SHALLOW GAS FIELD SCREENING IN NORTH DAKOTA: FIELD DATA REPORT FOR SELECTED COUNTIES

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On the cover: The author conducting shallow gas field screening on a shallow, ground-water observation well located in Burleigh County, North Dakota.

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BACKGROUND

Introduction

Field screening for shallow gas occurrences in wells was first considered as an applicable field oil & gas exploration investigative activity during initial project planning discussions at the Survey and Department of Mineral Resources, conducted in early 2005. these discussions were focused on activities and investigations supportive of an assessment of a potential shallow gas resource in central and eastern North Dakota.

It was known historically that shallow gas had been found in water wells in the north-central part of the state, in Renville and Bottineau Counties, and in the southeastern part of the state near LaMoure and Edgeley (Barry, 1908). Based on this, it was decided to investigate whether or not shallow gas may be occurring in currently existing wells, and if so, extend this work into areas where shallow gas occurrences have not previously been documented.

Since the locations of readily accessible observation wells and ground-water monitoring networks, maintained by the North Dakota State Water Commission (NDSWC), were well known; it was decided to embark on a reconnaissance style field screening investigative project that could quickly deliver potentially useful shallow gas exploration information. Results were desired on the field distribution of potential shallow gas occurrences throughout the central and eastern portions of the state.

Field work was conducted in Steele, Bottineau, Renville, Emmons, Stutsman, Rolette, and Towner Counties in 2006, Burleigh, Kidder, Ward, McHenry, Barnes, LaMoure, Morton, and Pierce Counties in 2007, and Sheridan, Benson, and Logan Counties in 2008 (Figure 1).

This report provides the field data collected during field screening work and is intended as a supporting document to the 1:150,000 scale shallow gas field screening maps and previously published shallow gas related investigative works (Anderson, 2006a-h, 2007a-I, 2008a-f).

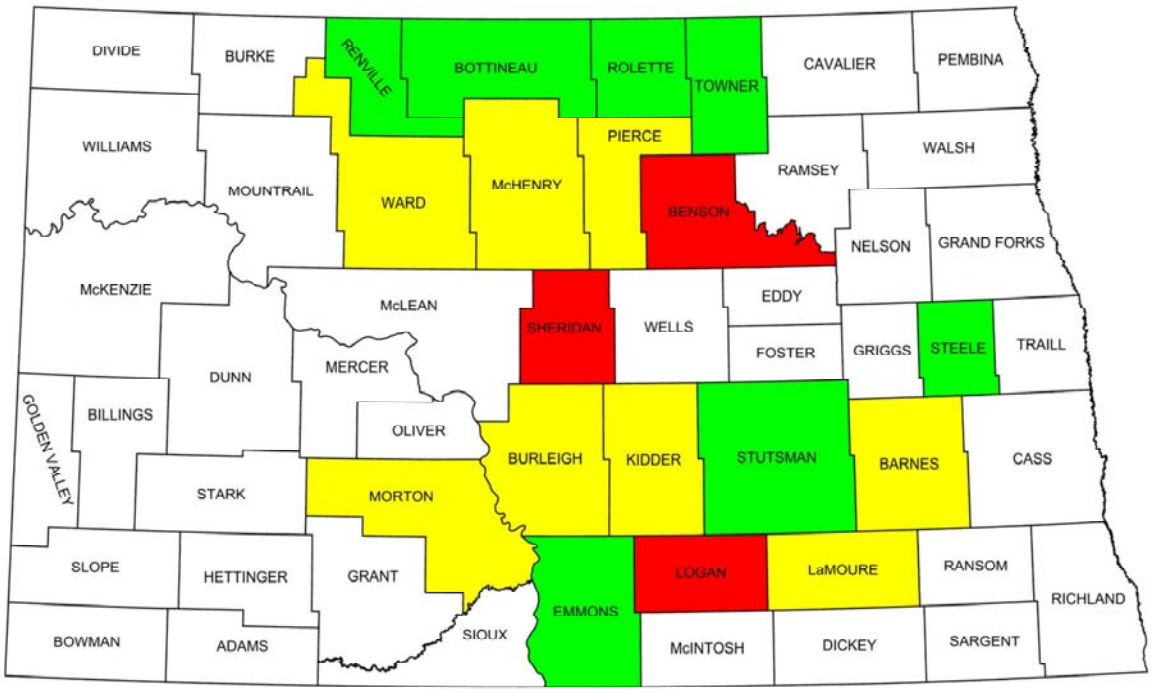

Figure 1. Counties in North Dakota where shallow gas field screening was completed in 2006 (green), 2007 (yellow), and 2008 (red).

FIELD SCREENING METHODOLOGY

Instrumentation

A Photovac Micro Flame-Ionization Detector (FID) was selected for use in this investigation based on durability, consistency within seasonal field screening, ease of calibration, overall reliability, and the author's previous experience with portable electronic gas monitoring instrumentation. The FID is a portable analytical instrument that analyzes total combustible organic compounds. Since this instrument is a total combustible compound meter, as such it is not compound specific. Any hydrocarbons present will be ignited and effectively "read" by the detector.

FID Specifications

The portable FID is around two feet in length and weighs only around 8 pounds. The operating temperature range is from 41°F to 105°F in a non-condensing humidity range of 0 to 100%. The FID operates in a low concentration range of 0.5 parts per million (ppm) to 2000 ppm (as C1 in air) and in a high concentration range of 10 ppm to 50,000 ppm with an accurary of 0.5 ppm within plus or minus 0.5 ppm or plus or minus 10% of the actual C1 concentration when operating in the low (0.5 ppm to 2000 ppm) concentration range. FID instrument precision is plus or minus 0.3 ppm or plus or minus 5% when operating within both the low and high concentration ranges (Photovac, 2007). The instrument response time is effectively immediate.

Figure 2. Photovac portable Flame Ionization Detector (FID) used in this investigation.

Operation and Calibration

The FID operates by pyrolyzing an influent sample of gas and measuring the electronic conductivity of the ionic intermediates produced. The portable FID instrument used in this investigation operates on an internal hydrogen gas supplied flame source. Hydrogen was added to the FID when levels indicated that the interal hydrogen cylinder was in need of charging. Since the intent of this investigation was to detect the presence of shallow natural gas in North Dakota, the FID was intentionally calibrated by bag calibration methods to a predetermined concentration of C1 (i.e. CH_4 or C1) in air. A gas concentration of 100 ppm (C1 in air) was used as the standard calibration for field screening. If a detected concentration was outside of the calibrated range of response, then the FID was recalibrated to a concentration of 10,000 ppm (C1 in air) as a high span calibration, and the measurement repeated in order to collect a more accurate reading at the well. The FID was calibrated in the morning prior to first use, in the afternoon around mid-day, or at major changes in atmospheric conditions (e.g., warming up during the day, cooling down in the evening), and at the end of daily use in accordance with the manufacturer's specifications.

Field Screening Procedures at the Well

Upon arrival at each well location, the FID was monitored as each well was approached in order to potentially detect any C1 emitting from the area around the well site. The well's cap (if present) was removed and a reading collected from the top of the well casing (TOC) and recorded (Figure 3a). Depending on the anticipated ground-water level within the well, an extended sample probe made of polyethylene was lowered into the well at a level just above the groundwater-atmospheric interface (GWI). An appropriate amount of elapsed time was recorded in order to account for the sample to be drawn up the line to the FID based on the total amount of extended sample line lowered into the well. At the calculated time, FID instrument response as the highest reading reached (as C1 in ppm) was recorded. The sample probe was then removed from the well and a depth to water measurement was taken and recorded in the well from the TOC to the water level in the well with an electronic well tape. This information was entered immediately into a spreadsheet database in the field.

Figure 3a.

Figure 3b.

Figures 3a and 3b. The author conducting FID field screening at the TOC in an observation well in Stutsman County, North Dakota (Fig. 3a at left) and collection of field screening readings from the groundwater/atmospheric interface in an observation well in Burleigh County. The FID is fitted with an extended sample line consisting of 3/8" polyethylene tubing (Figure 3b at right) .

This procedure was repeated at each well location throughout the investigation. Any positive readings on the instrument were field checked by repeating the measurement at each location and by measuring a calibration gas spike to demonstrate continued accuracy during field screening. Occasionally, a grab type ground-water sample was collected from a well if the well was under artesian conditions and a positive shallow gas field screening result was measured.

