

Derived Release Limits

Cameco Corporation’s (Cameco) Blind River Refinery (BRR or site) is located about 5 km west of the Town of Blind River, Ontario and adjacent to the Mississauga First Nation (see Figure 1). While the secured CNSC-licensed site has a relatively small footprint, the property owned by Cameco Corporation is significantly larger, bounded to the north by the railway line, to the west by the Mississagi River, and to the south by Lake Huron. Cameco has also leased from the Town of Blind River additional lands to the east of the existing property boundary as a buffer. The nearest residence is located approximately 1 km NE of the refinery.



Figure 1: Cameco Blind River Refinery

The BRR facility is operated under a licence from the Canadian Nuclear Safety Commission (CNSC). The Nuclear Safety and Control Act (NSCA) requires that no member of the public receive a radiation dose in any year above the regulatory limit of 1 millisievert (mSv) per year. In order to ensure compliance with this requirement, limits are placed on the quantities of radioactive substances that may be released from licensed facilities in the gaseous and liquid effluents, and in the form of gamma radiation emitted from the facility. These emission level limits are referred to as “Derived Release Limits” (“DRLs”). DRLs are developed on a case-by-case basis for each facility by evaluating all potentially significant pathways by which radioactive substances can reach people.

DRLs have previously been calculated for the BRR facility in 1983 prior to the start-up of the facility with an update to the air DRLs in 1986, 2013 and most recently updated in 2018. The latest study updates the DRLs to accommodate changes in plant operation, receptor assumptions and methods of analysis since 2013. It has also been updated to follow the guidance of *CSA Standard N288.1-14 (CSA 2017), Guidelines for Calculating Derived Release Limits for Radioactive Material in Airborne and Liquid Effluents for Normal Operation of Nuclear Facilities*.

The calculation of a DRL uses the following formula whereby the dose per unit release is calculated and multiplied by the allowable dose:

$$DRL = \frac{E_1}{D_1} \times D_{allowable}$$

Where:

DRL = the release rate from the source that corresponds to the allowable dose, in units specific to the source;

E1 = the annual average release rate in units specific to the source;

D1 = the dose, in mSv/y, from annual average releases from the source; and

Dallowable = the dose to members of the public, in mSv/y, allowed under the regulations

This summary provides the DRL methodology and results, which conclude there are no radiological health risks expected to members of the public.

The DRLs are based on releases to air, water and gamma radiation emissions from materials on the BRR site. Conceptual site model is shown in Figure 2 and overview of methodology in Figure 3. Releases to the environment and concentrations in media are expressed relative to uranium mass. Both measured data and modelling have been used to estimate the uranium concentrations in air, water and soil.

