

# An Overview of Hydrogeology Program Activities in 2015

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## Introduction

In 2015, the activities of the Nova Scotia Department of Natural Resources (DNR) Hydrogeology Program were focused on data management, the publication of a new web map application for accessing groundwater data and various collaborative projects, such as the mobilization of uranium in Nova Scotia's aquifers, the baseline interpretation of hydrogeologic conditions at a disturbed peatland on Brier Island and the baseline understanding of the groundwater resources of Sable Island. Technical advice was provided to various government and private sector clients, and groundwater related geohazard projects were conducted, which reviewed research related to the occurrence of arsenic in groundwater and the environmental impacts of historical gold mine tailings. DNR activities related to geohazard research are reported in the Geohazard Program report (Drage and Kennedy, this volume). In addition, as part of the Municipality of the District of Shelburne's plans for climate change adaptation, an investigation into indicators of seawater intrusion in wells in eastern Shelburne County was conducted to characterize the potential extent of saltwater intrusion in this region.

## Program Highlights

### Groundwater Data Management and Access

#### *Updates to Groundwater Databases*

Activities related to the organization and maintenance of provincial groundwater information included routine updating of groundwater

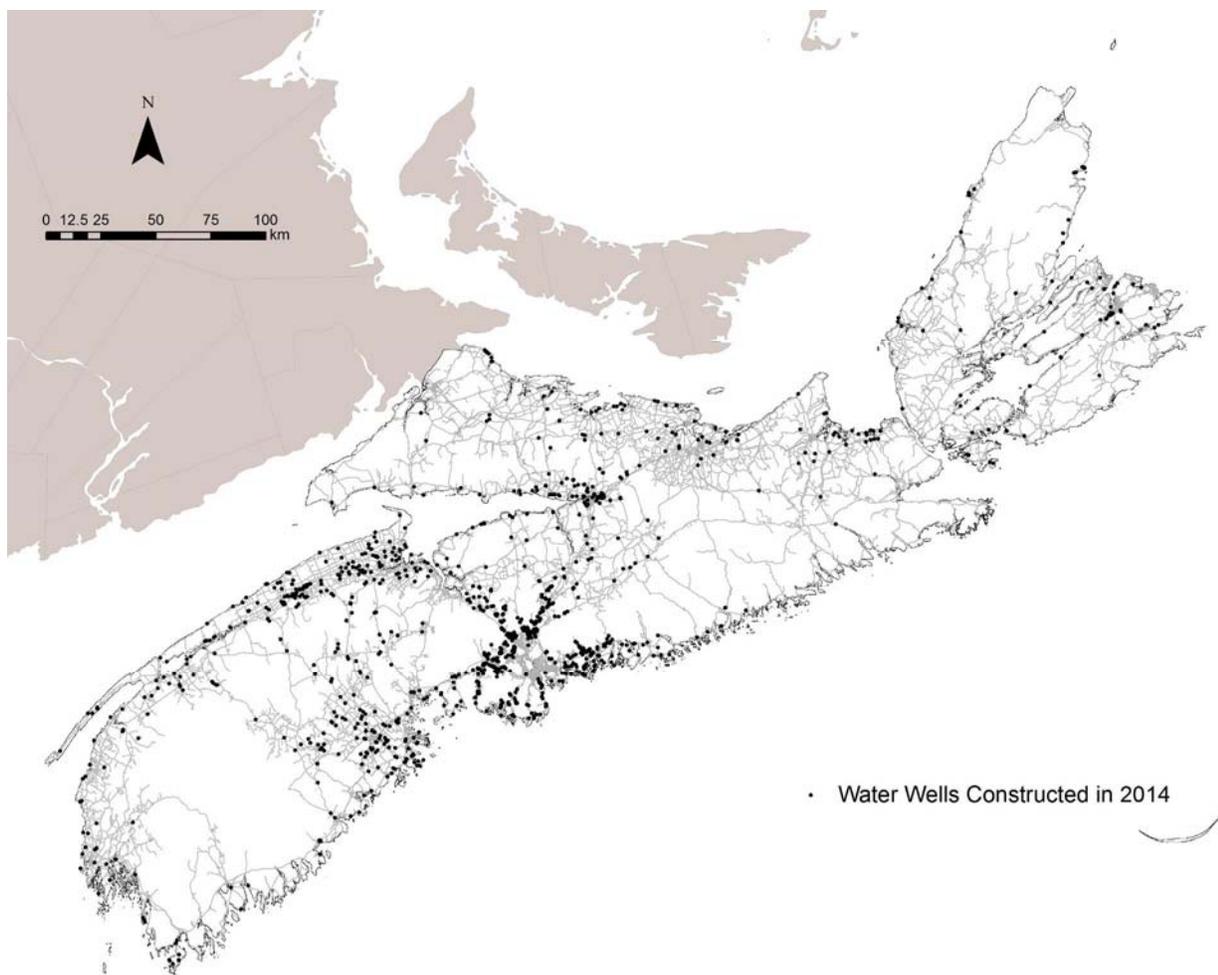
databases, such as the Nova Scotia Well Logs Database (Nova Scotia Department of Natural Resources, 2015a), the Nova Scotia Pumping Test Database (Nova Scotia Department of Natural Resources, 2015b), and the Nova Scotia Groundwater Chemistry Database (Nova Scotia Department of Natural Resources, 2015c). The locations of water wells constructed in 2014 are shown in Figure 1.

