Geohazards in Nova Scotia–An Overview of Program Activities in 2015

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Introduction

There are several naturally occurring geohazards in Nova Scotia that can pose a risk to human health, infrastructure and the environment. Examples include radon gas in indoor air, arsenic and uranium in well water, historical gold mine tailings, karst terrain and acid rock drainage. The Department of Natural Resources' (DNR) geohazard work focuses on identifying and mapping these hazards to ensure they are understood and mitigated through public education and land-use planning. Selected activities undertaken within DNR's Geohazard Program in 2015 are highlighted below.

Radon in Indoor Air

Radon gas occurs naturally in soil and rock and can migrate through cracks and openings in foundations and accumulate inside a home. Radon in indoor air is the leading cause of lung cancer after smoking. Health Canada estimates that radon causes more than 3,000 deaths in each year in Canada (Health Canada, 2015). In Nova Scotia, it is estimated that 11% of the population lives in homes that exceed the indoor air radon guideline (Health Canada, 2012).

In 2015, DNR's radon work focused on the provincial radon risk map and raising public awareness about radon. Specific activities included providing support for a project at Dalhousie University to improve the provincial radon risk map and participating on the Atlantic Radon Task Force, a group that collaborates to reduce radon exposure in Atlantic Canada (members include DNR, Health Canada, the Lung Association and Acadia University).

November was Canada's annual Radon Action Month. During this time there were numerous media releases and public events, including one at the Halifax Public Library, which DNR participated in. The number of visits to DNR's online interactive radon risk map was tracked at the same time to evaluate the impact of these outreach activities. As shown in Figure 1, there was a steady increase in the use of the radon map throughout November, with a total of 1,452 sessions logged by the end of the month.

Although the radon map can improve risk awareness, it is important for homeowners to follow up with radon testing and remediation to reduce radon exposure. The interactive radon map includes links to information on how to purchase test kits and how to find certified radon contractors for remediation work. Please visit the map here: https://fletcher.novascotia.ca/DNRViewer/?viewer=Radon.

Arsenic in Well Water

Arsenic is the most common naturally occurring chemical contaminant in Nova Scotia well water. It is estimated that 9% of drilled wells in the province exceed the arsenic drinking water guideline (Chappells *et al*., 2015). A project was initiated in 2014 to determine the hydrogeologic controls of arsenic in well water. It will develop an effective risk communication tool to inform well users, land-use planners and water treatment specialists about exposure to arsenic in well water. The project will promote water testing and appropriate treatment.

In 2015, the activities of the Geohazard Program focused on the preparation of an open file report, which is scheduled for publication in early 2016.

Drage, J. and Kennedy, G. W. 2016: *in* Geoscience and Mines Branch, Report of Activities 2015; Nova Scotia Department of Natural Resources, Report ME 2016-001, p. 23-27.

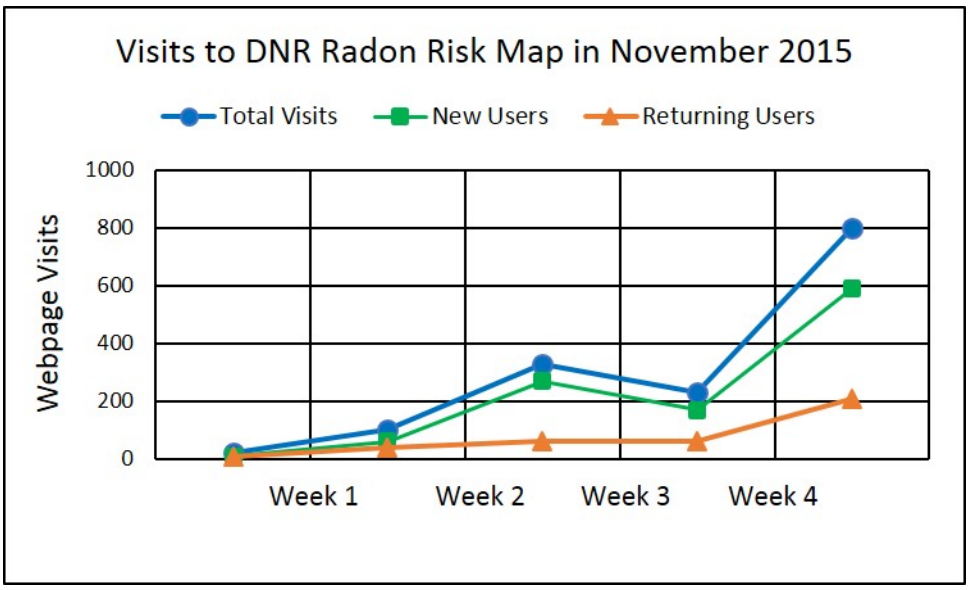

Figure 1. Visits to DNR's online interactive radon risk map in November 2015.

