

# FIELD SCREENING FOR SHALLOW GAS COMPLETED ACROSS NORTH DAKOTA

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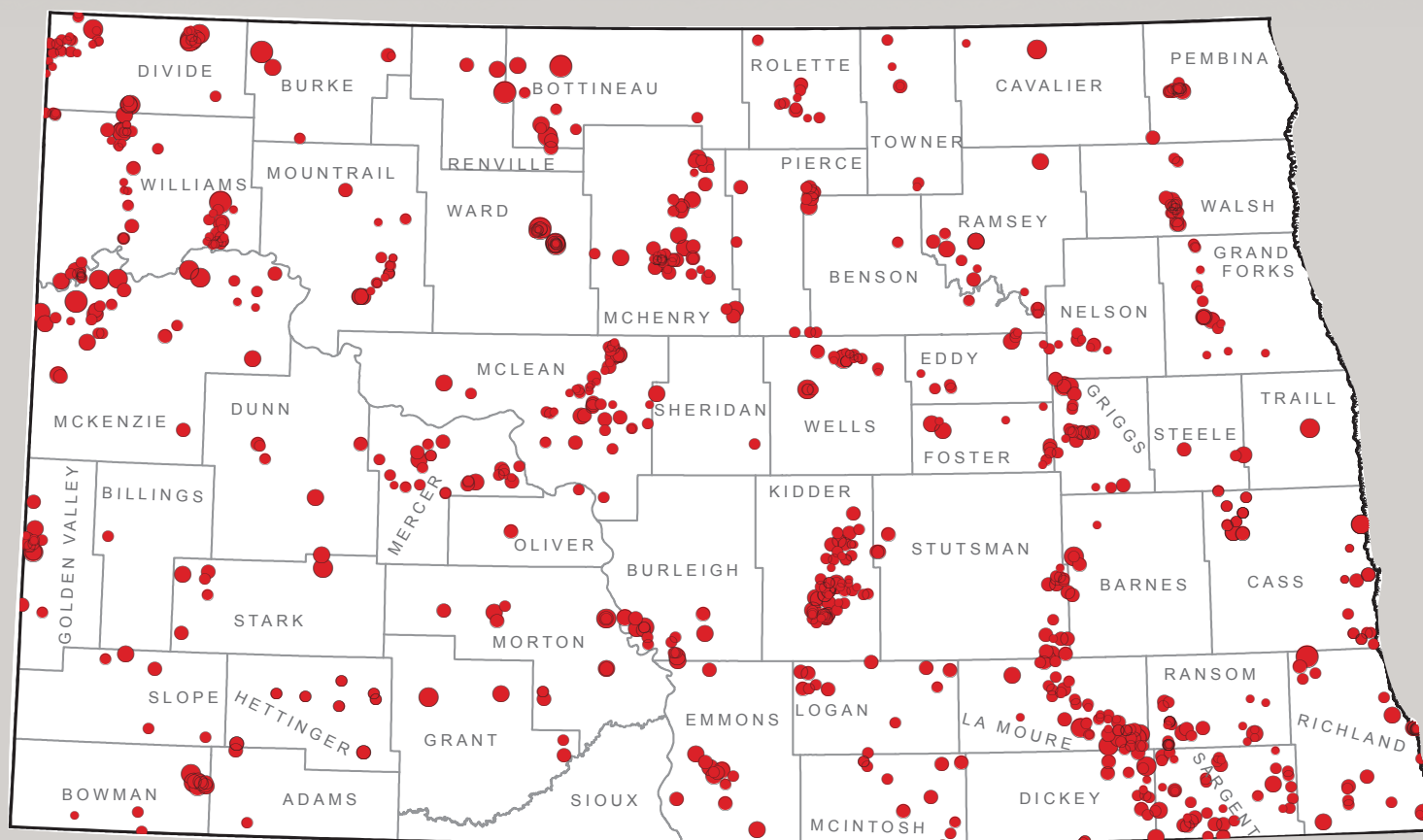
The North Dakota Geological Survey has completed the first state-wide reconnaissance of potential shallow natural gas occurrences in ground-water wells. The project involved testing for the presence of gas in water observation wells using a portable flame-ionization detector (FID). Over the course of this project 4,325 wells were field-screened for shallow gas. From this field screening, 905 gas occurrences (21%) were measured in wells located in 52 of North Dakota's 53 counties (fig. 1).

The project was started late in the 2006 field season with the initial objective of formulating a reproducible testing methodology. The methodology was refined by conducting well field-screening in areas of known shallow gas occurrence (Bottineau and Renville counties). The project was then expanded into "frontier" areas in the eastern part of the state where gas occurrences could be found based on our knowledge of favorable geologic conditions in the shallow subsurface. This first phase of the project investigated

522 wells in six counties: Steele, Bottineau, Renville, Emmons, Stutsman, and Towner and resulted in 56 wells (24%) with a shallow gas show (table 1). These positive results were presented during the 2007 legislative session and the project was expanded to seven additional frontier counties.

This second phase of the project, which was conducted over the 2007 and 2008 field seasons, resulted in the investigation of 2,365 wells in 12 counties. The 12 counties, five more than originally proposed, included Rolette, Burleigh, Ward, McHenry, Pierce, Kidder, Barnes, LaMoure, Morton, Sheridan, Benson, and Logan. FID field-screening detected an additional 270 gas shows in wells (18%) tested during the projects second phase.

After the 2008 field season we determined that, at the current rate of progress, canvassing the entire state would most likely take an additional 10 years. To speed up the process, we hired four



**Figure 1.** Locations of FID shallow gas occurrences in North Dakota collected from 2006 to 2010. The red circles are locations where shallow gas was detected and are sized proportionally to reflect recorded FID gas concentrations (modified from Anderson et al., 2010).