Collection of Water-Level Measurements

Depth to water measurements (in feet) were taken at each well field screened where a positive FID instrument response was recorded. A total depth of well measurement was also consecutively collected, when required, in order to identify individual wells within well nests that were not readily identifiable in the field. All ground-water level measurements were collected with an electronic well tape during field screening.

Figure 4. Measurement of ground-water level in an observation well in Emmons County, North Dakota with an electronic well tape.

Atmospheric Data Collection

After the 2006 field season, it was learned that collecting additional meteorological data during the field screening process at each well may reveal some interesting relationships between shallow gas flux within an individual well from aquifer to atmosphere. Thus, in the 2007 and 2008 field screening work, field measurements of temperature and pressure were collected at each well location where a positive FID instrument response was recorded.

Figure 5. Field instrumentation used for the collection of atmospheric pressure and temperature.

Temperature

A single measurement of air temperature in the vicinity of the well in degrees Fahrenheit (^{o}F) was collected after the field screening procedure was completed with a Hanna Instruments thermocouple temperature probe. Individual measurements were collected and entered directly into an electronic spreadsheet database at the time of collection.

Atmospheric Pressure

Single measurements of atmospheric pressure in millibars (mB) were also collected at the well site with a portable electronic barometer and altimeter at the completion of field screening. Measurements were collected and recorded in a similar fashion as were temperature readings.

DESCRIPTION OF SHALLOW GAS FIELD SCREENING WORK

The concept of using portable analytical instrumentation to field screen wells for the presence of C1 (i.e., shallow gas) was formulated during project discussions in the early Spring of 2006. Field screening ground-water observation wells throughout eighteen selected counties in North Dakota was completed during the latter parts of the 2006, 2007, and the 2008 field seasons (Figure 6). The overall concept was to take instrumentation that was readily available and portable and investigate areas, such as Bottineau County where a higher probability of success would be more likely, prior to turning investigative attention towards the more "frontier" counties in central and eastern North Dakota, where the historical record of shallow gas occurrences is much more limited. A total of 2,887 individual observation well locations were investigated during this project. Monitoring well locations were collected and compiled from an office review of the well location and construction information available from existing databases, well records, and publications. This information was plotted on field maps at a scale of 1:100,000 overlain onto a digital photographic base map. These maps were used, along with electronic database files, for well location and identification in the field and during the field screening process for data collection and compilation. On several occasions, it was found to be advantageous to have an initial well location run completed to positively identify and verify the existence and location of wells in the field, prior to commencing a field screening run, as many of the observation wells included in current databases and records had simply been abandoned or destroyed.

Shallow Gas Field Screening Conducted in 2006

The shallow gas field-screening program was initiated in September of 2006. The first set of wells tested was in Steele County, North Dakota. It was decided to use this set of wells as an initial "shake down" on the field screening testing instrumentation and apparatus prior to conducting work in Bottineau County where the likelihood of discovering shallow gas occurrences was more likely and because of a recently identified anecdotal show in a private water well near Blabon, ND in central Steele County. In the north-central and southeastern portion of the state, Bottineau, Renville, Rolette, and Towner counties, along with the south-central and southeastern counties of Emmons and Stutsman, were also selected for continued field investigation (Figures 7, 8, & 9). During the initial 2006 field season, approximately 15 non-consecutive days were used for shallow gas field screening. During this time, a total of 1,066 wells were investigated which resulted in 658 wells being visited in the field and field screened for shallow gas. The difference between the amount of wells investigated and the amount of wells visited in the field is that many of the wells on record do not exist in their respective field locations as many have most likely been abandoned through non-use or simply destroyed. FID instrument responses consistent with a shallow gas occurrence were found at 126 of the wells field screened. The balance, 532 wells, showed no response. A brief discussion of the results for each county where field screening was performed follows.

Timeline of Completed County Shallow Gas Field Screening Investigations in North Dakota

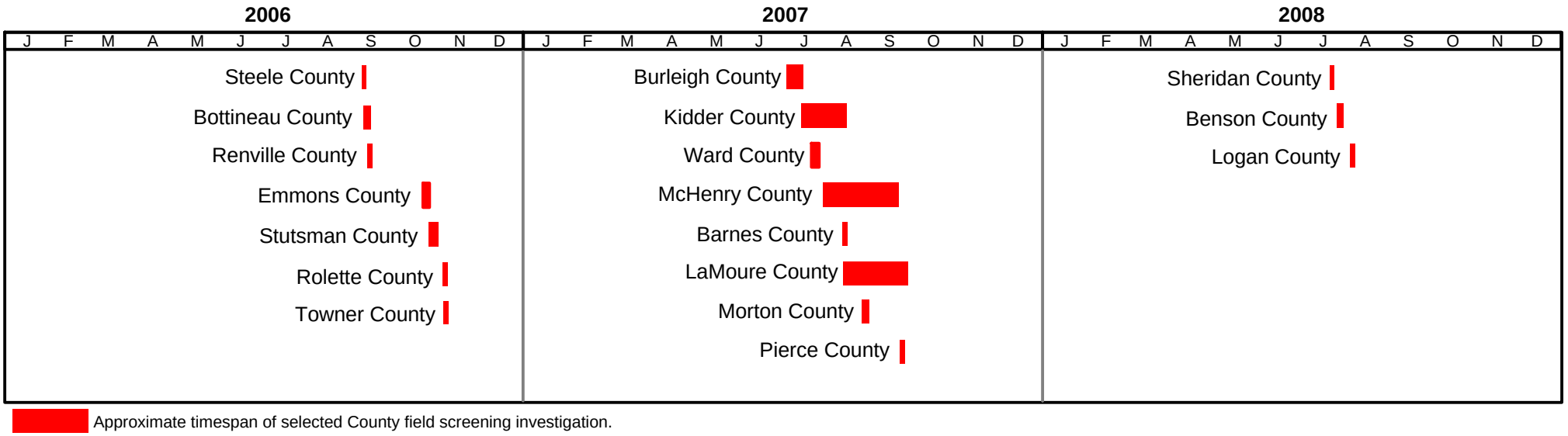

Figure 6. Generalized timeline of occurrence for shallow gas field screening investigations completed on selected counties in North Dakota in 2006, 2007, and 2008.

