Cefas

Radiological Habits Survey: Trawsfynydd, 2005

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Radiological Habits Survey: Trawsfynydd, 2005

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SUMMARY

This report presents the results of a survey conducted in 2005 into the habits and consumption patterns of people living, working and pursuing recreational activities in the vicinity of Trawsfynydd site. The site is owned by the Nuclear Decommissioning Authority and Magnox Electric Ltd. is responsible for the day-to-day operations of the site. When Trawsfynydd was a working power station, it was powered by twin Magnox reactors but it ceased energy production in 1991 and has been in the decommissioning phase since 1995. Trawsfynydd is licensed to Magnox Electric Ltd. for the purposes of operating certain activities prescribed under the Nuclear Installations Act, 1965 (as amended). Under the Radioactive Substances Act, 1993, the company is authorised to discharge gaseous radioactive wastes via stacks to the atmosphere and liquid radioactive wastes via an outfall into Lake Trawsfynydd. The Trawsfynydd site also contains sources of direct radiation.

Potential exposure pathways related to the site are:

- consumption of locally sourced aquatic and terrestrial foods
- occupancy of lake shore
- handling fishing gear and sediment
- occupancy on or in water
- consumption and use of groundwater and surface water
- off-site transfer of contamination by wildlife
- occupancy of buildings and the surrounding areas

The survey investigated all of these pathways. Individuals from the local population were interviewed and the data obtained are presented and discussed. Data for 391 individuals, who had positive observations, were collected. Gamma dose rate measurements were taken to supplement those made in routine surveillance programmes.

In the aquatic survey area, the only locally consumed food was fish. The main activity potentially leading to external exposure was angling on the lake or on the lake shore.

Additionally, a few people worked in or alongside the River Prysor. No observations for individuals handling commercial fishing gear or sediment were made. Water sports and swimming were not permitted in Lake Trawsfynydd, although gorge walking in the River Prysor was a popular activity carried out by groups of young people from outdoor activity centres.

In the terrestrial survey area, up to 5 km from the site, the main farming activity was sheep and cattle rearing. However one dairy farm and one chicken farm were also noted. Farmers and their families were consuming meat, milk and poultry from their farms. One allotment site was identified with four plots; the allotment tenants were producing a variety of fruit and vegetables. High consumption rates were found in the following groups of locally produced foods: root vegetables, sheep meat and eggs. For the purposes of this summary, high rates have been defined as when the observed 97.5 percentile rate exceeds the generic 97.5 percentile rate. If there is no observed 97.5 percentile rate because there is only one consumer in the age group, the observed critical group mean consumption rate is compared with the generic 97.5 percentile rate. Other local foods consumed were, green vegetables, other vegetables, potato, domestic fruit, milk, cattle meat, poultry, wild/free foods, rabbits/hares, honey, wild fungi and brown trout from a small, land-locked lake. Evidence of the consumption of groundwater and surface water was found, with several farmers using spring, stream and well water for their entire domestic and farm requirements. Four beekeepers and numerous people collecting and consuming wild/free foods were also identified.

External exposure may occur from direct radiation to those living or spending time near the site. Occupancy habits in the direct radiation survey area included those related to residential, work and recreational activities. The highest occupancies were associated with residences.

Transfer of radioactive contamination from the site into the surrounding area by wildlife was investigated. The survey team were informed by the Trawsfynydd site staff that rabbits, pigeons, otters and seagulls had all been noted on the site but no flesh analyses or culling had

been carried out. No consumption of any of these species was noted in the terrestrial survey area during the survey.

The data from the survey are presented in full for each individual in order to assist in assessments of the additive effects of exposures from multiple pathways. Additionally, the information recorded during interviews was processed in two different ways to identify high rates appropriate to the various aquatic and terrestrial pathways. One method estimated a representative figure for each pathway by selecting a group at the upper end of the distribution of observations. The other chose the 97.5 percentile rate from the distribution.

Comparisons are made with the results from previous aquatic and direct radiation surveys. No previous terrestrial surveys have been done.

Suggestions are made for changes to environmental monitoring programmes on the basis of the information collected during the survey.

1 INTRODUCTION

The public may be exposed to radiation as a result of the operations of the Trawsfynydd site either from discharges of liquid or gaseous radioactive wastes into the local environment, or from radiation emanating directly from the site. This report provides information about activities carried out by members of the public which may influence their radiation exposure. The study has been funded by the Environment Agency, the Food Standards Agency and the Health and Safety Executive in order to support their respective roles in protecting the public from the effects of radiation.

1.1 Regulatory framework

The Environment Agency regulates discharges of waste under the Radioactive Substances Act 1993 (RSA 93) (UK Parliament, 1993) as amended by: the Environment Act 1995 (EA 95) (UK Parliament, 1995a); by legislation implementing the European Union (EU) Basic Safety Standards (BSS) Directive 96/29/Euratom (CEC, 1996); and by the Energy Act 2004 (EA 04) (UK Parliament, 2004). The Directive takes account of Recommendations of the International Commission on Radiological Protection (ICRP), particularly ICRP 60 (ICRP, 1991). Authorisations under RSA 93 are issued by the Environment Agency after wide-ranging consultation, including the Food Standards Agency. As well as being a Statutory Consultee, the Food Standards Agency has responsibilities for ensuring that any radioactivity present in food does not compromise food safety and that authorised discharges of radioactivity do not result in unacceptable doses to consumers via the food chain. The Food Standards Agency also ensures that public radiation exposure via the food chain is within EU accepted limits. Consultation papers on Statutory Guidance to the Environment Agency on the regulation of radioactive waste discharges were issued by the Department of the Environment, Transport and the Regions (DETR) (now part of Department for Environment, Food and Rural Affairs (Defra)) in 2000 (DETR, 2000a) and the Welsh Assembly in 2002 (The Welsh Assembly Government, 2002). These draft Guidance documents include, *inter alia*, affirmation that protection of the critical groups of the public is the appropriate radiological protection

methodology to use. This report provides information to support assessments of critical groups.

Installation and operation of certain prescribed activities can only take place on nuclear sites if they are licensed under the Nuclear Installations Act 1965 (as amended) (NIA 65) (UK Parliament, 1965). The Nuclear Installations Inspectorate of the Health and Safety Executive implements this legislation and is also responsible for regulating, under the Ionising Radiations Regulations (IRR 99) (UK Parliament, 1999), the restriction of exposure of the public to direct radiation from operations occurring on these sites.

1.2 Radiological protection framework

UK policy on the control of radiation exposure has long been based on the Recommendations of ICRP which embody the principles of justification of practices, optimisation of protection and dose limitation. Radiological protection of the public is based on the concept of a critical group of individuals. This group is defined as those people who, because of where they live and their habits, receive the highest radiation dose due to the operations of a site. It follows that, if the dose to this group is acceptable when compared to relevant dose limits and constraints, other members of the public will receive lower doses, and overall protection is provided for.

Dose standards for the public are embodied in national policy (UK Parliament, 1995b), in guidance from the International Atomic Energy Agency (IAEA) in the Basic Safety Standards for Radiation Protection (IAEA, 1996) and in European Community legislation in the EU BSS Directive 96/29/Euratom. The public dose standards were incorporated into UK law in IRR 99. In order to implement the Directive in England and Wales, the Environment Agency was issued with a direction by the DETR in 2000 (DETR, 2000b). This includes the requirements that the Environment Agency ensure, wherever applicable,

- all public radiation exposures from radioactive waste disposal are kept As Low As Reasonably Achievable (ALARA);

- the sum of such exposures does not exceed the dose limit of 1 mSv a year;

The Environment Agency shall have regard for maximum doses to individuals for use at the planning stage:-

- 0.3 mSv a year from any source;
- 0.5 mSv a year from the discharges from any single site;

The Environment Agency is also required to ensure that the dose estimates made are as realistic as possible for the population as a whole and for reference groups of the population. It is also required to take all necessary steps to identify the reference groups of the population taking into account the effective pathways of transmission of radioactive substances. Guidance on the principles underlying prospective assessments (i.e. assessments of potential future doses) has been provided by a group of UK public bodies (EA, SEPA, DoENI, NRPB and FSA, 2002). Where relevant, this guidance may also be applied to retrospective assessments (i.e. assessments of doses already received). A discussion paper (Camplin *et al.,* 2002) has considered different ways in which data collected from habits surveys similar to this study may be used to carry out integrated (i.e. combined pathway) dose assessments.

2 THE SURVEY

2.1 Site activity

The Trawsfynydd site is owned by the Nuclear Decommissioning Authority (NDA). Magnox Electric Ltd. (itself a wholly owned subsidiary of British Nuclear Group (BNG)) is the site licensee company and is responsible for the day-to-day operations of the station. BNG is the site management company who provide employees at management level and where appropriate other levels to Magnox Electric Ltd. All other staff are employed by Magnox Electric Ltd. When Trawsfynydd was a working power station, it was powered by twin Magnox reactors but it ceased energy production in 1991, was defuelled between 1993 and 1995 and has been undergoing decommissioning since 1995. The Trawsfynydd site is located beside Lake Trawsfynydd, approximately 3 km north west of the village of Trawsfynydd (see Figures 1 and 2), in the Snowdonia National Park in Wales.

Under NIA 65, the holder of the site licence for Trawsfynydd is Magnox Electric Ltd., allowing the installation and operation of certain activities. Under RSA 93, Magnox Electric Ltd are authorised to discharge gaseous radioactive wastes via separate stacks to the atmosphere and liquid radioactive wastes via an outfall into Lake Trawsfynydd. Trawsfynydd is the only nuclear power station site in Britain where liquid radioactive waste discharges are made to a freshwater lake. Details of the amounts of radioactive waste discharged in 2004 have been published (EA, EHS, FSA and SEPA, 2005). The site also contains sources of direct radiation. Site activity was normal for the decommissioning phase during the survey fieldwork. Decommissioning is expected to last until 2012.

2.2 Survey objectives

The Centre for Environment, Fisheries & Aquaculture Science (Cefas) undertook the survey in 2005 on behalf of the Environment Agency, the Food Standards Agency, and the Health and Safety Executive. The aim of the survey was to obtain integrated habits data related to

public radiation exposure from the Trawsfynydd site via aquatic, terrestrial and direct radiation pathways in order to permit realistic assessments of critical group doses.

The last aquatic habits survey conducted by Cefas in the Trawsfynydd area was in 1994 (Smedley and Thurston, 1997). Data from this survey are used for dose assessments for the Trawsfynydd area (e.g. EA, EHS, FSA and SEPA, 2005). The last direct radiation survey conducted by Cefas in the Trawsfynydd area was in 2001. No previous terrestrial habits surveys have been done by Cefas at Trawsfynydd.

Fieldwork was undertaken in order to obtain site specific habits survey data. These data were used to establish exposure pathways for the local population and the characteristics of those most exposed. General habits survey information for the area such as the number and types of farms in the area was also obtained.

Investigations were carried out to ascertain the following:

- The consumption rates of aquatic and terrestrial foods from within the survey areas
- The production, use and destination of local produce
- External exposure activities on the lake shore
- Occupancy in and on water in the survey area affected by liquid and gaseous discharges
- The consumption and use of groundwater and surface water in the terrestrial survey area
- The extent of occupancy in the direct radiation survey area
- The extent of any unusual practices, which may be relevant such as the transfer of contamination off-site by wildlife

No additional site-specific investigations were identified by the Environment Agency, the Food Standards Agency and the Health and Safety Executive

2.3 Survey areas

Three survey areas were defined to encompass the dominant activities expected for aquatic, terrestrial and direct radiation pathways.

The aquatic survey area, shown in Figure 1, covered the whole of Lake Trawsfynydd and its shoreline, and the River Prysor from where it leaves the lake to its confluence with the River Dwyryd. The area is relevant to the effect of liquid discharges from the site. The 1994 survey only investigated activities on the lake and its shoreline.

The terrestrial survey area, shown in Figure 2, was defined as the circle to a radius of 5 km from the centre (NGR SH 691 382) of the Trawsfynydd site to encompass the main areas of potential deposition from gaseous discharges. Activities relating to groundwater and surface water in the terrestrial area were also investigated. Watercourses and areas potentially containing contamination only from washout of gaseous discharges are discussed in the terrestrial sections of this report. Water bodies and water courses, which are also part of the aquatic survey area, such as Lake Trawsfynydd, are discussed in the aquatic section of this report although they are relevant to both sections.

For direct radiation, the survey area, is usually defined as the area within 1 km of the licensed site perimeter. However, the 2001 direct radiation survey used an area of 1 km from the site perimeter, regardless of the licensed area. This gave a slightly larger survey area and included some properties that were up to 1.4 km from the licensed site area. In 2001 the site perimeter encompassed the electricity sub-station land which has since been sold. For consistency with the 2001 survey and to compensate for the small number of properties within 1 km of the licensed site, the 2005 survey used the same survey area as the 2001 survey (see Figure 2). Trawsfynydd was being decommissioned during both surveys.

2.4 Conduct of the survey

The fieldwork component of the survey was carried out from 9th – 19th May 2005 by a survey team of three people, according to techniques described by Leonard *et al.* (1982).

A programme of work was sent to the Environment Agency, the Food Standards Agency, and the Health and Safety Executive before the survey for comment. Prior to the start of the fieldwork, discussions were held between the Cefas survey team and representatives from Trawsfynydd, the Environment Agency, the Food Standards Agency and the Health and Safety Executive. These discussions provided an outline of the main aims of the survey and highlighted areas or items, which required special attention or effort by the team. On 10th May, a meeting was held between the survey team and representatives from the Trawsfynydd site. This served to provide details about site operations, including waste disposal, and information about potential pathways and activities in the area. Further information was sought about wildlife studies and pest control measures in and immediately around the site. Animals could carriers for transporting radioactive materials off-site and are also potential food items for some individuals.

People with a local knowledge of the survey area were contacted for information on any aspects relevant to the various exposure pathways. These included the local councils, beekeeping representatives, the local angling association and National Assembly for Wales Field Officers.

During the survey, individuals who were identified as having the potential to be exposed to radioactivity from the site were contacted and interviewed. Interviews were used to establish individuals' consumption rates of locally grown terrestrial foods and locally caught aquatic foods, their handling rates of lake and river sediments and fishing gear, their occupancy rates relevant to external exposure and occupancy rates in and on water. Any general information of possible use to the survey was also obtained. Using the information gained in the interviews, a list of occupations and activities was built up to produce a picture of potential

exposure pathways. This then enabled emphasis to be placed on those individuals who were likely to be the most exposed, and included anglers, farmers, beekeepers, allotment holders, keen gardeners and people living and/or working close to the site.

The survey did not involve the whole population in the vicinity of Trawsfynydd, but targeted subsets or groups, chosen in order to identify the potentially most exposed individuals. However, it is possible that even within a subset or group there may be people we did not interview at the time of the survey. Therefore, to aid interpretation, the number of people for whom data were obtained in each group as a percentage of what we estimate to be complete coverage for that group has been calculated. The results are summarised in Table 1. The 'groups' are described and quantified, and the numbers of people for whom data were obtained are given as percentages of the totals. It should be noted that for certain groups, such as anglers, it can be virtually impossible to calculate the total number of people who undertake the activity in the survey area as many people visit from outside or only visit occasionally during the year. In other cases, it may be necessary to estimate the number of individuals from the number of clubs for example. These cases are explained in Table 1. Overall, although the number of potential interviewees was estimated to be 3400, information was obtained for a significantly smaller number than this. In particular, it should be noted that the survey did not include site employees or contractors while working at Trawsfynydd. Dose standards applicable to people at work are different to those for members of the public.

For each of the three survey areas, the survey targeted pathways primarily relevant to that survey area. For example, people in the terrestrial survey were initially questioned because it was known that they grew significant quantities of terrestrial foodstuffs. However, where possible, every interviewee was asked about pathways in each of the three areas. During interviews with representatives from clubs such as extreme sports clubs, it was not possible to collect data for all pathways (such as consumption of local foods) for each member. In these cases, data were limited to those relating to the primary reason for the interview (e.g. in the case of occupancy rates within 0.25 km of the site for the electrical sub-station

employees, the manager could provide data for his staff for that pathway only). In Annex 1 and 2, such individuals only have data for the pathways of primary interest.

Thirty-three person-days were spent investigating the survey areas and interviewing individuals who were relevant to the survey. Observations for 391 individuals were recorded. During the survey, gamma dose rate measurements were taken to aid assessment of external exposure pathways.

3 METHODS FOR DATA ANALYSIS

3.1 Data recording

Data collected during the fieldwork were recorded in logbooks. On return to the laboratory, the data were examined and any notably high rates were double-checked where possible by way of a follow-up phone call. In rare cases where follow up phone calls were not possible (e.g. interviewees who wished to remain anonymous), the data were accepted at face value. The raw data were entered into a habits survey database where each individual for whom information was obtained was given a unique identifier (the observation number) to assist in maintaining data quality.

During the interviews, people could not always provide consumption rates in kilograms per year for food or litres per year for milk. In these cases, interviewees were asked to provide the information in a different format. For example, some estimated the size and number of items, e.g. eggs consumed per year, whereas others gave the number of plants in a crop or the length and number of rows in which the crop was grown per year. The database converted these data into consumption rates (kg/y for food and l/y for milk) using a variety of conversion factors. These included produce weights (Hessayon, 1990 and 1997 and Good Housekeeping, 1994), edible fraction data researched by Cefas and information supplied by the Meat and Livestock Commission. For the purpose of data analysis, foodstuffs were aggregated into food groups as identified in Table 2. Specific food types relevant to this survey are presented in the subsequent tables.

All consumption and occupancy data in the text of this report are rounded to two significant figures to reflect the authors' judgement on the accuracy of the methods used. In the tables and annexes, the consumption rate data are usually presented to one decimal place. Occasionally this rounding process causes the row totals to appear slightly erroneous ($\pm$ 0.1). Consumption rates less than 0.05 kg/y are presented to two decimal places in order to avoid them appearing as 0.0 kg/y. External exposure data are quoted as integers.

To ensure the quality of the data collected during the survey fieldwork and presented in the report, the following procedures have been employed:

- Experienced scientific staff were used for fieldwork and data assessment. They had been trained in the techniques of interviewing and obtaining data for all pathways which were relevant to the survey being conducted. Where individuals offered information during interview that was unusual, they were questioned further in order to double check the validity of their claims.
- Where possible, interviewees were contacted again to confirm the results of the initial interview if, when final consumption or occupancy rates were calculated, observations were found to be high in relation to our experience of other surveys, taking into account local factors.
- Data were manipulated in a database using a consistent set of conversion factors.
- Data were stored in a database in order to minimise transcription and other errors.
- Draft reports and data tables were formally reviewed by an experienced consultant in radiological protection.
- Final reports were only issued when the Environment Agency, the Food Standards Agency and the Health and Safety Executive were entirely satisfied with the format and content of the draft.