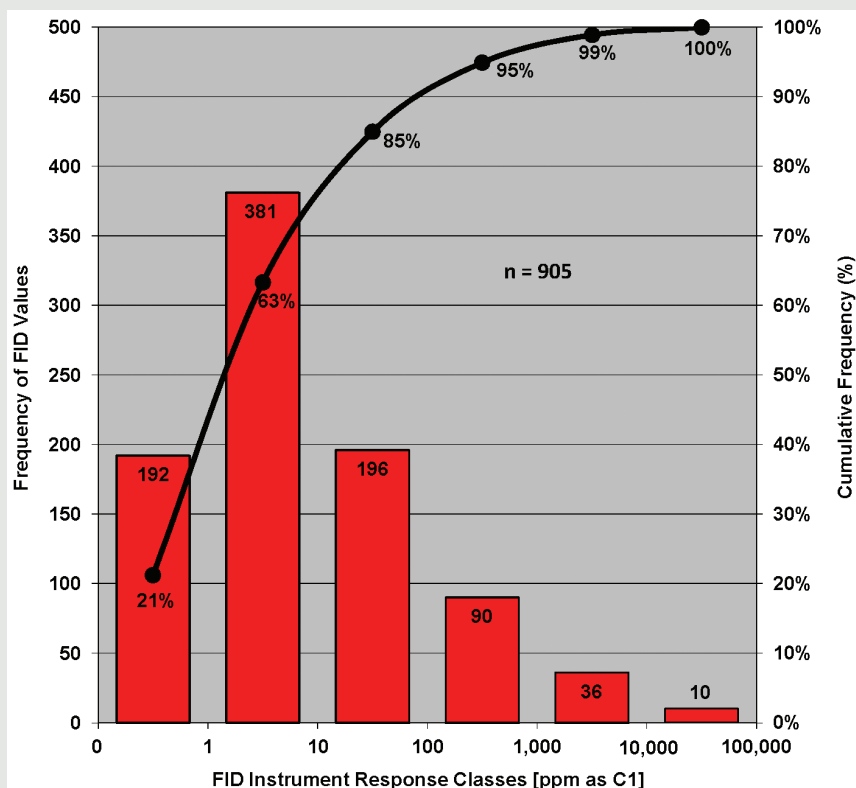
Field Season Completed	No. of Counties Investigated	Wells Investigated Summary				Cumulative C1 Occurrence (%)	Range of FID Instrument Response		
		Wells Investigated	Wells Field Screened	Wells with a positive FID response (>0.0)	Wells with no FID response (0.0)		Minimum (ppm as CH <sub>4</sub> )	Maximum (ppm as CH <sub>4</sub> )	Mean (ppm as CH <sub>4</sub> )
2006	6	522	238	56	182	24%	0.2	30,362	997
2007	9	1,826	1,294	247	1,047	20%	0.2	50,000	432
2008	3	539	209	23	186	18%	0.5	538	49
2009	30	5,148	2,048	511	1,537	24%	0.1	31,347	458
2010	4	1,355	536	68	468	22%	0.3	3,057	77
Project Totals		9,390	4,325	905	3,420	21%	Gas Shows Found in 21% of Tested Wells		

**Table 1.** Numbers of North Dakota wells investigated and tested for the presence of shallow natural gas during the 2006 to 2010 field seasons. It is important to note that the cumulative percentage of wells found to contain shallow gas ranged between 18% and 24% with a total project average of about 21%.

undergraduate geosciences students as summer workers for the 2009 field season. Students from the University of North Dakota in Grand Forks, North Dakota State University in Fargo, Dickinson State University, and Minot State University spent the 2009 field season field-screening in northwestern, southwestern, north-central and southeastern North Dakota. This also accomplished two vitally important scientific objectives. First, it enabled us to complete the well testing work contemporaneously in several regions of the state, providing a clearer temporal picture of shallow gas conditions in the shallow subsurface. Secondly, it most effectively demonstrated the reproducibility of the well testing methodology.

During the 2009 field season, 2,048 wells were tested; resulting in 511 gas shows (25%). In 2010, an undergraduate student from the University of North Dakota was hired to help complete the fourth and final phase of the project, which involved the field investigation of 1,355 wells in Grand Forks, Walsh, Pembina, and Dickey counties. During this final phase of the project, 536 wells were tested, with 68 (13%) returning a gas show.

Most (95%) of the 905 wells that tested positive for shallow gas produced FID responses between 1 and 1,000 ppm (as methane [CH<sub>4</sub>] in air) (fig. 2).



**Figure 2.** Frequency distributions of FID shallow gas occurrences detected in ground-water observation wells across North Dakota. The majority (95%) of values detected fall within the 0 to 1,000 ppm range.

As a result of this project, several significant shallow gas occurrences were discovered across the state. Gas was detected in both the oil- and coal-producing counties in the west as well as the eastern counties where fossil fuel resources are sparse or absent altogether. The geologic and hydrologic information collected from these shallow gas occurrences is providing insights and clues into the origins of natural gas in these areas. To date, the NDGS has published 75 maps and reports that were derived from the information generated from this project. Several more publications are forthcoming as we continue to investigate North Dakota's potential for shallow natural gas.

#### Reference

Anderson, F. J., Gudmunson, C. B., Hall, B.N., Ries, A.J., Christensen, A.R., and Bubach, B.J., 2010, Locations of FID Shallow Gas Occurrences in North Dakota: North Dakota Geological Survey, Geologic Investigations No. 128, 1:500,000 scale map.