

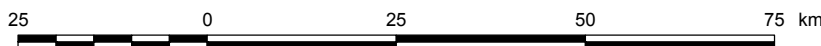
Nova Scotia Department of Natural Resources
Mineral Resources Branch

Open File Map ME 2009-7

Map Showing Potential for Uranium and Related Radionuclides in Groundwater in Nova Scotia

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Scale 1:1 000 000



Halifax, Nova Scotia
2009



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Introduction

Uranium and its related radionuclides, radon, radium and lead²¹⁰, are common radioactive elements and occur naturally in all rocks and soils throughout the province. These elements may enter groundwater through natural interactions that take place when the groundwater migrates through bedrock and soil. An examination of the drinking water in several select regions of the province carried out by a Provincial Uranium Task Force between 1979 and 1982 (Grantham, 1986) determined that there are numerous areas of the province where the level of uranium found within the groundwater may exceed the current Guidelines for Canadian Drinking Water Quality (GCDWQ) level of 0.02 mg/L (20 ppb). The Task Force also concluded that: (1) this is a naturally occurring phenomenon; (2) 99% of the GCDWQ exceedances were associated with drilled wells; and (3) although there are some regions of the province more prone to the phenomenon, this is a province-wide issue. This map shows areas of the province more likely to have elevated levels of uranium, radon, radium or lead²¹⁰ in groundwater, but it is stressed that this phenomenon is not restricted to these areas and GCDWQ exceedances may occur throughout the province. Note that there is no GCDWQ for radon. Health Canada holds that the inhalation of radon in air poses a health risk, but the ingestion of radon-rich water does not.

Data Sources

Derivation of this map used direct and indirect data sources. Direct indicators of groundwater radionuclide levels are well water analyses for these elements, because they are a direct indication of the frequency of GCDWQ exceedances in any particular region. Nova Scotia is fortunate to have several datasets that consist of some combination of uranium, radon, radium and lead²¹⁰ water analyses (see inset map and Selected References). These include the mid-1970s federal government survey of Dyck *et al.* (1976), provincial government surveys such as the Provincial Uranium Task Force (Grantham, 1986), well water testing of schools conducted by the Special Water Advisory Group (SWAG) between 2002 and 2004 (Nova Scotia Department of Natural Resources, 2009), and well water data from the Nova Scotia Department of Environment. Collectively, these federal and provincial government databases comprise 2676 locations (see inset map). Considerable well water and spring water analytical data for uranium and radon reside in mineral exploration assessment reports from several of the uranium exploration projects that were carried out in the province between 1976 and 1981 (see Selected References). These exploration assessment reports are maintained in the library of the Nova Scotia Department of Natural Resources and comprise a dataset of 2041 well and spring water locations. Please note that all datasets of well water analyses used to derive this map have been accepted as reported in their original reference sources and have not gone through a separate quality assurance/quality control analysis by the authors of this map.

Geological information providing indirect inferences regarding the potential for elevated radionuclide levels in the groundwater were also used to derive the map's patterns. Foremost was knowledge of the distribution of uranium occurrences throughout the province and the rocks in which they occur (Nova Scotia Department of Mines and Energy, 1982). The presence of uranium occurrences in particular geological units indicates that over geological time, uranium had been mobilized in these rocks and redeposited as uranium-bearing minerals in aquifers and along bedrock fracture systems, which now serve as pathways for migrating groundwater.

Nova Scotia and Prince Edward Island are the only provinces in the country to have complete coverage by federal government airborne gamma-ray spectrometric surveys that were flown between 1976 and 1985 (Ford *et al.*, 1989; Carson *et al.*, 2003). These airborne surveys are another source of indirect inference because maps compiled from these surveys for equivalent uranium (eU) clearly show the relative levels of background radioactivity of this element throughout the province. As a result, these maps are useful in defining regions where there is a higher background level of uranium in the rocks and soil which, under the proper conditions, could be available to dissolve into migrating groundwater.

Interpretation of the Map Patterns

The map has two designations: Level 1 - areas more likely to have groundwater containing elevated uranium and related radionuclides exceeding the GCDWQ; and Level 2 - areas less likely to have levels of uranium and related radionuclides exceeding the GCDWQ. There are two geological terranes that constitute the majority of Level 1. First are the granitic terranes of the southern and eastern mainland where the highest levels of uranium in well waters have been reported (up to 0.7 mg/L, Grantham, 1986). These rocks are naturally elevated in uranium and contain the more significant and numerous vein-type uranium occurrences. Second are the areas of Carboniferous and Jurassic sedimentary rocks that underlie much of northern Nova Scotia, the Annapolis Valley and some of the lowland areas throughout Cape Breton Island. Uranium occurrences in these rocks are low grade, but are widely distributed and occur within the same porous sedimentary units that serve as groundwater buffers. As a result, there are areas where a significant percentage of the wells approach, or exceed, the drinking water guideline for uranium.

