

**QUANTITATIVE EVALUATION OF ENVIRONMENTAL ISSUES RELATED  
TO HYDRAULIC FRACTURING FOR SHALE GAS PRODUCTION**

**John A. Connor\***

**Lisa J. Molofsky**

**Ann P. Smith**

GSI Environmental, Inc.  
2211 Norfolk Street, Suite 1000  
Houston, TX 77098  
Voice: 713-522-6300  
Fax: 713-522-8010  
[jaconnor@gsi-net.com](mailto:jaconnor@gsi-net.com)

Hydrofracturing activities related to development of shale gas deposits have generated significant concerns related to potential impacts on groundwater and surface water resources, as well as land use, particularly in regions of the U.S. without a long tradition of E&P operations. However, our survey of thousands of remediation sites in four principal oil and gas producing states shows that impacts to groundwater and surface water in the upstream oil and gas sector are quite rare, occurring at less than 0.4% and 0.03% of oilfield facilities, respectively. In addition, quantitative analysis of various energy sources shows shale gas to be relatively efficient in terms of water consumption and land use per unit of energy produced. With regard to groundwater protection, shale gas wells, like conventional oil and gas wells, require proper casing design to prevent impacts on drinking water units. However, as shown by microseismic mapping of hydraulic fracturing propagation at hundreds of well sites, impacts on drinking water aquifers by fracturing fluids are unlikely, given the great depth of most shale gas production zones and the limited length and height of the induced fractures. Similarly, stream monitoring data from areas of intense shale gas production demonstrate no measurable impact on regional surface water quality by produced water discharges. Review of environmental concerns related to hydrofracturing activities indicates that the two principal challenges will be management of water supplies and post-fracturing produced water.

###