, is significantly less than the level of risk tolerated by the existing policy. The Mark and Release monitoring programme is therefore having a negligible impact on reducing consumer risks.

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Annex 1 - Explanation of the sample size calculation

A1.1 Explanation of sample size calculation

Suppose n farms are randomly sampled from all N farms in Wales. Let the exposure level at the i-th farm be for i = 1 to n. Let the maximum value of X_i in the sample be noted as X_{max}.

Let t be a mean radiocaesium activity concentration that only k farms in Wales exceed. For Xmax to be less than t, all the other farms in the sample must have a mean concentration lower than t as well. The first farm sampled must be one of the N-k farms with a mean concentration less than t. The second farm must be one of the remaining N-k-1 farms, and so on for all n farms in the sample. Therefore,

$$P(X_{max} < t) = P(all\ X_i < t) = \frac{N-k}{N} \times \frac{N-k-1}{N-1} \times \cdots \times \frac{N-k-n+1}{N-n+1}$$
$$= \frac{(N-k)!}{(N-k-n)!} \times \frac{(N-n)!}{N!}$$

We are interested in the number of farms that have a higher mean concentration than X_{max}. By definition, the above probability is the chance that there is at least k such farms. The one-sided 95% confidence interval for the number of farms with a higher mean concentration than X_{max} can then be found by solving the following equation for k:

$$\frac{(N-k)!}{(N-k-n)!} \times \frac{(N-n)!}{N!} \leq 0.05$$

A1.2 Justification for number of Farms Sampled (Monitored)

The main interest of the survey is in the most contaminated sheep, and the most contaminated farms. Therefore, a good estimate of the high tail of the distribution is required. Consequently, the sample size was chosen to ensure that only a small proportion of farms would be more contaminated than the highest in the sample.

The mean radiocaesium activity concentration in sheep is estimated for each sampled farm. Even if the activity concentration is low on each of the sampled farms, it still might be of concern in some of the remaining farms. Therefore, it is of interest to estimate the number of farms where the activity concentration is higher than the maximum for the sampled farms.

There are 283 active farms in North Wales that are restricted or under direction. The 2011 survey measured the mean radiocaesium contamination in sheep from 54 of them. We would expect about four farms to have higher mean radiocaesium activity concentrations in sheep than the maximum observed in the sample. The one-sided 95% confidence interval ranges from 0 to 14 farms. Therefore, it is likely that no more than 5% (=14/283) of farms will have higher mean radiocaesium activity concentrations in their sheep than the maximum observed in the sample.

Combining the 2010 and 2011 surveys of Wales provides results for 72 farms. We would expect about three farms to have higher associated exposure levels than the maximum observed in the combined sample. The one-sided 95% confidence interval ranges from 0 to 11 farms. Therefore, it is likely that no more than 4% (=11/283) of farms will have higher mean radiocaesium activity concentrations in their sheep than the maximum observed in the sample.

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Annex 2 - Maps
(Farm Grazing Locations, Mean and Max Radiocaesium Concentrations)