The Level 2 designation consists of geological units in which wells exceeding the drinking water guideline for uranium are known to occur, but are less common than in the Level 1 areas. In these rocks the occurrences of uranium are rare and typically low grade. Even though the potential for elevated uranium and related radionuclides in the Level 2 area is low, there still is a risk. Nova Scotia Environment recommends that all private well owners test their wells for bacteria quality every 6 months and chemical quality, which includes uranium, every 2 years. For more information refer to Nova Scotia Environment (2009).

Map Notes

GIS Databases, cartography and reproduction by Brian Fisher and Angie Ehler of the Nova Scotia Department of Natural Resources, Geoscience Information Services Section, 2009. The GIS databases and map were developed using ArcGIS 9.3.

Universal Transverse Mercator Projection (UTM), Zone 20, Central Meridian 63°00' West.

North American Datum (NAD) 1983 Canadian Spatial Reference System (CSRS) 98.

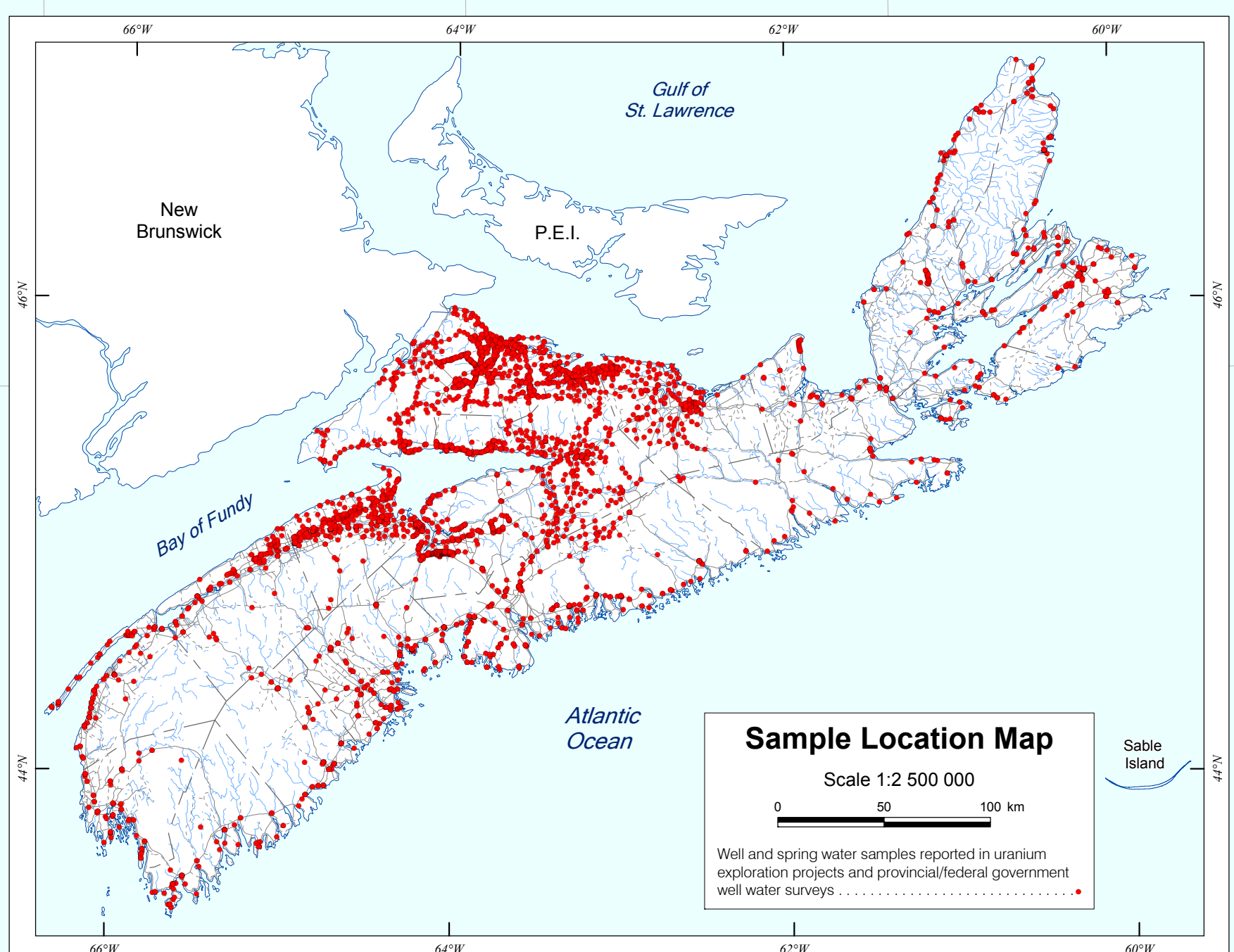
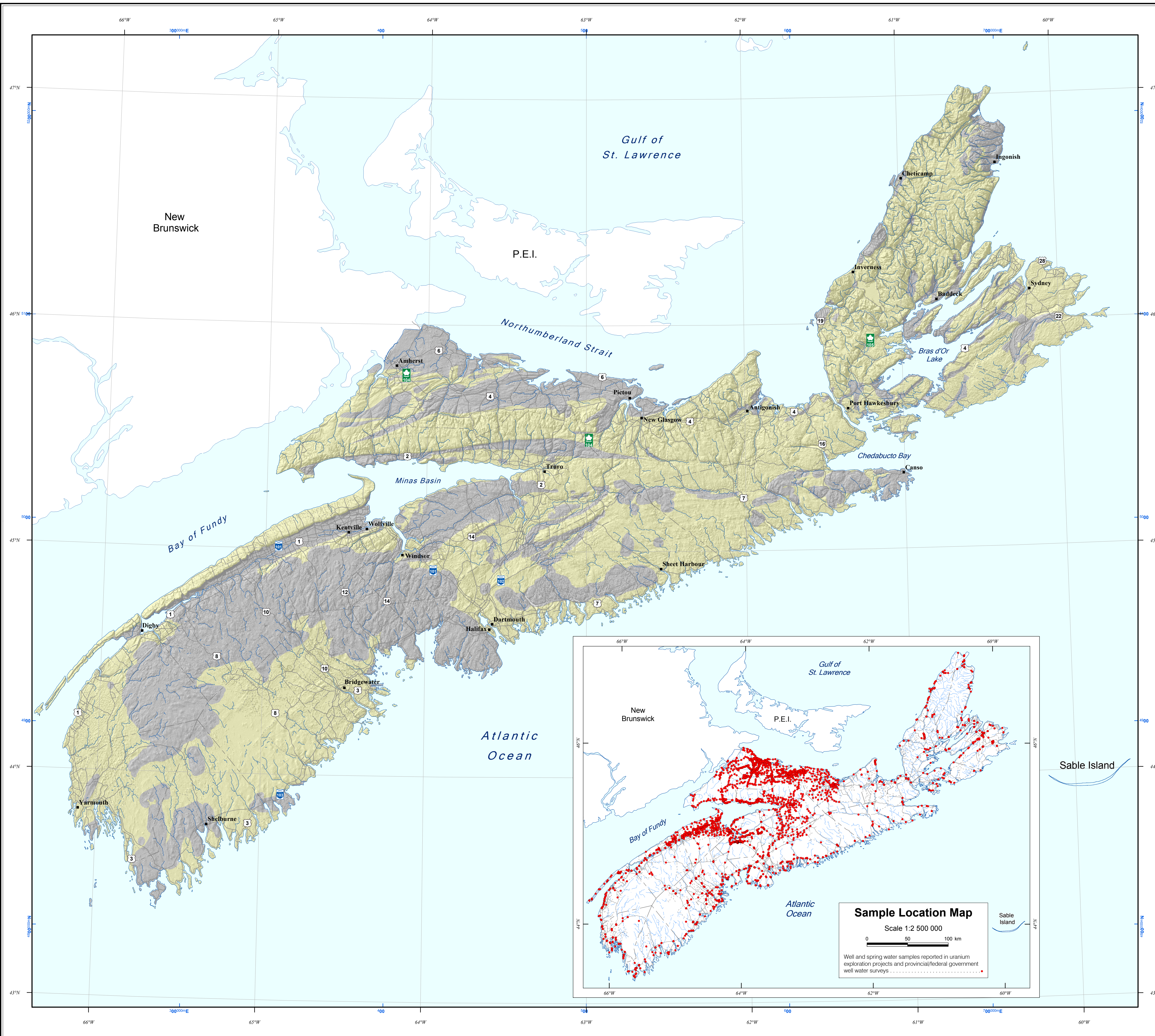
Base and digital data derived from the Nova Scotia Topographic Database (NSTDB). Copyright Her Majesty the Queen in Right of the Province of Nova Scotia. The NSTDB is available from Service Nova Scotia and Municipal Relations (SNSMR), Land Information Services Division (LIS), Nova Scotia Geomatics Centre (NSGC), Amherst, Nova Scotia. Shaded relief image derived from a 25 m Digital Elevation Model of the Province of Nova Scotia, DP ME 56. Azimuth of 315°, sun angle of 45° and a vertical exaggeration of 10.

Disclaimer

The information on these maps may have come from a variety of government and nongovernment sources. The Nova Scotia Department of Natural Resources does not assume any liability for errors that may occur. The Map Showing Potential for Uranium and Related Radionuclides in Groundwater in Nova Scotia is intended for use at the published scale of 1:1 000 000 and the Sample Location Map is intended for use at the published scale of 1:2 500 000.

Recommended Citation

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Legend

- Level 1 - Areas more likely to have groundwater containing a level of uranium approaching or exceeding the acceptable level of 0.02 mg/L, according to Health Canada's Guidelines for Canadian Drinking Water Quality. These areas may also have elevated levels of radionuclides related to uranium such as radon, lead²¹⁰ and radium. Based on the presence of geological bedrock known to contain occurrences of uranium as well as numerous confirmed instances of elevated levels of uranium in groundwater.
- Level 2 - Areas less likely to have groundwater containing elevated levels of uranium. However, though the instances of groundwater with elevated levels of these radionuclides are less common, there are still exceedances to Health Canada's Guidelines known to occur.

Symbols

- Roads (primary, secondary) - - - - -
- Roads (unpaved) - - - - -
- Coastline, rivers, streams - - - - -
- County boundary - - - - -
- Lakes/Ocean - - - - -

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