Radioactivity Monitoring of the Irish Environment 2014-2015

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

ENVIRONMENTAL PROTECTION AGENCY

The Environmental Protection Agency (EPA) is responsible for protecting and improving the environment as a valuable asset for the people of Ireland. We are committed to protecting people and the environment from the harmful effects of radiation and pollution.

The work of the EPA can be divided into three main areas:

Regulation: *We implement effective regulation and environmental compliance systems to deliver good environmental outcomes and target those who don't comply.*

Knowledge: *We provide high quality, targeted and timely environmental data, information and assessment to inform decision making at all levels.*

Advocacy: *We work with others to advocate for a clean, productive and well protected environment and for sustainable environmental behaviour.*

Our Responsibilities

Licensing

We regulate the following activities so that they do not endanger human health or harm the environment:

- waste facilities *(e.g. landfills, incinerators, waste transfer stations)*;
- large scale industrial activities (*e.g. pharmaceutical, cement manufacturing, power plants)*;
- intensive agriculture *(e.g. pigs, poultry)*;
- the contained use and controlled release of Genetically Modified Organisms *(GMOs)*;
- sources of ionising radiation *(e.g. x-ray and radiotherapy equipment, industrial sources)*;
- large petrol storage facilities;
- waste water discharges;
- dumping at sea activities.

National Environmental Enforcement

- Conducting an annual programme of audits and inspections of EPA licensed facilities.
- Overseeing local authorities' environmental protection responsibilities.
- Supervising the supply of drinking water by public water suppliers.
- Working with local authorities and other agencies to tackle environmental crime by co-ordinating a national enforcement network, targeting offenders and overseeing remediation.
- Enforcing Regulations such as Waste Electrical and Electronic Equipment (WEEE), Restriction of Hazardous Substances (RoHS) and substances that deplete the ozone layer.
- Prosecuting those who flout environmental law and damage the environment.

Water Management

- Monitoring and reporting on the quality of rivers, lakes, transitional and coastal waters of Ireland and groundwaters; measuring water levels and river flows.
- National coordination and oversight of the Water Framework Directive.
- Monitoring and reporting on Bathing Water Quality.

Monitoring, Analysing and Reporting on the Environment

- Monitoring air quality and implementing the EU Clean Air for Europe (CAFÉ) Directive.
- Independent reporting to inform decision making by national and local government *(e.g. periodic reporting on the State of Ireland's Environment and Indicator Reports)*.

Regulating Ireland's Greenhouse Gas Emissions

- Preparing Ireland's greenhouse gas inventories and projections.
- Implementing the Emissions Trading Directive, for over 100 of the largest producers of carbon dioxide in Ireland.

Environmental Research and Development

- Funding environmental research to identify pressures, inform policy and provide solutions in the areas of climate, water and sustainability.

Strategic Environmental Assessment

- Assessing the impact of proposed plans and programmes on the Irish environment *(e.g. major development plans)*.

Radiological Protection

- Monitoring radiation levels, assessing exposure of people in Ireland to ionising radiation.
- Assisting in developing national plans for emergencies arising from nuclear accidents.
- Monitoring developments abroad relating to nuclear installations and radiological safety.
- Providing, or overseeing the provision of, specialist radiation protection services.

Guidance, Accessible Information and Education

- Providing advice and guidance to industry and the public on environmental and radiological protection topics.
- Providing timely and easily accessible environmental information to encourage public participation in environmental decision-making *(e.g. My Local Environment, Radon Maps)*.
- Advising Government on matters relating to radiological safety and emergency response.
- Developing a National Hazardous Waste Management Plan to prevent and manage hazardous waste.

Awareness Raising and Behavioural Change

- Generating greater environmental awareness and influencing positive behavioural change by supporting businesses, communities and householders to become more resource efficient.
- Promoting radon testing in homes and workplaces and encouraging remediation where necessary.

Management and structure of the EPA

The EPA is managed by a full time Board, consisting of a Director General and five Directors. The work is carried out across five Offices:

- Office of Environmental Sustainability
- Office of Environmental Enforcement
- Office of Evidence and Assessment
- Office of Radiation Protection and Environmental Monitoring
- Office of Communications and Corporate Services

The EPA is assisted by an Advisory Committee of twelve members who meet regularly to discuss issues of concern and provide advice to the Board.

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of the Irish Environment
2014 - 2015

Environmental Protection Agency

An Ghníomhaireacht um Chaomhnú Comhshaoil

Johnstown Castle Estate

Wexford Ireland

www.epa.ie

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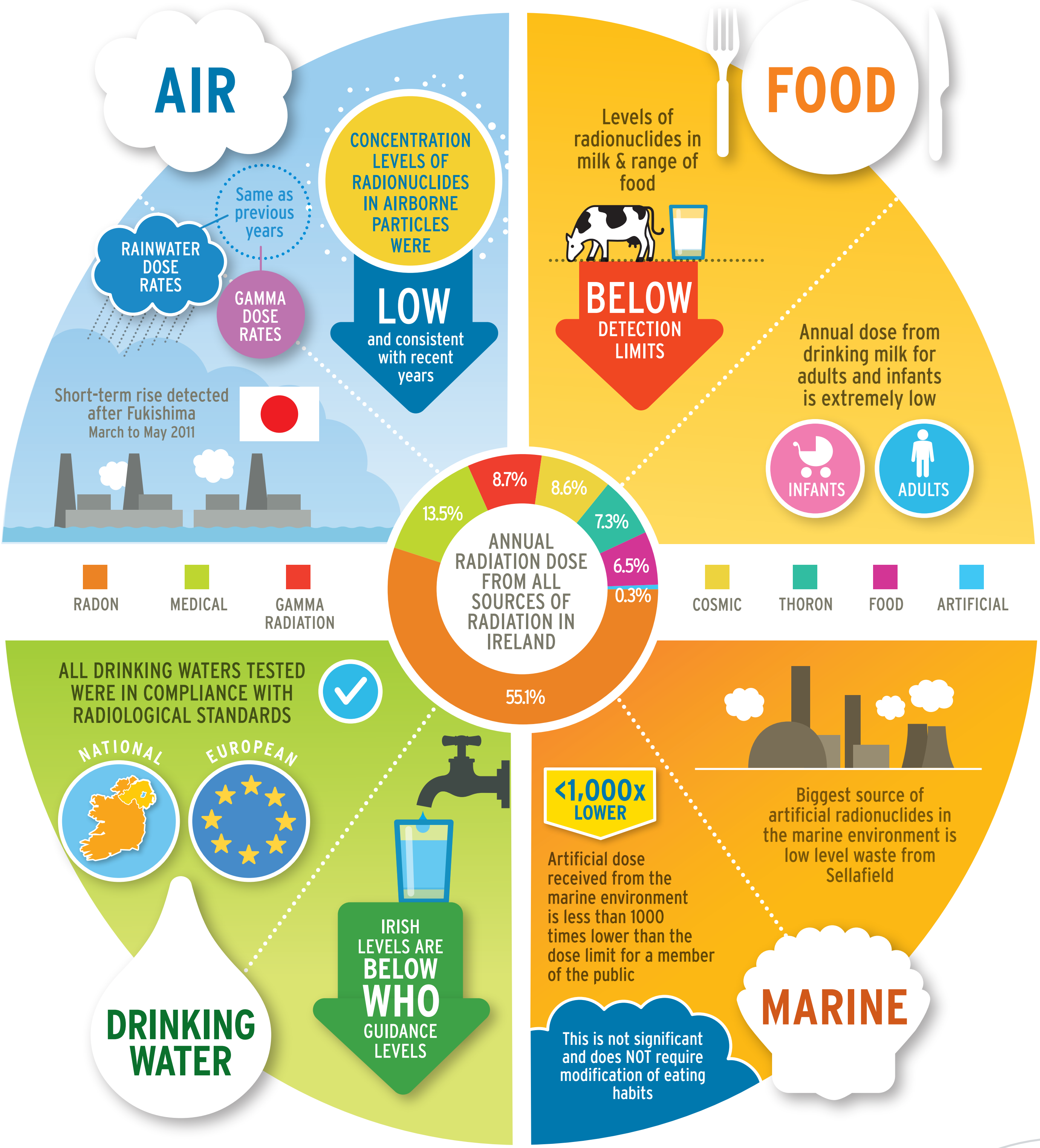

A sievert is a unit to measure the 'effective dose' of radiation on the human body to compare directly the effect of different types of radiation. Small doses are measured in microsieverts (µSv)

www.epa.ie/irelandsenvironment/

Key Statistics for 2014 & 2015

Radioactivity in Air

- 261 offline air samples taken from seven locations analysed
- Gamma dose rates monitored continuously at 15 locations across Ireland
- Levels of radionuclides detected were low and consistent with levels reported in previous years
- Annual committed effective doses due to inhalation of airborne Cs-137 were extremely low

Radioactivity in Food

- Milk samples collected monthly and analysed for radioactivity from four processing plants in Cork, Kilkenny, Monaghan and Roscommon
- Typical annual doses for adults from the consumption of milk were 0.10 µSv and 0.22 µSv for 2014 and 2015 respectively
- Typical annual doses for infants from the consumption of milk were 1.68 µSv and 1.69 µSv for 2014 and 2015 respectively

Radioactivity in Drinking Water

- Measurements carried out on 31 public drinking water supplies
- All samples tested were in compliance with national and European radiological standards

Radioactivity in the Marine Environment

- Seawater, sediments, seaweed and shellfish samples analysed from coastal and Irish Sea sampling points
- Typical annual doses to the public from eating fish and shellfish landed at north-east ports were 0.10 µSv and 0.06 µSv for 2014 and 2015 respectively.

