



Canadian Nuclear
Safety Commission

Commission canadienne
de sûreté nucléaire

308

INFO35_VA

Les enjeux de la filière uranifère au Québec

6211-08-012

Do environmental releases from uranium mines and mills present a health risk to the population?



Canadian Nuclear Safety Commission

nuclearsafety.gc.ca

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Canada 

Nuclear Safety and Control Act and Federal Legislation



Nuclear Safety and Control Act (NSCA):

- “Prevent **unreasonable risk**, to the environment and the health and safety of the public
- Make **adequate provision** for the protection of the environment and the health and safety of the public
- **Control the release** of radioactive **nuclear** substances and **hazardous** substances...”

CNSC Regulations and Responsibilities



- *General Nuclear Safety & Control Regulations*
- *Uranium Mines and Mills Regulations*
- *Radiation Protection Regulations*
- *Packaging and Transport of Nuclear Substances Regulations*

Licensees (mine operators) are responsible for ensuring security, protecting health and safety, protecting the environment, and respecting Canada's international commitments.

CNSC regulates licensees and assesses their compliance as to the *Nuclear Safety and Control Act*, the regulations and international obligations.

Control and Monitoring of Environmental Releases



- Control releases:
 - to the air
 - to the land
 - to surface water
 - to ground water
- Measure:
 - releases
 - environmental concentrations
- Assess:
 - effects
- Take action, when required



Environmental Monitoring Data Available for Uranium Mines and Mills



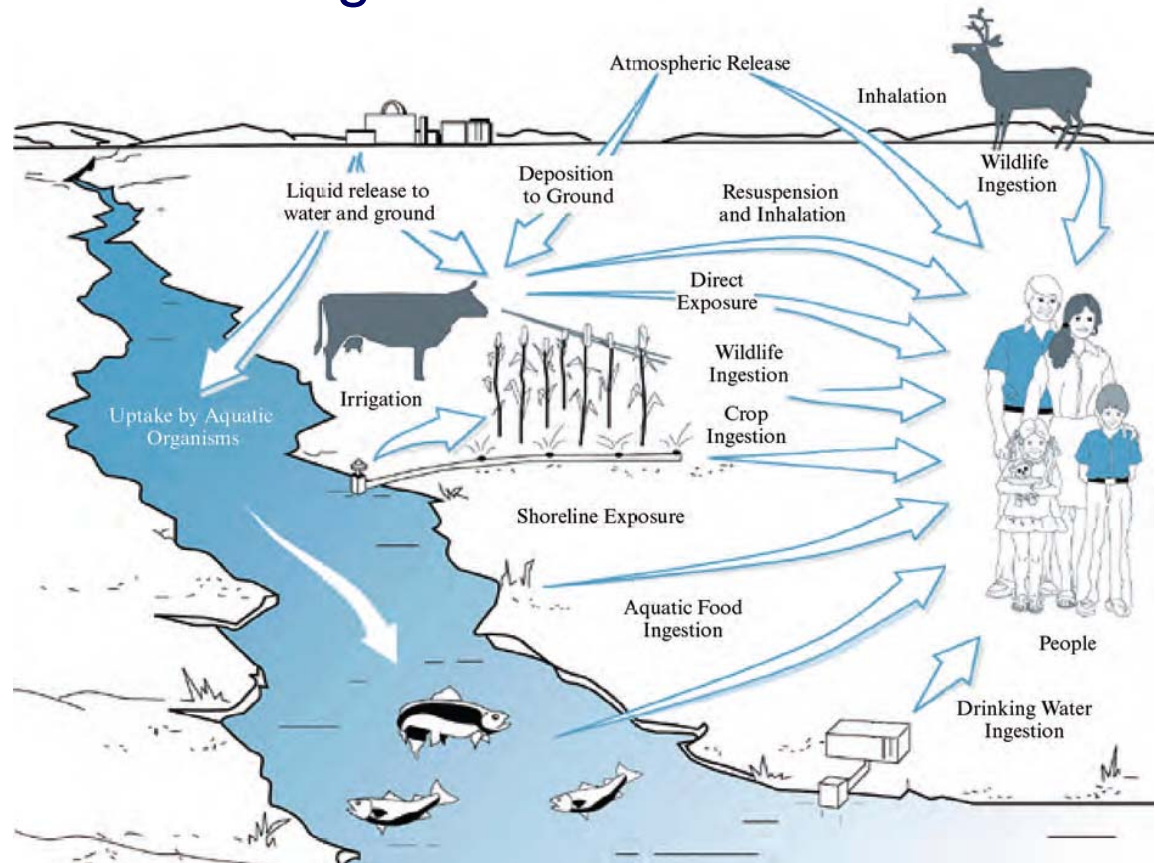
Exposure Pathway	Nuclear or Hazardous Substances Monitored		Source
Air	Nuclear Substances	U-234, Th-230, Ra-226+, Pb-210+, Po-210, U-238+, Rn progeny	Annual Reports Status of the Environment Reports
	Hazardous Substances	As, Cd, Pb, Ni, U, Se, Cu Mo Zn	
Water	Nuclear Substances	Ra-226+, Pb-210+, Th-230, Po-210	Annual Reports Status of the Environment Reports Environmental Effects Monitoring Reports
	Hazardous Substances	pH, NH ₃ , TSS, TP, Al, As, Ba, B, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Se, V, Zn, U	
Sediment	Nuclear Substances	Ra-226+, Pb-210+, Th-230, Po-210	Annual Reports Status of the Environment Reports Environmental Effects Monitoring Reports
	Hazardous Substances	Al, As, Ba, B, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Se, V, Zn, U	
Fish	Nuclear Substances	Ra-226+, Pb-210+, Th-230, Po-210	Annual Reports Status of the Environment Reports Environmental Effects Monitoring Reports
	Hazardous Substances	Al, As, Cd, Co, Cr, Cu, Fe, Mn, Mo, Ni, Pb, Se, V, Zn, U	
Soil	Nuclear Substances	Ra-226+, Pb-210+, Th-230, Po-210	Annual Reports Status of the Environment Reports
	Hazardous Substances	pH, Al, As, Cd, Co, Cu, Fe, Mo, Ni, Pb, Se, V, Zn, U	