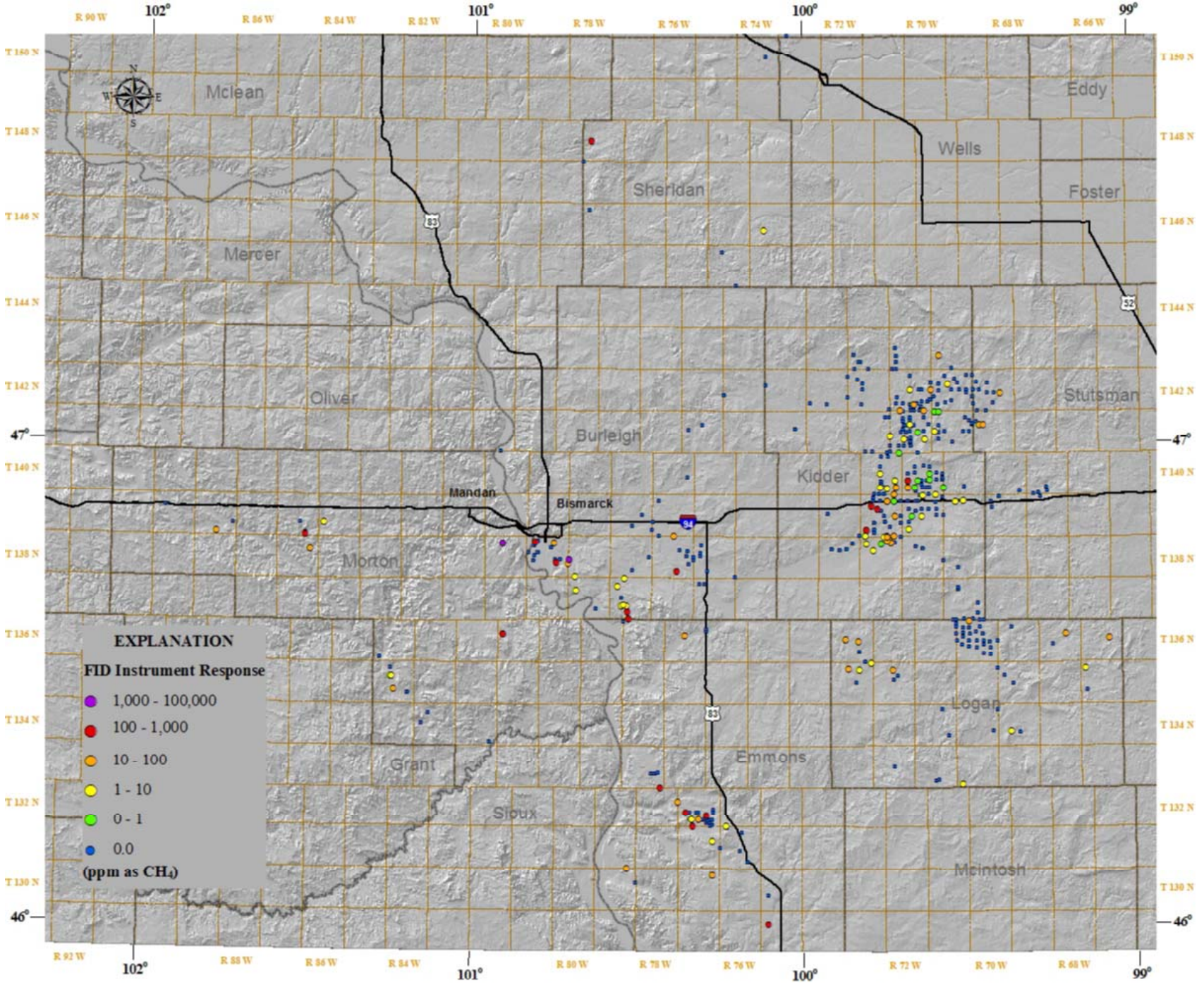

Figure 7. Locations of FID shallow gas occurrences in south-central North Dakota.

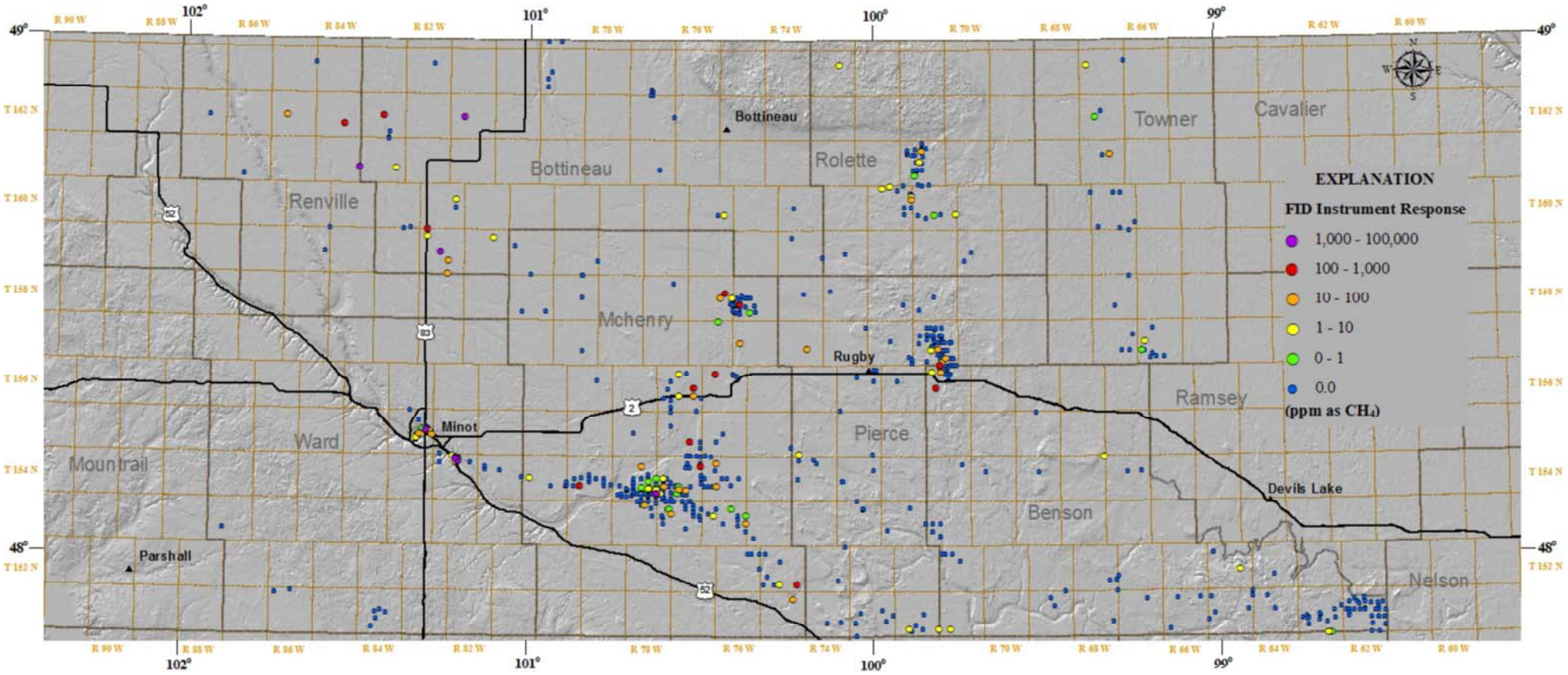

Figure 8. Locations of FID shallow gas occurrences in north-central North Dakota.

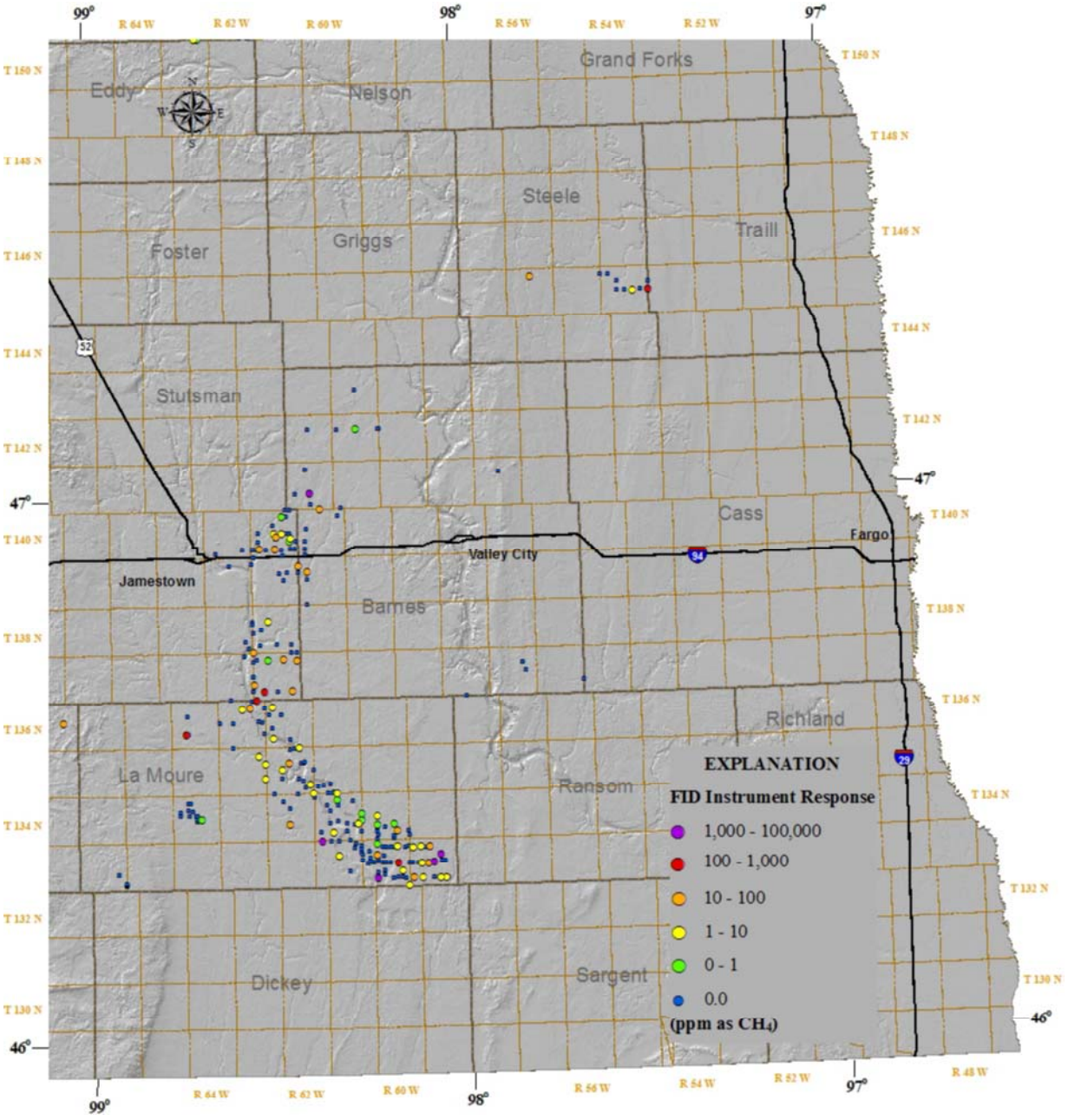

Figure 9. Locations of FID shallow gas occurrences in southeast-central North Dakota.