Radiation Doses to the Irish Public

- While levels of artificial radionuclides in the Irish environment are detectable, they are low
- There is no risk to the health of the Irish population from the presence of these radionuclides
- The public typically receive 4037 µSv each year from all sources of radiation in Ireland - doses from artifical radionuclides found in the environment account for < 1% of the typical annual dose

1. Introduction

Radioactivity from both natural and artificial origins exists throughout the environment. Natural radioactivity has been present since the formation of the Earth and is also formed in the Earth's atmosphere as a result of interactions with cosmic radiation. Artificial sources of radionuclides include fallout from atmospheric nuclear weapons testing, the Chernobyl and Fukushima nuclear accidents, and the routine discharge of radionuclides from nuclear installations abroad. Liquid discharges from the Sellafield nuclear fuel reprocessing plant in the north-west of England remain the dominant source of artificial radionuclides affecting the Irish Sea. Once present in the environment, there are a number of different routes or pathways by which the public can be exposed to radiation. These include:

- Exposure by inhalation (when radioactive material is breathed into the lungs);
- Exposure through ingestion (when radioactive material in fish, shellfish, crops, animal products and drinking water is consumed); and
- Direct or external exposure to radioactive material in the environment.

In order to monitor the levels of radioactivity in the Irish terrestrial and marine environments the EPA maintains a dedicated ISO-accredited radiation monitoring laboratory in Dublin. Each year an annual radiation monitoring programme is drawn up to:

- assess the levels of radionuclides in the environment to which the Irish population is exposed;
- study trends and establish the geographical distribution of artificial radionuclides in order to improve our understanding of the long-term behaviour of these contaminants in the food chain and in the environment;
- support the Irish food and agriculture industry through the rigorous assessment of the levels of radionuclides in Irish foodstuffs;
- maintain the systems, procedures and expertise necessary to ensure that any increases in radiation levels in the environment resulting from a nuclear or radiological incident anywhere are detected and assessed rapidly;
- support the provision of evidence-based information and advice on radiation levels in the environment to Government and the public; and
- comply with statutory and international obligations concerning environmental monitoring and individual and population dose assessment.

The exposure of the Irish population to environmental radioactivity is assessed by measuring the concentrations of radionuclides in food and in the environment and by combining the results with habits data: food consumption rates, breathing rates and other information. This exposure is expressed as a radiation dose, expressed in micro-sieverts (μSv).

On average, a person in Ireland receives an annual dose of 4037 μSv from all sources of radiation (O'Connor et al., 2014). By far the largest contribution (approximately 86 per cent; 3480 μSv) comes from natural sources, mainly from the accumulation of radon gas in homes. Man-made radiation contributes approximately 14 per cent (557 μSv), dominated by the beneficial use of radiation in medicine (546 μSv). Doses from other man-made sources, including radionuclides found in the environment, account for less than 1 per cent. The contribution from all sources of radiation to the average annual dose to a person in Ireland is shown in Figure 1.

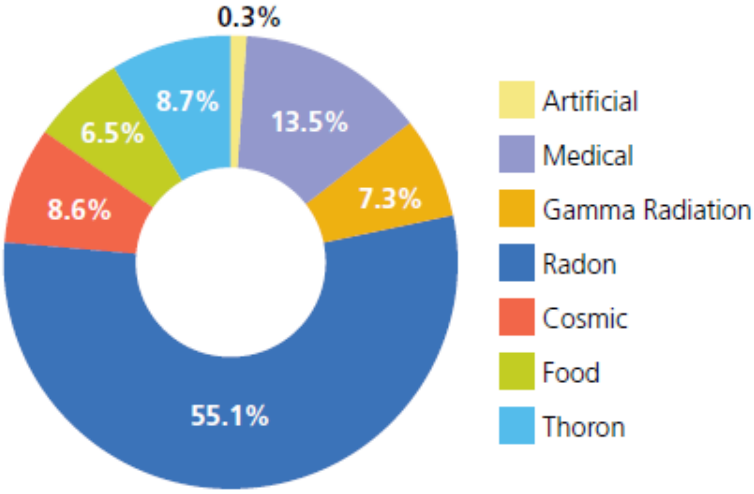

Figure 1. Contribution to annual radiation dose from all sources of radiation in Ireland

This report presents the results of Ireland's environmental radioactivity monitoring programme carried out by the EPA during 2014 and 2015.

2. Radioactivity in the Atmosphere

The National Radiation Monitoring Network

The EPA continuously assesses the level of radioactivity in the environment by operating the National Radiation Monitoring Network of permanent monitoring stations located throughout the country (Figure 2). Aerosol and rainwater samples are collected and the ambient gamma dose rate is measured at each station. The geographical distribution of the stations means that any environmental contamination can be quickly assessed across the whole country in the event of a radiological emergency – a core objective of the EPA's environmental radioactivity monitoring programme. The results of the measurements of airborne particulates and external gamma dose rates across these stations, together with the calculated annual radiation dose from the inhalation of airborne caesium-137, are presented in Tables 1 - 10.

Figure 2. The National Radiation Monitoring Network, 2014–2015

Airborne radioactivity

The EPA's radioactivity air sampling network includes both online and offline aerosol samplers. With the online system, levels of radionuclides are captured on a filter paper are measured *in situ* and the data is relayed directly to the EPA. With the offline system, the filter papers are transported to the EPA's radioanalytical laboratory in Clonskeagh for analysis. The online systems automatically correct for the natural radiation component due to radon daughters so that the readings transmitted back to the EPA are a direct estimate of the concentrations of airborne artificial radionuclides. While the online samplers provide instant results, their sensitivity is lower than what can be achieved by analysis of filters in a laboratory. The network includes one high-volume particulate sampler that allows ambient background levels of radionuclides in air to be measured. The low-volume radioactivity air sampling network includes five online and six offline stations.

Table 1. Radioactivity in airborne particulates (low-volume), Cahirciveen, 2014–2015

Sampling period		Concentration in air (Bq/m^3)		
Start date	End date	Gross beta	Cs-137	Be-7
2014				
5-Jan	12-Jan	nm	nm	nm
2-Feb	9-Feb	nm	nm	nm
1-Mar	8-Mar	nm	nm	nm
5-Apr	12-Apr	nm	nm	nm
3-May	10-May	nm	nm	nm
12-Jun	19-Jun	2.1×10^{-4}	nd	2.4×10^{-3}
3-Jul	10-Jul	1.0×10^{-4}	nd	1.5×10^{-3}
7-Aug	14-Aug	1.2×10^{-4}	nd	1.8×10^{-3}
4-Sep	11-Sep	3.6×10^{-4}	nd	2.1×10^{-3}
1-Oct	09-Oct	1.9×10^{-4}	nd	3.3×10^{-3}
6-Nov	13-Nov	9.8×10^{-5}	nd	1.5×10^{-3}
4-Dec	11-Dec	1.8×10^{-4}	nd	2.9×10^{-3}
2015				
1-Jan	8-Jan	1.3×10^{-4}	nd	2.1×10^{-3}
5-Feb	12-Feb	3.0×10^{-4}	nd	3.2×10^{-3}
5-Mar	12-Mar	2.5×10^{-4}	nd	3.8×10^{-3}
2-Apr	9-Apr	2.4×10^{-4}	nd	1.5×10^{-3}
7-May	14-May	3.1×10^{-4}	nd	3.2×10^{-3}
4-Jun	11-Jun	2.4×10^{-4}	nd	3.0×10^{-3}
2-Jul	9-Jul	1.0×10^{-4}	nd	1.9×10^{-3}
6-Aug	13-Aug	1.0×10^{-4}	nd	1.2×10^{-3}
3-Sep	10-Sep	2.8×10^{-4}	nd	2.8×10^{-3}
1-Oct	8-Oct	6.3×10^{-4}	nd	3.5×10^{-3}
5-Nov	12-Nov	1.2×10^{-4}	nd	1.7×10^{-3}
3-Dec	10-Dec	2.3×10^{-4}	nd	2.9×10^{-3}

Note: nd = not detected (the sample was analysed but the concentration of this radionuclide was below the limit of detection). nm= not measured as this system was out of service from January – May 2014.

