Sellafield Ltd

Annual Review of Environmental Performance **2024/25**

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1. Introduction

This publication outlines the variety of ways in which Sellafield Ltd. monitor our impacts on the environment, providing balanced information across a range of impact types.

2. Carbon footprint 2024/25

Sellafield Ltd. continues work across the business to manage carbon emissions in-line with our Carbon Management Transition Plan. Our carbon footprint is measured annually and externally verified.

The organisation's direct emissions (Scope 1 and 2) for FY 2024/25 are in the region of 171,000 tonnes of CO_2e, an estimated 41% below our Carbon Management Plan 'business as usual' trajectory. These emissions are primarily attributed to the electricity and steam used in the processing and storage of nuclear materials and waste, and for nuclear decommissioning.

In common with other businesses, Sellafield Ltd. is working to increase the quality of primary data reported for indirect emissions (Scope 3). We have reported emissions associated with business travel and commuting on an annual basis for several years and are making phased improvements to include other key indirect emissions data within our annual reporting. For FY 2024/25 the verified proportion of our Scope 3 emissions is estimated to be 60,000 tonnes CO_2e, including data for well-to-tank, transmission & distribution, and non-radiological waste (baseline total annual indirect emissions for Sellafield based on expenditure have previously been estimated as approximately 600,000 tonnes of CO_2e).

Continual improvement of carbon emissions data supports our understanding of progress against our long-term carbon reduction targets.

3. Non-radiological impacts of discharges and monitoring of non-radiological pollutants in the environment 2024 (calendar year)

The Installations Permit includes a requirement for a non-radiological monitoring programme. Compared to the radiological environmental monitoring programme, its scope is limited and comprises local air sampling on the Sellafield site, water sampling from the Rivers Calder and Ehen and seawater sampling from local beaches. Data are provided in the Appendix. A more comprehensive summary of non-radioactive releases to air, controlled waters, land and off-site transfers of waste is given in the Pollution Inventory supplied to the Environment Agency each year and is available from their website.

Measurements of nitrogen dioxide concentrations in air (using passive diffusion tubes) are made at five locations on the Sellafield site. Air sampling results show very low concentrations well within the UK Air Quality Standard [1].

Water samples are obtained from the Rivers Calder and Ehen at locations both upstream and downstream of the site. The downstream samples are taken above the confluence of the two rivers, and at times which minimise contamination with seawater. Seawater samples are obtained from the shoreline areas and confirm that the aqueous discharges from Sellafield are not causing the Environmental Quality Standards (EQS) and Environmental Assessment Levels (EAL) [2] to be exceeded and are therefore of negligible impact.

Sellafield Ltd. is committed to minimising the use of ozone depleting substances and fluorinated greenhouse gases and transitioning to more environmentally friendly alternatives where appropriate. Routine releases are estimated from the amounts of refrigerants used to top-up systems on site.

4. Monitoring of Sellafield's landfill sites 2024 (calendar year)

The Waste Management Licences for the North Landfill Site and Calder Floodplain Landfill Extensions require that environmental monitoring be carried out in the vicinity of the two sites. The monitoring comprises water sampling from the River Calder and New Mill Beck upstream and downstream of the landfills and gas monitoring over their surfaces. The results confirm that the impact of Sellafield's landfill sites remains negligible.

5. Radiological dose impacts 2024 (calendar year)

This report provides a summary of the comprehensive data that are available for inspection by members of the public on the Public Registers maintained by the Environment Agency. The full dataset is provided in the Appendix. Data on foodstuff consumption and occupancy rates were obtained from the comprehensive habit survey conducted on behalf of the environmental regulators by the Centre for Environment, Fisheries and Aquaculture (CEFAS) in 2023 [3] supplemented by an annual update of marine foodstuff consumption conducted in 2024 [4]. Supplementary data on terrestrial monitoring were obtained from the RIFE report for 2023 [5].

There were no instances of non-compliance with the numerical limits of permits regulating discharges and disposals of radioactive wastes at Sellafield in 2024. Radioactive discharges (aqueous and gaseous) were well below the permitted limits and were generally lower than those in 2023. Significant reductions in tritium, carbon-14 and krypton-85 occurred following the cessation of Magnox fuel reprocessing in July 2022. Krypton-85 has been removed from the Radioactive Substances Activities (RSA) Environmental Permit for the Sellafield site.

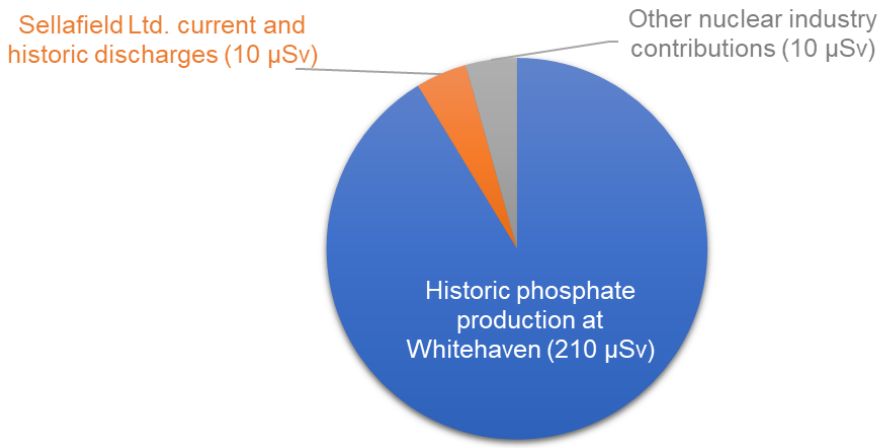
The estimated radiological doses to members of the public are summarised in the table below. The 'representative person' concept is considered equivalent to the previously used 'critical group'. Operations at Sellafield Ltd. were estimated to give a dose of 49 μSv to the marine representative person, which is slightly lower than the dose estimated for 2023 (58 μSv). The most significant radionuclides contributing to the seafood consumption dose were plutonium-alpha and americium-241, with the environmental concentrations of these radionuclides being mostly due to historic discharges and therefore changes in dose year on year reflect natural environmental variations.

The estimated dose to the terrestrial representative person due to the consumption of terrestrial foodstuffs was about 6 μSv. The total dose to the terrestrial representative person was estimated as 14 μSv which is similar to the dose reported for 2023.

Representative person doses from operations at Sellafield (µSv)		
Pathway	**2023**	**2024**
Marine representative person (adults)		
seafood consumption	20	13
aerial pathways	1.6	1.6
external radiation from beach occupancy (marine)	36	34
Total dose to marine representative person (adults)	**58**	**49**
Terrestrial representative person (adults)		
inhalation	0.56	0.55
external radiation from beach occupancy (terrestrial)	4.3	3.8
terrestrial foodstuff consumption	5.6	5.9
marine foodstuff consumption	0.48	0.43
direct radiation	3.8	2.9
Total dose to terrestrial representative person (adults)	**15**	**14**

The range of annual doses estimated herein are comparable to those from regulators' programme and consistent conclusions are made that doses are well below the legal limit of 1,000 µSv [6]. The regulators estimated that the total dose to adult crustacean consumers in 2023 in West Cumbria would be 230 µSv with approximately 210 µSv of this dose being from historic discharges to the Irish Sea from the phosphate production works at Whitehaven [5]. The contribution of Sellafield Ltd. discharges to the annual dose received by adult crustacean consumers has been estimated by both the regulators sampling [5] and equivalent sampling conducted by Sellafield Ltd. (reported herein) to be less than 10 µSv. The dose estimates presented in this report for 2024 related to Sellafield Ltd. operations are broadly comparable to those made by the regulators for 2023, although here assumptions about habits are applied relevant to assessing dose from the Sellafield site, rather than from all sources of man-made radiation in Cumbria. Doses from all sources of man-made radiation in Cumbria are dominated by the historical legacy of enhanced naturally-occurring radioactivity from phosphate production in Whitehaven [5].

Contributions to annual dose to West Cumbria crustacean consumers [5]

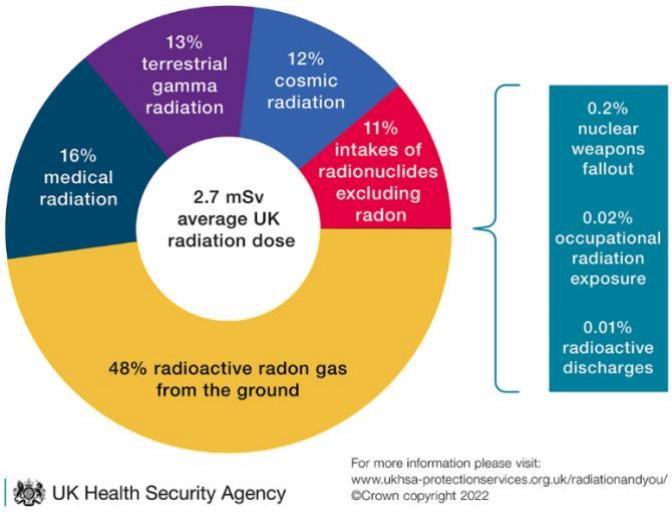


The distributions of caesium-137 and americium-241 activities for particles and larger objects recovered by the beach monitoring programme in 2024 were within the ranges previously observed and considered in the health risk assessment associated with public beach occupancy.

Independent environmental monitoring programmes and dose assessments are carried out and reported by government agencies and other groups [7–10].

Sellafield Ltd. has contributed to a number of initiatives that developed criteria for the protection of the natural environment and carried out assessments of exposure against the guidelines given in national and international publications. In 2023 the UK Health Security Agency (UKHSA) published a scientific paper on the impact of Sellafield discharges on biota [11]. They concluded that all current dose rates to marine and terrestrial biota were below the Derived Consideration Reference Level (DCRL). On the basis of work to date there is no reason to believe that radioactive discharges from Sellafield Ltd. are harming the natural environment and the dose assessments presented herein focus on the protection of human health.

The following visual is included as it is illustrative of the comparable dose impacts of Sellafield discharges versus various other sources of radiation exposure by the general public in the UK.



The measurements in this report relate to environmental radioactivity that is mainly attributable to discharges from the Sellafield site. However, natural radioactivity makes an appreciable contribution to the reported values in some instances, and it is important to recognise that natural radioactivity is the dominant source of radiation exposure to the population as a whole, including individuals living close to nuclear establishments.

In addition, the widespread radioactive fallout from the testing of nuclear weapons and from the Chernobyl accident make small contributions to overall doses. The subject has been reviewed comprehensively by the UK Health Security Agency [12,13] and others [14]. Any corrections to account for background radiation have been noted.

In summary

The impacts of radioactivity in the environment local to Sellafield remain low, as per recent years, with only a small portion of this already low impact attributable to present operations on the site. In contrast to earlier points in the site's history, the primary value of this extensive programme of environmental monitoring (in particular with respect to radioactivity in the environment) has moved on from measuring the impacts of the site's ongoing activities to:

- providing reassurance to both the public and other stakeholders,
- demonstrating compliance with both international obligations and our EPR (Environmental Permitting Regulations) permits - which directly place requirements on our environmental monitoring programme, and
- providing reassurance monitoring to Sellafield Ltd. ourselves, by allowing the detection of any abnormal or fugitive releases to the environment.

6. Monitoring for radioactivity in the environment 2024 (calendar year)

Statutory environmental monitoring programme

The statutory environmental monitoring programme provides public and stakeholder assurance that the environmental impacts of the Sellafield site are minimised according to the principles of Best Available Techniques (BAT). A BAT review of the environmental monitoring programme was submitted to the Environment Agency in January 2024 and the Environment Agency confirmed their agreement with the majority of the recommendations in December 2024.

In terms of radiological protection, the statutory environmental monitoring programme has the following remit:

- to take account of the most important pathways of radiation exposure to the public,
- conduct appropriate sampling and analysis relevant to those pathways, and
- to combine monitoring and habits data to yield estimates of radiation doses to the public.

The results of the 2024 environmental monitoring programme are presented within the Appendix of this report alongside supplementary data published by the Food Standards Agency (from 2023) [5]. The main pathways identified by Sellafield Ltd., the Environment Agency and Food Standards Agency as relevant to calculating radiological doses from discharges from the Sellafield site are:

- internal exposure from the high-rate consumption of seafood (particularly crustaceans and shellfish) and of local agricultural produce,
- external gamma radiation from exposed intertidal sediments, particularly the silts and muds of estuaries and harbours,
- direct radiation from the Sellafield site, and
- inhalation of, and exposure to, airborne radioactivity.

Marine monitoring

Concentrations of radionuclides in seafoods (fish, molluscs and crustaceans) were very low and comparable to previous years data. Concentrations of radioactivity in seaweed, seawater and in sediments were broadly similar to those of recent years with variations reflecting natural processes that transport sediment along the coast.

Gamma dose rate surveys are carried out in the areas most often frequented by members of the public and the site perimeter and the surrounding district. Particular attention is paid to areas where silt or mud accumulates, such as in harbours or estuaries, where dose rates tend to be higher because of the presence of fine-grained sediments. In general, gamma dose rates are declining towards background levels and are consistent with the radioactive decay of key gamma emitting radionuclides (cobalt-60, ruthenium-106 and caesium-137).

Freshwater monitoring

Water samples are collected from rivers (Calder and Ehen), lakes and domestic supplies. The results are all very low and rarely above the limits of detection, except for strontium-90 which is generally present in rainwater and surface water at levels typical of those throughout the UK.