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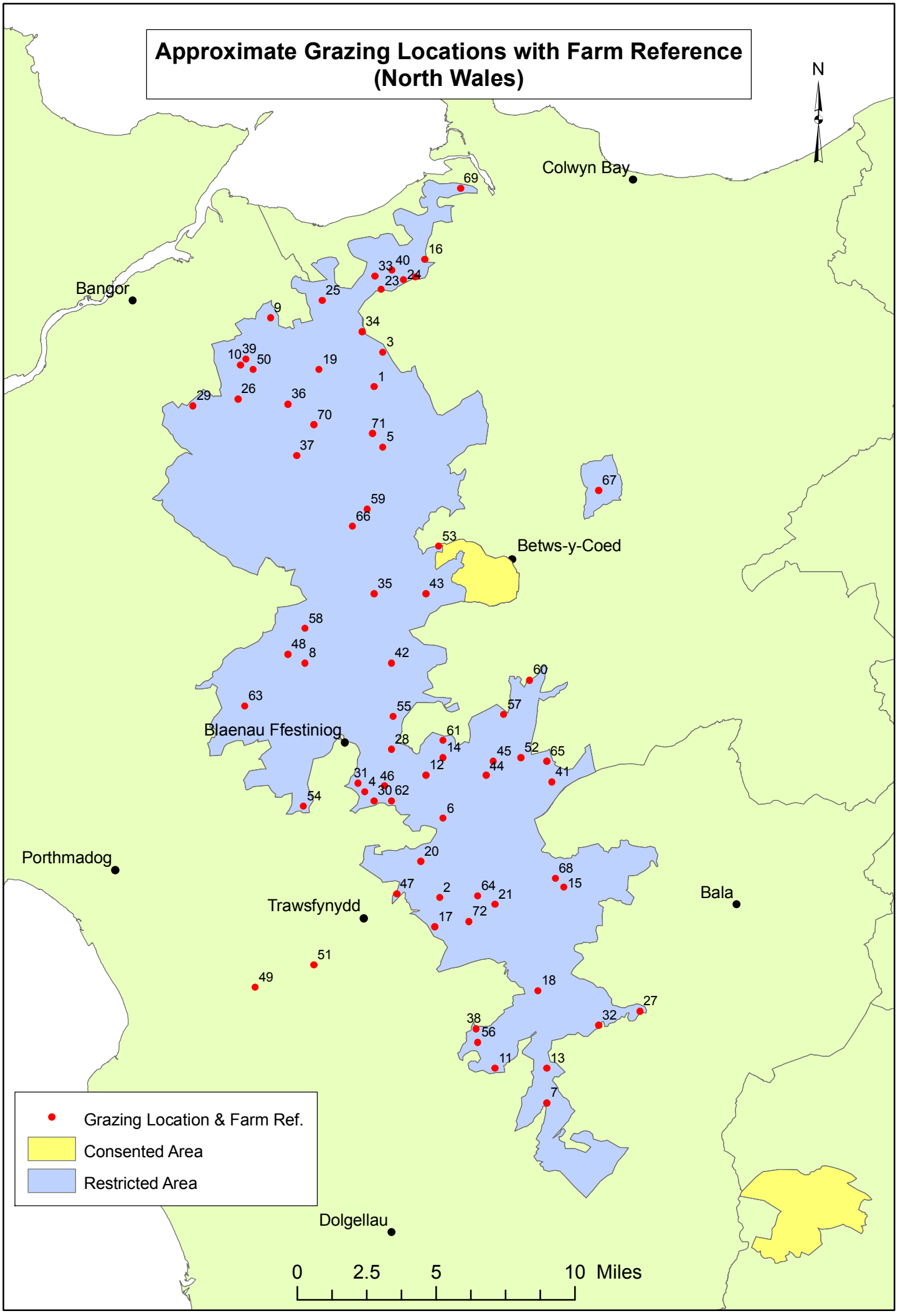
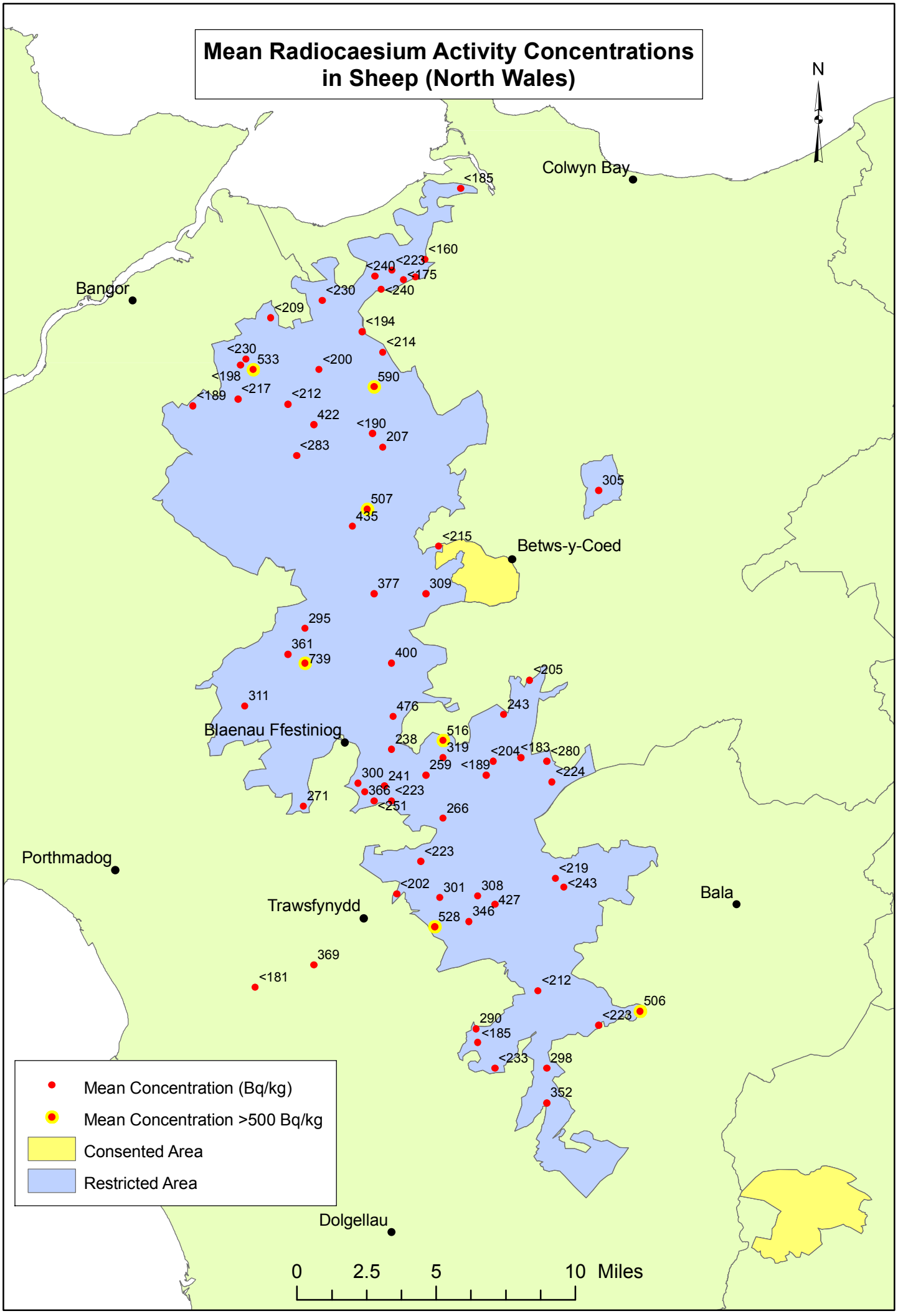