The habits data are structured into groups of activities with similar attributes. For example, when considering food consumption, all types of root vegetables are grouped together in a food group called 'root vegetables'. For external exposure over lake shore sediments, occupancy over a common substrate, (for example, sand and stones) is chosen. The choice of a group of activities is made when it is reasonable to assume that consistent concentrations or dose rates would apply within the group. In addition to grouping of activities, ingestion data are structured into age groups because different dose coefficients (i.e. the factors which convert intakes of radioactivity into dose) can apply to different ages. These age groups are from 0 to 1.0 y of age (called 3 month old); more than 1.0 y to 2.0 y (called 1 year old); more than 2.0 y to 7.0 y (called 5 year old); more than 7.0 y to 12.0 y (called 10 year old); more than 12.0 y to 17.0 y (called 15 year old). Individuals over 17 are

treated as adults. These age groupings are consistent with those used in ICRP 72 (1996). For the purpose of this report, the consumption of locally grown/produced foods for children in the 3 month old age group was considered to commence at the age of 6 months. Therefore their annual rate equates to 6 months' consumption. For direct radiation pathways, the data are grouped into distance zones from the site perimeter as a coarse indication of the potential dose rate distribution due to this source of exposure. The bands used were: 0 – 0.25 km, 0.25 – 0.5 km and 0.5 – 1.5 km. These distance bands are also useful when assessing exposure to gaseous discharges.

3.2 Data analysis

The main output of the study is the statement of individuals' consumption, handling and occupancy rates given in Annexes 1 and 2. If there are any qualitative or estimated data to supplement Annexes 1 and 2, they will be contained in Annex 3. These can be used by those undertaking radiological assessments of the effects of the operation of the Trawsfynydd site – taking into account the concentration and/or dose rate distributions in space and time relevant to the assessment. It is only with the outcome of such an assessment that the critical group can strictly be defined as those most exposed.

In addition to providing these data in the Annexes, we have also analysed them to provide estimates of rates of occupancy, handling and consumption which can be regarded as typical of those most exposed prior to a formal assessment being undertaken. Two approaches are used.

Firstly, the 97.5 percentile rate was calculated for each group using the Excel mathematical function for calculating percentiles. This method accords with precedents used in risk assessment of the safety of food consumption. Mean and 97.5 percentile rates based on national statistics have been derived by the Ministry of Agriculture, Fisheries and Food (MAFF) (now part of Defra) and the Food Standards Agency (Byrom *et al.,* 1995 and FSA, 2002), and these are referred to as generic rates in this report. Secondly, the 'cut-off' method

described by Hunt *et al.* (1982) was used. With the 'cut-off' method, the appropriate high rate was calculated by taking the arithmetic mean of the maximum observed rate and all rates observed within a factor of three of the maximum value (termed the lower threshold value). It accords with the principle expressed by ICRP (ICRP, 1984) that the critical group should be small enough to be reasonably homogeneous with respect to age, diet and those aspects of behaviour that affect the doses received. In this report, the term critical group rate is used to represent the data derived by the 'cut-off' method for ease of presentation. A separate critical group rate was calculated for each food group or activity identified in the survey.

In exceptional, cases the 'cut-off' method can result in only one member of the high rate group. In this case, judgement is used as to whether to include other individuals within the group.

In previous aquatic surveys (those undertaken prior to 2002) a factor of 1.5, instead of 3, was used to define the cut-off value for lake shore occupancy and handling. However, it is now considered appropriate that the same factor of 3 as for consumption is used. The factor reflects variations in the doses likely to be received due to natural variations in the interactions of radiations with tissues caused by, for example, differences in anatomy.

For ingestion pathways, high rates for children have been calculated from the survey data. However, because few child consumers were identified, the rates should be viewed with caution. For assessment purposes, an alternative, theoretical approach may be taken which involves scaling the critical group rates for adults by ratios. These ratios are given in Annex 4 and have been calculated using generic 97.5 percentile consumption rates.

Selection of 97.5 percentile and critical group rates for occupancy is not made for the direct radiation pathway. Such an analysis is of limited value without a detailed knowledge of the spatial extent of dose rates due to direct radiation.

For the purposes of assessing total dose integrated across all pathways, the data from the survey can be further analysed to take into account the degree of overlap of each pathway. This is discussed further in Section 7, and data to undertake a total dose assessment are provided in Annex 5. If there are any data in Annex 3, they are not included in Annex 5.

4 AQUATIC RADIATION PATHWAYS

4.1 Aquatic survey area

The aquatic survey area, shown in Figure 1, covered the whole of Lake Trawsfynydd and its shoreline, and the River Prysor from where it leaves the lake to its confluence with the River Dwyryd.

The shore of the lake was a very irregular shape with lots of small secluded bays and promontories into the lake. Vegetation and a varied shoreline of rock, sand and stones meant that most of the lake shore was popular with anglers. In periods of particularly low rainfall, the lake level can fall to expose areas of mud and peat. However, anglers tended to avoid these areas in favour of cleaner parts of the shoreline.

Lake Trawsfynydd – northern shore

The north-western corner of the lake, approximately 2.75 km from the centre of the power station, is where the River Prysor exits the lake by way of a large dam. It was possible to drive from the power station car park along a track to the dam and there was ample space for parking to the east of the dam. Anglers were observed around the promontory to the east of the dam where there was also vehicular access right down to the shore. There was a concrete bund in the lake running parallel with the northern shore. When the power station was producing electricity, the bund separated the cooling water intake from the rest of the lake but as the power station is now decommissioning it was no longer used for this purpose. Access to the bund used to be possible via a Bailey Bridge, but this has been removed. The water to the north of the bund is sheltered and it was a popular area for shore angling.

The power station, its car park and the access road from the A470 run alongside the lake in the north-eastern corner. The Trawsfynydd visitor centre is no longer open to the public and the building is used by the power station staff as offices.

The Prysor Angling Association has an equipment storage facility and car park just off the power station access road abutting the lake shore. The storage facility is part of the old Sports and Social Club for the Trawsfynydd site staff, which is now permanently closed for this purpose. The club had approximately 20 boats, which anglers from the club frequently use on the lake.

Lake Trawsfynydd – eastern shore

Footpaths leading from the Sports and Social Club through the woods to the south made this area popular with rod and line anglers.

The lake shore was bordered by farmland where livestock grazed. One farm in this area had grazing land extending to the shore but fencing prevented them from actually drinking the lake water. 400 metres south, access to the lake shore along this side of the lake was restricted to one or two footpaths leading across the farmland from lay-bys on the A470. It was possible to go fishing using these access paths. Sheep had access to the lake in this area, so they could drink from it if they wished.

In the south-eastern corner, the village of Trawsfynydd was separated from the lake again by rough grazing land where livestock again had access to the lake shore.

Lake Trawsfynydd – south and west shore

A minor road from the A470 runs next to the lake about two thirds of the way along the western shore. The road leads to a few properties and farms and the land either side of it is grazed by sheep. Since the last survey a footbridge linking the village of Trawsfynydd with this road has been removed for health and safety reasons. Another popular angling location was at Cae Adda, a farm on the lake shore. Again, sheep had access to the lake in this area.

The north-western shore was an area where only fly fishing was allowed. Part of the shore was wooded. Access was gained via a footpath leading from the dam.

River Prysor

The River Prysor exits the lake via a dam in the north-western corner of the lake. There is a steep drop down from the water level in the lake to the river. The sides of the river are very steep, especially on the eastern bank, and covered with vegetation. The discharge levels in the river were very low during the survey and in places the riverbed was virtually dry. No angling was observed on the river but two environmental researchers working for the Environment Agency were seen. Access to the river was gained by crossing to the west bank of the river at the dam, walking alongside the river on the west bank for a few hundred metres and descending to the river where it was less steep.

The only other activity to take place in the Prysor was gorge walking – a popular local activity where people walk along the river bed through the water. Most people did this sport in organized groups from outdoor activity centers. In the steeper areas, such as at waterfalls, gorge walking involve the use of zip wires to descend from the top of the fall into the pool below.

4.2 Commercial fisheries

No commercial fishing activity was allowed on Lake Trawsfynydd or in the River Prysor. The Prysor Angling Association hold the rights to fishing on the lake and they only allow angling with bait or fly fishing. Only Cefas and the power station are permitted to use netting gear in order to complete their environmental sampling programmes. There used to be a commercial rainbow trout hatchery in the lake but this is now closed.

4.3 Angling

The Prysor Angling Association currently hold the rights to all fishing on Lake Trawsfynydd. Angling from the shore or from a boat was very popular. The most frequently visited shore locations by anglers were around the dam, the clubhouse, the site of the old footbridge from Trawsfynydd village to the south shore and Cae Adda . The angling club had approximately 150 members and also issued day tickets. Rainbow trout (*Salmo gairdneri*) from outside the survey area were re-stocked into the lake at a rate of 500 kg per fortnight between January and October. The only other species of fish from the lake to be consumed by anglers was brown trout (*Salmo trutta*) in very small quantities. Occasional coarse fish were caught but not consumed by any of the anglers interviewed.

Salmon (*Salmo salar*) from the River Dwyryd were consumed by one family. Although not strictly in the aquatic survey area, these fish would have spent time in the River Dwyryd where the liquid discharges pass through before entering the sea. The consumption data have been included.

Hobby fishing, such as using static nets to catch fish, was not permitted on the lake except for the purpose of radiological monitoring by Cefas and British Nuclear Group.

4.4 Wholesalers and retailers

The survey team found no evidence of fish from the aquatic survey area being sold either inside or outside the survey area.

4.5 Wildfowl

In the past, the Prysor Angling Association have owned the rights to wildfowling on the shore of the lake. However, at the time of the survey, no wildfowling was permitted, and no consumption of wildfowl was noted.

4.6 Internal exposure

Consumption data for locally caught aquatic foodstuffs are presented in Table 3 for adults and in Table 4 for children. The tables include the mean consumption rates of the critical groups together with the observed 97.5 percentile rates calculated as described in Section 3.2. No adult or child consumers of crustaceans, molluscs, aquatic plants and algae or wildfowl were noted. For purposes of comparison, the data are summarised in Table 5 for adults and Tables 6 to 8 for children (15 year olds, 10 year olds and 5 year olds respectively). No children in the 1 year old and 3 month old age groups were noted to be consuming any local aquatic foods. The summary tables also include mean rates and 97.5 percentile rates based on national data (referred to as 'generic' data in this report). No generic data are available for the 5 year old and 1 year old age groups.

Adult consumption rates

The people consuming foods from the aquatic survey area were anglers and their friends and families.

The predominant species of fish consumed by adults were rainbow trout with much smaller quantities of brown trout and salmon. A critical group of one individual was identified with a consumption rate of 60 kg/y; all the fish consumed were rainbow trout. This individual has featured in previous surveys. His fish consumption increased significantly in 2005 because he has reduced his intake of meats containing higher cholesterol levels.

In this instance, no other observations lie above the cut-off rate when the highest consumption rate is divided by three. If the next observation down had been divided by three to give the cut-off rate, a critical group of 36 people with a mean consumption rate of 10.6 kg/y would have resulted. This rate was not considered to adequately represent the dose received by the top consumer, therefore it is recommended that the critical group is based on this single individual.

As brown trout contained significantly higher levels of radiocaesium than rainbow trout (EA, EHS, FSA and SEPA, 2005) it is considered prudent to consider this species separately. In this case, a critical group of three individuals with a mean consumption rate of 1.3 kg/y (maximum rate 1.8 kg/y) was identified. Two of these individuals also consumed rainbow trout at a rate of 4.1 kg/y. It may be noted that the alternative critical group of 36 people who eat rainbow trout would have included one individual consuming small amounts of brown trout.

The observed 97.5 percentile rate based on 123 observations for rainbow trout and salmon was 13 kg/y. The observed 97.5 percentile rate based on 3 observations for brown trout was 1.8 kg/y. This compares with the adult generic mean and 97.5 percentile consumption rates for fish of 15 kg/y and 40 kg/y respectively.

Children's consumption rates

In the following child age groups the only fish species consumed was rainbow trout.

15 year old age group

A critical group of five individuals was identified with a maximum consumption rate of 6.6 kg/y and a mean of 6.6 kg/y. The observed 97.5 percentile rate based on nine observations was 6.6 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for fish of 6.5 kg/y and 20 kg/y respectively.

10 year old age group

A critical group of three individuals was identified with a maximum consumption rate of 13 kg/y and a mean of 12 kg/y. The observed 97.5 percentile rate based on eight observations was 13 kg/y. This compares with the generic mean and 97.5 percentile consumption rates for fish of 6.0 kg/y and 20 kg/y respectively.

5 year old age group

A critical group of two individuals was identified with a maximum consumption rate of 6.6 kg/y and a mean of 6.5 kg/y. The observed 97.5 percentile rate based on two observations was 6.6 kg/y. No generic consumption rates have been derived for this age group.

4.7 External exposure

Lake shore and river bank occupancy

Table 11 shows the Lake Trawsfynydd shore and River Prysor bank occupancy data recorded during the survey. Sand and stones was the predominant substrate on the lake shore where public occupancy was identified. Although there were areas of mud and peat, anglers avoided these locations in favour of 'cleaner' substrates. Activities noted on the River Prysor took place over rock.

The maximum occupancy rate recorded over rock was 30 h/y for two people working along the bank of the River Prysor. No-one was noted who had any significant occupancy rates over rock so the critical group mean occupancy rate for this substrate was also 30 h/y. The work that these two people were doing was a one-off scientific study on behalf of the Environment Agency and so this exposure pathway may not be relevant in future years.

The maximum occupancy rate recorded over sand and stones on the lake shore was 700 h/y for an angler. Eleven other anglers had occupancy rates within a factor of three of this giving a critical group mean occupancy rate over sand and stone of 450 h/y.

Handling

No handling of lake sediments or fishing gear other than angling equipment was noted during the survey. Handling of angling equipment was not considered to be a significant pathway. Therefore, as in previous surveys, data for this pathway were not collected.

Gamma dose rate measurements

Representative gamma dose rate measurements at 1 m above the substrate were taken over peat, sand and stones, mud and sand and mud, sand and slate. These measurements (shown in Table 12) ranged from 0.061 μGy/h over peat to 0.126 μGy/h over sand and mud. Natural levels of around 0.05 and 0.07 μGy/h are expected over sand and mud respectively. A value of 0.06 μGy/h is expected for all other substrate types.

4.8 Water based activities

Activities taking place in or on the water can lead to ingestion of water and/or inhalation of spray. These pathways are generally considered to be minor in comparison with other exposure pathways such as the ingestion of foods produced in the vicinity of a nuclear site. However, in order to allow for their assessment, relevant data have been collected. Occupancy rates for activities taking place in or on water around Trawsfynydd are shown in Table 13. No further manipulation of the data (for example, calculating critical group rates) has been carried out.

Activities in the water

Water sports and swimming on Lake Trawsfynydd were not allowed. The only activity found to be taking place in the water elsewhere in the aquatic survey area was gorge walking in the River Prysor. Three observations for instructors from outdoor activity centres were recorded with the highest occupancy rate being 160 h/y. The instructors took several groups of young

people gorge walking in the River Prysor during the year. However, because most young people only go gorge walking with the centres once or twice per year, their occupancy rates would be restricted to a maximum of 5-10 h/y. Since we do not have details of the young people's ages, they have not been included in the data.

Activities on the water

The only activity taking place on water on Lake Trawsfynydd was boat angling. Observations for eight anglers were recorded and the highest occupancy rate was 440 h/y.

5 TERRESTRIAL RADIATION PATHWAYS

5.1 Terrestrial survey area

The terrestrial survey area covered all land and watercourses within 5 km of the site centre (NGR SH 691 382) as shown in Figure 2. Watercourses directly affected by liquid radioactive waste discharges (i.e. Lake Trawsfynydd and the River Prysor downstream of the dam) are dealt with separately in the aquatic section. However, it should be noted that these would also be affected by washout of gaseous discharge.

The land around the Trawsfynydd site was diverse. Large parts of the survey area were covered with woodland, and to the east and south-west the area was mountainous. Lake Trawsfynydd was located to the south of the site; there were also many small lakes, rivers and streams in the survey area. The main rivers were, the River Cynfal, the River Prysor and the River Tafarn-helyg which all flowed into the River Dwyryd in the Vale of Ffestiniog. Farms were predominantly located to the south, south-east, north and north-west. Within the survey area, the small town of Llan Ffestiniog and the village of Gellilydan were located to the north of the site and the village of Trawsfynydd was located to the south-east.

Thirty-six working farms were located in the area. Of these, 16 produced a mixture of lamb and beef, 15 produced lamb only, one produced beef only, one produced a mixture of beef, lamb and eggs, one produced a mixture of dairy, lamb, chickens and eggs, one produced chicken eggs only and one produced a mixture of vegetables and fruit. Cereal crops were not produced in the survey area. Three smallholdings were identified, two of which kept a small amount of sheep and one kept a small amount of turkeys. One other individual was identified who kept ducks for eggs.

Lambs and cattle were sold in Wales outside the survey area to markets at Dolgellau, Bala, Machynlleth, Corwen and Bryncir and Gaerwen and to abattoirs on Anglesey. Beef was also sold to a butcher in the survey area and cattle to abattoirs in England. Lamb was also sold to

Llanrwst abattoir, outside the area. Eggs and chickens were sold to local shops in villages both in and outside the survey area and to local customers from a farm. Milk was sold to South Carmarthan Creameries outside the area. Fruit, vegetables and a small number of duck eggs were sold to Country Market in Dolgellau also outside the area. Turkeys were sold to local customers.

Farmers and their families were noted to be consuming lamb, beef, chickens, eggs and milk from their own farms.

One allotment site with four plots was located in the survey area at Gellilydan; one plot was well established, two plots were new and one was rarely used. A range of fruit and vegetables was being grown at the allotment site. A local gardening club had four members that grew various varieties of vegetables and fruit in their gardens in the survey area. One of the members kept chicken and ducks in their garden and consumed eggs; one member kept ducks for eggs and gave excess eggs to family and friends. A Bed and Breakfast in the survey area kept chickens in their garden for eggs.

Four beekeepers were identified in the survey area. The average production of honey per hive per year was 13 kg/y. Beekeepers and their families consumed honey and excess was given to family and friends or sold through local shops outside the survey area.

The consumption of wild foods was common, they included blackberries, rosehips, plums, crab apples, elderberries, raspberries and mushrooms. The only game meat consumption identified in the survey area was hare, which was consumed in small amounts.