Steele County

Field screening was conducted in Steele County on September 11, 2006 and was the first field-screening run completed in this investigation. 21 observation well sites, consisting of historic and existing observation wells were reviewed prior to field investigation. Nine wells were field screened in a roughly west to east field screening traverse. Of the wells field screened, three returned positive FID responses (Table 1), ranging from 2.0 ppm to 146.3 ppm as C1 (Figure 10). One well (145-56-4DDD) recently installed by the North Dakota State Water Commission and screened just above shallow Cretaceous shales of the Pierre Formation returned responses of 89.2 ppm (initially) and 46.3 ppm (shortly after the first reading), from just above the groundwater/atmospheric interface. The other wells field screened were completed within the Page Aquifer (Appendix I) along the southeastern border of Steele County.

Bottineau County

Field screening in Bottineau County was conducted from September 12, 2006 to September 15, 2006. 110 observation wells were reviewed prior to field investigation, which resulted in 100 wells being visited in the field. 33 wells were found and field screened which resulted in 11 returning positive FID responses (Table 2), ranging from 2.4 to 30,362 ppm as C1 (Figure 11). One well (162-83-15CCD) was found to be flowing at less than one gallon per minute at the top of casing (TOC) and was bubbling gas continuously at the top of the well. The groundwater from this well was analyzed for light hydrocarbons, which returned a C1 in groundwater concentration of 8.3 mg/L (ppm). A second well (162-81-16CCC) could be heard bubbling gas at the groundwater/atmospheric interface within the well. Occurrence of the majority of FID responses were constrained to areas in the western part of the county where historic (ca. 1900) shallow natural gas occurrences were found. Sixty-seven observation well sites were not found, suggesting that these wells have either, been abandoned through disuse, which tends to be common practice, or were accidently destroyed. The majority of wells where a shallow gas field-screening occurrence was found were completed within the Gleburn aquifer (Appendix I).

Renville County

Field screening in Renville County was conducted on September 15 & 16, 2006. 34 observation wells were reviewed prior to field investigation, which resulted in eight wells being field screened. Of these, six returned positive FID responses (Table 3), ranging from 20.6 to 28,000 ppm as C1 (Figure 12). Occurrence of the majority of FID responses were located in the eastern part of the county where historic (ca. 1900) shallow natural gas occurrences have been noted (Barry, 1908). 26 wells were not found. During the initial Renville County field screening work in 2006 six wells near Glenburn were not visited. These wells were visited on June 26, 2007 which resulted in one well (158-82-3AAA) returning a positive FID reading of 883.3 ppm (as C1). The other five wells showed no response (i.e., 0.0 ppm). One well (161-84-24DDD) was completed in the Fox Hills Aquifer (Appendix I).

Table 1. Field screening information collected from ground-water observation wells in Steele County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data				
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)
14505604DDD	9/12/06	18:29	0.0	89.2/46.3	18.10
14505422AAA	9/12/06	16:48	0.0	2.0	21.07
14505413DDD3	9/12/06	17:37	0.0	146.3	13.30

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

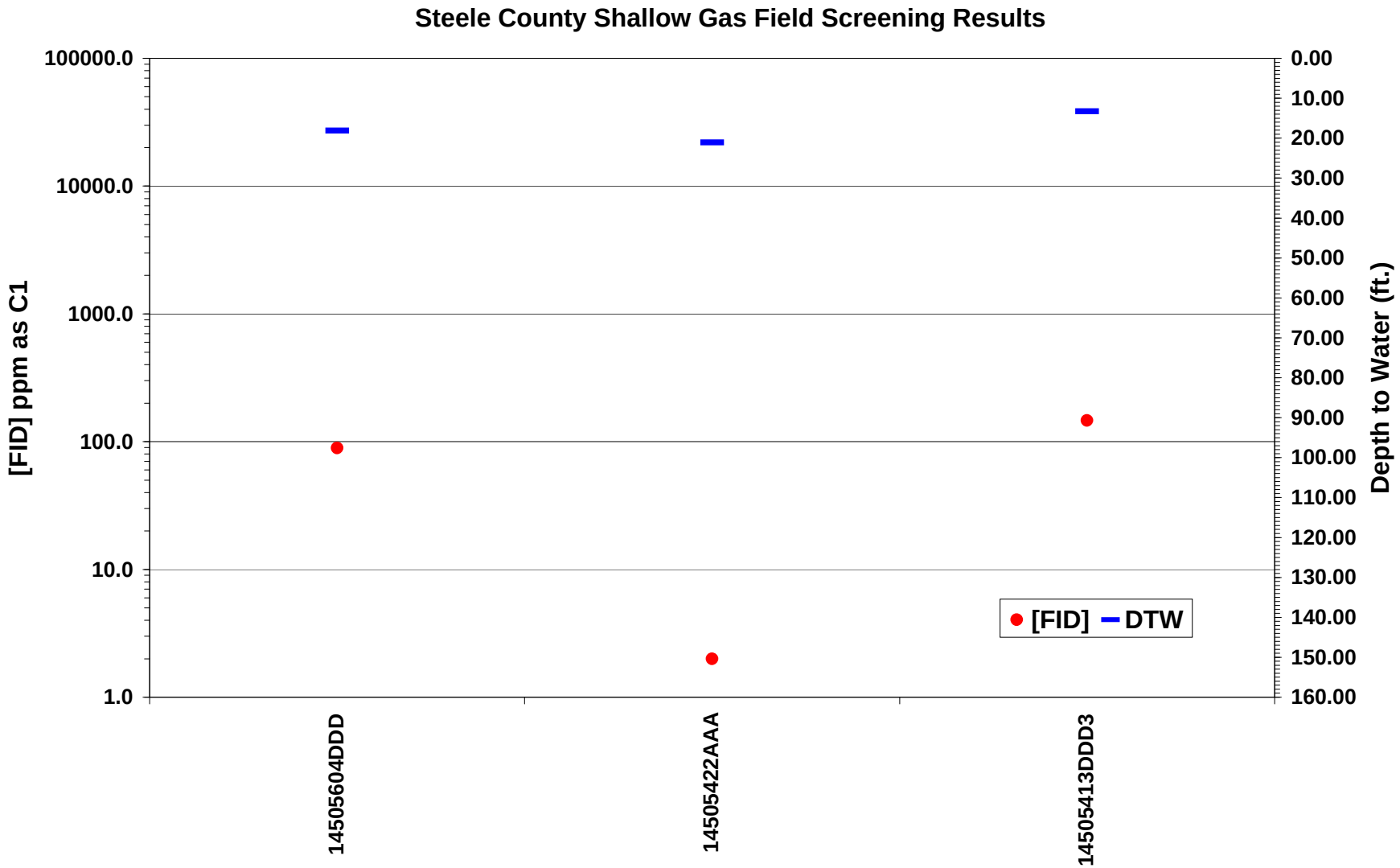

Figure 10. Shallow gas field screening results in Steele County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Table 2. Field screening information collected from ground-water observation wells in Bottineau County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data				
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)
15908205BBA	09/13/06	11:53	0.0	592	22.79
15908221AAA	09/13/06	13:30	226	2896	18.34
15908111BBB	09/13/06	17:05	0.0	3.5	8.42
16008214AAA1	09/13/06	17:53	0.0	2.4	6.83
16208116CCC	09/14/06	09:50	30,362	NA	Flowing
16208315CCD	09/14/06	10:05	236	NA	Flowing
16108323DDD	09/14/06	11:40	0.0	4.4	29.22
15908205CCD	09/14/06	13:00	0.0	2.5	17.00
15908227AAD	09/14/06	14:05	0.0	11.2	7.48
15908234DDC	09/14/06	14:25	0.0	11.7	66.5
16007623DDD	09/15/06	10:44	0.0	5.1	10.42

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
-- = No water level measured in well (Dry).
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