The report synthesizes available research related to arsenic occurrence in water wells in Nova Scotia. Other research activities included the compilation of various historical datasets, such as arsenic in well-water surveys, analyses of arsenic in geologic media, mapping of arsenic datasets and preliminary spatial analysis. Future work will focus on the spatial correlation between arsenic in well water and hydrogeologic criteria, and the development of a risk map and web mapping application.

Uranium Mobility in Groundwater

Uranium is the second most common naturally occurring chemical contaminant in Nova Scotia well water. It is estimated that 4% of drilled wells across the province exceed the uranium drinking water guideline (Kennedy and Finlayson-Bourque, 2011). In 2013, DNR completed a project that looked at the mobilization of uranium in groundwater due to the influence of dissolved calcium (Drage and Kennedy, 2013). In 2015, a follow up project was initiated to develop a laboratory leachate test for evaluating the leachability of uranium in the presence of calcium.

The purpose of the 2015 project was to develop a tool for identifying sites where bedrock may release naturally occurring uranium into groundwater if calcium is allowed to infiltrate into the ground. Examples of possible land-use activities that can potentially add calcium to groundwater include construction and demolition waste-handling sites (where wallboard waste is present) and agricultural operations where gypsum is used as a soil additive. Drill core samples from the DNR Core Library and outcrop samples from selected bedrock types were subjected to a series of leachate tests using variable pH, calcium, bicarbonate and chloride levels. The work is a collaboration amongst DNR, NS Environment and Dalhousie University, and is being completed as an M.Sc. research project at Dalhousie. The final results are expected in 2016.

Historical Gold Mine Tailings

Gold mining that occurred in Nova Scotia between the 1860s and the 1940s produced over three million tonnes of tailings at 64 historical gold mining districts (Fig. 2). During this period, no environmental regulations were in place and tailings were commonly discharged into streams, ponds, rivers, wetlands and surface depressions. This resulted in the formation of tailing deposits with high concentrations of arsenic, mercury and other metals. Recent land-use changes in the vicinity of historical mine sites—such as residential development, recreational development and shellfish harvesting—have raised concerns about the potential risks that tailings pose to human health and the environment.