Higher strontium-90 concentrations are measured in the River Calder at Sellafield due to seepage of groundwater from site to the river. This radionuclide is thought to be present due to the historic leaks to ground and measurements have determined that elevated concentrations in the river begin to occur immediately upstream of the statutory sampling point. There is no evidence of any elevated levels of strontium-90 in any other environmental media (seawater or seafoods) and the contribution of strontium-90 to external doses is minimal. Hence, the overall public dose consequences of these elevated levels would be insignificant. Nevertheless, a watching brief will be kept on the situation to ensure that these conclusions remain valid.

Terrestrial monitoring

High volume air samplers (HVAS) are generally located close to the site perimeter and in nearby centres of population and are used to measure particulate radionuclides. Levels at all locations were generally similar to previous years.

Total deposition collectors, grass plots and soil sampling plots are located in the vicinity of each of the five high volume air samplers close to the site perimeter. Measurements were similar to those collected over recent years with total deposition, grass and soil measurements in 2024 showing elevated concentrations of caesium-137 and strontium-90 at the North Gate sampling site. This sampling site is located closer to the centre of the Sellafield site and is typically downwind of the Open Fuel Storage Ponds.

Milk results for 2024 are broadly similar to, or lower than, those observed for previous years, with many analyses reported at the limit of detection. Potatoes are collected from farms close to the site and rabbits are collected on site. Measured concentrations were very low and typical of data from recent years.

Direct radiation

Dose rates at the site perimeter, corrected for natural radiation, averaged 0.01 μGy per hour, which is slightly elevated over natural background. Dose rates in the surrounding district were consistent with natural terrestrial background radiation and did not show a significant contribution from the Sellafield site. An assessment of the maximum theoretical direct shine offsite dose to members of the public illustrated that doses could be approximately 2.9 μSv per year to people living adjacent to the site boundary. This assessment is a slight decrease from the direct radiation dose for 2023 (3.8 μSv) due to a small reduction in the dose rate at the perimeter monitoring site closest to the nearest residential location.

Beach monitoring

The beach monitoring programme for 2024 conducted a total of 118 hectares of beach monitoring against the programme target of 105 hectares. A total of 42 particles and 9 larger objects were detected, recovered, and analysed. Of these, 38 were alpha-rich particles (where radioactivity was dominated by americium-241) and four were beta-rich particles (where

radioactivity was dominated by caesium-137). Eight beta-rich larger objects were recovered from Sellafield beach and a single beta-rich object was recovered from Braystones beach. Find rates and radioactive contents in 2024 did not require any form of intervention through the Environment Agency notification and intervention protocol [15].

Impacts on local groundwater

Sellafield Ltd. undertakes groundwater monitoring to characterise and monitor groundwater quality and the environmental fate of in-ground contamination across the site. The management of contaminated groundwater is underpinned by a Best Available Technique (BAT) assessment with the current best option (reassessed in FY 2023/24) to characterise groundwater properties, monitor changes in distribution and concentrations of substances and develop the hydrogeological model where relevant. This has led to an objective-based programme which determines the extent of the network used, the analytes and groundwater properties to be measured, along with testing and sampling frequencies.

The groundwater monitoring network for 2024 included 251 sample points (excluding surface water sample points, e.g. beach seepages and riverbed seepages) across the site and adjacent land, targeting both bedrock (sandstone - principal aquifer) and superficial deposits (secondary aquifer). This was designed to meet the monitoring objectives and provide targeted sampling in areas of interest.

The groundwater samples with the highest radiological activity concentrations were predominantly collected from monitoring wells within Separation Area. The general location of the contamination remained similar to previous years' but there was a slight decrease in activity concentrations observed site-wide. Radiological contamination is present both within the upper and lower groundwater, particularly local to the Magnox Swarf Storage Silo and the High Activity Liquor Evaporation and Storage plant. Radiological activity concentrations are very low in groundwater to the east of the River Calder. The distribution of non-radioactive contaminants has been consistent over time. Seawater is present in some groundwater monitoring wells closer to the coast.

The Magnox Swarf Storage Silo is the largest source of in-ground contamination at the site. A leak was declared in late 2019 and a programme of enhanced environmental monitoring instigated. This has undergone continuous refinement based on the observed results, with the most recent iteration being embedded within the routine groundwater monitoring programme. Chlorine-36 and carbon-14 are the key indicators of the 2019 leak; concentrations in shallow groundwater began to increase around 2021 but had dropped substantially by 2023 and have remained consistent at lower activity concentrations during 2024. In deep groundwater concentrations of chlorine-36 and carbon-14 began to increase around 2022 but decreased in 2024. Enhanced monitoring of the River Calder has not detected chlorine-36 or carbon-14. Although the movement of the leak through groundwater can be measured, the overall concentrations of radionuclides are very low in the context of the World Health Organisation Drinking Water Guideline Levels. The first phase of a project is underway to install continuous dataloggers which measure groundwater parameters for use as proxies to assess changes in contaminant concentrations and groundwater dynamics over time.

7. Impacts of solid waste dispositions 2024/25

Ensuring that the Best Available Technique waste route is used and diverting waste from the Low Level Waste Repository and non-radioactive waste landfills continues. The Waste

Operating Unit has reduced the accumulation of waste stored on site by transferring radioactive waste to interim stores, the onsite landfill, despatched waste offsite for treatment, incineration or if there are no other routes, for the waste to be consigned to the repository or non-radioactive waste landfills.

Historically, the majority of low activity waste (95%) was disposed of at the Low Level Waste Repository with the remainder being diverted, however by 2021 this trend was reversed with only 2% being disposed and 98% being diverted. Exceeding the target for the diversion of waste is therefore a positive outcome as it demonstrates increased volumes of waste being removed from the Sellafield site. However, the Waste Operating Unit recognises the importance of good quality forecasts to provide certainty for the supply chain, demands on resources, to inform decision making for new capability and storage requirements; improvement works are now underway in this regard.

Targets for waste diversion/disposal are set by Nuclear Waste Services (NWS) and Sellafield Ltd. in the Joint Waste Management Plan (NWS/JWMP), and by the Waste Operating Unit Master Production Schedule (MPS). In FY 2024/25 the targets for metallic, combustible and low-level waste were met. The very low level waste (VLLW) target covers two measures, onsite disposals at the Calder Landfill Extension Segregated Area (CLESA) and offsite disposals via the Nuclear Waste Services framework. The CLESA target was 4,000 m^3 and the actual disposals at year end were 2,187 m^3; disposals were lower than forecast due to a number of reasons such as projects not generating the waste as planned and some wastes not meeting the conditions for acceptance so alternative waste routes were utilised instead. The offsite disposals target was 177 m^3 and actual disposals were 329 m^3, so that element of the forecast was exceeded due to disposal of more VLLW from across the site from such as the Waste Parks and demolition projects. For FY 2025/26, the JWMP and MPS forecasts continue to be aligned, with some waste streams having stretch targets in place to reduce inventory further across the Sellafield site.

Diversion/disposal route	NWS/JWMP target	Waste Operating Unit MPS target	Actual
Metallic (tonne)	750*	750	1,801
Combustible (m^3)	2,150	2,150	2,469
Very low level waste (m^3)	4,177	4,177	2,516
Sort and segregation (m^3)	0	0	38
Low level waste disposal (containers)	10	10	10
Intermediate level waste to low level waste (m^3)	0	0	0.65

* The forecast produced for NWS included what Sellafield Ltd. believed would be sent to Cyclife under ‘Mixed Metals’. ‘Exempt Metals’ were not included in the forecast as a contract was not in place at that time. Both ‘Mixed Metals’ and ‘Exempt Metals’ are included in the actual disposal.

In FY 2024/25 a recycling and recovery rate of 97.8% was achieved for all non-radioactive waste, surpassing the target set for the year of 80% or greater.

The Waste Operating Unit also oversees the assets process which is a key part of how Sellafield Ltd. keeps items in use and supports the circular economy. Funds from the sale of the assets are put back into the Nuclear Decommissioning Authority. In total 48 batches went through the assets process including locomotives, furniture, forklift trucks, generators, isofreights and various miscellaneous items.

8. References

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Environmental Monitoring Location Figures