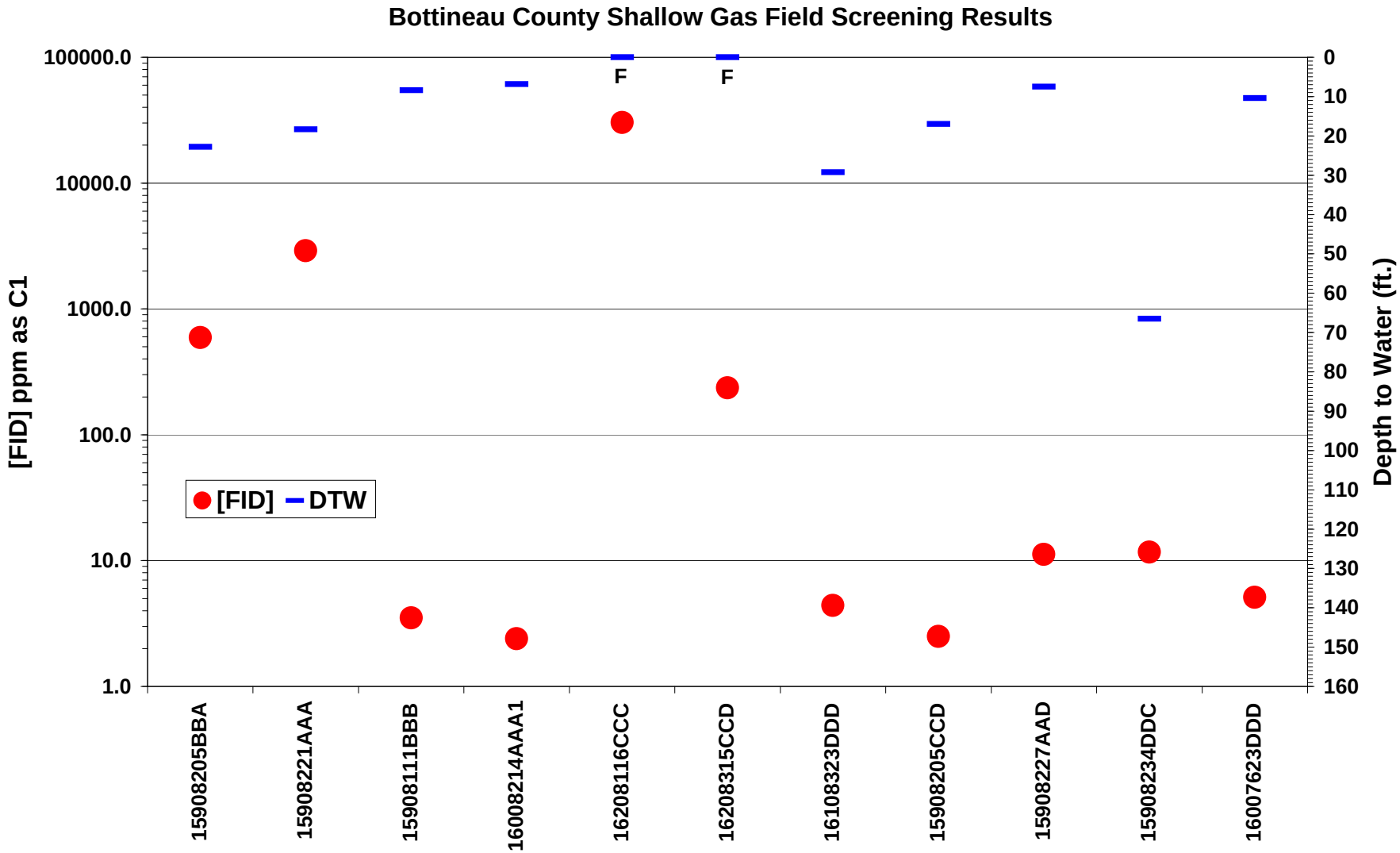

Figure 11. Shallow gas field screening results in Bottineau County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. Flowing wells (F) are highlighted.

Table 3. Field screening information collected from ground-water observation wells in Renville County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data				
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)
16208516CCD	09/15/06	18:25	20.6	NM	53.66
16208427AAA	09/15/06	19:53	0.0	238	6.61
16108424CBB	09/16/06	09:10	3,811	28,000	40.54
15808203AAA*	07/26/07	14:18	0.0	888.3	66.55

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
NM = Not Measured
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
*Atmospheric conditions measured at the well: 81.0 ^{o}F, 1,026 mB.

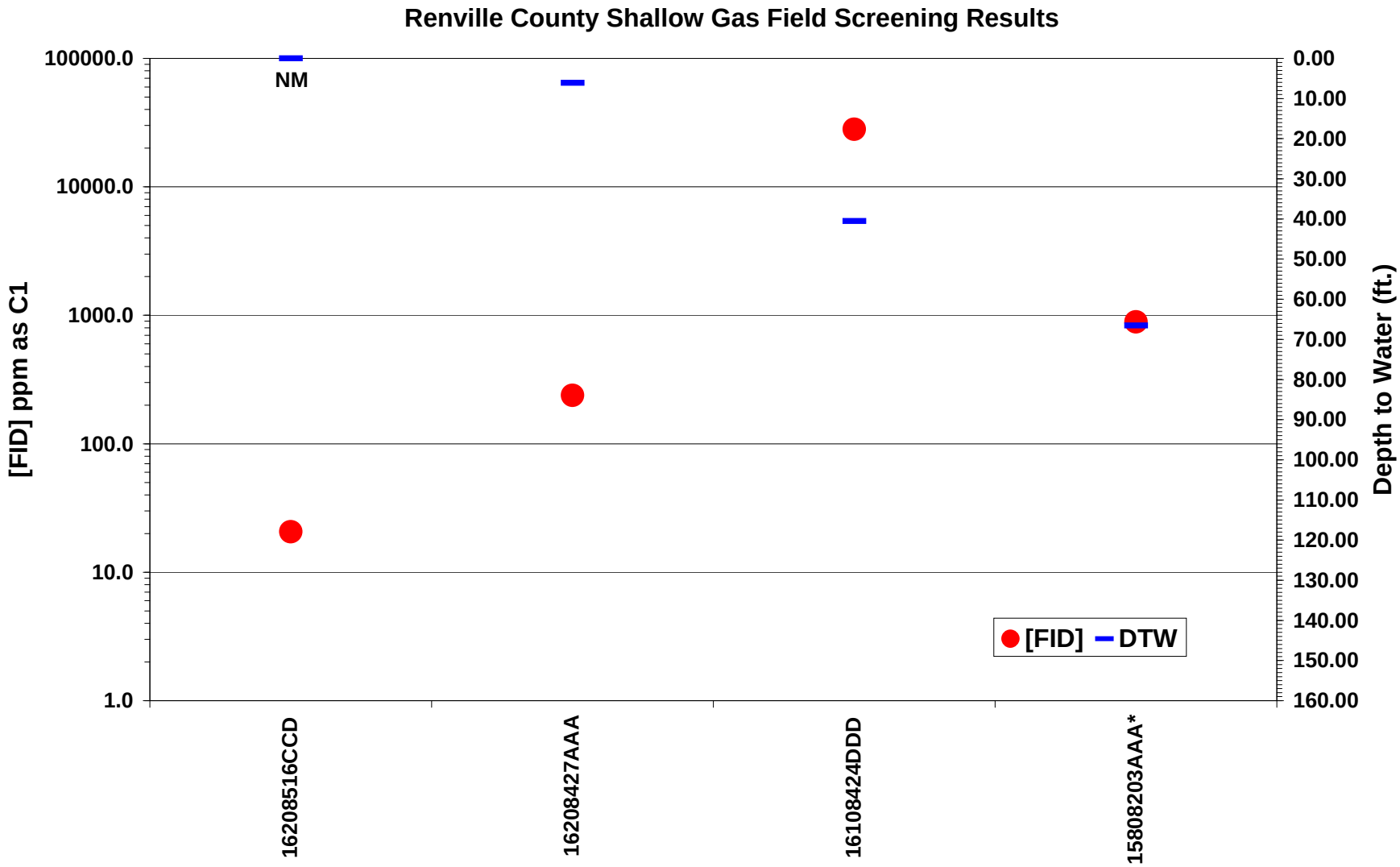

Figure 12. Shallow gas field screening results in Renville County. FID response [FID] in ppm as C1 is plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. *Collected on June 26, 2007.