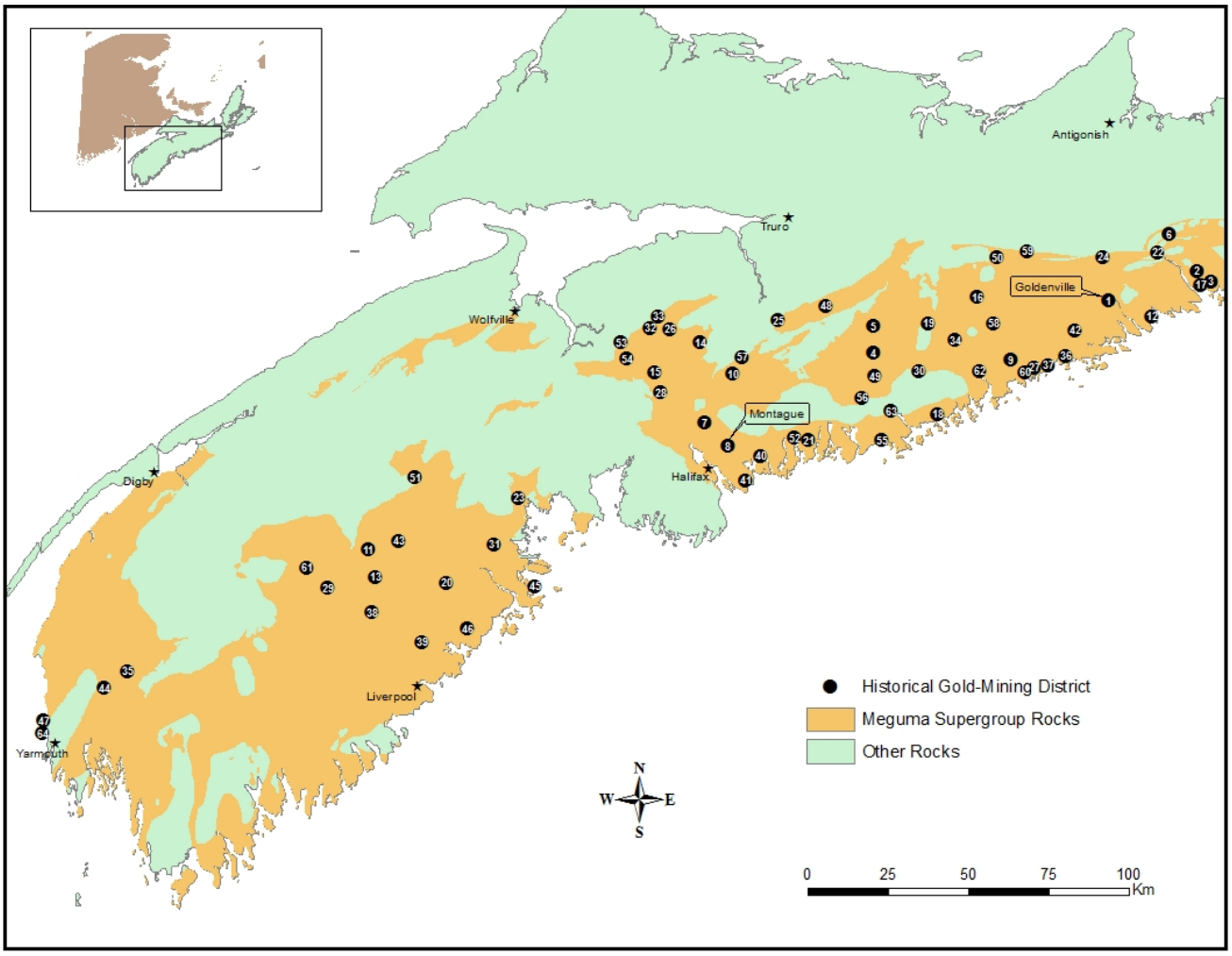

Figure 2. Map of historical gold-mining districts in Nova Scotia.

In 2015, the Geohazard Program provided geoscience advice to other government departments and divisions to support tailings management activities. In addition, an open file report was published that summarizes the results from the key investigations that have been previously published on the environmental impacts of the tailings (Drage, 2015). Further information about the tailings is available on the Nova Scotia Environment webpage (NSE, 2015).

Background Characterization of Soil Chemistry

DNR continued efforts to develop quantitative information on background concentrations of various substances in soils in both rural and urban areas of the province. This information is needed to develop appropriate soil quality standards and to enhance science- and evidence-based decision making in relation to contaminated sites.

In 2015, DNR participated in a project with Dalhousie University and Nova Scotia Environment to conduct soil sampling in urban areas of the Halifax Regional Municipality (HRM). Samples were analyzed for metals and polycyclic aromatic hydrocarbons (PAHs). DNR's involvement included technical advice, assistance with sample-site identification and land access, development of soil sampling protocols, soil sampling at selected sites, and report review. A total of 50 samples were collected in the summer of 2015 from 39 properties across HRM (Fig. 3). A key finding of the 2015 survey was that 98% of the soil samples tested for iron and 32% of the soil samples tested for aluminum had concentrations