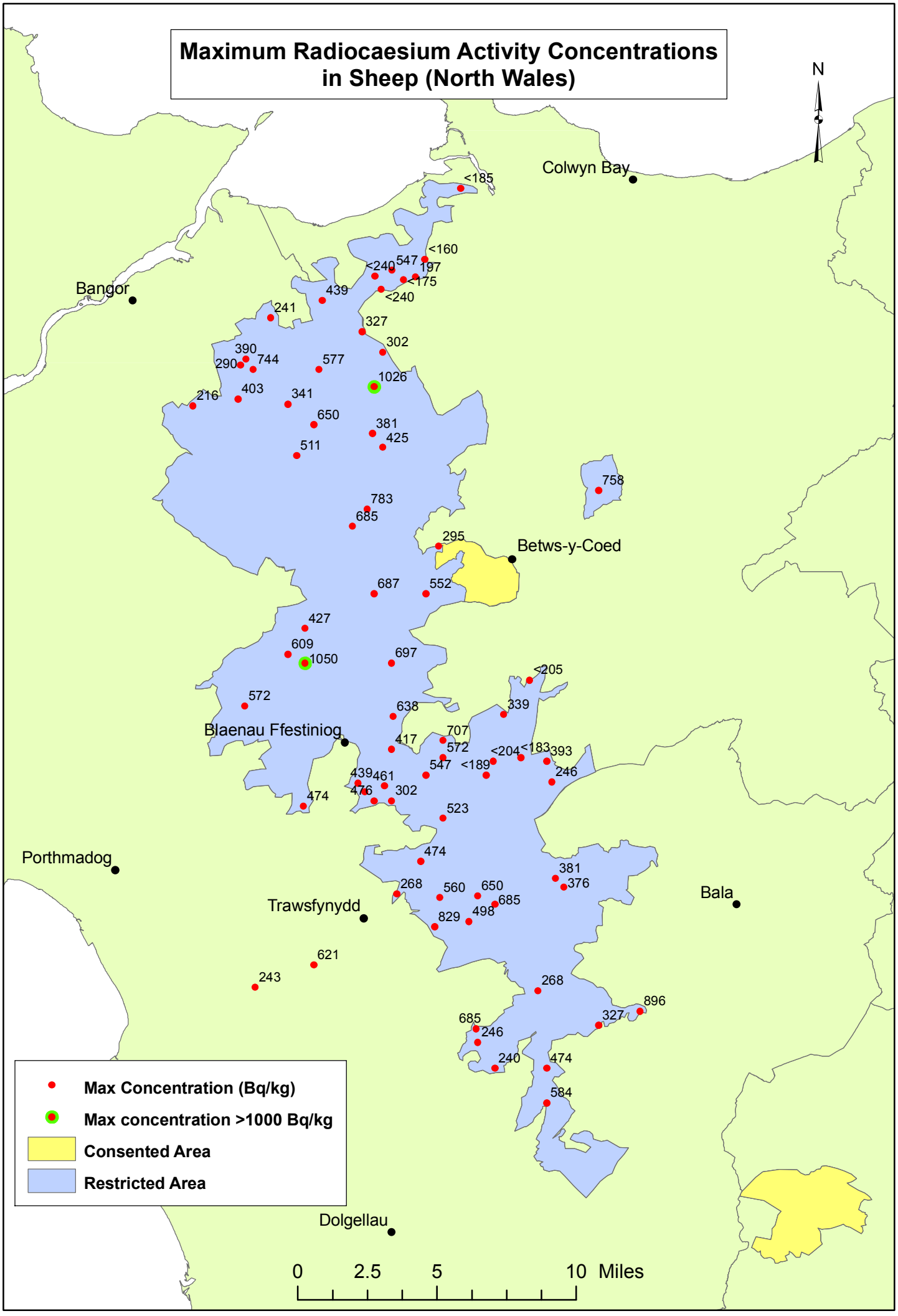
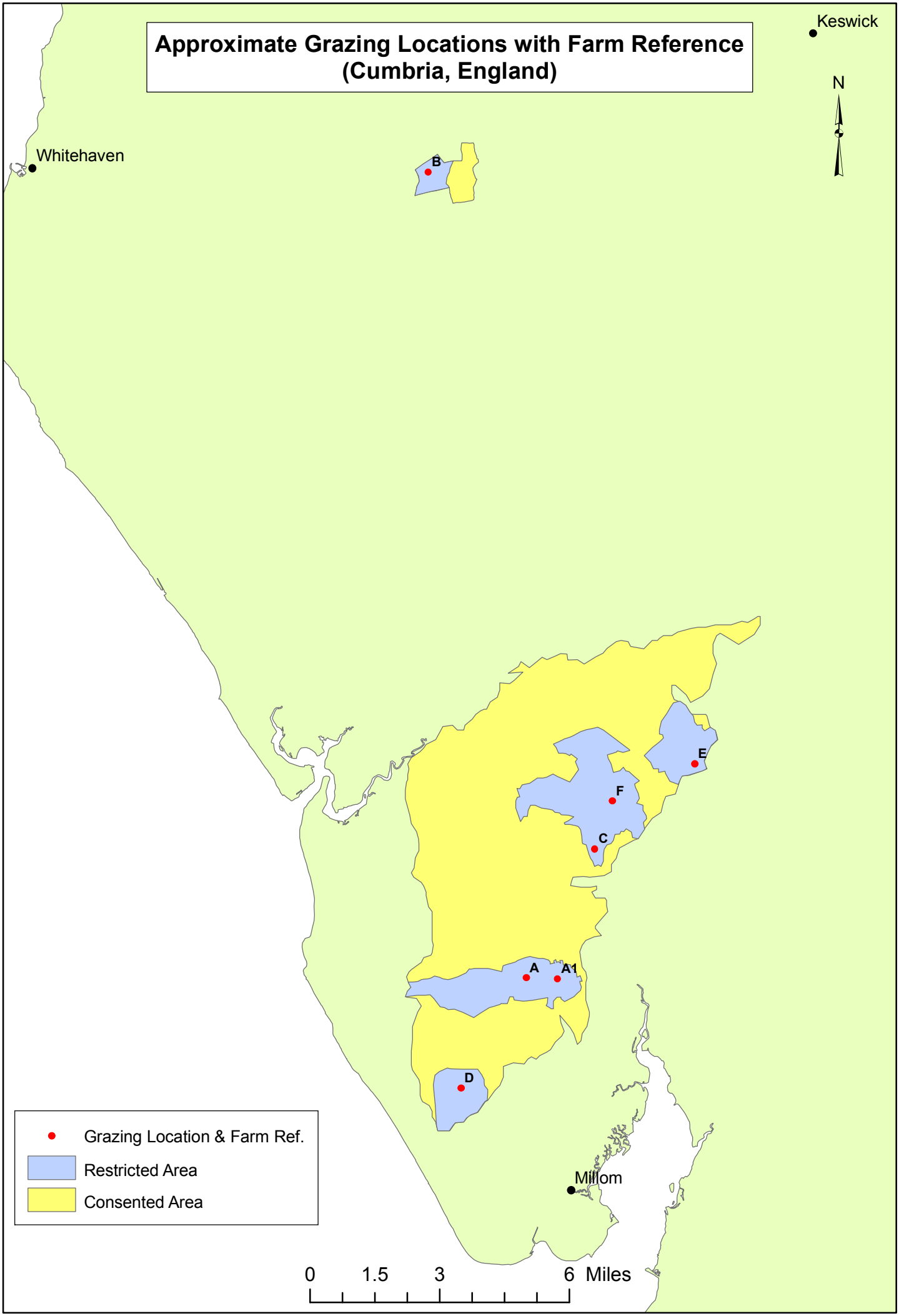
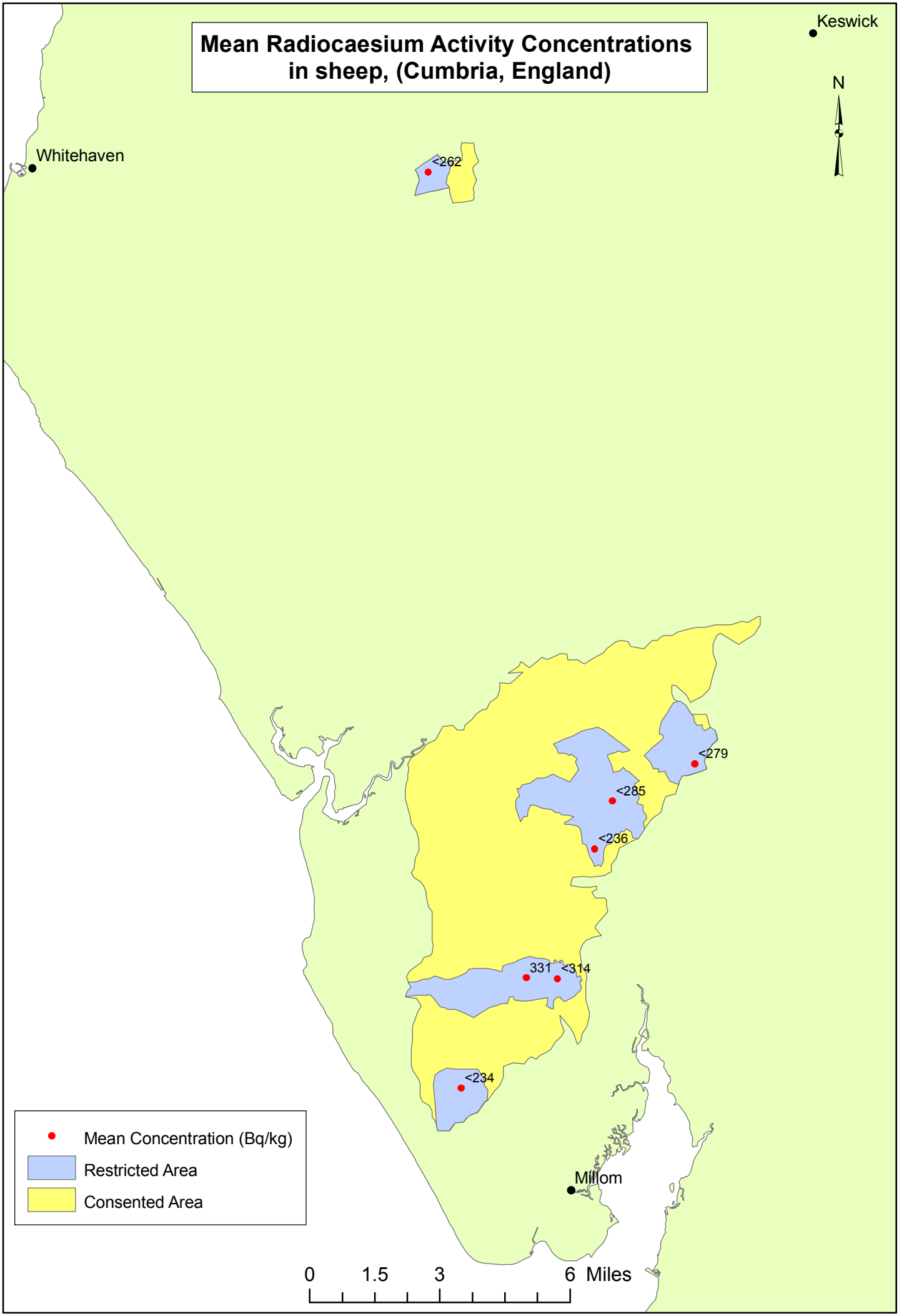
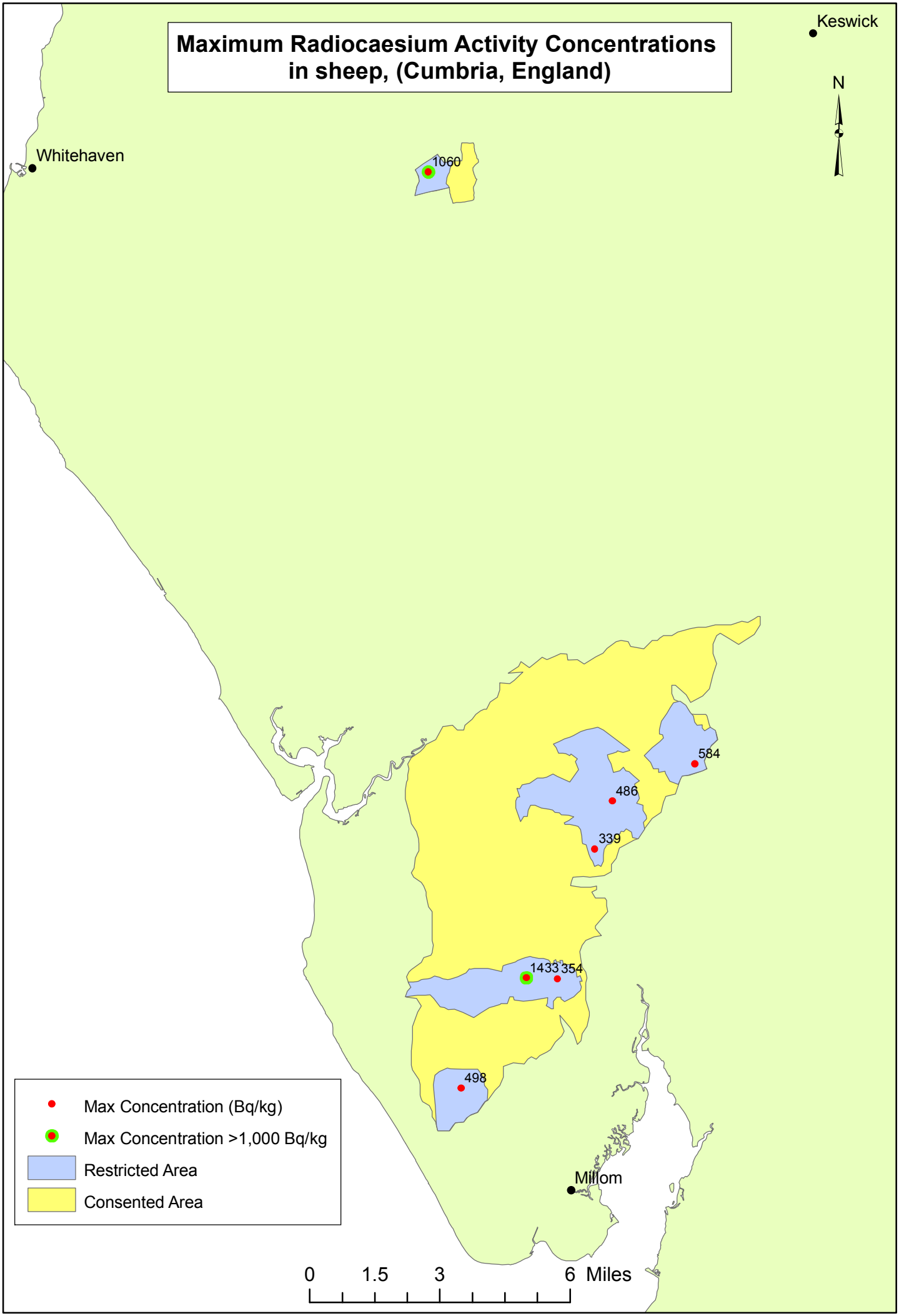