Emmons County

Field screening was conducted in Emmons County during the fall of 2006 from October 23, 2006 to October 25, 2006. 109 observation well sites were reviewed prior to field investigation. 83 of these observation well sites were selected to be visited in the field, which resulted in 50 wells being field screened. Of these, 12 returned positive FID responses (Table 4), ranging from 1.6 to 775 ppm as C1 (Figure 13), with the balance (38 wells) showing no response (i.e., a 0.0 ppm as C1 instrument reading). The occurrence of the majority of FID responses found are constrained to areas in the central portion of the county coincident with the location of the Strasburg Aquifer (Appendix I).

Stutsman County

Shallow gas field screening in Stutsman County was also conducted during the fall of 2006 on October 27 and 31, and November 1, 2006. 170 observation well sites were reviewed prior to field investigation. Of these, a total of 106 wells were field screened which resulted in 21 wells returning positive FID responses (Table 5), ranging from 0.4 to 182 ppm as C1 (Figure 14), with 86 of the wells showing no response. 24 wells were not found. Occurrence of the majority of FID responses were constrained to wells in areas of the eastern and westernmost portions of the county coincident with the location of the Spiritwood Aquifer.

Rolette County

Field screening was conducted in Rolette County during the mid-fall on November 6 and 7, 2006. 114 observation well sites were reviewed prior to field investigation. Ninety-eight of these observation well sites were visited in the field which resulted in fifty-two wells being field screened (Table 6). Of these, 10 returned positive FID responses, ranging from 0.6 to 15.2 ppm as C1 (Figure 15). 42 wells showed no response. 46 observation wells were not found during the investigation. Occurrence of the majority of FID responses were within wells that were constrained to areas in the south-central portions of the county coincident with the location of the Shell Valley Aquifer.

Towner County

Field screening was conducted in Towner County during the fall on November 7 and 8, 2006. 78 observation wells were reviewed prior to field investigation. 72 wells were selected to be visited in the field which resulted in 31 wells being field screened. Of these, six returned positive FID responses (Table 7), ranging from 0.2 to 32.8 ppm as C1 (Figure 16); 25 of the wells showed no response. 44 observation well sites were not found. The distribution of shallow gas occurrences were located in wells in the northern and southern portions of the county completed in an, as yet, unnamed shallow aquifer.

Table 4. Field screening information collected from ground-water observation wells in Emmons County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data				
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)
13007603CBB	10/25/2006	9:35:00	0.0	32.7	99.74
12907508CCC1	10/25/2006	8:10:00	20.8	230	87.63
13207720CCC2	10/24/2006	15:33:00	0.0	775	40.13
13207726BCC1	10/24/2006	18:45:00	0.0	718	78.28
13307836DCC	10/24/2006	14:31:00	0.0	206	33.58
13207733CCC	10/24/2006	16:44:00	0.0	142	48.74
13607716AAD	10/24/2006	11:32:00	0.0	42.1	17.44
13207813ADD	10/24/2006	15:03:00	0.0	20.2	60.91
13207728DDD	10/24/2006	17:10:00	0.0	18.7	62.57
13107714AAA	10/25/2006	12:55:00	0.0	2.6	>150.00
13207631DDD	10/25/2006	11:41:00	0.0	1.9	143.14
13207729DDD	10/24/2006	16:17:00	0.0	1.6	38.62

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air
>150.00 = Depth to water greater than 150-ft
[1]Measured from top of well casing.

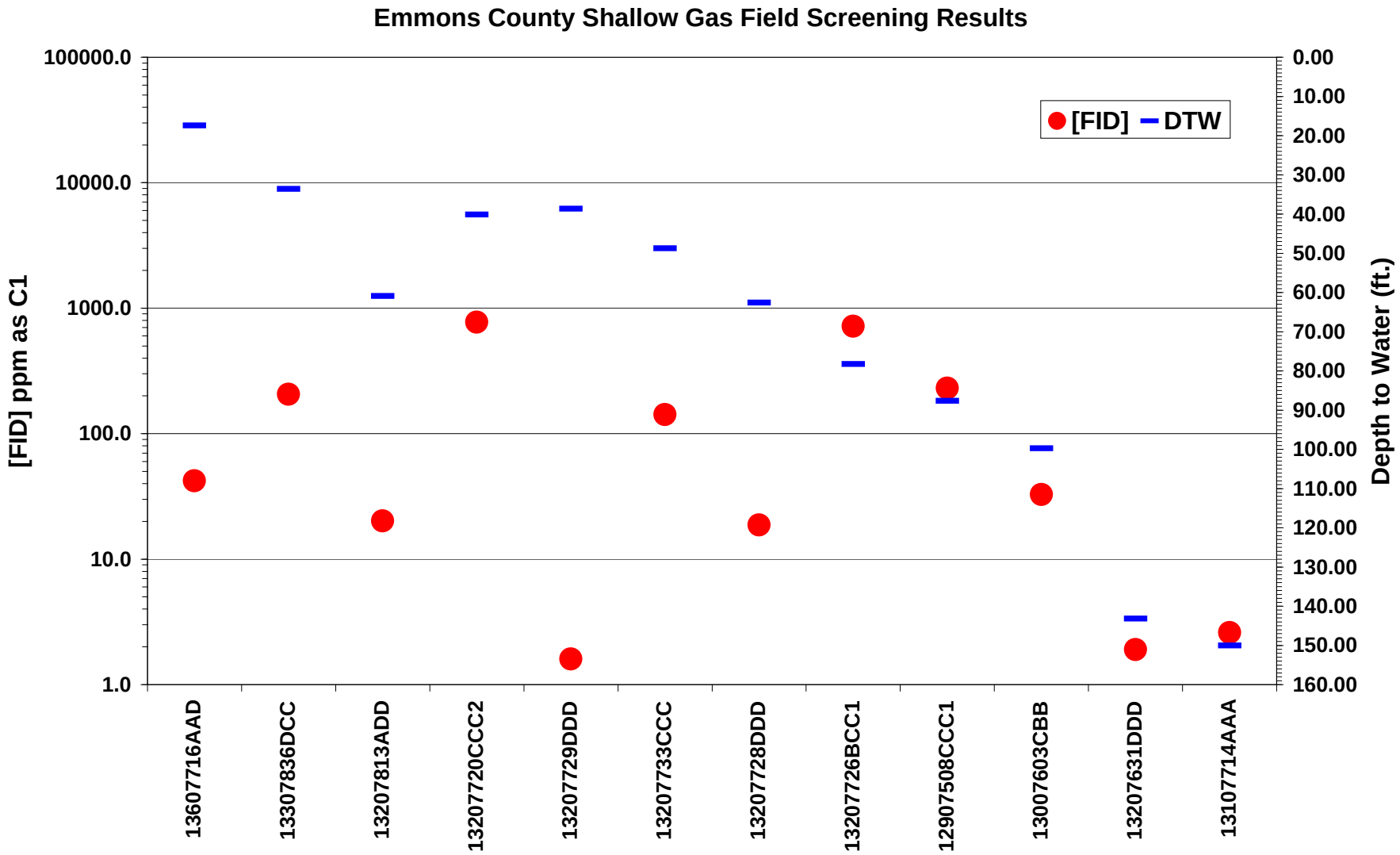

Figure 13. Shallow gas field screening results in Emmons County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Table 5. Field screening information collected from ground-water observation wells in Stutsman County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data				
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)
14206922ADD	10/27/06	11:05	0.0	20.6	48.82
14106907DDD2	10/27/06	14:26	0.0	76.1	16.99
14106908CDD	10/27/06	14:43	0.0	49.5	15.26
14006202CCC1	10/31/06	12:27	0.0	0.4	24.13
14006216DDD1	10/31/06	13:01	0.0	3.2	96.55
14006222BDC	10/31/06	13:19	0.0	10.2	108.05
14006222AAA2	10/31/06	13:36	0.0	1.9	97.87
14006224CBB	10/31/06	14:22	0.0	5.4	101.35
14006226AAA1	10/31/06	14:29	0.0	1.0	92.18
13906212AAD	10/31/06	16:38	0.0	28.6	36.48
14006227CCC1	10/31/06	17:10	0.0	48.5	30.54
14006229CCC2	11/01/06	08:40	0.0	30.6	18.22
13706226DDD	11/01/06	12:44	0.0	31.4	56.70
13706229CDD	11/01/06	12:53	1.4	182.0	88.25
13706230BBB1	11/01/06	13:30	0.0	65.1	47.89
14006223AAB	11/01/06	13:47	0.0	0.4	98.65
13706205DDD	11/01/06	14:37	0.0	0.7	71.00
13706203DDD1	11/01/06	14:45	0.0	55.1	54.19
13706212ABB	11/01/06	14:58	0.0	19.9	24.10
13806231CCC1	11/01/06	15:50	0.0	44.3	103.59
13806217AAA	11/01/06	16:32	0.0	1.3	53.93

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.

