The rapid expansion of shale gas and shale oil exploration and exploitation using hydraulic fracturing techniques has created an energy boom in the USA but raised questions regarding the possible environmental risks, such as the potential for groundwater contamination (e.g. Jackson et al., 2013; Vidic et al., 2013) and fugitive emissions of hydrocarbons in to the atmosphere (e.g. Miller et al., 2013). Boreholes drilled to explore for and extract hydrocarbons must penetrate shallower strata before reaching the target horizons.

Some of the shallower strata may contain groundwater used for human consumption or which supports surface water flows and wetland ecosystems. Although it has been routine practice to seal wells passing through such layers, they remain a potential source of fluid mixing in the subsurface and potential contamination (King and King, 2013). This can occur for many reasons, including poor well completion practices, the corrosion of steel casing, and the deterioration of cement during production or after well abandonment. Boreholes can then become high-permeability potential conduits for both natural and man-made fluids (e.g. Watson and Bachu, 2009), and vertical pressure gradients in the subsurface can drive movement of fluids along these flow paths. The potential importance of wellbore integrity to the protection of shallow groundwater has recently been highlighted in research papers and reports (e.g. Osborn et al., 2011; The Royal Society & The Royal Academy of Engineering Report (2012); Jackson et al., 2013; King and King, 2013).

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