Figure 1. Marine environmental monitoring around Sellafield

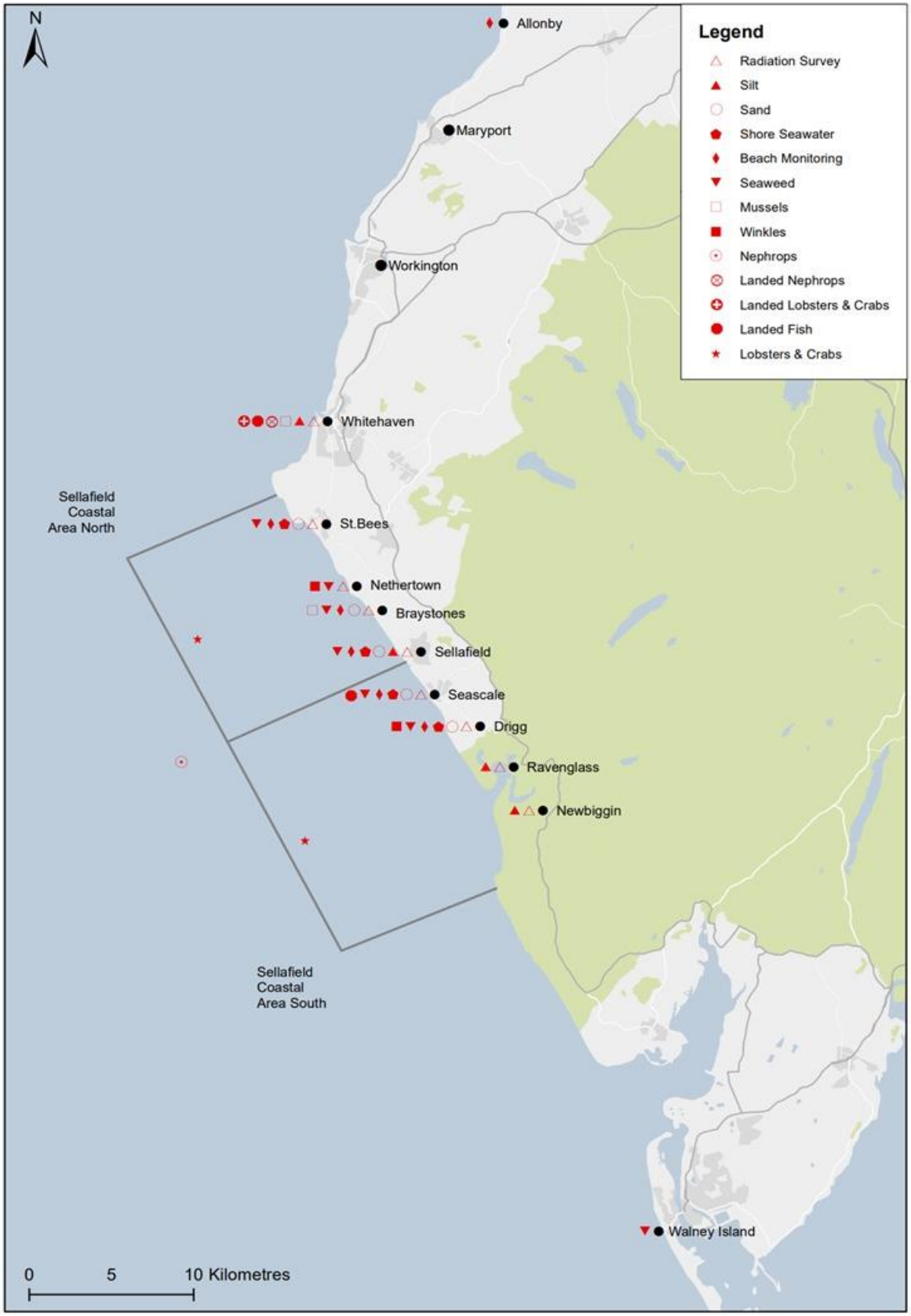


Figure 2. Terrestial environmental monitoring around Sellafield

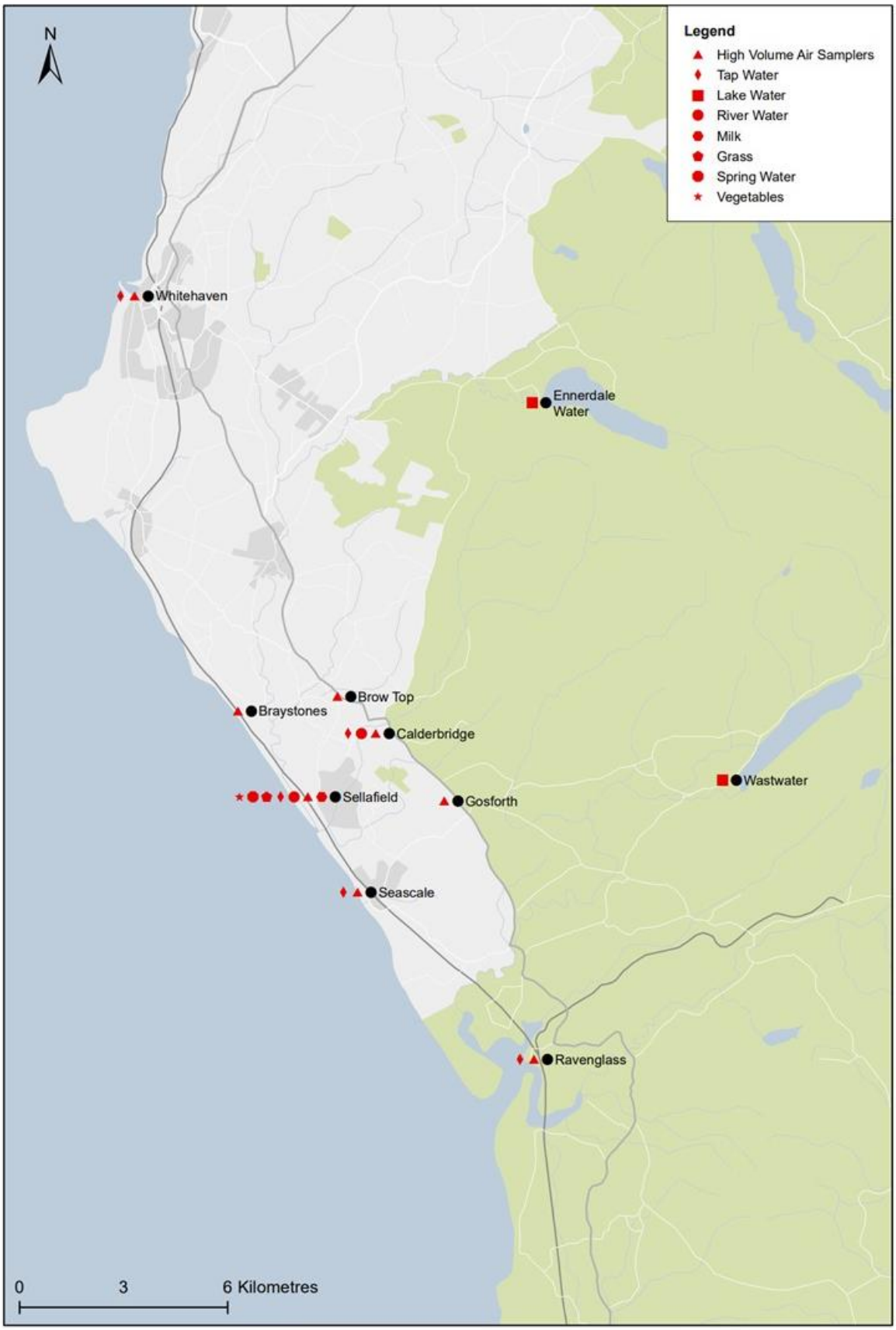
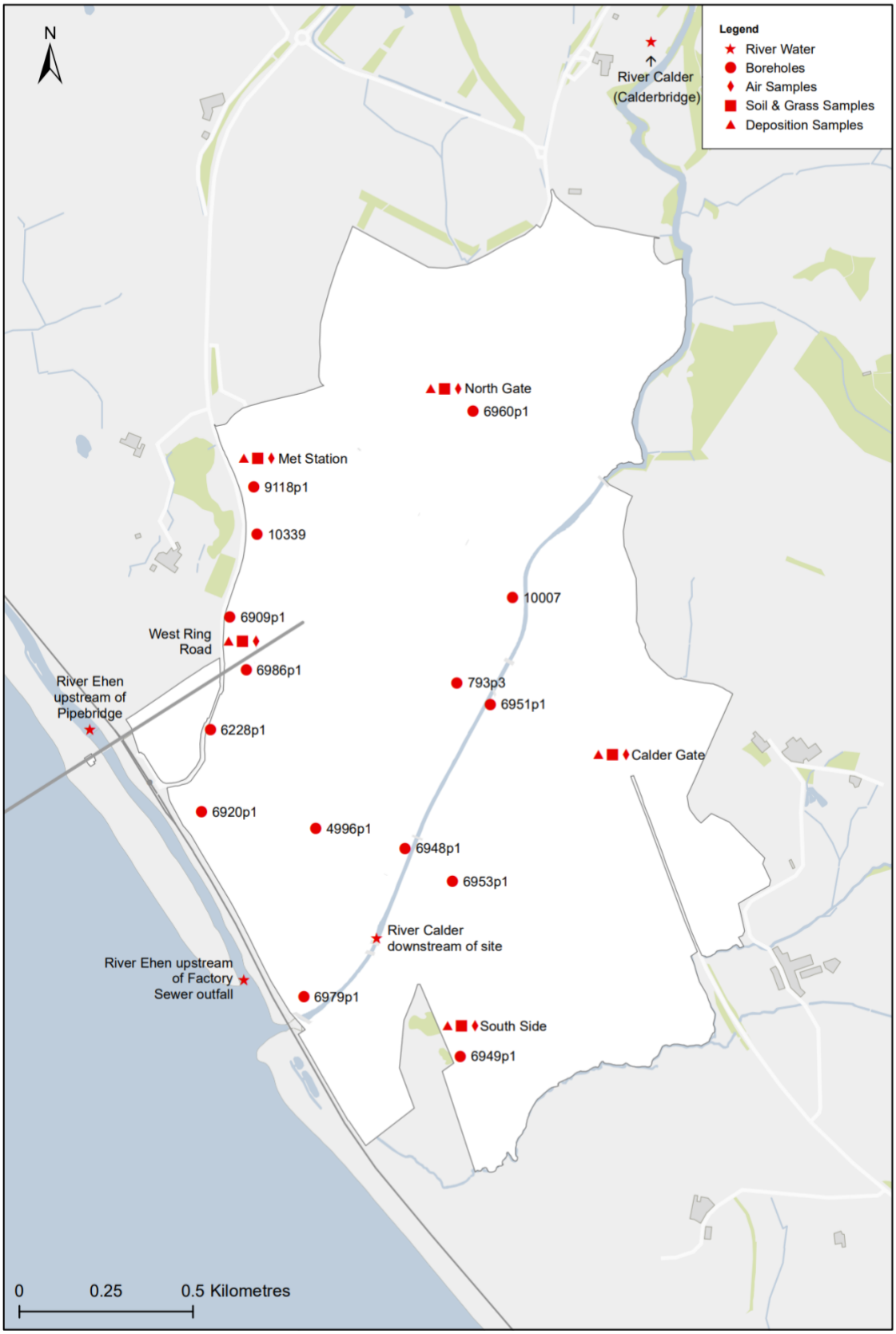


Figure 3. Environmental monitoring at the Sellafield site



Discharge Data Tables

Table 1. Radioactive discharges to the Irish Sea, 2020 – 2024

Radionuclides	Annual discharge (TBq)					Annual Limits
	2020	2021	2022	2023	2024	
Tritium	190	180	130	9.7	4.8	700
Carbon-14	1.2	1.3	0.85	0.10	0.07	5.1
Cobalt-60	0.02	0.01	0.01	0.01	0.01	2.5
Strontium-90	1.4	2.4	1.8	1.3	1.6	14
Technetium-99	0.62	0.48	0.35	0.07	0.13	4.5
Ruthenium-106	0.27	0.17	0.16	0.17	0.10	3.1
Iodine-129	0.03	0.02	0.02	0.02	0.008	0.32
Caesium-137	2.5	1.4	1.3	1.06	1.1	17
Plutonium-alpha	0.10	0.08	0.07	0.07	0.05	0.29
Plutonium-241	1.1	0.83	0.73	0.63	0.41	6
Americium-241	0.01	0.01	0.01	0.01	0.007	0.14
Total alpha	0.12	0.09	0.08	0.08	0.06	0.34
Total beta	7.1	7.4	6.5	5.2	4.4	63
Uranium	0.006	0.005	0.004	0.004	0.001	0.02

Annual limits are the lower tier permit limits.

Table 2. Total airborne radioactive discharges, 2020 – 2024

Radionuclides	Annual discharge (GBq)					Annual Limits
	2020	2021	2022	2023	2024	
Strontium-90	0.01	0.004	0.003	0.003	0.003	0.50
Ruthenium-106	0.55	0.55	0.61	0.63	0.57	2.8
Antimony-125	1.1	0.53	0.41	0.005	-	30 / no limit
Iodine-129	2.1	1.8	1.8	1.3	1.2	13
Caesium-137	0.08	0.05	0.04	0.06	0.04	4.8
Plutonium-alpha	0.01	0.009	0.006	0.007	0.01	0.13
Americium-241 + Curium-242	0.01	0.009	0.009	0.010	0.02	0.084
Total alpha	0.10	0.07	0.07	0.06	0.07	0.66
Total beta	0.74	0.70	0.90	0.64	0.57	32

Annual limits are the lower tier permit limits. The limit for antimony-125, and the associated reporting requirements, were removed on 31 March 2023.

Table 3. Total airborne radioactive discharges, 2020 – 2024

Radionuclides	Annual discharge (TBq)					Annual Limits
	2020	2021	2022	2023	2024	
Tritium	38	39	15	0.13	0.07	170
Carbon-14	0.13	0.07	0.09	0.06	0.06	0.38
Krypton-85	4,300	4,300	2,500	7.3	-	70,000 / no limit

Annual limits are the lower tier permit limits. The limit for krypton-85, and the associated reporting requirements, were removed on 31 March 2023.

Table 4. Solid low level waste arisings from Sellafield, 2020 – 2024

Low level waste arisings (m^3)	2020	2021	2022	2023	2024
LLW produced on site which has been reused, recycled or disposed of	5,100	12,000	8,200	6,000	6,600
LLW metal waste recycled	1,700	140	800	700	870
Combustible LLW treated	2,500	2,100	2,400	1,800	2470
LLW disposed of directly to landfill (as LLW, HV-VLLW or exempt waste but excluding waste that is out of scope of regulation)	210	400	320	100	330
LLW disposed of on site	600	9,300	4,000	3,200	2,200
Volume of LLW disposed of at LLWR	520	80	300	600	190

Table 5. Non-radioactive aqueous waste discharges (kg), 2020 – 2024

Substance	Release points	2020	2021	2022	2023	2024	Annual Limit
Chromium	SIXEP, SETP, EARP	14	4.1	13.7	23.5	189	1,200
N as NO_2 and NO_3	SETP, EARP	410,000	590,000	311,000	244,000	143,000	4,080,000
N as NO_2 and NO_3	Thorp-C14 Removal Plant	110	260	55	0	0.95	26,900
Glycol	SETP, SIXEP, EARP, Lagoon	2,000	3,400	9,800	9,710	11,000	12,000 / no limit

The limit for glycol was removed during 2024.

Table 6. Non-radioactive gaseous waste discharges (kg), 2020 – 2024

Substance	Release points	2020	2021	2022	2023	2024	Annual Limit
Oxides of nitrogen (as NO_2)	Vitrification Test Rig	43	48	26	23	40.3	1,000
Oxides of nitrogen (as NO_2)	NNL Central Laboratory	5.4	7.3	2.2	8.8	8.7	500
Particulate matter	Fellside CHP (as PM_{10})	190	160	324	425	306	-

Table 7. Site total (including Fellside CHP plant) non-radioactive gaseous waste discharges (tonne), 2020 – 2024

Substance	2020	2021	2022	2023	2024
Oxides of nitrogen (as NO_2)	180	83	90	68	68
Carbon dioxide	260,000	137,000	156,000	125,000	150,000
Carbon monoxide	17	6.9	14	12	7.5
Non-Methane Volatile organic compounds	23	23	22	22	22
Methane	14	10	7.99	9.52	10.72

EA agreed carbon monoxide reporting value as discharges are significantly below reporting threshold values.

Table 8. Discharges of ozone depleting substances and fluorinated greenhouse gases (kg), 2020 – 2024

Substance	2020	2021	2022	2023	2024
R22 HCFC	-	-	0.5	9	7
R134A HFC	320	203	1284	130	-
R407C HFC	100	70	39	81	74
R404A HFC	-	7	2.1	0.9	5.5
R410A HFC	42	56	80	218	79

HCFCs are ozone depleting substances and HFCs are fluorinated greenhouse gases.
Note: the range of substances discharged varies each year depending on which equipment is topped up with refrigerants. No annual mass limits apply.

Table 9. Non-radioactive solid waste arisings from Sellafield, 2020 – 2024

	Non-Radioactive Waste Arisings (te)	2020	2021	2022	2023	2024
Non-Hazardous Waste Arisings	Non-hazardous waste produced on site	43,000	22,000	24,000	20,000	54,000
	Non-hazardous waste reused or recycled	30,000	21,000	24,000	20,000	54,000
	% of non-hazardous waste reused or recycled	69%	94%	>99%	99%	>99%
Hazardous Waste Arisings	Hazardous waste produced on site	2,900	1,700	1,400	1,000	1,400
	Hazardous waste reused or recycled	170	290	135	120	140
	% of hazardous waste reused or recycled	5.8%	17%	9.8%	11%	10%

Whilst every effort is made to centrally record all Non-Rad waste arisings, some sub-contractors may not provide this information, so the actual quantity produced may be higher than the centrally recorded figure. Note that no annual mass limits apply.