The main watercourses affected only by gaseous discharge were the small lakes, the River Prysor in the south-east of the survey area before it reached Lake Trawsfynydd, the River Cynfal and the River Dwyryd. No activities in or on freshwater were identified in these areas. Brown trout was consumed from Llyn y Graig-wen, a small freshwater lake in the east of the

survey area. Small amounts of salmon were caught and consumed from the River Dwyryd, upstream of the confluence with the River Prysor.

Twenty-one farms in the area used groundwater or surface water as their domestic supply, for most farms it was their sole supply of water. Twelve farms used spring water, six used stream water, two used well water and one farm was using water from a small lake nearby. Livestock were identified as drinking stream, lake, ditch, spring, and river water.

The transfer of contamination from the Trawsfynydd site by wildlife was investigated. Representatives from Trawsfynydd were asked about wildlife that could act as carriers for the transfer of radioactivity off site. Rabbits, pigeons, otters and seagulls had been observed on site by the operators, but there had never been a monitoring or culling programme in place for any of these species. No consumers of the edible species (rabbits and pigeons) occurring on site were identified during the survey.

5.2 Wholesalers and retailers

No terrestrial food wholesalers were noted within the survey area. Retailers were interviewed in order to find out whether they were selling produce from within the survey area. They included two village shops, a garage, a post office, a café, Heritage Centre, a bakery, a butcher, a milkman and a newsagent. The butcher was selling beef from within the survey area. One of the village shops and the newsagent sold local eggs, and the bakery used eggs from the survey area.

5.3 Internal exposure

Consumption data for locally produced foodstuffs potentially affected by gaseous discharges are presented in Tables 14 to 28 for adults and Tables 29 to 41 for children. These tables include the mean consumption rates of the critical groups together with the observed 97.5 percentile rates calculated as described in Section 3.2. For purposes of comparison, the data

are summarised in Table 5 for adults and in Tables 6 to 10 for children (15 year olds, 10 year olds, 5 year olds, 1 year olds and 3 month olds respectively).

In order to provide information relevant to surveillance and assessments studies, the consumption rate data collected during the survey were analysed to indicate which food types most commonly contributed to each food group. The data are summarised in Table 42. Those food types shown in bold and labelled with an asterisk were sampled as part of the 2004 Food Standards Agency monitoring programme (EA, EHS, FSA and SEPA, 2005).

Adult consumption rates

Consumption of locally produced foods was identified in the following 15 food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk, cattle meat, sheep meat, poultry, eggs, wild/free foods, rabbits/hares, honey, wild fungi and fish affected by gaseous discharges. No consumption of pig meat, venison or local cereals was identified.

The critical group mean consumption rate for sheep meat was greater than the generic 97.5 percentile consumption rate. Seven critical group mean consumption rates exceeded the generic mean consumption rates. These were for green vegetables, root vegetables, milk, cattle meat, poultry, eggs and wild/free foods. Three observed 97.5 percentile consumption rates exceeded the generic 97.5 percentile consumption rates. These were for root vegetables, sheep meat and eggs.

Children's consumption rates

15 year old age group

Thirteen children in this age group were identified to be eating locally produced food. Consumption was identified in the following 13 food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk, cattle meat, sheep meat, poultry,

eggs, wild/free foods, honey and wild fungi. No consumption was identified for pig meat, rabbits/hares, venison, fish affected by gaseous discharges and local cereals. The critical group mean consumption rate of sheep meat exceeded its generic 97.5 percentile consumption rate. The critical group mean consumption rates of green vegetables and eggs exceeded their generic mean consumption rates. The observed 97.5 percentile consumption rate for sheep meat exceeded its generic 97.5 percentile consumption rate.

10 year old age group

Eleven children in this age group were identified as eating locally produced food. Consumption was identified in the following nine food groups: other vegetables, potato, milk, cattle meat, sheep meat, poultry, eggs, wild/free foods and wild fungi. No consumption was identified for the following food groups: green vegetables, root vegetables, domestic fruit, pig meat, rabbits/hares, honey, venison, fish affected by gaseous discharges and local cereals. The critical group mean consumption rate of sheep meat exceeded its generic 97.5 percentile consumption rate. In two food groups, the critical mean consumption rates were higher than the generic mean consumption rates, these were cattle meat and eggs. The observed 97.5 percentile consumption rate for sheep meat was greater than the generic 97.5 percentile consumption rate.

5 year old age group

Fourteen children in this age group were identified as eating locally produced food. Consumption was identified in the following 13 food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk, cattle meat, sheep meat, poultry, eggs, wild/free foods, honey and wild fungi. No consumption was identified for the following food groups: pig meat, rabbits/hares, venison, fish affected by gaseous discharges and local cereals. No generic 97.5 percentile or generic mean consumption rates have been determined for this age group so no comparisons with the corresponding observed rates are possible.

1 year old age group

One child in this age group was identified as eating locally produced food. Consumption was identified in the following three food groups: cattle meat, sheep meat and poultry. No consumption was identified for the following food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk, pig meat, eggs, wild/free foods, rabbits/hares, honey, wild fungi, venison, fish affected by gaseous discharges and local cereals. No generic 97.5 percentile or generic mean consumption rates have been determined for this age group so no comparisons with the corresponding observed rates are possible.

3 month old age group

One child in this age group was identified as eating locally produced food. Consumption was identified in the following two food groups: cattle meat and sheep meat. No consumption was identified for the following food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk, pig meat, poultry, eggs, wild/free foods, rabbits/hares, honey, wild fungi, venison, fish affected by gaseous discharges and local cereals. No critical group mean consumption rates exceeded its generic 97.5 percentile consumption rate. Both the cattle meat and sheep meat critical mean consumption rates were higher than their generic mean consumption rates. No 97.5 percentile consumption rates can be determined for a single observation, so no comparisons with the generic 97.5 percentile consumption rates are possible.

6 DIRECT RADIATION PATHWAYS

6.1 Direct radiation survey area

The direct radiation survey area covered the area within 1.5 km of the Trawsfynydd licensed site perimeter fence, as shown in Figure 2. The reason for increasing the distance from the usual 1 km to 1.5 km was to include occupancy observations obtained in the 2001 survey so that direct comparisons could be made.

Most of the area to the south of the site was Lake Trawsfynydd. The small section of land between the site and the lake shore contained a building owned by the site which had been used as a visitors' centre. This was now closed to the public and served as additional office space for Trawsfynydd site staff. To the north of the site was mainly woodland and grazing land and the village of Gellilydan. The woodland was intersected with several footpaths that the public were permitted to use. A road, owned by the site, leading to the lake dam was used frequently by anglers on foot and in vehicles for access to several positions on the shore. To the east, an access road led to the site from the A470. Near the entrance of the access road was a disused building that had once been a social club for site staff. The Prysor Angling Association used the garage of this building as an equipment store. There was also a disused portacabin adjacent to this building that had been used by a boat hire and lake trip business. This recreational pursuit business no longer existed. Further north along the A470 were Utica Chapel and Utica Laboratory. Adjoining the Trawsfynydd site to the east was an electricity sub-station which was still in use but was not part of the licensed site. A trout hatchery which used the warm water discharged from the site had once been located immediately south of the site, but was now demolished. Another hatchery that belonged to the Prysor Angling Association, shown in Figure 1, was unused.

6.2 Residential activities

The direct radiation survey area was sparsely populated with two farms, approximately 25 residences, a public house and a caravan park. No properties were within the 0 – 0.25 km zone, a farm was in the 0.25 – 0.5 km zone and the remainder of the properties, the second farm, the caravan park and the public house were in the 0.5 – 1.5 km zone. Interviews were conducted at 15 of the households, both farms and the caravan park.

6.3 Leisure activities

The main leisure activities in the direct radiation survey area were angling on the lake shore and walking along the footpaths and road leading to the dam. With the exception of boat angling, no other activities were allowed in or on the lake.

6.4 Commercial activities

Commercial activities within the direct radiation survey area included maintenance and running of the electricity sub-station and caravan park, farming and people working in the public house and Utica Laboratory.

6.5 Occupancy rates

Table 43 presents indoor, outdoor and total occupancy data for adults and children and includes distances from the site perimeter fence where these occupancies took place. An analysis of the data by distance zones and occupancy rates is shown in Table 44.

0 - 0.25 km from the site perimeter fence

Occupancy data were collected for 11 individuals in the 0.0 to 0.25 km zone. The observations were for staff operating and maintaining the electricity sub-station. They all had a total occupancy rate of 1800 h/y. No residential dwellings were present in this zone.

0.25 – 0.5 km from the site perimeter fence

Occupancy data were collected for two residents in the 0.25 to 0.5 km zone, both having a total occupancy rate of 8600 h/y.

0.5 – 1.5 km from the site perimeter fence

Occupancy data were collected for 69 people in the 0.5 to 1.5 km zone. The majority of observations were for residents. One house-bound resident had the maximum occupancy rate of 8760 h/y.

6.6 Gamma dose rate measurements

Table 45 presents gamma dose rate measurements in the Trawsfynydd direct radiation survey. Representative gamma dose rate measurements were taken both inside and outside a selection of residences and at outdoor background locations outside the area. It should be noted that the measurements, which were taken at a height of 1 metre, have not been adjusted for natural background dose rates.

The outdoor measurements were taken approximately 5 to 10 metres from the nearest buildings. With the exception of the electricity sub-station and Position 1 at the perimeter fence, all measurements were over grass and, in the survey area, ranged from 0.073 to 0.102 µGy/h and along the perimeter fence ranged from 0.088 to 0.136 µGy/h. Indoor measurements ranged from 0.071 to 0.148 µGy/h and were for the most part higher than the

corresponding outdoor measurements. This is more likely to be due to natural radioactivity in the building materials than to any artificial sources. Background readings over grass taken outside the direct radiation survey area ranged from 0.072 – 0.082 μGy/h. It can be seen that, at the time of the survey, some outdoor measurements were higher than the maximum background measurement.

Comprehensive studies of background radiation have been carried out on a national scale by the National Radiological Protection Board (since 1st April 2005, the Radiation Protection Division of the Health Protection Agency), the most recent of these being a review conducted during 1999 (Hughes, 1999). The results from these could be used for comparison.

7 COMBINED PATHWAYS

In determining habits data for the purposes of assessing radiological doses to the public, it may be necessary to consider a combination of pathways. Data are provided in Annexes 1 and 2 so that the full effect of combining pathways can be assessed for individual observations, given the concentrations and dose rates for a particular assessment. In some circumstances, it will be possible to make simplifying assumptions and define the consumption and external exposure rates appropriate to a series of potential critical groups. Such assumptions will depend on the assessment in question but some initial observations are provided here as a starting point for those undertaking assessments.

The most extensive combinations of pathways for adult dose assessment are shown in Table 46. Each of the 22 combinations shown in Table 46 represents an actual individual (or individuals) from Annex 1 who has positive data (irrespective of the magnitude), for each pathway marked with an asterisk. It should be noted that combination numbers in Table 46 do not correlate directly with observation numbers in Annex 1. Other individuals from Annex 1 have combinations that are not listed in Table 46 because they have fewer pathways and a dose assessment for them would be adequately covered by one of the 22 listed combinations.

Combinations of pathways at critical group rates may be achieved by considering the data in Annexes 1 and 2. Although critical group rates are not given in the annexes, the rates for individuals making up the groups are shown emboldened. Possible combinations of pathways and their associated critical group rates are therefore apparent.

The Environment Agencies and the Food Standards Agency have considered ways of using habits data to calculate total dose retrospectively. The adopted approach is to use the adult consumption and occupancy data collected in each habits survey to create a matrix with a series of habits profiles for each site. The relevant matrix for the Trawsfynydd adults' profiled habits data is shown in Annex 5. The National Dose Assessment Working Group (NDAWG) has considered this approach to assessing retrospective total doses (Camplin *et al*, 2005) and

has agreed that using habits profiles is an appropriate approach. Retrospective total doses around Trawsfynydd will in future be made using these profiles and reported in the Radioactivity in Food and the Environment Reports (See Appendix 7. EA, EHS, FSA and SEPA, 2005).

8 CONCLUSIONS AND SUGGESTIONS

8.1 Survey findings

The survey investigated the three potential sources of public radiation exposure from the Trawsfynydd site, which were:

- Discharges of liquid radioactive waste to Lake Trawsfynydd
- Discharges of gaseous radioactive waste to the atmosphere
- Emitters of direct radiation

Data were collected for 391 individuals including shore and boat anglers, gorge walkers, farmers, allotment holders, keen gardeners and people spending time within 1.5 km of the site. These people were targeted because their habits and where they live may cause them to be exposed to radioactivity from the site. However, it should be noted that the most exposed people can only be defined with the outcome of a dose assessment.

All consumption rates recorded in this report include only locally produced or caught foods.

The adult critical group rates (as defined in Section 3.2) for the separate local aquatic consumption pathways were:

- 60 kg/y for rainbow trout affected by liquid discharges
- 1.3 kg/y for brown trout affected by liquid discharges

No consumption of crustaceans, molluscs, aquatic plants and algae or wildfowl was noted.

The critical group occupancy rates over the separate lake shore substrates were:

- 30 h/y for rock
- 450 h/y for sand and stone

No handling of fishing gear (other than angling equipment) or lake sediment was identified.

The maximum occupancy rate in water was 160 h/y and the maximum occupancy rate for time spent on water was 440 h/y.

The adult critical group rates for the separate local consumption pathways for foods affected by gaseous discharges were:

- 19 kg/y for green vegetables
- 19 kg/y for other vegetables
- 35 kg/y for root vegetables
- 28 kg/y for potato
- 14 kg/y for domestic fruit
- 100 l/y for milk
- 19 kg/y for cattle meat
- 25 kg/y for sheep meat
- 13 kg/y for poultry
- 15 kg/y for eggs
- 10 kg/y for wild/free foods
- 0.88 kg/y for rabbits/hares
- 2.0 kg/y for honey
- 1.6 kg/y for wild fungi
- 0.87 kg/y for fish affected by gaseous discharges

No consumption of pig meat, venison or cereals from the survey area was identified. Consumption of foodstuffs by children was also recorded. Combinations of food groups (both aquatic and terrestrial) consumed at critical group rates, together with external pathway exposures, may be achieved from the data for individuals in Annexes 1 and 2. Rates for individuals making up the critical groups are presented in bold type.

The consumption of groundwater and surface water was commonplace and identified at many of the farms. This was usually their only domestic supply.

Transfer of radioactive contamination from the site into the surrounding area by wildlife was investigated. Rabbits and pigeons were resident on site but no members of the public who lived in the survey area were noted to be consuming either species.

For occupancy by members of the public within 1.5 km of the Trawsfynydd licensed site perimeter fence, the highest rates (indoors plus outdoors) were:

- 1800 h/y for the 0 to 0.25 km zone
- 8600 h/y for the 0.25 to 0.5 km zone
- 8760 h/y for the 0.5 to 1.5 km zone

In the inner zone, the highest occupancy rate was due to employment in the area and for the other two zones, the highest occupancy rates were for residents.

8.2 Comparisons with previous surveys

The results from this survey can be compared with results from the previous aquatic and direct radiation surveys at Trawsfynydd in 1994 and 2001 respectively. The 2005 aquatic survey area differed slightly from the one used in 1994 in that it also included the River Prysor between the lake and the River Dwyryd. The direct radiation survey areas were the same in both surveys. No comparisons can be made for the terrestrial survey results as no previous terrestrial surveys have been carried out at Trawsfynydd.

In 1994, the critical group mean consumption rates for fish affected by liquid discharges were 22 kg/y of rainbow trout for a group of 25 people and 1.8 kg/y of brown trout for a group of five people. One consumer belonged to both critical groups. The maximum adult consumption rates were 34 and 2.7 kg/y respectively. Although no consumption of perch (*Perca fluvialitis*) was noted in the 1994 survey, it was decided to retain a value of 0.93 kg/y noted from a

previous survey for the purpose of dose assessment. This was because two interviewed anglers said that they would consume this species if they caught large enough specimens. In 2005, the critical group (formed by one individual) consumption rate for rainbow trout increased significantly to 60 kg/y. The critical group (formed by three individuals) consumption rate for brown trout of 1.3 kg/y was similar to that of 1994. Two of these individuals also consumed rainbow trout in amounts well below the critical group rate. As in 1994, no consumption of perch was noted in the 2005 survey.

Neither survey identified any consumption rates for molluscs, crustaceans or aquatic plants and algae.

The 1994 survey identified three people consuming small quantities of wildfowl but did not calculate consumption rates for them as it was considered to be of negligible radiological significance. In 2005, this pathway had ceased, as wildfowling was no longer permitted at Lake Trawsfynydd.

For occupancy on the lake shore, rates from 1994 over areas of mud, sand and stones can be compared with rates identified in 2005 over sand and stone. No comparison of occupancy rates on the bank of the River Prysor can be made as this was not considered in 1994.

For external pathways, it should be noted that the methodology for determining the critical group has changed since the 1994 survey so care is needed when comparing results. In the following paragraphs, the critical group rates from the 1994 survey have been recalculated using the current method and the rates in brackets were calculated using the original method.

The 1994 critical group mean occupancy rate on lake shore areas of mud, sand and stones using the 2005 methodology was 730 h/y for 28 people consisting of two bailiffs and 26 anglers (1000 h/y for 12 people), with a maximum rate of 1200 h/y. The 2005 critical group mean occupancy rate on lake shore areas of sand and stones was 450 h/y for 12 anglers, the maximum rate being 700 h/y.

Neither survey identified any handling of fishing gear (other than angling equipment) or lake sediment.

A comparison of occupancy rates in and on water cannot be made because this pathway was not investigated in the 1994 survey.

A comparison of the 2001 and 2005 direct radiation survey results shows that in 2001 the highest recorded occupancy rate was 8700 h/y for a person who lived and worked in the 0.25 – 0.5 km zone. In the 2005 survey, the highest occupancy rate was 8760 h/y for a house-bound person who lived 1.25 km from the perimeter fence.

Commercial activities noted in 2001 and still being carried out in 2005 were people working at the electricity sub-station, the caravan park and the public house. However, commercial activities in the visitors centre, the social club and a boat hire portacabin in 2001 were no longer taking place in 2005. Leisure activities in both surveys included angling and walking.

Gamma dose rate measurements for six residences in 2005 can be compared with gamma dose rate measurements taken at similar locations in 2001. Outdoor gamma dose measurements in 2001 over grass ranged from 0.063 to 0.083 μGy/h outdoors. No indoor measurements were taken for comparison. Gamma dose measurements in 2005 ranged from 0.071 to 0.148 μGy/h indoors and from 0.073 to 0.102 μGy/h outdoors over grass.