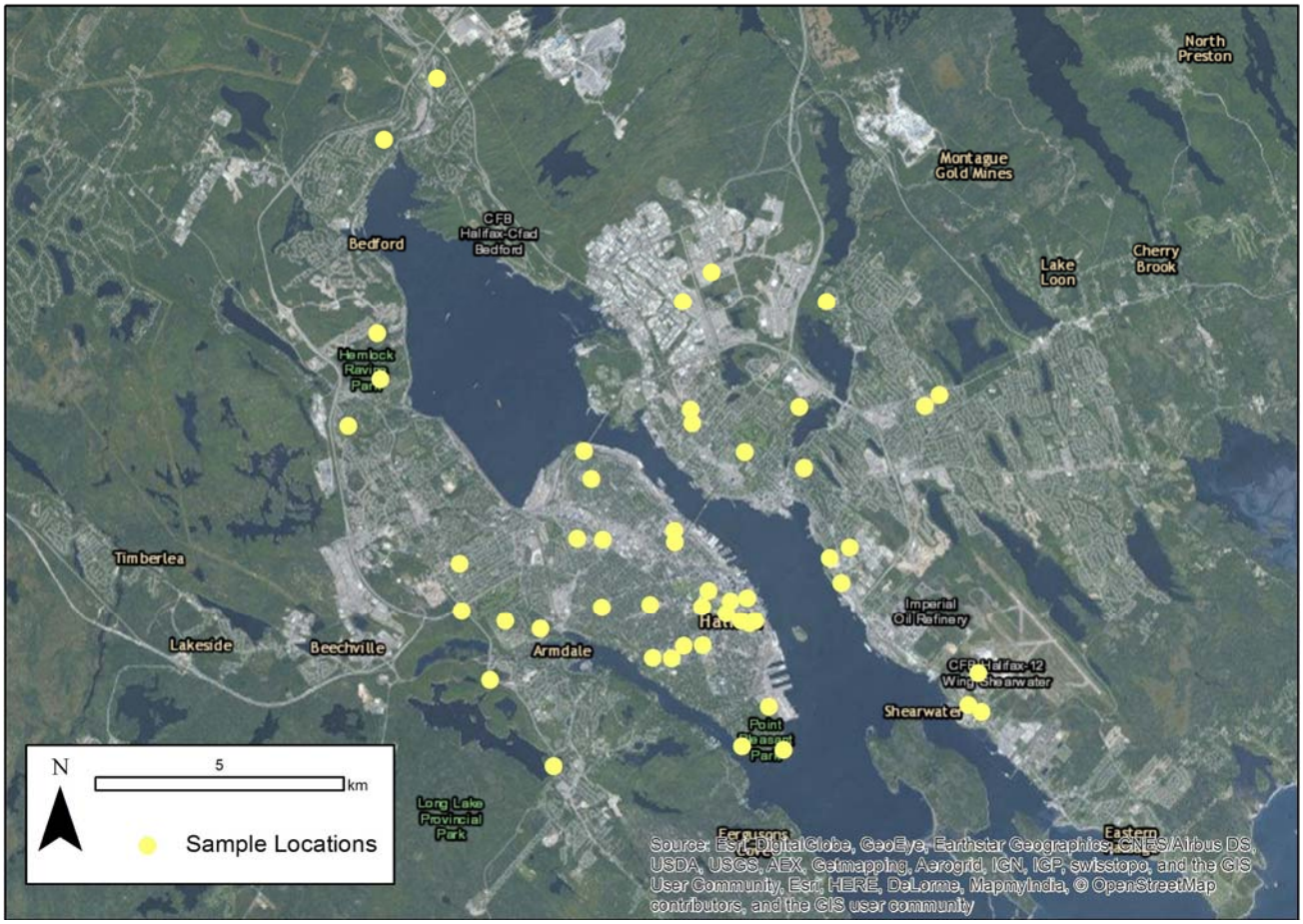

Figure 3. Location of soil samples collected in HRM during 2015 sampling project.

exceeding the residential soil quality standard. Future work will involve statistical analyses of provincial soil chemistry data and the publication of these data for public use.

Karst Risk Mapping

Sinkhole development in karst terrain can cause extensive damage to buildings, roads and other infrastructure. In Nova Scotia, most natural sinkholes associated with karst are formed in areas where gypsum occurs. In 2015, a project was initiated to develop a new provincial karst risk map. The work has involved the compilation of existing geology maps and karst occurrence data, review of lidar data, and field verification of sinkhole occurrences. The project will be ongoing in 2016.

Acid Rock Drainage

Acid Rock Drainage (ARD) occurs when sulphide minerals in rocks are oxidized by exposure to air and water. This process generates sulphuric acid, which can discharge to groundwater, streams, rivers and lakes. Acidic water can be harmful to aquatic life and water supplies, and can cause excessive corrosion in metal and concrete. Acidic waters may also break down other metal-bearing minerals in the rock, causing the release of dissolved metals. No new work was completed on ARD by the Geohazard Program in 2015. For more information and ARD risk maps, consult NSDNR (2015).

References

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