Table 2. Radioactivity in airborne particulates (low-volume), Clonskeagh, 2014–2015

Sampling period		Concentration in air (Bq/m3)		
Start date	End date	Gross beta	Cs-137	Be-7
2014				
2-Jan	9-Jan	7.1×10^{-5}	nd	2.7×10^{-3}
6-Feb	13-Feb	2.9×10^{-4}	nd	3.2×10^{-3}
6-Mar	13-Mar	4.1×10^{-4}	nd	4.5×10^{-3}
3-Apr	10-Apr	2.7×10^{-4}	nd	3.5×10^{-3}
24-Apr	1-May	3.0×10^{-4}	nd	3.3×10^{-3}
5-Jun	12-Jun	2.3×10^{-4}	nd	4.1×10^{-3}
3-Jul	10-Jul	1.3×10^{-4}	nd	1.9×10^{-3}
7-Aug	14-Aug	2.1×10^{-4}	nd	3.0×10^{-3}
4-Sep	11-Sep	4.8×10^{-4}	nd	2.8×10^{-3}
2-Oct	13-Oct	3.3×10^{-4}	nd	3.9×10^{-3}
6-Nov	13-Nov	1.5×10^{-4}	nd	1.8×10^{-3}
4-Nov	11-Dec	3.0×10^{-4}	nd	3.1×10^{-3}
2015				
2-Jan	9-Jan	1.2×10^{-4}	nd	1.7×10^{-3}
5-Feb	12-Feb	3.0×10^{-4}	nd	3.0×10^{-3}
5-Mar	12-Mar	3.9×10^{-4}	nd	4.8×10^{-3}
2-Apr	9-Apr	4.3×10^{-4}	nd	2.8×10^{-3}
7-May	15-May	2.8×10^{-4}	nd	3.0×10^{-3}
4-Jun	11-Jun	3.2×10^{-4}	nd	4.0×10^{-3}
2-Jul	9-Jul	2.1×10^{-4}	nd	2.5×10^{-3}
6-Aug	13-Aug	2.5×10^{-4}	nd	2.4×10^{-3}
3-Sep	9-Sep	3.2×10^{-4}	nd	3.4×10^{-3}
8-Oct	15-Oct	5.6×10^{-4}	nd	4.0×10^{-3}
10-Nov	19-Nov	2.2×10^{-4}	nd	2.9×10^{-3}
3-Dec	11-Dec	3.7×10^{-4}	nd	4.0×10^{-3}

Note: nd = not detected (sample was analysed but the concentration of this radionuclide was below the limit of detection.

Table 3. Radioactivity in airborne particulates (low-volume), Cork Airport, 2014–2015

Sampling period		Concentration in air (Bq/m^3)		
Start date	End date	Gross beta	Cs-137	Be-7
2014				
3-Jan	10-Jan	4.6×10^{-5}	nd	1.8×10^{-3}
7-Feb	14-Feb	1.4×10^{-4}	nd	2.1×10^{-3}
7-Mar	14-Mar	3.2×10^{-4}	nd	1.6×10^{-3}
4-Apr	11-Apr	2.3×10^{-4}	nd	3.1×10^{-3}
2-May	09-May	1.9×10^{-4}	nd	1.6×10^{-3}
6-Jun	13-Jun	1.2×10^{-4}	nd	1.3×10^{-3}
4-Jul	11-Jul	1.6×10^{-4}	nd	1.7×10^{-3}
1-Aug	8-Aug	1.8×10^{-4}	nd	2.0×10^{-3}
5-Sep	12-Sep	4.4×10^{-4}	nd	2.6×10^{-3}
3-Oct	10-Oct	1.4×10^{-4}	nd	2.8×10^{-3}
14-Nov	21-Nov	1.8×10^{-4}	nd	1.7×10^{-3}
5-Dec	12-Dec	1.9×10^{-4}	nd	2.4×10^{-3}
2015				
2-Jan	9-Jan	1.2×10^{-4}	nd	1.8×10^{-3}
6-Feb	13-Feb	3.1×10^{-4}	nd	2.5×10^{-3}
6-Mar	13-Mar	1.5×10^{-4}	nd	2.3×10^{-3}
3-Apr	10-Apr	3.0×10^{-4}	nd	1.5×10^{-3}
1-May	8-May	1.6×10^{-4}	nd	1.9×10^{-3}
5-Jun	12-Jun	2.8×10^{-4}	nd	3.3×10^{-3}
3-Jul	10-Jul	1.2×10^{-4}	nd	2.1×10^{-3}
7-Aug	14-Aug	3.1×10^{-4}	nd	2.0×10^{-3}
4-Sep	12-Sep	3.1×10^{-4}	nd	1.7×10^{-3}
2-Oct	9-Oct	5.9×10^{-4}	nd	2.4×10^{-3}
2-Nov	6-Nov	1.3×10^{-3}	nd	1.3×10^{-3}
4-Dec	11-Dec	3.1×10^{-4}	nd	2.7×10^{-3}

Note: nd = not detected (sample was analysed but the concentration of this radionuclide was below the limit of detection).

Table 4. Radioactivity in airborne particulates (low-volume), Glasnevin, 2014–2015

Sampling period		Concentration in air (Bq/m^3)		
Start date	End date	Gross beta	Cs-137	Be-7
		2014		
8-Jan	14-Jan	9.5×10^{-5}	nd	1.4×10^{-3}
5-Feb	12-Feb	1.6×10^{-4}	nd	1.7×10^{-3}
5-Mar	12-Mar	2.5×10^{-4}	nd	2.3×10^{-3}
2-Apr	09-Apr	2.5×10^{-4}	nd	1.9×10^{-3}
7-May	14-May	1.3×10^{-4}	nd	1.4×10^{-3}
4-Jun	11-Jun	1.6×10^{-4}	nd	3.3×10^{-3}
2-Jul	9-Jul	1.7×10^{-4}	nd	2.0×10^{-3}
7-Aug	13-Aug	1.5×10^{-4}	nd	2.4×10^{-3}
3-Sep	10-Sep	3.8×10^{-4}	nd	2.3×10^{-3}
1-Oct	8-Oct	2.7×10^{-4}	nd	3.6×10^{-3}
5-Nov	12-Nov	1.6×10^{-4}	nd	1.4×10^{-3}
3-Dec	10-Dec	1.8×10^{-4}	nd	1.6×10^{-3}
		2015		
7-Jan	14-Jan	1.1×10^{-4}	nd	2.5×10^{-3}
4-Feb	11-Feb	2.2×10^{-4}	nd	2.0×10^{-3}
4-Mar	11-Mar	2.6×10^{-4}	nd	3.7×10^{-3}
1-Apr	8-Apr	2.3×10^{-4}	nd	1.4×10^{-3}
6-May	13-May	2.1×10^{-4}	nd	2.6×10^{-3}
3-Jun	10-Jun	2.0×10^{-4}	nd	2.6×10^{-3}
1-Jul	8-Jul	2.1×10^{-4}	nd	2.5×10^{-3}
5-Aug	12-Aug	2.0×10^{-4}	nd	1.8×10^{-3}
2-Sep	9-Sep	2.4×10^{-4}	nd	2.2×10^{-3}
7-Oct	14-Oct	3.6×10^{-4}	nd	2.2×10^{-3}
4-Nov	11-Nov	3.5×10^{-4}	nd	3.2×10^{-3}
2-Dec	9-Dec	2.5×10^{-4}	nd	2.2×10^{-3}

Note: nd = not detected (sample was analysed but the concentration of this radionuclide was below the limit of detection).