8.3 Suggestions for environmental monitoring

The 2004 monitoring programmes operated by the Environment Agency and the Food Standards Agency included the following samples and measurements (EA, EHS, FSA and SEPA, 2005):

Aquatic surveillance

- Brown trout from Lake Trawsfynydd
- Rainbow trout from Lake Trawsfynydd
- Perch from Lake Trawsfynydd
- Rudd from Lake Trawsfynydd
- Mud and mud, sand and stones from the pipeline
- Sediment from the lake shore, Bailey Bridge, fish farm, footbridge and Cae Adda
- Freshwater from the Bailey Bridge, Cold Lagoon, public supply, Gwylan Stream, Diversion Culvert, Hot Lagoon, Afon Prysor and the lake

Gamma dose rate measurements

- Stones, pebbles and stones, and pebbles and rock at the footbridge
- Stones at Nant Islyn Bay
- Stones west of the footbridge
- Pebbles and stones, and pebbles and rocks at the lake shore
- Pebbles at the Bailey Bridge
- Pebbles and pebbles and rock at the fish farm
- Mud and pebbles, and pebbles and rock at Cae Adda

Terrestrial surveillance

- Milk
- Blackberries
- Cabbage
- Carrots
- Eggs
- Ovine muscle
- Ovine offal
- Potatoes
- Sloes

The following are suggestions for changes to the current environmental monitoring programmes. It should be noted that the suggestions are based on the findings of this survey and information about samples taken as environmental indicators. They are not the outcome of any form of assessment. It is suggested that samples currently monitored, which are not listed below, remain unchanged in the monitoring programme.

(1) Environment Agency monitoring

- Groundwater and surface water was consumed at many farms. This could be added to the monitoring programme.

(2) Food Standards Agency monitoring

- Cattle meat and runner beans could be added to the programme as both food types were eaten in significant quantities
- Black currants could replace sloes because they are consumed in larger quantities and are much easier to obtain

9 ACKNOWLEDGEMENTS

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www.statistics.gov.uk

Figure 1. The Trawsfynydd aquatic survey area

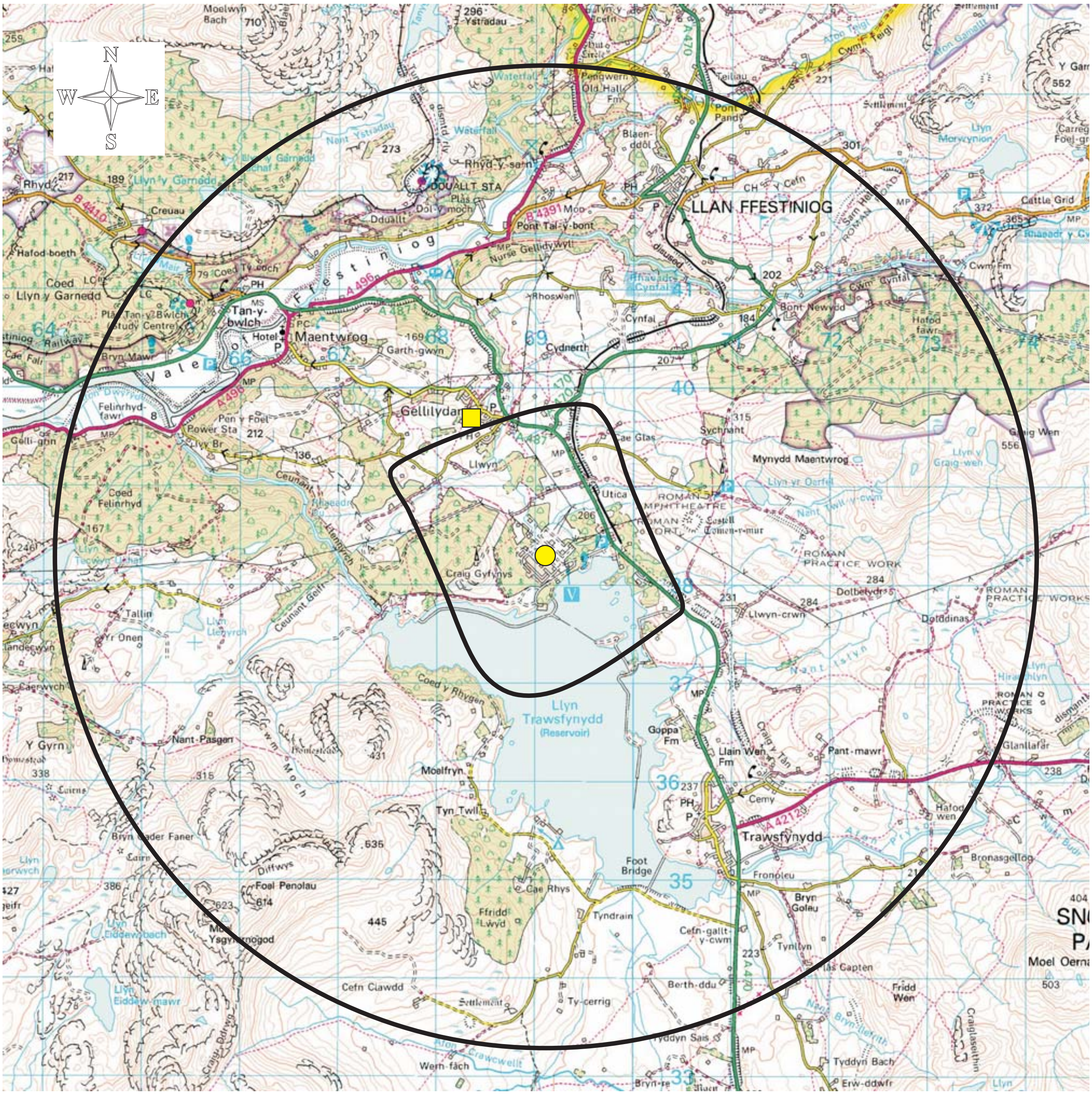

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Figure 2. The Trawsfynydd terrestrial (outer ring) and direct radiation (inner ring) survey areas

○ Trawsfynydd site centre

□ Gellilydan allotments

Table 1. Survey coverage

Group	Criteria	Estimate of complete coverage	Number for whom positive data was obtained	Coverage for positive observations	Notes
SUMMARY OF ALL PATHWAYS					
All potential people in Trawsfynydd aquatic, terrestrial and direct radiation survey areas	Number of people resident in terrestrial survey area (excluding those resident in the direct radiation survey area) (See (B) terrestrial pathways)	3400^	147^^	*	The survey targeted individuals who were potentially the most exposed (Section 2.4), mostly producers of local food (farmers and allotment holders). Number for whom positive data was obtained includes 36 people who consumed terrestrial foods but lived outside 5 km.
	Number of people resident in the direct radiation survey area (See (C), direct radiation pathways)	80	52	****	Number for whom positive data was obtained includes 4 holiday home occupants and 4 people who also work in the direct radiation survey area.
	Number of people working in or visiting, but not resident in the direct radiation survey area (See (C), direct radiation pathways)	U	30	U	Excluding employees and contractors of Magnox Electric Ltd and people living in the direct radiation survey area.
	Number of people affected by liquid discharges (excluding people resident in the terrestrial survey area) (See (A) aquatic pathways)	U	162^^	U	
	Approximate total for aquatic, terrestrial and direct radiation survey areas	U	391^^	U	In the All Pathways section each interviewee has only been counted once. This is in the section where their predominant activities took place.
(A) AQUATIC PATHWAYS					
Boat anglers	Number spoken to or heard of during survey	20	8	**	Regular angling club members using boats.
Lake shore anglers	Number spoken to during survey	150	30	*	Regular angling club members.
Gorge walking	Members of extreme sports clubs	U	3	U	Interviews with 3 instructors.

Table 1. Survey coverage

Group	Criteria	Estimate of complete coverage	Number for whom positive data was obtained	Coverage for positive observations	Notes
(B) TERRESTRIAL PATHWAYS^^^					
Farms and smallholdings	Number of farmers and their family members consuming farm produce from the survey area	150	131	*****	Estimate of 46 farms or smallholdings in the area, 39 of which were interviewed.
Bee keepers	Number of people consuming honey from the survey area	U	17	U	4 beekeepers were identified in the survey area, all were interviewed.
(C)DIRECT RADIATION PATHWAYS					
Occupancy of area	Number with occupancies > 100 hours (excluding site employees)	U	68	U	
Residents	Number of residents in the survey area	80	52	****	Estimate of 30 occupied houses in the area (including holiday and weekend homes), occupants from 19 of which were interviewed.
Employees	Number of people predominantly based in survey area (>500 hours)	15	15	*****	Including 4 people who live in the direct radiation area, excluding site employees and contractors,
BREAKDOWN OF AGE GROUPS					
Adults	Individuals over 17	U	332	U	
15 year old	More than 12.0 year old to 17.0 year old	U	21	U	
10 year old	More than 7.0 year old to 12.0 year old	U	20	U	
5 year old	More than 2.0 year old to 7.0 year old	U	16	U	
1 year old	More than 1.0 year old to 2.0 year old	U	1	U	
3 month old	From 0 to 1.0 year old	U	1	U	

Notes

^ - Data from www.statistics.gov.uk were used to estimate this figure for people resident in the 5 km survey area

^^ - The number of people for whom positive data was obtained, for pathways (A) and (B), will not equal the relevant totals in the summary. This is because some individuals, for example someone who fishes from a boat and the shore and digs their own bait, will be counted three times within the pathway, whereas others, such as the families of fishermen, will not be counted at all.

^^^ - 3 retail outlets, out of a possible 3 were visited during the survey

U - Unknown

Coverage

* = >0-20% ** = 20 - 40% *** = 40 - 60% **** = 60-80% ***** =80-100%

Table 2. Typical food groups used in habits surveys

Green vegetables	Globe artichoke, asparagus, broccoli, brussel sprout, cabbage, calabrese, cauliflower, chard, courgettes, cucumber, gherkin, herbs, kale, leaf beet, lettuce, marrow, spinach
Other vegetables	Aubergine, broad bean, chilli pepper, french bean, mangetout, pea, pepper, runner bean, sweetcorn, tomato
Root vegetables	Jerusalem artichoke, beetroot, carrot, celeriac, celery, chicory, fennel, garlic, kohl rabi, leek, onion, parsnip, radish, shallot, spring onion, swede, turnip
Potato	
Domestic fruit	Apple, apricot, blackberry, blackcurrant, boysenberry, cherry, damson, fig, gooseberry, grapes, greengages, huckleberry, loganberry, melon, nectarines, peach, pear, plum, pumpkin, raspberry, redcurrants, rhubarb, rowanberry, strawberry, tayberry, whitecurrant
Milk	Milk, butter, cream, cheese, yoghurt, goats milk
Cattle meat †	
Pig meat †	
Sheep meat †	
Poultry	Chicken, duck, goose, grouse, guinea fowl, partridge, pheasant, pigeon, snipe, turkey, woodcock
Eggs	Chicken egg, duck egg, goose egg
Wild/free foods	Blackberry, blackcurrant, chestnut, crab apple, damson, dandelion root, elderberry, nettle, raspberry, rowanberry, samphire, sloe, strawberry, watercress, wild apple
Honey	
Wild Fungi	Mushrooms
Rabbits/Hare	Hare, rabbit
Venison †	
Fish (sea)	Bass, brill, cod, common ling, dab, Dover sole, flounder, gurnard, haddock, hake, herring, lemon sole, mackerel, monkfish, mullet, plaice, pollack, witch saithe, salmon, sea trout, squid*, cuttlefish*, rays, turbot, whitebait, whiting
Fish (freshwater)	Brown trout, rainbow trout, perch, pike, salmon (river), eels
Crustaceans	Brown crab, spider crab, crawfish, lobster, *Nephrops*, squat lobster, prawn, shrimp
Molluscs	Cockles, limpets, mussels, oysters, queens, scallops, razor shell, whelks, winkles

Notes:
* Although squid and cuttlefish are molluscs, radiologically they are more akin to fish
† Including offal

Table 3. Adults' consumption rates of fish affected by liquid discharges in the Trawsfynydd area (kg/y)

Observation number	Brown trout	Rainbow trout	Salmon	Total
43		**59.8**		**59.8**
225		17.0		17.0
59		15.3		15.3
44-45		13.1		13.1
207		13.0		13.0
86		13.0		13.0
48-49		11.5		11.5
84-85		11.3		11.3
224		11.3		11.3
214-215		10.4		10.4
135-136		10.3		10.3
97-98		8.8		8.8
313	**1.8**	7.1		8.8
40-41		8.3		8.3
42		7.1		7.1
99-102		6.6		6.6
217-218		6.6		6.6
187		6.5		6.5
60-64		6.2		6.2
236-237		6.1		6.1
204		5.2		5.2
220-221	**1.1**	4.1		5.2
118-119		5.2		5.2
233-235		5.1		5.1
216		5.0		5.0
191-192		4.7		4.7
127-128		4.6		4.6
80		4.1		4.1
114-117		4.1		4.1
120-123		4.1		4.1
129-130		4.1		4.1
238-241		4.1		4.1
361		4.0		4.0
308		3.5		3.5
277-278			2.9	2.9
375-379		2.8		2.8
275-276		2.5		2.5
108-111		2.3		2.3
88-92		2.2		2.2
299-302		2.1		2.1
82-83		2.1		2.1
148-149		1.9		1.9
107		1.4		1.4
112-113		1.4		1.4
188-189		1.4		1.4
210-211		1.2		1.2
339-346		1.1		1.1
310		1.1		1.1
124-126		0.9		0.9
193-194		0.8		0.8
226-229		0.7		0.7
190		0.5		0.5
309		0.4		0.4
351-352		0.4		0.4
257-258		0.2		0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of fish based on the 1 highest adult consumer is 59.8 kg/y

The observed 97.5 percentile rate for rainbow trout and salmon based on 123 observations is 13.1 kg/y

If brown trout are considered separately, a critical group consumption rate based on 3 individuals is 1.3 kg/y

The observed 97.5 percentile rate for brown trout based on 3 observations is 1.8 kg/y

Table 4. Children's consumption rates of fish affected by liquid discharges in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Rainbow trout
106	**15**	**6.6**
103	**14**	**6.6**
104	**13**	**6.6**
105	**12**	**6.6**
186	**15**	**6.5**
150	15	1.9
353	14	0.4
195	13	0.4
354	12	0.4

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of fish based on the 5 highest 15 year old consumers is 6.6 kg/y
The observed 97.5 percentile rate based on 9 observations is 6.6 kg/y

10 year old age group

Observation number	Age	Rainbow trout
46	**8**	**13.1**
50	**9**	**11.5**
51	**8**	**11.5**
93	10	2.2
95	9	2.2
96	8	2.2
94	7	2.2
196	11	0.4

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of fish based on the 3 highest 10 year old consumers is 12.0 kg/y
The observed 97.5 percentile rate based on 8 observations is 12.9 kg/y

5 year old age group

Observation number	Age	Rainbow trout
47	**6**	**6.6**
87	**5**	**6.5**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of fish based on the 2 highest 5 year old consumers is 6.5 kg/y
The observed 97.5 percentile rate based on 2 observations is 6.6 kg/y

Table 5. Summary of adults' consumption rates in the Trawsfynydd area (kg/y or l/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed minimum critical consumption rate	Observed critical group mean consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Rainbow trout[1]	123	1	59.8	59.8	59.8	13.1	15.0	40.0
Brown trout[1]	3	3	1.8	1.1	1.3	1.8	15.0	40.0
Crustaceans[1]	NC	NC	NC	NC	NC	NC	3.5	10.0
Molluscs[1]	NC	NC	NC	NC	NC	NC	3.5	10.0
Green vegetables	41	18	32.3	11.4	19.1	32.3	15.0	45.0
Other vegetables	46	16	33.6	11.3	19.3	32.1	20.0	50.0
Root vegetables	41	11	56.0	19.6	35.2	56.0	10.0	40.0
Potato	43	17	47.2	20.2	28.3	46.9	50.0	120.0
Domestic fruit	49	15	24.7	9.1	13.9	23.4	20.0	75.0
Milk	4	4	170.5	81.1	104.5	164.1	95.0	240.0
Cattle meat	58	30	30.0	11.8	18.9	27.0	15.0	45.0
Pig meat	NC	NC	NC	NC	NC	NC	15.0	40.0
Sheep meat	96	31	50.9	17.0	25.4	33.9	8.0	25.0
Poultry	21	4	17.3	8.8	13.0	17.3	10.0	30.0
Eggs	47	37	26.7	8.9	14.8	26.7	8.5	25.0
Wild/free foods	50	6	15.1	5.4	10.4	15.1	7.0	25.0
Rabbits/hares	5	5	1.0	0.8	0.9	1.0	6.0	15.0
Honey	13	7	3.4	1.1	2.0	3.4	2.5	9.5
Wild fungi	16	10	2.3	0.9	1.6	2.3	3.0	10.0
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Fish[2]	3	3	0.9	0.9	0.9	0.9	15.0	40.0

[1] = Affected by liquid discharges

[2] = Affected by gaseous discharges

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 6. Summary of 15 year old children's consumption rates in the Trawsfynydd area (kg/y or l/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed minimum critical consumption rate	Observed critical group mean consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Rainbow trout[1]	9	5	6.6	6.5	6.6	6.6	6.5	20.0
Crustaceans[1]	NC	NC	NC	NC	NC	NC	2.5	6.0
Molluscs[1]	NC	NC	NC	NC	NC	NC	2.5	6.0
Green vegetables	3	1	11.5	11.5	11.5	10.9	9.0	25.0
Other vegetables	1	1	3.6	3.6	3.6	NA	10.0	30.0
Root vegetables	3	3	11.8	3.2	6.1	11.4	7.5	20.0
Potato	2	2	22.6	11.1	16.9	22.3	60.0	130.0
Domestic fruit	6	5	5.1	4.2	4.5	5.0	15.0	50.0
Milk	1	1	81.1	81.1	81.1	NA	110.0	260.0
Cattle meat	7	6	21.4	11.8	13.4	20.0	15.0	35.0
Pig meat	NC	NC	NC	NC	NC	NC	10.0	30.0
Sheep meat	7	6	28.3	12.7	19.3	27.0	5.5	15.0
Poultry	1	1	1.8	1.8	1.8	NA	6.5	20.0
Eggs	6	4	15.8	7.9	13.7	15.8	7.0	25.0
Wild/free foods	6	2	0.9	0.8	0.8	0.9	3.0	13.0
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	3	3	1.1	0.7	0.8	1.1	2.0	5.0
Wild fungi	3	2	2.3	1.5	1.9	2.2	2.0	5.5
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Fish[2]	NC	NC	NC	NC	NC	NC	6.5	20.0

