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ARPS2



### **Presentation Outline**

- Site history & Dam levels
- Naturally occurring radioactive material
- Site layout
- Gamma radiation mapping
- Soil/sediment sampling
- Radium-228 and radium-226 concentrations
- Take home message



### The Project Site – Dam Levels





## NORM (Naturally Occurring Radioactive Material)



### Human activities can significantly increase the concentration of NORM radionuclides.

Processes associated with NORM with elevated concentrations of radioactive materials include mining and milling of metalliferous and non-metallic ores, production of coal, oil and gas, **extraction** and purification **of water**, generation of geothermal energy, and production of industrial minerals, including phosphate, clay and building materials.

Reference: International Atomic Energy Agency (IAEA) www.iaea.org/topics/radiation-safety-norm accessed 02/08/2023

### **Primordial Decay Series**



Polonium

Lead 206



### The Project Site – Groundwater Discharge Point



### The Project Site – Creek Bed





### Fieldwork – Surveying Gamma Radiation



### Fieldwork – Surveying Gamma Radiation



## Gamma Radiation Dose Rate Map



Terrestrial dose rate only; excludes cosmic.



### Soil Sampling Transects

#### Purpose

To investigate radioactivity concentrations laterally and vertically.

#### Process

- 4 1 transect upstream (baseline)
- 3 transects downstream
- Hand auger to sample depth profile
- Note elevation relative to outlet (creek topography)
- Lab analysis via HPGe gamma spectrometry
- Results in Bq/kg for key NORM radionuclides



### Sampling Transect A (upstream)





### Sampling Transect B





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### More Transect Sampling





## Transect Topography



### Radium-228 Concentration



### Radium-228 Concentration



### Radium-228 Concentration



### Radium-226 Concentration











### <sup>228</sup>Ra:<sup>226</sup>Ra Concentration Ratios





### **Creek Dam Junction & Freshwater Mussels**

Up to 3000 Bq/kg Ra-228 in sediment where the creek meets the dam.

Ra-228 and Ra-226 concentrations in freshwater mussels of 100 to 500 Bq/kg wet weight.

Freshwater mussels as biomonitor. 





### What does this teach us?

This site demonstrates the ease of inadvertently impacting sites with NORM.

The importance of representative sampling and maintaining the link between the sample and the analytical result.



