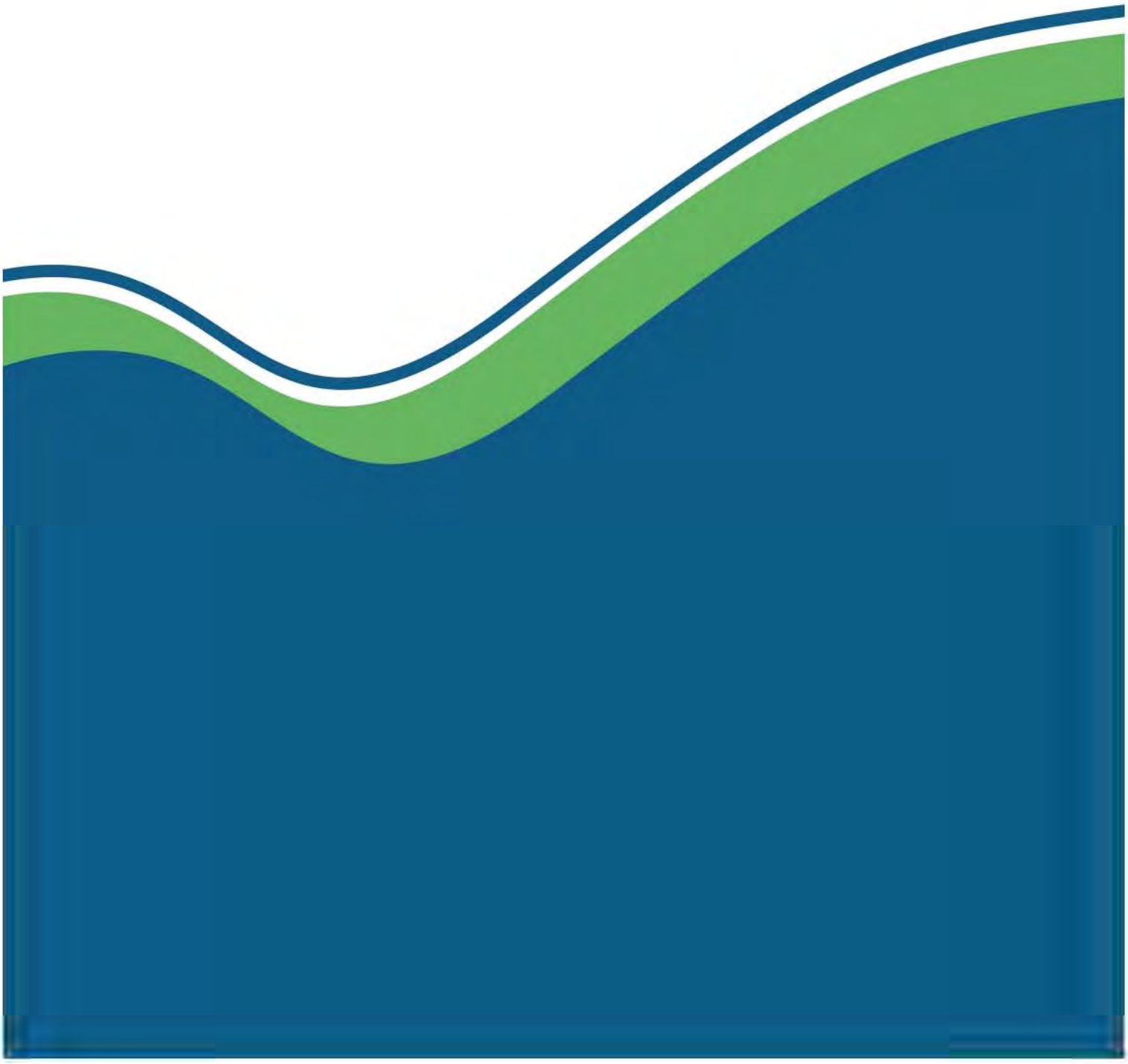
Radiological Habits Survey: Chapelcross, 2010



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Environment Report RL 17/13

Final report

Radiological Habits Survey: Chapelcross, 2010

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Peer reviewed by G.J. Hunt
Approved for publication by W.C. Camplin

2013

The work described in this report was carried out
under contract to the Scottish Environment Protection Agency
SEPA contract R90077PUR
Cefas contract C3745

This report should be cited as: Clyne, F.J., Garrod, C.J., Rumney, P., and Ly, V.E., 2013. Radiological Habits Survey: Chapelcross, 2010. RL 17/13. Cefas, Lowestoft

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SUMMARY

This report presents the results of a survey conducted in 2010 to determine the habits and consumption patterns of people living, working and undertaking recreational activities in the vicinity of the Chapelcross nuclear site. The site discharges radioactive wastes via stacks to the atmosphere, liquid radioactive wastes via a pipeline outfall into the Solway Firth and contains sources of direct radiation.

Four survey areas, which were likely to be most affected by the discharges and sources of radiation, were defined as:

- The aquatic survey area; which covered the Scottish side of the Solway Firth and its intertidal area from Scar Point in the west to Gretna in the east.
- The terrestrial survey area; which included all land within a 5 km radius of the site centre (National Grid Reference NY 217 697).
- The direct radiation survey area; which covered the area up to 1 km from the site centre and was extended to include the residences and businesses to the south of the main road in Creca village.
- The pipeline survey area; which covered the 5 km length of the Chapelcross pipeline.

The following potential exposure pathways were investigated during the survey: the consumption of foods from the aquatic survey area; occupancy of intertidal areas; handling of fishing gear and sediment; the consumption of foods from the terrestrial survey area; occupancy within the direct radiation survey area; and occupancy along the pipeline.

Interviews were conducted with members of the public and the data collected for 309 individuals are presented and discussed. High rates of consumption, intertidal occupancy and handling are identified using established methods comprising a 'cut off' to define the high-rate group, and 97.5th percentiles. The rates so identified can be used in dose assessments.

The aquatic survey area

The main fishing activity in the survey area was fishing for salmon and sea trout with stake nets, poke nets and haaf nets. All of these types of fishing gear were operated from the shore, mainly in an area just to the east of the mouth of the River Annan between Waterfoot and Battlehill. There was a by-catch of flounders and bass. Fish were consumed locally and salmon and sea trout were also sold outside the survey area as far away as Billingsgate Market in London. Two shrimping trawlers operated out of Annan for approximately six months per year and the catch of brown shrimps was sent outside the survey area for processing.

Aquatic foods were consumed from the following food groups: fish, crustaceans, wildfowl and marine plants/algae. The mean consumption rates for the adult high-rate groups for each of these food groups were:

- 8.7 kg y^{-1} for fish (comprising salmon, sea trout, flounder and bass, caught by fishermen and shore anglers)
- 15 kg y^{-1} for crustaceans (comprising only brown shrimps, caught by commercial fishermen)
- 31 kg y^{-1} of wildfowl (comprising mallard, pink-footed goose, greylag goose, pintail duck, goose (unspecified species), wigeon, teal and snipe, shot by wildfowlers)
- 0.2 kg y^{-1} for marine plants/algae (comprising only samphire, collected from the salt marsh at Brow Well and from the salt marsh between Seafield and Waterfoot)

No consumption of molluscs was identified.

The relative contribution of the component species within each food group for the adult high-rate groups were:

- For fish, 65% salmon, 25% sea trout, 5% flounder and 5% bass
- For crustaceans, 100% brown shrimps
- For wildfowl, 48% mallard, 21% pink-footed goose, 14% greylag goose, 7% pintail duck and 10% a mix of goose (unspecified species), wigeon, teal and snipe
- For marine plants/algae, 100% samphire

The use of seaweed as a fertiliser or animal feed was not identified.

Intertidal activities identified for adults included stake netting, wildfowling, poke netting, dog walking, haaf netting, nature reserve warden duties, walking, collecting peeler crabs, angling, collecting samphire, beachcombing, tending livestock, inshore rescue duties and bait digging.

The mean rates for the adult high-rate group for occupancy over intertidal substrates were:

- 550 h y^{-1} over mud (for five people, who were stake netting at Battlehill and wildfowling from Caerlaverock to Seafield, at Battlehill and from Browhouses to Gretna)
- 36 h y^{-1} over mud and sand (for two walkers at Powfoot)
- 130 h y^{-1} over mud and stones (for one person who was angling and collecting peeler crabs at Newbiebarns and one person who was stake netting at Newbiebarns)
- 180 h y^{-1} over mud, sand and stones (for one person who was dog walking from Todruff Point to Gretna)
- 1100 h y^{-1} over salt marsh (for one person who was dog walking and collecting samphire at Brow Well and wildfowling between Brow Well and Powfoot)

- 260 h y^{-1} over sand (for five people who were poke netting off Seafield, haaf netting from Waterfoot to Battlehill, beachcombing between Battlehill and Powfoot, and dog walking from Seafield to Powfoot)
- 12 h y^{-1} over sand and stones (for two people who were walking at Powfoot)

Gamma dose rate measurements were taken over intertidal substrates in the aquatic survey area where people were spending time.

The activities identified for adults involving handling fishing gear were haaf netting, poke netting, trawling and repairing stake nets. Activities for adults involving handling sediment included poke netting, stake netting, wildfowling, collecting peeler crabs and bait digging. The mean rates for the adult high-rate groups for handling were:

- 290 h y^{-1} for handling fishing gear (for five fishermen who were haaf netting from Waterfoot to Battlehill, one of which was also poke netting off Seafield)
- 550 h y^{-1} for handling sediment (for six people who were poke netting off Seafield, stake netting at Battlehill, and wildfowling from Caerlaverock to Seafield, at Battlehill and from Browhouses to Gretna)

The handling of angling equipment was not considered to be a significant pathway, and therefore, as in previous surveys, data for this pathway were not collected.

The activities identified taking place on the water in the survey area were trawling, haaf netting and operating a rescue boat. The maximum occupancy rate on water was 670 h y^{-1} for a commercial trawl fisherman in the Solway Firth. No activities were identified taking place in the water in the survey area.

The terrestrial survey area

Farmers in the area predominantly produced beef, lamb, milk and arable crops (barley, wheat, maize, fodder beet, hay and grass) for winter feed. Farmers and their families were consuming milk, beef and lamb produced on their own farms. Several farmers also kept a small number of pigs for their own and their families' consumption. Fruit and vegetables were grown at two allotment sites in Annan and private gardens in the area and were consumed by the gardeners and their families. Two beekeepers were identified who kept hives in the area and consumed honey. The consumption of wild foods was identified and included blackberries, sloes, bilberries and mushrooms. Pheasant, partridge, rabbits and deer shot on farmland in the area were also consumed. The human consumption of groundwater was not identified. Livestock at several farms were supplied with borehole water for drinking and some had access to burn or river water. A large peat cutting works was located to the east and northeast of the survey area.

In the terrestrial survey area, foods were identified being consumed from 17 food groups. The mean consumption rates for the high-rate groups for terrestrial foods were:

- 22 kg y^{-1} for green vegetables
- 24 kg y^{-1} for other vegetables
- 39 kg y^{-1} for root vegetables
- 77 kg y^{-1} for potato
- 24 kg y^{-1} for domestic fruit
- 420 l y^{-1} for milk
- 38 kg y^{-1} for cattle meat
- 24 kg y^{-1} for pig meat
- 6.0 kg y^{-1} for sheep meat
- 19 kg y^{-1} for poultry
- 21 kg y^{-1} for eggs
- 4.6 kg y^{-1} for wild/free foods
- 1.4 kg y^{-1} for rabbits/hares
- 9.1 kg y^{-1} for honey
- 0.9 kg y^{-1} for wild fungi
- 36 kg y^{-1} for venison
- 0.7 kg y^{-1} for freshwater fish

Control measures were in place at the Chapelcross site to limit the possibility that contamination was transferred off-site by wildlife; the site boundary fence extended below ground to prevent access by burrowing animals, and birds were actively discouraged from entering the buildings on site.

The direct radiation survey area

Occupancy rates were obtained at 11 residential properties and five businesses within the direct radiation survey area.

The highest occupancy rates in the direct radiation survey area were as follows:

- 8400 h y^{-1} for the total occupancy rate (for a resident who also worked in the area)
- 8100 h y^{-1} for the indoor occupancy rate (for a resident)
- 2900 h y^{-1} for the outdoor occupancy rate (for the same resident with the highest total occupancy rate)

Gamma dose rate measurements were taken indoors and outdoors at most properties where interviews were conducted. For comparison, background gamma dose rate measurements were taken at distances further than 5 km from the Chapelcross site centre.

The pipeline survey area

Occupancy rates were obtained for 23 people spending time in close proximity to the Chapelcross site pipeline. The most well used area of the pipeline route was the southern section between the railway line and Seafield. The maximum occupancy rate was 730 h y^{-1} for a dog walker who was spending time in sections of the pipeline route to the north and south of the A75 road.

Comparisons with the previous survey

The results of the 2010 Chapelcross habits survey were compared with the last habits survey undertaken at Chapelcross in 2005.

In the aquatic survey area, the mean consumption rate for the adult high-rate group decreased for fish and increased for wildfowl in 2010 when compared with 2005. The consumption of crustaceans and marine plants/algae was identified in 2010 but was not identified in 2005. No consumption of molluscs was identified in 2005 or 2010. The mean occupancy rate for the adult high-rate group over intertidal substrates decreased significantly for mud, increased significantly for salt marsh and decreased for sand in 2010. Activities were recorded taking place over mud and sand, over mud and stones, over mud sand and stones, and over sand and stones in 2010 but no activities were recorded taking place over these substrates in 2005. The mean rates for the adult high-rate group for handling fishing gear and for handling sediment decreased in 2010.

In the terrestrial survey area, the food groups showing significant increases in the mean consumption rates for the adult high-rate groups in 2010 were other vegetables, milk, wild/free foods and venison. The most significant decreases in the mean consumption rates for the adult high-rate groups were for potato, rabbits/hares, and wild fungi. The consumption of freshwater fish was recorded in the 2010 survey but was not identified in the 2005 survey.

In the direct radiation survey in 2010, the highest total occupancy rate decreased slightly, the highest indoor occupancy rate increased slightly and the highest outdoor occupancy rate decreased when compared with 2005.

In the pipeline survey area, the highest occupancy rate increased slightly in 2010 compared to 2005.

Suggestions for changes to the monitoring programme

Based on the findings of this survey, the following suggestions for changes to the current environmental monitoring programme are provided for consideration:

- Within the 'root vegetable' food group the annual sample of turnips currently monitored could be replaced by an annual sample of onions, since these were consumed at a higher rate.
- Within the 'wild/free' food group the annual samples of crab apples and rowan berries currently monitored could be replaced with an annual sample of blackberries since no consumption of crab apples or rowan berries was identified during the survey and blackberries were the most highly consumed food in this food group.

1 INTRODUCTION

1.1 Regulation of radioactive waste discharges

There are generally three main sources of radiation exposure to members of the public from nuclear sites during routine operations: discharges of liquid radioactive waste to the aquatic environment, discharges of gaseous radioactive waste to the atmosphere and direct radiation emanating from the site. Regulation of radioactive waste discharges in Scotland is carried out under the Radioactive Substances Act 1993, (RSA93) (UK Parliament, 1993). Authorisations granted under RSA93 set limits on the activities of specified radionuclides that are authorised to be released from the site. For discharges in Scotland, the Scottish Environment Protection Agency (SEPA) is the regulatory authority under RSA93. Sources of direct radiation from sites are regulated by the Nuclear Installations Inspectorate (NII) of the Health and Safety Executive (HSE).

1.2 The representative person

Radiological protection of the public is based on the concept of a 'representative person'. This notional individual is defined as being representative of the more highly exposed members of the population. It follows that, if the dose to the representative person is acceptable when compared to relevant dose limits and constraints, members of the public generally will receive lower doses, and overall protection of the public is provided from the effects of radiation. The term 'representative person' is equivalent to, and replaces, the term 'average member of the critical group' as recommended by the International Commission on Radiological Protection (ICRP) (ICRP, 2007).

The representative person can only be established once a dose assessment using environmental monitoring data and habits survey data has been undertaken. This survey provides information to assist SEPA in determining the representative person in the Chapelcross area.

1.3 Dose limits and constraints

Doses to the representative person can be compared to nationally and internationally recommended dose limits and constraints. The Radioactive Substances (Basic Safety Standards) (Scotland) Direction 2000 (Scottish Executive, 2000) directs SEPA to ensure that the sum of doses of ionising radiation to the public do not exceed the limits set out in Article 13 of Council Directive 96/29/Euratom (CEC, 1996) and that doses should be as low as reasonably achievable (ALARA), economic and social factors being taken into account. In connection with this, SEPA is directed to have regard to

the following maximum doses which may result from a defined source, for use at the planning stage in radiation protection:

a) 0.3 millisieverts per year from any source from which radioactive discharges are first made on, or after 13 May, 2000: or
b) 0.5 millisieverts per year from the discharges from any single site.

Additionally, the Government accepts that, in general it should be possible to operate existing facilities within the 0.3 mSv per year constraint. The ICRP recommends a dose limit of 1 mSv per year to members of the public from all anthropogenic sources.

2 THE SURVEY

2.1 Site activity

The Chapelcross nuclear site has four Magnox reactors which were shut down in 2004. Defuelling of the reactors began in 2008 and is expected to be completed in 2012. The site is owned by the Nuclear Decommissioning Authority and is operated and managed by Magnox North Ltd. At the time of the survey the main activities were defueling and removing asbestos from the heat exchangers in preparation for decommissioning. The site discharges liquid radioactive waste via a pipeline outfall into the Solway Firth and is authorised to discharge gaseous radioactive waste into the atmosphere. The site contains sources of direct radiation.

2.2 Survey aims

The Centre for Environment, Fisheries & Aquaculture Science (Cefas) undertook the survey on behalf of SEPA (Cefas contract C3745 and SEPA contract R90077PUR). The aim of the survey was to obtain information on the habits of the public that might lead them to be exposed to the effects of liquid discharges, gaseous discharges and direct radiation arising from the routine activities undertaken at the Chapelcross nuclear site. The survey provided comprehensive information to ensure that all potential pathways were identified.

Specifically, investigations were carried out to ascertain the following:

- The consumption of food from the aquatic survey area
- Activities and occupancy over intertidal areas
- The handling of fishing gear and sediment
- Activities and occupancy in and on water
- The use of seaweed as human or animal food or use as a fertiliser
- The consumption of food from the terrestrial survey area
- The production, use and destination of local produce
- The consumption and use of groundwater and surface water in the terrestrial survey area
- The transfer of contamination off-site by wildlife
- Activities and occupancy within the direct radiation survey area
- Any new or unusual exposure pathways

Additionally, SEPA requested that particular attention was paid to the consumption of foods that are grown in Creca village and the consumption of wild foods that are collected in or near the village.

Occupancy along the Chapelcross site pipeline and occupancy in the vicinity of the pipeline outfall was also investigated.

2.3 Survey areas

Four survey areas were defined to encompass the main areas potentially affected by the discharges from the site and sources of radioactivity. These were an aquatic area relating to liquid discharges, a terrestrial area relating to the deposition of gaseous discharges, a direct radiation area relating to ionising radiation emanating directly from the site, and a pipeline survey area.

The aquatic survey area (Figure 1) covered the Scottish side of the Solway Firth and its intertidal areas from Scar Point in the west to Gretna in the east.

The terrestrial survey area, shown in Figure 2, covered all land within 5 km of the site centre (National Grid Reference: NY 217 697). Watercourses and lakes within the survey area, which potentially contained contamination from the washout of gaseous discharges, are included in the terrestrial section of this report.

The direct radiation survey area is also shown in Figure 2. This survey area covered all land within 1 km of the site centre and at the request of SEPA it was extended to include residences on the south side of the Creca village main road.

The pipeline survey area, shown in Figure 3, covered the whole length of the 5 km liquid effluent discharge pipeline from the boundary of the site to the pipeline outfall at Seafield.

The same survey areas were used in the previous habits survey conducted by Cefas around the Chapelcross site, which was in 2005 (Sherlock *et al*., 2006).