Progress continued in 2015 with respect to the improvement of georeferencing of groundwater data. For example, compared to 2008, the percentage of well logs georeferenced to at least the property level of spatial accuracy (total of methods D1, D2, G, GC and M in Table 1) has increased from 9.3% (9,923 wells) to 32.6% (39,039 wells).

#### *Web Services and Client Applications*

The Nova Scotia interactive groundwater map application was upgraded to a new platform in the fall of 2015. The map application is now referred to as the Nova Scotia Groundwater Atlas and can be accessed at <https://fletcher.novascotia.ca/DNRViewer/?viewer=Groundwater>.

The Groundwater Atlas online map application features a number of improvements including easier map navigation, new and improved functionality with respect to map customization and printing, and the capability to export data from the application to a variety of file formats including ESRI shapefile and MS excel. New layers added to the application include surficial aquifers (Kennedy, 2014), groundwater budgets (Kennedy *et al.*, 2010), seawater intrusion vulnerability (Kennedy and McKinnon, 2013), and flood ranges based on the



**Figure 1.** Distribution of water wells constructed in 2014 in Nova Scotia (as submitted by well drillers and diggers).

provincial digital elevation model (Nova Scotia Geomatics Centre and Nova Scotia Department of Natural Resources, 2006).

## Groundwater Research and Mapping

### *Groundwater Resources of Sable Island*

The DNR Hydrogeology program assisted with the advancement of the baseline understanding of groundwater resources on Sable Island to inform the park management plan being developed by Parks Canada. Staff participated in meetings, co-authored a presentation at the Science and History of Sable Island conference, provided technical advice, submitted a chapter for

publication in the book ‘Sable Island: Exploration in Ecology and Biodiversity’ (Kennedy *et al.*, 2016), and co-authored a paper on the hydrogeology of Sable Island (Hennigar and Kennedy, 2016).

### *Hydrologic Baseline Characterization of the Big Meadow Bog*

The DNR Hydrogeology program continued its participation in a collaborative, multi-disciplinary wetland research project at the Big Meadow Bog on Brier Island to assess baseline hydrological conditions at the site. This research is needed to help inform the restoration approach of the disturbed wetland complex, which has been impacted by historical drainage activities and hosts

**Table 1.** Summary of Well Log Georeferencing.

Georeference Method	Description	Estimated Georeference Accuracy	Count 2008	Count 2014	Count 2015
A1	Nova Scotia Mapbook (grid reference centroid)	±707 m	74,439 (69.4%)	58,782 (49.6%)	58,123 (48.6%)
A2	Nova Scotia Atlas (grid reference centroid)	±641 m	869 (0.8%)	964 (0.8%)	953 (0.8%)
B1	NTS – Claim (grid reference centroid)	±1130 m	1,862 (1.7%)	1,871 (1.6%)	1,870 (1.6%)
B2	NTS – Tract (grid reference centroid)	±282 m	16,064 (15.0%)	14,588 (12.3%)	14,532 (12.2%)
C	Community gazetteer location from Nova Scotia Mapbook	±7,829 m	3,619 (3.4%)	3,006 (2.5%)	2,986 (2.5%)
D1	Property centroid from NSPRD	~10 to 2000 m	1,149 (1.1%)	14,966 (12.6%)	15,203 (12.7%)
D2	Property location using NSPRD/ NSCAF/other	~10 to 2000 m	595 (0.6%)	1,584 (1.3%)	1,573 (1.3%)
E	Grid reference centroid plots location in ocean so point moved to nearest coast	707 to 1130 m	0 (0%)	1,711 (1.4%)	1,716 (1.4%)
G	GPS	±15 m	7,812 (7.3%)	16,722 (14.1%)	17,699 (14.8%)
GC	Geocoded address	~10 to 2000 m	0	0	606 (0.5%)
M	Estimated from site map	50 to 150 m	367 (0.3%)	3,899 (3.3%)	3,958 (3.3%)
U	Could not locate co-ordinates	-	429 (0.4%)	382 (0.3%)	376 (0.3%)
<b>TOTAL</b>			<b>107,205</b>	<b>118,475</b>	<b>119,595</b>

NSPRD: Nova Scotia Property Registration Database.  
NSCAF: Nova Scotia Civic Addressing File.

*Geum peckii* (Eastern mountain avens), a globally rare plant. An open file report was released in 2015 (Kennedy *et al.*, 2015) that provides an assessment of available hydrological data since the initiation of monitoring activities in 2013.