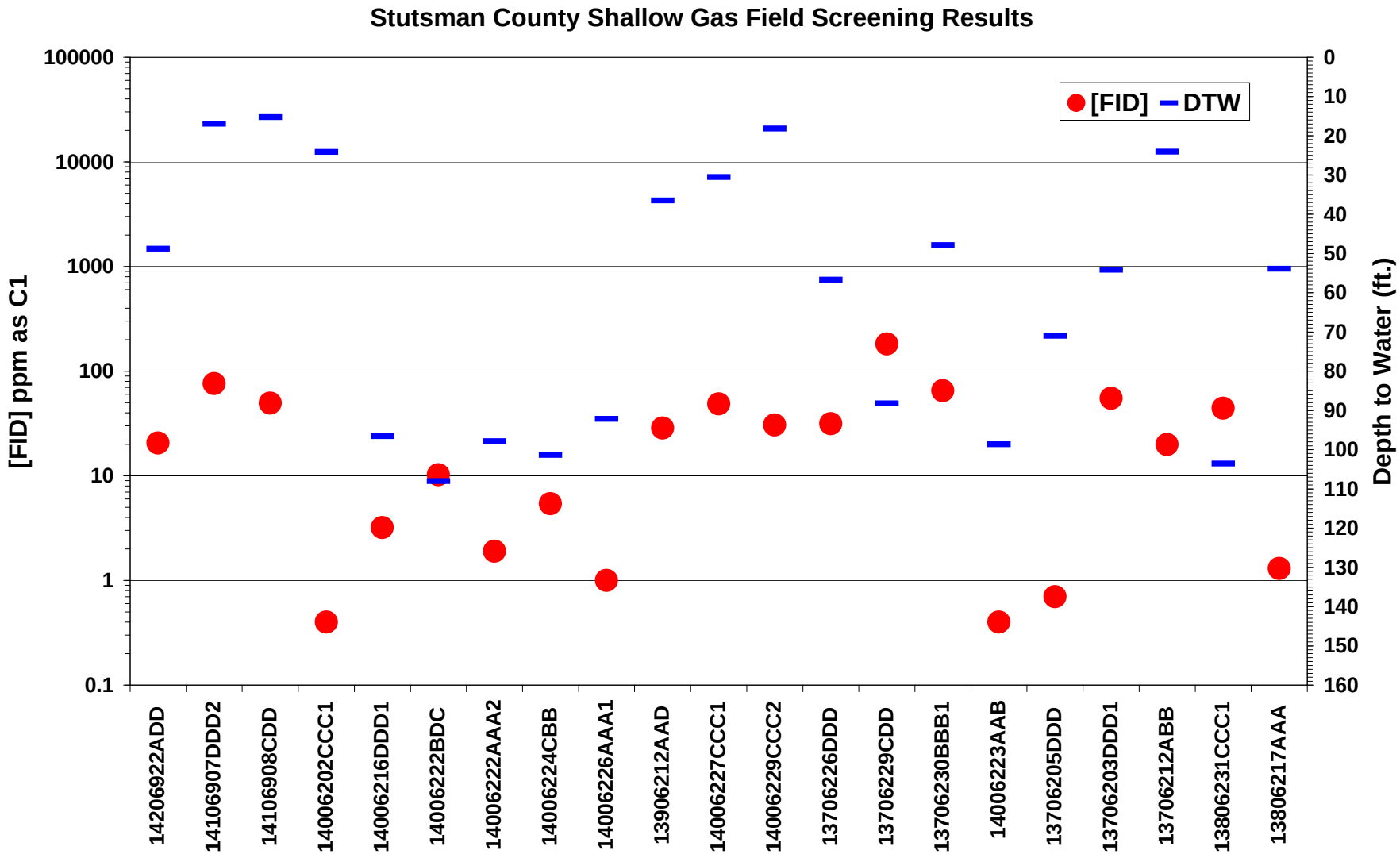

Figure 14. Shallow gas field screening results in Stutsman County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Table 6. Field screening information collected from ground-water observation wells in Rolette County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data				
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)
16307311CCC1	11/06/06	14:34	0.0	3.2	59.28
16007124DDD	11/06/06	16:54	0.0	1.9	14.47
16007128AAA	11/06/06	17:10	0.0	0.9	7.60
16007212DDD	11/07/06	08:50	0.0	15.2	21.58
16007212ADD	11/07/06	09:13	0.0	3.4	17.33
16007203BBC	11/07/06	10:52	0.0	1.1	43.26
16007205ADD	11/07/06	11:15	0.0	4.8	34.50
16107129DAD	11/07/06	12:00	0.0	0.6	18.20
16107116DCD1	11/07/06	12:42	0.0	2.9	7.76
16107109ADD	11/07/06	14:51	0.0	13.8	16.48

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.

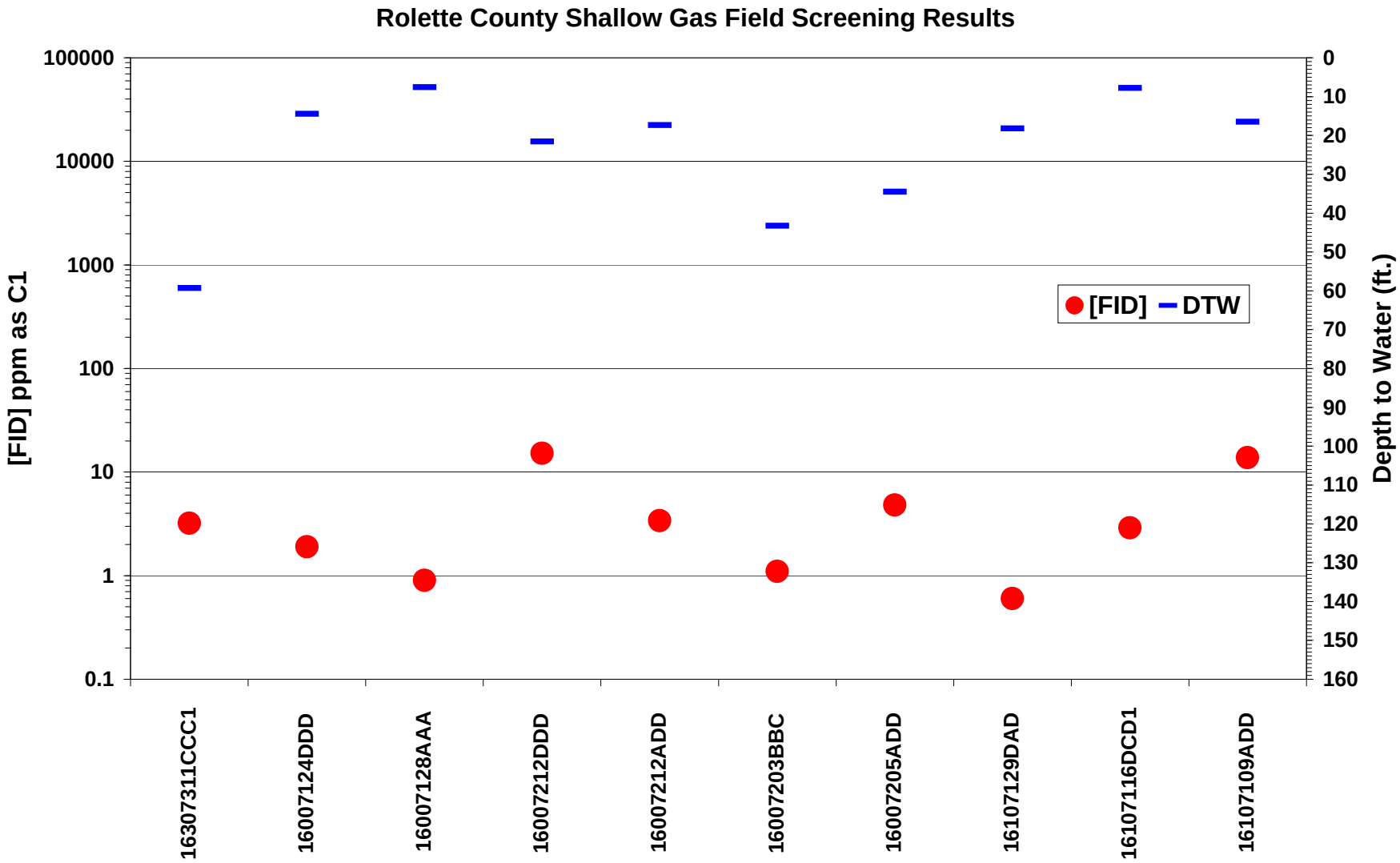

Figure 15. Shallow gas field screening results in Rolette County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Table 7. Field screening information collected from ground-water observation wells in Towner County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data				
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)
16306718AAA1	11/07/06	16:07	0.0	6.2	43.15
16206716CCC	11/07/06	17:15	0.0	0.2	62.59
16106711CCC2	11/07/06	17:59	0.0	0.2	--
16106711CCC1	11/07/06	18:04	0.0	32.8	43.80
15706630ABB2	11/08/06	12:19	0.0	0.4	13.40
15706618DDD1	11/08/06	13:03	0.0	7.8	12.05

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
-- = No water level measured in well (Dry).
[1]Measured from top of well casing.