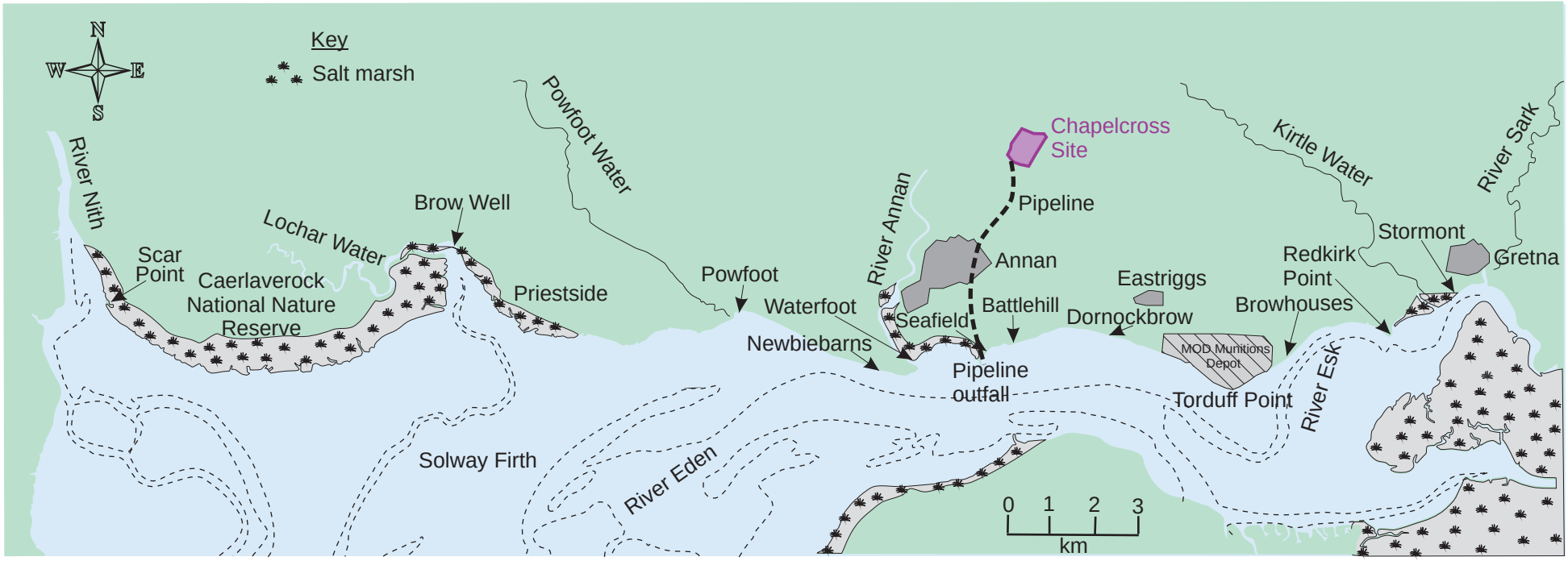

Figure 1. The Chapelcross aquatic survey area

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

- Chapelcross site centre
- 1 Greenknowe allotments
- 2 John Bell allotments

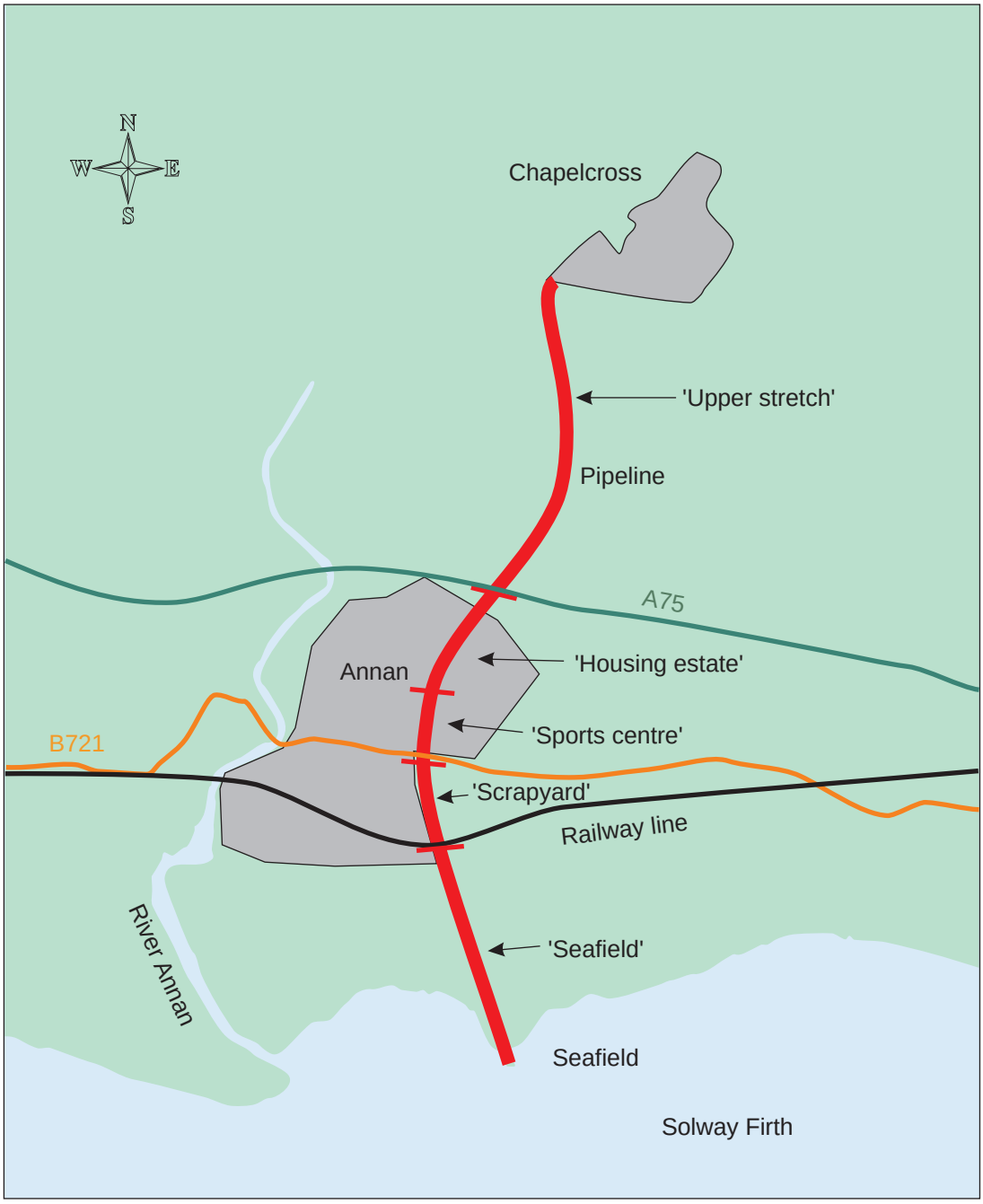

Figure 3. The Chapelcross pipeline survey area

2.4 Conduct of the survey

As part of the pre-survey preparation, SEPA was contacted to identify any additional requirements. Information relating to the activities of people in the aquatic and terrestrial survey areas was obtained from internet searches, Ordnance Survey maps and from previous habits surveys undertaken at Chapelcross. People with local knowledge of the survey area were contacted for information on any aspects relevant to the exposure pathways. These included fisheries officers and representatives of the local fishing industry and councils. Prior to the fieldwork a proposed fieldwork programme was distributed to SEPA for their comment.

The fieldwork component of the survey was carried out during the period 9th to the 22nd August 2010 by three members of staff from the Cefas laboratory at Lowestoft, according to techniques described by Leonard *et al.,* (1982). A meeting was held between the survey team and Chapelcross site representatives. These discussions provided details about current site activities, local information, potential pathways and activities in the area, and the potential transfer of contamination off-site by wildlife.

Interviews were conducted with individuals who were identified from the pre-survey preparation, or encountered during the fieldwork, that had the potential to be exposed to radioactivity from the site. These included, for example, fishermen, anglers, people carrying out activities on intertidal areas, farmers, gardeners, beekeepers and people living or working close to the site. Interviews were used to establish individuals' consumption, occupancy and handling rates relevant to the aquatic, terrestrial and direct radiation areas. Any general information of use to the survey was also obtained. Gamma dose rate measurements were taken over intertidal substrates in the aquatic area, indoors and outdoors at most properties visited within the direct radiation area, and along the pipeline. Measurements of background gamma dose rates were taken at locations beyond 5 km from the site centre.

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3 METHODS FOR DATA ANALYSIS

3.1 Data recording and presentation

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. 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 purpose-built database where each individual for whom information was obtained was given a unique identifier (the observation number) to assist in maintaining data quality.

The results of the individuals' consumption, occupancy and handling rates collected during the survey were grouped and presented in tables with the high-rate group members indicated in bold print and with the calculated mean rates for the high-rate group and 97.5th percentile rates noted at the foot of each table. The consumption rates, occupancy rates and handling rates for all groups are presented in Annex 1 for adults and Annex 2 for children and infants, with the high-rate group members indicated in bold print.

3.2 Data conversion

During the interviews, people could not always provide consumption rates in kilograms per year for food or litres per year for milk. In these circumstances, 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. These data were converted into consumption rates by the database using a variety of standard conversion factors. These factors included produce weights (Hessayon, 1997 and Good Housekeeping, 1994), edible fraction data researched by Cefas, and information supplied by the Meat and Livestock Commission.

3.3 Rounding and grouping of data

The consumption and occupancy data in the text of this report are rounded to two significant figures, except for values less than 1.0, which are rounded to one decimal place. This method of presentation reflects 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 computed values (row totals, mean rates and 97.5th percentiles), which are based on un-rounded data, to appear slightly erroneous. Consumption rates less than 0.05 kg y^{-1} are

presented to two decimal places in order to avoid the value of 0.0 kg y^{-1}. External exposure data are quoted as integer numbers of hours per year.

The habits data are structured into groups of food items or substrate types with similar attributes. For example, when considering terrestrial food consumption, all types of root vegetables are grouped together in a food group called 'root vegetables'. Similarly, for aquatic food consumption, all crustacean species are grouped as 'crustaceans'. For external exposure over intertidal sediments, occupancies over the same substrate, such as sand, are grouped together. The typical food groups used in habits surveys are shown in Table 1.

Data were structured into age groups because different dose coefficients (i.e. the factors which convert intakes of radioactivity into dose) can apply to different ages. The International Commission on Radiological Protection (ICRP) revised its recommendations for the age groupings to be used in radiological assessments and these recommendations were adopted in the 2010 habits survey reports. Consequently, the age ranges used in the habits survey reports prior to 2010 differ from those used currently. The age ranges used in this report and the names used for the age groups, based on the recommendations in ICRP 101 (ICRP, 2007), are listed below, together with those used in reports prior to 2010, for comparison.

Age ranges used from 2010 onwards

Name of age group	Age range in group
• Infant	0 to 5-year-old
• Child	6-year-old to 15-year-old
• Adult	16-year-old and over

Age ranges used in reports prior to 2010

Name of age group	Age range in group
• 3-month-old	Under 1-year-old
• 1-year-old	1-year-old
• 5-year-old	2-year-old to 6-year-old
• 10-year-old	7-year-old to 11-year-old
• 15-year-old	12-year-old to 16-year-old
• Adult	17-year-old and over

Since there are fewer age groups for children in the current regime, there should, in general, be more observations in each group, resulting in greater robustness in the data. However, data for children since 2010 will not be directly comparable with data for children prior to 2010, since the age ranges in the age groups will be different.

3.4 Approaches for the identification of high rates

The habits data have been analysed to indicate high rates of consumption, occupancy and handling, prior to a formal assessment being undertaken. Two approaches have been used:

Firstly, 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 values between the

maximum observed rate and one third of the maximum observed rate. In this report, the term 'high-rate group' is used to represent the individuals derived by the 'cut-off' method. The mean of the high-rate group was calculated for each food group, intertidal substrate and handling pathway identified in the survey. In certain cases, using the 'cut-off' method resulted in only one person being in the high-rate group. In these cases, expert judgement was used to decide whether the high-rate group should remain as one individual or whether others should be included. If others were included, the second highest rate was divided by three and all observations above this were included in the high-rate group.

Secondly, 97.5th percentile rates were calculated using the Excel mathematical function for calculating percentiles. The use of percentiles accords with precedents used in risk assessment of the safety of food consumption. It should be noted that the interviewees in this study are often selected and therefore the calculated percentiles are not based on random data.

Mean and 97.5th 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. The observed rates can be compared with the generic rates.

For the direct radiation pathway, mean occupancy rates and 97.5th percentile rates have not been calculated. Such an analysis is of limited value without a detailed knowledge of the spatial extent of dose rates due to direct radiation.

3.5 Infant and child ratios for use in dose assessments

For ingestion pathways, mean rates for the high-rate groups for infants and children have been calculated from the survey data. However, because few infant and child observations were identified, the rates should be viewed with caution. For assessment purposes, an alternative approach may be taken which involves scaling the mean rates for the adult high-rate groups by ratios. These ratios are given in Table 2 and have been calculated using generic 97.5th percentile consumption rates. Note that the age ranges within the age groups in Table 2 do not correspond exactly with the age ranges within the age groups used throughout the rest of this report.

4 AQUATIC RADIATION PATHWAYS

4.1 Aquatic survey area

The aquatic survey area, shown in Figure 1, covered the Scottish side of the Solway Firth and its intertidal areas from Scar Point to Gretna. The Scotland/England border was delineated by the channels of the River Eden and the River Esk in the Solway Firth. Several rivers and burns in the survey area flowed into the Solway Firth, the main ones being, from west to east; the River Nith, Lochar Water, Powfoot Water, the River Annan, Kirtle Water and the River Sark.

Scar Point and Caerlaverock

Scar Point was located at the mouth of the River Nith (see Figure 4) at the western end of the survey area. The shore from Scar Point to the eastern end of the Caerlaverock National Nature Reserve was dominated by a large area of salt marsh, parts of which were only tide washed on exceptionally high tides. This area was popular with wildfowlers, bird watchers and walkers. Several farmers grazed beef cattle on the salt marsh.

Figure 4. The River Nith at Scar Point

Brow Well, Priestside and Powfoot

At the eastern end of the Caerlaverock National Nature Reserve there was access to the salt marsh shore at Brow Well and dog walking, samphire collecting and mushroom collecting were identified in this area. The salt marsh, mud and sand shore extended east to Priestside and Powfoot. Wildfowling and cattle grazing were taking place on the salt marsh between Brow Well and Powfoot. There was a large expanse of sand exposed at low tide at Powfoot (see Figure 5) and this was a popular area for walkers, horse riders and dog walkers.

Figure 5. Powfoot

Newbiebarns, Waterfoot, Seafield and Battlehill

Between Powfoot and the mouth of the River Annan the shore was predominantly mud and stones. There was access to this area at Newbiebarns where a stake net was in operation and one person was identified angling and collecting peeler crabs for bait. Two shrimp boats were kept anchored in the lower reaches of the River Annan. On the eastern shores of the lower reaches of the River Annan the salt marsh was used for grazing beef and dairy cattle. A track provided access to the shore at Waterfoot and the salt marsh was popular with walkers and dog walkers from the nearby town of Annan. Two anglers were identified fishing at Waterfoot and one person collected small quantities of mushrooms for their own consumption from the upper salt marsh close by. The Chapelcross pipeline outfall was at the end of a stone faced embankment jutting out into the Solway Firth at Seafield. An angler was identified fishing from the concrete casing directly over the outfall, but he did not intend to fish there again. It was reported that children had occasionally been seen swimming close to the pipe

outfall at high tide but this was not observed at the time of the survey. From Seafield to Battlehill the shore was predominantly mud and stones with large expanses of mud and sand exposed at low tide (see Figure 6). The area between Waterfoot and Battlehill was important for salmonid fishing activities and haaf netters operated throughout this area. The main stake net operation (see Figure 7) was located close to the shore at Battlehill and most of the poke nets were situated on sand banks several hundred metres offshore at Seafield.

Figure 6. Seafield (with the Chapelcross pipeline in the foreground)

Figure 7. Stake net at Battlehill

Dornockbrow, Torduff Point and Browhouses

Between Battlehill and Browhouses the shore was mud and sand with patches of stones and was backed by salt marsh. The Eastriggs MoD munitions depot covered approximately 4 km of this stretch of coastline and there was no public access through the depot to the shore. There was access to the shore at either end of the depot at Dornockbrow and Browhouses and there was a public right of way all along the shore in front of the depot, which led to Torduff Point. The only activities identified in this area were haaf netting from Browhouses and wildfowling on the shore between Torduff Point and Browhouses. It was reported that children occasionally played on the shore at Dornockbrow.

Redkirk Point, Stormont and Gretna

The shore between Browhouses and Stormont was backed by salt marsh and a large expanse of mud and sand with patches of stones was exposed at low tide. At Stormont (see Figure 8) and east to Gretna the shore was salt marsh, mud and sand, however, the channel of the River Esk flowed close to the shore and only a small area of mud and sand was exposed at low tide. Wildfowling and haaf netting were popular in this area and parts of the salt marsh were used by farmers to the east of Stormont to graze sheep. Dog walking was identified between Torduff Point and Gretna. Samphire was collected from Redkirk Point and mushrooms were collected on the salt marsh between Stormont and Gretna.

Figure 8. Stormont

4.2 Commercial fisheries

Salmonids

The main fishing activity in the survey area was fishing for salmon and sea trout. Three fishing methods were used: poke netting, stake netting and haaf netting. These methods are described below. Poke nets and stake nets are fixed in position but haaf nets can easily be moved.

Poke nets are individual bag shaped nets approximately one metre wide which are strung between metal posts set in a line across the water current, thus forming a wall of netting. The nets are set on sand flats several hundred metres offshore so that they are covered at high tide but exposed at low tide. Fish swim into the nets over the high water period and become trapped in the net bags as the tide falls. The fishermen visit the nets at low tide to retrieve the catch and clean the nets.

Stake nets are walls of heavy netting about three metres high, supported on wooden poles, which are set out perpendicular from the shore. They have a cross wall of netting and a maze like trap at the seaward end. When the tide is in, fish that are swimming along the shore are guided into the maze trap by the walls of netting and cannot escape. As with the poke nets, the fishermen visit the nets at low tide to retrieve the catch from the trap and clean the nets. The nets can be set singly or in rows, with the net wall of one extending seawards from the trap of the other.

Haaf nets are rectangular nets hung from a beam approximately five metres long, with sticks at either end of the beam to hold the net open. A central pole in the middle of the net forms a handle and the complete rig is similar to a giant scoop or ladle. The fishermen stand up to chest deep in the water holding the net so that it faces into the current. Any fish swimming into the net are scooped up and caught. Often, several fishermen fish together, standing in a line perpendicular to the shore so that the nets form a barrier to passing fish.

Traditionally the salmon and sea trout fishing season on the north Solway coast extends from 25th February to 9th September but recent conservation initiatives and voluntary restrictions have resulted in a later start to the season and many fishermen did not begin fishing until May or June in 2010. No fishing was allowed over the weekends, from 1800 Friday until 0600 Monday; the haaf netters did not go out at the weekends and the poke and stake nets were set so as not to catch any fish. However, the fishermen often visited the poke nets and stake nets at the weekends to clear debris from them, particularly when tides were strong. In the close-season the poke and stake nets were dismantled and the nets were either discarded or repaired and stored. The stake net and poke net operators usually used tractors to go out to their nets and the haaf netters also occasionally used tractors to take their nets to the water's edge.

In 2010, Dumfries and Galloway Council issued 33 haaf net licences, seven poke net licences, and one stake net licence to fishermen operating in the Annan area. One other fisherman held private stake netting rights. The council licensed stake net operator had four nets situated at Battlehill and the private operator had a single net at Newbiebarns. The poke nets were set on sandbanks offshore from Seafield. Most of the Annan haaf netters fished mainly in the area between Waterfoot and Battlehill. Other haaf net fishermen operated from places further east along the coast including Browhouses, Redkirk and Stormont, but they mainly held licences issued by the Environment Agency in England and usually waded or used small boats to cross the main channel of the river and fish from the banks on the English side. Haaf netting also took place in the far west of the survey area, around Scar Point. Many fishermen operated on a part-time basis.

The majority of the salmon and sea trout caught were sold, with small amounts being consumed by the fishermen and their families. Other marine fish species were occasionally caught during salmonid fishing as a by-catch, the most common being flounder, bass and grey mullet. Most of the grey mullet and many of the flounders were discarded but some of the flounders and the bass were consumed by the fishermen and their families.

Crustaceans

Two small vessels based at Annan used beam trawls to fish for brown shrimps in the survey area for six months of the year through the summer. These vessels were not fishing within the survey area in 2005. It was reported that approximately eight other shrimping vessels, based at Silloth and Maryport in England, occasionally fished within the survey area. A small part of the catch was consumed by the fishermen and their families. No other crustacean fisheries were identified within the survey area.

Molluscs

Historically there has been a cockle fishery in the Solway Firth pursued by fishing vessels, tractor rakes and hand gatherers but the fishery was closed at the time of the survey and had not been open since 2007. The fishery may reopen in a limited capacity in the future. No other mollusc fisheries were identified in the survey area.

4.3 Seafood wholesalers and retailers

Salmon and sea trout were sold directly to members of the public and two individuals bought fish from other fishermen and sent them to Billingsgate Market in London and other buyers throughout the country. Brown shrimps were sent to processors in England at Grange Over Sands and Kings Lynn.

4.4 Angling and shellfish collecting

The survey area was not very popular for sea angling. Two people were identified angling from the shore at Powfoot, two at Waterfoot, one at Newbiebarns and one from the concrete casing over the Chapelcross pipeline outfall point at Seafield. The angler at the pipeline outfall point said that he had never fished there before and probably never would again. The anglers caught and consumed small quantities of bass and flounders. No angling charter vessels were working in the survey area.

Angling for salmon and sea trout was very popular on the River Annan. The fishing rights along the banks of the river were privately owned and the fishers purchased tickets or were members of syndicates.

One individual was identified collecting peeler crabs for angling bait at Newbiebarns. No other shellfish collecting was identified within the survey area.

4.5 Wildfowling

Two wildfowling clubs, one with approximately 100 members and one with approximately 45 members, and several other individuals who were not members of clubs, were identified shooting in the survey area. The wildfowling season extended from 1st September to 20th February and wildfowling took place from many areas of mud and salt marsh scattered along the coast. The species of wildfowl shot in the survey area and consumed were goose (unspecified), greylag goose, pink-footed goose, mallard, pintail duck, shoveler, snipe, teal and wigeon.

4.6 Other pathways

The use of seaweed for human or animal food, or for use as a fertiliser was not identified. Cattle were grazing on areas of salt marsh at Caerlaverock, Priestside and Waterfoot, and sheep were grazing on the salt marsh to the east of Stormont. Mushrooms were collected from the salt marsh at Brow Well, Waterfoot and between Stormont and Gretna although they were growing in the drier areas of the salt marsh and it was considered that these areas would only be tide washed in exceptional circumstances.