[1] = Affected by liquid discharges

[2] = Affected by gaseous discharges

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 7. Summary of 10 year old children's consumption rates in the Trawsfynydd area (kg/y or l/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed minimum critical consumption rate	Observed critical group mean consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Rainbow trout[1]	8	3	13.1	11.5	12.0	12.9	6.0	20.0
Crustaceans[1]	NC	NC	NC	NC	NC	NC	2.5	7.0
Molluscs[1]	NC	NC	NC	NC	NC	NC	2.5	7.0
Green vegetables	NC	NC	NC	NC	NC	NC	6.0	20.0
Other vegetables	1	1	2.1	2.1	2.1	NA	8.0	25.0
Root vegetables	NC	NC	NC	NC	NC	NC	6.0	20.0
Potato	2	1	22.6	22.6	22.6	22.1	45.0	85.0
Domestic fruit	NC	NC	NC	NC	NC	NC	15.0	50.0
Milk	1	1	81.1	81.1	81.1	NA	110.0	240.0
Cattle meat	6	3	21.4	11.8	18.2	21.4	15.0	30.0
Pig meat	NC	NC	NC	NC	NC	NC	8.5	25.0
Sheep meat	7	3	20.0	11.3	17.1	20.0	4.0	10.0
Poultry	2	1	1.8	1.8	1.8	1.8	5.5	15.0
Eggs	3	3	15.8	7.9	10.6	15.5	6.5	20.0
Wild/free foods	3	3	1.0	0.8	0.8	1.0	3.0	11.0
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	NC	NC	NC	NC	NC	NC	2.0	7.5
Wild fungi	3	3	0.5	0.2	0.4	0.5	1.5	4.5
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Fish[2]	NC	NC	NC	NC	NC	NC	6.0	20.0

[1] = Affected by liquid discharges

[2] = Affected by gaseous discharges

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 8. Summary of 5 year old children's consumption rates in the Trawsfynydd area (kg/y or l/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed minimum critical consumption rate	Observed critical group mean consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Rainbow trout[1]	2	2	6.6	6.5	6.5	6.6	ND	ND
Crustaceans[1]	NC	NC	NC	NC	NC	NC	ND	ND
Molluscs[1]	NC	NC	NC	NC	NC	NC	ND	ND
Green vegetables	1	1	5.7	5.7	5.7	NA	ND	ND
Other vegetables	2	2	10.3	5.7	8.0	10.2	ND	ND
Root vegetables	1	1	14.9	14.9	14.9	NA	ND	ND
Potato	2	1	11.3	11.3	11.3	11.1	ND	ND
Domestic fruit	1	1	0.5	0.5	0.5	NA	ND	ND
Milk	1	1	40.6	40.6	40.6	NA	ND	ND
Cattle meat	6	4	10.7	5.9	8.9	10.6	ND	ND
Pig meat	NC	NC	NC	NC	NC	NC	ND	ND
Sheep meat	8	6	10.0	3.6	6.8	9.6	ND	ND
Poultry	3	3	0.9	0.1	0.4	0.9	ND	ND
Eggs	4	4	8.0	4.0	6.1	7.9	ND	ND
Wild/free foods	4	4	1.0	0.5	0.7	1.0	ND	ND
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	1	1	0.9	0.9	0.9	NA	ND	ND
Wild fungi	2	2	0.5	0.2	0.3	0.4	ND	ND
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Fish[2]	NC	NC	NC	NC	NC	NC	ND	ND

[1] = Affected by liquid discharges

[2] = Affected by gaseous discharges

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 9. Summary of 1 year old children's consumption rates in the Trawsfynydd area (kg/y or l/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed minimum critical consumption rate	Observed critical group mean consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Rainbow trout[1]	NC	NC	NC	NC	NC	NC	ND	ND
Crustaceans[1]	NC	NC	NC	NC	NC	NC	ND	ND
Molluscs[1]	NC	NC	NC	NC	NC	NC	ND	ND
Green vegetables	NC	NC	NC	NC	NC	NC	ND	ND
Other vegetables	NC	NC	NC	NC	NC	NC	ND	ND
Root vegetables	NC	NC	NC	NC	NC	NC	ND	ND
Potato	NC	NC	NC	NC	NC	NC	ND	ND
Domestic fruit	NC	NC	NC	NC	NC	NC	ND	ND
Milk	NC	NC	NC	NC	NC	NC	ND	ND
Cattle meat	1	1	0.7	0.7	0.7	NA	ND	ND
Pig meat	NC	NC	NC	NC	NC	NC	ND	ND
Sheep meat	1	1	1.8	1.8	1.8	NA	ND	ND
Poultry	1	1	0.1	0.1	0.1	NA	ND	ND
Eggs	NC	NC	NC	NC	NC	NC	ND	ND
Wild/free foods	NC	NC	NC	NC	NC	NC	ND	ND
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	NC	NC	NC	NC	NC	NC	ND	ND
Wild fungi	NC	NC	NC	NC	NC	NC	ND	ND
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Fish[2]	NC	NC	NC	NC	NC	NC	ND	ND

[1] = Affected by liquid discharges

[2] = Affected by gaseous discharges

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 10. Summary of 3 month old children's consumption rates in the Trawsfynydd area (kg/y or l/y)

Food group	Number of observations	No. higher rate consumers	Observed maximum critical consumption rate	Observed minimum critical consumption rate	Observed critical group mean consumption rate	Observed 97.5 %ile consumption rate	Generic mean consumption rate	Generic 97.5 %ile consumption rate
Rainbow trout[1]	NC	NC	NC	NC	NC	NC	3.5	15.0
Crustaceans[1]	NC	NC	NC	NC	NC	NC	ND	ND
Molluscs[1]	NC	NC	NC	NC	NC	NC	ND	ND
Green vegetables	NC	NC	NC	NC	NC	NC	3.5	10.0
Other vegetables	NC	NC	NC	NC	NC	NC	3.0	10.0
Root vegetables	NC	NC	NC	NC	NC	NC	5.0	15.0
Potato	NC	NC	NC	NC	NC	NC	10.0	35.0
Domestic fruit	NC	NC	NC	NC	NC	NC	9.0	35.0
Milk	NC	NC	NC	NC	NC	NC	130.0	320.0
Cattle meat	1	1	4.4	4.4	4.4	NA	3.0	10.0
Pig meat	NC	NC	NC	NC	NC	NC	1.5	5.5
Sheep meat	1	1	2.9	2.9	2.9	NA	0.8	3.0
Poultry	NC	NC	NC	NC	NC	NC	2.0	5.5
Eggs	NC	NC	NC	NC	NC	NC	5.0	15.0
Wild/free foods	NC	NC	NC	NC	NC	NC	1.2	1.8
Rabbits/hares	NC	NC	NC	NC	NC	NC	ND	ND
Honey	NC	NC	NC	NC	NC	NC	2.0	7.5
Wild fungi	NC	NC	NC	NC	NC	NC	0.6	1.5
Venison	NC	NC	NC	NC	NC	NC	ND	ND
Fish[2]	NC	NC	NC	NC	NC	NC	3.5	15.0

[1] = Affected by liquid discharges

[2] = Affected by gaseous discharges

ND = not determined

NC = not consumed

NA = not applicable

For 1 observation, the terms maximum, minimum and mean are not strictly valid

Table 11. Lake shore and river bank occupancy rates in the Trawsfynydd area (h/y)

Observation number	Location	Activity	Rock	Sand and stone
314-315	**River Prysor**	**Working on the bank**	**30**	
213	**Lake Trawsfynydd**	**Angling on the shore**		**700**
59	**" "**	**" "**		**672**
212	**" "**	**" "**		**600**
338	**" "**	**" "**		**572**
224	**" "**	**" "**		**540**
216	**" "**	**" "**		**450**
107	**" "**	**" "**		**432**
43	**" "**	**" "**		**360**
84	**" "**	**" "**		**324**
42	**" "**	**" "**		**288**
114	**" "**	**" "**		**264**
312	**" "**	**" "**		**250**
97	" "	" "		208
186	" "	" "		200
112	" "	" "		192
40	" "	" "		180
233	" "	" "		150
236	" "	" "		150
238	" "	" "		150
135	" "	" "		120
207	" "	" "		120
204-206	" "	" "		110
220	" "	" "		110
118	" "	" "		90
193	" "	" "		80
361	" "	" "		79
86	" "	" "		78
88	" "	" "		78
127-128	" "	" "		64
297-298	" "	" "		64
309-310	" "	" "		64
80-81	" "	" "		50
210-211	" "	" "		50
120	" "	" "		42
122	" "	" "		42
303	" "	" "		36
124-126	" "	" "		30
188	" "	" "		30
191	" "	" "		30
190	" "	" "		20
351	" "	" "		12
354	" "	" "		12
311	" "	" "		10

Notes

Emboldened observations are the critical group members

The critical group intertidal occupancy rate over rock based on 2 observations is 30 h/y

The observed 97.5 percentile rate based on 2 observations for rock is 30 h/y

The critical group intertidal occupancy rate over sand and stones based on 12 observations is 454 h/y

The observed 97.5 percentile rate based on 52 observations for sand and stones is 652 h/y

Table 12. Gamma dose rate measurements over lake shore substrates in the Trawsfynydd area (micro Gy/h)

Location	NGR	Substrate	Gamma dose rate at 1 metre
Cae Adda Bay	SH 692 357	Peat	0.061
Footbridge	SH 703 349	Sand and stone	0.096
Clubhouse	SH 698 383	Mud and sand	0.126
Walkers Bay	SH 697 382	Sand and stone	0.085
Prysor Hatchery shore	SH 698 383	Mud, sand and slate	0.099

Table 13. Occupancy rates in and on water in the Trawsfynydd area (h/y)

Observation number	Location	Activity	In water	On water
316	River Prysor	Working in the river	156	
317-318	River Prysor	Working in the river	54	
226	Lake Trawsfynydd	Angling		440
43	Lake Trawsfynydd	Angling		360
361	Lake Trawsfynydd	Angling		246
129	Lake Trawsfynydd	Angling		132
304	Lake Trawsfynydd	Angling		130
137	Lake Trawsfynydd	Angling		72
208	Lake Trawsfynydd	Angling		70
209	Lake Trawsfynydd	Angling		70

Table 14. Adults' consumption rates of green vegetables in the Trawsfynydd area (kg/y)

Observation number	Asparagus	Broccoli	Brussel sprout	Cabbage	Cauliflower	Courgettes	Cucumber	Kale	Lettuce	Marrow	Spinach	Total
275-276						**22.1**	**10.2**					**32.3**
5	**1.0**	**6.0**	**3.6**	**4.9**	**3.7**	**1.5**	**3.4**		**2.4**	**1.4**	**1.4**	**29.3**
139	**1.0**	**6.0**	**3.6**	**4.9**	**3.7**	**1.5**	**3.4**		**2.4**	**1.4**	**1.4**	**29.3**
145-146		**2.7**	**2.7**		**2.0**		**17.0**		**2.0**			**26.5**
293-294		**2.9**	**1.0**	**2.9**	**1.0**		**3.4**	**2.9**	**3.0**		**1.0**	**18.1**
75-76				**12.8**					**5.0**			**17.8**
295-296				**11.1**					**2.9**			**14.0**
267-269		**3.0**	**1.8**	**2.4**	**1.5**		**2.1**		**0.6**			**11.5**
362-364		**0.7**		**5.4**	**3.3**		**2.0**					**11.4**
374-379			1.5	4.3	1.4				2.5			9.6
325-326							2.0		3.6			5.6
366-373		0.1		1.0	0.6		0.4					2.1
248-249									1.4			1.4
380-381									1.2			1.2
243-245									1.0			1.0

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of green vegetables based on the 18 highest adult consumers is 19.1 kg/y

The observed 97.5 percentile rate based on 41 observations is 32.3 kg/y

Table 15. Adults' consumption rates of other vegetables in the Trawsfynydd area (kg/y)

Observation number	Broad bean	French bean	Mangetout	Pea	Pepper	Runner bean	Sweetcorn	Tomato	Total
275-276				**4.5**		**6.1**	**1.4**	**21.6**	**33.6**
169-171				**10.8**		**10.6**			**21.4**
362-364	**2.0**	**1.6**		**4.0**		**10.2**		**2.9**	**20.6**
380-381						**18.4**			**18.4**
5	**0.9**	**0.4**	**1.8**	**1.8**		**5.4**		**5.8**	**16.1**
139	**0.9**	**0.4**	**1.8**	**1.8**		**5.4**		**5.8**	**16.1**
295-296				**5.9**		**5.9**			**11.8**
201-202				**4.5**		**6.8**			**11.3**
75-76								9.0	9.0
248-249				2.0		6.1			8.1
145-146		0.9				2.3			7.7
293-294	1.4	2.0		2.3		0.7			6.4
70-72								4.8	4.8
325-326				2.1				2.3	4.4
374-379				0.1	0.3			3.6	4.0
367-369	0.4	0.3		0.7		1.9		0.5	3.9
371-372	0.4	0.3		0.7		1.9		0.5	3.9
366	0.4	0.3		0.7		1.9		0.5	3.9
370	0.4	0.3		0.7		1.9		0.5	3.9
373	0.4	0.3		0.7		1.9		0.5	3.9
267-269								3.6	3.6

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of other vegetables based on the 16 highest adult consumers is 19.3 kg/y

The observed 97.5 percentile rate based on 46 observations is 32.1 kg/y

Table 16. Adults' consumption rates of root vegetables in the Trawsfynydd area (kg/y)

Observation number	Beetroot	Carrot	Celery	Kohl rabi	Leek	Onion	Parsnip	Radish	Shallot	Spring onion	Swede	Turnip	Total
295-296	**2.9**	**35.4**									**17.7**		**56.0**
75-76	**6.8**	**4.5**			**4.0**	**11.0**	**9.1**	**2.3**					**37.7**
5	**3.6**	**7.2**	**2.2**		**7.2**	**5.8**	**2.9**				**5.4**	**1.1**	**35.3**
139	**3.6**	**7.2**	**2.2**		**7.2**	**5.8**	**2.9**				**5.4**	**1.1**	**35.3**
362-364	**5.9**	**4.0**		**5.9**	**7.9**	**3.2**			**1.4**				**28.3**
381	**4.5**	**1.3**					**5.4**				**13.7**		**24.8**
380	**4.5**	**1.3**								**0.2**	**13.7**		**19.6**
145-146	5.7	2.7				2.7	2.3	3.5					16.9
294	0.7	0.5			2.7	6.8	0.9		1.4				12.9
267-269		7.4				1.4	3.0						11.8
293	0.7	0.5				6.8	0.9		1.4				10.2
275-276		1.0				2.6		1.5	2.4				7.5
367-368	1.1	0.7		2.2	1.5	0.6			0.5				6.7
366	1.1	0.7		2.2	1.5	0.6			0.5				6.7
369-373	1.1	0.7		2.2	1.5	0.6			0.5				6.7
374-379	0.5	0.5			1.3	2.1				0.3			4.6
243-245	1.4	1.8											3.2
248-249										0.9			0.9
325-326										0.1			0.1

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of root vegetables based on the 11 highest adult consumers is 35.2 kg/y

The observed 97.5 percentile rate based on 41 observations is 56.0 kg/y

Table 17. Adults' consumption rates of potato in the Trawsfynydd area (kg/y)

Observation number	Potato
295-296	**47.2**
293-294	**41.3**
5	**27.3**
139	**27.3**
169-171	**25.0**
145-146	**22.7**
8-9	**22.6**
248-249	**21.8**
380	**20.2**
381	**20.2**
267-269	11.1
75-76	10.6
275-276	6.1
362-364	4.0
374-379	3.6
325-326	1.8
366-373	0.8

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of potato based on the 17 highest adult consumers is 28.3 kg/y

The observed 97.5 percentile rate based on 43 observations is 46.9 kg/y

Table 18. Adults' consumption rates of domestic fruit in the Trawsfynydd area (kg/y)

Observation number	Apple	Black-berry	Black-currant	Blue-berry	Cherry	Damson	Goose-berry	Logan-berry	Pear	Plum	Rasp-berry	Red-currant	Rhubarb	Straw-berry	White-currant	Total
145-146	**1.4**		**2.7**			**4.5**	**2.3**		**1.1**	**4.5**	**4.5**	**1.4**		**2.3**		**24.7**
294			**0.9**				**3.6**				**4.5**		**9.1**			**18.1**
248-249	**2.3**		**0.9**		**0.2**				**0.9**		**6.1**	**0.9**		**4.3**		**15.6**
5	**1.1**		**4.5**			**0.04**	**1.1**	**1.1**	**1.1**		**1.1**		**2.3**	**2.3**		**14.8**
139	**1.1**		**4.5**				**1.1**	**1.1**	**1.1**		**1.1**		**2.3**	**2.3**		**14.7**
275-276	**0.5**		**1.4**	**0.2**					**0.5**	**0.2**	**1.4**		**4.5**	**2.7**		**11.3**
222-223	**3.5**		**1.8**						**2.3**		**0.9**		**1.8**		**0.5**	**10.8**
2-4			**3.0**									**3.0**			**3.0**	**9.1**
31						**4.5**				**4.5**						**9.1**
231-232			2.3			4.5	1.1									7.9
267-269	2.3		2.3				0.6									5.1
243-244	3.6												0.9			4.5
245	3.6												0.9			4.5
293			0.9								1.8		1.8			4.5
351-352	1.1								1.1	1.8			0.2			4.2
362-364			0.4				0.4						0.9			1.7
358													1.5			1.5
359-360													1.5			1.5
374-379							0.7				0.1			0.6		1.4
6													0.9			0.9
142-143		0.5														0.5
367-370			0.1				0.2						0.2			0.4
372-373			0.1				0.2						0.2			0.4
366			0.1				0.2						0.2			0.4
371			0.1				0.2						0.2			0.4

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of domestic fruit based on the 15 highest adult consumers is 13.9 kg/y

The observed 97.5 percentile rate based on 49 observations is 23.4 kg/y

Table 19. Adults' consumption rates of milk in the Trawsfynydd area (l/y)

Observation number	Milk
165	**170.5**
166	**85.2**
8-9	**81.1**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of milk based on the 4 highest adult consumers is 104.5 l/y
The observed 97.5 percentile rate based on 4 observations is 164.1 l/y

Table 20. Adults' consumption rates of cattle meat in the Trawsfynydd area (kg/y)

Observation number	Beef
32	**30.0**
179-185	**27.0**
347-348	**23.7**
33	**20.0**
152-153	**18.9**
157-158	**18.9**
172-174	**18.9**
175-176	**15.1**
267-269	**11.8**
259-261	**11.8**
295-296	**11.8**
351-352	**11.8**
160-161	5.0
293-294	4.5
277-288	2.7
5	2.5
139	2.5
304-307	2.3
257-258	1.4
328-329	1.4
275-276	0.7