Environmental Monitoring Data

Table 10. Radioactivity in fish (Bq kg^{-1} wet weight), 2024

Species	**Location**	**Mean radionuclide concentration (Bq kg^{-1} wet weight)**				
		Total ^{14}C	**^{99}Tc**	**^{137}Cs**	**Pu(α)**	**^{241}Am**
Cod	Seascale landed	26	0.15	1.4	0.002	0.003
	Whitehaven landed	29	0.36	1.5	0.0008	0.002
Plaice	Seascale landed	37	0.89	1.0	0.004	0.01
	Whitehaven landed	35	0.57	0.95	0.02	0.03

Table 11. Radioactivity in molluscs (Bq kg^{-1} {wet weight}), 2024

Species	Location	Mean radionuclide concentration (Bq kg^{-1} wet weight)																
		Total **Alpha**	**Total Beta**	**Total ^{14}C**	**^{60}Co**	**^{90}Sr**	**^{99}Tc**	**^{106}Ru**	**^{129}I**	**^{137}Cs**	**U(α)**	**^{237}Np**	**Pu(α)**	**^{238}Pu**	**$^{239+240}$Pu**	**^{241}Pu**	**^{241}Am**	**Cm(α)**
Mussels	SCAN - A	-	-	40	-	0.15	18	-	-	-	1.0	-	2.6	0.39	2.3	8.1	6.4	-
	SCAN - B	18	67	-	0.31	-	-	<0.79	-	0.96	-	-	-	-	-	-	6.0	-
	SCAN - B	22	56	-	0.18	-	-	<0.65	-	1.0	-	-	-	-	-	-	5.8	-
	SCAN Ave.	20	62	40	0.25	0.15	18	<0.72	-	0.98	1.0	-	2.6	0.39	2.3	8.1	6.1	-
	WH - A	-	-	33	-	0.82	7.3	-	-	-	1.2	-	2.2	0.35	1.8	5.9	4.0	-
	WH - B	25	50	-	<0.08	-	-	<0.78	-	0.79	-	-	-	-	-	-	3.5	-
	WH - B	27	49	-	<0.07	-	-	<0.63	-	0.63	-	-	-	-	-	-	3.4	-
	WH Ave.	26	50	33	<0.08	0.82	7.3	<0.71	-	0.71	1.2	-	2.2	0.35	1.8	5.9	3.6	-
	SCA Ave.	**23**	**56**	**37**	**<0.16**	**0.49**	**13**	**<0.71**	**-**	**0.85**	**1.1**	**-**	**2.4**	**0.37**	**2.1**	**7.0**	**4.9**	**-**
Winkles	SCAN - A	-	-	42	-	-	-	-	<0.09	-	-	-	-	-	-	-	-	-
	SCAN - Q	28	77	-	0.24	1.2	18	<0.80	-	2.0	2.2	0.005	4.5	0.73	3.7	14	8.3	<0.05
	SCAN - Q	47	91	-	0.28	0.74	14	<0.87	-	2.3	2.4	0.008	7.1	1.0	6.1	24	13	<0.10
	SCAN - Q	7.3	71	-	0.26	0.62	2.8	<1.2	-	0.63	0.92	0.002	1.2	0.14	1.0	2.6	3.0	<0.03
	SCAN - Q	11	80	-	0.24	0.15	8.8	<0.94	-	1.0	1.6	-	3.1	0.39	2.7	8.5	5.1	0.03
	SCAN Ave	23	80	42	0.26	0.68	11	<0.95	<0.09	1.5	1.8	0.005	4.0	0.57	3.4	12	7.4	<0.05
	SCAS - A	-	-	54	-	-	-	-	<0.12	-	-	-	-	-	-	-	-	-
	SCAS - Q	20	67	-	0.23	0.56	18	<0.72	-	0.96	2.2	0.004	3.1	0.55	2.6	10.0	5.3	0.02
	SCAS - Q	48	100	-	0.23	0.73	15	<0.97	-	2.3	2.7	0.007	8.1	1.1	7.0	26	14	<0.20
	SCAS - Q	11	62	-	0.14	0.11	3.9	<1.3	-	0.82	1.4	0.002	1.9	0.24	1.7	5.3	3.8	<0.08
	SCAS - Q	16	69	-	0.18	0.29	8.5	<0.74	-	1.1	1.7	-	3.4	0.51	2.9	9.2	7.1	<0.05
	SCAS Ave.	24	75	54	0.20	0.42	11	<0.93	<0.12	1.3	2.0	0.004	4.1	0.60	3.6	13	7.6	<0.09
	SCA Ave.	**24**	**77**	**48**	**0.23**	**0.55**	**11**	**<0.94**	**<0.11**	**1.4**	**1.9**	**0.005**	**4.1**	**0.58**	**3.5**	**12**	**7.5**	**<0.07**

Notes: SCA – Sellafield Coastal Area; N – North, S- South, A – Annual sample, B – Biannual sample, Q – Quarterly sample, Ave.- Average.

Table 12. Radioactivity in crustaceans (Bq kg^{-1} wet weight), 2024

Species	Location	Mean concentration (Bq kg^{-1} {wet weight})							
		Total ^{14}C	^{90}Sr	^{99}Tc	^{129}I	^{137}Cs	U(α)	Pu(α)	^{241}Am
Edible Crab	SCA (north) - Early	51	0.05	1.4	-	0.61	0.16	0.28	0.63
	SCA (north) - Late	50	0.04	<0.99	-	0.30	0.19	0.09	0.42
	SCA (north) Average	51	0.05	<1.2	-	0.46	0.18	0.19	0.53
	SCA (south) - Early	48	0.06	1.1	-	0.47	0.14	0.18	0.80
	SCA (south) - Late	49	0.08	1.0	-	0.30	0.13	0.07	0.33
	SCA (south) Average	49	0.07	1.1	-	0.39	0.14	0.13	0.57
	SCA Average	50	0.06	1.1	-	0.42	0.16	0.16	0.55
	WL - Early	63	0.02	3.0	-	0.16	0.14	0.10	0.60
	WL - Late	48	<0.05	1.2	-	0.29	0.16	0.09	0.39
	WL - Average	56	<0.04	2.1	-	0.23	0.15	0.10	0.50
Lobster	SCA (north) - Early	32	-	20	<0.21	0.51	0.03	0.05	0.41
	SCA (north) - Late	46	-	27	<0.19	0.52	0.14	0.13	0.78
	SCA (north) Average	39	-	24	<0.20	0.52	0.09	0.09	0.60
	SCA (south) - Early	35	-	17	<0.22	0.55	0.04	0.08	0.84
	SCA (south) - Late	60	-	54	<0.19	0.72	0.03	0.09	0.63
	SCA (south) Average	48	-	36	<0.21	0.64	0.04	0.09	0.74
	SCA Average	43	-	30	<0.20	0.58	0.06	0.09	0.67
	WL – Early	37	-	5.2	<0.30	0.57	0.03	0.06	0.35
	WL – Late	49	-	27	<0.14	0.55	0.09	0.08	0.46
	WL - Average	43	-	16	<0.22	0.56	0.06	0.07	0.41
***Nephrops* (Scampi)**	SCA – Annual	40	<0.03	-	<0.20	-	-	-	-
	SCA – Early	-	-	17	-	1.3	-	0.67	2.9
	SCA – Late[b]	-	-	7.0	-	0.76	-	0.14	0.53
	SCA Average	40	<0.03	12	<0.20	1.0	-	0.41	1.7
	WL – Annual	35	0.05	-	<0.26	-	-	-	-
	WL – Early	-	-	12	-	1.2	-	0.97	3.9
	WL – Late[b]	-	-	6.6	-	0.70	-	0.16	0.47
	WL - Average	35	0.05	9.3	<0.26	0.95	-	0.57	2.2

Notes: SCA – Sellafield coastal area; WL – Whitehaven Landed

Table 13. Radioactivity in seaweed, 2024

Species	Location	Mean concentration (Bq kg^{-1} wet weight)											
		Total α	Total β	Total ^{14}C	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{129}I	^{137}Cs	U(α)	Pu(α)	^{241}Am
Fucus vesiculosis	Nethertown	8.5	140	23	0.12	0.79	210	-	<0.29	0.76	2.2	3.7	1.4
	Drigg Barnscar	13	190	34	0.10	<0.15	120	-	<0.27	0.78	4.5	4.1	2.1
	Walney Island	11	190	18	-	0.23	76	-	<0.27	0.71	4.5	2.3	0.90
Porphyra umbilicalis	St Bees	24	150	24	-	0.27	2.6	<0.49	-	1.4	0.54	5.1	6.7
	Braystones	7.7	120	24	0.06	0.32	0.94	<0.46	-	0.78	0.35	1.8	3.6
	Sellafield	18	150	97	-	<0.13	1.3	<0.54	-	0.74	0.55	4.0	6.4
	Seascale Neb	9.4	140	26	-	0.15	0.76	<0.50	-	0.40	0.39	1.8	3.4
	St. Bees - Selker (Av)	16	140	43	0.06	0.22	1.5	<0.50	-	0.89	0.46	3.4	5.2

Fucus vesiculosus is collected because it accumulates many radionuclides (particularly technetium-99) and is sensitive to fluctuations in their concentrations in seawater. Porphyra umbilicalis is also collected and monitored as an indicator species particularly due to its historical exposure pathway role for ruthenium-106.

Table 14. Radioactivity in coastal samples of seawater from the Irish Sea, 2024

Location		Mean concentration (Bq l^{-1})												
		Total α	Total β	^{3}H	Net ^{14}C	^{90}Sr	^{99}Tc	^{129}I	^{137}Cs	U(α)	^{237}Np	Pu(α)	^{241}Pu	^{241}Am
St Bees	filtrate	<2.7	9.0	<5.0	<0.62	0.01	<0.02	<0.02	<0.03	0.10	0.0007	0.003	<0.05	0.0008
	solids	0.14	0.16	-	-	0.003	-	-	<0.01	0.002	0.00003	0.02	0.07	0.04
Sellafield	filtrate	<2.8	10	<4.6	<0.52	0.02	<0.02	<0.03	0.03	0.09	<0.0006	0.003	<0.05	0.001
	solids	0.18	0.17	-	-	0.004	-	-	0.01	0.003	0.00002	0.03	0.09	0.06
Seascale Neb	filtrate	<3.0	9.4	<5.0	<0.62	0.01	<0.02	<0.02	<0.03	0.09	<0.0006	0.002	<0.06	0.001
	solids	0.24	0.22	-	-	0.006	-	-	0.02	0.004	0.00005	0.04	0.14	0.08
Drigg Barnscar	filtrate	<3.0	10	<5.0	<0.53	0.008	<0.02	<0.02	0.03	0.10	<0.0006	0.003	<0.05	0.0008
	solids	0.10	0.18	-	-	0.003	-	-	<0.01	0.002	0.00001	0.02	0.05	0.03

Table 15. Radioactivity in sediment from the West Cumbrian Coast, 2024

Location		Mean radionuclide concentration (Bq kg^{-1} dry weight)									
		Total α	Total β	^{60}Co	^{90}Sr	^{99}Tc	^{137}Cs	U-α	Pu-α	^{241}Pu	^{241}Am
Sand	St Bees	1,100	480	0.20	-	-	34	-	120	-	130
	Braystones	500	320	0.15	-	-	27	-	88	-	100
	Sellafield	520	430	<0.12	-	-	29	-	84	-	92
	Seascale Neb	750	460	<0.09	-	-	16	-	81	-	100
	Drigg Barnscar	560	420	0.11	-	-	15	-	71	-	89
Silt	Ravenglass Ford	1,100	560	<2.0	7.9	8.7	48	36	170	500	240
	Ravenglass Garth	660	330	<1.4	0.71	4.3	16	25	110	310	130
	Ravenglass Opp Raven Villa	1,100	550	<1.8	5.6	16	45	42	170	450	240
	Eskmeals, R Esk south bank downstream of viaduct	1,500	740	<1.4	15	27	160	30	330	830	470
	Eskmeals Newbiggin Marsh	2,600	610	<1.3	34	33	230	30	540	1,500	880
	R Esk Muncaster Rd Bridge; Downstream	2,200	1,300	<1.4	51	42	250	30	490	1,400	890
	Whitehaven Outer Harbour (south)	570	560	<1.3	<0.92	7.7	94	17	100	230	140
	Silt from R Calder	380	300	<1.3	2.0	3.5	55	23	90	220	83
	Silt from R Ehen	880	730	<1.3	2.9	2.6	66	43	71	200	120
	Waberthwaite	1,500	850	<1.8	9.7	23	130	31	290	690	480

Table 16. Mean gamma dose rates measured in air in intertidal and other coastal areas of Cumbria, 2024

Area of survey	Description	Nature of ground	N	Mean dose rate (μGy h^{-1})
Whitehaven Harbour (north)	outer harbour	mud/silt	4	0.12
St Bees (groynes)	groynes	pebbles/rocks	1	0.17
St Bees	Seamill Lane car park	car park	1	0.14
Coulderton	grassed areas/beach bungalows	grass banks	1	0.15
Nethertown	beach	pebbles/shingle	1	0.16
Braystones	beach	pebbles/shingle	1	0.14
Sellafield Beach	beach		1	0.14
Sellafield Dunes	dunes		1	0.13
Factory Sewer	outfall	rocks / boulders / sand / shingle	4	0.13
Seascale Beach	south of pipeline	rocks/sand	4	0.12
Drigg Beach	beach	sand	1	0.12
Ravenglass	Raven Villa	saltmarsh	1	0.14
Ravenglass	small boat area	firm silt / pebbles	1	0.12
Ravenglass	Salmon Garth (saltmarsh)	sand / firm silt	1	0.13
Eskmeals Viaduct	saltmarsh	saltmarsh	1	0.13
Newbiggin	saltmarsh	saltmarsh	4	0.15
Muncaster Road Bridge	riverbank	grass	1	0.13
Hall Waberthwaite	saltmarsh	saltmarsh turf	1	0.14

Dose rates include contributions from natural background, typically 0.05 μGy h^{-1} over sandy areas and 0.07 μGy h^{-1} over silt.