Environmental Monitoring Data Allows for Dose Modelling

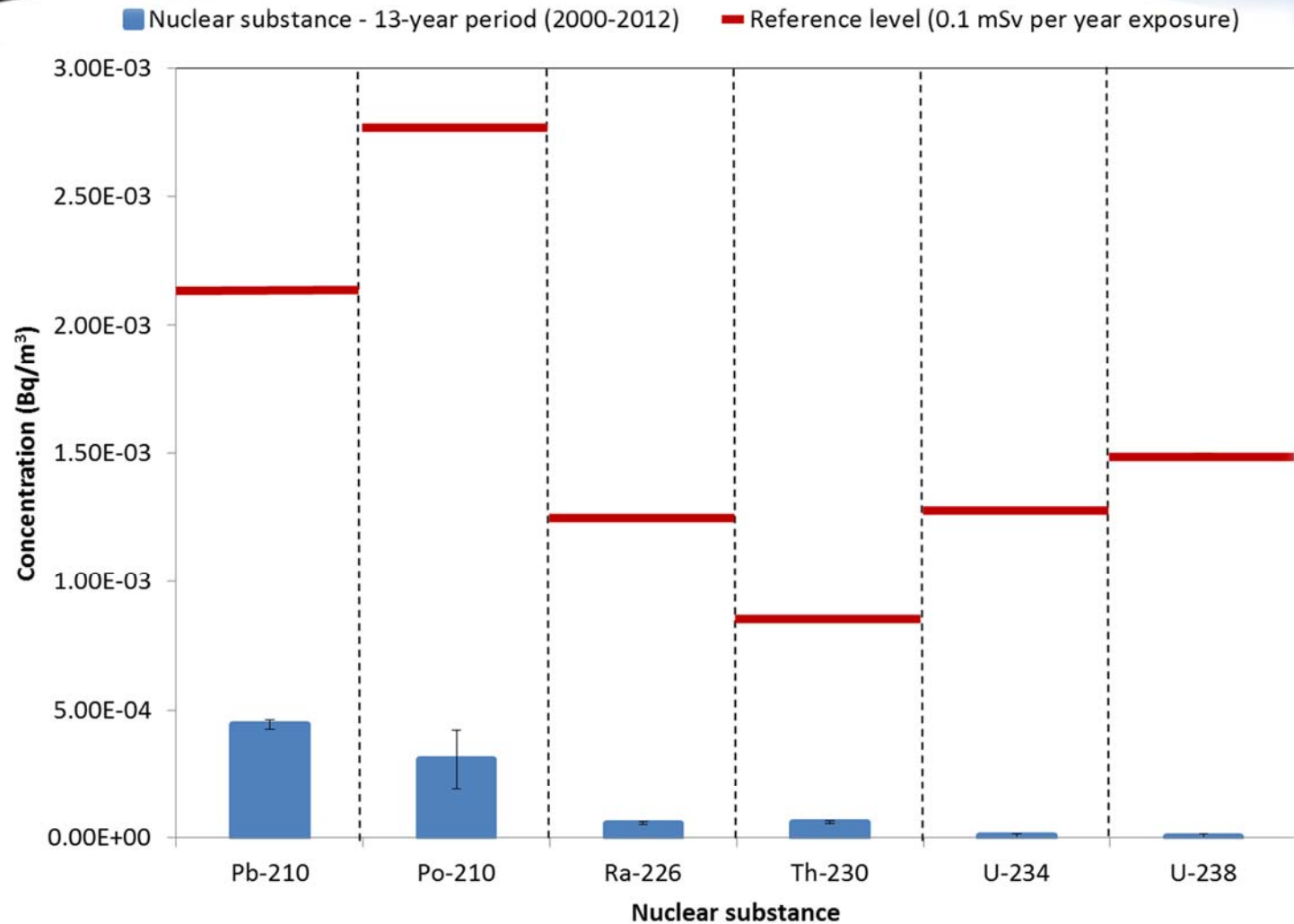


- Potential doses to the most exposed members of the public can be modelled using environmental monitoring data:

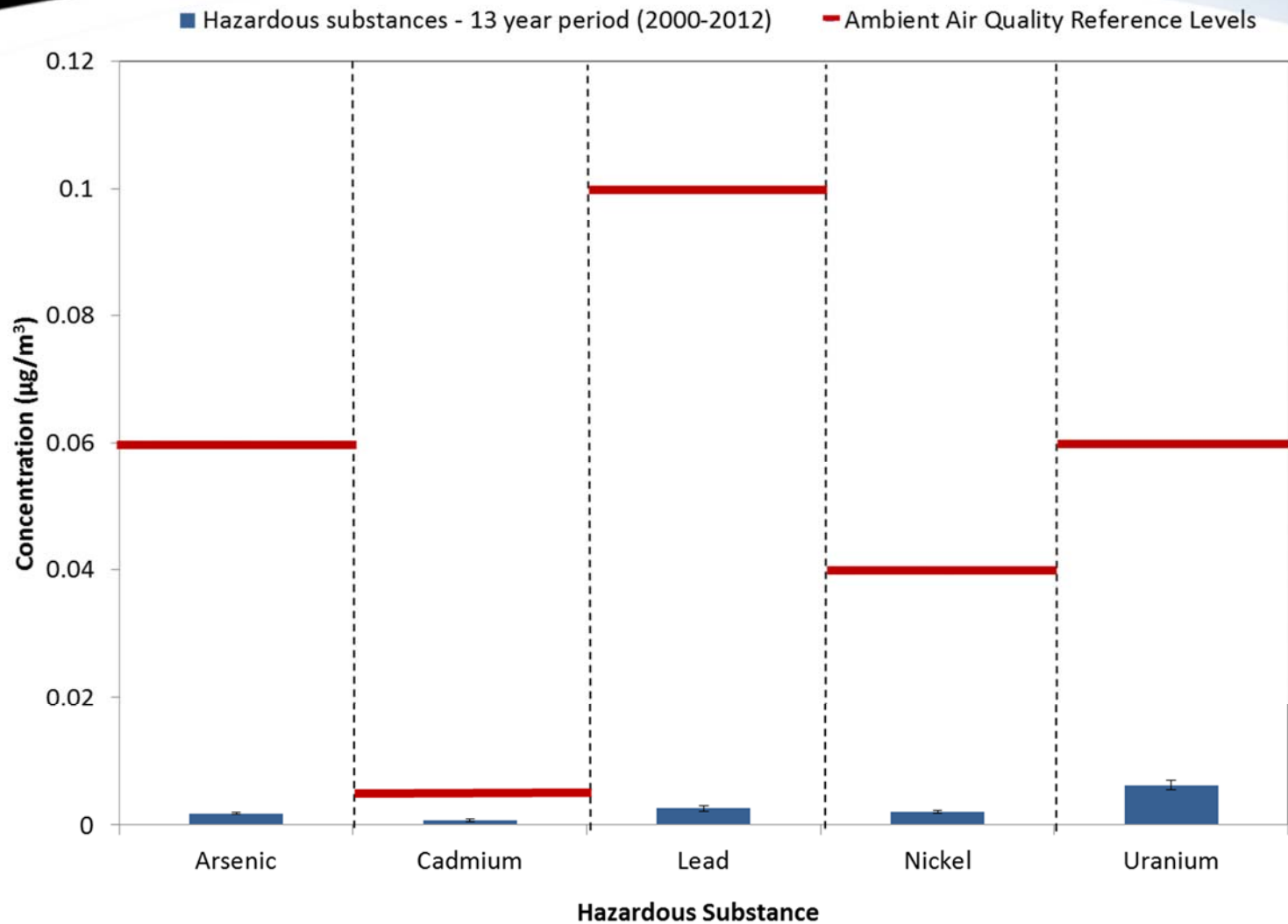
Exposure Pathway	Route of Exposure
Air	Inhalation Immersion
Water	Inhalation Immersion
Animals	Ingestion
Plants	Ingestion
Soil & Sediment	Ingestion External exposure