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the 30 highest adult consumers is 18.9 kg/y
The observed 97.5 percentile rate based on 58 observations is 27.0 kg/y

Table 21. Adults' consumption rates of sheep meat in the Trawsfynydd area (kg/y)

Observation number	Lamb
5	**50.9**
139	**50.9**
28	**33.9**
38-39	**33.9**
32	**30.0**
141-143	**28.3**
347-350	**28.3**
160-161	**25.4**
358-360	**22.6**
33	**20.0**
177-178	**19.8**
148-149	**18.8**
243-245	**18.1**
1	**17.0**
24-25	**17.0**
29-30	**17.0**
152-153	15.8
157-158	15.8
172-174	13.6
179-185	12.9
267-269	12.7
13-20	11.3
26-27	11.3
159	11.3
169-171	11.3
250	11.3
253-256	11.3
277-278	11.3
175-176	10.8
332-335	9.0
337	9.0
167-168	8.5
279-288	6.6
2-3	5.7
197-200	5.7
8-9	5.0

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of sheep meat based on the 31 highest adult consumers is 25.4 kg/y

The observed 97.5 percentile rate based on 96 observations is 33.9 kg/y

Table 22. Adults' consumption rates of poultry in the Trawsfynydd area (kg/y)

Observation number	Chicken	Duck	Turkey	Total
5	**2.3**	**4.5**	**10.5**	**17.3**
139	**2.3**	**4.5**	**10.5**	**17.3**
6			**8.8**	**8.8**
140			**8.8**	**8.8**
172-174	3.6			3.6
175-176	2.9			2.9
8-9	1.8			1.8
279-288			0.3	0.3

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of poultry based on the 4 highest adult consumers is 13.0 kg/y
The observed 97.5 percentile rate based on 21 observations is 17.3 kg/y

Table 23. Adults' consumption rates of eggs in the Trawsfynydd area (kg/y)

Observation number	Chicken egg	Duck egg	Total
222-223	**26.7**		**26.7**
5	**8.9**	**17.6**	**26.5**
139	**8.9**	**17.6**	**26.5**
293-294		**22.6**	**22.6**
276	**14.8**	**5.9**	**20.7**
259-261	**15.8**		**15.8**
141-143	**15.2**		**15.2**
382	**15.2**		**15.2**
145-146	**8.9**	**5.9**	**14.8**
172-174	**14.2**		**14.2**
169-171	**11.9**		**11.9**
277-278	**11.9**		**11.9**
332	**11.9**		**11.9**
334-335	**11.9**		**11.9**
147		**11.8**	**11.8**
175-176	**11.4**		**11.4**
362-364	**10.2**		**10.2**
248-249	**8.9**		**8.9**
356-357	**8.9**		**8.9**
8-9	7.9		7.9
275	7.4		7.4
337	7.4		7.4
167-168	5.9		5.9
351-352	4.4		4.4
257-258	1.5		1.5

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of eggs based on the 37 highest adult consumers is 14.8 kg/y
The observed 97.5 percentile rate based on 47 observations is 26.7 kg/y

Table 24. Adults' consumption rates of wild/free foods in the Trawsfynydd area (kg/y)

Observation number	Blackberry	Crab apple	Elderberry	Plums	Raspberry	Rosehip	Total
2-4	**15.1**						**15.1**
380-381	**5.7**						**5.7**
151	**2.7**			**2.7**			**5.4**
293-294	2.3			1.4			3.6
5	1.1					2.3	3.4
139	1.1					2.3	3.4
147	2.7						2.7
248-249	2.7						2.7
220-221	1.9	0.6					2.5
231-232	2.3						2.3
277-278	2.3						2.3
159	1.2			0.8			2.0
250	1.2			0.8			2.0
275-276	0.7		0.7				1.4
222-223	1.2						1.2
148-149	0.9						0.9
347-348	0.9						0.9
32-33	0.8						0.8
356-357	0.7						0.7
6	0.5						0.5
140-141	0.5						0.5
319	0.5						0.5
362-364	0.3				0.1		0.3
322-324	0.3						0.3
243-245	0.3						0.3
257-258	0.2						0.2
351-352	0.2						0.2

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of wild/free foods based on the 6 highest adult consumers is 10.4 kg/y

The observed 97.5 percentile rate based on 50 observations is 15.1 kg/y

Table 25. Adults' consumption rates of rabbits/hares in the Trawsfynydd area (kg/y)

Observation number	Hare
172-174	**1.0**
175-176	**0.8**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of rabbits/hares based on the 5 highest adult consumers is 0.9 kg/y
The observed 97.5 percentile rate based on 5 observations is 1.0 kg/y

Table 26. Adults' consumption rates of honey in the Trawsfynydd area (kg/y)

Observation number	Honey
222-223	**3.4**
201-202	**1.8**
271-273	**1.1**
248-249	0.9
351-352	0.7
380-381	0.2

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of honey based on the 7 highest adult consumers is 2.0 kg/y
The observed 97.5 percentile rate based on 13 observations is 3.4 kg/y

Table 27. Adults' consumption rates of wild fungi in the Trawsfynydd area (kg/y)

Observation number	Mushrooms
267-269	**2.3**
1-2	**1.6**
148-149	**1.5**
151	**1.4**
347-348	**0.9**
32-33	0.5
167-168	0.5
159	0.3
250	0.3

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of wild fungi based on the 10 highest adult consumers is 1.6 kg/y
The observed 97.5 percentile rate based on 16 observations is 2.3 kg/y

Table 28. Adults' consumption rates of fish affected by gaseous discharges in the Trawsfynydd area (kg/y)

Observation number	Brown trout
169-171	**0.9**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of fish based on the 3 highest adult consumers is 0.9 kg/y
The observed 97.5 percentile rate based on 3 observations is 0.9 kg/y

Table 29. Children's consumption rates of green vegetables in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Broccoli	Brussel sprout	Cabbage	Cauliflower	Cucumber	Lettuce	Total
270	**16**	**3.0**	**1.8**	**2.4**	**1.5**	**2.1**	**0.6**	**11.5**
246-247	15						1.0	1.0

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of green vegetables based on the highest 15 year old age group consumer is 11.5 kg/y

The observed 97.5 percentile rate based on 3 observations is 10.9 kg/y

5 year old age group

Observation number	Age	Broccoli	Brussel sprout	Cabbage	Cauliflower	Cucumber	Lettuce	Total
365	**2**	**0.3**		**2.7**	**1.6**	**1.0**		**5.7**

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of green vegetables based on the only 5 year old age group consumer is 5.7 kg/y

The observed 97.5 percentile rate is not applicable for 1 observation

Table 30. Children's consumption rates of other vegetables in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Broad bean	French bean	Pea	Runner bean	Tomato	Total
270	**16**					**3.6**	**3.6**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of other vegetables based on the only 15 year old age group consumer is 3.6 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

10 year old age group

Observation number	Age	Broad bean	French bean	Pea	Runner bean	Tomato	Total
327	**7**			**2.1**			**2.1**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of other vegetables based on the only 10 year old age group consumer is 2.1 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

5 year old age group

Observation number	Age	Broad bean	French bean	Pea	Runner bean	Tomato	Total
365	**2**	**1.0**	**0.8**	**2.0**	**5.1**	**1.4**	**10.3**
203	**6**			**2.3**	**3.4**		**5.7**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of other vegetables based on the 2 highest 5 year old age group consumers is 8.0 kg/y
The observed 97.5 percentile rate based on 2 observations is 10.2 kg/y

Table 31. Children's consumption rates of root vegetables in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Beetroot	Carrot	Kohl rabi	Leek	Onion	Parsnip	Shallot	Total
270	**16**		**7.4**			**1.4**	**3.0**		**11.8**
246	**15**	**1.4**	**1.8**						**3.2**
247	**15**	**1.4**	**1.8**						**3.2**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of root vegetables based on the 3 highest 15 year old age group consumers is 6.1 kg/y
The observed 97.5 percentile rate based on 3 observations is 11.4 kg/y

5 year old age group

Observation number	Age	Beetroot	Carrot	Kohl rabi	Leek	Onion	Parsnip	Shallot	Total
365	**2**	**3.0**	**2.0**	**3.0**	**4.0**	**1.6**		**1.4**	**14.9**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of root vegetables based on the only 5 year old age group consumer is 14.9 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 32. Children's consumption rates of potato in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Potato
10	**15**	**22.6**
270	**16**	**11.1**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of potato based on the
2 highest 15 year old age group consumers is 16.9 kg/y
The observed 97.5 percentile rate based on 2 observations is 22.3 kg/y

10 year old age group

Observation number	Age	Potato
11	**11**	**22.6**
327	7	1.8

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of potato based on the highest
10 year old age group consumer is 22.6 kg/y
The observed 97.5 percentile rate based on 2 observations is 22.1 kg/y

5 year old age group

Observation number	Age	Potato
12	**5**	**11.3**
365	2	2.0

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of potato based on the highest
5 year old age group consumer is 11.3 kg/y
The observed 97.5 percentile rate based on 2 observations is 11.1 kg/y

Table 33. Children's consumption rates of domestic fruit in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Apple	Blackberry	Blackcurrant	Gooseberry	Pear	Plum	Raspberry	Rhubarb	Total
270	**16**	**2.3**		**2.3**	**0.6**					**5.1**
246-247	**15**	**3.6**							**0.9**	**4.5**
353	**14**	**1.1**				**1.1**	**1.8**		**0.2**	**4.2**
354	**12**	**1.1**				**1.1**	**1.8**		**0.2**	**4.2**
144	16		0.5							0.5

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of domestic fruit based on the 5 highest 15 year old age group consumers is 4.5 kg/y

The observed 97.5 percentile rate based on 6 observations is 5.0 kg/y

5 year old age group

Observation number	Age	Apple	Blackberry	Blackcurrant	Gooseberry	Pear	Plum	Raspberry	Rhubarb	Total
365	**2**							**0.03**	**0.5**	**0.5**

Notes

Emboldened observations are the critical group consumers

The critical group consumption rate of domestic fruit based on the only 5 year old age group consumer is 0.5 kg/y

The observed 97.5 percentile rate is not applicable for 1 observation

Table 34. Children's consumption rates of milk in the Trawsfynydd area (l/y)

15 year old age group

Observation number	Age	Milk
10	**15**	**81.1**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of milk based on the only 15 year old age group consumer is 81.1 l/y
The observed 97.5 percentile rate is not applicable for 1 observation

10 year old age group

Observation number	Age	Milk
11	**11**	**81.1**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of milk based on the only 10 year old age group consumer is 81.1 l/y
The observed 97.5 percentile rate is not applicable for 1 observation

5 year old age group

Observation number	Age	Milk
12	**5**	**40.6**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of milk based on the only 5 year old age group consumer is 40.6 l/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 35. Children's consumption rates of cattle meat in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Beef
34	**12**	**21.4**
270	**16**	**11.8**
262	**14**	**11.8**
353	**14**	**11.8**
263	**12**	**11.8**
354	**12**	**11.8**
331	13	1.4

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the 6 highest 15 year old age group consumers is 13.4 kg/y
The observed 97.5 percentile rate based on 7 observations is 20.0 kg/y

10 year old age group

Observation number	Age	Beef
35	**11**	**21.4**
36	**9**	**21.4**
264	**10**	**11.8**
265	8	5.9
330	10	1.4
289	7	1.4

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the 3 highest 10 year old age group consumers is 18.2 kg/y
The observed 97.5 percentile rate based on 6 observations is 21.4 kg/y

5 year old age group

Observation number	Age	Beef
37	**4**	**10.7**
154	**5**	**9.5**
155	**4**	**9.5**
266	**5**	**5.9**
290	5	1.4
291	2	0.7

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the 4 highest 5 year old age group consumers is 8.9 kg/y
The observed 97.5 percentile rate based on 6 observations is 10.6 kg/y

Table 35. Children's consumption rates of cattle meat in the Trawsfynydd area (kg/y)

1 year old age group

Observation number	Age	Beef
292	**1**	**0.7**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the only 1 year old age group consumer is 0.7 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

3 month old age group

Observation number	Age	Beef
156	**0.5**	**4.4**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of cattle meat based on the only 3 month old age group consumer is 4.4 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 36. Children's consumption rates of sheep meat in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Lamb
144	**16**	**28.3**
34	**12**	**20.0**
150	**15**	**18.8**
246-247	**15**	**18.1**
270	**16**	**12.7**
10	15	5.0

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of sheep meat based on the 6 highest 15 year old age group consumers is 19.3 kg/y
The observed 97.5 percentile rate based on 7 observations is 27.0 kg/y

10 year old age group

Observation number	Age	Lamb
35	**11**	**20.0**
36	**9**	**20.0**
21	**10**	**11.3**
251	8	5.7
22	7	5.7
11	11	5.0
289	7	3.6

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of sheep meat based on the 3 highest 10 year old age group consumers is 17.1 kg/y
The observed 97.5 percentile rate based on 7 observations is 20.0 kg/y

5 year old age group

Observation number	Age	Lamb
37	**4**	**10.0**
154	**5**	**7.9**
155	**4**	**7.9**
252	**5**	**5.7**
23	**3**	**5.7**
290	**5**	**3.6**
12	5	2.5
291	2	1.8

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of sheep meat based on the 6 highest 5 year old age group consumers is 6.8 kg/y
The observed 97.5 percentile rate based on 8 observations is 9.6 kg/y

Table 36. Children's consumption rates of sheep meat in the Trawsfynydd area (kg/y)

1 year old age group

Observation number	Age	Lamb
292	**1**	**1.8**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of sheep meat based on the only 1 year old age group consumer is 1.8 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

3 month old age group

Observation number	Age	Lamb
156	**0.5**	**2.9**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of sheep meat based on the only 3 month age old group consumer is 2.9 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 37. Children's consumption rates of poultry in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Chicken	Turkey	Total
10	**15**	**1.8**		**1.8**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of poultry based on the only 15 year old age group consumer is 1.8 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

10 year old age group

Observation number	Age	Chicken	Turkey	Total
11	**11**	**1.8**		**1.8**
289	7		0.2	0.2

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of poultry based on the highest 10 year old age group consumer is 1.8 kg/y
The observed 97.5 percentile rate based on 2 observations is 1.8 kg/y

5 year old age group

Observation number	Age	Chicken	Turkey	Total
12	**5**	**0.9**		**0.9**
290	**5**		**0.2**	**0.2**
291	**2**		**0.1**	**0.1**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of poultry based on the 3 highest 5 year old age group consumers is 0.4 kg/y
The observed 97.5 percentile rate based on 3 observations is 0.9 kg/y

1 year old age group

Observation number	Age	Chicken	Turkey	Total
292	**1**		**0.1**	**0.1**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of poultry based on the only 1 year old age group consumer is 0.1 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 38. Children's consumption rates of eggs in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Chicken egg
262	**14**	**15.8**
263	**12**	**15.8**
144	**16**	**15.2**
10	**15**	**7.9**
353	14	4.4
354	12	4.4

Notes

Emboldened observations are the critical group consumers
The critical group consumption rate of eggs based on the 4 highest 15 year old age group consumers is 13.7 kg/y
The observed 97.5 percentile rate based on 6 observations is 15.8 kg/y

10 year old age group

Observation number	Age	Chicken egg
264	**10**	**15.8**
265	**8**	**8.0**
11	**11**	**7.9**

Notes

Emboldened observations are the critical group consumers
The critical group consumption rate of eggs based on the 3 highest 10 year old age group consumers is 10.6 kg/y
The observed 97.5 percentile rate based on 3 observations is 15.5 kg/y

5 year old age group

Observation number	Age	Chicken egg
266	**5**	**8.0**
336	**4**	**7.4**
365	**2**	**5.1**
12	**5**	**4.0**

Notes

Emboldened observations are the critical group consumers
The critical group consumption rate of eggs based on the 4 highest 5 year old age group consumers is 6.1 kg/y
The observed 97.5 percentile rate based on 4 observations is 7.9 kg/y

Table 39. Children's consumption rates of wild/free foods in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Blackberry	Plums	Total
150	**15**	**0.9**		**0.9**
34	**12**	**0.8**		**0.8**
246-247	15	0.3		0.3
353	14	0.2		0.2
354	12	0.2		0.2

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of wild/free foods based on the 2 highest 15 year old age group consumers is 0.8 kg/y
The observed 97.5 percentile rate based on 6 observations is 0.9 kg/y

10 year old age group

Observation number	Age	Blackberry	Plums	Total
251	**8**	**0.6**	**0.4**	**1.0**
35	**11**	**0.8**		**0.8**
36	**9**	**0.8**		**0.8**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of wild/free foods based on the 3 highest 10 year old age group consumers is 0.8 kg/y
The observed 97.5 percentile rate based on 3 observations is 1.0 kg/y

5 year old age group

Observation number	Age	Blackberry	Plums	Total
252	**5**	**0.6**	**0.4**	**1.0**
37	**4**	**0.8**		**0.8**
321	**6**	**0.5**		**0.5**
320	**3**	**0.5**		**0.5**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of wild/free foods based on the 4 highest 5 year old age group consumers is 0.7 kg/y
The observed 97.5 percentile rate based on 4 observations is 1.0 kg/y

Table 40. Children's consumption rates of honey in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Honey
274	**15**	**1.1**
353	**14**	**0.7**
354	**12**	**0.7**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of honey based on the 3 highest 15 year old age group consumers is 0.8 kg/y
The observed 97.5 percentile rate based on 3 observations is 1.1 kg/y

5 year old age group

Observation number	Age	Honey
203	**6**	**0.9**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of honey based on the only 5 year old age group consumer is 0.9 kg/y
The observed 97.5 percentile rate is not applicable for 1 observation

Table 41. Children's consumption rates of wild fungi in the Trawsfynydd area (kg/y)

15 year old age group

Observation number	Age	Mushrooms
270	**16**	**2.3**
150	**15**	**1.5**
34	12	0.5

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of wild fungi based on the 2 highest 15 year old age group consumers is 1.9 kg/y
The observed 97.5 percentile rate based on 3 observations is 2.2 kg/y

10 year old age group

Observation number	Age	Mushrooms
35	**11**	**0.5**
36	**9**	**0.5**
251	**8**	**0.2**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of wild fungi based on the 3 highest 10 year old age group consumers is 0.4 kg/y
The observed 97.5 percentile rate based on 3 observations is 0.5 kg/y

5 year old age group

Observation number	Age	Mushrooms
37	**4**	**0.5**
252	**5**	**0.2**

Notes
Emboldened observations are the critical group consumers
The critical group consumption rate of wild fungi based on the 2 highest 5 year old age group consumers is 0.3 kg/y
The observed 97.5 percentile rate based on 2 observations is 0.4 kg/y