4.7 Internal exposure

Consumption data for foods from the aquatic survey area are shown in Tables 3 to 6 for adults and in Tables 7 and 8 for children. No infants were identified consuming aquatic foods from the survey area.

Adults' consumption rates

The main consumers of seafood from the Chapelcross survey area were commercial fishermen, anglers, wildfowlers and their families.

Table A presents a summary of the adult consumption rates for fish, crustaceans, wildfowl and marine plants/algae from the aquatic survey area. No consumption of molluscs was identified. The table includes the mean consumption rates for the high-rate groups and the observed 97.5th percentile rates. For comparison, the table also includes mean consumption rates and 97.5th percentile consumption rates based on national data, which are referred to as 'generic' data in this report.

Table A. Summary of adults' consumption rates of foods from the aquatic survey area

Food group	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1})	Observed minimum for the high-rate group (kg y^{-1})	Observed mean for the high-rate group (kg y^{-1})	Observed 97.5th percentile (kg y^{-1})	Generic mean (kg y^{-1})	Generic 97.5th percentile (kg y^{-1})
Fish	67	23	12.9	4.4	8.7	12.9	15.0	40.0
Crustaceans	5	4	20.4	8.2	15.3	20.0	3.5	10.0
Wildfowl	15	4	45.1	22.8	30.6	40.4	ND	ND
Marine plants/algae	4	4	0.2	0.2	0.2	0.2	ND	ND

Notes
ND = not determined

The predominant species of fish consumed by adults were salmon and sea trout. Smaller quantities of flounder and bass were also consumed. These fish were caught throughout the survey area. Of the fish consumed by the 23 people in the high-rate group, the percentage breakdown of species was 65% salmon, 25% sea trout, 5% flounder and 5% bass.

The only species of crustacean consumed by adults were brown shrimps which were caught over a wide area of the Solway Firth.

The predominant species of wildfowl consumed by adults were mallard, pink-footed goose and greylag goose. Smaller quantities of pintail duck, goose (unspecified species), wigeon, teal, snipe and shoveler were also consumed. These were shot on the salt marsh at Caerlaverock, from Brow Well to Seafield, at Torduff Point, Browhouses and Gretna. Of the wildfowl consumed by the four people in the high-rate group, the percentage breakdown of species was 48% mallard, 21% pink-footed goose, 14% greylag goose, 7% pintail duck and 10% a mix of goose (unspecified species), wigeon, teal and snipe.

The only species of marine plants/algae consumed by adults was samphire, which was collected from the salt marsh at Brow Well, Redkirk and between Waterfoot and Seafield.

Children's consumption rates

Table B presents a summary of children's consumption rates of fish and wildfowl from the aquatic survey area. The table includes the mean consumption rates for the high-rate groups and the observed 97.5th percentile rates. For individuals in the child age group, no consumption of crustaceans, molluscs or marine plants/algae was identified. The age group names and their relevant age ranges are listed in Section 3.3.

Table B. Summary of children's consumption rates of foods from the aquatic survey area

Food group	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1})	Observed minimum for the high-rate group (kg y^{-1})	Observed mean for the high-rate group (kg y^{-1})	Observed 97.5th percentile (kg y^{-1})
Child age group (6 – 15 years old)						
Fish	4	2	3.9	2.9	3.4	3.8
Wildfowl	2	2	0.4	0.4	0.4	0.4

Notes
NC = not consumed

The species of fish consumed by the child age group were salmon and sea trout, which were caught throughout the survey area. The percentage breakdown of fish species consumed by the high-rate group was 68% salmon and 32% sea trout.

The only species of wildfowl consumed by the child age group was greylag goose which was shot on the salt marsh between Waterfoot and Seafield.

4.8 External exposure

Intertidal occupancy

Intertidal occupancy rates for adults are presented in Table 9 and intertidal occupancy rates for children and infants are presented in Table 10. It should be noted that there are often more than one substrate at one named location and that substrates at a given location are liable to change over time. Activities were assigned to the predominant substrate over which they were taking place.

Adults' intertidal occupancy rates

Intertidal activities identified for adults included stake netting, wildfowling, poke netting, dog walking, haaf netting, nature reserve warden duties, walking, collecting peeler crabs, angling, beachcombing, tending livestock, inshore rescue duties and bait digging.

Table C presents a summary of the adults' intertidal occupancy rates in the aquatic survey area. The table includes the mean occupancy rates for the high-rate groups and the observed 97.5th percentile rates.

Table C. Summary of adults' intertidal occupancy rates

Intertidal substrate	Number of observations	Number of people in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Mud	16	5	692	549	685
Mud and sand	3	2	36	36	36
Mud and stones	3	2	136	125	135
Mud, sand and stones	1	1	180	180	Not applicable
Salt marsh	41	1	1130	1130	365
Sand	26	5	405	263	393
Sand and stones	2	2	12	12	12

The activities undertaken by people in the adult high-rate groups for occupancy over the following intertidal substrates included:

- For mud: stake netting at Battlehill and wildfowling from Caerlaverock to Seafield, at Battlehill and from Browhouses to Gretna
- For mud and sand: walking at Powfoot
- For mud and stones: collecting peeler crabs, angling and stake netting at Newbiebarns
- For mud, sand and stones: dog walking from Todruff Point to Gretna
- For salt marsh: dog walking and collecting samphire at Brow Well and wildfowling between Brow Well and Powfoot

- For sand: poke netting off Seafield, haaf netting from Waterfoot to Battlehill, beachcombing between Battlehill and Powfoot, and dog walking from Seafield to Powfoot
- For sand and stones: walking at Powfoot

Children's and infants' intertidal occupancy rates

Table D presents a summary of the children's and infants' intertidal occupancy rates in the aquatic survey area. The table includes the mean occupancy rates for the high-rate groups and the observed 97.5th percentile rates.

Table D. Summary of children's and infants' intertidal occupancy rates

Intertidal substrate	Number of observations	Number of people in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Child age group (6 - 15 years old)					
Mud and sand	2	2	36	36	36
Salt marsh	1	1	39	39	Not applicable
Sand	1	1	5	5	Not applicable
Sand and stones	1	1	12	12	Not applicable
Infant age group (0 - 5 years old)					
Sand and stones	3	3	12	12	12

The following activities were undertaken by the individuals in the child age group high-rate groups for occupancy over intertidal substrates:

- For mud and sand: walking at Powfoot
- For salt marsh: beachcombing at Stormont
- For sand: walking at Powfoot
- For sand and stones: walking at Powfoot

The following activity was undertaken by the individuals in the infant age group high-rate group for occupancy over one intertidal substrate:

- For sand and stones: walking at Powfoot

Gamma dose rate measurements

Gamma dose rate measurements were taken over intertidal substrates to supplement those of SEPA's scheduled monitoring programme. The results are presented in Table 11 and are summarised below.

- Four measurements taken over mud ranged from 0.073 µGy h^{-1} to 0.084 µGy h^{-1}
- One measurement taken over mud and sand was 0.086 µGy h^{-1}
- Four measurements taken over salt marsh ranged from 0.064 µGy h^{-1} to 0.087 µGy h^{-1}

- One measurement taken over sand and stones was 0.085 µGy h^{-1}

Handling fishing gear and sediment

Handling fishing gear that has become entrained with fine sediment particles, or handling sediment while undertaking activities such as bait digging or mollusc collecting, can potentially give rise to skin exposure from beta radiation. Doses to the skin need consideration, as there is a separate dose limit for skin for members of the public. There is also a contribution to effective dose due to skin exposure (ICRP, 1991). The handling of angling equipment was not considered to be a significant pathway since angling equipment does not generally become entrained with sediment. Therefore, as in previous surveys, data for this pathway were not collected.

Table 12 presents the adult handling rates of fishing gear and sediment recorded during the survey. Time spent setting up and dismantling poke nets and stake nets has been classified as sediment handling since it involves activities such as erecting poles in sediment. Time spent emptying and cleaning poke nets has been classified as gear handling (as is usual with other fishing methods such as trawling) but time spent emptying and cleaning stake nets has been classified as sediment handling since this is considered more appropriate for this particular gear type because of the nature of the fishing operation.

No children or infants were identified handling fishing gear or sediment.

Adults' handling rates of fishing gear and sediment

The activities for adults involving handling fishing gear were haaf netting, poke netting, trawling and repairing stake nets. Activities for adults involving sediment handling included poke netting, stake netting, wildfowling, collecting peeler crabs and bait digging.

Table E presents a summary of the handling rates of fishing gear and sediment for adults. The table includes the mean handling rates for the high-rate groups and the observed 97.5th percentile rates.

Table E. Summary of adults' handling rates of fishing gear and sediment

Handling activity	Number of observations	Number of people in the high-rate group	Maximum of the high-rate group (h y^{-1})	Mean of the high-rate group (h y^{-1})	97.5th percentile (h y^{-1})
Handling fishing gear	20	5	514	290	403
Handling sediment	23	6	732	547	714

The people in the adult high-rate group for handling fishing gear were haaf netting from Waterfoot to Battlehill and poke netting off Seafield. The activities undertaken by the people in the high-rate group for handling sediment were poke netting off Seafield, stake netting at Battlehill, and wildfowling from Caerlaverock to Seafield and from Browhouses to Gretna. Most of the fishermen either did not wear gloves or did not wear them all the time while undertaking fishing operations and did not wear gloves when mending nets ashore. Stake net fishermen were liable to get debris and sediment on their faces when cleaning nets above head height. Wildfowlers spent much of their time lying or kneeling in the mud and often did not wear gloves.

Water based activities

Activities taking place in or on the water can potentially 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, relevant data have been collected for consideration in dose assessments. Mean occupancy rates and 97.5th percentile rates have not been calculated. Activities where there is a high potential of the individual's face submersing under the water have been classified as activities 'in water' since they are likely to lead to ingestion of water. All other activities have been classified as activities 'on water'.

Occupancy rates for activities taking place 'on water' in the survey area for adults are presented in Table 13. No adults were identified undertaking activities 'in water' and no children or infants were identified undertaking activities in water or on water in the survey area. Activities taking place on the water in the survey area included trawling, haaf netting and operating a rescue boat. Twenty-nine observations were recorded for adults. The highest occupancy rate on water for adults was 670 h y^{-1} for a commercial trawl fisherman operating in the Solway Firth.

5 TERRESTRIAL RADIATION PATHWAYS

5.1 Terrestrial survey area

The terrestrial survey area is shown in Figure 2. Thirty-four working farms were identified, which produced beef, lamb, milk and arable crops. Milk was sold to four national distributors. Most of the beef was sold through livestock markets or abattoirs in Aberdeen, Ayr, Perth, Dumfries or Lockerbie. A small amount of beef was sold privately. Most of the lamb was sold through Lockerbie or Dumfries livestock markets or to abattoirs further afield. Arable crops including barley, wheat, maize, fodder beet, hay and grass were grown for winter animal feed. Many farmers consumed milk, beef and lamb that were produced on their own farms. Three farmers kept a small number of pigs and several farmers kept chickens for eggs for their own and their families' consumption.

There were two allotment sites in Annan. One allotment site had 11 plots which were all well maintained and the other allotment site had six plots, three of which were not used. The allotment holders grew a variety of vegetables and fruit, which were consumed by their families and friends. Vegetables and fruit were also grown in the gardens of private houses.

Two beekeepers were identified, one with hives near Eaglesfield and the other with hives on farmland to the west of the Chapelcross site. One beekeeper had 20 hives and the other beekeeper had 12 hives. The honey produced per hive ranged from 4 kg y^{-1} to 14 kg y^{-1}. The honey produced was consumed by the beekeepers and their families and was sold to local shops. One beekeeper who was identified during the last habits survey at Chapelcross was no longer keeping hives.

The consumption of wild foods from within the survey area was limited to small amounts of blackberries, sloes, bilberries and mushrooms. Partridge, pheasant, rabbits and deer shot on farmland in the area were also consumed.

The human consumption of groundwater was not identified. Livestock on several farms were supplied with borehole or spring water for drinking and some also had access to burn or river water.

The River Annan and Kirtle water flowed through the terrestrial survey area. Salmon and sea trout were caught in the river Annan and brown trout were caught in Kirtle Water and were consumed.

A large peat cutting works was located to the east and northeast of the survey area. The peat was sold throughout the UK for horticulture compost.

The transfer of contamination off-site by wildlife was investigated as radionuclides could enter the food chain or contaminate the environment through this pathway. Control measures were in place at the Chapelcross site to limit the possibility that contamination was transferred off-site by wildlife. The site boundary fence extended below ground to prevent rabbits from burrowing under the fence and birds were actively discouraged from entering the buildings on site. No routine culling or monitoring of wildlife found on site was undertaken.

5.2 Land cover

Figure 9 shows the soil types in the area around the Chapelcross site. The figure is reproduced from a land cover map produced by Macaulay Land Use Research Institute, with their consent.

The area consisted mainly of arable land and improved grassland. There were also pockets of coniferous (both plantation and semi-natural) and broadleaved and mixed woodland. There were a few small areas of blanket bog and other peat land vegetation, along with pits and quarries.

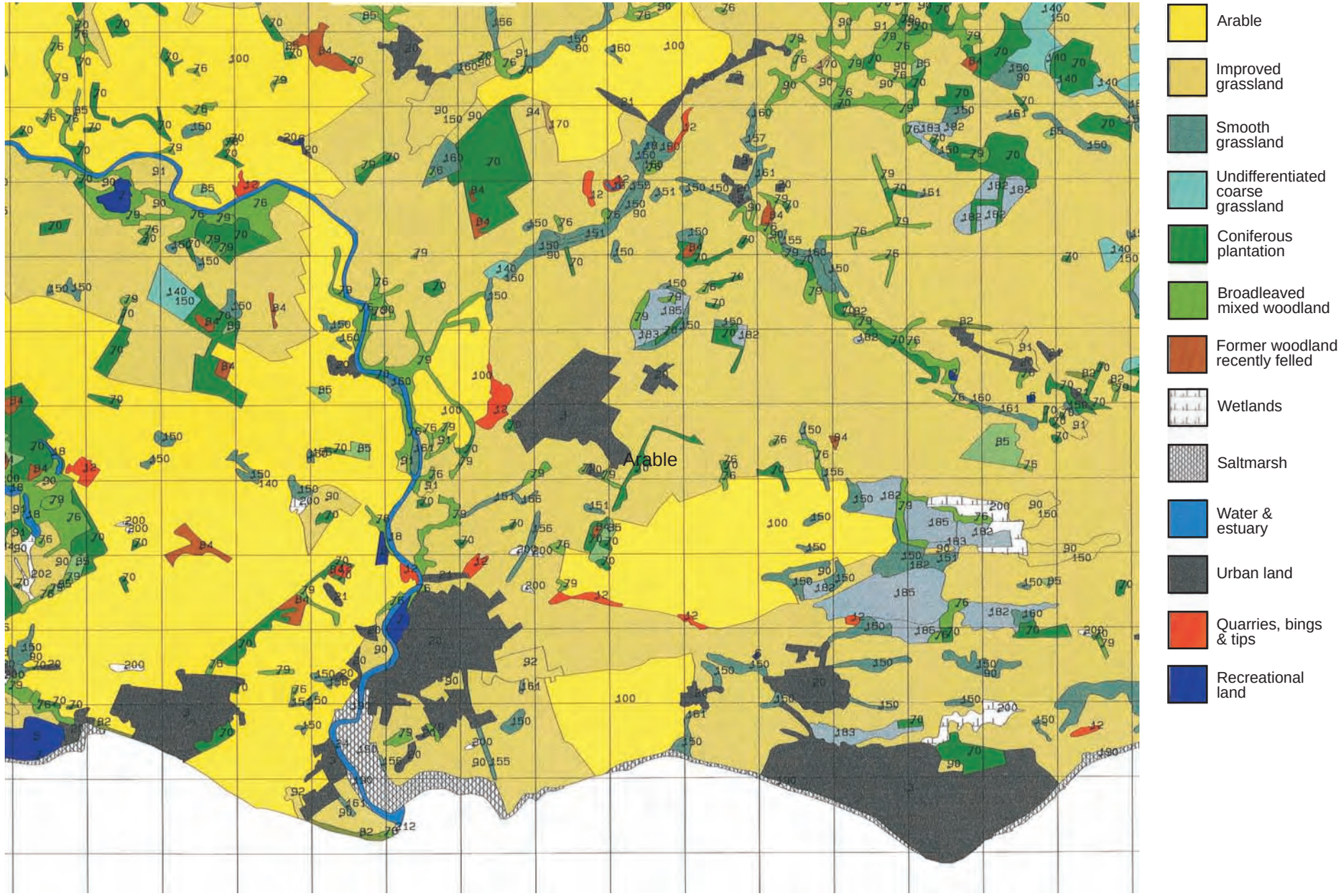

Figure 9. Land cover around Chapelcross.
Reproduced with the permission of The Macaulay Institute for Soil Research, Aberdeen. Base scale is 1:500000.

5.3 Internal exposure

Consumption data for locally produced foodstuffs potentially affected by deposition of gaseous discharges are presented in Tables 14 to 30 for adults and Tables 31 to 37 for children and infants.

Adults' consumption rates

Table F presents a summary of the consumption rates for the foods consumed from the terrestrial survey area for adults. The table includes the mean consumption rates for the high-rate groups and the observed 97.5th percentile rates. For comparison, the table also includes mean consumption rates and 97.5th percentile consumption rates based on national data, which are referred to as 'generic' data in this report. The consumption of foods from the terrestrial survey area were identified in the following 17 food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk, cattle meat, pig meat, sheep meat, poultry, eggs, wild/free foods, rabbits/hares, honey, wild fungi, venison and freshwater fish.

Table F. Summary of adults' consumption rates of foods from the terrestrial survey area

Food group	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1} or l y^{-1})	Observed minimum for the high-rate group (kg y^{-1} or l y^{-1})	Observed mean for the high-rate group (kg y^{-1} or l y^{-1})	Observed 97.5th percentile (kg y^{-1} or l y^{-1})	Generic mean (kg y^{-1} or l y^{-1})	Generic 97.5th percentile (kg y^{-1} or l y^{-1})
Green vegetables	37	19	35.8	14.5	22.4	35.8	15.0	45.0
Other vegetables	40	9	34.3	15.1	24.3	34.3	20.0	50.0
Root vegetables	39	10	58.8	19.8	38.9	58.8	10.0	40.0
Potato	53	24	127.4	47.0	76.6	122.2	50.0	120.0
Domestic fruit	38	5	35.0	12.7	23.8	35.0	20.0	75.0
Milk	25	7	730.0	276.6	419.6	620.5	95.0	240.0
Cattle meat	11	9	57.0	20.8	38.5	57.0	15.0	45.0
Pig meat	9	7	35.0	16.9	24.5	35.0	15.0	40.0
Sheep meat	15	15	11.3	3.8	6.0	11.3	8.0	25.0
Poultry	10	4	28.1	10.2	19.1	28.1	10.0	30.0
Eggs	32	18	39.9	13.3	21.0	39.9	8.5	25.0
Wild/free foods	30	8	6.8	2.5	4.6	6.8	7.0	25.0
Rabbits/hares	2	2	1.4	1.4	1.4	1.4	6.0	15.0
Honey	3	1	9.1	9.1	9.1	8.7	2.5	9.5
Wild fungi	21	9	1.0	0.5	0.9	1.0	3.0	10.0
Venison	2	2	36.3	36.3	36.3	36.3	ND	ND
Freshwater fish	2	2	0.7	0.7	0.7	0.7	ND	ND

Notes

ND = not determined

One observed mean consumption rate for the high-rate group was found to be greater than the generic 97.5th percentile consumption rate, which was for milk. Eleven observed mean consumption

rates for the high-rate groups exceeded the generic mean consumption rates. These were for green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk, cattle meat, pig meat, poultry, eggs and honey. Five observed 97.5th percentile consumption rates exceeded the generic 97.5th percentile consumption rates. These were for root vegetables, potato, milk, cattle meat and eggs. There are currently no generic consumption data available for venison or freshwater fish so no comparisons can be made.

The percentage contribution each food type makes to its terrestrial food group, for adults, is presented in Table 38.

Children's and infants' consumption rates

Table G presents a summary of the consumption rates for the foods consumed from the terrestrial survey area for children and infants. No generic rates have been determined for the child and the infant age groups so no comparisons with the observed rates can be made.

For the child age group, consumption of terrestrial foods was identified in the following seven food groups: green vegetables, other vegetables, root vegetables, potato, domestic fruit, milk and pig meat. No consumption was identified for the following food groups: cattle meat, sheep meat, poultry, eggs, wild/free foods, rabbits/hares, honey, wild fungi, venison and freshwater fish.

For the infant age group, only the consumption of potatoes was identified. No consumption was identified for the following food groups: green vegetables, other vegetables, root vegetables, domestic fruit, milk, cattle meat, pig meat, sheep meat, poultry, eggs, wild/free foods, rabbits/hares, honey, wild fungi, venison and freshwater fish.