Approximate Grazing Locations with Farm Reference
(North Wales)
N
Colwyn Bay
Bangor
Betws-y-Coed
Blaenau Ffestiniog
Porthmadog
Trawsfynydd
Bala
Dolgellau
69
16
33
40
24
23
25
9
34
3
10
39
50
19
1
29
26
36
70
71
5
37
67
59
66
53
35
43
58
48
8
42
60
63
55
57
61
28
14
45
52
65
12
44
41
31
4
46
30
62
54
6
20
68
47
2
64
15
21
17
72
51
49
18
27
38
32
56
11
13
7
Grazing Location & Farm Ref.
Consented Area
Restricted Area
0
2.5
5
10 Miles


Mean Radiocaesium Activity Concentrations in Sheep (North Wales)
N
Colwyn Bay
Bangor
Betws-y-Coed
Blaenau Ffestiniog
Porthmadog
Trawsfynydd
Bala
Dolgellau
<185
<160
<240
<223
<175
<230
<240
<209
<194
<214
<230
533
<200
<198
590
<217
<189
<212
422
<190
207
<283
305
507
435
<215
377
309
295
361
739
400
<205
311
476
243
516
238
319
<204
<183
<280
259
<189
<224
300
241
366
<223
271
<251
266
<223
<219
<202
301
308
<243
427
346
528
369
<181
<212
506
290
<223
<185
<233
298
352
Mean Concentration (Bq/kg)
Mean Concentration >500 Bq/kg
Consented Area
Restricted Area
0
2.5
5
10 Miles