Table 17. Mean gamma dose rates measured in air at Sellafield site perimeter, 2024

Area of survey	Number of locations	Mean dose rate (μGy h^{-1})
North	4	0.006
East	5	0.02
South	3	0.0008
West	4	0.03
River Ehen	2	0.005
River Calder	12	0.0006
Representative person	1	0.03
Mean annual average	-	0.01

Dose rates exclude contribution from natural background (approximately 0.06 μSv h^{-1}).

Table 18. Mean gamma dose rates measured in air in the vicinity of Sellafield, 2024

Location	Mean dose rate (µGy h^{-1})
Calderbridge	0.05
Seascale	0.04
Ravenglass	0.04
Braystones	0.05
Whitehaven	0.04
Gosforth	0.04
Brow Top	0.05

Dose rates exclude contribution from natural background (approximately 0.06 µSv h^{-1}).

Table 19. Radioactivity in air in the vicinity of Sellafield - Site Perimeter Locations, 2024

Radionuclide	Mean concentration (mBq m^{-3})				
	Calder Gate	Met. Station	North Gate	West Ring Road	South Side
Total Alpha	0.05	0.04	0.05	0.04	0.05
Total Beta	0.31	0.30	0.30	0.28	0.30
^{90}Sr	0.006	0.004	0.004	0.001	<0.001
^{106}Ru	<0.04	<0.04	<0.04	<0.04	<0.04
^{125}Sb	<0.01	<0.01	<0.01	<0.01	<0.01
^{137}Cs	0.008	0.01	0.02	<0.005	<0.004
Pu(α)	0.0002	0.0005	0.0004	0.0002	0.0002
^{241}Pu	<0.03	<0.03	<0.03	<0.03	<0.03
^{241}Am	0.0003	0.0006	0.0005	0.0003	0.0003
^{235}U	0.00001	0.00001	0.00001	0.000009	0.00001
^{238}U	0.0002	0.0003	0.0003	0.0002	0.0002

Table 20. Radioactivity in air in the vicinity of Sellafield - Residential Locations, 2024

Radionuclide	Mean concentration (mBq m^{-3})						
	Brow Top	Braystones	Calderbridge	Gosforth	Ravenglass	Seascale	Whitehaven
^{90}Sr	0.0007	0.0004	0.0005	<0.0004	<0.0004	0.0006	0.0004
^{137}Cs	<0.004	<0.004	<0.004	<0.004	<0.004	<0.005	<0.004
Pu(α)	0.00006	0.0001	0.0001	0.00007	0.0001	0.001	0.00009
^{241}Pu	<0.03	<0.03	<0.04	<0.03	<0.03	<0.03	<0.02
^{241}Am	0.00009	0.0001	0.0001	0.00003	0.0001	0.002	0.0001
^{235}U	<0.000007	0.000006	<0.00001	<0.000008	<0.000008	<0.00002	<0.000005
^{238}U	0.0001	0.00007	<0.00008	0.00009	<0.00009	0.0003	0.00009

Table 21. Radioactivity in milk from farms near Sellafield, 2024

Location	Mean concentration (Bq l^{-1})								
	Total α	Total β	^{3}H	Total ^{14}C	Net ^{14}C	^{90}Sr	^{129}I	^{131}I	^{137}Cs
Farm A	<0.23	41	<3.3	19	<0.78	0.02	<0.009	<0.04	<0.04
Farm B	<0.23	41	<3.3	16	<0.63	0.02	<0.009	<0.04	<0.04
Farm C	<0.21	37	<2.9	18	<0.68	0.02	<0.009	<0.04	0.09

Milk from Farm B has been used in the radiological assessment.

Table 22. Radioactivity in potatoes and rabbits from farms near Sellafield, 2024

Sample	Mean concentration (Bq kg^{-1})			
	^{3}H	Total ^{14}C	Net ^{14}C	^{137}Cs
Potatoes - Early	<7.9	12	<0.50	0.20
Potatoes - Late	<7.8	14	<0.60	0.19
Potatoes - Average	<7.9	13	<0.55	0.19
Rabbit	-	-	-	2.5

Table 23. Radioactivity in total deposition, 2024

Location	Mean radionuclide concentration (Bq m^{-3})						
	Total α	Total β	^{3}H	^{90}Sr	^{137}Cs	Pu- α	^{241}Am
Calder Gate	20	150	<4,700	1.8	6.3	0.13	0.51
Met Station	23	450	<4,900	110	44	0.55	0.24
North Gate	26	1,200	5,300	550	410	1.4	3.7
South Side	20	<140	<4,700	0.47	<3.2	0.29	0.41
West Ring Road	39	310	<4,900	70	18	0.22	2.3

Table 24. Radioactivity in grass, 2024

Location	Mean concentration (Bq kg^{-1} {wet weight})										
	Total α	Total β	^{3}H	Total ^{14}C	Net ^{14}C	^{90}Sr	^{99}Tc	^{137}Cs	U- α	Pu- α	^{241}Am
Calder Gate	4.1	91	7.9	27	<1.1	1.4	<0.82	4.1	0.13	0.17	0.12
Met Station	2.8	110	<7.8	21	<0.83	7.4	<0.58	7.8	0.10	0.07	0.11
North Gate	3.8	150	6.7	26	<1.0	34	<0.77	42	0.11	0.15	0.10
South Side	2.9	130	7.7	21	<0.80	0.50	<0.55	0.66	0.12	0.03	0.05
West Ring Road	2.9	110	<8.2	21	<0.80	1.2	0.41	2.3	0.19	0.17	0.22

Table 25. Radioactivity in soil, 2024

Location	Mean concentration (Bq kg^{-1} {wet weight})									
	Total α	Total β	^{3}H	Net ^{14}C	Total ^{14}C	^{90}Sr	^{137}Cs	U- α	Pu- α	^{241}Am
Calder Gate	800	890	<4.8	5.1	1.3	1.9	42	46	21	6.6
Met Station	700	690	<5.2	5.1	0.51	6.8	150	49	67	28
North Gate	900	940	<5.1	6.6	2.2	21	250	55	130	28
South Side	1,800	690	<5.4	10	<0.50	1.3	54	55	10	5.5
West Ring Road	750	740	<5.1	5.1	<0.20	2.4	79	62	55	31

Table 26. Radioactivity in local waters, 2024

Location		Mean concentration (Bq l^{-1})							
		Total α	Total β	^{3}H	^{90}Sr	^{99}Tc	^{137}Cs	Pu(α)	Am+ Cm
River water:	R. Calder at Sellafield	<0.01	0.30	<4.8	0.11	<0.02	<0.005	<0.001	-
	R. Calder at Calderbridge	<0.01	0.10	<4.6	0.005	<0.02	<0.006	<0.001	-
	R. Ehen, 5m upstream of Factory Sewer outfall	<0.03	0.24	<4.9	0.002	<0.03	<0.005	0.0004	-
	R. Ehen, 100m north of pipeline	<0.02	0.13	<4.9	0.003	<0.02	<0.005	<0.002	-
Lake water:	Ennerdale Water	<0.02	0.02	<5.3	0.002	-	<0.002	<0.001	-
Tap water:	Calderbridge	<0.01	<0.07	<5.2	0.003	-	<0.005	-	-
	Sellafield	0.04	<0.08	<5.1	0.002	-	<0.006	-	-
	Ravenglass	<0.02	<0.06	<5.0	0.002	-	<0.006	-	-
	Seascale	<0.02	<0.08	<5.1	0.002	-	<0.006	-	-
	Whitehaven	<0.02	<0.07	<5.1	0.002	-	<0.005	-	-
Spring water:	Sellafield Beach (Maximum)	4.0	8.8	103	0.08	1.2	0.2	0.013	0.04
	Sellafield Beach (Average)	2.4	7.4	28	0.04	0.1	0.1	0.008	0.02

Note: Spring water data are no longer corrected for estimated seawater content

Table 27. Non-radioactive monitoring of nitrogen dioxide in air in the vicinity of Sellafield, 2024

Location	Mean concentration (µg m^{-3})
Calder Gate	5.7
Met. Station	6.6
North Gate	5.5
West Ring Road	6.7
South Side	5.4
Air Quality Limit Value (annual mean)	*40*

Table 28. Non-radioactive monitoring of nitrate in river waters, 2024

Location	pH	Mean concentration (mg l^{-1})
River Calder - downstream of site	7.6	0.54
River Calder - upstream of site	7.5	0.54
River Ehen - upstream of Seaburn outfall	8.0	1.0
River Ehen - upstream of pipebridge	8.0	1.0
National Environmental Quality Standard	*6.0 - 9.0*	*N/A*

Table 29. Non-radioactive monitoring of coastal waters, 2024

Location	Mean concentration (mg l^{-1})	
	Nitrite	Nitrate
St Bees	<0.005	0.35
Sellafield	<0.006	0.12
Seascale Neb	<0.007	0.23
Drigg Barnscar	<0.006	0.09

Table 30. Non-radioactive monitoring of surface water around Calder Landfill Extension Segregated Area, 2024

Location	BOD (mg l^{-1})	COD (mg l^{-1})	TOC (mg l^{-1})	Dissolved O_2 (ppm)	NH_4^+ (mg l^{-1})	SO_4^{2-} (mg l^{-1})	Conductivity (µS cm^{-1})
River Calder upstream	<1.0	<5.9	2.1	10	<0.009	3.9	99
New Mill Beck upstream	<1.1	17	6.8	10	0.04	8.5	240
New Mill Beck overflow drain	<1.5	28	9.6	10	0.10	8.2	220
River Calder downstream	<1.1	9.3	3.2	10	0.07	5.3	150

New Mill Beck overflow drain only available under flood conditions.
BOD – Biological Oxygen Demand; COD – Chemical Oxygen Demand; TOC – Total Organic Carbon.

Table 31. Non-radioactive monitoring of gases on Sellafield's landfill sites, 2024

Gas spike probe monitoring	Mean concentration (% volume)		
	CH_4	CO_2	O_2
Calder Landfill Complex Boreholes	0.20	2.52	18
Calder Landfill Complex Probes	0.17	1.3	18

Beach Monitoring Data

Table 32. Beach monitoring conducted during 2024

Programme	Planned monitoring (ha)	Actual monitoring(ha)
Sellafield	52	56
Northern Beaches	32	35
Southern Beaches	16	22
Allonby	5	5
Total	**105**	**118**

Table 33. Particle and larger object beach finds recovered during 2024

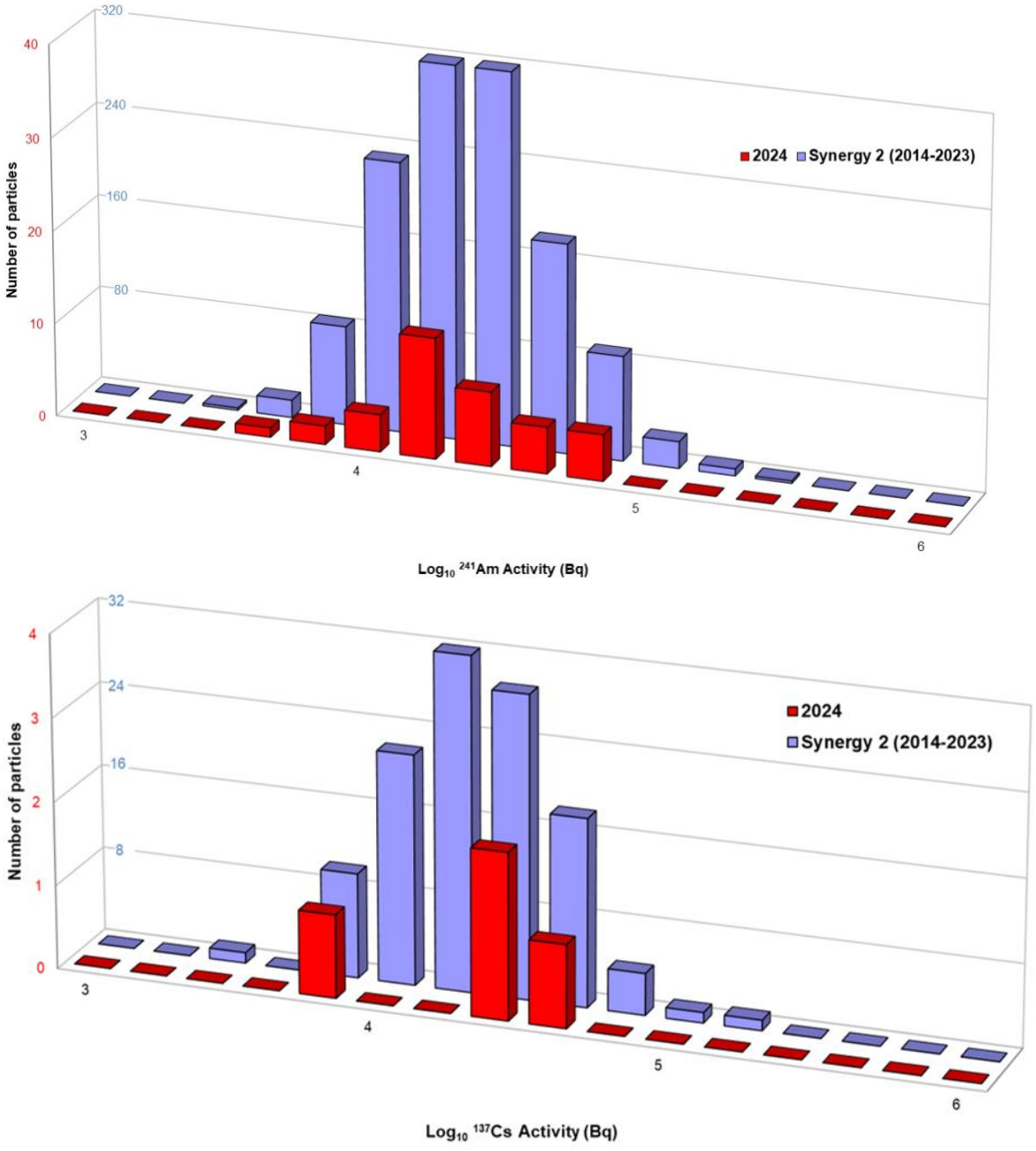
Programme	No. of particles found			No. of larger objects found			Total finds
	Alpha rich	Beta rich	Other	Alpha rich	Beta rich	Other	
Sellafield	20	4	0	0	8	0	32
Northern Beaches	14	0	0	0	1	0	15
Southern Beaches	4	0	0	0	0	0	4
Allonby	0	0	0	0	0	0	0
Total	**38**	**4**	**0**	**0**	**9**	**0**	**51**