Table G. Summary of children's and infants' consumption rates of foods from the terrestrial survey area

Food group	Number of observations	Number of people in the high-rate group	Observed maximum for the high-rate group (kg y^{-1} or l y^{-1})	Observed maximum for the high-rate group (kg y^{-1} or l y^{-1})	Observed mean for the high-rate group (kg y^{-1} or l y^{-1})	Observed 97.5th percentile (kg y^{-1} or l y^{-1})
Child age group (6 - 15 years old)						
Green vegetables	4	1	35.8	35.8	35.8	33.8
Other vegetables	4	1	19.3	19.3	19.3	18.2
Root vegetables	4	1	58.8	58.8	58.8	54.8
Potato	5	5	27.1	11.1	16.1	25.9
Domestic fruit	7	2	20.8	13.6	17.2	19.7
Milk	7	4	219.0	75.4	111.3	197.5
Pig meat	1	1	18.6	18.6	18.6	NA
Infant age group (0 - 5 years old)						
Potato	1	1	15.5	15.5	15.5	NA

Notes
NA = not applicable

6 DIRECT RADIATION PATHWAYS

6.1 Direct radiation survey area

The direct radiation survey area, shown in Figure 2, covered the area within 1 km of the site centre and it was extended to include residences on the south side of the Creca village main road.

The Chapelcross site is situated on the site of a former RAF airfield at the head of small valley encompassing Gullielands Burn. The land in the direct radiation survey area was predominantly agricultural. Farmers kept livestock and grew arable crops on the fields in the area including the fields adjacent to the site. The closest occupied residences to the site centre were located to the north and to the south of the site. The main concentration of residences and businesses was in the village of Creca, which was located approximately 1 km north-east of the Chapelcross site centre. A scrap yard was located to the south of the site.

6.2 Occupancy rates and gamma dose rate measurements

Interviews were conducted at 11 residential properties and five businesses. One of the residential properties was occupied by a family with an infant and at two properties children visited their family regularly. Indoor, outdoor and total occupancy rates for adults, children and infants are presented in Table 39. The highest total and outdoor occupancy rates were 8400 h y^{-1} and 2900 h y^{-1}, respectively, for a resident who also worked in the area. The highest indoor occupancy rate was 8100 h y^{-1} for a resident.

It should be noted that the activities of the employees and contractors of the Chapelcross site, while at work on the site, were not considered in the direct radiation survey.

Gamma dose rate measurements were taken both indoors and outdoors at most properties where interviews were conducted. Outdoor measurements were taken approximately 5 to 10 metres from the nearest building. Gamma dose rate measurements over rough grass were taken at locations at distances further than 5 km from the site centre to obtain background dose rates. All measurements were taken at a height of 1 metre above the substrate. It should be noted that the indoor and outdoor measurements have not been adjusted for natural background dose rates.

The results are presented in Table 40 and are summarised below.

Indoor measurements

- Five measurements taken over wood ranged from 0.075 µGy h^{-1} to 0.103 µGy h^{-1}
- Eight measurements taken over concrete ranged from 0.069 µGy h^{-1} to 0.109 µGy h^{-1}

Outdoor measurements

- Ten measurements taken over grass ranged from 0.069 µGy h^{-1} to 0.099 µGy h^{-1}
- One measurement taken over grass and gravel was 0.092 µGy h^{-1}
- Two measurements taken over gravel ranged from 0.082 µGy h^{-1} to 0.089 µGy h^{-1}

Background measurements

- Four measurements taken over grass ranged from 0.064 µGy h^{-1} to 0.071 µGy h^{-1}

It should be noted that the underlying geology may cause variations in the gamma dose measurement readings. The geology of the areas where measurements were taken during this survey was not investigated. The gamma dose rate measurements were taken at varying times of the day.

7. PIPELINE OCCUPANCY

7.1 The pipeline survey area

The discharge pipeline is approximately 5 km long and carries liquid effluent from the Chapelcross site to Seafield, along the path of a dismantled railway, where it is discharged into the Solway Firth. Figure 3 shows a diagrammatic layout of the pipeline's path. For the purposes of the survey, the pipeline area was divided into 5 sections and these are also shown in Figure 3. From Seafield, northwards towards the Chapelcross site the sections were named 'Seafield', 'Scrap yard', 'Sports centre', 'Housing estate' and 'Upper stretch', according to their location.

The pipeline runs above ground in the 'Seafield', 'Scrap yard' and 'Sports centre' sections, but is buried underground through the 'Housing estate' and most of the 'Upper stretch'. A path of grass, bare earth or gravel ran down most of the route. The entire length of the pipeline route was fenced but this varied from low strung wire fencing, typical in the 'Seafield' section and 'Upper stretch', to high steel fencing which was typical in the 'Scrap yard', 'Sports centre' and 'Housing estate' sections. There was easy public access through unlocked gates to the 'Seafield' and 'Scrap yard' sections and access could be gained to most of the 'Housing estate' section and the 'Upper stretch' via climbing over low barred gates or stiles. Most of the 'Sports centre' section was not accessible to the public because of high fencing and high locked gates. However access was possible to a small part at the south end of this section via a low barred fence by the B721 road.

7.2 Occupancy rates and gamma dose rate measurements

Occupancy rates along the pipeline are presented in Table 41. Twenty-three observations were made with occupancy rates ranging from 1 h y^{-1} to 730 h y^{-1}. The activities observed included walking, dog walking and grounds maintenance. One dog walker reported that they collected small quantities of blackberries from the 'Seafield' section. The 'Seafield' section was the most heavily used, followed by the 'Housing estate' and the 'Upper stretch'. Although the 'Upper stretch' extended to the site boundary, the northern part was not well used and most people did not go beyond half way along it from the A75 road. The only people identified using the 'Scrap yard' and 'Sports centre' sections were the ground maintenance crew.

Gamma dose rate measurements taken along the pipeline are presented in Table 42. All measurements were taken at a height of 1 metre above the substrate. Where the pipe was above ground the measurements were taken at a distance of 1 metre from the side of the pipe. The eight

gamma dose rate measurements taken over grass ranged from 0.066 µGy h^{-1} to 0.129 µGy h^{-1} and the single measurement taken over gravel was 0.141 µGy h^{-1}.

8 USE OF HABITS DATA FOR DOSE ASSESSMENTS

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 Annex 1 and Annex 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. The rates for individuals in the high-rate groups are emboldened and are therefore apparent. 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 high-rate groups.

The most extensive combinations of pathways for adult dose assessment are shown in Annex 3. Each of the 29 combinations shown in this table represents an actual individual (or individuals) from Annex 1 who has positive data (irrespective of the magnitude), for each pathway marked with a cross. It should be noted that combination numbers in Annex 3 do not correlate directly with observation numbers in Annex 1. Other individuals from Annex 1 have combinations that are not listed in Annex 3 because they have fewer pathways and a dose assessment for them would be adequately covered by one of the 29 listed combinations.

9 COMPARISONS WITH THE PREVIOUS SURVEY

The results from this 2010 survey can be compared with results from the last habits survey, undertaken at Chapelcross in 2005.

Aquatic survey

A comparison between the 2005 and 2010 adults' consumption rates of aquatic foods is presented in Table H

Table H. Comparison between 2005 and 2010 consumption rates of aquatic food groups for adults

	2005			2010		
Food group	Number of people in the high-rate group	Maximum consumption rate (kg y^{-1})	Mean consumption rate for the high-rate group (kg y^{-1})	Number of people in the high-rate group	Maximum consumption rate (kg y^{-1})	Mean consumption rate for the high-rate group (kg y^{-1})
Fish	3	47.9	30.8	23	12.9	8.7
Crustaceans	Not identified			4	20.4	15.3
Wildfowl	14	22.5	18.5	4	45.1	30.6
Marine plants/algae	Not identified			4	0.2	0.2

The mean consumption rate for the adult high-rate group decreased for fish and increased for wildfowl in 2010 when compared with 2005. The consumption of crustaceans and marine plants/algae was identified in 2010 but was not identified in 2005. The main species of fish consumed by the adult high-rate group in 2005 and in 2010 were salmon and sea trout. In 2005 the wildfowl consumed by the adult high-rate group were mainly unidentified species of duck and goose and in 2010 the main species consumed were mallard, pink-footed goose and greylag goose. No consumption of molluscs was identified in 2005 or 2010.

The decrease in fish consumption was attributed to a large reduction in fishing effort by the fishermen who were the high-rate consumers in 2005, resulting in less fish being available for consumption by them and their families in 2010. The consumption of crustaceans increased in 2010 because two commercial fishermen were identified fishing for shrimps in the area who were not fishing in the area in 2005. These fishermen and their families' were consuming large quantities of brown shrimps. In 2005, only a small amount of commercial fishing for shrimps took place in the survey area and this was undertaken by a few boats from the English side of the Solway.

A comparison between the 2005 and 2010 aquatic external exposure pathways for adults is presented in Table I.

Table I. Comparison between 2005 and 2010 intertidal occupancy rates and handling rates of fishing gear and sediments for adults

	2005			2010		
Intertidal substrate or handling pathway	Number of people in the high-rate group	Maximum occupancy or handling rate (h y^{-1})	Mean occupancy or handling rate for the high-rate group (h y^{-1})	Number of people in the high-rate group	Maximum occupancy or handling rate (h y^{-1})	Mean occupancy or handling rate for the high-rate group (h y^{-1})
Mud	3	1066	950	5	692	549
Mud and sand	Not observed			2	36	36
Mud and stones	Not observed			2	136	125
Mud, sand and stones	Not observed			1	180	180
Salt marsh	17	831	447	1	1130	1130
Sand	5	508	431	5	405	263
Sand and stones	Not observed			2	12	12
Handling fishing gear	15	618	388	5	514	290
Handling sediment	9	1066	606	6	732	547

In 2010, compared to 2005, the mean occupancy rate for the adult high-rate group decreased significantly for mud, increased significantly for salt marsh and decreased for sand. Activities were recorded over mud and sand, over mud and stones, over mud sand and stones, and over sand and stones in 2010 but no activities were recorded taking place over these substrates in 2005. Changes in occupancy rates on various substrates may be partially attributable to substrates at given locations changing over time. The range of intertidal activities observed in 2010 was broadly the same as in 2005, including commercial fishing, wildfowling, marsh warden duties, coastguard duties, angling, tending livestock, bird watching and walking. There were a limited number of beaches in the survey area where leisure activities were taking place. Activities that were identified in 2010 but that were not observed in 2005 included dog walking and beachcombing.

In 2010, the mean rates for the adults' high-rate groups for handling fishing gear and for handling sediment both decreased compared with 2005.

Terrestrial survey

A comparison between the 2005 and 2010 mean consumption rates for the adult high-rate groups for terrestrial foods is presented in Table J.

Table J. Comparison between 2005 and 2010 mean consumption rates for the adult high-rate groups for terrestrial food groups (kg y^{-1} or l y^{-1})

Food group	2005	2010
Green vegetables	19.9	22.4
Other vegetables	11.4	24.3
Root vegetables	53.5	38.9
Potato	107.9	76.6
Domestic fruit	27.1	23.8
Milk	272.1	419.6
Cattle meat	40.4	38.5
Pig meat	33.7	24.5
Sheep meat	8.9	6.0
Poultry	19.2	19.1
Eggs	19.0	21.0
Wild/free foods	1.5	4.6
Rabbits/hares	5.9	1.4
Honey	10.2	9.1
Wild fungi	1.4	0.9
Venison	7.0	36.3
Freshwater fish	Not consumed	0.7

In 2010, consumption rates had increased in the following food groups; green vegetables, other vegetables, milk, eggs, wild/free foods and venison. Consumption rates had decreased in the following food groups: root vegetables, potato, domestic fruit, cattle meat, pig meat, sheep meat, poultry, rabbits/hares, honey and wild fungi. The consumption of freshwater fish was recorded in the 2010 survey but was not identified in the 2005 survey.

The increase in the consumption rates of milk was due to several families increasing the amount of milk that they consumed. The increase in venison was due to the identification of a gamekeeper who was not identified in 2005. No specific reasons were identified for the other changes in consumption rates.

Direct radiation survey

The activities identified in the direct radiation survey area in 2005 and 2010 were similar and included people residing, working and farming. A comparison between the 2005 and 2010 direct radiation occupancy rates is presented in Table K.

Table K. Comparison between 2005 and 2010 direct radiation occupancy rates (h y^{-1})

	2005	**2010**
Highest total	8500	8400
Highest indoor	7800	8100
Highest outdoor	4200	2900

In 2010 the highest total occupancy rate decreased slightly, the highest indoor occupancy rate increased slightly and the highest outdoor rate decreased when compared with 2005. In 2010 and in 2005, the highest total and outdoor occupancy rates were for a resident who also worked in the area and the highest indoor occupancy rate was for a resident.

Pipeline survey

The activities identified in the pipeline survey area in 2005 and 2010 were the same and included walking, dog walking and carrying out grounds maintenance. The maximum occupancy rate increased slightly from 670 h y^{-1} in 2005 to 730 h y^{-1} in 2010. The activity carried out by the individual with the highest occupancy rate was dog walking in both years. In 2005 the highest occupancy rate was for a person spending time only in the 'Seafield' section whereas in 2010 the person with the highest occupancy rate spent time in the 'Housing estate' section and the 'Upper stretch'. The 'Seafield' section had the highest number of users in both years.

10 MAIN FINDINGS

10.1 Survey findings

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

- Discharges of liquid radioactive waste to the Solway Firth
- Discharges of gaseous radioactive waste to the atmosphere
- Emissions of direct radiation from the site and from the pipeline

Data were collected for 309 individuals including, for example, commercial fishermen, anglers, people spending time on intertidal substrates, farmers, allotment holders, beekeepers and people spending time within the direct radiation survey area and along the pipeline. These people were targeted because their habits or where they live may cause them to be exposed to radioactivity or radiation from the site. However, it should be noted that the most exposed people could only be defined with the outcome of a dose assessment.

All consumption rates recorded are only for foods produced, collected or caught from within the aquatic and terrestrial survey areas as defined in Section 2.3. The consumption and occupancy rates presented in this section are for adults only. However, consumption and occupancy rates were also obtained for individuals in the child age group (6 - 15 years old), and in the infant age group (0 - 5 years old).

Aquatic survey area

The mean consumption rate for the adult high-rate group (as defined in Section 3.4) for the separate aquatic consumption pathways for foods potentially affected by liquid discharges were:

- 8.7 kg y^{-1} for fish
- 15 kg y^{-1} for crustaceans
- 31 kg y^{-1} for wildfowl
- 0.2 kg y^{-1} for marine plants/algae

The predominant foods consumed by the high-rate groups for fish were salmon and sea trout; for crustaceans was brown shrimps; for wildfowl were mallard, pink-footed goose, greylag goose and pintail duck; and for marine plants/algae was samphire. The consumption of molluscs was not identified.

The use of seaweed for a soil conditioner or animal feed was not identified. Cattle and sheep were observed grazing on salt marsh in the survey area.

The mean occupancy rates for adult high-rate groups over the separate intertidal substrates were:

- 550 h y^{-1} for mud
- 36 h y^{-1} for mud and sand
- 130 h y^{-1} for mud and stones
- 180 h y^{-1} for mud, sand and stones
- 1100 h y^{-1} for salt marsh
- 260 h y^{-1} for sand
- 12 h y^{-1} for sand and stones

The mean handling rates for the adult high-rate groups were:

- 290 h y^{-1} for handling fishing gear
- 550 h y^{-1} for handling sediment

The handling of angling equipment was not considered to be a significant pathway, and therefore, as in previous surveys, data for this pathway were not collected.

The adult maximum occupancy rate on water was 670 h y^{-1}. No adults were identified undertaking activities in water.

Terrestrial survey area

The mean consumption rates for the adult high-rate groups for the separate consumption pathways for foods potentially affected by gaseous discharges were:

- 22 kg y^{-1} for green vegetables
- 24 kg y^{-1} for other vegetables
- 39 kg y^{-1} for root vegetables
- 77 kg y^{-1} for potato
- 24 kg y^{-1} for domestic fruit
- 420 l y^{-1} for milk
- 38 kg y^{-1} for cattle meat
- 24 kg y^{-1} for pig meat
- 6.0 kg y^{-1} for sheep meat
- 19 kg y^{-1} for poultry
- 21 kg y^{-1} for eggs
- 4.6 kg y^{-1} for wild/free foods

- 1.4 kg y^{-1} for rabbits/hares
- 9.1 kg y^{-1} for honey
- 0.9 kg y^{-1} for wild fungi
- 36 kg y^{-1} for venison
- 0.7 kg y^{-1} for freshwater fish

The human consumption of groundwater was not identified. Livestock were supplied with borehole water for drinking and also had access to burn or river water.

Control measures were in place at the Chapelcross site to limit the possibility that contamination was transferred off-site by wildlife; the site boundary fence extended below ground and birds were actively discouraged from entering the buildings on site.

Direct radiation survey area

The highest occupancy rates for members of the public who were spending time within the direct radiation survey area were:

- 8400 h y^{-1} for the total occupancy rate (for a resident who also worked in the area)
- 8100 h y^{-1} for the indoor occupancy rate (for a resident)
- 2900 h y^{-1} for the outdoor occupancy rate (for the same resident with the highest total occupancy rate)

Pipeline survey area

The highest occupancy rate by a member of the public along the route of the pipeline was 730 h y^{-1} for a dog walker who was spending time in the 'Housing estate' section and along the 'Upper stretch'.

11 SUGGESTIONS FOR CHANGES TO THE MONITORING PROGRAMME

Information collected during the 2010 Chapelcross habits survey can be used to make recommendations for changes to the current SEPA environmental monitoring programme. A summary of the current programme is provided below, followed by the suggestions for changes to the programme.

11.1 Summary of the current environmental monitoring programme

The 2009 SEPA environmental monitoring programme, which is published in the RIFE report (EA, FSA, NIEA and SEPA 2010) included the samples and measurements listed below. The location names, foods and substrate classifications are taken directly from that publication. Some of the samples and measurements taken for the monitoring programmes may be from outside the survey area used for this habits survey.

Aquatic monitoring

Sample	**Location**
Flounder	Inner Solway
Salmon	Inner Solway
Trout	Inner Solway
Shrimps	Inner Solway
Cockles	North Solway
Mussels	North Solway
Winkles	Southerness
Fucus vesiculosus	Pipeline
Fucus vesiculosus	Browhouses
Sediment	Pipeline
Sediment	Southerness
Seawater	Pipeline
Seawater	Southerness

Gamma dose rate measurements over intertidal areas

Substrate	**Location**
Winkle bed	Southerness
Mud and sand	Glencaple Harbour
Salt marsh	Priestside Bank
Mud	Powfoot Merse
Sand	Pipeline
Salt marsh	Pipeline
Sand	Battlehill
Mud and sand	Dornoch Brow

(Gamma dose rate measurements continued)

Salt marsh	Dornoch Brow
Unspecified substrate	Browhouses
Unspecified substrate	Redkirk

Beta dose rate measurements on intertidal areas

Substrate	Location
Stake nets	Pipeline
Unspecified material	500 m east of the pipeline
Unspecified material	500 m west of the pipeline

Terrestrial monitoring

- Milk
- Apples
- Barley
- Beef muscle
- Cabbage
- Crab apples
- Eggs
- Pears
- Potatoes
- Rhubarb
- Rowan berries
- Turnips
- Grass
- Soil
- Surface water
- Freshwater from Purdomstone, Winterhope and Black Esk
- Radioactivity in air near Chapelcross; measurements taken at Eastriggs, Kirtlebridge and Brydekirk.

11.2 Suggestions for changes

It is considered that SEPA's current monitoring programme provides adequate coverage. However, based on the findings of this habits survey, the following suggestions are presented for consideration:

- Within the 'root vegetable' food group the annual sample of turnips currently monitored could be replaced by an annual sample of onions, since these were consumed at a higher rate.

- Within the ‘wild/free’ food group the annual samples of crab apples and rowan berries could be replaced with an annual sample of blackberries since no consumption of crab apples or rowan berries was identified during the survey and blackberries were the most highly consumed food in this food group.

It is recommended that all other samples currently monitored remain unchanged.

12 ACKNOWLEDGEMENTS

Gratitude is expressed to representatives of local authorities and associations and members of the public who offered helpful advice and information during the survey. This survey was undertaken on behalf of the Scottish Environment Protection Agency, who provided the funding for this study.

13 REFERENCES

Byrom, J., Robinson, C., Simmonds, J. R., Walters, B., and Taylor, R.R., 1995. Food consumption rates for use in generalised radiological dose assessments. J. Radiol. Prot. Vol. 15 (4) 335-341.

CEC, 1996. Council Directive 96/29/Euratom of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionizing radiation. Off. J. Eur. Commun., 39 (L159): 1-114.

EA, FSA, NIEA and SEPA, 2010. Radioactivity in Food and the Environment, 2009. EA, FSA, NIEA and SEPA, Warrington, London, Belfast and Stirling. RIFE (15).

FSA, 2002. Assessment Methodology for the Potential Impact on Food of Radioactive Discharges to the Environment. FSA, London.

Good Housekeeping, 1994. Good Housekeeping Cook Book. Ebury Press, London.

Hessayon, D. G., 1997. The New Vegetable & Herb Expert. Expert Books, London.

Hunt, G. J., Hewett, C. J. and Shepherd, J.G., 1982. The identification of critical groups and its application to fish and shellfish consumers in the coastal area of the north-east Irish Sea. Health Physics, Vol. 43, No 6, pp. 875-889.

ICRP, 1991. 1990 Recommendations of the International Commission on Radiological Protection. Annal. ICRP 21 (1-3). Pergamon Press, Oxford, 201 pp. (ICRP Publ. 60.).

ICRP, 1996. Age-dependant doses to members of the public from intake of radionuclides. Annal. ICRP 26 (1). Elsevier Science, Oxford, (ICRP Publ. (72)).

ICRP, 2007. Assessing the dose of the representative person for the purpose of radiological protection of the public and the optimisation of radiological protection. Annal. ICRP 36 (3). Elsevier Science, Oxford, (ICRP Publ. 101.).