Maximum Radiocaesium Activity Concentrations in Sheep (North Wales)
N
Colwyn Bay
Bangor
Betws-y-Coed
Blaenau Ffestiniog
Porthmadog
Trawsfynydd
Bala
Dolgellau
<185
<160
<240
547
197
<175
<240
439
241
327
302
390
290
744
577
1026
216
403
341
650
381
425
511
758
783
685
295
687
552
427
609
1050
697
<205
572
638
339
707
417
572
<204
<183
393
547
<189
246
439
461
476
302
474
523
474
381
376
268
560
650
685
498
829
621
243
268
896
685
327
246
240
474
584
Max Concentration (Bq/kg)
Max concentration >1000 Bq/kg
Consented Area
Restricted Area
0
2.5
5
10 Miles


Approximate Grazing Locations with Farm Reference
(Cumbria, England)
Keswick
N
Whitehaven
B
E
F
C
A
A1
D
Millom
Grazing Location & Farm Ref.
Restricted Area
Consented Area
0
1.5
3
6 Miles


Mean Radiocaesium Activity Concentrations in sheep, (Cumbria, England)
Keswick
N
Whitehaven
<262
<279
<285
<236
331
<314
<234
Millom
Mean Concentration (Bq/kg)
Restricted Area
Consented Area
0
1.5
3
6 Miles


Maximum Radiocaesium Activity Concentrations in sheep, (Cumbria, England)
Keswick
N
Whitehaven
1060
584
486
339
1433
354
498
Millom
Max Concentration (Bq/kg)
Max Concentration >1,000 Bq/kg
Restricted Area
Consented Area
0
1.5
3
6 Miles

Annex 3 - Assessment Results

(Radiocaesium Activity Concentration in Sheep and Consumer Doses for individual Farms in Cumbria and North Wales)

Note: The highlighted dose for each farm relates to the Representative Person.

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
1	590	1026	40	Adult	Farmer	8	0.10
						20	0.24
						25	0.30
					Bulk Buyer	8	0.08
						20	0.20
						25	0.24
					Frequent Buyer	8	0.07
						20	0.17
						25	0.22
				Child	Farmer	4	0.04
						10	0.10
						10	0.10
					Bulk Buyer	4	0.03
						10	0.08
						10	0.08
					Frequent Buyer	4	0.03
						10	0.07
						10	0.07
				Infant	Farmer	0.8	<0.01
						2	0.03
						3	0.04
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.03

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
2	302	560	40	Adult	Farmer	8	0.06
						20	0.14
						25	0.17
					Bulk Buyer	8	0.05
						20	0.11
						25	0.13
					Frequent Buyer	8	0.04
						20	0.09
						25	0.12
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
3	<214	303	40	Adult	Farmer	8	<0.03
						20	0.08
						25	0.09
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	0.02
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
4	367	572	40	Adult	Farmer	8	0.07
						20	0.16
						25	0.20
					Bulk Buyer	8	0.06
						20	0.13
						25	0.16
					Frequent Buyer	8	0.05
						20	0.11
						25	0.14
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	<0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	<0.02
						10	0.05
						10	0.05
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
5	208	425	40	Adult	Farmer	8	0.04
						20	0.10
						25	0.12
					Bulk Buyer	8	<0.03
						20	0.08
						25	0.10
					Frequent Buyer	8	<0.03
						20	0.07
						25	0.08
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	0.02
						10	0.03
						10	0.03
					Frequent Buyer	4	<0.01
						10	0.03
						10	0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
6	266	523	40	Adult	Farmer	8	0.05
						20	0.12
						25	0.15
					Bulk Buyer	8	0.04
						20	0.10
						25	0.12
					Frequent Buyer	8	0.04
						20	0.08
						25	0.10
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
7	353	584	40	Adult	Farmer	8	0.07
						20	0.16
						25	0.19
					Bulk Buyer	8	0.05
						20	0.12
						25	0.15
					Frequent Buyer	8	0.05
						20	0.11
						25	0.13
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	<0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	<0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
8	740	1050	40	Adult	Farmer	8	0.11
						20	0.26
						25	0.33
					Bulk Buyer	8	0.09
						20	0.23
						25	0.28
					Frequent Buyer	8	0.09
						20	0.21
						25	0.26
				Child	Farmer	4	0.04
						10	0.1
						10	0.1
					Bulk Buyer	4	0.04
						10	0.09
						10	0.09
					Frequent Buyer	4	0.04
						10	0.08
						10	0.08
				Infant	Farmer	0.8	<0.01
						2	0.03
						3	0.04
					Bulk Buyer	0.8	<0.01
						2	0.03
						3	0.04
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.03

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
9	<209	241	40	Adult	Farmer	8	<0.03
						20	0.07
						25	0.08
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
10	<198	290	200	Adult	Farmer	8	<0.03
						20	0.07
						25	0.09
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	0.02
						10	0.03
						10	0.03
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
11	<233	241	40	Adult	Farmer	8	<0.03
						20	<0.07
						25	<0.08
					Bulk Buyer	8	<0.03
						20	<0.07
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.07
						25	<0.08
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
12	260	548	40	Adult	Farmer	8	0.05
						20	0.11
						25	0.14
					Bulk Buyer	8	0.04
						20	0.09
						25	0.12
					Frequent Buyer	8	0.04
						20	0.08
						25	0.10
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	<0.03
						10	0.03
				Infant	Farmer	0.8	0.01
						2	0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
13	298	474	40	Adult	Farmer	8	0.05
						20	0.13
						25	0.16
					Bulk Buyer	8	0.05
						20	0.11
						25	0.13
					Frequent Buyer	8	0.04
						20	0.09
						25	0.11
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
14	319	573	40	Adult	Farmer	8	0.06
						20	0.14
						25	0.18
					Bulk Buyer	8	0.05
						20	0.11
						25	0.14
					Frequent Buyer	8	0.04
						20	0.10
						25	0.12
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
15	<243	376	40	Adult	Farmer	8	0.04
						20	0.09
						25	0.11
					Bulk Buyer	8	<0.03
						20	<0.07
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.07
						25	<0.08
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
16	<160	<160	40	Adult	Farmer	8	<0.02
						20	<0.05
						25	<0.06
					Bulk Buyer	8	<0.02
						20	<0.05
						25	<0.06
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.06
				Child	Farmer	4	<0.01
						10	<0.02
						10	<0.02
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
17	529	830	40	Adult	Farmer	8	0.09
						20	0.22
						25	0.27
					Bulk Buyer	8	0.07
						20	0.18
						25	0.22
					Frequent Buyer	8	0.07
						20	0.16
						25	0.19
				Child	Farmer	4	0.04
						10	0.09
						10	0.09
					Bulk Buyer	4	0.03
						10	0.07
						10	0.07
					Frequent Buyer	4	0.03
						10	0.06
						10	0.06
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.03