### ***Planning for Climate Change Adaptation in Eastern Shelburne County—Groundwater Resources***

As part of a project to assist the Municipality of the District of Shelburne with plans for climate change adaptation, DNR compiled historical reports and

data, and developed mapping to help determine the state of knowledge with respect to groundwater resources and seawater intrusion in eastern Shelburne County.

A survey of electrical conductivity in water wells (n=33) was completed in the summer of 2015 in eastern Shelburne County to provide baseline information on salt levels in wells to help understand the current extent of saltwater intrusion. The project was carried out as a partnership between DNR and the Municipality of the District of Shelburne. This project is reported as “Results of

a Well Water Survey in Eastern Shelburne County” (Drage *et al.*, this volume).

## Groundwater Management

DNR worked with Nova Scotia Environment (NSE) and Dalhousie University on research that will assist with the development of policy on and with the management of occurrences of induced uranium in groundwater. This work builds on existing DNR research that identified the potential for uranium to be mobilized in groundwater by certain land use activities (Drage and Kennedy, 2013). The intent of the research is to develop new methods for proactively identifying situations where uranium can be mobilized so that mitigation measures can be implemented. The work is being carried out as an M.Sc. research project and will continue in 2016.

## Outreach and Support Activities

DNR assisted various clients with data requests and requests for technical advice in 2015, including homeowners, municipalities, groundwater consultants and other provincial government departments. For example, DNR prepared groundwater budgets for Nova Scotia Environment at a subwatershed scale in the Salmon River watershed to provide information related to the sustainability of groundwater withdrawals in this area. In addition, DNR provided advice to the Department of Transportation and Infrastructure Renewal on potential groundwater supply development at the Shubenacadie Wildlife Park.

### *Aquifer Sustainability in Subdivision Developments*

In recent years, several subdivision developments in HRM that rely on private wells have experienced water shortages due to declining aquifer levels. To help address this problem, DNR had previously worked with NSE to develop a groundwater assessment guide and toolkit as planning tools to ensure aquifer sustainability in subdivision developments (Nova Scotia Environment, 2011). DNR is building on this work by supporting research at Dalhousie University to model the

effects of low impact design stormwater management methods on aquifer sustainability. The work is being carried out as an M.Sc. research project and will continue in 2016.

### *Meetings, Input to Policy Documents and Working Group Activities*

The Hydrogeology Program provided technical input to various government policy and strategy documents and participated on working groups such as the NS Flood Working Group and the Atlantic Radon Task Force.

### *Presentations*

The DNR Hydrogeology Program delivered the following presentations during 2015:

- A lecture on the province’s surficial aquifers for a St. Mary’s University hydrogeology class
- A two-part presentation to the International Association of Hydrogeologists–Atlantic Chapter on surficial aquifers and ways to access to government groundwater data

## Publications

Gavin Kennedy served as one of three guest editors for a special series on Environmental Geoscience in the Atlantic Geology journal. The following is a list of publications by the DNR Hydrogeology program released in 2015:

- An overview of Hydrogeology Program activities in 2014, available online at [http://novascotia.ca/natr/meb/data/pubs/15re01/15re01\\_07\\_KennedyDrageROA2014.pdf](http://novascotia.ca/natr/meb/data/pubs/15re01/15re01_07_KennedyDrageROA2014.pdf)
- Preliminary Results of Baseline Hydrological Monitoring at Big Meadow Bog, Brier Island, Digby County, Nova Scotia; available online at [http://novascotia.ca/natr/meb/data/pubs/15ofr01/ofr\\_me\\_2015-001.pdf](http://novascotia.ca/natr/meb/data/pubs/15ofr01/ofr_me_2015-001.pdf)
- 2014 Update on Baseline Hydrological Monitoring at Big Meadow Bog, Brier Island, Nova Scotia; available online at <http://>

[novascotia.ca/natr/meb/data/pubs/15ofr05/ofr\\_me\\_2015-005.pdf](http://novascotia.ca/natr/meb/data/pubs/15ofr05/ofr_me_2015-005.pdf)

The following is a publication associated with the DNR Hydrogeology program and was released in 2015:

- Kennedy, G. W. and Drage, J. 2015: Assessing patterns of dissolved methane in shallow aquifers related to Carboniferous and Triassic sedimentary basins, Nova Scotia, Canada. *Atlantic Geology*. [doi:10.4138/atlgcol.2015.009](https://doi.org/10.4138/atlgcol.2015.009)

## Research Directions

An area of focus for the Hydrogeology Program continues to be the compilation of legacy groundwater data, the improvement of data capture processes, and the maintenance and publication of spatial data. The capabilities of online applications for viewing and accessing provincial groundwater data will continue to be expanded. Other areas of research include the hydrogeochemical controls on naturally occurring contaminants such as arsenic and uranium in well water supplies, as discussed in the Geohazards Program report (Drage and Kennedy, this volume).

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