Leonard, D. R. P., Hunt, G. J. AND Jones, P. G. W., 1982. Investigations of individual radiation exposures from discharges to the aquatic environment: the technique of habit surveys. pp. 512-517 *In:* 'Proceedings of the Third International Symposium on Radiological Protection - Advances in Theory and Practice', Inverness, 6-11 June 1982, Volume 2. The Society of Radiological Protection.

Macaulay Institute for Soil Research, Land cover of Scotland 1988, (LCS88) 1:50,000 series.

Scottish Executive, 2000. Radioactive Substances (Basic Safety Standards) (Scotland) Direction 2000. Scottish Executive, Edinburgh.

Smith, K.R. and Jones, A.L., 2003. Generalised habit data for radiological assessments. NRPB-W41. NRPB, Chiltern.

Sherlock, M., Tipple, J.R., and Clyne, F.J., 2006. Radiological Habits Survey, Chapelcross, 2005. Environment Report RL 04/06. Cefas, Lowestoft.

UK Parliament, 1993. Radioactive Substances Act, 1993. HMSO, London.

Table 1. Typical food groups used in habits surveys

Food group	Examples of foods within the group
Green vegetables	Asparagus, broccoli, Brussels sprout, cabbage, calabrese, cauliflower, chard, courgettes, cucumber, gherkin, globe artichoke, herbs, kale, leaf beet, lettuce, marrow, spinach
Other vegetables	Aubergine, broad bean, chilli pepper, French bean, mangetout, pea, kohl rabi, pepper, pumpkin, runner bean, sweetcorn, tomato
Root vegetables	Beetroot, carrot, celeriac, celery, chicory, fennel, garlic, Jerusalem artichoke, leek, onion, parsnip, radish, shallot, spring onion, swede, turnip
Potato	Potato
Domestic fruit	Apple, apricot, blackberry, blackcurrant, boysenberry, cherry, damson, fig, gooseberry, grapes, greengages, huckleberry, loganberry, melon, nectarines, peach, pear, plum, raspberry, redcurrants, rhubarb, rowanberry, strawberry, tayberry, whitecurrant
Milk	Cows' milk, cream, yoghurt, goats' milk
Cattle meat[a]	Beef
Pig meat[a]	Pork
Sheep meat[a]	Lamb, mutton
Poultry[b]	Chicken, duck, goose, grouse, guinea fowl, partridge, pheasant, pigeon, snipe, turkey, woodcock
Eggs	Chicken egg, duck egg, goose egg
Wild/free foods	Blackberry, chestnut, crab apple, damson, dandelion root, elderberry, nettle, raspberry, rowan berry, sloe, strawberry,
Honey	Honey
Wild Fungi	Mushrooms, other edible fungi
Rabbits/Hares	Rabbit, hare
Venison[a]	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[c], cuttlefish[c], 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, scallops, razor clams, whelks, winkles
Wildfowl[b]	Canada goose, greylag goose, mallard, pink-footed goose, pintail, shoveler, teal, wigeon

Notes

[a] Including offal

[b] Domesticated ducks and geese are classified as poultry. Wild ducks and geese are classified as wildfowl

[c] Although squid and cuttlefish are molluscs, radiologically they are more akin to fish

Table 2. Ratios for determining consumption and occupancy rates for infants and children

Group	Ratio[a]	
	Infant[e]/adult	Child[e]/adult
Fish[b]	0.050	0.200
Crustaceans[b]	0.050	0.250
Molluscs[b]	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[c]	0.110	0.490
Game[d]	0.140	0.500
Honey	0.789	0.789
Wild fungi	0.150	0.450
Freshwater fish[b]	0.050	0.250
External exposure over intertidal sediments	0.030	0.500

Notes

[a]Excepting notes b and c, consumption ratios were derived from Byrom et al., (1995) which presented data for infants aged 6 to 12 months and children aged 10 to 11 years.

[b]Ratios were derived from Smith and Jones, (2003) which presented data for infants and children of unspecified ages.

[c]Ratios were derived from FSA data for wild fruit and nuts for infants and 10-year-old children.

[d]Game includes rabbits/hares and venison.

[e]Note that the age ranges within the age groups in this table do not correspond exactly with the age ranges within the age groups used throughout the rest of this report.

Table 3. Adults' consumption rates of fish from the Chapelcross area (kg y^{-1})

Observation number	Bass	Flounder	Salmon	Sea trout	Total
77	**-**	**-**	**8.2**	**4.7**	**12.9**
78	**-**	**-**	**8.2**	**4.7**	**12.9**
79	**-**	**-**	**8.2**	**4.7**	**12.9**
80	**-**	**-**	**8.2**	**4.7**	**12.9**
232	**-**	**-**	**4.1**	**7.7**	**11.8**
233	**-**	**-**	**4.1**	**7.7**	**11.8**
6	**-**	**-**	**11.5**	**-**	**11.5**
7	**-**	**-**	**11.5**	**-**	**11.5**
8	**-**	**-**	**11.5**	**-**	**11.5**
243	**2.7**	**1.4**	**2.7**	**2.7**	**9.5**
244	**2.7**	**1.4**	**2.7**	**2.7**	**9.5**
268	**-**	**1.8**	**5.7**	**1.4**	**9.0**
269	**-**	**1.8**	**5.7**	**1.4**	**9.0**
240	**1.8**	**0.9**	**1.8**	**1.8**	**6.4**
241	**1.8**	**0.9**	**1.8**	**1.8**	**6.4**
242	**1.8**	**0.9**	**1.8**	**1.8**	**6.4**
117	**-**	**-**	**4.9**	**0.7**	**5.6**
118	**-**	**-**	**4.9**	**0.7**	**5.6**
104	**-**	**-**	**4.7**	**-**	**4.7**
106	**-**	**-**	**4.7**	**-**	**4.7**
127	**-**	**-**	**3.9**	**0.5**	**4.4**
128	**-**	**-**	**3.9**	**0.5**	**4.4**
129	**-**	**-**	**3.9**	**0.5**	**4.4**
237	-	-	4.1	-	4.1
238	-	-	4.1	-	4.1
258	-	-	2.6	1.3	3.9
259	-	-	2.6	1.3	3.9
262	-	1.4	2.3	-	3.6
192	-	-	3.3	-	3.3
193	-	-	3.3	-	3.3
252	1.0	-	2.3	-	3.2
253	-	-	1.4	1.4	2.7
254	-	-	1.4	1.4	2.7
255	-	-	1.8	0.9	2.7
256	-	-	1.8	0.9	2.7
257	-	-	1.8	0.9	2.7
270	-	-	-	2.7	2.7
265	-	-	1.1	1.1	2.3
266	-	-	1.1	1.1	2.3
247	-	-	1.3	0.9	2.2
248	-	-	1.3	0.9	2.2
214	-	1.0	-	0.9	2.0
271	-	-	1.9	-	1.9
272	-	-	1.9	-	1.9
273	-	-	1.9	-	1.9
263	-	-	1.6	-	1.6

Table 3. Adults' consumption rates of fish from the Chapelcross area (kg y^{-1})

Observation number	Bass	Flounder	Salmon	Sea trout	Total
264	-	-	1.6	-	1.6
278	1.3	-	-	-	1.3
279	1.3	-	-	-	1.3
50	-	-	-	1.1	1.1
160	-	-	0.8	0.1	0.9
161	-	-	0.8	0.1	0.9
162	-	-	0.8	0.1	0.9
163	-	-	0.8	0.1	0.9
282	-	-	0.3	0.5	0.8
283	-	-	0.3	0.5	0.8
284	-	-	0.3	0.5	0.8
225	-	0.5	-	-	0.5
226	-	0.5	-	-	0.5
206	-	-	-	0.5	0.5
207	-	-	-	0.5	0.5
235	-	-	-	0.5	0.5
236	-	-	-	0.5	0.5
92	-	-	-	0.3	0.3
93	-	-	-	0.3	0.3
183	-	-	-	0.2	0.2
184	-	-	-	0.2	0.2

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of fish based on the 23 high-rate adult consumers is 8.7 kg y^{-1}

The observed 97.5th percentile rate based on 67 observations is 12.9 kg y^{-1}

Table 4. Adults' consumption rates of crustaceans from the Chapelcross area (kg y^{-1})

Observation number	Brown shrimp
230	**20.4**
227	**16.3**
231	**16.3**
228	**8.2**
229	4.1

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of crustaceans based on the 4 high-rate adult consumers is 15.3 kg y^{-1}

The observed 97.5th percentile rate based on 5 observations is 20.0 kg y^{-1}

Table 5. Adults' consumption rates of wildfowl from the Chapelcross area (kg y^{-1})

Observation number	Goose (unspecified species)	Greylag goose	Mallard	Pink-footed goose	Pintail duck	Shoveler	Snipe	Teal	Wigeon	Total
50	**-**	**11.0**	**9.0**	**20.0**	**-**	**-**	**-**	**1.6**	**3.5**	**45.1**
214	**-**	**6.6**	**11.3**	**5.1**	**8.8**	**-**	**-**	**-**	**-**	**31.7**
30	**3.3**	**-**	**19.1**	**-**	**-**	**-**	**0.4**	**-**	**-**	**22.8**
31	**3.3**	**-**	**19.1**	**-**	**-**	**-**	**0.4**	**-**	**-**	**22.8**
77	-	2.1	1.3	5.2	0.2	0.2	-	1.5	0.3	10.8
267	-	2.2	3.4	1.7	-	-	-	-	-	7.3
268	-	2.2	3.4	1.7	-	-	-	-	-	7.3
79	-	1.1	0.6	2.6	0.1	0.1	-	1.5	0.1	6.2
80	-	1.1	0.6	2.6	0.1	0.1	-	1.5	0.1	6.2
147	-	-	-	2.6	-	-	-	-	-	2.6
148	-	-	-	2.6	-	-	-	-	-	2.6
149	-	-	-	2.6	-	-	-	-	-	2.6
150	-	-	-	2.6	-	-	-	-	-	2.6
247	-	0.7	-	-	-	-	-	-	-	0.7
248	-	0.7	-	-	-	-	-	-	-	0.7

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of wildfowl based on the 4 high-rate adult consumers is 30.6 kg y^{-1}

The observed 97.5th percentile rate based on 15 observations is 40.4 kg y^{-1}

Table 6. Adults' consumption rates of marine plants/algae from the Chapelcross area (kg y^{-1})

Observation number	Samphire
247	**0.2**
248	**0.2**
147	**0.2**
148	**0.2**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of marine plants/algae based on the 4 high-rate adult consumers is 0.2 kg y^{-1}

The observed 97.5th percentile rate based on 4 observations is 0.2 kg y^{-1}

Table 7. Children's consumption rates of fish from the Chapelcross area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Salmon	Sea trout	Total
260	**15**	**2.6**	**1.3**	**3.9**
261	**13**	**2.0**	**0.9**	**2.9**
249	12	0.7	0.5	1.1
250	12	0.7	0.5	1.1

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of fish for the child age group based upon the 2 high-rate consumers is 3.4 kg y^{-1}

The observed 97.5th percentile rate based on 4 observations is 3.8 kg y^{-1}

Table 8. Children's consumption rates of wildfowl from the Chapelcross area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Greylag goose
249	**12**	**0.4**
250	**12**	**0.4**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of wildfowl for the child age group based upon the 2 high-rate consumers is 0.4 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 0.4 kg y^{-1}

Table 9. Adults' intertidal occupancy in the Chapelcross area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud and stones	Mud, sand and stones	Salt marsh[a]	Sand	Sand and stones
267	**Battlehill**	**Stake netting and wildfowling**	**692**	-	-	-	-	-	-
	Off Seafield	**Poke netting**	-	-	-	-	-	**135**	-
50	**Browhouses to Gretna**	**Wildfowling**	**672**	-	-	-	-	-	-
	Stormont	Dog walking	-	-	-	-	365	-	-
	Browhouses to Gretna	Haaf netting	-	-	-	-	-	80	-
270	**Battlehill**	**Stake netting**	**660**	-	-	-	-	-	-
	Off Seafield	Poke netting	-	-	-	-	-	134	-
30	**Caerlaverock to Seafield**	**Wildfowling**	**432**	-	-	-	-	-	-
31	**Caerlaverock to Seafield**	**Wildfowling**	**288**	-	-	-	-	-	-
81	Gretna, Browhouses and Todruff Point	Wildfowling	225	-	-	-	-	-	-
304	Battlehill	Stake netting	225	-	-	-	-	-	-
305	Battlehill	Stake netting	225	-	-	-	-	-	-
306	Battlehill	Stake netting	225	-	-	-	-	-	-
307	Battlehill	Stake netting	225	-	-	-	-	-	-
308	Battlehill	Stake netting	225	-	-	-	-	-	-
309	Battlehill	Stake netting	225	-	-	-	-	-	-
77	Gretna, Browhouses and Todruff Point	Wildfowling	169	-	-	-	-	-	-
	Todruff Point to Gretna	**Dog walking**	-	-	-	**180**	-	-	-
130	Caerlaverock	Nature reserve warden duties	18	-	-	-	104	-	-
131	Caerlaverock	Nature reserve warden duties	18	-	-	-	104	-	-
132	Caerlaverock	Nature reserve warden duties	18	-	-	-	104	-	-
138	**Powfoot**	**Walking**	-	**36**	-	-	-	-	-
137	**Powfoot**	**Walking**	-	**36**	-	-	-	-	-
94	Seafield	Dog walking	-	6	-	-	-	-	-
278	**Newbiebarns**	**Collecting peeler crabs and angling**	-	-	**136**	-	-	-	-
271	**Newbiebarns**	**Stake netting**	-	-	**114**	-	-	-	-
274	Newbiebarns	Stake netting	-	-	24	-	-	-	-
147	**Brow Well**	**Dog walking and collecting samphire**	-	-	-	-	**1130**	-	-
	Brow Well to Powfoot	**Wildfowling**	-	-	-	-		-	-

Table 9. Adults' intertidal occupancy in the Chapelcross area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud and stones	Mud, sand and stones	Salt marsh[a]	Sand	Sand and stones
247	Seafield to Waterfoot	Beachcombing, wildfowling and walking	-	-	-	-	360	-	-
	Waterfoot to Battlehill	**Haaf netting**	-	-	-	-	-	**385**	-
	Off Seafield	**Poke netting**	-	-	-	-	-		-
287	Near Waterfoot	Tending livestock	-	-	-	-	274	-	-
54	Stormont	Dog walking	-	-	-	-	252	-	-
281	Seafield to Waterfoot	Dog walking	-	-	-	-	234	-	-
248	Seafield to Waterfoot	Walking	-	-	-	-	180	-	-
133	Caerlaverock	Tending livestock	-	-	-	-	168	-	-
134	Caerlaverock	Tending livestock	-	-	-	-	168	-	-
135	Caerlaverock	Tending livestock	-	-	-	-	168	-	-
136	Caerlaverock	Tending livestock	-	-	-	-	168	-	-
303	Powfoot	Dog walking	-	-	-	-	136	46	-
151	Scar Point	Dog walking	-	-	-	-	108	-	-
232	Waterfoot	Dog walking	-	-	-	-	104	-	-
	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	80	-
190	Priestside Marsh	Tending livestock	-	-	-	-	98	-	-
214	Caerlaverock	Wildfowling	-	-	-	-	89	-	-
	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-		-	-
275	Waterfoot	Dog walking	-	-	-	-	73	-	-
265	Waterfoot	Walking	-	-	-	-	52	-	-
	Seafield to Waterfoot	Walking	-	-	-	-	-	122	-
	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-		-
51	Stormont	Beachcombing	-	-	-	-	39	-	-
52	Stormont	Beachcombing	-	-	-	-	39	-	-
276	Waterfoot	Dog walking	-	-	-	-	33	-	-
277	Waterfoot	Dog walking	-	-	-	-	33	-	-
251	Waterfoot	Dog walking	-	-	-	-	26	-	-
	Battlehill to Powfoot	Beachcombing	-	-	-	-	-	78	-
	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-		-
280	Waterfoot	Dog walking	-	-	-	-	26	-	-

Table 9. Adults' intertidal occupancy in the Chapelcross area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud and stones	Mud, sand and stones	Salt marsh[a]	Sand	Sand and stones
258	Waterfoot	Walking	-	-	-	-	18	-	-
	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	35	-
215	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
216	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
217	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
218	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
219	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
220	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
221	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
222	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
223	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
224	Scar Point to Powfoot	Inshore rescue duties	-	-	-	-	14	-	-
225	Waterfoot	Angling	-	-	-	-	9	-	-
226	Waterfoot	Angling	-	-	-	-	9	-	-
127	Seafield	Tending livestock	-	-	-	-	5	-	-
252	**Battlehill to Powfoot**	**Beachcombing**	-	-	-	-	-	**405**	-
	Seafield to Powfoot	**Dog walking**	-	-	-	-	-		-
240	**Off Seafield**	**Poke netting**	-	-	-	-	-	**196**	-
243	**Off Seafield**	**Poke netting**	-	-	-	-	-	**196**	-
235	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	88	-
255	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	67	-
	Gretna	Dog walking	-	-	-	-	-		-
234	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	57	-
262	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	53	-
263	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	45	-
253	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	45	-
237	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	27	-
239	Waterfoot to Battlehill	Haaf netting	-	-	-	-	-	18	-
301	Powfoot	Angling	-	-	-	-	-	9	-
302	Powfoot	Angling	-	-	-	-	-	9	-

Table 9. Adults' intertidal occupancy in the Chapelcross area (h y^{-1})

Observation number	Location	Activity	Mud	Mud and sand	Mud and stones	Mud, sand and stones	Salt marsh[a]	Sand	Sand and stones
119	Powfoot	Walking	-	-	-	-	-	5	-
120	Powfoot	Walking	-	-	-	-	-	5	-
245	Powfoot	Bait digging	-	-	-	-	-	1	-
246	Powfoot	Bait digging	-	-	-	-	-	1	-
141	**Powfoot**	**Walking**	-	-	-	-	-	-	**12**
142	**Powfoot**	**Walking**	-	-	-	-	-	-	**12**

Notes

Emboldened observations are the high-rate individuals

The mean intertidal occupancy rate over mud based on 5 high-rate observations is 549 h y^{-1}

The observed 97.5th percentile rate based on 16 observations for mud is 685 h y^{-1}

The mean intertidal occupancy rate over mud and sand based on 2 high-rate observations is 36 h y^{-1}

The observed 97.5th percentile rate based on 3 observations for mud and sand is 36 h y^{-1}

The mean intertidal occupancy rate over mud and stones based on 2 high-rate observations is 125 h y^{-1}

The observed 97.5th percentile rate based on 3 observations for mud and stones is 135 h y^{-1}

The mean intertidal occupancy rate over mud, sand and stones based on 1 observation is 180 h y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

The mean intertidal occupancy rate over salt marsh based on 1 observation is 1130 h y^{-1}

The observed 97.5th percentile rate based on 41 observations for salt marsh is 365 h y^{-1}

The mean intertidal occupancy rate over sand based on 5 high-rate observations is 263 h y^{-1}

The observed 97.5th percentile rate based on 26 observations for sand is 393 h y^{-1}

The mean intertidal occupancy rate over sand and stones based on 2 high-rate observations is 12 h y^{-1}

The observed 97.5th percentile rate based on 2 observations for sand and stones is 12 h y^{-1}

[a]At some locations the salt marsh is only tide washed on exceptionally high tides.

Table 10. Children's and infants' intertidal occupancy in the Chapelcross area (h y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Location	Activity	Mud and sand	Salt marsh	Sand	Sand and stones
139	**7**	**Powfoot**	**Walking**	**36**	-	-	-
140	**9**	**Powfoot**	**Walking**	**36**	-	-	-
53	**10**	**Stormont**	**Beachcombing**	**-**	**39**	**-**	**-**
121	**6**	**Powfoot**	**Walking**	**-**	**-**	**5**	**-**
143	**10**	**Powfoot**	**Walking**	**-**	**-**	**-**	**12**

Notes

Emboldened observations are the high-rate individuals

The mean intertidal occupancy rate over mud and sand based on 2 high-rate observations is 36 h y^{-1}

The observed 97.5th percentile rate based on 2 observations for mud and sand is 36 h y^{-1}

The mean intertidal occupancy rate over salt marsh based on the only observation is 39 h y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

The mean intertidal occupancy rate over sand based on the only observation is 5 h y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

The mean intertidal occupancy rate over sand and stones based on the only observation is 12 h y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

Infant age group (0 - 5 years old)

Observation number	Age	Location	Activity	Mud and sand	Salt marsh	Sand	Sand and stones
144	**5**	**Powfoot**	**Walking**	**-**	**-**	**-**	**12**
145	**5**	**Powfoot**	**Walking**	**-**	**-**	**-**	**12**
146	**3**	**Powfoot**	**Walking**	**-**	**-**	**-**	**12**

Notes

Emboldened observations are the high-rate individuals

The mean intertidal occupancy rate over sand and stones based on 3 high-rate observations is 12 h y^{-1}

The observed 97.5th percentile rate based on 3 observations for sand and stones is 12 h y^{-1}

Table 11. Gamma dose rate measurements over intertidal substrates in the Chapelcross aquatic survey area (µGy h^{-1})

Location	NGR	Substrate	Gamma dose rate at 1 metre[a]
Scar Point	NY 004 660	Salt marsh	0.082
Brow Well	NY 084 673	Salt marsh	0.087
Powfoot	NY 151 656	Mud and sand	0.086
Powfoot	NY 151 658	Sand and stones	0.085
Waterfoot	NY 191 645	Salt marsh	0.077
West of pipe outfall	NY 205 644	Sand	0.073
East of pipe outfall	NY 206 644	Mud	0.073
Battlehill	NY 214 647	Mud	0.078
Browhouses	NY 282 649	Mud	0.075
Redkirk Point	NY 302 650	Mud	0.064
Stormont	NY 316 660	Mud	0.084

Notes

[a] These measurements have not been adjusted for natural background dose rates.