Table 5. Radioactivity in airborne particulates (low-volume), Knock Airport, 2014–2015

Sampling period		Concentration in air (Bq/m^3)		
Start date	End date	Gross beta	Cs-137	Be-7
2014				
27-Jan	3-Feb	1.1×10^{-4}	nd	1.7×10^{-3}
3-Feb	10-Feb	2.3×10^{-4}	nd	2.6×10^{-3}
3-Mar	10-Mar	2.9×10^{-4}	nd	3.3×10^{-3}
7-Apr	14-Apr	4.3×10^{-4}	nd	5.9×10^{-3}
5-May	12-May	1.3×10^{-4}	nd	1.7×10^{-3}
2-Jun	09-Jun	1.6×10^{-4}	nd	2.7×10^{-3}
7-Jul	14-Jul	1.4×10^{-4}	nd	1.3×10^{-3}
3-Aug	11-Aug	2.0×10^{-4}	nd	2.8×10^{-3}
8-Sep	15-Sep	5.2×10^{-4}	nd	2.0×10^{-3}
6-Oct	13-Oct	3.3×10^{-4}	nd	1.3×10^{-3}
3-Nov	10-Nov	7.1×10^{-5}	nd	0.9×10^{-3}
1-Dec	8-Dec	1.6×10^{-4}	nd	2.4×10^{-3}
2015				
5-Jan	12-Jan	1.4×10^{-4}	nd	3.0×10^{-3}
2-Feb	9-Feb	1.8×10^{-4}	nd	1.2×10^{-3}
2-Mar	9-Mar	2.2×10^{-4}	nd	2.3×10^{-3}
6-Apr	13-Apr	5.5×10^{-4}	nd	3.4×10^{-3}
4-May	11-May	2.9×10^{-4}	nd	3.3×10^{-3}
1-Jun	8-Jun	1.6×10^{-4}	nd	3.2×10^{-3}
13-Jul	20-Jul	1.8×10^{-4}	nd	1.9×10^{-3}
3-Aug	10-Aug	1.7×10^{-4}	nd	1.9×10^{-3}
7-Sep	14-Sep	4.4×10^{-4}	nd	2.7×10^{-3}
5-Oct	12-Oct	2.8×10^{-4}	nd	2.2×10^{-3}
2-Nov	9-Nov	9.1×10^{-4}	nd	1.5×10^{-3}
7-Dec	14-Dec	3.3×10^{-4}	nd	1.8×10^{-3}

Note: nd = not detected (sample was analysed but the concentration of this radionuclide was below the limit of detection).

Table 6. Radioactivity in airborne particulates (low-volume), Shannon Airport, 2014–2015

Sampling period		Concentration in air (Bq/m^3)		
Start date	End date	Gross beta	Cs-137	Be-7
		2014		
2-Jan	09-Jan	4.1×10^{-5}	nd	1.9×10^{-3}
6-Feb	13-Feb	2.3×10^{-4}	nd	2.5×10^{-3}
6-Mar	13-Mar	2.9×10^{-4}	nd	2.0×10^{-3}
10-Apr	17-Apr	3.6×10^{-4}	nd	4.0×10^{-3}
1-May	8-May	2.4×10^{-4}	nd	2.2×10^{-3}
5-Jun	13-Jun	1.8×10^{-4}	nd	3.6×10^{-3}
3-Jul	17-Jul	1.6×10^{-4}	nd	2.2×10^{-3}
14-Aug	21-Aug	2.4×10^{-4}	nd	3.3×10^{-3}
4-Sep	11-Sep	4.5×10^{-4}	nd	2.7×10^{-3}
2-Oct	9-Oct	2.2×10^{-4}	nd	2.8×10^{-3}
7-Nov	20-Nov	1.6×10^{-4}	nd	1.6×10^{-3}
4-Dec	11-Dec	2.1×10^{-4}	nd	2.5×10^{-3}
		2015		
22-Dec	29-Jan	1.6×10^{-4}	nd	3.1×10^{-3}
5-Feb	12-Feb	3.1×10^{-4}	nd	3.3×10^{-3}
5-Mar	13-Mar	2.1×10^{-4}	nd	3.3×10^{-3}
2-Apr	9-Apr	3.8×10^{-4}	nd	2.8×10^{-3}
7-May	14-May	3.1×10^{-4}	nd	4.3×10^{-3}
4-Jun	11-Jun	3.0×10^{-4}	nd	3.4×10^{-3}
2-Jul	9-Jul	1.4×10^{-4}	nd	2.2×10^{-3}
6-Aug	13-Aug	1.4×10^{-4}	nd	1.4×10^{-3}
3-Sep	10-Sep	4.0×10^{-4}	nd	3.2×10^{-3}
1-Oct	15-Oct	5.4×10^{-4}	nd	2.6×10^{-3}
5-Nov	12-Nov	1.8×10^{-4}	nd	2.5×10^{-3}
26-Nov	10-Dec	2.0×10^{-4}	nd	2.1×10^{-3}

Note: nd = not detected (sample was analysed but the concentration of this radionuclide was below the limit of detection).

Table 7. Radioactivity in airborne particulates (high-volume), Belfield (Dublin), 2014–2015

Sampling period		Concentration in air (Bq/m^3)	
Start date	**End date**	**Cs-137**	**Be-7**
2014			
02-Jan	30-Jan	1.6×10^{-7}	1.4×10^{-3}
30-Jan	28-Feb	1.3×10^{-7}	1.6×10^{-3}
28-Feb	28-Mar	1.6×10^{-7}	1.8×10^{-3}
28-Mar	30-Apr	3.4×10^{-7}	2.0×10^{-3}
30-Apr	29-May	1.2×10^{-7}	1.7×10^{-3}
29-May	27-Jun	1.2×10^{-7}	2.4×10^{-3}
27-Jun	31-Jul	1.1×10^{-7}	2.2×10^{-3}
31-Jul	29-Aug	1.4×10^{-7}	2.1×10^{-3}
29-Aug	02-Oct	1.9×10^{-7}	2.6×10^{-3}
02-Oct	30-Oct	2.1×10^{-7}	2.4×10^{-3}
30-Oct	27-Nov	8.9×10^{-7}	1.6×10^{-3}
27-Nov	30-Dec	8.1×10^{-7}	1.7×10^{-3}
Mean		**2.8×10^{-7}**	**2.0×10^{-3}**
2015			
30-Dec	29-Jan	4.6×10^{-7}	1.7×10^{-3}
29-Jan	26-Feb	8.2×10^{-7}	1.7×10^{-3}
26-Feb	02-Apr	6.0×10^{-7}	2.0×10^{-3}
02-Apr	30-Apr	12×10^{-7}	2.2×10^{-3}
30-Apr	29-May	1.4×10^{-7}	1.9×10^{-3}
29-May	30-Jun	1.1×10^{-7}	1.9×10^{-3}
30-Jun	31-Jul	0.7×10^{-7}	1.5×10^{-3}
01-Sep	29-Sep	0.8×10^{-7}	2.2×10^{-3}
29-Sep	30-Oct	1.2×10^{-7}	2.7×10^{-3}
4-Dec	04-Jan	1.3×10^{-7}	2.1×10^{-3}
Mean		**3.6×10^{-7}**	**2.0×10^{-3}**

Radiation doses from inhalation of airborne caesium-137

Annual radiation doses due to inhalation of airborne caesium-137 in 2014 and 2015 (as measured in high-volume airborne particulates) were calculated from the mean annual activity concentrations of this radionuclide as set out in Table 7. Committed effective dose coefficients were taken from the Basic Safety Standards Directive (European Commission, 1996). A breathing rate of 22.2 m^3/day of air was assumed (Smith and Simmonds, 2009). The doses were calculated to be 0.9×10^{-4} μSv and 1.1×10^{-4} μSv for 2014 and 2015 respectively. These are in broad agreement with the values reported in recent years (see Table 8) with the exception of 2011 in which the figure was higher, though still radiologically insignificant, as a result of elevated airborne levels of this radionuclide due to the Fukushima nuclear accident.

Table 8. Annual committed effective doses due to inhalation of airborne caesium-137, 2001-2015

Year	Average Cs-137 concentration in air (Bq/m^3)	Annual committed effective dose (μSv)
2001/02	22×10^{-7}	5.8×10^{-4}
2003	16×10^{-7}	4.3×10^{-4}
2004	3.4×10^{-7}	0.9×10^{-4}
2005	2.9×10^{-7}	0.8×10^{-4}
2006	4.0×10^{-7}	1.1×10^{-4}
2007	3.7×10^{-7}	1.0×10^{-4}
2008	2.8×10^{-7}	0.7×10^{-4}
2009	3.0×10^{-7}	0.8×10^{-4}
2010	6.2×10^{-7}	2.0×10^{-4}
2011	98×10^{-7}	30.9×10^{-4}
2012	4.9×10^{-7}	1.5×10^{-4}
2013	6.1×10^{-7}	1.9×10^{-4}
2014	2.8×10^{-7}	0.9×10^{-4}
2015	3.6×10^{-7}	1.1×10^{-4}

Rainwater

Rainwater samples collected at the Clonskeagh site were analysed for caesium-137 and other gamma emitting radionuclides. All measurements of caesium-137 were below the limits of detection.