Table 42. Percentage contribution each food type makes to its terrestrial food group for adults

Green vegetables	
***Cabbage**	27.4 %
Cucumber	20.0 %
Lettuce	14.3 %
Courgettes	10.7 %
Cauliflower	9.3 %
Broccoli	8.1 %
Brussel sprout	6.7 %
Kale	1.3 %
Spinach	1.1 %
Marrow	0.7 %
Asparagus	0.5 %
Asparagus	0.5 %
Other vegetables	
Runner bean	39.5 %
Tomato	31.9 %
Pea	21.1 %
French bean	3.0 %
Broad bean	2.7 %
Mangetout	0.8 %
Sweetcorn	0.6 %
Pepper	0.4 %
Pepper	0.4 %
Root vegetables	
***Carrot**	26.1 %
Onion	15.1 %
Beetroot	13.9 %
Swede	12.5 %
Leek	11.7 %
Parsnip	7.6 %
Kohl rabi	6.1 %
Shallot	2.7 %
Radish	2.5 %
Celery	0.7 %
Spring onion	0.7 %
Turnip	0.4 %

Domestic fruit	
Blackcurrant	16.1 %
Rhubarb	14.1 %
Apple	12.9 %
Raspberry	12.1 %
Strawberry	9.1 %
Damson	7.8 %
Gooseberry	7.3 %
Plum	6.1 %
Pear	4.8 %
Redcurrants	4.7 %
Whitecurrant	3.4 %
Loganberry	0.8 %
Blackberry	0.3 %
Cherry	0.2 %
Blueberry	0.2 %
Eggs	
***Chicken egg**	81.8 %
Duck egg	18.2 %
Wild/free foods	
***Blackberry**	88.1 %
Plums	5.8 %
Rosehip	3.8 %
Elderberry	1.1 %
Crab apple	0.9 %
Raspberry	0.2 %
Poultry	
Turkey	55.1 %
Chicken	32.9 %
Duck	12.0 %
Rabbits/hares	
Hare	100.0 %
Fish (freshwater)	
Brown Trout	100.0 %

Notes

Food types astrisked and emboldened were monitored by FSA in 2004 (EA, EHS, FSA and SEPA, 2005)
Other foods monitored were milk, ovine muscle, ovine offal, potatoes and sloe berries
Percentages are based on the consumption of all adults in the survey consuming that particular food group

Table 43. Occupancy rates in the Trawsfynydd direct radiation survey area for adults and children (h/y)

Observation Number	Age (in years) (U if unknown)	Distance from site perimeter fence (km)	Indoor occupancy	Outdoor occupancy	Total occupancy
0 to 0.25 km zone					
138	U	0.10	1620	180	1800
383	U	0.10	1620	180	1800
384	U	0.10	1620	180	1800
385	U	0.10	1620	180	1800
386	U	0.10	1620	180	1800
387	U	0.10	1620	180	1800
388	U	0.10	1620	180	1800
389	U	0.10	1620	180	1800
390	U	0.10	1620	180	1800
391	U	0.10	1620	180	1800
392	U	0.10	1620	180	1800
0.25 to 0.5 km zone					
0.5 to 1.5 km zone					
54	71	1.25	8760		8760
65	67	1.25	8398	182	8580
352	39	1.30	8131	365	8496
162	71	0.80	7213	1275	8488
53	72	1.25	7811	637	8448
66	65	1.25	7591	819	8410
359	58	1.20	7665	730	8395
163	51	0.80	7784	600	8384
72	80	1.25	6524	1820	8344
358	60	1.20	5495	2700	8195
71	49	1.25	7665	342	8007
52	45	1.25	7309	651	7960
69	50	1.25	7796	52	7848
230	U	1.30	6700	1050	7750
360	26	1.20	7523	104	7627
160	64	1.10	5524	2100	7624
244	42	0.70	6854	400	7254
161	18	1.10	5088	2100	7188
164	12	0.80	6319	700	7019
354	12	1.30	6746	156	6902
73	52	1.25	6269	586	6855
353	14	1.30	6381	365	6746
381	52	1.20	6236	364	6600
243	44	0.70	6202	300	6502
78	45	1.25	6379	52	6431
76	47	1.25	5864	446	6310
380	57	1.20	5894	364	6258
55	41	1.25	5542	715	6257
56	39	1.25	5542	715	6257
245	17	0.70	5821	400	6221
246	15	0.70	5821	400	6221
247	15	0.70	5821	400	6221
319	30	1.30	5680	364	6044
70	51	1.25	5685	342	6027
74	26	1.25	5552	358	5909
351	41	1.30	3950	1939	5889

Table 43. Occupancy rates in the Trawsfynydd direct radiation survey area for adults and children (h/y)

Observation Number	Age (in years) (U if unknown)	Distance from site perimeter fence (km)	Indoor occupancy	Outdoor occupancy	Total occupancy
0.5 to 1.5 km zone					
79	18	1.25	5508	52	5560
75	48	1.25	4944	446	5390
320	3	1.30	5004	364	5368
321	6	1.30	5004	364	5368
131	45	1.25	3780	1540	5320
132	45	1.25	3780	1540	5320
133	45	1.25	4620	700	5320
134	45	1.25	4620	700	5320
355	U	1.30	4328	416	4744
219	76	1.30	3474	350	3824
67	U	1.25	2895		2895
57	37	1.25	2217	286	2503
58	36	1.25	2217	286	2503
242	U	0.70	1739		1739
68	U	1.25	1386		1386
77	22	1.25	165	165	329
212	U	0.60		100	100
207	60	0.60		60	60
204	49	0.60		50	50
205	13	0.60		50	50
206	10	0.60		50	50
193	45	0.60		40	40
303	33	0.60		36	36
304	U	0.60		33	33
309	58	0.60		32	32
310	31	0.60		32	32
186	15	0.60		30	30
187	49	0.60		30	30
188	68	0.60		30	30
191	U	0.60		30	30
190	68	0.60		20	20

Table 44. Analysis of occupancy rates in the Trawsfynydd direct radiation survey area

0 to 0.25 km zone	
Number of hours per year	Number of observations
8000 to 8760	0
7000 to 8000	0
6000 to 7000	0
5000 to 6000	0
4000 to 5000	0
3000 to 4000	0
2000 to 3000	0
1000 to 2000	11
0 to 1000	0

0.25 to 0.5 km zone	
Number of hours per year	Number of observations
8000 to 8760	2
7000 to 8000	0
6000 to 7000	0
5000 to 6000	0
4000 to 5000	0
3000 to 4000	0
2000 to 3000	0
1000 to 2000	0
0 to 1000	0

0.5 to 1.5 km zone	
Number of hours per year	Number of observations
8000 to 8760	11
7000 to 8000	8
6000 to 7000	15
5000 to 6000	10
4000 to 5000	3
3000 to 4000	1
2000 to 3000	3
1000 to 2000	2
0 to 1000	16

Table 45. Gamma dose rate measurements for the Trawsfynydd direct radiation survey (µGy/h)

Location	Distance from perimeter (km)	NGR	Outdoor substrate	Gamma dose rate at 1 metre	House material	Gamma dose rate at 1 metre
Electricity sub-station	0.01	SH 693 383	Concrete	0.091		
Utica Laboratory	0.70	SH 695 390	Grass	0.073	Stone	0.099
House 1	1.25	SH 685 395	Grass	0.074	Wood	0.088
House 2	1.25	SH 686 396	Grass	0.082	Wood	0.081
House 3	1.25	SH 686 395	Grass	0.082	Stone	0.138
House 4	1.25	SH 686 395	Grass	0.086	Wood	0.071
House 5	1.25	SH 685 395	Grass	0.083	Stone	0.148
House 6	1.25	SH 685 395	Grass	0.082	Stone	0.136
House 7	1.25	SH 685 395	Grass	0.084	Wood	0.088
House 8	1.25	SH 685 395	Grass	0.081	Wood	0.073
House 9	1.30	SH 686 396			Stone	0.098
House 10	1.20	SH 692 396	Grass	0.102	Stone	0.138
House 11	1.20	SH 695 395	Grass	0.083	Stone	0.100
House 12	1.30	SH 693 396	Grass	0.083	Stone	0.130
House 13	1.40	SH 678 391	Grass	0.090	Stone	0.074
House 14	0.50	SH 691 389	Grass	0.101	Stone	0.079
House 15	1.30	SH 687 396	Grass	0.092	Stone	0.110

Background 1	6.30	SH 633 402	Grass	0.072
Background 2	6.75	SH 712 317	Grass	0.082
Background 3	7.25	SH 621 377	Grass	0.078
Background 4	6.50	SH 757 367	Grass	0.081

Site perimeter fence measurements[1]

Position 1	0.01	SH 690 380	Soil	0.089
Position 2	0.01	SH 689 380	Grass	0.117
Position 3	0.01	SH 689 381	Grass	0.136
Position 4	0.01	SH 688 381	Grass	0.101
Position 5	0.01	SH 688 382	Grass	0.088
Position 6	0.01	SH 688 383	Grass	0.104

[1] = Taken on footpath approximately 10 metres west of fence where public occupancy occurs

Table 46. Examples of food groups eaten and external exposure combinations by adults for consideration for dose assessment purposes

Combination number	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	Intertidal occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1 km of site perimeter fence	Outdoor occupancy within 1 km of site perimeter fence
1							*			*			*			*							
2			*	*	*	*	*		*	*	*	*	*										
3						*		*		*	*	*											
4									*	*			*			*							
5		*																	*		*		
6			*	*	*	*							*		*							*	*
7		*								*			*			*							
8									*	*												*	*
9								*														*	*
10										*		*				*							
11				*		*				*		*					*						
12									*	*	*	*		*									
13		*					*		*			*	*		*				*			*	*
14			*	*	*	*	*					*	*		*								
15			*		*		*			*			*									*	*
16		*	*	*	*	*	*		*			*	*										
17			*	*	*	*	*		*	*						*							
18		*							*	*		*	*										
19									*												*		*
20																		*					
21																				*			
22	*	*											*						*				

Notes

The food groups and external exposure pathways marked with an asterisk are combined for the corresponding combination number.
For example, combination number 1 represents an individual from Annex 1 who had positive data in the following pathways;
domestic fruit, sheep meat, wild/free foods and wild fungi.

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
1	M	41	4.6										**17.0**						**1.6**							
2	F	39	4.6							**9.1**			5.7			**15.1**			**1.6**							
3	M	65	U							**9.1**			5.7			**15.1**										
4	F	35	U							**9.1**						**15.1**										
5	F	60	5.0			**29.3**	**16.1**	**35.3**	**27.3**	**14.8**		2.5	**50.9**	**17.3**	**26.5**	3.4										
6	F	64	4.3							0.9				**8.8**		0.5										
8	M	46	3.2						**22.6**		**81.1**		5.0	1.8	7.9											
9	F	45	3.2						**22.6**		**81.1**		5.0	1.8	7.9											
13	M	64	3.6										11.3													
14	F	58	3.6										11.3													
15	M	U	U										11.3													
16	M	U	U										11.3													
17	F	U	U										11.3													
18	F	U	U										11.3													
19	F	U	U										11.3													
20	F	U	U										11.3													
24	M	63	2.1										**17.0**													
25	F	57	2.1										**17.0**													
26	M	53	1.7										11.3													
27	M	52	1.7										11.3													
28	M	62	3.8										**33.9**													
29	M	59	3.8										**17.0**													
30	F	58	3.8										**17.0**													
31	M	45	2.6							**9.1**																
32	M	47	3.5									**30.0**	**30.0**			0.8			0.5							
33	F	47	3.5									**20.0**	**20.0**			0.8			0.5							

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
38	M	71	2.8										**33.9**													
39	M	64	4.6										**33.9**													
40	M	72	U		8.3																	180				
41	F	72	U		8.3																					
42	M	46	U		7.1																	**288**				
43	M	70	U		**59.8**																	**360**		360		
44	M	36	U		13.1																					
45	F	35	U		13.1																					
48	M	34	U		11.5																					
49	F	32	U		11.5																					
52	M	45	1.3																						7309	651
53	M	72	1.3																						7811	637
54	F	71	1.3																						8760	
55	F	41	1.3																						5542	715
56	F	39	1.3																						5542	715
57	F	37	1.3																						2217	286
58	F	36	1.3																						2217	286
59	M	63	U		15.3																	**672**				
60	M	U	U		6.2																					
61	M	U	U		6.2																					
62	M	U	U		6.2																					
63	F	U	U		6.2																					
64	F	U	U		6.2																					
65	M	67	1.3																						8398	182
66	F	65	1.3																						7591	819
67	M	U	1.3																						2895	

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
68	F	U	1.3																						1386	
69	M	50	1.3																						7796	52
70	M	51	1.3				4.8																		5685	342
71	F	49	1.3				4.8																		7665	342
72	M	80	1.3				4.8																		6524	1820
73	F	52	1.3																						6269	586
74	M	26	1.3																						5552	358
75	M	48	1.3			**17.8**	9.0	**37.7**	10.6																4944	446
76	F	47	1.3			**17.8**	9.0	**37.7**	10.6																5864	446
77	F	22	1.3																						165	165
78	F	45	1.3																						6379	52
79	F	18	1.3																						5508	52
80	M	29	U		4.1																	50				
81	M	26	U																			50				
82	M	U	U		2.1																					
83	F	U	U		2.1																					
84	M	51	U		11.3																	**324**				
85	F	25	U		11.3																					
86	M	44	U		13.0																	78				
88	M	49	U		2.2																	78				
89	F	U	U		2.2																					
90	F	U	U		2.2																					
91	M	U	U		2.2																					
92	M	U	U		2.2																					
97	M	52	U		8.8																	208				
98	F	52	U		8.8																					

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
99	M	U	U		6.6																					
100	M	U	U		6.6																					
101	F	U	U		6.6																					
102	F	U	U		6.6																					
107	M	64	U		1.4																	**432**				
108	M	U	U		2.3																					
109	M	U	U		2.3																					
110	F	U	U		2.3																					
111	F	U	U		2.3																					
112	M	46	U		1.4																	192				
113	F	45	U		1.4																					
114	M	53	1.5		4.1																	**264**				
115	F	55	1.5		4.1																					
116	M	U	1.5		4.1																					
117	F	U	1.5		4.1																					
118	M	U	7.4		5.2																	90				
119	F	U	7.4		5.2																					
120	M	61	U		4.1																	42				
121	F	60	U		4.1																					
122	M	49	U		4.1																	42				
123	M	49	U		4.1																					
124	M	62	U		0.9																	30				
125	M	64	U		0.9																	30				
126	M	67	U		0.9																	30				
127	M	67	U		4.6																	64				
128	F	65	U		4.6																	64				

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
129	M	66	3.0		4.1																			132		
130	F	64	3.0		4.1																					
131	M	45	1.2																						3780	1540
132	M	45	1.2																						3780	1540
133	F	45	1.2																						4620	700
134	F	45	1.2																						4620	700
135	M	43	U		10.3																	120				
136	F	42	U		10.3																					
137	M	47	U																					72		
138	M	U	U																						1620	180
139	M	63	5.0			**29.3**	**16.1**	**35.3**	**27.3**	**14.7**		2.5	**50.9**	**17.3**	**26.5**	3.4										
140	M	69	4.3											**8.8**		0.5										
141	M	62	1.8										**28.3**		**15.2**	0.5										
142	F	46	1.8							0.5			**28.3**		**15.2**											
143	M	24	1.8							0.5			**28.3**		**15.2**											
145	M	63	2.0			**26.5**	7.7	16.9	**22.7**	**24.7**					**14.8**											
146	F	62	2.0			**26.5**	7.7	16.9	**22.7**	**24.7**					**14.8**											
147	F	72	4.5												**11.8**	2.7										
148	M	63	4.5		1.9								**18.8**			0.9			**1.5**							
149	F	45	4.5		1.9								**18.8**			0.9			**1.5**							
151	M	76	4.5													**5.4**			**1.4**							
152	M	36	4.0									**18.9**	15.8													
153	F	35	4.0									**18.9**	15.8													
157	M	99	4.5									**18.9**	15.8													
158	F	99	4.5									**18.9**	15.8													
159	M	46	4.5										11.3			2.0			0.3							

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
160	M	64	1.1									5.0	**25.4**												5524	2100
161	M	18	1.1									5.0	**25.4**												5088	2100
162	M	71	0.8																						7213	1275
163	F	51	0.8																						7784	600
165	M	67									**170.5**														6840	1800
166	F	63									**85.2**														7640	1000
167	M	U	3.2										8.5		5.9				0.5							
168	F	U	3.2										8.5		5.9				0.5							
169	M	50	3.5				**21.4**		**25.0**				11.3		**11.9**					**0.9**						
170	F	45	3.5				**21.4**		**25.0**				11.3		**11.9**					**0.9**						
171	M	25	3.5				**21.4**		**25.0**				11.3		**11.9**					**0.9**						
172	M	53	1.8									**18.9**	13.6	3.6	**14.2**		**1.0**									
173	F	50	1.8									**18.9**	13.6	3.6	**14.2**		**1.0**									
174	M	48	1.8									**18.9**	13.6	3.6	**14.2**		**1.0**									
175	M	76	1.8									**15.1**	10.8	2.9	**11.4**		**0.8**									
176	F	74	1.8									**15.1**	10.8	2.9	**11.4**		**0.8**									
177	M	64	2.3										**19.8**													
178	F	62	2.3										**19.8**													
179	M	U	2.0									**27.0**	12.9													
180	F	U	2.0									**27.0**	12.9													
181	M	32	3.8									**27.0**	12.9													
182	F	32	3.8									**27.0**	12.9													
183	M	30	U									**27.0**	12.9													
184	F	29	U									**27.0**	12.9													
185	M	25	2.0									**27.0**	12.9													
187	F	49	U		6.5																					30

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
188	M	68	U		1.4																	30				30
189	F	65	U		1.4																					
190	M	68	U		0.5																	20				20
191	M	U	U		4.7																	30				30
192	F	U	U		4.7																					
193	M	45	U		0.8																	80				40
194	F	43	U		0.8																					
197	F	57	2.8										5.7													
198	M	56	2.8										5.7													
199	M	26	2.8										5.7													
200	M	21	2.8										5.7													
201	M	62	1.5				**11.3**											**1.8**								
202	F	42	1.5				**11.3**											**1.8**								
204	M	49	2.7		5.2																	110				50
207	M	60	U		13.0																	120				60
208	M	25	U																					70		
209	M	23	U																					70		
210	M	65	U		1.2																	50				
211	M	23	U		1.2																	50				
212	M	U	U																			**600**				100
213	M	U	U																			**700**				
214	M	93	U		10.4																					
215	F	67	U		10.4																					
216	M	U	7.0		5.0																	**450**				
217	M	U	U		6.6																					
218	F	U	U		6.6																					