Table 12. Adults' handling rates of fishing gear and sediment in the Chapelcross area (h y^{-1})

Observation number	Location	Activity	Fishing gear	Sediment
247	**Waterfoot to Battlehill**	**Haaf netting**	**514**	-
	Off Seafield	**Poke netting**		-
	Seafield to Waterfoot	Wildfowling	-	28
232	**Waterfoot to Battlehill**	**Haaf netting**	**281**	-
235	**Waterfoot to Battlehill**	**Haaf netting**	**264**	-
234	**Waterfoot to Battlehill**	**Haaf netting**	**210**	-
265	**Waterfoot to Battlehill**	**Haaf netting**	**181**	-
227	Solway Firth	Trawling	144	-
262	Waterfoot to Battlehill	Haaf netting	136	-
251	Waterfoot to Battlehill	Haaf netting	134	-
267	Off Seafield	Poke netting	128	-
	Battlehill	Repairing stake nets		-
	Off Seafield	**Poke netting**	-	**732**
	Battlehill	**Stake netting and wildfowling**	-	
270	Off Seafield	Poke netting	128	-
	Battlehill	Repairing stake nets		-
	Battlehill	**Stake netting**	-	**700**
230	Solway Firth	Trawling	115	-
263	Waterfoot to Battlehill	Haaf netting	114	-
253	Waterfoot to Battlehill	Haaf netting	113	-
258	Waterfoot to Battlehill	Haaf netting	91	-
304	Battlehill	Repairing stake nets	80	-
		Stake netting	-	225
237	Waterfoot to Battlehill	Haaf netting	61	-
239	Waterfoot to Battlehill	Haaf netting	61	-
240	Off Seafield	Poke netting	60	-
			-	16
243	Off Seafield	Poke netting	60	-
			-	16

Table 12. Adults' handling rates of fishing gear and sediment in the Chapelcross area (h y^{-1})

Observation number	Location	Activity	Fishing gear	Sediment
255	Waterfoot to Battlehill	Haaf netting	11	-
50	**Browhouses to Gretna**	**Wildfowling**	-	**672**
147	**Brow Well to Powfoot**	**Wildfowling**	-	**460**
30	**Caerlaverock to Seafield**	**Wildfowling**	-	**432**
31	**Caerlaverock to Seafield**	**Wildfowling**	-	**288**
81	Gretna, Browhouses and Todruff Point	Wildfowling	-	225
305	Battlehill	Stake netting	-	225
306	Battlehill	Stake netting	-	225
307	Battlehill	Stake netting	-	225
308	Battlehill	Stake netting	-	225
309	Battlehill	Stake netting	-	225
77	Gretna, Browhouses and Todruff Point	Wildfowling	-	169
271	Newbiebarns	Stake netting	-	114
214	Caerlaverock	Wildfowling	-	75
278	Newbiebarns	Collecting peeler crabs	-	32
274	Newbiebarns	Stake netting	-	24
245	Powfoot	Bait digging	-	1
246	Powfoot	Bait digging	-	1

Notes

Emboldened observations are the high-rate individuals

The mean fishing gear handling rate based on 5 high-rate observations is 290 h y^{-1}

The observed 97.5th percentile rate based on 20 observations for fishing gear is 403 h y^{-1}

The mean sediment handling rate based on 6 high-rate observations is 547 h y^{-1}

The observed 97.5th percentile rate based on 23 observations for sediment is 714 h y^{-1}

Most of the fishermen either did not wear gloves or did not wear them all the time while undertaking fishing operations and did not wear gloves when mending nets ashore. Stake net fishermen were liable to get debri and sediment on their faces when cleaning nets above head height. Wildfowlers spent much of their time lying or kneeling in the mud and often did not wear gloves.

Table 13. Adults' occupancy rates on water in the Chapelcross area (h y^{-1})

Observation number	Location	Activity	On water
227	Solway Firth	Trawling	672
230	Solway Firth	Trawling	538
81	Stormount, Redkirk Point and Browhouses	Haaf netting	416
247	Waterfoot to Battlehill	Haaf netting	380
50	Browhouses to Gretna	Haaf netting	280
232	Waterfoot to Battlehill	Haaf netting	280
235	Waterfoot to Battlehill	Haaf netting	263
234	Waterfoot to Battlehill	Haaf netting	209
77	Stormount, Redkirk Point and Browhouses	Haaf netting	208
265	Waterfoot to Battlehill	Haaf netting	180
214	Scar Point to Powfoot	Operating a rescue boat	156
215	Scar Point to Powfoot	Operating a rescue boat	156
216	Scar Point to Powfoot	Operating a rescue boat	156
217	Scar Point to Powfoot	Operating a rescue boat	156
218	Scar Point to Powfoot	Operating a rescue boat	156
219	Scar Point to Powfoot	Operating a rescue boat	156
220	Scar Point to Powfoot	Operating a rescue boat	156
221	Scar Point to Powfoot	Operating a rescue boat	156
222	Scar Point to Powfoot	Operating a rescue boat	156
223	Scar Point to Powfoot	Operating a rescue boat	156
224	Scar Point to Powfoot	Operating a rescue boat	156
262	Waterfoot to Battlehill	Haaf netting	135
251	Waterfoot to Battlehill	Haaf netting	133
263	Waterfoot to Battlehill	Haaf netting	113
253	Waterfoot to Battlehill	Haaf netting	112
258	Waterfoot to Battlehill	Haaf netting	90
237	Waterfoot to Battlehill	Haaf netting	60
239	Waterfoot to Battlehill	Haaf netting	60
255	Waterfoot to Battlehill	Haaf netting	10

Notes

No adults were identified undertaking activities in the water.

Table 14. Adults' consumption rates of green vegetables from the Chapelcross area (kg y^{-1})

Observation number	Artichoke	Broccoli	Brussels sprout	Cabbage	Cauliflower	Courgette	Cucumber	Kale	Lettuce	Total
42	**-**	**3.6**	**3.0**	**5.7**	**5.0**	**12.9**	**-**	**1.8**	**3.8**	**35.8**
43	**-**	**3.6**	**3.0**	**5.7**	**5.0**	**12.9**	**-**	**1.8**	**3.8**	**35.8**
124	**-**	**6.0**	**-**	**4.9**	**-**	**16.2**	**-**	**-**	**2.4**	**29.4**
125	**-**	**6.0**	**-**	**4.9**	**-**	**16.2**	**-**	**-**	**2.4**	**29.4**
126	**-**	**6.0**	**-**	**4.9**	**-**	**16.2**	**-**	**-**	**2.4**	**29.4**
87	**-**	**5.6**	**3.4**	**-**	**-**	**7.4**	**7.7**	**-**	**-**	**24.0**
88	**-**	**5.6**	**3.4**	**-**	**-**	**7.4**	**7.7**	**-**	**-**	**24.0**
75	**-**	**-**	**-**	**17.6**	**5.1**	**-**	**-**	**1.4**	**-**	**24.0**
76	**-**	**-**	**-**	**17.6**	**5.1**	**-**	**-**	**1.4**	**-**	**24.0**
30	**-**	**7.5**	**-**	**6.1**	**3.7**	**-**	**-**	**-**	**2.3**	**19.6**
31	**-**	**7.5**	**-**	**6.1**	**3.7**	**-**	**-**	**-**	**2.3**	**19.6**
62	**-**	**2.2**	**-**	**3.7**	**2.2**	**1.8**	**8.5**	**-**	**-**	**18.5**
63	**-**	**2.2**	**-**	**3.7**	**2.2**	**1.8**	**8.5**	**-**	**-**	**18.5**
55	**-**	**9.0**	**5.5**	**3.7**	**-**	**-**	**-**	**-**	**-**	**18.1**
56	**-**	**9.0**	**5.5**	**3.7**	**-**	**-**	**-**	**-**	**-**	**18.1**
38	**-**	**11.2**	**3.4**	**-**	**-**	**-**	**-**	**-**	**-**	**14.6**
39	**-**	**11.2**	**3.4**	**-**	**-**	**-**	**-**	**-**	**-**	**14.6**
32	**-**	**-**	**-**	**6.4**	**5.1**	**-**	**-**	**-**	**3.0**	**14.5**
33	**-**	**-**	**-**	**6.4**	**5.1**	**-**	**-**	**-**	**3.0**	**14.5**
16	-	-	6.1	-	-	2.5	1.0	-	-	9.5
17	-	-	6.1	-	-	2.5	1.0	-	-	9.5
206	2.7	-	-	-	-	5.5	-	-	-	8.2
207	2.7	-	-	-	-	5.5	-	-	-	8.2
122	-	-	-	8.1	-	-	-	-	-	8.1
123	-	-	-	8.1	-	-	-	-	-	8.1
45	-	-	1.2	4.9	-	-	-	-	-	6.1
46	-	-	1.2	4.9	-	-	-	-	-	6.1
47	-	-	1.2	4.9	-	-	-	-	-	6.1
48	-	-	1.2	4.9	-	-	-	-	-	6.1

Table 14. Adults' consumption rates of green vegetables from the Chapelcross area (kg y^{-1})

Observation number	Artichoke	Broccoli	Brussels sprout	Cabbage	Cauliflower	Courgette	Cucumber	Kale	Lettuce	Total
108	-	-	-	6.0	-	-	-	-	-	6.0
109	-	-	-	6.0	-	-	-	-	-	6.0
71	-	-	-	-	-	1.8	-	-	-	1.8
72	-	-	-	-	-	1.8	-	-	-	1.8
192	-	-	-	1.2	-	-	-	-	-	1.2
193	-	-	-	1.2	-	-	-	-	-	1.2
117	-	-	-	-	-	-	-	-	0.8	0.8
118	-	-	-	-	-	-	-	-	0.8	0.8

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of green vegetables based on the 19 high-rate adult consumers is 22.4 kg y^{-1}

The observed 97.5th percentile rate based on 37 observations is 35.8 kg y^{-1}

Table 15. Adults' consumption rates of other vegetables from the Chapelcross area (kg y^{-1})

Observation number	Broad bean	French bean	Pea	Pepper	Pumpkin	Runner bean	Squash	Sweetcorn	Tomato	Total
62	**-**	**-**	**-**	**-**	**-**	**16.3**	**-**	**-**	**18.0**	**34.3**
63	**-**	**-**	**-**	**-**	**-**	**16.3**	**-**	**-**	**18.0**	**34.3**
122	**11.4**	**-**	**15.8**	**-**	**-**	**-**	**-**	**-**	**-**	**27.1**
123	**11.4**	**-**	**15.8**	**-**	**-**	**-**	**-**	**-**	**-**	**27.1**
87	**-**	**-**	**-**	**7.4**	**-**	**-**	**-**	**-**	**13.5**	**20.9**
88	**-**	**-**	**-**	**7.4**	**-**	**-**	**-**	**-**	**13.5**	**20.9**
42	**6.7**	**0.7**	**-**	**-**	**4.6**	**-**	**-**	**7.4**	**-**	**19.3**
43	**6.7**	**0.7**	**-**	**-**	**4.6**	**-**	**-**	**7.4**	**-**	**19.3**
107	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**15.1**	**15.1**
55	5.5	-	5.4	-	-	-	-	-	-	10.9
56	5.5	-	5.4	-	-	-	-	-	-	10.9
30	-	-	9.0	-	-	-	-	-	-	9.0
31	-	-	9.0	-	-	-	-	-	-	9.0
72	-	-	-	-	-	-	-	-	8.1	8.1
75	-	-	-	-	-	7.7	-	-	-	7.7
76	-	-	-	-	-	7.7	-	-	-	7.7
124	-	-	-	-	-	-	-	-	7.2	7.2
125	-	-	-	-	-	-	-	-	7.2	7.2
126	-	-	-	-	-	-	-	-	7.2	7.2
38	-	-	6.8	-	-	-	-	-	-	6.8
39	-	-	6.8	-	-	-	-	-	-	6.8
206	-	0.5	-	-	-	6.1	-	-	-	6.7
207	-	0.5	-	-	-	6.1	-	-	-	6.7
181	-	-	-	-	-	-	-	-	5.4	5.4
182	-	-	-	-	-	-	-	-	5.4	5.4
16	-	-	0.0	0.7	-	-	0.2	0.5	3.0	4.3
17	-	-	0.0	0.7	-	-	0.2	0.5	3.0	4.3
64	-	-	1.5	-	-	-	-	-	-	1.5
65	-	-	1.5	-	-	-	-	-	-	1.5

Table 15. Adults' consumption rates of other vegetables from the Chapelcross area (kg y^{-1})

Observation number	Broad bean	French bean	Pea	Pepper	Pumpkin	Runner bean	Squash	Sweetcorn	Tomato	Total
192	-	-	-	-	-	-	-	-	1.2	1.2
193	-	-	-	-	-	-	-	-	1.2	1.2
117	1.1	-	-	-	-	-	-	-	-	1.1
118	1.1	-	-	-	-	-	-	-	-	1.1
66	-	-	1.0	-	-	-	-	-	-	1.0
32	-	-	0.6	-	-	-	-	-	-	0.6
33	-	-	0.6	-	-	-	-	-	-	0.6
45	-	0.1	-	-	-	-	-	-	-	0.1
46	-	0.1	-	-	-	-	-	-	-	0.1
47	-	0.1	-	-	-	-	-	-	-	0.1
48	-	0.1	-	-	-	-	-	-	-	0.1

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of other vegetables based on the 9 high-rate adult consumers is 24.3 kg y^{-1}

The observed 97.5th percentile rate based on 40 observations is 34.3 kg y^{-1}

Table 16. Adults' consumption rates of root vegetables from the Chapelcross area (kg y^{-1})

Observation number	Beetroot	Carrot	Garlic	Leek	Onion	Parsnip	Radish	Shallot	Swede	Turnip	Total
43	**-**	**-**	**2.6**	**0.4**	**22.9**	**-**	**-**	**4.1**	**24.9**	**3.9**	**58.8**
42	**-**	**-**	**2.6**	**0.4**	**22.9**	**-**	**-**	**4.1**	**24.9**	**3.9**	**58.8**
10	**-**	**-**	**-**	**-**	**55.0**	**-**	**-**	**-**	**-**	**-**	**55.0**
11	**-**	**-**	**-**	**-**	**55.0**	**-**	**-**	**-**	**-**	**-**	**55.0**
88	**3.4**	**6.8**	**-**	**3.4**	**13.5**	**2.7**	**-**	**-**	**10.2**	**-**	**39.9**
87	**3.4**	**6.8**	**-**	**3.4**	**13.5**	**2.7**	**-**	**-**	**10.2**	**-**	**39.9**
75	**7.5**	**13.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**21.0**
76	**7.5**	**13.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**21.0**
30	**-**	**9.0**	**-**	**-**	**10.8**	**-**	**-**	**-**	**-**	**-**	**19.8**
31	**-**	**9.0**	**-**	**-**	**10.8**	**-**	**-**	**-**	**-**	**-**	**19.8**
6	11.7	7.3	-	-	-	-	-	-	-	-	19.0
7	11.7	7.3	-	-	-	-	-	-	-	-	19.0
8	11.7	7.3	-	-	-	-	-	-	-	-	19.0
9	11.7	7.3	-	-	-	-	-	-	-	-	19.0
126	3.3	-	-	-	11.5	-	1.4	-	-	2.2	18.4
124	3.3	-	-	-	11.5	-	1.4	-	-	2.2	18.4
125	3.3	-	-	-	11.5	-	1.4	-	-	2.2	18.4
108	-	6.0	-	-	6.0	-	-	-	6.0	-	18.0
109	-	6.0	-	-	6.0	-	-	-	6.0	-	18.0
38	6.8	-	-	6.8	-	-	-	-	-	-	13.5
39	6.8	-	-	6.8	-	-	-	-	-	-	13.5
55	2.7	-	-	8.1	-	2.2	-	-	-	-	13.0
56	2.7	-	-	8.1	-	2.2	-	-	-	-	13.0
62	1.4	5.4	-	-	2.2	1.1	-	-	-	-	10.0
63	1.4	5.4	-	-	2.2	1.1	-	-	-	-	10.0
45	-	2.2	-	2.2	-	1.0	-	-	-	1.4	6.9
46	-	2.2	-	2.2	-	1.0	-	-	-	1.4	6.9
47	-	2.2	-	2.2	-	1.0	-	-	-	1.4	6.9
48	-	2.2	-	2.2	-	1.0	-	-	-	1.4	6.9

Table 16. Adults' consumption rates of root vegetables from the Chapelcross area (kg y^{-1})

Observation number	Beetroot	Carrot	Garlic	Leek	Onion	Parsnip	Radish	Shallot	Swede	Turnip	Total
16	0.8	0.4	-	-	1.5	0.2	-	2.6	-	-	5.3
17	0.8	0.4	-	-	1.5	0.2	-	2.6	-	-	5.3
122	-	-	-	-	-	-	-	-	-	4.7	4.7
123	-	-	-	-	-	-	-	-	-	4.7	4.7
32	-	-	-	4.5	-	-	-	-	-	-	4.5
33	-	-	-	4.5	-	-	-	-	-	-	4.5
117	-	-	-	1.1	0.9	-	-	-	-	-	2.0
118	-	-	-	1.1	0.9	-	-	-	-	-	2.0
60	-	0.4	-	-	-	-	-	-	-	-	0.4
61	-	0.4	-	-	-	-	-	-	-	-	0.4

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of root vegetables based on the 10 high-rate adult consumers is 38.9 kg y^{-1}

The observed 97.5th percentile rate based on 39 observations is 58.8 kg y^{-1}

Table 17. Adults' consumption rates of potato from the Chapelcross area (kg y^{-1})

Observation number	Potato
30	**127.4**
31	**127.4**
160	**110.0**
161	**110.0**
162	**110.0**
163	**110.0**
6	**106.5**
7	**106.5**
8	**106.5**
9	**106.5**
45	**54.3**
46	**54.3**
47	**54.3**
48	**54.3**
38	**54.0**
39	**54.0**
40	**54.0**
41	**54.0**
122	**47.8**
123	**47.8**
55	**47.8**
56	**47.8**
164	**47.0**
165	**47.0**
10	30.3
11	30.3
107	25.5
124	21.8
125	21.8
126	21.8
42	15.1
43	15.1
32	14.6
33	14.6
20	13.7
21	13.7
75	13.2
76	13.2
16	11.1
17	11.1
60	9.1
61	9.1
62	8.1
63	8.1
206	6.1
207	6.1

Table 17. Adults' consumption rates of potato from the Chapelcross area (kg y^{-1})

Observation number	Potato
64	5.9
65	5.9
66	3.9
117	2.3
118	2.3
192	1.2
193	1.2

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of potato based on the 24 high-rate adult consumers is 76.6 kg y^{-1}

The observed 97.5^{th} percentile rate based on 53 observations is 122.2 kg y^{-1}

Table 18. Adults' consumption rates of domestic fruit from the Chapelcross area (kg y^{-1})

Observation number	Apple	Blackberry	Blackcurrant	Blueberry	Damson	Gooseberry	Jostaberry	Pear	Plum	Raspberry	Redcurrant	Rhubarb	Strawberry	Tayberry	Whitecurrant	Yellowcurrant	Total
206	**11.3**	**-**	**7.5**	**-**	**6.3**	**1.0**	**4.5**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**	**3.0**	**-**	**35.0**
207	**11.3**	**-**	**7.5**	**-**	**6.3**	**1.0**	**4.5**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**	**3.0**	**-**	**35.0**
43	**2.3**	**1.8**	**0.8**	**0.8**	**-**	**-**	**-**	**3.8**	**1.8**	**2.8**	**3.4**	**-**	**3.0**	**-**	**0.3**	**-**	**20.8**
10	**5.1**	**-**	**-**	**-**	**-**	**-**	**-**	**9.9**	**0.3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**15.4**
42	**2.3**	**-**	**0.8**	**0.8**	**-**	**-**	**-**	**3.8**	**1.8**	**-**	**-**	**-**	**3.0**	**-**	**0.3**	**-**	**12.7**
45	-	-	2.8	-	-	4.1	-	-	-	-	4.5	-	-	-	-	-	11.5
30	-	4.1	2.7	-	-	0.9	-	-	-	-	1.8	-	-	-	-	1.4	10.9
124	6.7	-	-	-	-	-	-	2.0	2.0	-	-	-	-	-	-	-	10.7
125	6.7	-	-	-	-	-	-	2.0	2.0	-	-	-	-	-	-	-	10.7
126	6.7	-	-	-	-	-	-	2.0	2.0	-	-	-	-	-	-	-	10.7
122	-	-	1.4	-	-	-	-	-	-	5.9	-	2.7	-	-	-	-	10.0
123	-	-	1.4	-	-	-	-	-	-	5.9	-	2.7	-	-	-	-	10.0
31	-	4.1	2.7	-	-	-	-	-	-	-	1.8	-	-	-	-	1.4	10.0
117	6.8	-	-	-	-	-	-	-	-	2.5	-	-	-	-	-	-	9.3
118	6.8	-	-	-	-	-	-	-	-	2.5	-	-	-	-	-	-	9.3
38	-	-	3.3	-	-	-	-	-	-	4.1	-	-	-	-	-	-	7.3
181	-	-	-	-	-	-	-	-	-	-	-	-	5.1	-	-	-	5.1
182	-	-	-	-	-	-	-	-	-	-	-	-	5.1	-	-	-	5.1
39	-	-	-	-	-	-	-	-	-	4.1	-	-	-	-	-	-	4.1
32	-	0.8	-	-	-	0.7	-	-	-	0.8	-	1.2	-	-	-	-	3.4
33	-	0.8	-	-	-	0.7	-	-	-	0.8	-	1.2	-	-	-	-	3.4
16	0.5	0.3	-	-	-	-	-	-	-	-	-	-	2.3	-	-	-	3.0
17	0.5	0.3	-	-	-	-	-	-	-	-	-	-	2.3	-	-	-	3.0
46	-	-	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	2.8
55	-	-	0.9	-	-	-	-	-	-	1.4	-	-	-	-	-	-	2.3
56	-	-	0.9	-	-	-	-	-	-	1.4	-	-	-	-	-	-	2.3
87	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4
88	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4
119	-	-	-	-	-	-	-	-	-	-	-	1.4	-	-	-	-	1.4
20	-	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	0.5
21	-	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	0.5
6	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.4
11	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	0.3
86	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	0.2
34	-	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	-	0.2
35	-	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	-	0.2
37	-	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	-	0.2
7	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of domestic fruit based on the 5 high-rate adult consumers is 23.8 kg y^{-1}

