The Geology of Prince Edward Island and Hydraulic Fracturing

The bedrock everywhere at and near the surface in PEI consists of sequences of sandstone ‘red-beds’, of generally high, but variable, permeability. The most commonly referenced report on the geology of the island is by H.W. Van de Poll (1983. Geology of Prince Edward Island. Prince Edward Island Dept. of Energy and Forestry, Energy and Minerals Branch, Report 83-1, Charlottetown, PEI, 66 p.). Van de Poll describes several stacked series of sedimentary beds, each series grading from coarse sandstone-conglomerate (especially porous), through thick layers of sandstone (most of the island rock), to rocks that are mixtures of clay, silt, and sand (some potential to retard/divert flow of groundwater or pollutants). Here are some factors that complicate efforts to control/mitigate pollutant releases on/within these rocks:

- The high porosity and permeability of the sandstones (majority of island rocks) means that the rocks (and sandy soils/tills on top of them) will have high capacity to absorb and rapidly spread tainted fluids.
- The rocks sequences (large stacks of beds mapped by Van de Poll) slant a few degrees downward to the north or, at west end of the island, to the east, which makes it possible that lighter-than-water pollutants (such as petroleum products) or heavier-than-water pollutants (such as brines) could move significant distances horizontally while rising/falling past silt-and-clay-rich beds.
- The more detailed typical structure of red-bed rocks consists of chaotically piled-together lenses of sandstone with variable permeability, rather than nice even-thickness regionally continuous layers. Therefore, even sandy-silty zones will not consistently seal off between one rock sequence and the next one above or below. Also, it’s going to be very difficult to predict the very local directions and rates of fluid/pollutant flow through the red-beds.
- An island-wide survey of groundwater conditions was provided by L.V. Brandon (1966. Groundwater Hydrology and Water Supply of Prince Edward Island. Survey of Canada Paper 64-38, 37 p.). Brandon argues (and subsequent groundwater researchers support) that 1) fractures widespread in the sandstone, and 2) thin bedrock layers of very high-permeability sediment, are very important routes of rapid groundwater flow. This again suggests that local (for example, site-scale) groundwater/pollutant flow rates and directions will be difficult to predict, and that the rates will be severely underestimated by lab permeability tests on most solid samples of bedrock.

Because fracking is usually used to enhance the release of natural gas or oil from truly low-permeability rocks such as shales, I’ll assume for now (though you might correct) that any proposals for fracking on PEI will involve deep drilling to rock beds below the red-beds, hundreds to thousands of meters below the surface, and well below the depth where groundwater is saline. In such circumstances the main threat of fracking to groundwater and surface water quality will come from failures of well containment closer to the surface, and spills/blowouts of fracking fluids onto the surface. Given the character of rocks I’ve described above, both spill infiltration from the surface and direct leakage to rocks from leaking drill holes are significant threats to groundwater quality.

I must say that one of the additional issues I found most compelling in presentations on NS/NB fracking is the large-scale industrialization of landscape that attends these operations (as well as other forms of petroleum development), and its potential to affect quality of life for residents, as well as tourism. In a 2009 PEI-Island Studies policy document The Island Landscape http://www.gov.pe.ca/photos/original/clg_iisa_09.pdf, Carol Horne provides compelling statistics
showing that PEI’s scenery is a primary tourist draw (arguably the #1 draw). Additional degradations of view quality are real threats to the island economy.

Scott Rice-Snow, Chair
Dept. of Geological Sciences
Ball State University
Muncie, IN 47306