Figure 2: Conceptual Site Model

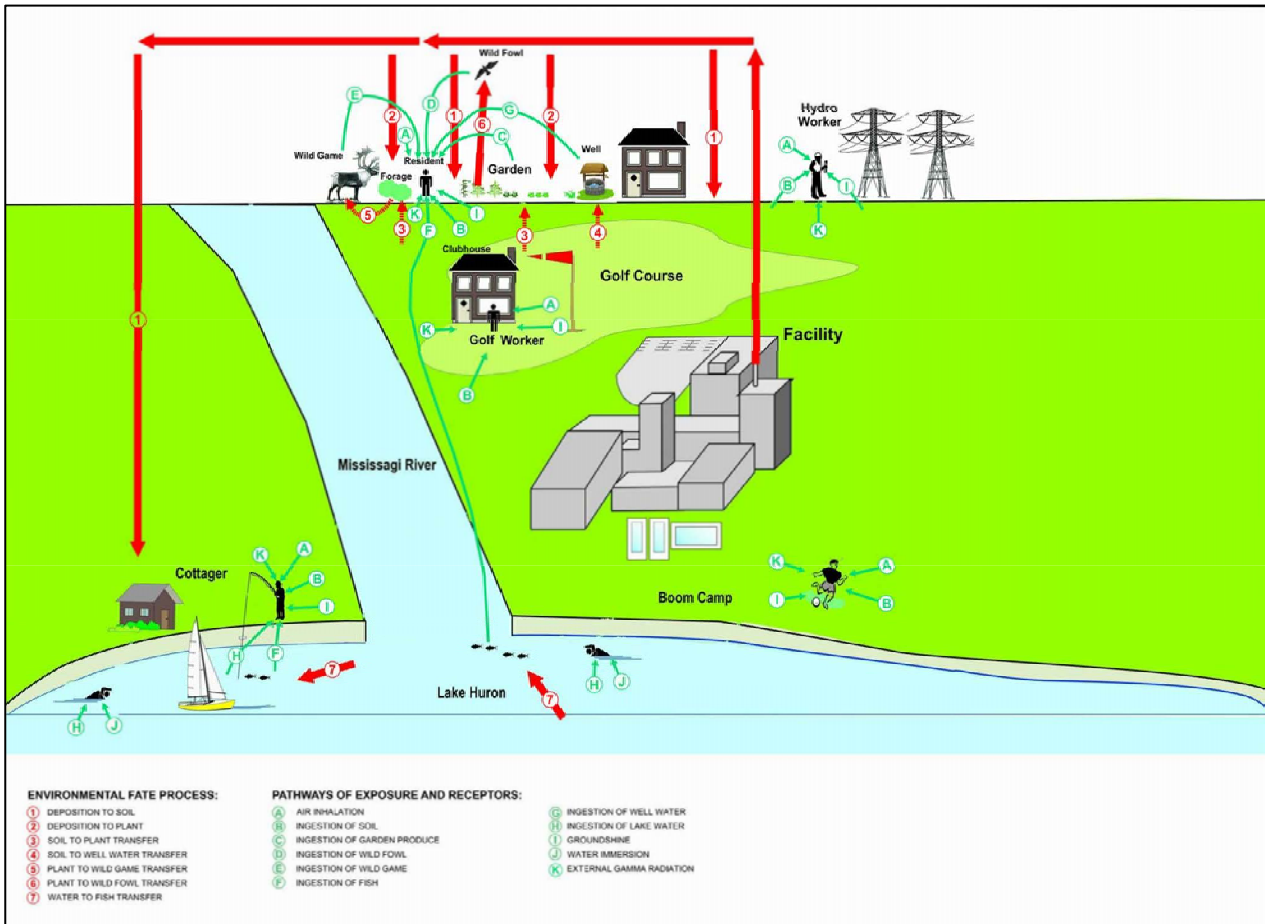
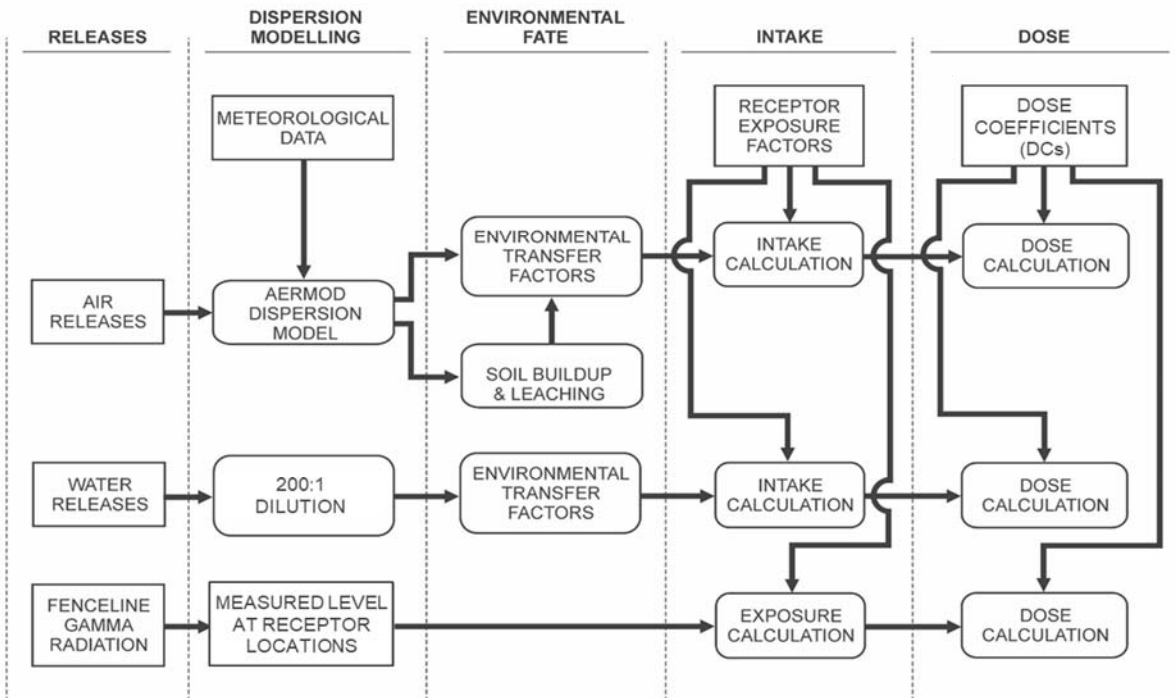