External gamma dose rate

External gamma dose rates were recorded every minute by a network of fifteen stations in 2014 and 2015. These readings were automatically transmitted at hourly intervals to the EPA's database at its Clonskeagh office. This network is an important component of the EPA's early warning arrangements for elevated levels of radioactivity in the atmosphere. Recent data from each station can be viewed on the EPA website (http://www.epa.ie/radiation/monassess/mapmon/). Each station has an alarm that is triggered in the event of a high reading or a technical failure.

Table 9. Minimum and maximum external gamma dose rates (terrestrial), 2014

Location	Monthly ranges (nSv/h)											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
	2014											
Cahirciveen	79 – 98	78 – 93	78 – 92	78 – 99	79 – 91	80 – 92	82 – 106	82 – 91	81 – 117	79 – 99	79 – 102	76 - 89
Casement	73 – 89	74 – 93	72 – 86	72 – 90	71 – 88	71 – 86	73 – 99	71 – 89	72 – 93	72 – 94	73 – 93	71 – 82
Clones	75 – 95	75 – 90	73- 82	73 – 89	72 – 89	70 – 87	71 – 86	72 – 87	72 – 84	74 – 88	74 - 98	72 – 81
Clonskeagh	117 – 129	116 – 136	112 – 127	111 – 127	111 – 125	110 – 126	110 – 133	111 – 126	113 – 134	114 – 128	115 -134	114 – 125
Coolgreany	96 – 134	96 – 115	95 -106	95 – 113	96 – 126	96 – 114	99 – 133	96 – 109	96 – 110	95 – 123	95 – 173	93 – 100
Cork Airport	81 – 118	81 – 101	79 – 107	81 – 99	82 – 94	83 – 99	87 – 108	85 – 96	87 – 109	81 – 125	81 – 139	78 – 87
Dundalk	103 – 119	103 – 115	101 – 120	101 – 127	101 – 120	104 – 116	108 – 120	106 – 118	106 – 120	103 – 131	102 – 137	99 – 109
Gurteen	77 – 93	78 – 95	75 – 94	75 – 92	73 – 98	76 – 87	78 – 111	77 – 98	77 – 113	76 – 90	76 – 103	74 – 86
Kilmeadan	91 – 112	90 – 109	88 – 108	88 – 106	89 – 111	91 – 105	99 – 114	95 – 111	96 – 111	90 – 123	82 – 157	86 – 95
Kiltrough	86 – 102	85 – 104	83 – 97	83 – 101	82 – 103	87 – 89	85 – 98	84 – 109	85 – 100	84 – 104	84 – 107	83 – 92
Knock Airport	69 – 92	70 – 83	67 – 86	67 – 86	68 – 89	67- 81	67 – 84	67 – 80	67 – 95	67 – 106	68 – 90	65 – 77
Malin Head	67 – 88	69 – 88	67 – 77	67 – 86	68 – 77	67 – 86	68 – 78	68 – 86	68 – 80	68 – 90	67 – 88	65 – 75
Mullingar	66 – 80	67 – 89	64 – 76	65 – 89	65 – 88	64 – 80	66 – 88	65 – 87	65 – 77	65 – 88	65 – 88	64 – 74
Rosslare	73 – 99	74 – 92	72 – 97	72 – 93	75 – 108	76 – 90	78 – 97	77 – 90	77 – 100	74 – 97	71 – 121	71 – 82
Shannon Airport	79 – 98	78 – 97	78 – 104	77 – 89	78 – 107	78 – 90	81 – 102	79 – 93	80 – 149	78 – 90	79 – 94	78 – 86

Table 10. Minimum and maximum external gamma dose rates (terrestrial), 2015

Location	Monthly ranges (nSv/h)											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
	2015											
Cahirciveen	77 – 93	77 – 92	76 – 88	78 – 88	78 – 91	79 – 96	78 – 91	78 – 90	79 – 90	79 – 96	78 - 89	77 – 106
Casement	72 – 86	71 – 82	71 – 85	71 – 82	71 – 84	71 -80	74 – 83	71 – 106	73 – 85	72 – 111	72 – 85	73 – 112
Clones	72 – 85	71– 85	71 – 81	71 – 80	71 – 84	70 – 80	72 – 84	71 – 99	70 – 86	72 – 114	72 – 86	73 – 112
Clonskeagh	114 – 126	111 – 126	112 – 126	111 – 12	111 – 124	112 – 123	113 – 125	113 – 137	112 – 130	114 – 184	113 – 125	114 – 139
Coolgreany	91 – 105	93 – 105	92 - 105	93 – 104	93 – 119	95 – 107	96 – 118	95 – 117	94 – 117	95 – 149	92 – 111	92 – 182
Cork Airport	79 – 99	78 – 95	78 – 89	79 – 93	81 – 98	82 – 100	82 – 108	102 – 110	101 – 114	101 – 185	100 – 112	100 – 158
Dundalk	99 – 111	99 – 112	99 – 108	99 – 112	100 – 122	101 – 114	105 – 122	103 – 141	101 – 128	101 – 152	99 – 111	99 – 123
Gurteen	74 – 90	75 – 86	75 – 85	76 – 84	76 – 88	75 – 85	77 – 92	77 – 94	75 – 99	76 – 131	75 – 92	77 – 100
Kilmeadan	87 – 99	87 – 101	87 – 98	89 – 105	89 – 102	90 – 109	91 – 115	91 – 102	91 – 109	89 – 143	87 – 101	87 – 146
Kiltrough	82 – 93	82 – 94	80 – 95	81 – 93	81 – 95	81 – 92	85 – 100	88 – 117	83 – 110	83 – 148	82 – 94	82 – 104
Knock Airport	65 – 83	66 – 85	65 – 78	67 – 76	67 – 86	66 – 76	67 – 82	67 – 86	67 – 93	67 – 108	67 – 85	66 – 106
Malin Head	65 – 79	65 – 80	65 – 77	66 – 76	67 – 79	65 – 74	67 – 82	66 – 113	66 – 96	66 – 105	66 – 87	66 – 91
Mullingar	64 – 76	64 – 76	65 – 76	65 – 75	64 – 86	64 – 74	65 – 83	66 – 80	64 – 81	66 – 117	65 – 78	66 – 99
Rosslare	71 – 87	72 – 85	71 – 83	73 – 83	73 – 91	74 – 88	75 – 86	74 – 92	73 – 102	74 – 126	72 – 98	71 – 121
Shannon Airport	76 – 95	78 – 89	77 – 88	77 – 86	77 – 91	77 – 91	79 – 95	78 – 89	77 – 89	78 – 112	77 – 90	78 – 100

3. Radioactivity in foodstuffs and drinking water

Foodstuffs

The European Commission advises member states to carry out routine measurement of radioactivity in milk and mixed diet (European Commission, 2000). In particular, it recommends measuring levels of caesium-137 and strontium-90 in milk, as these radionuclides may concentrate in milk in the event of an accidental release of radioactivity from a nuclear facility abroad. Milk is also of particular importance as a foodstuff for children.

Radioactivity in milk

Milk samples were taken monthly at four processing plants in different parts of the country, in counties Cork, Kilkenny, Monaghan and Roscommon. For three locations – Cork, Monaghan and Roscommon – raw milk samples were bulked quarterly and analysed for strontium-90 and caesium-137 in line with the Commission's recommendation. Table 11 presents the results of these analyses for 2014 and 2015. Potassium-40 (K-40) is a naturally occurring radionuclide and was measured for quality control purposes. In cases where strontium-90 was detected concentrations were below 1 Bq/l. Caesium-137 was only detected once during the reporting period.

In addition, the samples collected from a single processing plant in Kilkenny were also analysed monthly for iodine-131, caesium-137, and potassium-40. Results for the Kilkenny plant are presented in Table 12. Neither caesium-137 nor iodine-131 was detected in any samples during the reporting period. Following rapid analyses of these samples by gamma spectrometry they were bulked on a quarterly basis and analysed for Sr-90 by liquid scintillation counting. The results are also included in Table 12.

Table11. Radioactivity in milk

County	Concentration (Bq/l)											
	Sr-90	Cs-137	K-40	Sr-90	Cs-137	K-40	Sr-90	Cs-137	K-40	Sr-90	Cs-137	K-40
	Jan-Mar			Apr-Jun			Jul-Sep			Oct-Dec		
2014												
Cork	nd	nd	47.5	0.041	nd	47.5	0.061	nd	53.1	0.021	nd	40.1
Monaghan	nd	nd	46.3	0.054	nd	47.2	nd	nd	51.7	0.022	nd	49.8
Roscommon	nd	nd	45.3	0.089	nd	45.8	nd	nd	51.8	-	-	-
2015												
Cork	nd	nd	50.6	nd	nd	50.2	nd	nd	48.8	nd	nd	45.3
Monaghan	nd	nd	41.5	nd	nd	45.7	nd	nd	49.4	nd	nd	45.2
Roscommon	nd	nd	44.2	nd	nd	47.4	nd	nd	47.0	nd	0.14	46.8

Note: nd = not detected (the sample was analysed but levels were below the limit of detection).