Particles are less than 2 mm in size; Larger objects are greater than 2 mm in size; "Alpha rich", higher americium-241 activity than caesium-137 activity; "Beta rich", where caesium-137 was the major radionuclide; "other" denotes the principal radionuclide is neither americium-241 activity or caesium-137, for example cobalt-60

Table 34. Total area monitored and finds by category, beach and calendar year (2020 – 2024)

Beach	Year	Area (ha)	Alpha rich particle	Beta rich particle	Beta rich larger object	Other finds
Sellafield	2020	58	48	4	2	0
	2021	57	24	1	4	0
	2022	55	30	2	7	1
	2023	59	51	2	3	0
	2024	56	20	4	8	0
Northern Beaches	2020	30	19	0	0	0
	2021	36	68	0	0	0
	2022	35	11	0	0	0
	2023	34	20	0	0	0
	2024	35	14	0	1	0
Southern Beaches	2020	19	1	0	0	0
	2021	24	1	0	0	0
	2022	22	5	0	0	0
	2023	22	2	0	0	0
	2024	22	4	0	0	0
Allonby	2020	6	0	0	0	0
	2021	5	0	0	0	0
	2022	5	0	0	0	0
	2023	5	3	0	0	0
	2024	5	0	0	0	0

Figure 4. Radioactivity of finds classified as alpha-rich particles (upper) and beta rich particles (lower) between 2014 – 2023 (shown in blue) compared to data from 2024 shown in red)



RIFE data used in the Radiological Dose Assessment

Table 35. Radioactivity in animal produce from farms near Sellafield, 2023 (data From RIFE29)

Species	Mean concentration (Bq kg^{-1} {wet weight})												
	^{3}H	Total ^{14}C	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{125}Sb	^{134}Cs	^{137}Cs	^{238}Pu	$^{239+240}$Pu	^{241}Pu	^{241}Am
Bovine muscle	<14	40	<0.04	<0.04	<0.13	<0.31	<0.08	<0.05	0.47	<0.00005	0.00007	<0.33	0.0002
Bovine liver	<25	44	<0.05	<0.05	<0.10	<0.37	<0.09	<0.05	<0.16	0.0003	0.003	<0.38	0.003
Bovine kidney	<25	27	<0.07	<0.05	<0.12	<0.59	<0.15	<0.07	0.23	<0.0001	0.0002	<0.50	0.0005
Ovine muscle	<20	43	<0.04	<0.05	<0.11	<0.34	<0.09	<0.04	0.89	0.00008	0.0003	<0.41	0.001
Ovine kidney/ liver	<20	41	<0.04	0.04	<0.11	<0.35	<0.09	<0.04	0.30	0.001	0.008	<0.42	0.01
Deer	<25	41	<0.03	<0.05	<0.12	<0.26	<0.07	<0.02	2.1	0.00005	0.0003	<0.49	0.0002
Pheasant	<25	45	<0.04	<0.05	<0.14	<0.33	<0.09	<0.06	1.2	<0.0006	0.0009	<0.93	0.0005
Rabbit	<25	55	<0.05	<0.05	<0.11	<0.43	<0.10	<0.04	1.1	0.00002	0.0004	<0.49	0.0005
Eggs - Chicken	<25	45	<0.05	<0.06	-	<0.38	<0.10	<0.05	<0.04	0.00006	0.0004	<0.30	0.0004

Measured concentrations that equal to or smaller than background value are indicated by a zero.

Table 36. Radioactivity in fruit and vegetable produce collected near Sellafield, 2023 (Data From RIFE29)

Species	Mean concentration (Bq kg^{-1} {wet weight})												
	^{3}H	Total ^{14}C	^{60}Co	^{90}Sr	^{99}Tc	^{106}Ru	^{125}Sb	^{134}Cs	^{137}Cs	^{238}Pu	$^{239+240}$Pu	^{241}Pu	^{241}Am
Potato	<25	30	<0.07	0.05	-	<0.46	<0.14	<0.08	0.13	0.0005	0.006	<0.46	0.004
Cabbage	<1.2	11	<0.05	0.26	-	<0.44	<0.11	<0.04	<0.05	<0.00006	0.0001	<0.34	0.0003
Barley	<50	130	<0.10	0.53	-	<1.2	<0.28	<0.21	0.73	0.0006	0.007	<0.82	0.005
Carrots	<1.2	7.5	<0.03	0.10	<0.12	<0.26	<0.07	<0.02	0.09	-	-	-	-
Beetroot	<1.2	17	<0.03	0.15	-	<0.29	<0.08	<0.03	0.11	-	-	-	-
Mushrooms	<25	16	<0.07	0.03	-	<0.45	<0.13	<0.05	0.33	0.003	0.02	0.48	0.03
Apple	<1.3	16	<0.02	0.06	<0.11	<0.24	<0.07	<0.03	0.15	<0.00008	0.0001	<0.51	0.0003
Grapes	<25	35	<0.04	0.04	-	<0.33	<0.17	<0.04	<0.06	0.00004	0.0002	<0.30	0.0004

Radiological Dose Assessment Data Tables

The radiological dose assessment presented herein takes account of research studies carried out both nationally and internationally. In addition, the guidance of UKHSA, the National Dose Assessment Working Group (NDAWG) and the most recent dose coefficients in the International Commission for Radiological Protection (ICRP) Publication 119 are adopted where available and appropriate. In general, default values recommended by the ICRP for each radionuclide are assumed for the purpose of dose calculations unless specific studies indicate that an alternative is appropriate.

Table 37. Summary of doses associated with seafood (µSv), 2024

Radionuclide	Cod				Plaice				Lobsters				Crabs			
	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus
Carbon-14	0.04	0.01	0.006	0.06	0.26	0.07	0.04	0.36	0.15	0.04	0.02	0.20	0.12	0.03	0.02	0.17
Cobalt-60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Strontium-90	-	-	-	-	-	-	-	-	-	-	-	-	0.01	0.006	0.002	0.02
Technetium-99	0.002	0.0007	0.0006	0.001	0.01	0.005	0.005	0.01	0.24	0.10	0.09	0.17	0.005	0.002	0.002	0.004
Ruthenium-106	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iodine-129	-	-	-	-	-	-	-	-	0.28	0.10	0.03	0.11	-	-	-	-
Caesium-137	0.19	0.03	0.009	0.09	0.36	0.06	0.02	0.16	0.09	0.01	0.004	0.04	0.04	0.007	0.002	0.02
Neptunium-237	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plutonium-alpha	0.004	0.0008	0.0003	0.0001	0.09	0.02	0.007	0.003	0.28	0.06	0.02	0.01	0.31	0.07	0.03	0.01
Plutonium-241	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Americium-241	0.005	0.001	0.0005	0.00007	0.11	0.03	0.01	0.002	1.7	0.37	0.15	0.02	0.86	0.19	0.08	0.01
Curium-alpha	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0.25	0.04	0.02	0.15	0.84	0.18	0.08	0.54	2.7	0.68	0.32	0.56	1.4	0.30	0.13	0.24

Radionuclide	Nephrops				Winkles				Mussels				Total			
	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus
Carbon-14	0.02	0.006	0.003	0.03	0.04	0.01	0.005	0.05	0.03	0.007	0.004	0.04	0.66	0.17	0.10	0.91
Cobalt-60	-	-	-	-	0.002	0.001	0.0007	0.001	0.001	0.001	0.0006	0.0008	0.003	0.002	0.001	0.002
Strontium-90	0.002	0.0009	0.0003	0.003	0.04	0.02	0.006	0.06	0.04	0.02	0.006	0.06	0.09	0.05	0.01	0.14
Technetium-99	0.02	0.007	0.007	0.01	0.02	0.007	0.006	0.01	0.02	0.009	0.008	0.02	0.32	0.13	0.12	0.23
Ruthenium-106	-	-	-	-	0.02	0.006	0.005	0.0008	0.01	0.006	0.005	0.0007	0.03	0.01	0.01	0.002
Iodine-129	0.05	0.02	0.005	0.02	0.03	0.01	0.003	0.01	-	-	-	-	0.36	0.13	0.04	0.14
Caesium-137	0.03	0.005	0.001	0.01	0.04	0.006	0.002	0.02	0.03	0.005	0.001	0.01	0.78	0.12	0.04	0.35
Neptunium-237	-	-	-	-	0.001	0.0003	0.0001	4E-05	-	-	-	-	0.001	0.0003	0.0001	4E-05
Plutonium-alpha	0.24	0.05	0.02	0.009	0.94	0.20	0.08	0.04	1.6	0.35	0.14	0.06	3.5	0.75	0.30	0.13
Plutonium-241	-	-	-	-	0.05	0.01	0.003	0.001	0.09	0.02	0.005	0.002	0.14	0.03	0.008	0.003
Americium-241	0.78	0.17	0.07	0.01	1.4	0.30	0.13	0.02	2.6	0.58	0.24	0.04	7.5	1.6	0.68	0.10
Curium-alpha	-	-	-	-	0.02	0.005	0.003	0.02	-	-	-	-	0.02	0.005	0.003	0.02
Total	1.1	0.26	0.11	0.10	2.6	0.58	0.24	0.23	4.5	1.0	0.41	0.23	13	3.0	1.3	2.1

Background corrected values for carbon-14 in fish, molluscs and crustaceans have been used in the assessment of radiation doses to the representative person. For these marine foodstuffs, the natural concentration of carbon-14 of 218 Bq carbon-14 per kg carbon has been taken from data published by the EA and FSA.

Table 38. Summary of doses to terrestrial representative person from terrestrial foodstuffs and inhalation (µSv), 2024

Radionuclide	Milk				Beef Muscle				Beef Offal				Sheep Muscle			
	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus
Total tritium	0.01	0.02	0.05	0.02	0.009	0.01	0.005	0.01	0.003	0.002	0.002	0.004	0.007	0.005	0.002	0.01
Carbon-14	0.04	0.06	0.14	0.05	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt-60	-	-	-	-	0.002	0.007	0.003	0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	<0.001	<0.001
Strontium-90	0.06	0.14	0.24	0.09	0.02	0.04	0.01	0.03	0.004	0.005	0.002	0.006	0.01	0.01	0.004	0.02
Technetium-99	-	-	-	-	0.001	0.003	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ruthenium-106	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony-125	-	-	-	-	0.001	0.003	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iodine-129	0.09	0.19	0.26	0.04	0.006	0.01	0.002	0.002	0.003	0.003	0.001	0.001	0.008	0.007	0.002	0.003
Caesium-134	-	-	-	-	0.01	0.01	0.002	0.007	0.003	0.001	<0.001	0.001	0.006	0.002	<0.001	0.003
Caesium-137	0.11	0.10	0.14	0.05	0.09	0.07	0.02	0.04	0.007	0.003	0.001	0.003	0.09	0.04	0.009	0.04
Plutonium-alpha	-	-	-	-	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Plutonium-241	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Americium-241	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Total	0.31	0.51	0.83	0.25	0.14	0.16	0.05	0.10	0.03	0.02	0.01	0.02	0.13	0.07	0.02	0.08

Table 38. Summary of doses to terrestrial representative person from terrestrial foodstuffs and inhalation (μSv), 2024 Continued.