Air Exposure Pathway 2000-2012: Nuclear Substances



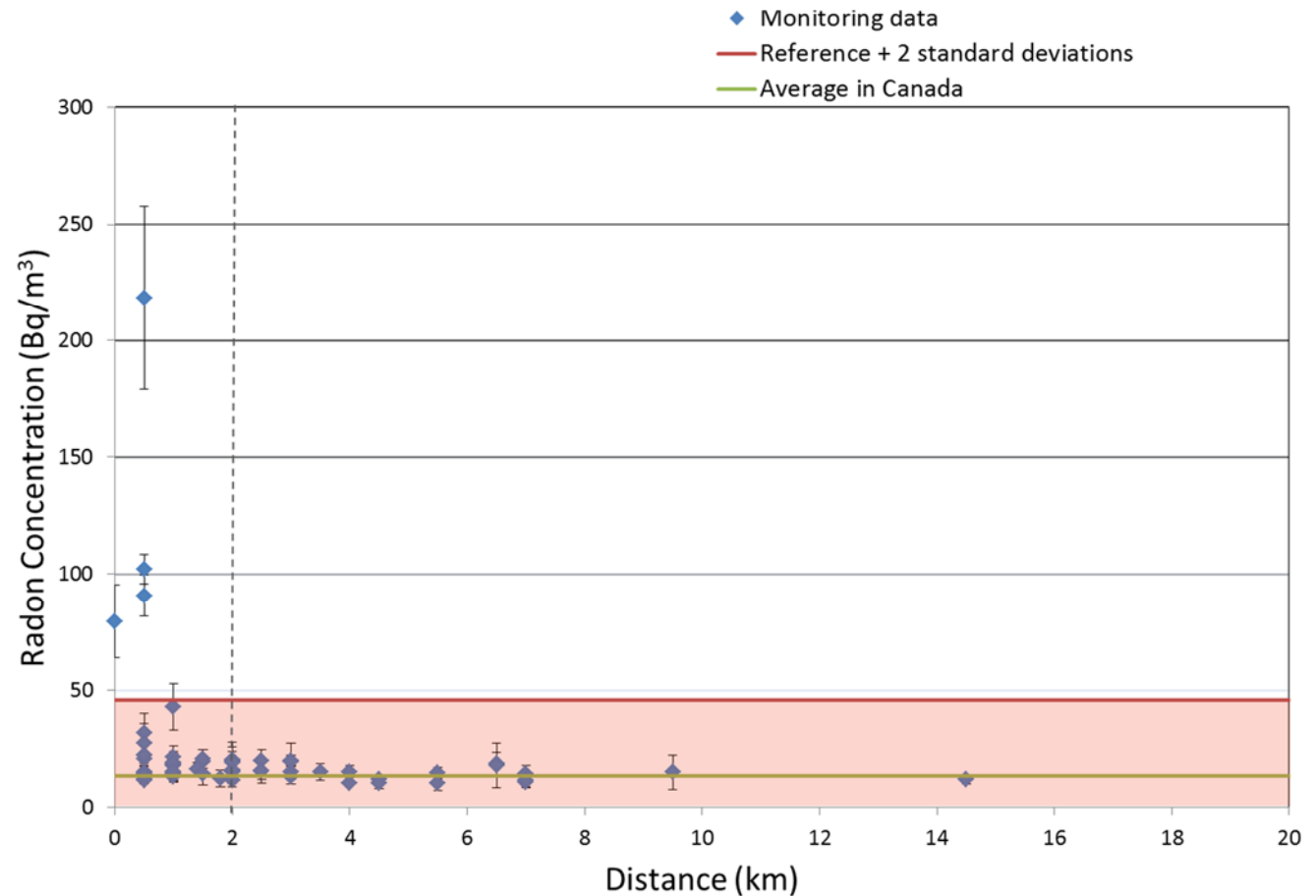
Air Exposure Pathway 2000-2012: Hazardous Substances