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
219	M	76	1.3																						3474	350
220	M	69	U	**1.1**	4.1											2.5						110				
221	F	67	U	**1.1**	4.1											2.5										
222	M	52	3.1							**10.8**					**26.7**	1.2		**3.4**								
223	F	52	3.1							**10.8**					**26.7**	1.2		**3.4**								
224	M	21	7.5		11.3																	**540**				
225	F	62	7.5		17.0																					
226	M	U	U		0.7																			440		
227	M	U	U		0.7																					
228	M	U	U		0.7																					
229	M	U	U		0.7																					
230	F	U	1.3																						6700	1050
231	M	28	[redacted]							7.9						2.3									4264	700
232	F	60	[redacted]							7.9						2.3									4266	590
233	M	40	U		5.1																	150				
234	F	40	U		5.1																					
235	M	18	U		5.1																					
236	M	60	U		6.1																	150				
237	F	58	U		6.1																					
238	M	50	U		4.1																	150				
239	F	50	U		4.1																					
240	M	21	U		4.1																					
241	M	23	U		4.1																					
242	F	U	U																						1739	
243	M	44	0.7			1.0		3.2		4.5			**18.1**			0.3									6202	300
244	F	42	0.7			1.0		3.2		4.5			**18.1**			0.3									6854	400

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
245	M	17	0.7			1.0		3.2		4.5			**18.1**			0.3									5821	400
248	F	61	1.5			1.4	8.1	0.9	**21.8**	**15.6**					**8.9**	2.7		0.9								
249	F	56	1.5			1.4	8.1	0.9	**21.8**	**15.6**					**8.9**	2.7		0.9								
250	F	U	4.5										11.3			2.0			0.3							
253	M	U	U										11.3													
254	F	U	U										11.3													
255	M	U	U										11.3													
256	F	U	U										11.3													
257	F	64	3.8		0.2							1.4			1.5	0.2										
258	F	61	3.8		0.2							1.4			1.5	0.2										
259	M	36	5.0									**11.8**			**15.8**											
260	F	33	5.0									**11.8**			**15.8**											
261	F	75	U									**11.8**			**15.8**											
267	M	57	4.8			**11.5**	3.6	11.8	11.1	5.1		**11.8**	12.7						**2.3**							
268	F	53	4.8			**11.5**	3.6	11.8	11.1	5.1		**11.8**	12.7						**2.3**							
269	F	21	4.8			**11.5**	3.6	11.8	11.1	5.1		**11.8**	12.7						**2.3**							
271	M	44	5.8															**1.1**								
272	F	42	5.8															**1.1**								
273	M	18	5.8															**1.1**								
275	F	72	3.0		2.5	**32.3**	**33.6**	7.5	6.1	**11.3**		0.7			7.4	1.4										
276	M	67	3.0		2.5	**32.3**	**33.6**	7.5	6.1	**11.3**		0.7			**20.7**	1.4										
277	M	48	2.0		2.9							2.7	11.3		**11.9**	2.3										
278	F	47	2.0		2.9							2.7	11.3		**11.9**	2.3										
279	M	U	3.5									2.7	6.6	0.3												
280	F	U	3.5									2.7	6.6	0.3												
281	M	U	3.5									2.7	6.6	0.3												

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
282	M	U	3.5									2.7	6.6	0.3												
283	M	U	3.5									2.7	6.6	0.3												
284	M	U	3.5									2.7	6.6	0.3												
285	F	U	3.5									2.7	6.6	0.3												
286	F	U	3.5									2.7	6.6	0.3												
287	F	U	3.5									2.7	6.6	0.3												
288	F	U	3.5									2.7	6.6	0.3												
293	F	62	3.0			**18.1**	6.4	10.2	**41.3**	4.5		4.5			**22.6**	3.6										
294	M	61	3.0			**18.1**	5.0	12.9	**41.3**	**18.1**		4.5			**22.6**	3.6										
295	F	69	U			**14.0**	**11.8**	**56.0**	**47.2**			**11.8**														
296	M	78	U			**14.0**	**11.8**	**56.0**	**47.2**			**11.8**														
297	M	U	60.0																			64				
298	M	U	60.0																			64				
299	U	U	60.0		2.1																					
300	U	U	60.0		2.1																					
301	U	U	60.0		2.1																					
302	U	U	60.0		2.1																					
303	M	33	U																			36				36
304	M	U	3.0									2.3												130		33
305	F	U	3.0									2.3														
306	M	17	3.0									2.3														
307	F	19	3.0									2.3														
308	M	U	3.0		3.5																					
309	M	58	U		0.4																	64				32
310	M	31	U		1.1																	64				32
311	M	58	U																			10				

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
312	M	37	80.0																			**250**				
313	M	39	80.0	**1.8**	7.1																					
314	F	U	U																		**30**					
315	F	U	U																		**30**					
316	M	U	U																				156			
317	M	U	U																				54			
318	M	U	U																				54			
319	F	30	1.3													0.5									5680	364
322	M	67	1.3													0.3										
323	F	53	1.3													0.3										
324	M	24	1.3													0.3										
325	F	28	1.3			5.6	4.4	0.1	1.8																	
326	M	39	1.3			5.6	4.4	0.1	1.8																	
328	M	45	1.3									1.4														
329	F	43	1.3									1.4														
332	F	53	1.5										9.0		**11.9**											
333	M	57	1.5										9.0													
334	M	34	1.5										9.0		**11.9**											
335	F	24	1.5										9.0		**11.9**											
337	F	29	1.5										9.0		7.4											
338	M	U	U																			**572**				
339	U	U	U		1.1																					
340	U	U	U		1.1																					
341	U	U	U		1.1																					
342	U	U	U		1.1																					
343	U	U	U		1.1																					

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
344	U	U	U		1.1																					
345	U	U	U		1.1																					
346	U	U	U		1.1																					
347	M	45	4.0									**23.7**	**28.3**			0.9			**0.9**							
348	F	40	4.0									**23.7**	**28.3**			0.9			**0.9**							
349	F	50	U										**28.3**													
350	M	48	U										**28.3**													
351	M	41	1.3		0.4					4.2		**11.8**			4.4	0.2		0.7				12			3950	1939
352	F	39	1.3		0.4					4.2		**11.8**			4.4	0.2		0.7							8131	365
355	M	U	1.3																						4328	416
356	M	61	1.0												**8.9**	0.7										
357	F	43	1.0												**8.9**	0.7										
358	M	60	1.2							1.5			**22.6**												5495	2700
359	F	58	1.2							1.5			**22.6**												7665	730
360	F	26	1.2							1.5			**22.6**												7523	104
361	M	U	1.3		4.0																	79		246		
362	M	67	1.5			**11.4**	**20.6**	**28.3**	4.0	1.7					**10.2**	0.3										
363	F	61	1.5			**11.4**	**20.6**	**28.3**	4.0	1.7					**10.2**	0.3										
364	M	29	1.5			**11.4**	**20.6**	**28.3**	4.0	1.7					**10.2**	0.3										
366	U	U	U			2.1	3.9	6.7	0.8	0.4																
367	U	U	U			2.1	3.9	6.7	0.8	0.4																
368	U	U	U			2.1	3.9	6.7	0.8	0.4																
369	U	U	U			2.1	3.9	6.7	0.8	0.4																
370	U	U	U			2.1	3.9	6.7	0.8	0.4																
371	U	U	U			2.1	3.9	6.7	0.8	0.4																
372	U	U	U			2.1	3.9	6.7	0.8	0.4																

Annex 1. Adults' consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years (U if unknown)	Distance from site	Brown trout affected by liquid discharges	Rainbow trout and salmon affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Fish affected by gaseous discharges	River bank occupancy over rock	Lake shore occupancy over sand and stone	Occupancy in water	Occupancy on water	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
373	U	U	U			2.1	3.9	6.7	0.8	0.4																
374	F	22	1.5			9.6	4.0	4.6	3.6	1.4																
375	F	43	1.5		2.8	9.6	4.0	4.6	3.6	1.4																
376	M	43	1.5		2.8	9.6	4.0	4.6	3.6	1.4																
377	M	18	1.5		2.8	9.6	4.0	4.6	3.6	1.4																
378	F	71	1.5		2.8	9.6	4.0	4.6	3.6	1.4																
379	M	73	1.5		2.8	9.6	4.0	4.6	3.6	1.4																
380	M	57	1.2			1.2	**18.4**	**19.6**	**20.2**							**5.7**		0.2							5894	364
381	F	52	1.2			1.2	**18.4**	**24.8**	**20.2**							**5.7**		0.2							6236	364
382	M	80	2.5												**15.2**											
383	M	U	U																						1620	180
384	M	U	U																						1620	180
385	M	U	U																						1620	180
386	M	U	U																						1620	180
387	M	U	U																						1620	180
388	M	U	U																						1620	180
389	M	U	U																						1620	180
390	M	U	U																						1620	180
391	M	U	U																						1620	180
392	M	U	U																						1620	180

Annex 2. Children's consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years	Distance from site	Rainbow trout affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Honey	Wild fungi	Lake shore occupancy over sand and stone	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
15 year old group																				
144	F	16	1.8						**0.5**			**28.3**		**15.2**						
270	M	16	4.8		**11.5**	**3.6**	**11.8**	**11.1**	**5.1**		**11.8**	**12.7**					**2.3**			
10	M	15	3.2					**22.6**		**81.1**		5.0	**1.8**	**7.9**						
106	M	15	U	**6.6**																
150	F	15	4.5	1.9								**18.8**			**0.9**		**1.5**			
186	M	15	U	**6.5**														200		30
246	M	15	0.7		1.0		**3.2**		**4.5**			**18.1**			0.3				5821	400
247	M	15	0.7		1.0		**3.2**		**4.5**			**18.1**			0.3				5821	400
274	M	15	5.8													**1.1**				
103	F	14	U	**6.6**																
262	F	14	5.0								**11.8**			**15.8**						
353	M	14	1.3	0.4					**4.2**		**11.8**			4.4	0.2	**0.7**			6381	365
104	F	13	U	**6.6**																
195	M	13	U	0.4																
205	M	13	2.7															110		50
331	M	13	1.3								1.4									
34	M	12	3.5								**21.4**	**20.0**			**0.8**		**0.5**			
105	F	12	U	**6.6**																
164	M	12	0.8																6319	700
263	F	12	5.0								**11.8**			**15.8**						
354	M	12	1.3	0.4					**4.2**		**11.8**			4.4	0.2	**0.7**		12	6746	156

Annex 2. Children's consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years	Distance from site	Rainbow trout affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Honey	Wild fungi	Lake shore occupancy over sand and stone	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
10 year old age group																				
11	F	11	3.2					**22.6**		**81.1**		5.0	**1.8**	**7.9**						
35	M	11	3.5								**21.4**	**20.0**			**0.8**		**0.5**			
196	F	11	U	0.4																
21	F	10	U									**11.3**								
93	F	10	U	2.2																
206	F	10	2.7															110		50
264	F	10	5.0								**11.8**			**15.8**						
330	M	10	1.3								1.4									
36	M	9	3.5								**21.4**	**20.0**			**0.8**		**0.5**			
50	M	9	U	**11.5**																
95	M	9	U	2.2																
46	F	8	U	**13.1**																
51	F	8	U	**11.5**																
96	M	8	U	2.2																
251	M	8	4.5									5.7			**1.0**		**0.2**			
265	F	8	5.0								5.9			**8.0**						
22	M	7	U									5.7								
94	F	7	U	2.2																
289	F	7	3.5								1.4	**3.6**	0.2							
327	F	7	1.3			2.1		1.8												

Annex 2. Children's consumption rates (kg/y or l/y) and occupancy rates (h/y) in the Trawsfynydd area

Observation number	Sex (U if unknown)	Age in years	Distance from site	Rainbow trout affected by liquid discharges	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Sheep meat	Poultry	Eggs	Wild/free foods	Honey	Wild fungi	Lake shore occupancy over sand and stone	Indoor occupancy within 1.5 km of site perimeter fence	Outdoor occupancy within 1.5 km of site perimeter fence
5 year old age group																				
47	F	6	U	**6.6**																
203	F	6	1.5			**5.7**										**0.9**				
321	M	6	1.3												**0.5**				5004	364
12	M	5	3.2					**11.3**		**40.6**		2.5	**0.9**	**4.0**						
87	M	5	U	**6.5**																
154	M	5	4.0								**9.5**	**7.9**								
252	F	5	4.5									**5.7**			**1.0**		**0.2**			
266	M	5	5.0								**5.9**			**8.0**						
290	F	5	3.5								1.4	**3.6**	**0.2**							
37	F	4	3.5								**10.7**	**10.0**			**0.8**		**0.5**			
155	F	4	4.0								**9.5**	**7.9**								
336	M	4	1.5											**7.4**						
23	M	3	U									**5.7**								
320	F	3	1.3												**0.5**				5004	364
291	F	2	3.5								0.7	1.8	**0.1**							
365	M	2	1.5		**5.7**	**10.3**	**14.9**	2.0	**0.5**					**5.1**						
1 year old age group																				
292	M	1	3.5								0.7	1.8	**0.1**							
3 month old age group																				
156	M	0.5	4.0								**4.4**	2.9								

Annex 3. Qualitative and estimated data for use in dose assessment

	Details of activity	Exposure pathways involved	Estimated rate	Other related exposure pathways potentially involved
	No activities to report	None	None	None

Annex 4. Ratios for determining consumption rates for children

Food group	Ratio child/adult[1]	
	1 yr old	10 yr old
Fish[2]	0.050	0.200
Crustaceans[2]	0.050	0.250
Molluscs[2]	0.050	0.250
Green vegetables	0.222	0.444
Other vegetables	0.200	0.500
Root vegetables	0.375	0.500
Potatoes	0.292	0.708
Domestic fruit	0.467	0.667
Milk	1.333	1.000
Cattle meat	0.222	0.667
Pig meat	0.138	0.625
Sheep meat	0.120	0.400
Poultry	0.183	0.500
Eggs	0.600	0.800
Wild/free foods[3]	0.110	0.490
Game[4]	0.140	0.500
Honey	0.789	0.789
Wild fungi	0.150	0.450
Freshwater fish[2]	0.050	0.250
Direct radiation	1.000	1.000
External exposure	0.500	0.030
Plume	1.000	1.000

Notes

1. The age groups suggested for assessment in this table are those relating to dose coefficients representing 1 to 2 yr olds (labelled 1 yr old) and 7 to 12 yr olds (labelled 10 yr old). Excepting notes 2 and 3, ratios were derived from Byrom et al., (1995) for 1yr old (6 - 12 months) and 10 yr old children (10 - 11 yrs).
2. Ratios were derived from Smith and Jones, (2003) which presented data for infants and children.
3. Ratios were derived from FSA data for wild fruit and nuts for infants and 10 yr old children.
4. Game includes rabbits/hares and venison

Annex 5. Summary of adults' profiled habits data in the Trawsfynydd area

Profile Name	Number of individuals	Pathway Name	Direct[3]	Eggs	Fish - Affected by gaseous discharges	Fish - Brown trout affected by liquid discharges	Fish - Rainbow trout and salmon affected by liquid	Fruit - Domestic	Fruit and nuts - Wild	Gamma ext - Sand and stone	Honey	Meat - Cow	Meat - Game[1]	Meat - Poultry	Meat - Sheep	Milk	Mushrooms	Occupancy In water	Occupancy On water	Plume (IN; 0-0.25km)[2]	Plume (MID; 0.25-0.5km)[2]	Plume (OUT; 0.5-1km)[2]	Vegetables - Green	Vegetables - Other Domestic	Vegetables - Potatoes
			-	kg	kg	kg	kg	kg	kg	h	kg	kg	kg	kg	kg	l	kg	h	h	h	h	h	kg	kg	kg
Occupants for direct radiation	31		1				1.1			37		0.1			1.7	8.2			4	639	557	1261	0.1		
Egg consumers	37			14.8	0.1		0.2	4.6	0.9		0.2	3.9	0.1	1.4	9.0								5.9	6.3	8.6
Fish (affected by gaseous discharges) consumers	3			11.9	0.9										11.3									21.4	25.0
Fish - Brown trout (affected by liquid discharges) consumers	3					1.3	5.1		1.7	37															
Fish - Rainbow trout and salmon (affected by liquid discharges) consumers	1						59.8			360									360						
Wild fruit and nut consumers	15			13.6			0.3	13.9	4.4		0.6	0.7		2.3	7.5		0.1						13.1	9.1	13.1
Occupants for exposure - sand and stone	6							4.5	10.4		0.1				1.9		0.5						0.4	6.1	6.7
Honey consumers	12		0.1				9.6			454									30			8			
Cow meat consumers	7			7.6				3.1	0.4		2.0														
Game meat consumers	30			4.1				0.8	0.1			18.9	0.1	0.6	12.0		0.3						2.1	1.1	4.3
Poultry meat consumers	5			13.1								17.4	0.9	3.3	12.5										
Sheep meat consumers	4			13.3				7.6	1.9			1.3		13.0	25.4								14.7	8.0	13.7
Milk consumers	31		0.1	3.2			0.1	1.6	0.4			3.6		1.1	25.4		0.2					644	2.0	1.0	1.8
Mushroom consumers	4		0.5	4.0										0.9	2.5	104.5					4320				11.3
Occupants in water	10						0.4	2.4	2.4			8.3			15.5		1.6						3.4	1.1	3.3
Occupants on water	3																	88							
Occupants for plume pathways (inner area)	3						21.5			146									349						
Occupants for plume pathways (middle area)	11		1																	1800					
Occupants for plume pathways (outer area)	2		1													127.9					8640				
Green vegetable consumers	5		1					2.7	0.2						10.8							7370	0.6		
Other domestic vegetable consumers	18			10.4			0.3	8.0	1.0			4.1		1.9	7.8		0.4						19.1	13.4	19.8
Potato consumers	16			9.2	0.2		0.3	3.6	1.4		0.3	1.9		2.2	8.5								11.7	19.3	18.0
Root vegetable consumers	17			11.6	0.2			7.8	1.8		0.1	2.2		2.2	8.6	9.5							10.6	11.7	28.3
Vegetables - Root	11			7.6				3.1	1.7			2.6		3.1	9.2								14.4	15.7	20.2

Notes

For the purpose of the adults' profiled habits data, individuals in the direct and plume pathways have only been considered within 1km of the licensed site perimeter fence.

1. Game meat includes rabbits/hares
2. Plume times are the sums of individuals' indoor and outdoor times.
3. Expressed as proportion of group who are present within 1km of site

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