Figure 3: Overview of Methodology for Dose Calculations for Facility Releases



Receptors included in this DRL (Figure 4) are derived primarily from those outlined in the previous BRR DRL from 2013. Five human receptor groups that are off-site members of the public are considered: residents at the four closest locations around the facility (Lantain, Mississauga, Colonization and Railway), seasonal residents staying in the cottage located on the shores of Lake Huron on the west side of the Mississagi River, seasonal commercial workers working at the golf course clubhouse located on the facility property, full-time commercial workers working at the hydro yard located north of the facility and residents recreating at the Boom Camp located south of the facility. For the nearby residents, cottagers and Boom Camp users, three age groups were considered: adult, child and infant.

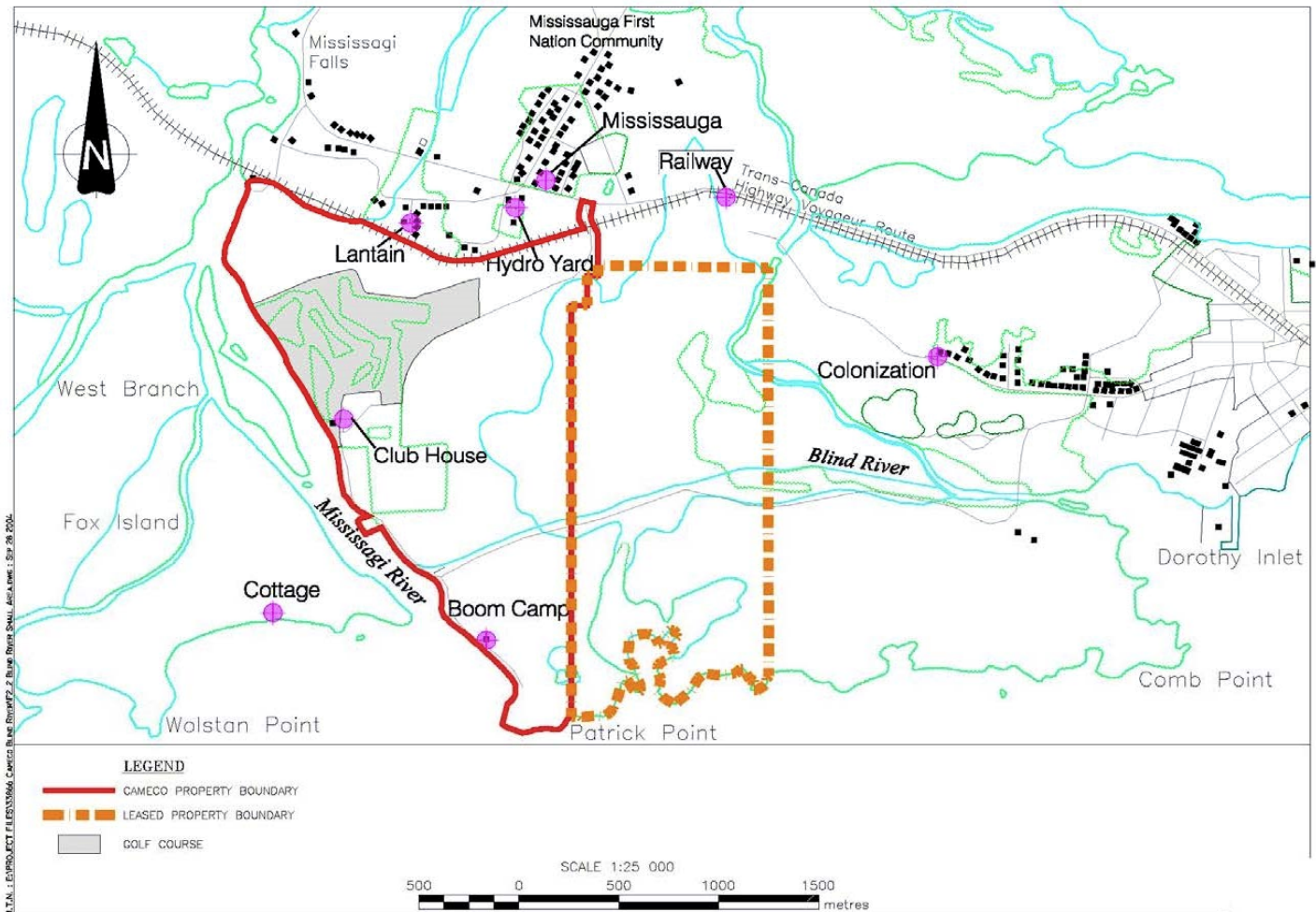
The Boom Camp users are also nearby residents, and the golf workers and hydro workers may also be nearby residents. Therefore, “compound” receptors are also assessed, by adding doses from these activities to the resident doses.