The observed 97.5th percentile rate based on 38 observations is 35.0 kg y^{-1}

Table 19. Adults' consumption rates of milk from the Chapelcross area (l y^{-1})

Observation number	Milk
120	**730.0**
183	**547.5**
62	**414.9**
63	**414.9**
12	**276.6**
13	**276.6**
14	**276.6**
108	219.0
109	219.0
110	219.0
111	219.0
184	182.5
185	182.5
1	165.9
2	165.9
3	165.9
4	165.9
5	165.9
186	121.7
187	121.7
188	121.7
15	91.3
24	75.4
25	75.4
119	26.0

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of milk based on the 7 high-rate adult consumers is 419.6 l y^{-1}

The observed 97.5th percentile rate based on 25 observations is 620.5 l y^{-1}

Table 20. Adults' consumption rates of cattle meat from the Chapelcross area (kg y^{-1})

Observation number	Beef
206	**57.0**
207	**57.0**
67	**42.5**
68	**42.5**
69	**42.5**
70	**42.5**
124	**20.8**
125	**20.8**
126	**20.8**
30	13.6
31	13.6

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of cattle meat based on the 9 high-rate adult consumers is 38.5 kg y^{-1}

The observed 97.5th percentile rate based on 11 observations is 57.0 kg y^{-1}

Table 21. Adults' consumption rates of pig meat from the Chapelcross area (kg y^{-1})

Observation number	Pork
10	**35.0**
11	**35.0**
206	**25.3**
207	**25.3**
124	**16.9**
125	**16.9**
126	**16.9**
30	7.5
31	7.5

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of pig meat based on the 7 high-rate adult consumers is 24.5 kg y^{-1}

The observed 97.5th percentile rate based on 9 observations is 35.0 kg y^{-1}

Table 22. Adults' consumption rates of sheep meat from the Chapelcross area (kg y^{-1})

Observation number	Lamb
119	**11.3**
120	**11.3**
108	**5.7**
109	**5.7**
206	**5.7**
207	**5.7**
288	**5.7**
289	**5.7**
290	**5.7**
291	**5.7**
292	**5.7**
293	**5.7**
124	**3.8**
125	**3.8**
126	**3.8**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of sheep meat based on the 15 high-rate adult consumers is 6.0 kg y^{-1}

The observed 97.5th percentile rate based on 15 observations is 11.3 kg y^{-1}

Table 23. Adults' consumption rates of poultry from the Chapelcross area (kg y^{-1})

Observation number	Partridge	Pheasant	Pigeon	Turkey	Total
30	**0.6**	**5.6**	**17.8**	**4.0**	**28.1**
31	**0.6**	**5.6**	**17.8**	**4.0**	**28.1**
285	**-**	**6.8**	**3.5**	**-**	**10.2**
286	**-**	**6.8**	**3.5**	**-**	**10.2**
10	-	1.4	-	-	1.4
71	-	1.4	-	-	1.4
72	-	1.4	-	-	1.4
67	-	0.6	-	-	0.6
68	-	0.6	-	-	0.6
11	-	0.5	-	-	0.5

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of poultry based on the 4 high-rate adult consumers is 19.1 kg y^{-1}

The observed 97.5th percentile rate based on 10 observations is 28.1 kg y^{-1}

Table 24. Adults' consumption rates of eggs from the Chapelcross area (kg y^{-1})

Observation number	Chicken egg
30	**39.9**
31	**39.9**
10	**25.7**
1	**20.8**
2	**20.8**
3	**20.8**
4	**20.8**
5	**20.8**
96	**19.5**
97	**19.5**
124	**17.8**
125	**17.8**
126	**17.8**
285	**17.8**
286	**17.8**
181	**13.3**
182	**13.3**
206	**13.3**
57	11.9
67	8.9
68	8.9
69	8.9
70	8.9
11	8.6
89	8.6
90	8.6
91	8.6
192	8.3
193	8.3
207	5.9
58	4.4
59	4.4

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of eggs based on the 18 high-rate adult consumers is 21.0 kg y^{-1}

The observed 97.5th percentile rate based on 32 observations is 39.9 kg y^{-1}

Table 25. Adults' consumption rates of wild/free foods from the Chapelcross area (kg y^{-1})

Observation number	Bilberry	Blackberry	Sloe	Total
62	**-**	**6.8**	**-**	**6.8**
63	**-**	**6.8**	**-**	**6.8**
122	**-**	**5.7**	**-**	**5.7**
123	**-**	**5.7**	**-**	**5.7**
206	**-**	**3.0**	**0.2**	**3.2**
207	**-**	**3.0**	**0.2**	**3.2**
117	**-**	**2.5**	**-**	**2.5**
118	**-**	**2.5**	**-**	**2.5**
30	0.9	-	-	0.9
113	-	0.8	-	0.8
114	-	0.8	-	0.8
115	-	0.8	-	0.8
116	-	0.8	-	0.8
67	-	0.7	-	0.7
73	-	-	0.7	0.7
74	-	-	0.7	0.7
183	-	0.7	-	0.7
184	-	0.7	-	0.7
124	-	0.7	-	0.7
125	-	0.7	-	0.7
126	-	0.7	-	0.7
64	-	0.6	-	0.6
65	-	0.6	-	0.6
66	-	0.6	-	0.6
252	-	0.5	-	0.5
20	-	-	0.3	0.3
21	-	-	0.3	0.3
127	-	0.3	-	0.3
128	-	0.3	-	0.3
129	-	0.3	-	0.3

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of wild/free foods based on the 8 high-rate adult consumers is 4.6 kg y^{-1}

The observed 97.5th percentile rate based on 30 observations is 6.8 kg y^{-1}

Table 26. Adults' consumption rates of rabbits/hares from the Chapelcross area (kg y^{-1})

Observation number	Rabbit
30	**1.4**
31	**1.4**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of rabbits/hares based on the 2 high-rate adult consumers is 1.4 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 1.4 kg y^{-1}

Table 27. Adults' consumption rates of honey from the Chapelcross area (kg y^{-1})

Observation number	Honey
191	**9.1**
282	1.5
283	1.5

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of honey based on the only high-rate adult consumer is 9.1 kg y^{-1}

The observed 97.5th percentile rate based on 3 observations is 8.7 kg y^{-1}

Table 28. Adults' consumption rates of wild fungi from the Chapelcross area (kg y^{-1})

Observation number	Mushrooms
124	**1.0**
125	**1.0**
126	**1.0**
181	**1.0**
182	**1.0**
119	**0.9**
120	**0.9**
117	**0.5**
118	**0.5**
89	0.3
90	0.3
91	0.3
206	0.3
207	0.3
127	0.2
128	0.2
129	0.2
160	0.1
161	0.1
162	0.1
163	0.1

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of wild fungi based on the 9 high-rate adult consumers is 0.9 kg y^{-1}

The observed 97.5th percentile rate based on 21 observations is 1.0 kg y^{-1}

Table 29. Adults' consumption rates of venison from the Chapelcross area (kg y^{-1})

Observation number	Venison
285	**36.3**
286	**36.3**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of venison based on the 2 high-rate adult consumers is 36.3 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 36.3 kg y^{-1}

Table 30. Adults' consumption rates of freshwater fish in the Chapelcross area (kg y^{-1})

Observation number	Brown trout
30	**0.7**
31	**0.7**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of freshwater fish based on the 2 high-rate adult consumers is 0.7 kg y^{-1}

The observed 97.5th percentile rate based on 2 observations is 0.7 kg y^{-1}

Table 31. Children's consumption rates of green vegetables in the Chapelcross area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Broccoli	Brussel sprout	Cabbage	Cauliflower	Courgette	Cucumber	Kale	Lettuce	Total
44	**13**	**3.6**	**3.0**	**5.7**	**5.0**	**12.9**	**-**	**1.8**	**3.8**	**35.8**
18	9	-	6.1	-	-	2.5	1.0	-	-	9.5
49	7	-	0.6	2.4	-	-	-	-	-	3.0
19	7	-	-	-	-	-	0.5	-	-	0.5

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of green vegetables for the child age group based upon the only high-rate consumer is 35.8 kg y^{-1}

The observed 97.5th percentile rate based on 4 observations is 33.8 kg y^{-1}

Table 32. Children's consumption rates of other vegetables in the Chapelcross area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Broad bean	French bean	Pea	Pepper	Pumpkin	Squash	Sweetcorn	Tomato	Total
44	**13**	**6.7**	**0.7**	-	-	**4.6**	-	**7.4**	-	**19.3**
18	9	-	-	0.03	0.7	-	0.2	0.5	3.0	4.3
19	7	-	-	0.01	-	-	-	0.2	-	0.2
49	7	-	0.1	-	-	-	-	-	-	0.1

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of other vegetables for the child age group based upon the only high-rate consumer is 19.3 kg y^{-1}

The observed 97.5th percentile rate based on 4 observations is 18.2 kg y^{-1}

Table 33. Children's consumption rates of root vegetables in the Chapelcross area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Beetroot	Carrot	Garlic	Leek	Onion	Parsnip	Shallot	Swede	Turnip	Total
44	**13**	**-**	**-**	**2.6**	**0.4**	**22.9**	**-**	**4.1**	**24.9**	**3.9**	**58.8**
18	9	0.8	0.4	-	-	1.5	0.2	2.6	-	-	5.3
49	7	-	1.1	-	1.1	-	0.5	-	-	0.7	3.4
19	7	-	0.2	-	-	-	0.1	1.3	-	-	1.5

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of root vegetables for the child age group based upon the only high-rate consumer is 58.8 kg y^{-1}

The observed 97.5th percentile rate based on 4 observations is 54.8 kg y^{-1}

Table 34. Children's and infants' consumption rates of potato in the Chapelcross area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Potato
49	**7**	**27.1**
44	**13**	**15.1**
22	**14**	**13.7**
23	**9**	**13.7**
18	**9**	**11.1**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of potato for the child age group based upon the 5 high-rate consumers is 16.1 kg y^{-1}

The observed 97.5th percentile rate based on 5 observations is 25.9 kg y^{-1}

Infant age group (0 - 5 years old)

Observation number	Age	Potato
166	**3**	**15.5**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of potato for the infant age group based upon the only high-rate consumer is 15.5 kg y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

Table 35. Children's consumption rates of domestic fruit in the Chapelcross area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Apple	Blackberry	Blackcurrant	Blueberry	Pear	Plum	Raspberry	Redcurrant	Rhubarb	Strawberry	Whitecurrant	Total
44	**13**	**2.3**	**1.8**	**0.8**	**0.8**	**3.8**	**1.8**	**2.8**	**3.4**	**-**	**3.0**	**0.3**	**20.8**
49	**7**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**13.6**	**-**	**13.6**
18	9	0.5	0.3	**-**	**-**	**-**	**-**	**-**	**-**	**-**	2.3	**-**	3.0
19	7	0.2	0.1	**-**	**-**	**-**	**-**	**-**	**-**	**-**	1.2	**-**	1.5
22	14	-	-	**-**	**-**	**-**	**-**	**-**	**-**	0.5	**-**	**-**	0.5
23	9	-	-	**-**	**-**	**-**	**-**	**-**	**-**	0.5	**-**	**-**	0.5
36	12	-	-	**-**	**-**	**-**	**-**	0.2	**-**	**-**	**-**	**-**	0.2

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of domestic fruit for the child age group based upon the 2 high-rate consumers is 17.2 kg y^{-1}

The observed 97.5th percentile rate based on 7 observations is 19.7 kg y^{-1}

Table 36. Children's consumption rates of milk in the Chapelcross area (l y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Milk
112	**7**	**219.0**
26	**13**	**75.4**
27	**11**	**75.4**
28	**11**	**75.4**
29	6	37.7
189	13	36.5
121	6	26.0

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of milk for the child age group based upon the 4 high-rate consumers is 111.3 l y^{-1}

The observed 97.5th percentile rate based on 7 observations is 197.5 l y^{-1}

Table 37. Children's consumption rates of pig meat in the Chapelcross area (kg y^{-1})

Child age group (6 - 15 years old)

Observation number	Age	Pork
121	**6**	**18.6**

Notes

Emboldened observations are the high-rate consumers

The mean consumption rate of pig meat for the child age group based upon the only high-rate consumer is 18.6 kg y^{-1}

The observed 97.5th percentile rate is not applicable for 1 observation

Table 38. Percentage contribution each food type makes to its terrestrial food group for adults

Green vegetables	
Cabbage	28.9 %
Courgette	21.5 %
Broccoli	18.4 %
Brussel sprout	9.1 %
Cauliflower	8.1 %
Cucumber	6.6 %
Lettuce	5.1 %
Kale	1.2 %
Artichoke	1.0 %

Other vegetables	
Tomato	35.3 %
Pea	22.0 %
Runner bean	16.7 %
Broad bean	13.7 %
Pepper	4.5 %
Sweetcorn	4.4 %
Pumpkin	2.5 %
French bean	0.8 %
Squash	0.1 %

Root vegetables	
Onion	37.7 %
Carrot	17.5 %
Beetroot	14.7 %
Swede	11.9 %
Leek	8.3 %
Turnip	4.3 %
Parsnip	2.3 %
Shallot	1.9 %
Garlic	0.8 %
Radish	0.6 %

Potato	
Potato	100.0 %

Domestic fruit	
Apple	24.7 %
Blackcurrant	14.1 %
Raspberry	12.1 %
Pear	8.7 %
Strawberry	7.7 %
Blackberry	4.7 %
Damson	4.6 %
Redcurrants	4.3 %
Plum	3.8 %
Rhubarb	3.7 %
Jostaberry	3.3 %
Gooseberry	3.2 %
Whitecurrant	2.4 %
Tayberry	1.1 %
Yellow currant	1.0 %
Blueberry	0.6 %

Milk	
Cows' milk	100.0 %

Cattle meat	
Beef	100.0 %

Pig meat	
Pork	100.0 %

Sheep meat	
Lamb	100.0 %

Poultry	
Pigeon	51.8 %
Pheasant	37.0 %
Turkey	9.8 %
Partridge	1.5 %

Eggs	
Chicken egg	100.0 %

Wild/free foods	
Blackberry	93.1 %
Sloe	5.0 %
Bilberry	1.8 %

Honey	
Honey	100.0 %

Wild fungi	
Mushrooms	100.0 %

Rabbits/hares	
Rabbit	100.0 %

Venison	
Venison	100.0 %

Freshwater fish	
Brown trout	100.0 %

Notes

Food types in emboldened italics were monitored by SEPA in 2009 (EA, FSA, NIEA and SEPA, 2010).

Barley, crab apples and rowan berries were also monitored.

Percentages are based on the consumption of all adults in the survey consuming that particular food group

Table 39. Occupancy rates in the Chapelcross direct radiation survey area

Observation number	Sex	Age (years)	Indoor occupancy (h y^{-1})	Outdoor occupancy (h y^{-1})	Total occupancy (h y^{-1})
Adult observations					
89	M	19	5526	2898	8424
64	M	53	8052	216	8268
65	F	51	7968	216	8184
152	M	U	7990	84	8074
96	M	39	5544	2516	8060
181	F	U	7436	588	8024
100	M	52	6465	1500	7965
101	F	50	6465	1500	7965
102	M	20	7215	750	7965
103	M	23	7215	750	7965
153	F	U	7640	84	7724
97	F	41	6194	1480	7674
73	M	65	6588	1074	7662
72	F	68	7418	206	7624
74	F	65	7231	87	7318
82	F	51	7107	192	7298
71	M	69	6992	300	7292
192	M	U	4742	2460	7202
155	M	73	6205	730	6935
182	M	U	5659	480	6139
83	M	41	4907	81	4988
193	F	U	3804	960	4764
157	M	23	2601	77	2678
200	M	U	-	2115	2115
201	M	U	-	2115	2115
202	M	U	-	2115	2115
203	M	U	-	2115	2115
204	M	U	-	2115	2115
205	M	U	-	2115	2115
167	M	U	1575	450	2025
168	M	U	1575	450	2025
169	M	U	1575	450	2025
170	M	U	1980	45	2025
171	M	U	1980	45	2025
172	M	U	1980	45	2025
173	M	U	1980	45	2025
174	M	U	1980	45	2025
175	M	U	1980	45	2025
176	M	U	1980	45	2025
177	M	U	1980	45	2025
178	M	U	1980	45	2025
179	M	U	1980	45	2025
180	M	U	1980	45	2025
66	M	24	1925	25	1950

Table 39. Occupancy rates in the Chapelcross direct radiation survey area

Observation number	Sex	Age (years)	Indoor occupancy (h y^{-1})	Outdoor occupancy (h y^{-1})	Total occupancy (h y^{-1})
195	M	U	-	1927	1927
196	M	U	-	1927	1927
197	M	U	-	1927	1927
198	M	U	-	1927	1927
199	M	U	-	1927	1927
288	M	50	-	1080	1080
104	M	U	-	1040	1040
194	F	U	893	47	940
156	M	46	832	52	884
84	M	42	336	84	420
105	M	U	-	416	416
158	M	U	224	32	256
159	M	U	-	72	72
85	F	38	10.8	1.2	12
Child and infant observations					
154	F	1	7640	84	7724
98	F	11	1002	6	1008
99	M	9	1002	6	1008

Table 40. Gamma dose rate measurements for the Chapelcross direct radiation survey (μGy h^{-1})

Properties

Location	Indoor substrate	Indoor gamma dose rate at 1 metre[a]	Outdoor substrate	Outdoor gamma dose rate at 1 metre[a]
Property 1	Wood	0.093	Grass	0.075
Property 2	Concrete	0.104	Grass	0.069
Property 3	Concrete	0.086	Grass	0.077
Property 4	Wood	0.099	Gravel	0.089
Property 5	Wood	0.103	Grass	0.072
Property 6	Concrete	0.076	Grass	0.072
Property 7	Concrete	0.090	Grass and gravel	0.092
Property 8	Concrete	0.073	Grass	0.069
Property 9	Wood	0.075	Gravel	0.082
Property 10	Concrete	0.103	Grass	0.081
Property 11	Concrete	0.109	Grass	0.075
Property 12	Wood	0.103	Grass	0.070
Property 13	Concrete	0.069	Grass	0.076

Backgrounds

	Location	NGR	Substrate	Background gamma dose rate at 1 metre
Background 1	Eaglesfield	NY 264 747	Grass	0.064
Background 2	Near Brydekirk	NY 169 730	Grass	0.071
Background 3	Moss Side	NY 139 652	Grass	0.071
Background 4	Redkirk	NY 302 653	Grass	0.071
			Mean background	0.070

Notes

[a] These measurements have not been adjusted for natural background dose rates.

Table 41. Occupancy rates near the Chapelcross pipeline (h y^{-1})

Observation number	Age (years)	Sex	Pipeline (Seafield)	Pipeline (Scrap yard)	Pipeline (Sports centre)	Pipeline (Housing estate)	Pipeline (Upper stretch)	Total
297	67	M	-	-	-	365	365	730
296	30	F	130	-	-	-	498	628
94	57	M	625	-	-	-	-	625
295	56	M	548	-	-	-	-	548
252	63	M	274	-	-	-	-	274
294	63	M	243	-	-	-	-	243
208	U	M	19	9	60	42	28	158
209	U	M	19	9	60	42	28	158
95	73	M	138	-	-	-	-	138
210	U	M	19	9	32	42	28	130
211	U	M	-	-	32	42	28	102
298	37	M	-	-	-	91	-	91
299	36	F	-	-	-	91	-	91
92	64	M	67	-	-	-	-	67
93	57	F	67	-	-	-	-	67
232	60	M	52	-	-	-	-	52
300	14	M	-	-	-	45	-	45
212	U	M	-	-	-	42	-	42
213	U	M	-	-	-	42	-	42
233	58	F	26	-	-	-	-	26
251	37	M	26	-	-	-	-	26
96	39	M	1	-	-	-	-	1
97	41	F	1	-	-	-	-	1

Table 42. Gamma dose rate measurements along the Chapelcross pipeline (µGy h^{-1})

Pipeline section	National Grid Reference	Substrate	Gamma dose rate at 1 metre[a]
Seafield	NY 206 644	Grass	0.086
Seafield	NY 206 644	Gravel	0.141
Seafield	NY 203 652	Grass	0.066
Scrap yard	NY 201 660	Grass	0.107
Sports centre	NY 200 665	Grass	0.098
Housing estate	NY 203 672	Grass	0.081
Upper stretch	NY 208 678	Grass	0.080
Upper stretch	NY 210 688	Grass	0.129
Upper stretch	NY 209 693	Grass	0.078

Notes

[a] These measurements have not been adjusted for natural background dose rates.