Radon Progeny 2000-2012



- Radon concentrations decrease with distance from the radon release point
- After 2 km, the radon concentration is not higher than the Canadian average background concentration of radon
- People living close to uranium mines and mills in Canada are not exposed to radon doses that are higher than the radon dose to the average Canadian



Water Exposure Pathway 2000-2012: Nuclear and Hazardous Substances



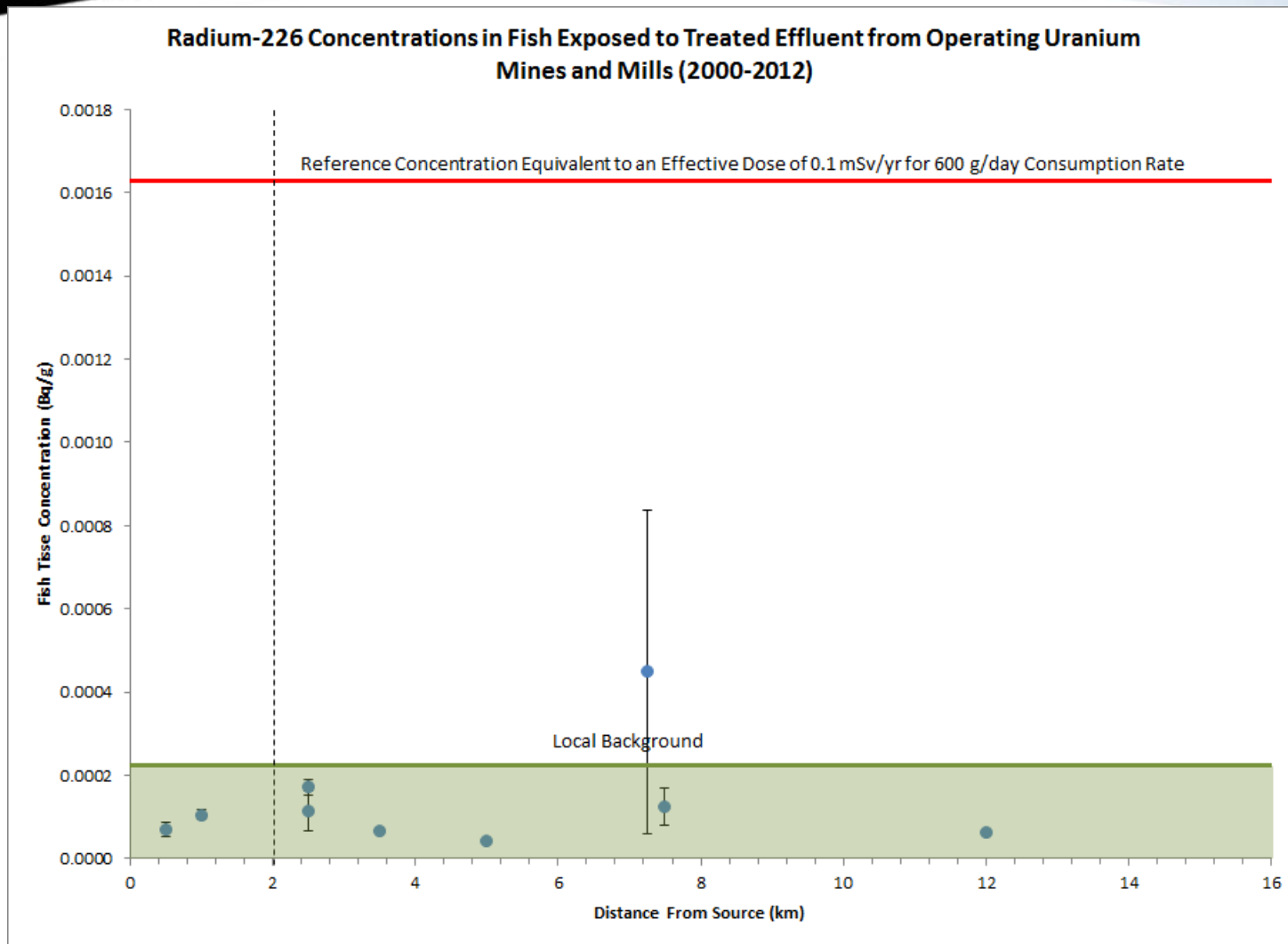
- All nuclear and hazardous substances in surface water beyond 2 km from the effluent release point were below Health Canada's Guidelines for Canadian Drinking Water Quality (2012) with the following exceptions:
 - the mean uranium concentration 5.5 km from Rabbit Lake for 2000-2012 was 25.4 µg/L.
 - Maximum Allowable Concentration (MAC) = 20 µg/L
 - mean uranium concentrations at the same Rabbit Lake monitoring station decreased to 7.3 µg/L (<MAC) for the 2010 to 2012 period due to effluent treatment improvements

