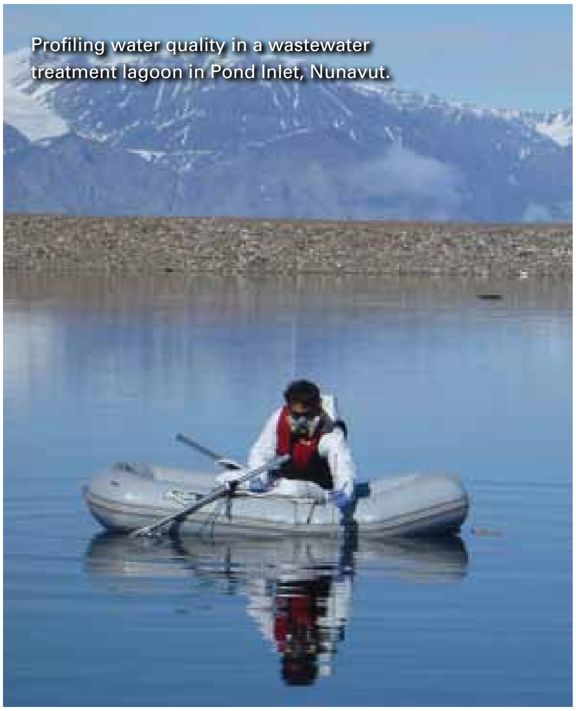

Profiling water quality in a wastewater treatment lagoon in Pond Inlet, Nunavut.

Characterizing soils and vegetation in a treatment wetland in Grise Fiord, Nunavut.

Credits: Centre for Water Resources Studies

Breaking the Ice

The trouble with implementing national wastewater standards in our country's coldest climates.

BY ROB JAMIESON AND WENDY KRKOSEK

MANAGING SEWAGE in Canada's Arctic communities is very different than in the more populated southern regions of Canada. Arctic communities tend to have small populations of 100 to 2,000 people and many can only be accessed by air, or by sea during the brief summer season. The cold climate and permafrost conditions generally prevent the use of underground pipes for transporting sewage from homes and buildings to a centralized sewage treatment plant. Therefore, people living in the Arctic often have to rely on a trucked system for water delivery and wastewater collection. Homes and other buildings are often equipped with two tanks: one for potable water, the other for wastewater. Drinking water deliveries and wastewater collection are usually conducted around every one to two days.

In the majority of communities in the Canadian Arctic, the collected sewage is then transported to lagoons (or waste stabilization ponds) located on the outskirts of town. The lagoons are typically designed to hold a full year's worth of sewage and are frozen for approximately nine months of the year. The lagoon contents thaw during the short summer season, which is approximately two to three months long. At the end of the summer, around early September, the water in the lagoon is pumped out into a natural tundra wetland, or directly into a lake, a river, or the ocean.

Sewage treatment occurs in the lagoon, or the tundra wetland, due to a number of natural physical, chemical, and biological processes. These types of wastewater management systems are termed "passive" as they do not require chemicals, or mechanical equipment (besides a pump to empty the lagoon), as part of their operation.

The main advantages of these types of systems, and the reasons why they are used in small Arctic communities, are they are simple to operate and maintain, do not require energy inputs, and do not use mechanical equipment that would be susceptible to malfunction and failure in extreme cold climates.

The problem, however, is that while these types of treatment systems have been well studied and tested in temperature climates, very little research has been conducted on how they perform in extreme arctic climates.

The impact of new regulations

Environment Canada has recently implemented new Wastewater Systems Effluent Regulations (WSER). The regulations include National Performance Standards (NPS) for municipal wastewater facilities, and specific timelines for upgrading facilities based on an environmental risk assessment framework. However, Environment Canada has specifically acknowledged the challenges that remote, northern communities will face in complying with the WSER. It was recognized that little information exists on the performance of wastewater systems operating in Canada's far north, and the risk they pose to human and environmental health (CCME, 2009). Therefore, the regulations do not immediately apply to wastewater systems located in the Northwest Territories, Nunavut, and north of the 54th parallel in the provinces of Quebec and Newfoundland and Labrador. A five-year grace period (ending in 2014) was provided to conduct research on northern wastewater system performance, and to propose alternative effluent quality guidelines.

The Territory of Nunavut, in particular, faces considerable challenges with respect to establishing and maintaining wastewater infrastructure. Nunavut is comprised of 25 communities that have populations ranging from 130 in Grise Fiord to 6,700 in Iqaluit. These communities are scattered across an area that makes up 20 per cent of the Canadian land mass, and there are no roads connecting any of the communities to each other, or to the southern communities. This means that they are extremely isolated, making it difficult and expensive to move energy, equipment, fuel, and people to and from the communities. These transportation challenges, in addition to the extreme climate, make the construction and operation of a mechanical wastewater treatment plant expensive and difficult.

In response to the impending federal wastewater regulations and the need to identify cost-effective approaches for sewage management, the Government of Nunavut and Dalhousie University have developed a long-term research program focused on municipal wastewater management in Nunavut. The goals of the five-year project, currently in its third year, are to characterize the performance of existing lagoon and wetland wastewater treatment systems in Nunavut, assess the risks these systems pose to both human and environmental health, and identify and test strategies for improving the performance of passive treatment systems in Arctic climates. This work is also meant to provide the information needed to develop appropriate wastewater treatment standards for northern regions.

Over the past two years, researchers and graduate students from Dalhousie University's Centre for Water Resources Studies (*waterstudies.ca*) have established environmental monitoring programs in six Nunavut communities: Grise Fiord, Pond Inlet, Clyde River, Coral Harbour, Pangnirtung, and Kugaaruk. One of main challenges with conducting this type of research in the North is getting samples analyzed in a timely manner, which is partially why very little data has been collected on Arctic wastewater systems. There are no commercial environmental laboratories in the Territory, and it is not usually feasible to ship the samples to a southern centre for analysis due to the time sensitive nature of the analyses.

To address this issue, Dalhousie University has collaborated with the Nunavut Research Institute to establish a water quality laboratory in Iqaluit. The lab is equipped to analyze for all primary wastewater parameters, and is also used to provide training to students enrolled in the Nunavut Arctic College's Environmental Technology Program.

The research conducted to date has produced some very interesting results. The unique summer arctic climate, where some communities receive up to 24 hours of sunlight, can have a number of advantages. For example, extended daylight can stimulate a tremendous amount of algae growth in sewage treatment lagoons. These algae populations are capable of adding considerable amounts of oxygen to the lagoons through photosynthesis, which helps facilitate biological treatment processes.

Trying to understand and harness the natural processes that occur within lagoons and tundra wetlands will be key to predicting and optimizing the performance of these systems. As these types of "open" treatment systems are heavily influenced by environmental factors such as ambient temperature and solar radiation, it will also be important to understand how their performance may be influenced by climate change. Initial findings also indicate that the characteristics of the water bodies which receive the treated effluent must be carefully considered in the establishment of appropriate treatment standards for the Arctic. WC

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