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
1	M	U	-	-	-	-	-	-	-	-	-	165.9	-	-	-	-	**20.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	F	U	-	-	-	-	-	-	-	-	-	165.9	-	-	-	-	**20.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	M	U	-	-	-	-	-	-	-	-	-	165.9	-	-	-	-	**20.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	M	U	-	-	-	-	-	-	-	-	-	165.9	-	-	-	-	**20.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	F	U	-	-	-	-	-	-	-	-	-	165.9	-	-	-	-	**20.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	M	76	**11.5**	-	-	-	-	-	19.0	**106.5**	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	F	76	**11.5**	-	-	-	-	-	19.0	**106.5**	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	F	60	**11.5**	-	-	-	-	-	19.0	**106.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	M	48	-	-	-	-	-	-	19.0	**106.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	M	62	-	-	-	-	-	-	**55.0**	30.3	**15.4**	-	-	**35.0**	-	1.4	**25.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	F	58	-	-	-	-	-	-	**55.0**	30.3	0.3	-	-	**35.0**	-	0.5	8.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	F	63	-	-	-	-	-	-	-	-	-	**276.6**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	F	59	-	-	-	-	-	-	-	-	-	**276.6**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	M	29	-	-	-	-	-	-	-	-	-	**276.6**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	M	44	-	-	-	-	-	-	-	-	-	91.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	M	42	-	-	-	-	9.5	4.3	5.3	11.1	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	F	35	-	-	-	-	9.5	4.3	5.3	11.1	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	M	47	-	-	-	-	-	-	-	13.7	0.5	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	F	44	-	-	-	-	-	-	-	13.7	0.5	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	M	40	-	-	-	-	-	-	-	-	-	75.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	F	37	-	-	-	-	-	-	-	-	-	75.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	F	43	-	-	-	**22.8**	**19.6**	9.0	**19.8**	**127.4**	10.9	-	13.6	7.5	-	**28.1**	**39.9**	0.9	**1.4**	-	-	-	**0.7**	-	-	-	**432**	-	-	-	-	**432**	-	-	-	-
31	M	44	-	-	-	**22.8**	**19.6**	9.0	**19.8**	**127.4**	10.0	-	13.6	7.5	-	**28.1**	**39.9**	-	**1.4**	-	-	-	**0.7**	-	-	-	**288**	-	-	-	-	**288**	-	-	-	-
32	M	73	-	-	-	-	**14.5**	0.6	4.5	14.6	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	F	72	-	-	-	-	**14.5**	0.6	4.5	14.6	3.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	F	46	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
35	M	48	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37	F	16	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38	M	78	-	-	-	-	**14.6**	6.8	13.5	**54.0**	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
39	F	74	-	-	-	-	**14.6**	6.8	13.5	**54.0**	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40	M	52	-	-	-	-	-	-	-	**54.0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41	M	49	-	-	-	-	-	-	-	**54.0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
42	M	50	-	-	-	-	**35.8**	**19.3**	**58.8**	15.1	**12.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43	F	48	-	-	-	-	**35.8**	**19.3**	**58.8**	15.1	**20.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
45	M	61	-	-	-	-	6.1	0.1	6.9	**54.3**	11.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46	F	60	-	-	-	-	6.1	0.1	6.9	**54.3**	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
47	F	37	-	-	-	-	6.1	0.1	6.9	**54.3**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
48	M	38	-	-	-	-	6.1	0.1	6.9	**54.3**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50	M	18	1.1	-	-	**45.1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**672**	80	-	365	-	**672**	280	-	-	-
51	M	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	-	-	-	-	-	-
52	F	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	-	-	-	-	-	-
54	M	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	252	-	-	-	-	-	-
55	M	83	-	-	-	-	**18.1**	10.9	13.0	**47.8**	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
56	F	76	-	-	-	-	**18.1**	10.9	13.0	**47.8**	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
57	F	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
58	M	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
59	F	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
60	M	28	-	-	-	-	-	-	0.4	9.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
61	F	26	-	-	-	-	-	-	0.4	9.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
62	M	58	-	-	-	-	**18.5**	**34.3**	10.0	8.1	-	**414.9**	-	-	-	-	-	**6.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
63	F	48	-	-	-	-	**18.5**	**34.3**	10.0	8.1	-	**414.9**	-	-	-	-	-	**6.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64	M	53	-	-	-	-	-	1.5	-	5.9	-	-	-	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8052	216	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
65	F	51	-	-	-	-	-	1.5	-	5.9	-	-	-	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7968	216	-
66	M	24	-	-	-	-	-	1.0	-	3.9	-	-	-	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1925	25	-
67	M	43	-	-	-	-	-	-	-	-	-	-	**42.5**	-	-	0.6	8.9	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
68	F	46	-	-	-	-	-	-	-	-	-	-	**42.5**	-	-	0.6	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
69	M	20	-	-	-	-	-	-	-	-	-	-	**42.5**	-	-	-	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
70	F	16	-	-	-	-	-	-	-	-	-	-	**42.5**	-	-	-	8.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
71	M	69	-	-	-	-	1.8	-	-	-	-	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6992	300	-
72	F	68	-	-	-	-	1.8	8.1	-	-	-	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7418	206	-
73	M	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6588	1074	-
74	F	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7231	87	-
75	M	75	-	-	-	-	**24.0**	7.7	**21.0**	13.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
76	F	70	-	-	-	-	**24.0**	7.7	**21.0**	13.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
77	M	42	**12.9**	-	-	10.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**180**	169	-	-	-	-	169	208	-	-	-
78	F	41	**12.9**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79	F	17	**12.9**	-	-	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
80	F	19	**12.9**	-	-	6.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
81	M	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	-	-	-	-	225	416	-	-	-
82	F	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7107	192	-
83	M	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4907	81	-
84	M	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	336	84	-
85	F	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	1	-
86	M	65	-	-	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
87	M	54	-	-	-	-	**24.0**	**20.9**	**39.9**	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
88	F	54	-	-	-	-	**24.0**	**20.9**	**39.9**	-	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
89	M	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.6	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	5526	2898	-
90	M	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.6	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
91	F	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.6	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92	M	64	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67
93	F	57	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67
94	M	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	625
95	M	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	138
96	M	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**19.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5544	2516	1
97	F	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**19.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6194	1480	1
100	M	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6465	1500	-
101	F	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6465	1500	-
102	M	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7215	750	-
103	M	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7215	750	-
104	M	U	**4.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1040	-
105	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	416	-
106	F	U	**4.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
107	M	82	-	-	-	-	-	**15.1**	-	25.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
108	M	U	-	-	-	-	6.0	-	18.0	-	-	219.0	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
109	F	U	-	-	-	-	6.0	-	18.0	-	-	219.0	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
110	M	U	-	-	-	-	-	-	-	-	-	219.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
111	F	U	-	-	-	-	-	-	-	-	-	219.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
113	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
114	F	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
115	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
116	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
117	M	U	**5.6**	-	-	-	0.8	1.1	2.0	2.3	9.3	-	-	-	-	-	-	**2.5**	-	-	**0.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
118	F	U	**5.6**	-	-	-	0.8	1.1	2.0	2.3	9.3	-	-	-	-	-	-	**2.5**	-	-	**0.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
119	F	41	-	-	-	-	-	-	-	-	1.4	26.0	-	-	**11.3**	-	-	-	-	-	**0.9**	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
120	M	60	-	-	-	-	-	-	-	-	-	**730.0**	-	-	**11.3**	-	-	-	-	-	**0.9**	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
122	M	74	-	-	-	-	8.1	**27.1**	4.7	**47.8**	10.0	-	-	-	-	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
123	F	72	-	-	-	-	8.1	**27.1**	4.7	**47.8**	10.0	-	-	-	-	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
124	F	52	-	-	-	-	**29.4**	7.2	18.4	21.8	10.7	-	**20.8**	**16.9**	**3.8**	-	**17.8**	0.7	-	-	**1.0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
125	M	54	-	-	-	-	**29.4**	7.2	18.4	21.8	10.7	-	**20.8**	**16.9**	**3.8**	-	**17.8**	0.7	-	-	**1.0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
126	M	19	-	-	-	-	**29.4**	7.2	18.4	21.8	10.7	-	**20.8**	**16.9**	**3.8**	-	**17.8**	0.7	-	-	**1.0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
127	M	57	**4.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	0.2	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-
128	F	53	**4.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
129	M	25	**4.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.3	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
130	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	104	-	-	-	-	-	-
131	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	104	-	-	-	-	-	-
132	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	104	-	-	-	-	-	-
133	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	168	-	-	-	-	-	-
134	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	168	-	-	-	-	-	-
135	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	168	-	-	-	-	-	-
136	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	168	-	-	-	-	-	-
137	M	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**36**	-	-	-	-	-	-	-	-	-	-	-	-
138	F	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**36**	-	-	-	-	-	-	-	-	-	-	-	-
141	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**12**	-	-	-	-	-	-	-
142	F	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**12**	-	-	-	-	-	-	-
147	M	63	-	-	**0.2**	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1130**	-	**460**	-	-	-	-
148	M	U	-	-	**0.2**	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
149	U	U	-	-	-	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
150	U	U	-	-	-	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
151	F	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	108	-	-	-	-	-	-
152	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7990	84	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
153	F	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7640	84	-
155	M	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6205	730	-
156	M	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	832	52	-
157	M	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2601	77	-
158	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	224	32	-
159	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	72	-
160	F	62	0.9	-	-	-	-	-	-	**110.0**	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
161	M	60	0.9	-	-	-	-	-	-	**110.0**	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
162	M	28	0.9	-	-	-	-	-	-	**110.0**	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
163	F	25	0.9	-	-	-	-	-	-	**110.0**	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
164	M	31	-	-	-	-	-	-	-	**47.0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
165	F	32	-	-	-	-	-	-	-	**47.0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
167	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1575	450	-
168	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1575	450	-
169	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1575	450	-
170	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
171	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
172	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
173	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
174	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
175	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
176	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
177	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
178	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
179	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-
180	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1980	45	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
181	F	U	-	-	-	-	-	5.4	-	-	5.1	-	-	-	-	-	**13.3**	-	-	-	**1.0**	-	-	-	-	-	-	-	-	-	-	-	-	7436	588	-
182	M	U	-	-	-	-	-	5.4	-	-	5.1	-	-	-	-	-	**13.3**	-	-	-	**1.0**	-	-	-	-	-	-	-	-	-	-	-	-	5659	480	-
183	M	55	0.2	-	-	-	-	-	-	-	-	**547.5**	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
184	F	50	0.2	-	-	-	-	-	-	-	-	182.5	-	-	-	-	-	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
185	M	28	-	-	-	-	-	-	-	-	-	182.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
186	F	26	-	-	-	-	-	-	-	-	-	121.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
187	M	54	-	-	-	-	-	-	-	-	-	121.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
188	F	48	-	-	-	-	-	-	-	-	-	121.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
190	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	98	-	-	-	-	-	-
191	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**9.1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
192	M	U	3.3	-	-	-	1.2	1.2	-	1.2	-	-	-	-	-	-	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4742	2460	-
193	F	U	3.3	-	-	-	1.2	1.2	-	1.2	-	-	-	-	-	-	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3804	960	-
194	F	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	893	47	-
195	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1927	-
196	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1927	-
197	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1927	-
198	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1927	-
199	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1927	-
200	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2115	-
201	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2115	-
202	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2115	-
203	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2115	-
204	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2115	-
205	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2115	-
206	F	U	0.5	-	-	-	8.2	6.7	-	6.1	**35.0**	-	**57.0**	**25.3**	**5.7**	-	**13.3**	**3.2**	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
207	M	U	0.5	-	-	-	8.2	6.7	-	6.1	**35.0**	-	**57.0**	**25.3**	**5.7**	-	5.9	**3.2**	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
208	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	158
209	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	158
210	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130
211	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	102
212	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42
213	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42
214	M	U	2.0	-	-	**31.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	89	-	75	156	-	-	-
215	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
216	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
217	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
218	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
219	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
220	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
221	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
222	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
223	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
224	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	156	-	-	-
225	M	58	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
226	F	56	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-
227	M	74	-	**16.3**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	144	-	672	-	-	-
228	M	43	-	**8.2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
229	M	27	-	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
230	M	40	-	**20.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	115	-	538	-	-	-
231	F	38	-	**16.3**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
232	M	60	**11.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	-	104	**281**	-	280	-	-	52
233	F	58	**11.8**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
234	M	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57	-	-	**210**	-	209	-	-	-
235	M	67	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	88	-	-	**264**	-	263	-	-	-
236	F	63	0.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
237	M	44	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-	-	61	-	60	-	-	-
238	F	46	4.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
239	M	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	61	-	60	-	-	-
240	M	68	**6.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**196**	-	-	60	16	-	-	-	-
241	F	64	**6.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
242	M	43	**6.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
243	M	70	**9.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**196**	-	-	60	16	-	-	-	-
244	F	68	**9.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
245	M	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-
246	M	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-
247	M	77	2.2	-	**0.2**	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**385**	-	360	**514**	28	380	-	-	-
248	F	73	2.2	-	**0.2**	0.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	180	-	-	-	-	-	-
251	M	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78	-	26	134	-	133	-	-	26
252	M	63	3.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.5	-	-	-	-	-	-	-	-	-	**405**	-	-	-	-	-	-	-	274
253	M	53	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	-	-	113	-	112	-	-	-
254	F	52	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
255	M	56	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	-	-	11	-	10	-	-	-
256	F	48	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
257	M	25	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
258	M	45	3.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	-	18	91	-	90	-	-	-
259	F	42	3.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
262	M	44	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	-	-	136	-	135	-	-	-
263	M	56	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	53	-	-	114	-	113	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
264	F	56	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
265	M	62	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	122	-	52	**181**	-	180	-	-	-
266	M	30	2.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
267	M	65	-	-	-	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**692**	**135**	-	-	128	**732**	-	-	-	-
268	F	39	**9.0**	-	-	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
269	F	39	**9.0**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
270	M	54	2.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**660**	134	-	-	128	**700**	-	-	-	-
271	M	51	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**114**	-	-	-	-	-	-	114	-	-	-	-
272	F	50	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
273	M	19	1.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
274	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	-	-	-	-	-	24	-	-	-	-
275	M	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	-	-	-	-	-	-
276	M	69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-	-	-	-
277	F	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-	-	-	-
278	M	28	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**136**	-	-	-	-	-	-	32	-	-	-	-
279	F	28	1.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
280	F	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	-	-	-	-	-	-
281	M	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	234	-	-	-	-	-	-
282	M	69	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
283	F	64	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1.5**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
284	F	30	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
285	M	44	-	-	-	-	-	-	-	-	-	-	-	-	-	**10.2**	**17.8**	-	-	-	-	**36.3**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
286	F	44	-	-	-	-	-	-	-	-	-	-	-	-	-	**10.2**	**17.8**	-	-	-	-	**36.3**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
287	M	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	274	-	-	-	-	-	-
288	M	50	-	-	-	-	-	-	-	-	-	-	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1080	-
289	F	48	-	-	-	-	-	-	-	-	-	-	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Annex 1. Adults' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
290	F	22	-	-	-	-	-	-	-	-	-	-	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
291	F	21	-	-	-	-	-	-	-	-	-	-	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
292	M	19	-	-	-	-	-	-	-	-	-	-	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
293	M	17	-	-	-	-	-	-	-	-	-	-	-	-	**5.7**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
294	M	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	243
295	M	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	548
296	F	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	628
297	M	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	730
298	M	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	91
299	F	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	91
301	M	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-
302	M	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-
303	F	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	-	136	-	-	-	-	-	-
304	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	-	-	-	80	225	-	-	-	-
305	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	-	-	-	-	225	-	-	-	-
306	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	-	-	-	-	225	-	-	-	-
307	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	-	-	-	-	225	-	-	-	-
308	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	-	-	-	-	225	-	-	-	-
309	M	U	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	225	-	-	-	-	225	-	-	-	-

Notes

U - Unknown

Emboldened observations are the high-rate individuals

Annex 2. Children's and infants' consumption rates (kg y^{-1} or l y^{-1}) and occupancy rates (h y^{-1}) in the Chapelcross area

Observation number	Sex	Age (years)	Fish	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Pig meat	Intertidal occupancy over mud and sand	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
Child age group (6 - 15 years old)																		
18	F	9	-	-	9.5	4.3	5.3	**11.1**	3.0	-	-	-	-	-	-	-	-	-
19	F	7	-	-	0.5	0.2	1.5	-	1.5	-	-	-	-	-	-	-	-	-
22	F	14	-	-	-	-	-	**13.7**	0.5	-	-	-	-	-	-	-	-	-
23	M	9	-	-	-	-	-	**13.7**	0.5	-	-	-	-	-	-	-	-	-
26	M	13	-	-	-	-	-	-	-	**75.4**	-	-	-	-	-	-	-	-
27	M	11	-	-	-	-	-	-	-	**75.4**	-	-	-	-	-	-	-	-
28	M	11	-	-	-	-	-	-	-	**75.4**	-	-	-	-	-	-	-	-
29	F	6	-	-	-	-	-	-	-	37.7	-	-	-	-	-	-	-	-
36	M	12	-	-	-	-	-	-	0.2	-	-	-	-	-	-	-	-	-
44	F	13	-	-	**35.8**	**19.3**	**58.8**	**15.1**	**20.8**	-	-	-	-	-	-	-	-	-
49	M	7	-	-	3.0	0.1	3.4	**27.1**	**13.6**	-	-	-	-	-	-	-	-	-
53	F	10	-	-	-	-	-	-	-	-	-	-	-	-	**39**	-	-	-
98	F	11	-	-	-	-	-	-	-	-	-	-	-	-	-	1002	6	-
99	M	9	-	-	-	-	-	-	-	-	-	-	-	-	-	1002	6	-
112	M	7	-	-	-	-	-	-	-	**219.0**	-	-	-	-	-	-	-	-
121	F	6	-	-	-	-	-	-	-	26.0	**18.6**	-	**5**	-	-	-	-	-
139	M	9	-	-	-	-	-	-	-	-	-	**36**	-	-	-	-	-	-
140	F	7	-	-	-	-	-	-	-	-	-	**36**	-	-	-	-	-	-
143	M	10	-	-	-	-	-	-	-	-	-	-	-	**12**	-	-	-	-
189	M	13	-	-	-	-	-	-	-	36.5	-	-	-		-	-	-	-
249	M	12	1.1	**0.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
250	M	12	1.1	**0.4**	-	-	-	-	-	-	-	-	-	-	-	-	-	-
260	M	15	**3.9**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
261	F	13	**2.9**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
300	M	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45
Infant age group (0 - 5 years old)																		
144	M	5	-	-	-	-	-	-	-	-	-	-	-	**12**	-	-	-	-
145	M	5	-	-	-	-	-	-	-	-	-	-	-	**12**	-	-	-	-
146	M	3	-	-	-	-	-	-	-	-	-	-	-	**12**	-	-	-	-
154	F	1	-	-	-	-	-	-	-	-	-	-	-	-	-	7640	84	-
166	F	3	-	-	-	-	-	**15.5**	-	-	-	-	-	-	-	-	-	-

Notes

U - Unknown

Emboldened observations are the high-rate individuals

Annex 3. Combinations of adult pathways for consideration in dose assessments in the Chapelcross area

Combination number	Fish	Crustaceans	Marine plants/algae	Wildfowl	Green vegetables	Other vegetables	Root vegetables	Potato	Domestic fruit	Milk	Cattle meat	Pig meat	Sheep meat	Poultry	Eggs	Wild/free foods	Rabbits/hares	Honey	Wild fungi	Venison	Freshwater fish	Intertidal occupancy over mud and sand	Intertidal occupancy over mud and stones	Intertidal occupancy over mud, sand and stones	Intertidal occupancy over mud	Intertidal occupancy over sand	Intertidal occupancy over sand and stones	Intertidal occupancy over salt marsh	Handling fishing gear	Handling sediment	Occupancy on water	Indoor occupancy within the direct radiation survey area	Outdoor occupancy within the direct radiation survey area	Pipeline occupancy
1										X					X																			
2	X				X	X	X	X	X							X			X															
3				X	X	X	X	X	X		X	X		X	X	X	X				X				X					X					
4	X			X																					X	X		X		X	X				
5					X	X	X	X		X						X																			
6						X		X								X																X	X		
7					X	X								X																		X	X		
8	X			X																				X	X					X	X				
9						X			X						X				X													X	X		
10	X																									X		X	X		X				X
11																						X													X
12															X																	X	X		X
13	X				X	X		X							X																	X	X		
14					X		X			X			X																						
15									X	X			X						X							X									
16					X	X	X	X	X		X	X	X		X	X			X																
17	X															X			X									X							
18																											X								
19	X		X	X												X										X		X	X	X	X				
20	X									X						X																			
21	X																	X																	
22	X				X	X		X	X		X	X	X		X	X			X																
23		X																											X		X				
24	X															X										X									X
25				X																					X	X			X	X					
26	X																								X	X			X	X					
27	X																						X							X					
28														X	X					X																
29													X																					X		

Notes

The food groups and external exposure pathways marked with a cross are combined for the corresponding combination number. For example, combination number 1 represents an individual (or individuals) from Annex 1 who had positive data in the following pathways; milk and eggs.