Table 12. Radioactivity in milk, Ballyragget, Co Kilkenny

Sampling period	Concentration (Bq/l)			
	Cs-137	I-131	K-40	Sr-90
2014				
Jan	nd	nd	43.7	nd
Feb	nd	nd	45.9	
Mar	nd	nd	46.8	
Apr	nd	nd	48.2	0.035
May	nd	nd	51.4	
Jun	nd	nd	50.7	
Jul	nd	nd	44.3	nd
Aug	nd	nd	42.6	
Sep	nd	nd	52.2	
Oct	nd	nd	45.0	0.024
Nov	nd	nd	46.5	
Dec	nd	nd	44.9	
Mean	-	-	46.9	
2015				
Jan	nd	nd	43.5	nd
Feb	nd	nd	45.8	
Mar	nd	nd	45.7	
Apr	nd	nd	46.1	nd
May	nd	nd	48.8	
Jun	nd	nd	48.9	
Jul	nd	nd	48.5	nd
Aug	nd	nd	54.5	
Sep	nd	nd	44.1	
Oct	nd	nd	45.1	0.032
Nov	nd	nd	38.4	
Dec	nd	nd	43.7	
Mean	-	-	46.1	

Note: nd = not detected (the sample was analysed but levels were below the limit of detection).

Radiation doses from consumption of milk

Annual committed effective doses to adults and children from the consumption of milk were estimated for strontium-90 and caesium-137. Doses were calculated using the mean of measured concentrations for these radionuclides (Tables 11 and 12). Ingestion dose coefficients for adults and infants were taken from the Basic Safety Standards Directive (European Commission, 1996) (Table 13). Typical milk consumption rates for adults and children were derived from the results of the National Adult Nutrition Survey (IUNA, 2011) and the National Pre-school Nutrition Survey (IUNA, 2012) respectively. Based on these, the mean milk consumption for an adult male and a child (1 year old) in Ireland has been estimated as 78 kg/year and 150 kg/year respectively (IUNA, 2015). The figure for adults includes the contribution from both whole and semi-skimmed milk and from other milks. The figure for children includes contributions from these milks as well as infant formula and growing up milks. In calculating the dose for strontium-90 it is assumed that its daughter product yttrium-90 is in equilibrium.

Table 13. Ingestion dose coefficients for radionuclides detected in milk

Radionuclide	Category	Dose coefficient (Sv/Bq)
Cs-137	Infant	2.1×10^{-8}
	Adult	1.3×10^{-8}
Sr-90	Infant	2.3×10^{-7}
	Adult	2.8×10^{-8}
Y-90	Infant	3.1×10^{-8}
	Adult	2.7×10^{-9}

The calculated doses for consumption of milk are dominated by strontium-90, as shown in Table 14. Doses to infants from consuming milk were estimated to be 1.68 μSv in 2014 and 1.69 μSv in 2015. The annual committed effective doses due milk consumption for both adults and infants in 2014 and 2015 are radiologically insignificant.

Table 14. Annual committed effective dose from radionuclides in milk, 2014–2015

Radionuclide	Category	Average concentration (Bq/l)	Annual committed effective dose (μSv)
2014			
Cs-137	Infant	-	-
	Adult		-
Sr-90	Infant	0.043	1.48
	Adult		0.09
Y-90	Infant	0.043	0.20
	Adult		0.01
Total	**Infant**		**1.68**
	Adult		**0.10**
2015			
Cs-137	Infant	0.14	0.44
	Adult		0.14
Sr-90	Infant	0.032	1.10
	Adult		0.07
Y-90	Infant	0.032	0.15
	Adult		0.01
Total	**Infant**		**1.69**
	Adult		**0.22**

Radioactivity in mixed diet foodstuffs

In 2014 and 2015, complete meals (mixed diet) from restaurant facilities in Dublin were sampled and analysed for gamma-emitting radionuclides on a monthly basis. This sampling strategy has been implemented on the basis that, as modern food distribution networks are extensive and that regional variations regarding consumption in Ireland are not significant, it is more effective to monitor mixed diet at a single location with a higher sampling frequency rather than from multiple locations.

The results of these measurements of mixed diet samples are provided in Table 15. With the exception of four, all measurements of caesium-137 concentrations during 2014 and 2015 were below the level of detection. Potassium-40 (K-40) is a naturally occurring radionuclide and was measured for quality control purposes.

Table 15. Radioactivity in mixed diet samples, Co Dublin

Sampling period	Concentration (Bq/kg)	
	Cs-137	K-40
2014		
Jan	nd	63.4
Feb	nd	66.1
Mar	nd	66.1
Apr	nd	6.2
May	nd	72.3
Jun	nd	94.0
Aug	nd	46.2
Sep	nd	75.1
Oct	nd	77.1
Nov	nd	65.0
Dec	0.20	87.0
Mean	**-**	**59.7**
2015		
Jan	nd	49.6
Feb	0.09	77.3
Mar	nd	52.1
Apr	nd	67.1
May	nd	98.6
Jun	nd	47.7
Jul	nd	94.0
Aug	nd	75.7
Sep	nd	91.3
Oct	nd	58.8
Nov	0.06	49.0
Dec	0.18	69.2
Mean	**0.11**	**49.6**

Note: nd = not detected (the sample was analysed but levels were below the limit of detection).

In conjunction with the Department of Agriculture, Food and the Marine, grain samples from various locations nationwide were sampled and screened for gamma-emitting radionuclides following the 2014 and 2015 harvests. The results are shown in Table 16. All activities in these samples were below the limit of detection of 5 Bq/kg.

Table 16. Radioactivity in grain samples

Sampling location	Type	Concentration (Bq/kg)	
		Cs-137	K-40
2014			
Cork	Wheat	nd	104
Kildare	Barley	nd	115
Kildare	Oats	nd	74.7
Waterford	Oats	nd	61.6
Wexford	Wheat	nd	60.2
Wexford	Wheat	nd	94.7
2015			
Cork	Wheat	nd	123
Kildare	Barley	nd	93.3
Louth	Oats	nd	94.7
Louth	Wheat	nd	98.2
Waterford	Barley	nd	111

Note: nd **=** not detected (the sample was analysed but levels were below the limit of detection).

Drinking water

The EPA routinely measures samples from major drinking water supplies serving large populations in rotation so that supplies from every county are sampled approximately every four years. Major supplies are defined as those serving a population of 10,000 or more or the largest supply in a county.

The results from 31 supplies monitored during 2014 and 2015 are presented in Table 17. Samples were analysed for gross alpha and gross beta activities respectively and assessed for compliance with the Indicative Dose (ID), a parametric standard for radioactivity set out in the Drinking Water Directive (European Commission, 2013). In the case of gross alpha and gross beta activity, screening levels are set at 100 mBq/l and 1000 mBq/l respectively.

All drinking water supplies tested were found to be below the screening levels, and hence with the ID, and were therefore considered acceptable for human consumption from a radiological perspective.

Table 17. Gross alpha and gross beta activity concentrations in drinking water, 2014–2015

County	Supply	Concentration (mBq/l)		Compliance with ID
		Gross alpha	Gross beta	
2014				
Dublin/Kildare	Leixlip	53.9	100.9	Yes
Louth	Cavanhill	nd	97.9	Yes
	Staleen	36.9	123.8	Yes
Meath	Trim	51.0	123.8	Yes
	Kells Old-Castle	28.2	85.8	Yes
	Navan Mid-Meath	56.7	68.0	Yes
Monaghan	LERWSS	nd	116.0	Yes
Mayo	Lough Mask	nd	62.7	Yes
	Ballina	nd	44.0	Yes
Offaly	Tullamore	26.7	91.8	Yes
Roscommon	Killeglan	nd	128.5	Yes
Sligo	Lough Talt	11.3	30.5	Yes
	Foxes Den	nd	49.6	Yes
Tipperary	Nenagh	nd	100.3	Yes
Wicklow	Arklow	12.5	61.4	Yes
	Wicklow	11.9	62.3	Yes
2015				
Dublin	DLR Zone 1	11.5	73.9	Yes
	DLR Zone 2	10.2	nd	Yes
	DLR Zone 6	22.4	61.2	Yes
	DLR Zone 7	28.9	57.2	Yes
	DLR Zone 8	12.5	35.6	Yes
	Finglas Zone 1	21.5	66.5	Yes
	Finglas Zone 3	74.3	118.4	Yes
	South Dublin Zone 1	nd	31.7	Yes
	South Dublin Zone 2	11.1	nd	Yes
	South Dublin Zone 4	21.7	68.1	Yes
Dublin/Kildare	Leixlip	nd	124.9	Yes
Meath	Navan Mid-Meath	nd	145.2	Yes

