



Human Health Risk Assessment of Lake Charles Involving Water, Sediment, and Fish Halifax Regional Municipality

Lake Charles is in the community of Dartmouth, Nova Scotia, and has residential dwellings along the east shoreline. The historical Montague Gold Mines site is upstream of Lake Charles, and water and sediment flow naturally downstream into the lake through Mitchell's Brook and Barry's Run.

By-products of the processed gold ore, referred to as tailings, were historically deposited in low-lying areas around the former gold mine site and have remained uncontained as part of the landscape. Sampling has indicated that some of these fine-grained tailings have migrated downstream into Barry's Run and Lake Charles likely as a result of natural processes during rainfall and runoff events during operations and over the several decades since mining ceased in the 1940s.

The Province of Nova Scotia has committed to reclaiming the former mine site and commissioned a Conceptual Closure Plan for the former Montague Mines site in late 2018. Preliminary studies were completed and a conceptual closure plan was released in July of 2019, with further studies being required to refine the conceptual plan.

The need for the closure plan is related to the presence of elevated levels of naturally occurring arsenic in the tailings and, to a lesser extent, mercury that was used to extract the gold from the ore, some of which had entered the tailings during ore processing. Both arsenic and mercury occur naturally in the environment; however, they are present at higher concentrations in tailings at historical mining areas.

The closure plan identified the need for further study in areas downstream of the mines, including Barry's Run and Lake Charles, as a result of preliminary sampling conducted in these areas during the closure plan investigation. Additional samples were collected in the fall and early winter of 2019 to determine concentrations of arsenic and mercury in water, sediment, and fish in Lake Charles and Barry's Run.

The information gathered from the sampling and analysis was incorporated into a human health risk assessment (HHRA) focused on Lake Charles residents and visitors. Barry's Run was the subject of a separate assessment completed in 2020.

The environmental sampling and risk assessment study followed widely accepted methods. The HHRA considered how frequently people might use the area for various activities, including swimming and wading. These activities represent the most common ways that people may contact the lake water and sediments containing arsenic. The studies found that mercury concentrations were low in Lake Charles sediment and water and did not require any further assessment. The HHRA also considered people who may eat fish from Lake Charles, and both mercury and arsenic were included in the fish consumption assessment.



The human health risk assessment found that:

- Arsenic is present in surface waters and sediments in Lake Charles at levels that are higher than those associated with natural background conditions. This was consistent with findings from previous studies.
- The sediments in Lake Charles have arsenic levels that appear to be related to historical releases from the former Montague mines site. The largest concentrations of arsenic are in deeper sediment layers that were deposited in the lake many decades ago, likely during the active mining in the early 1900s. These deeper sediments are now covered by sediments with lower concentrations of arsenic in many parts of the lake, which suggests that the shallow lake sediments are slowly returning to pre-mining conditions. The area with the highest sediment concentrations corresponds to the area where Barry's Run flows into the lake, and some parts of this area continue to be influenced by the former mines site. Many areas with sediment containing the higher levels of arsenic are in deep water, where human contact is unlikely.
- The study found that exposures to arsenic while swimming in and consuming fish from, Lake Charles were so low that health risks were concluded to be negligible, or insignificant.
- The public beach at Shubie Park does not have elevated arsenic levels, and risks from swimming or using the beach in this area are considered to be insignificant.
- The study concluded that mercury is not a concern for human health in residents or visitors to Lake Charles who chose to consume fish from the lake. Consumption of fish from the lake was not associated with elevated risk levels for mercury, as long as people respect the Provincial fish consumption guidelines (Province of Nova Scotia, 2019).
- While the study attempted to be all-encompassing for Lake Charles residents and visitors, sediment samples were not collected from areas close to or on private properties near Barry's Run, due to property access issues. In addition, the frequency that people swim in or use the lake may be different from that considered in the assessment. Therefore, there may be some uncertainties in the risk assessment results for specific situations.

Based on the understanding of sediment and surface water arsenic concentrations, the closure and reclamation plan of the historical mines site is important to implement in order to reduce the movement of arsenic from the former mine site downstream into Lake Charles. The closure and reclamation planning project underway for the Montague Mines site is expected to further reduce concentrations of arsenic and mercury in the water and sediment in areas downstream, including Lake Charles. No specific risk management is recommended for Lake Charles.

As indicated in the recently completed Barry's Run HHRA, it is important that sediments in upstream areas not be disturbed while the closure studies are being completed. Disturbing sediments through activities such as ATV use or dirt biking on the main tailings area, or other activities such as walking through Mitchell's Brook or Barry's Run can result in sediments being



transported downstream towards Lake Charles. Sediment disturbance in upstream areas should be minimized until the closure plan for the mines site is completed.