Memorandum

Project Name: Resolute Bay Wastewater	Project #: FRE-00261400-A0	/File No: 62
To: Bhabesh Roy	From: Daryl Burke	
Date: September 14, 2020		
Subject: Ammonia Guidelines Review and Proposed Treatment Performance		
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The current trends in wastewater regulations indicate that effluent ammonia is likely to become a parameter of concern throughout Nunavut (and specifically the Hamlet of Resolute Bay) in the future. The GN has requested EXP assist with better understanding how the proposed Resolute Bay wastewater treatment system will perform with respect to ammonia. This technical memo is intended to provide the Government of Nunavut (GN) with direction regarding effluent ammonia (NH_3-N) from the proposed future wastewater treatment facility. The current water license (#3BM-RUT 1520) does not include an effluent ammonia discharge limit for the wastewater system.

The primary concern with respect to ammonia discharged from wastewater treatment facilities is the potential toxic effects on aquatic life. The following regulatory bodies are the major contributors to the decisions concerning the toxic effects of Ammonia:

- The Canadian Council of Ministers of the Environment has published guidelines for the protection of aquatic life which includes a fact sheet on ammonia. The fact sheet identifies the un-ionized fraction of total ammonia as being toxic to aquatic life at specific concentrations. The breakdown of ammonia in to the ionized and un-ionized fraction is dependent upon both pH and temperature. The CCME identified a recommended guideline for un-ionized ammonia in freshwater environments of 0.019 mg/L.

- In 2012, the Federal Government of Canada introduced the *Wastewater Systems Effluent Regulations* (WSER) under the *Fisheries Act*. The regulations define minimum performance standards in terms of effluent quality for municipal wastewater systems. Some provinces and territories are currently exempted from these regulations including many areas in the Far North and the entire territory of Nunavut. While these regulations do not currently apply to the Hamlet of Resolute Bay, it is anticipated that future regulatory changes could one day require similar minimum performance standards for the Far North. The WSER define the minimum performance standard for un-ionized ammonia as a maximum effluent concentration 1.25 mg/L, expressed as nitrogen at 15°C.

Wastewater treatment systems remove ammonia by a process known as biological nitrification. Under proper process operating conditions including temperature, solids retention time, and sufficient aeration, the biological process will generate and sustain a population of nitrifying bacteria. The nitrifying bacteria in the presence of oxygen (aeration) convert ammonia (NH_3-N) to nitrate (NO_3-N). Perhaps the most critical parameter for successful nitrification as it pertains to operation in Nunavut is process temperature. Nitrifying bacteria grow slower than the heterotrophic bacteria that reduce biochemical oxygen demand (BOD) and are much more sensitive to temperature. With the extreme cold climate experienced in Nunavut it can be challenging to ensure sustained nitrification.

For the Hamlet of Resolute, EXP has recommended a biological-mechanical treatment process for wastewater treatment. A previous design, completed in 2012 by EXP, was based on the membrane bioreactor treatment process. This process is a compact variation on the activated sludge treatment process that uses submerged ultrafiltration membranes to remove suspended solids and produce a very high-quality effluent. In 2020, EXP revised the recommendation for Resolute Bay to be based on a modular mechanical treatment process of which there are numerous process variations. Both the 2012 and 2020 updated designs are based on the use of an aerobic activated sludge treatment process that is capable of fully nitrifying under suitable conditions as noted above. To combat the extreme seasonal cold experienced in Resolute Bay, the biological treatment process would be contained within a heated and insulated building. This design concept would provide year-round climate control for the treatment process promoting process temperatures in the optimal range for nitrification to be sustained. With proper detailed design including aeration capacity, the system could be capable of fully nitrifying on a year-round basis.

In summary, there are currently no regulations currently in place in Nunavut or the Hamlet of Resolute Bay that would require biological nitrification to meet an effluent ammonia discharge objective. However, it is anticipated that there will be future regulatory changes for the far north that could include new guidance on ammonia. With the uncertainty of the future regulatory changes, the Hamlet of Resolute Bay will be well served by installing a biological-mechanical treatment system in accordance with EXP's updated pre-design report (2020). The proposed process technology could be designed for ammonia removal to meet the current WSER performance standards in effect throughout Canada.

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