Wexford	Gorey Region	10.8	36.4	Yes
	Fardystown	49.5	98.8	Yes
	Wexford Town	nd	95.8	Yes
	Enniscorthy	nd	75.1	Yes
	Sow Regional	nd	113.4	Yes

Note: nd = not detected (the sample was analysed but levels were below the limit of detection). Drinking water samples were assessed for compliance with the total indicative dose (ID), a parametric standard for radioactivity set out in the Euratom Drinking Water Directive

4. Radioactivity in the marine environment

The most significant source of artificial radionuclides in the Irish marine environment is the discharge of low level liquid radioactive waste from the Sellafield Nuclear Fuel Reprocessing Plant on the north-west coast of England. The focus of the marine environmental radioactivity monitoring programme is to assess the radiation doses to the Irish population arising from discharges from the Sellafield reprocessing plant and to assess geographic and temporal distribution of artificial radionuclides in the marine environment. The artificial radionuclides of greatest concern from a dose point of view are caesium-137, technetium-99 and actinides (isotopes of plutonium and americium). In order to assess the exposure arising from this source, levels of radionuclides are measured in seawater, sediments, and seaweed as well as samples of fish and shellfish landed at ports along the north-east coast of Ireland. The locations of the sampling points are shown in Figure 3.

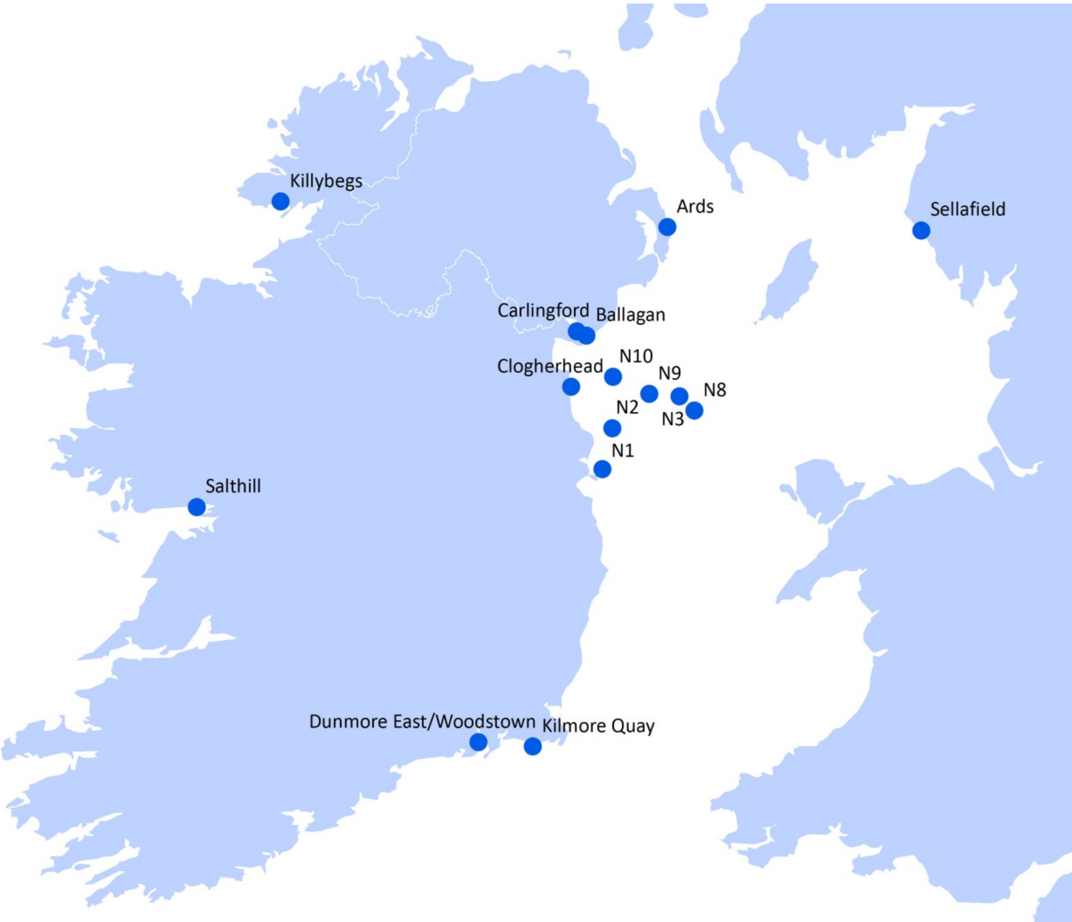

Figure 3. Marine sampling locations, 2014–2015

Radioactivity in seawater

The results of the analyses of caesium-137 and tritium (H-3) in coastline and offshore seawater (in the western Irish Sea) are presented in Table 18. Since 2000, discharges of Cs-137 from Sellafield have remained relatively constant and this is reflected in the seawater concentrations measured during 2014 and 2015 which are similar to those in previous years. The highest concentrations of Sellafield-derived caesium-137 are found on the north-east coast, and this is consistent with the known water circulation patterns in the Irish Sea.

Table 18. Radioactivity in seawater, 2014–2015

Sampling location	Month	Concentration (Bq/l)	
		H-3	Cs-137
2014			
Ards	Jun	nd	0.009
Ballagan	Feb	nd	0.005
	May	nd	0.007
	Jul	nd	0.009
	Oct	nd	0.005
	Mean	**-**	**0.007**
Dunmore East	May	nd	0.001
Salthill	Jun	nd	0.001
Irish Sea – N1	Nov	nd	0.003
Irish Sea – N2	Nov	nd	0.003
Irish Sea – N3	Nov	nd	0.002
Irish Sea – N4	Nov	nd	0.003
Irish Sea – N5	Nov	nd	0.003
Irish Sea – N6	Nov	nd	0.005
2015			
Ards	Sep	nd	0.009
Ballagan	Feb	nd	0.005
	Mar	1.4	0.005
	May	nd	0.008
	Jul	nd	0.008
	Sep	nd	0.009
	Oct	nd	0.009
	Nov	nd	0.012
	Mean	**=**	**0.008**

Note: nd = not detected (the sample was analysed but levels were below the limit of detection).

Radioactivity in sediment

Caesium-137 concentrations in sediment samples collected at Ballagan, Dunmore East and Salthill are shown in Table 19. Similar to the concentrations of caesium-137 found in seawater, the concentrations found in sediment taken from Dunmore East and Salthill are lower than those from samples taken from Ballagan and are close to those levels typical of global weapons fallout at this latitude. Concentrations in seawater and sediments from along the south and west coasts have remained stable since the mid-1990s.

Table 19. Cs-137 concentration in marine sediments, 2014–2015

Sampling location	Month	Concentration (Bq/kg, dry weight)
	2014	
Ballagan	Feb	3.0
	Mar	2.6
	May	2.6
	Jul	2.5
	Sep	2.5
	Oct	2.6
	Nov	2.7
	Mean	**2.6**
Dunmore East	June	0.3
Salthill	May	0.1
	2015	
Ballagan	Feb	2.8
	Mar	3.7
	Mar	3.8
	Mar	3.3
	May	2.1
	July	3.0
	Sep	3.5
	Oct	3.7
	Nov	3.7
	Mean	**3.3**

Radioactivity in seaweed

The results for caesium-137 and technetium-99 concentrations in seaweed (*Fucus vesiculosis*) are given in Table 20. These results are presented on a dry weight basis.

Table 20. Radioactivity in seaweed (Fucus vesiculosis), 2014–2015

Sampling location	Month	Concentration (Bq/kg, dry weight)	
		Tc-99	Cs-137
2014			
Ballagan	Feb		1.23
	Mar	137.9	0.77
	May	198.4	1.12
	Jul	110.8	1.38
	Sep	101.9	1.39
	Oct	141.2	1.32
	Nov	137.3	1.19
	Mean	**137.9**	**1.20**
Dunmore East	Jun	-	0.20
Salthill	May	-	0.12
2015			
Ballagan	Feb	142.4	0.65
	Mar	180.3	1.07
	May	162.8	1.47
	Jul	114.6	1.58
	Sep	185.0	1.57
	Oct	172.2	1.25
			1.32
	Nov	168.4	1.49
	Mean	**160.8**	**1.30**

Radioactivity in fish and shellfish

The results of radioactivity measurements in fish and shellfish collected from major Irish fishing ports and aquaculture areas are shown in Tables 21 - 23. The concentrations measured in 2014 and 2015 were similar to those recorded in recent years and are not considered to present a risk to human health. It should be noted that for fish, lobsters and prawns the attributed sampling location represents the landing port. For farmed mussels, oysters and winkles this is the true sampling location. All results are presented on a fresh weight basis.