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
18	<212	268	40	Adult	Farmer	8	<0.03
						20	0.07
						25	0.08
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
19	<200	577	40	Adult	Farmer	8	0.05
						20	0.11
						25	0.14
					Bulk Buyer	8	<0.03
						20	0.07
						25	0.09
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.03
						10	0.03
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	0.01
						2	0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
20	<223	474	40	Adult	Farmer	8	0.04
						20	0.10
						25	0.12
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.08
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	0.01
						2	0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
21	428	685	40	Adult	Farmer	8	0.07
						20	0.16
						25	0.20
					Bulk Buyer	8	0.06
						20	0.14
						25	0.17
					Frequent Buyer	8	0.05
						20	0.13
						25	0.16
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	0.03
						10	0.06
						10	0.06
					Frequent Buyer	4	0.02
						10	0.05
						10	0.05
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
22	<185	197	40	Adult	Farmer	8	0.03
						20	0.06
						25	<0.07
					Bulk Buyer	8	<0.02
						20	<0.05
						25	<0.07
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.07
				Child	Farmer	4	<0.01
						10	0.03
						10	0.03
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
23	<240	<240	30	Adult	Farmer	8	<0.03
						20	<0.07
						25	<0.08
					Bulk Buyer	8	<0.03
						20	<0.07
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.07
						25	<0.08
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
24	<175	<175	40	Adult	Farmer	8	<0.02
						20	<0.05
						25	<0.06
					Bulk Buyer	8	<0.02
						20	<0.05
						25	<0.06
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.06
				Child	Farmer	4	<0.01
						10	<0.02
						10	<0.02
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
25	<230	440	40	Adult	Farmer	8	0.04
						20	0.08
						25	0.10
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.08
				Child	Farmer	4	0.02
						10	0.03
						10	0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	0.01
						2	0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
26	<217	403	40	Adult	Farmer	8	<0.03
						20	<0.06
						25	<0.08
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.08
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
27	506	896	40	Adult	Farmer	8	0.09
						20	0.21
						25	0.26
					Bulk Buyer	8	0.07
						20	0.17
						25	0.21
					Frequent Buyer	8	0.06
						20	0.15
						25	0.19
				Child	Farmer	4	0.04
						10	0.08
						10	0.08
					Bulk Buyer	4	0.03
						10	0.07
						10	0.07
					Frequent Buyer	4	0.03
						10	0.06
						10	0.06
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.03

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
28	238	418	40	Adult	Farmer	8	0.05
						20	0.11
						25	0.14
					Bulk Buyer	8	0.04
						20	0.09
						25	0.11
					Frequent Buyer	8	<0.03
						20	0.08
						25	0.09
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	<0.03
						10	0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
29	<189	217	25	Adult	Farmer	8	0.03
						20	0.06
						25	0.08
					Bulk Buyer	8	0.03
						20	0.06
						25	<0.07
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.07
				Child	Farmer	4	0.01
						10	0.03
						10	0.03
					Bulk Buyer	4	<0.01
						10	0.03
						10	0.03
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	0.01
						2	0.01
						3	0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
30	<251	477	40	Adult	Farmer	8	0.05
						20	0.11
						25	0.14
					Bulk Buyer	8	0.04
						20	0.08
						25	0.10
					Frequent Buyer	8	<0.03
						20	<0.07
						25	<0.09
				Child	Farmer	4	<0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	<0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	<0.02
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
31	301	440	40	Adult	Farmer	8	0.05
						20	0.12
						25	0.14
					Bulk Buyer	8	0.04
						20	0.10
						25	0.12
					Frequent Buyer	8	0.04
						20	0.09
						25	0.11
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
32	<223	327	40	Adult	Farmer	8	0.04
						20	0.09
						25	0.11
					Bulk Buyer	8	<0.03
						20	0.07
						25	0.09
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.08
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	0.02
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
33	<240	<240	40	Adult	Farmer	8	<0.03
						20	<0.07
						25	<0.08
					Bulk Buyer	8	<0.03
						20	<0.07
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.07
						25	<0.08
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
34	<194	327	40	Adult	Farmer	8	<0.03
						20	0.08
						25	0.10
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	0.02
						10	0.03
						10	0.03
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
35	378	688	40	Adult	Farmer	8	0.08
						20	0.18
						25	0.22
					Bulk Buyer	8	0.06
						20	0.14
						25	0.17
					Frequent Buyer	8	0.05
						20	0.12
						25	0.15
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	0.03
						10	0.06
						10	0.06
					Frequent Buyer	4	0.02
						10	0.05
						10	0.05
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
36	<212	342	40	Adult	Farmer	8	0.04
						20	0.10
						25	0.12
					Bulk Buyer	8	<0.03
						20	0.07
						25	0.09
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	0.02
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
37	<283	511	50	Adult	Farmer	8	0.05
						20	0.12
						25	0.15
					Bulk Buyer	8	0.04
						20	0.09
						25	0.11
					Frequent Buyer	8	<0.03
						20	<0.08
						25	<0.1
				Child	Farmer	4	<0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	<0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	<0.02
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	<0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
38	291	685	40	Adult	Farmer	8	0.07
						20	0.16
						25	0.20
					Bulk Buyer	8	0.05
						20	0.12
						25	0.15
					Frequent Buyer	8	0.04
						20	0.10
						25	0.12
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
39	<230	391	40	Adult	Farmer	8	0.04
						20	0.10
						25	0.13
					Bulk Buyer	8	0.04
						20	0.08
						25	0.10
					Frequent Buyer	8	<0.03
						20	0.07
						25	<0.08
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	0.02
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
40	<223	548	40	Adult	Farmer	8	0.05
						20	0.12
						25	0.15
					Bulk Buyer	8	0.04
						20	0.09
						25	0.11
					Frequent Buyer	8	<0.03
						20	0.07
						25	0.08
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	<0.01
						10	<0.03
						10	0.03
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
41	<224	246	40	Adult	Farmer	8	<0.03
						20	0.07
						25	0.09
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.08
				Child	Farmer	4	0.02
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
42	401	697	50	Adult	Farmer	8	0.08
						20	0.20
						25	0.24
					Bulk Buyer	8	0.06
						20	0.15
						25	0.19
					Frequent Buyer	8	0.05
						20	0.13
						25	0.16
				Child	Farmer	4	0.03
						10	0.08
						10	0.08
					Bulk Buyer	4	0.03
						10	0.06
						10	0.06
					Frequent Buyer	4	0.02
						10	0.05
						10	0.05
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
43	310	553	40	Adult	Farmer	8	0.07
						20	0.16
						25	0.19
					Bulk Buyer	8	0.05
						20	0.12
						25	0.15
					Frequent Buyer	8	0.04
						20	0.10
						25	0.12
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	<0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	<0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
44	<189	<189	40	Adult	Farmer	8	<0.02
						20	<0.05
						25	<0.07
					Bulk Buyer	8	<0.02
						20	<0.05
						25	<0.07
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.07
				Child	Farmer	4	<0.01
						10	<0.02
						10	<0.02
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
45	<204	<204	40	Adult	Farmer	8	<0.03
						20	<0.06
						25	<0.07
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
46	241	462	40	Adult	Farmer	8	0.05
						20	0.12
						25	0.14
					Bulk Buyer	8	0.04
						20	0.09
						25	0.11
					Frequent Buyer	8	0.03
						20	0.08
						25	0.09
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	0.03
						10	0.03
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
47	<202	268	40	Adult	Farmer	8	<0.03
						20	<0.06
						25	0.08
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
48	361	609	40	Adult	Farmer	8	0.06
						20	0.14
						25	0.18
					Bulk Buyer	8	0.05
						20	0.12
						25	0.15
					Frequent Buyer	8	0.05
						20	0.11
						25	0.13
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
49	<181	244	40	Adult	Farmer	8	0.03
						20	0.06
						25	0.08
					Bulk Buyer	8	0.03
						20	0.06
						25	0.07
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.06
				Child	Farmer	4	0.01
						10	0.03
						10	0.03
					Bulk Buyer	4	<0.01
						10	0.03
						10	0.03
					Frequent Buyer	4	<0.01
						10	<0.02
						10	0.02
				Infant	Farmer	0.8	0.01
						2	0.01
						3	0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
50	534	744	40	Adult	Farmer	8	0.08
						20	0.18
						25	0.23
					Bulk Buyer	8	0.07
						20	0.16
						25	0.20
					Frequent Buyer	8	0.06
						20	0.15
						25	0.19
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	0.03
						10	0.07
						10	0.07
					Frequent Buyer	4	0.03
						10	0.06
						10	0.06
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.03