Radionuclide	Sheep offal				Poultry				Eggs				Game			
	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus
Total tritium	0.002	0.002	0.001	0.003	0.01	0.008	0.006	0.02	0.009	0.009	0.02	0.01	0.006	0.006	0.002	0.009
Carbon-14	-	-	-	-	0.08	0.06	0.04	0.11	0.07	0.07	0.11	0.10	0.06	0.05	0.02	0.08
Cobalt-60	<0.001	<0.001	<0.001	<0.001	0.001	0.002	0.002	<0.001	0.001	0.004	0.007	<0.001	<0.001	0.002	<0.001	<0.001
Strontium-90	0.003	0.004	0.002	0.005	0.02	0.02	0.009	0.02	0.02	0.03	0.03	0.02	0.009	0.01	0.004	0.01
Technetium-99	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	-	-	-	-	<0.001	<0.001	<0.001	<0.001
Ruthenium-106	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony-125	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.001	<0.001	<0.001	0.001	0.003	<0.001	<0.001	<0.001	<0.001	<0.001
Iodine-129	0.003	0.003	0.001	0.001	0.01	0.010	0.004	0.004	0.005	0.006	0.006	0.002	0.005	0.006	0.001	0.002
Caesium-134	0.002	<0.001	<0.001	<0.001	0.01	0.005	0.002	0.005	0.008	0.005	0.004	0.004	0.005	0.002	<0.001	0.002
Caesium-137	0.01	0.005	0.002	0.005	0.16	0.07	0.03	0.07	0.004	0.003	0.002	0.002	0.15	0.08	0.02	0.07
Plutonium-alpha	0.006	0.004	0.002	<0.001	0.004	0.002	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	<0.001	<0.001	<0.001
Plutonium-241	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Americium-241	0.006	0.003	0.002	<0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total	0.04	0.03	0.02	0.02	0.30	0.18	0.10	0.24	0.12	0.13	0.19	0.14	0.24	0.16	0.05	0.18

Radionuclide	Honey				Mushroom				Potato				Root veg.			
	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus
Total tritium	-	-	-	-	0.003	0.002	0.002	0.005	0.02	0.02	0.009	0.02	<0.001	<0.001	<0.001	<0.001
Carbon-14	-	-	-	-	0.02	0.01	0.01	0.03	0.02	0.02	0.009	0.02	0.03	0.03	0.04	0.04
Cobalt-60	-	-	-	-	<0.001	0.001	0.001	<0.001	0.01	0.03	0.02	0.007	0.001	0.002	0.004	<0.001
Strontium-90	-	-	-	-	0.003	0.003	0.002	0.004	0.08	0.15	0.05	0.12	0.04	0.05	0.06	0.06
Technetium-99	-	-	-	-	-	-	-	-	-	-	-	-	<0.001	<0.001	0.003	<0.001
Ruthenium-106	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony-125	-	-	-	-	<0.001	<0.001	<0.001	<0.001	0.008	0.01	0.009	0.003	<0.001	<0.001	0.002	<0.001
Iodine-129	0.001	0.002	0.002	<0.001	0.001	<0.001	<0.001	<0.001	0.02	0.03	0.007	0.007	0.004	0.004	0.004	0.001
Caesium-134	-	-	-	-	0.003	0.001	<0.001	0.001	0.08	0.05	0.01	0.03	0.005	0.002	0.002	0.002
Caesium-137	-	-	-	-	0.01	0.005	0.002	0.006	0.12	0.09	0.02	0.05	0.01	0.006	0.006	0.006
Plutonium-alpha	-	-	-	-	0.02	0.009	0.006	<0.001	0.08	0.08	0.03	0.003	-	-	-	-
Plutonium-241	-	-	-	-	0.007	0.004	0.002	<0.001	-	-	-	-	-	-	-	-
Americium-241	-	-	-	-	0.02	0.010	0.007	<0.001	0.04	0.04	0.01	<0.001	-	-	-	-
Total	0.002	0.003	0.003	0.002	0.09	0.05	0.04	0.05	0.48	0.52	0.18	0.26	0.09	0.10	0.12	0.11

Radionuclide	Green veg.				Domestic Fruit				Wild Fruit				Legumes			
	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus
Total tritium	0.05	0.03	0.03	0.07	0.04	0.04	0.06	0.06	0.007	0.004	0.003	0.01	0.01	0.006	0.005	0.02
Carbon-14	0.61	0.38	0.38	0.85	0.76	0.70	0.98	1.1	0.11	0.06	0.04	0.15	0.15	0.08	0.06	0.21
Cobalt-60	0.01	0.02	0.02	0.006	0.008	0.02	0.03	0.004	<0.001	0.001	0.001	<0.001	0.003	0.005	0.004	0.002
Strontium-90	0.55	0.52	0.37	0.82	0.12	0.16	0.16	0.17	0.009	0.008	0.004	0.01	0.09	0.08	0.04	0.14
Technetium-99	-	-	-	-	0.005	0.007	0.02	0.004	-	-	-	-	0.001	0.001	0.002	0.001
Ruthenium-106	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Antimony-125	0.010	0.008	0.01	0.004	0.010	0.01	0.03	0.004	0.001	0.001	0.001	<0.001	0.003	0.002	0.002	0.001
Iodine-129	0.02	0.01	0.007	0.007	0.04	0.05	0.04	0.02	0.004	0.003	0.001	0.002	0.009	0.006	0.003	0.003
Caesium-134	0.11	0.04	0.02	0.05	0.05	0.02	0.02	0.02	0.005	0.002	<0.001	0.002	0.02	0.007	0.003	0.01
Caesium-137	0.23	0.08	0.05	0.10	0.10	0.05	0.04	0.04	0.005	0.002	<0.001	0.002	0.06	0.02	0.008	0.02
Plutonium-alpha	0.04	0.02	0.02	0.002	0.004	0.003	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	0.03	0.01	0.008	0.001
Plutonium-241	0.18	0.08	0.05	0.004	0.11	0.08	0.06	0.002	0.01	0.005	0.002	<0.001	0.05	0.02	0.009	0.001
Americium-241	0.02	0.01	0.010	<0.001	0.005	0.004	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	0.03	0.01	0.007	<0.001
Total	1.8	1.2	0.97	1.9	1.3	1.1	1.4	1.4	0.16	0.09	0.06	0.18	0.46	0.25	0.15	0.41

Radionuclide	Drinking water				Inhalation				Total dose			
	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus	Adult	Child	Infant	Foetus
Total tritium	0.13	0.10	0.16	0.19	-	-	-	-	0.32	0.27	0.36	0.46
Carbon-14	-	-	-	-	-	-	-	-	2.0	1.5	1.8	2.7
Cobalt-60	-	-	-	-	-	-	-	-	0.04	0.10	0.10	0.03
Strontium-90	0.04	0.05	0.05	0.06	0.001	<0.001	<0.001	<0.001	1.1	1.3	1.0	1.6
Technetium-99	-	-	-	-	-	-	-	-	0.01	0.02	0.03	0.01
Ruthenium-106	-	-	-	-	0.01	0.009	0.008	<0.001	0.03	0.03	0.02	0.02
Antimony-125	-	-	-	-	<0.001	<0.001	<0.001	<0.001	0.04	0.04	0.07	0.02
Iodine-129	-	-	-	-	-	-	-	-	0.23	0.34	0.34	0.10
Caesium-134	-	-	-	-	-	-	-	-	0.32	0.15	0.07	0.14
Caesium-137	0.04	0.02	0.02	0.02	<0.001	<0.001	<0.001	<0.001	1.2	0.65	0.37	0.53
Plutonium-alpha	<0.001	<0.001	<0.001	<0.001	0.13	0.07	0.04	0.003	0.32	0.21	0.12	0.02
Plutonium-241	-	-	-	-	0.27	0.14	0.06	0.003	0.63	0.33	0.18	0.01
Americium-241	<0.001	<0.001	<0.001	<0.001	0.14	0.08	0.05	<0.001	0.27	0.17	0.10	0.02
Total	0.21	0.17	0.23	0.27	0.55	0.30	0.16	0.01	6.4	5.1	4.6	5.7

Doses assessed as being less than 0.001 μSv have been presented as "<0.001".
Foodstuff consumption rates used for 2024 are summarised later in this section. The two food groups assigned "high consumption rates" in 2024 were potatoes and green vegetables.
The doses from ruthenium-106 and iodine-129in all terrestrial foodstuffs were assessed using standard modelling techniques. These are based on knowledge of the transfer of these radionuclides through the food chain. This is considered to be more realistic than using the limits of detection from the radiochemical analysis.

Table 39. Modelled concentrations of Ru-106 and I-129 in terrestrial foodstuffs (Bq kg^{-1} or Bq l^{-1}) in 2024

	Milk	Beef	Mutton	Liver	Green Veg.	Root Veg.	Fruit	Poultry	Eggs
Ru-106	2.21E-07	1.19E-04	1.74E-04	1.74E-04	7.57E-04	6.84E-06	6.61E-05	5.51E-08	4.72E-08
I-129	2.77E-03	3.53E-03	9.31E-03	9.31E-03	3.40E-03	3.22E-03	5.00E-03	1.73E-04	5.20E-03

Table 40. Summary of doses to the terrestrial representative person from seafood consumption (µSv) in 2024

Radionuclide	Adult	Child	Infant	Foetus
Carbon-14	0.10	0.03	0.01	0.14
Technetium-99	0.004	0.002	0.002	0.003
Caesium-137	0.24	0.04	0.01	0.10
Plutonium-alpha	0.04	0.008	0.003	0.001
Americium-241	0.05	0.01	0.004	0.0006
Total	0.43	0.09	0.03	0.25

Table 41. Summary of doses to the terrestrial representative person (µSv), 2024

Pathway	Adult	Child	Infant	Foetus
Terrestrial food consumption	5.9	4.8	4.5	5.7
Marine food consumption	0.43	0.09	0.03	0.25
Inhalation	0.55	0.30	0.16	0.01
External (beach)	3.8	1.9	0.11	3.8
External (direct shine)	2.9	1.4	1.4	1.4
Total	14	8	6	11

Table 42. Representative person doses from operations at Sellafield (µSv)

Pathway	2022	2023	2024
Marine representative person (adults)			
seafood consumption	28	20	13
aerial pathways	1.6	1.6	1.6
external radiation from beach occupancy (marine)	42	36	34
Total dose to marine representative person (adults)	**72**	**58**	**49**
Terrestrial representative person (adults)			
inhalation	0.6	0.56	0.55
external radiation from beach occupancy (terrestrial)	2.9	4.3	3.8
terrestrial foodstuff consumption	4.6	5.6	5.9
marine foodstuff consumption	0.55	0.48	0.43
direct radiation	3.0	3.8	2.9
Total dose to terrestrial representative person (adults)	**12**	**15**	**14**

Table 43. Collective doses from Sellafield's discharges, 2024

Radionuclide	Collective Dose (manSv)					
	Aerial Discharges			Marine Discharges		
	UK	Europe	World	UK	Europe	World
Tritium	5.E-05	8.E-05	1.E-04	2.E-06	9.E-06	2.E-04
Carbon-14	1.E-02	6.E-02	7.E-01	1.E-02	5.E-02	5.E-01
Cobalt-60	-	-	-	7.E-04	2.E-03	2.E-03
Strontium-90	6.E-06	3.E-05	3.E-05	1.E-03	3.E-03	5.E-03
Technetium-99	-	-	-	3.E-04	1.E-03	1.E-03
Ruthenium-106	2.E-04	2.E-04	2.E-04	2.E-03	5.E-03	6.E-03
Iodine-129	5.E-02	3.E-01	4.E-01	2.E-04	5.E-04	2.E-03
Caesium-137	7.E-04	2.E-03	2.E-03	2.E-02	5.E-02	8.E-02
Plutonium-alpha	8.E-03	1.E-02	1.E-02	2.E-02	4.E-02	5.E-02
Plutonium-241	0.E+00	0.E+00	0.E+00	1.E-02	3.E-02	3.E-02
Americium-241	2.E-03	3.E-03	3.E-03	9.E-03	2.E-02	3.E-02
Total	8.E-02	3.E-01	1.E+00	7.E-02	2.E-01	7.E-01

Collective doses have been calculated, using a 500 year integration period, based on the most recent European Union (EU) methodology.