Table 21. Caesium-137 concentrations in fish, 2014–2015

Sampling location	Month	Concentration (Bq/kg, fresh weight)				
		Cod	Haddock	Mackerel	Plaice	Ray
2014						
Clogherhead	Feb	0.38	0.06	0.05	0.04	0.43
	May	0.21	0.06	0.06	0.31	0.09
	Jul	0.59	nd	0.06	0.04	0.25
	Oct	0.65	0.20	0.06	0.08	0.21
	Mean	**0.46**	**0.11**	**0.06**	**0.12**	**0.25**
Killybegs	June	0.13	0.06	0.07	0.04	0.14
Kilmore Quay	Jul	-	0.11	-	-	-
2015						
Clogherhead	Feb	0.65	0.19	nd	0.03	0.34
	May	0.26	0.05	0.06	0.03	0.23
	Jul	0.47	0.06	0.04	0.12	0.15
	Oct	0.21	0.07	0.07	0.04	0.32
	Mean	**0.40**	**0.09**	**0.06**	**0.06**	**0.26**
Killybegs	Jul	0.17	0.05	0.06	0.06	0.10
Kilmore Quay	Aug	0.10	0.07	-	0.14	0.11

Table 22. Caesium-137 concentrations in shellfish, 2014–2015

Sampling location	Month	Concentration (Bq/kg, fresh weight)				
		Lobster	Mussels	Oysters	Prawns	Winkles
2014						
Carlingford	Feb	-	0.17	0.10	-	-
	May	-	0.22	0.03	-	-
	Jul	-	0.26	0.05	-	-
	Oct	-	0.18	0.04	-	0.21
	Mean	**-**	**0.21**	**0.06**	**-**	-
Clogherhead	Feb	0.22	-	-	0.05	-
	May	0.25	-	-	0.06	-
	July	0.24	-	-	0.04	-
	Oct	0.20	-	-	0.04	-
	Mean	**0.23**	-	-	**0.05**	-
Killybegs	Jun	**-**	nd	-	**-**	-
2015						
Carlingford	Feb	-	-	-	-	-
	May	-	0.23	0.04	-	-
	Jul	-	0.16	0.05	-	-
	Oct	-	0.09	0.06	-	0.07
	Mean	**-**	**0.16**	**0.05**	**-**	**-**
Clogherhead	Feb	0.21	-	-	-	-
	May	0.12	-	-	0.14	-
	Jul	0.15	-	-	0.04	-
	Nov	0.24	-	-	0.10	-
	Mean	**0.18**	**-**	**-**	**0.09**	**-**

Notes: nd = not detected (the sample was analysed but levels were below the limit of detection).

Table 23. Technetium-99 and plutonium-238, 239 and 240 concentrations in fish and shellfish, 2014–2015

Sampling location	Species	Concentration (Bq/kg, fresh weight)			
		Tc-99	Pu-238	Pu-239,240	Am-241
2014					
Carlingford	Mussels	0.94	0.01	0.06	0.03
	Oysters	0.22	0.01	0.04	0.15
	Winkles	0.48	nd	0.07	-
Clogherhead	Fish[a]	nd	nd	nd	-
	Prawns	nd	nd	0.002	Nd
2015					
Carlingford	Mussels	1.32	0.008	0.06	0.05
	Oysters	0.25	0.005	0.03	0.01
	Winkles	0.26	0.004	0.03	0.02
Clogherhead	Fish[a]	nd	nd	0.0001	0.0001
	Lobster	6.72	0.001	0.005	0.004
	Prawns	0.90	0.001	0.01	0.03

Notes: nd = not detected (the sample was analysed but levels were below the limit of detection). [a] Cod, haddock, mackerel, plaice, ray.

Radiation doses from consumption of fish and shellfish

For the purposes of the assessment of radiation doses from exposure to artificial radionuclides in the marine environment, four groups of interest were identified:

- Group A – commercial fishermen: a group of commercial fishermen who consume large amounts of fish and crustaceans (26 kg fish and 10 kg crustaceans annually);
- Group B – commercial oyster and mussel farmers working along the north-east coast who consume large amounts of molluscs (25 kg annually);
- Typical consumer: consumes 15 kg of fish and 2kg shellfish annually;
- Heavy consumer: consumes 73 kg fish and 7 kg shellfish annually.

Relevant ingestion dose coefficients were taken from ICRP (1996). The annual committed effective doses due to the consumption of seafood for 2014 and 2015 were estimated by combining these consumption rates and dose coefficients with the mean concentrations of artificial radionuclides measured in fish, crustaceans and molluscs from north-east ports during the two years. The north-east coast is the area in which the highest levels of radioactivity attributable to Sellafield are observed. The annual committed effective doses for the four groups of interest are summarised in Table 24.

Table 24. Annual committed effective doses from artificial radionuclides due to consumption of fish and shellfish landed at north-east ports, 2014 and 2015

Radionuclide	Annual committed effective dose (μSv)			
	Group A	Group B	Notional typical consumer	Notional heavy consumer
2014				
Tc-99	-	0.013	0.001	0.003
Cs-137	0.061	0.063	0.041	0.201
Pu-238		0.052	0.004	0.017
Pu-239,240	0.002	0.369	0.026	0.103
Am-241	-	0.195	0.033	0.131
Total[a]	**0.06**	**0.69**	**0.10**	**0.46**
2015				
Tc-99	0.003	0.018	0.003	0.010
Cs-137	0.056	0.046	0.035	0.174
Pu-238	0.014	0.042	0.003	0.010
Pu-239,240	0.014	0.323	0.012	0.047
Am-241	0.030	0.212	0.008	0.032
Total[a]	**0.12**	**0.64**	**0.06**	**0.28**

Note: [a] Totals have been rounded to 2 decimal places

In 2014 the annual committed effective dose of 0.06 μSv to commercial fishermen (Group A) was less than 0.01 per cent of the annual dose limit of 1000 μSv for members of the public from practices involving controllable sources of radiation (Ireland , 2000). For 2015 the annual committed effective dose for these workers was less than 0.02 per cent of the annual dose limit. The dominant contributor to dose for these workers is the presence of trace levels of caesium-137 in fish and shellfish.

In 2014 the annual committed effective dose of 0.69 μSv to commercial oyster and mussel farmers along the North-East coast (Group B) was less than 0.07 per cent of the annual dose limit of 1000 μSv for members of the public. In 2015 the annual committed effective dose for these workers was also less than 0.07 per cent of the annual dose limit. The dominant contributors to dose for this group are the actinides which are present at trace level in shellfish; in particular molluscs which tend to accumulate plutonium.

The annual committed effective doses calculated for the notional typical consumer for 2014 and 2015 are 0.10 μSv and 0.06 μSv respectively, which are very low. To put these doses into context, the dose due to the presence of the naturally occurring radionuclide plutonium-210 in seafood has been estimated to be 32 μSv for a notional typical consumer (Pollard et al., 1998)

6. Conclusions

Levels of radioactivity in the Irish environment have been routinely monitored since 1982. This report presents the results of Ireland's environmental radioactivity monitoring programme carried out by the Environmental Protection Agency during 2014 and 2015 and is the latest in a series of environmental radioactivity monitoring reports which are available for download from the EPA website.

During 2014 and 2015, radioactivity was measured in air, drinking water, a range of foods and marine environmental samples. Concentrations of artificial radionuclides in airborne particles were low and consistent with measurements made in recent years, with the exception of the short-term rise in levels detected during the period March to May 2011 following the Fukushima accident. Levels of radionuclides in milk, mixed diet and a wide range of foodstuffs were low and, for the majority of samples, below the detection limits. All drinking waters tested were found to be in compliance with the radiological standards defined in national and EU legislation.

The most significant source of artificial radionuclides in the Irish marine environment is the discharge of low level liquid radioactive waste from the Sellafield Nuclear Fuel Reprocessing Plant on the north-west coast of England. In order to assess the exposure arising from this source, levels of radionuclides were measured in samples of fish and shellfish landed at ports along the north-east coast of Ireland. Doses to typical consumers were found to be extremely low and the levels of radioactive contamination present in the marine environment do not warrant any modification of the habits of people in Ireland, either in respect of consumption of seafood or any other use of the amenities of the marine environment.

In summary, the results of the 2014 and 2015 environmental radioactivity monitoring programme show that, while levels of artificial radioactivity in the Irish environment remain detectable, they are low and broadly consistent with levels reported previously, posing no risk to the health of the Irish population.

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AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL

Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú

Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:

- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil

- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce

- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol

- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn

- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil

- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta

- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch

- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas

- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta

- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil

Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:

- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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