Fish Exposure Pathway 2000-2012: Nuclear Substances

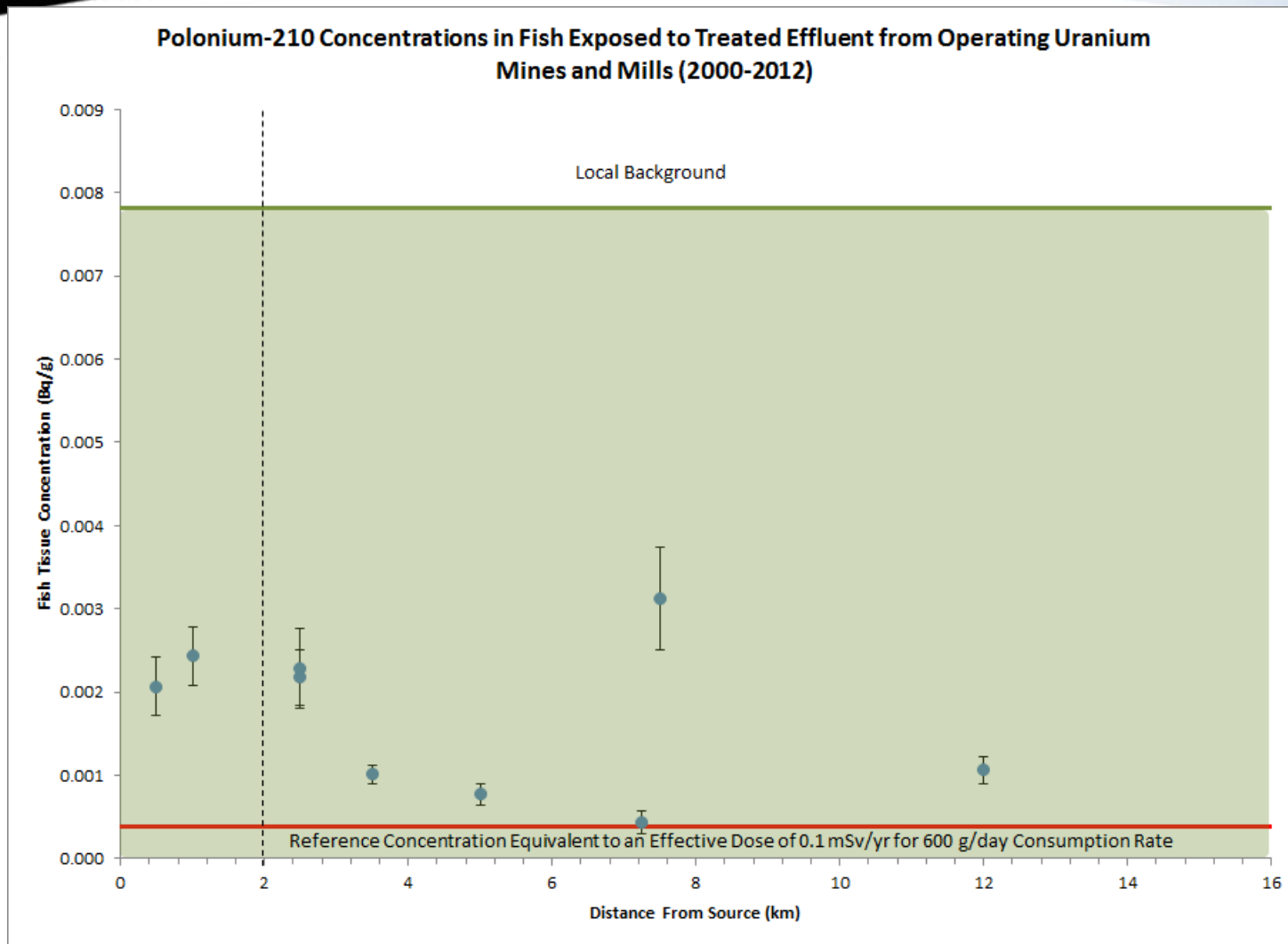


- The levels of nuclear substances measured in fish that were caught between 2-10 km downstream of uranium mills are consistent with levels measured in local background areas
- Consumption of fish caught between 2-10 km downstream of uranium mines and mills does not result in an incremental dose of radiation above the natural background radiation for northern Saskatchewan

Fish Exposure Pathway 2000-2012: Radium -226



Fish Exposure Pathway 2000-2012: Polonium -210



Fish Exposure Pathway 2000-2012: Hazardous Substances



- Elevated consumption (600 g per day) of fish caught between 2-10 km downstream of uranium mills could result in health effects due to selenium intake
- Fish caught beyond 10 km have selenium levels consistent with the local background
- CNSC required enhanced control of selenium at all uranium mines and mills with treatment systems fully operational as of 2009; it is anticipated that selenium levels in fish tissue will improve over time with improved effluent control

Exposure to Members of the Public: Nuclear Substances



- Radiation doses to hypothetical persons living 2-10 km from a uranium mine in Canada are very low
- **Incremental levels** in air, water and fish tissue monitored around uranium mines in Canada are well below reference levels corresponding to 0.1 mSv
- Radon concentrations after 2 km from the release point are within the local natural background
- The total dose to people living 2-10 km from the nearest release point is similar to the dose to the average Canadian

Effects on Population Health: Nuclear Substances



- Epidemiology studies have shown that excess cancers are only observed from radiation exposures greater than 100 mSv