Representative Persons Dose Assessment

Table 44. Summary of representative person dose calculations for various age groups, 2024

Pathway	Adult Dose (microSv)			Child Dose (microSv)			Infant Dose (microSv)		
	Total	Marine	Terrestrial	Total	Marine	Terrestrial	Total	Marine	Terrestrial
Crustacean Consumers	9	0	9	1	0	1	0	0	0
Occupants for Direct Radiation	6	3	9	1	3	5	3	**3**	7
Egg Consumers	4	3	7	1	**4**	5	0	0	0
Freshwater Fish Consumers	**51**	**5**	**56**	0	0	0	0	0	0
Sea Fish Consumers	22	0	22	1	0	1	14	0	14
Domestic Fruit Consumers	0	2	3	3	4	**7**	3	**3**	7
Wild Fruit and Nut Consumers	21	0	21	0	0	0	0	0	0
Salt Marsh Grazed Cow Meat Consumers	20	0	20	0	0	0	0	0	0
Occupants over Saltmarsh	**53**	1	**54**	**10**	0	**10**	**17**	0	**17**
Occupants over Sediment	0	1	1	0	0	0	0	0	0
Honey Consumers	5	0	5	0	0	0	**27**	0	**27**
Consumers of Marine Plants and Algae	0	2	2	0	3	3	0	0	0
Cattle Meat Consumers	2	2	4	0	0	0	0	0	0
Game Meat Consumers	2	3	5	0	0	0	0	0	0
Poultry Meat Consumers	0	2	3	0	2	3	1	0	1
Sheep Meat Consumers	9	0	9	0	0	0	0	0	0
Wildfowl Consumers	0	2	2	0	0	0	0	0	0
Milk Consumers	32	0	32	0	0	0	0	0	0
Salt Marsh Grazed Cows' Milk Consumers	10	4	14	3	4	**7**	3	**3**	7
Mollusc Consumers	31	1	32	1	0	1	0	0	0
Mushroom Consumers	5	0	5	**4**	0	4	4	0	4
Occupants In Water	0	**4**	4	0	4	4	3	**3**	7
Occupants On Water	2	4	6	1	**4**	5	0	0	0
Local Inhabitants (0 - 0.25km)	3	4	7	0	3	3	0	0	0
Local Inhabitants (0.25 - 0.5km)	5	2	7	3	4	**7**	0	0	0
Local Inhabitants (0.5 - 1km)	4	4	8	3	4	**7**	0	0	0
Green Vegetable Consumers	4	3	8	0	0	0	0	0	0
Other Domestic Vegetable Consumers	4	4	8	2	2	4	0	0	0
Potato Consumers	16	0	16	0	0	0	0	0	0
Root Vegetable Consumers	9	0	9	1	0	1	0	0	0
Salt Marsh Grazed Sheep Meat Consumers	6	3	9	1	3	5	3	**3**	7

Dosimetric considerations for individual and collective doses

Data identifying the representative person and their habits by pathway have been provided by the FSA, EA and the Centre for Environment, Fisheries and Aquaculture Science (Cefas), or their predecessors, based on published survey work.

Worked example of committed effective dose calculation for a representative person

Table 45 CED received by an adult member of the seafood consuming representative person from Am-241 in winkles

	Parameter	Value	Location in report
A	Am-241 activity concentration in winkles	7.5 Bq kg^{-1}	Table 11
B	Consumption rate of winkles by adults	2.3 kg y^{-1}	Table 46
C	Committed effective dose per unit intake value for ingestion for Am-241 in Cumbrian winkle consumed by an adult	8.0E-08 Sv Bq^{-1}	Table 49

CED received by an adult member of the seafood consuming representative person from Am-241 in winkles is:
CED = A x B x C in units of Sv per year;
CED = 7.5 Bq kg^{-1} x 2.3 kg y^{-1} x 8.0E-08 Sv Bq^{-1} = 1.4E-06 Sv y^{-1},

This approach is repeated for all radionuclides of interest in each seafood species of interest, through the incorporation of the appropriate consumption rates and committed effective dose per unit intake values.

Care is needed in using the correct dose per unit intake values for Cumbrian winkles as a specific set of data for transuranic radionuclides are available.

Table 46. Seafood consumption rates used for dose assessments for marine discharges (2020 – 2024) average data)

Seafood	Consumption rates (kg y^{-1}) (2020 – 2024 average)		
	Representative person (Cumbria Coastal Community 2020 - 2024)	Whitehaven Commerical (1998)	Typical fish consumer
Fish:			
Cod	10.3	20	7.5
Plaice	28.5	20	7.5
Crustacea:			
Crabs	7.8	0	0
Lobsters	12.5	0	0
Nephrops	2.3	9.7	0
Molluscs:			
Winkles	2.3	0	0
Mussels	2.7	0	0

Data for the representative person (Cumbria Coastal Community) are taked from CEFAS, 2025. Radiological Habits Survey: Sellafield Review, 2024. All other consumption rates are from RIFE-29.

Table 47. Consumption rates of representative person consumers associated with aerial discharges

Foodstuff	Consumption rate (kg y^{-1})		
	Adult	Child	Infant
milk	95	110	130
beef	15	15	3
beef liver	2.75	1.5	0.5
mutton	8	4	0.8
mutton liver	2.75	1.5	0.5
poultry	10	5.5	2
game	6	4	0.8
fish (cod + plaice)	15	3	0.75
leafy vegetables	45	20	10
potatoes	50	45	10
root vegetables	10	6	5
legumes	20	8	3
domestic fruit	75	50	35
wild fruit	7	3	1
mushrooms	3	1.5	0.6
honey	2.5	2	2
eggs	8.5	6.5	5

Domestic fruit and Green Vegetables are set to above average consumption rates for 2024. Adult consumption rates are used for the calculation of foetal doses.

Table 48. Parameters for calculation of drinking water and plume inhalation doses

	Adult	Child	Infant
Occupancy (%)	100%	100%	100%
Breathing rate (m^3 a^{-1})	9,860	5,600	1,900
Drinking Water (l a^{-1})	600	350	260

Adult parameters are used for the calculation of foetal doses.

Table 49. Committed effective doses per unit intake for ingestion

Radionuclide	f_1	Dose per unit intake (Sv Bq^{-1})			
		Foetus	1 year old	10 year old	Adult
H-3 organic	1E+00	6.3E-11	1.2E-10	5.7E-11	4.2E-11
C-14	1E+00	8.0E-10	1.6E-09	8.0E-10	5.8E-10
Co-60	1E-01	1.9E-09	2.7E-08	1.1E-08	3.4E-09
Sr-90	3E-01	4.6E-08	9.3E-08	6.6E-08	3.1E-08
Zr-95	1E-02	7.6E-10	8.8E-09	3.0E-09	1.5E-09
Nb-95	1E-02	3.7E-10	3.2E-09	1.1E-09	5.8E-10
Tc-99	5E-01	4.6E-10	4.8E-09	1.3E-09	6.4E-10
Ru-106	5E-02	3.8E-10	4.9E-08	1.5E-08	7.0E-09
Ag-110m	5E-02	2.1E-09	1.4E-08	5.2E-09	2.8E-09
Sb-125	1E-01	4.7E-10	6.1E-09	2.1E-09	1.1E-09
I-129	1E+00	4.4E-08	2.2E-07	1.9E-07	1.1E-07
I-131	1E+00	2.3E-08	1.8E-07	5.2E-08	2.2E-08
Cs-134	1E+00	8.7E-09	1.6E-08	1.4E-08	1.9E-08
Cs-137	1E+00	5.7E-09	1.2E-08	1.0E-08	1.3E-08
U-234	2E-02	1.5E-08	1.3E-07	7.4E-08	4.9E-08
U-235	2E-02	1.4E-08	1.3E-07	7.1E-08	4.7E-08
U-238	2E-02	1.3E-08	1.5E-07	7.5E-08	4.8E-08
Np-237	5E-04	3.6E-09	2.1E-07	1.1E-07	1.1E-07
Pu-238	5E-04	9.0E-09	4.0E-07	2.4E-07	2.3E-07
Pu-239	5E-04	9.5E-09	4.2E-07	2.7E-07	2.5E-07
Pu-240	5E-04	9.5E-09	4.2E-07	2.7E-07	2.5E-07
Pu-241	5E-04	1.1E-10	5.7E-09	5.1E-09	4.8E-09
Am-241	5E-04	2.7E-09	3.7E-07	2.2E-07	2.0E-07
Cm-242	5E-04	4.7E-10	7.6E-08	2.4E-08	1.2E-08
Cm-243	5E-04	1.5E-07	3.3E-07	1.6E-07	1.5E-07
Cm-244	5E-04	2.2E-09	2.9E-07	1.4E-07	1.2E-07
Pu-238 (winkle only)	2E-04	3.6E-09	1.6E-07	9.6E-08	9.2E-08
Pu-239 (winkle only)	2E-04	3.8E-09	1.7E-07	1.1E-07	1.0E-07
Pu-240 (winkle only)	2E-04	3.8E-09	1.7E-07	1.1E-07	1.0E-07
Pu-241 (winkle only)	2E-04	4.4E-11	2.3E-09	2.0E-09	1.9E-09
Am-241 (winkle only)	2E-04	1.1E-09	1.5E-07	8.8E-08	8.0E-08

Table 50. Committed effective doses per unit intake for inhalation

Radionuclide	Lung absorption type	f_1	Dose per unit intake (Sv Bq^{-1})				Basis for choice of lung absorption type
			Foetus	1 year old	10 year old	Adult	
H-3 organic	V	1E+00	6.3E-11	1.1E-10	5.5E-11	4.1E-11	Organically bound
C-14	M	1E-01	6.6E-11	6.6E-09	2.8E-09	2.0E-09	ICRP default
Co-60	M	1E-01	1.2E-09	3.4E-08	1.5E-08	1.0E-08	ICRP default
Sr-90	M	1E-01	1.0E-08	1.2E-07	5.4E-08	3.8E-08	ICRP default
Zr-95	M	2E-03	4.6E-10	2.1E-08	9.0E-09	6.3E-09	ICRP default
Nb-95	M	1E-02	1.6E-10	5.2E-09	2.2E-09	1.5E-09	ICRP default
Tc-99	M	1E-01	8.3E-11	1.3E-08	5.7E-09	4.0E-09	ICRP default
Ru-106	M	5E-02	4.1E-10	1.1E-07	4.1E-08	2.8E-08	ICRP default
Ag-110m	M	5E-02	1.5E-09	2.8E-08	1.2E-08	7.6E-09	ICRP default
Sb-125	M	1E-02	2.6E-10	1.6E-08	6.8E-09	4.8E-09	ICRP default
I-129	F	1E+00	1.5E-08	8.6E-08	6.7E-08	3.6E-08	ICRP default
I-131	F	1E+00	8.1E-09	7.2E-08	1.9E-08	7.4E-09	ICRP default
Cs-134	F	1E+00	3.0E-09	7.3E-09	5.3E-09	6.6E-09	ICRP default
Cs-137	F	1E+00	2.0E-09	5.4E-09	3.7E-09	4.6E-09	ICRP default
U-234	M	2E-02	4.9E-08	1.1E-05	4.8E-06	3.5E-06	ICRP default
U-235	M	2E-02	4.5E-08	1.0E-05	4.3E-06	3.1E-06	ICRP default
U-238	M	2E-02	4.4E-08	9.4E-06	4.0E-06	2.9E-06	ICRP default
Pu-238	M	5E-04	1.1E-06	7.4E-05	4.4E-05	4.6E-05	ICRP default
Pu-239	M	5E-04	1.2E-06	7.7E-05	4.8E-05	5.0E-05	ICRP default
Pu-240	M	5E-04	1.2E-06	7.7E-05	4.8E-05	5.0E-05	ICRP default
Pu-241	M	5E-04	1.4E-08	9.7E-07	8.3E-07	9.0E-07	ICRP default
Am-241	M	5E-04	3.2E-07	6.9E-05	4.0E-05	4.2E-05	ICRP default
Cm-242	M	5E-04	5.1E-08	1.8E-05	7.3E-06	5.2E-06	ICRP default
Cm-243	M	5E-04	3.1E-05	6.1E-05	3.1E-05	3.1E-05	ICRP default
Cm-244	M	5E-04	2.6E-07	5.7E-05	2.7E-05	2.7E-05	ICRP default

Table 51. Collective dose commitment (man Sv per Bq discharged, integrated to 500 years): atmospheric discharges

Radionuclide	UK	EU	World
H-3	6.7E-16	1.2E-15	1.5E-15
C-14	2.0E-13	1.0E-12	1.3E-11
Kr-85	4.3E-18	1.5E-17	2.6E-16
Sr-90	1.9E-12	8.8E-12	8.8E-12
Ru-106	3.1E-13	4.2E-13	4.2E-13
Sb-125	1.2E-13	1.7E-13	1.7E-13
I-129	4.5E-11	2.1E-10	2.9E-10
I-131	7.8E-13	4.8E-13	4.8E-13
Cs-137	1.8E-12	6.1E-12	6.1E-12
Pu-239 & Pu-240	1.7E-10	2.4E-10	2.4E-10
Pu-241	3.0E-12	4.4E-12	4.4E-12
Am-241	1.4E-10	2.0E-10	2.0E-10

EU is defined as the population of the EU12 member states, 360 million

Table 52. Collective dose commitment (man Sv per Bq discharged, integrated to 500 years): liquid discharges

Radionuclide	UK	EU	World
H-3	4.6E-19	1.9E-18	3.5E-17
C-14	2.0E-13	6.6E-13	6.8E-12
Co-60	6.7E-14	1.9E-13	2.4E-13
Sr-90	7.0E-16	1.8E-15	3.0E-15
Zr-95	7.3E-17	1.5E-16	1.6E-16
Nb-95	1.7E-17	3.5E-17	3.8E-17
Tc-99	2.5E-15	7.6E-15	9.5E-15
Ru-106	1.9E-14	5.1E-14	5.6E-14
I-129	1.9E-14	5.7E-14	2.2E-13
Cs-134	1.3E-14	3.0E-14	4.6E-14
Cs-137	1.6E-14	4.1E-14	7.1E-14
Ce-144	6.9E-17	1.8E-16	2.0E-16
Pu-239 & Pu-240	3.0E-13	8.4E-13	9.8E-13
Pu-241	2.5E-14	7.1E-14	7.9E-14
Am-241	1.3E-12	3.6E-12	3.9E-12
Cm-242	2.3E-15	6.1E-15	6.8E-15
Cm-243 & Cm-244	4.3E-14	1.1E-13	1.2E-13

The collective dose factors include the contribution from the first decay product where appropriate.
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