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
51	369	621	80	Adult	Farmer	8	0.06
						20	0.15
						25	0.19
					Bulk Buyer	8	0.05
						20	0.12
						25	0.15
					Frequent Buyer	8	0.05
						20	0.11
						25	0.14
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	0.02
						10	0.05
						10	0.05
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
52	<183	<183	40	Adult	Farmer	8	<0.02
						20	<0.05
						25	<0.06
					Bulk Buyer	8	<0.02
						20	<0.05
						25	<0.06
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.06
				Child	Farmer	4	<0.01
						10	<0.02
						10	<0.02
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
53	<215	295	40	Adult	Farmer	8	<0.03
						20	0.07
						25	0.09
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	0.02
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
54	272	474	40	Adult	Farmer	8	0.05
						20	0.11
						25	0.14
					Bulk Buyer	8	0.04
						20	0.09
						25	0.12
					Frequent Buyer	8	0.04
						20	0.08
						25	0.10
				Child	Farmer	4	0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
55	477	639	40	Adult	Farmer	8	0.07
						20	0.17
						25	0.21
					Bulk Buyer	8	0.07
						20	0.17
						25	0.21
					Frequent Buyer	8	0.06
						20	0.14
						25	0.18
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	0.03
						10	0.07
						10	0.07
					Frequent Buyer	4	0.03
						10	0.06
						10	0.06
				Infant	Farmer	0.8	0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
56	<185	246	40	Adult	Farmer	8	0.03
						20	0.06
						25	<0.07
					Bulk Buyer	8	<0.02
						20	<0.05
						25	<0.07
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.07
				Child	Farmer	4	<0.01
						10	<0.02
						10	<0.02
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
57	243	339	40	Adult	Farmer	8	0.04
						20	0.10
						25	0.12
					Bulk Buyer	8	0.04
						20	0.08
						25	0.10
					Frequent Buyer	8	<0.03
						20	0.07
						25	0.09
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	0.02
						10	0.03
						10	0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
58	295	428	40	Adult	Farmer	8	0.05
						20	0.12
						25	0.15
					Bulk Buyer	8	0.04
						20	0.10
						25	0.13
					Frequent Buyer	8	0.04
						20	0.09
						25	0.11
				Child	Farmer	4	<0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	<0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	<0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
59	508	783	40	Adult	Farmer	8	0.09
						20	0.21
						25	0.26
					Bulk Buyer	8	0.07
						20	0.17
						25	0.21
					Frequent Buyer	8	0.06
						20	0.15
						25	0.19
				Child	Farmer	4	0.04
						10	0.08
						10	0.08
					Bulk Buyer	4	0.03
						10	0.07
						10	0.07
					Frequent Buyer	4	0.03
						10	0.06
						10	0.06
				Infant	Farmer	0.8	0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.03

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
60	<205	<205	40	Adult	Farmer	8	<0.03
						20	<0.06
						25	<0.07
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.07
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.07
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
61	517	707	40	Adult	Farmer	8	0.08
						20	0.19
						25	0.24
					Bulk Buyer	8	0.07
						20	0.17
						25	0.21
					Frequent Buyer	8	0.06
						20	0.15
						25	0.19
				Child	Farmer	4	0.03
						10	0.08
						10	0.08
					Bulk Buyer	4	0.03
						10	0.07
						10	0.07
					Frequent Buyer	4	0.03
						10	0.06
						10	0.06
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.03