Radiological doses to the most exposed members of the public from ongoing activities were estimated to be only a small fraction of the allowable dose of 1 millisievert (mSv) per year.

The intakes of radioactivity by potential receptors were calculated using the exposure habits (e.g., times spent at various locations, amount of backyard produce consumed, quantity of air inhaled, etc.) and the modelled concentrations in the corresponding environmental media. Annual doses to the receptors were calculated based on the intakes and the corresponding dose coefficients (DCs).

Dose from water releases to the most exposed receptors was calculated to be less than 1 microsievert per year ($\mu\text{Sv}/\text{y}$) for a nearby infant resident recreating at the Boom Camp. The largest total dose from ongoing air releases (from refinery and incinerator stacks combined) was predicted to be around $0.82 \mu\text{Sv}/\text{y}$, for an adult resident living in Lantain and working seasonally at the golf course clubhouse. The most exposed member of the public from gamma radiation was determined to be the golf worker with ongoing dose up to $8.77 \mu\text{Sv}/\text{y}$, which is still well below the regulatory limit.

The relationship between dose and facility releases was used to develop the DRLs. The DRLs calculated in 2018 study for the BRR are shown in Table 1. The updated DRLs are all lower than the ones estimated in 2013 due to changes in exposure factors, transfer factors and other assumptions, which in general are more conservative than the ones used in 2013.

Figure 4: Human Receptor Locations

Table 1: DRLs for BRR

Pathway	Source	Receptor	Age	Units	DRL	DRL (2013)	Current CNSC Limit
Air	Refinery stacks (DCEV, absorber and HVAC)	Resident – Lantain + Golf Worker + Boom Camp User	Adult	g U/h	1,000	7,200	100 g U/h for DCEV; 100 g U/h for Absorber
Air	Incinerator Stack	Resident – Lantain + Golf Worker + Boom Camp User	Adult	g U/h	1,300	8,000	10 g U/h
Water	Liquid Effluent Releases to Lake Huron	Resident – All Locations + Boom Camp User	Infant	g U/h	9,500	16,000	2 mg/L for Liquid Effluent Discharges ^b
Gamma Radiation	Material Inside Fenceline	Resident – All Locations + Golf Worker + Boom Camp User	Adult	µSv/h	1.1 ^a	2.0 ^a	None for Golf Course location

Notes: a – incremental gamma level at Golf Course location (On-site 1).

b – with 2014 annual discharge volume of 202,694 m³, 2 mg/L is equivalent to 46.3 g U/h.

Conclusions

In summary there are no potential radiological health risks expected to members of the public. The largest total dose from ongoing air and water releases was predicted to be below 0.1% of the regulatory limit respectively. The most exposed member of the public from gamma radiation receives dose below 1% of the regulatory limit. Derived release limits for air water and gamma emissions have been calculated .to be used as guidance for setting the facility operating release levels and action levels to ensure ongoing safety of members of the public.