- However, it is assumed that the probability of cancer incidence increases as radiation dose increases
- The International Commission on Radiological Protection derived a nominal risk coefficient of 0.005% per mSv for all cancers
- At an incremental dose <0.1 mSv the excess number of death from cancer would be 0.0005%. This would not be detectable relative to the average number of death from cancer in Canada which would make it barely increase from 25% to 25.0005%

Exposure to Members of the Public: Hazardous Substances



- All hazardous substances monitored from 2000 to 2012 beyond 2 km of operating uranium mines and mills were below Health Canada guidelines except for uranium and selenium
- Uranium concentrations in the period 2010 to 2012 decreased below the guideline value due to effluent treatment improvements
- Although elevated consumption of fish caught between 2-10 km downstream of uranium mills could result in health effects due to selenium intake, it is anticipated that selenium levels in fish tissue will improve over time due to improved effluent control

Conclusions



- Public exposures to nuclear and hazardous substances from uranium mines and mills in Canada are controlled
- Release limits and compliance monitoring ensure the protection of the health and safety of Canadians and the environment
- The extensive monitoring data and conservative exposure scenarios indicate that releases of radionuclides and hazardous substances from uranium mines and mills do not represent a risk to the health of the public

To Learn More



- CNSC, “A Review of Environmental Performance of Operation Uranium Mines and Mills in Northern Saskatchewan 2000-2012”.



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Thanks!