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
62	<223	303	40	Adult	Farmer	8	<0.03
						20	<0.06
						25	<0.08
					Bulk Buyer	8	<0.03
						20	<0.06
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.08
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
63	311	572	40	Adult	Farmer	8	0.06
						20	0.15
						25	0.18
					Bulk Buyer	8	0.05
						20	0.12
						25	0.14
					Frequent Buyer	8	0.04
						20	0.10
						25	0.12
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	<0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	<0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	<0.02
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	<0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
64	309	651	40	Adult	Farmer	8	0.07
						20	0.17
						25	0.21
					Bulk Buyer	8	0.06
						20	0.14
						25	0.17
					Frequent Buyer	8	0.05
						20	0.12
						25	0.14
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	0.03
						10	0.06
						10	0.06
					Frequent Buyer	4	0.02
						10	0.05
						10	0.05
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
65	<280	393	40	Adult	Farmer	8	0.05
						20	0.11
						25	0.13
					Bulk Buyer	8	0.04
						20	0.08
						25	0.10
					Frequent Buyer	8	<0.03
						20	<0.08
						25	<0.1
				Child	Farmer	4	<0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	<0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	<0.02
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
66	435	685	56	Adult	Farmer	8	0.07
						20	0.18
						25	0.22
					Bulk Buyer	8	0.06
						20	0.15
						25	0.18
					Frequent Buyer	8	0.05
						20	0.13
						25	0.16
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	0.03
						10	0.06
						10	0.06
					Frequent Buyer	4	0.02
						10	0.05
						10	0.05
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
67	305	759	40	Adult	Farmer	8	0.08
						20	0.19
						25	0.24
					Bulk Buyer	8	0.05
						20	0.13
						25	0.16
					Frequent Buyer	8	0.04
						20	0.10
						25	0.12
				Child	Farmer	4	0.03
						10	0.08
						10	0.08
					Bulk Buyer	4	<0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	<0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
68	<219	381	40	Adult	Farmer	8	0.04
						20	0.09
						25	0.12
					Bulk Buyer	8	<0.03
						20	0.07
						25	0.09
					Frequent Buyer	8	<0.03
						20	<0.06
						25	<0.08
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	0.02
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
69	<185	<185	40	Adult	Farmer	8	<0.02
						20	<0.05
						25	<0.07
					Bulk Buyer	8	<0.02
						20	<0.05
						25	<0.07
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.07
				Child	Farmer	4	<0.01
						10	<0.02
						10	<0.02
					Bulk Buyer	4	<0.01
						10	<0.02
						10	<0.02
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose (mSvy^{-1}) at 97.5th percentile of exposure distribution
70	422	651	40	Adult	Farmer	8	0.07
						20	0.17
						25	0.21
					Bulk Buyer	8	0.06
						20	0.14
						25	0.18
					Frequent Buyer	8	0.05
						20	0.13
						25	0.16
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	0.03
						10	0.06
						10	0.06
					Frequent Buyer	4	0.02
						10	0.05
						10	0.05
				Infant	Farmer	0.8	0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	0.02

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
71	<190	381	40	Adult	Farmer	8	0.05
						20	0.11
						25	0.13
					Bulk Buyer	8	0.03
						20	0.07
						25	0.08
					Frequent Buyer	8	<0.02
						20	<0.05
						25	<0.07
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	<0.01
						10	0.03
						10	0.03
					Frequent Buyer	4	<0.01
						10	<0.02
						10	<0.02
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

NORTH WALES

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
72	346	499	40	Adult	Farmer	8	0.06
						20	0.14
						25	0.17
					Bulk Buyer	8	0.05
						20	0.12
						25	0.14
					Frequent Buyer	8	0.04
						20	0.10
						25	0.13
				Child	Farmer	4	0.03
						10	0.06
						10	0.06
					Bulk Buyer	4	0.02
						10	0.05
						10	0.05
					Frequent Buyer	4	0.02
						10	0.04
						10	0.04
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	0.02

CUMBRIA

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
A (Fell Grazing)	331	1433	643 (Full-Flock)	Adult	Farmer	8	0.11
						20	0.28
						25	0.35
					Bulk Buyer	8	0.08
						20	0.2
						25	0.25
					Frequent Buyer	8	0.06
						20	0.14
						25	0.17
				Child	Farmer	4	0.05
						10	0.11
						10	0.11
					Bulk Buyer	4	0.04
						10	0.08
						10	0.08
					Frequent Buyer	4	0.03
						10	0.06
						10	0.06
				Infant	Farmer	0.8	0.02
						2	0.03
						3	0.04
					Bulk Buyer	0.8	<0.01
						2	0.02
						3	0.03
					Frequent Buyer	0.8	<0.01
						2	0.02
						3	<0.02

CUMBRIA

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
A1 (In-Bye Grazing)	<314	354	245 (Full-Flock)	Adult	Farmer	8	<0.04
						20	<0.09
						25	<0.11
					Bulk Buyer	8	<0.04
						20	<0.09
						25	<0.11
					Frequent Buyer	8	<0.04
						20	<0.09
						25	<0.11
				Child	Farmer	4	<0.02
						10	<0.04
						10	<0.04
					Bulk Buyer	4	<0.02
						10	<0.04
						10	<0.04
					Frequent Buyer	4	<0.02
						10	<0.04
						10	<0.04
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.02

CUMBRIA

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
B	<262	1060	372 (Full-Flock)	Adult	Farmer	8	0.08
						20	0.18
						25	0.23
					Bulk Buyer	8	0.04
						20	0.1
						25	0.13
					Frequent Buyer	8	<0.03
						20	<0.07
						25	<0.09
				Child	Farmer	4	0.03
						10	0.07
						10	0.07
					Bulk Buyer	4	<0.02
						10	0.04
						10	0.04
					Frequent Buyer	4	<0.02
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	0.01
						2	0.02
						3	0.03
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

CUMBRIA

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
C	<236	339	226 (Full-Flock)	Adult	Farmer	8	<0.03
						20	<0.07
						25	<0.08
					Bulk Buyer	8	<0.03
						20	<0.07
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.07
						25	<0.08
				Child	Farmer	4	<0.01
						10	<0.03
						10	<0.03
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.01
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

CUMBRIA

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
D	<234	499	891 (Full-Flock)	Adult	Farmer	8	0.04
						20	0.09
						25	0.11
					Bulk Buyer	8	<0.03
						20	<0.07
						25	<0.08
					Frequent Buyer	8	<0.03
						20	<0.07
						25	<0.08
				Child	Farmer	4	0.02
						10	0.04
						10	0.04
					Bulk Buyer	4	<0.01
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.01
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	0.01
						2	0.01
						3	0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.01
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.01

CUMBRIA

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
E	<279	585	846 (Full-Flock)	Adult	Farmer	8	0.05
						20	0.12
						25	0.15
					Bulk Buyer	8	<0.03
						20	<0.08
						25	<0.1
					Frequent Buyer	8	<0.03
						20	<0.08
						25	<0.1
				Child	Farmer	4	<0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	<0.02
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.02
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	0.02
						3	<0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.02

CUMBRIA

FARM REF.	RADIOACTIVITY IN SHEEP			DOSE TO REPRESENTATIVE PERSON			
	Mean ^{137}Cs Concentration (Bq/kg)	Max ^{137}Cs Concentration (Bq/kg)	No. of sheep Monitored	Age Category	Exposure Population	Consumption Rate (kgy^{-1})	Dose ($mSvy^{-1}$) at 97.5th percentile of exposure distribution
F	<285	487	49 (10% of Flock)	Adult	Farmer	8	0.05
						20	0.11
						25	0.14
					Bulk Buyer	8	<0.03
						20	<0.08
						25	<0.1
					Frequent Buyer	8	<0.03
						20	<0.08
						25	<0.1
				Child	Farmer	4	<0.02
						10	0.05
						10	0.05
					Bulk Buyer	4	<0.02
						10	<0.03
						10	<0.03
					Frequent Buyer	4	<0.02
						10	<0.03
						10	<0.03
				Infant	Farmer	0.8	<0.01
						2	<0.01
						3	<0.02
					Bulk Buyer	0.8	<0.01
						2	<0.01
						3	<0.02
					Frequent Buyer	0.8	<0.01
						2	<0.01
						3	<0.02