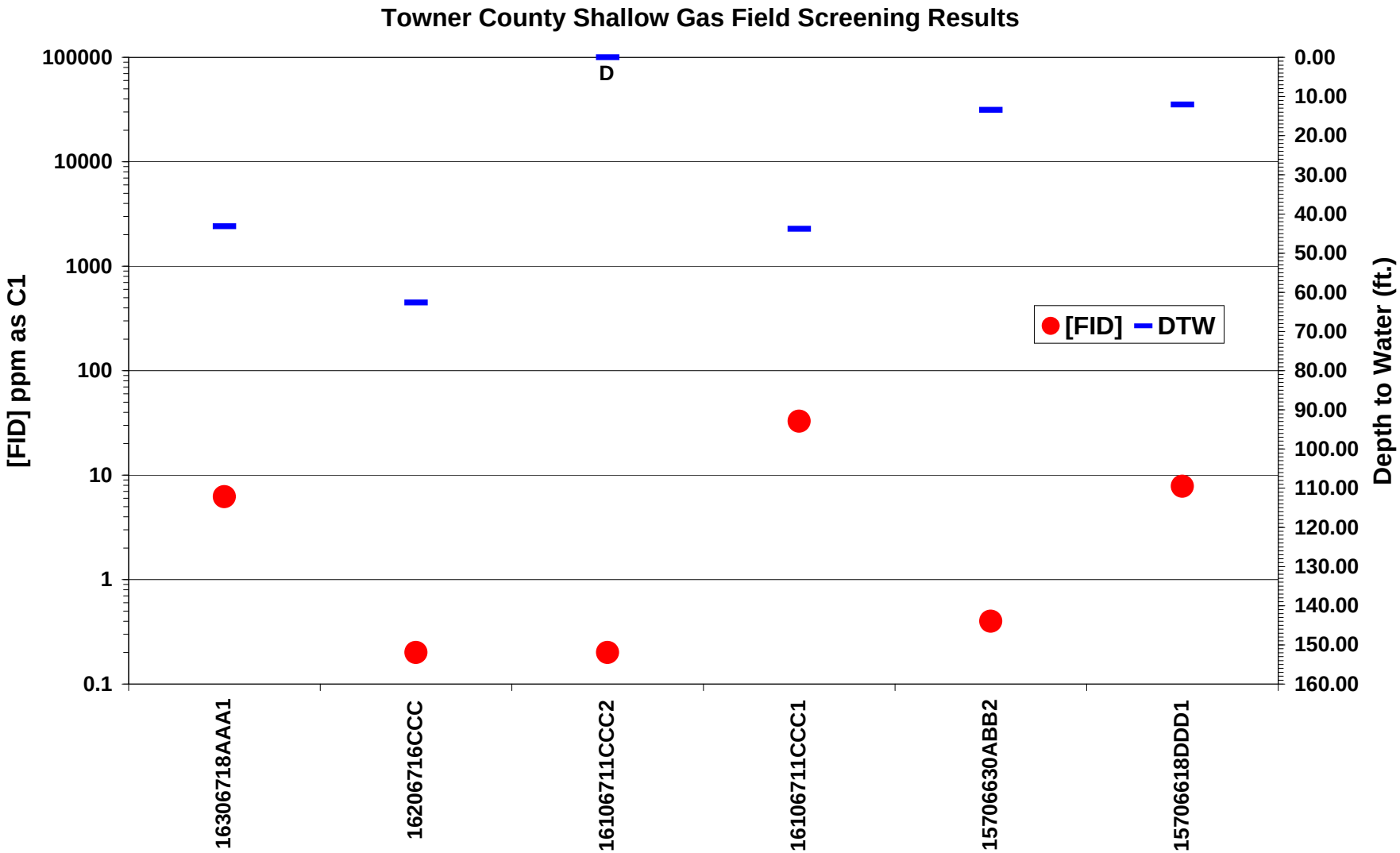

Figure 16. Shallow gas field screening results in Towner County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. Well with no measurable water level (D) highlighted.

Shallow Gas Field Screening Conducted in 2007

After the initial success of the first round of field screening completed on the seven originally selected counties in 2006. It was decided to expand the field screening program into eight additional counties in central and eastern North Dakota. Building on the counties completed in the north-central portion of the state, Ward, McHenry, and Pierce Counties were selected for continued field investigation. In the south-central and southeastern portion of the state, Burleigh, Morton, Kidder, Barnes, and LaMoure counties were also selected for continued field investigation. During the 2007 field season, a total of 40 days were used for continued shallow gas field screening. 1,282 wells were investigated during this time which resulted in 859 wells being field screened. FID instrument responses consistent with a shallow gas occurrence were found at 177 wells. 682 wells showed no response. 420 wells were not found in the field and were presumed abandoned or destroyed. A discussion of results for each county investigated in 2007 is provided below.

Burleigh County

Since the observation well network in Burleigh County is relatively close to the current location of Survey offices, the wells in this county were visited repeatedly in order to collect information on the effects of shallow gas occurrences found in wells over time. The results from the initial Burleigh County field screening investigation are described here. The results and discussion of the results from subsequent shallow gas field screening events conducted in Burleigh County will be reported in a separate Survey publication.

Field screening was conducted in Burleigh County over a six, non-consecutive day period on July 6, 9 -12, and 15, 2007. 144 observation wells were reviewed prior to field investigation. 125 of these observation wells were visited in the field resulting in 63 observation wells being field screened. Of these, 18 wells returned positive FID responses (Table 8), ranging from 1.1 to 1,208 ppm as C1 (Figure 17); 46 of the wells showed no response. Two wells reported a detectable concentration of C1 at the TOC: Well 138-79-19-BCC1 had an FID response of 7.5 ppm. Well 137-78-28DCC3 had an FID response of 296.2 ppm. 60 observation wells were not found during the investigation, suggesting that these wells have either been abandoned or destroyed. The occurrence of FID responses are distributed in the southeastern part of the county. This is due, in part, to the location of monitoring wells completed in the Lower Apple Creek, Bismarck, Soo, and Glencoe Channel Aquifers (Appendix I).

Table 8. Field screening information collected from ground-water observation wells in Burleigh County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
13807734ABB	7/9/2007	17:39	0.0	926.5	45.10	90.10	1009
13707833DCD	7/10/2007	10:21	0.0	463.9	72.33	73.00	1022
13707828BAA	7/10/2007	11:01	0.0	6.2	73.37	72.30	1022
13707829ABA	7/10/2007	11:35	0.0	2.2	76.40	71.80	1022
13707820DDD	7/10/2007	11:51	0.0	1.1	69.33	73.60	1022
13907734CCC	7/10/2007	14:39	0.0	12.7	20.85	79.70	1022
13707804BBB	7/10/2007	16:46	0.0	4.6	61.60	81.30	1024
13707808BCB	7/10/2007	17:09	0.0	7.8	53.57	80.60	1024
13707908CCD2	7/10/2007	17:58	0.0	1.8	74.97	78.60	1025
13808025AAA	7/11/2007	13:21	0.0	14.7	78.16	79.50	1025
13807919BCC2	7/11/2007	13:47	0.0	4.9	68.18	84.90	1025
13807919BCC1	7/11/2007	13:49	7.5	1208	69.08	84.90	1025
13807919BCC3	7/11/2007	13:51	0.0	7.5	66.81	84.90	1025
13807931DDD2	7/11/2007	15:16	0.0	1.7	95.66	81.10	1024
13808008BBAA	7/12/2007	13:20	0.0	445.0	15.76	87.60	1028
13808023CCDD	7/12/2007	16:10	0.0	455.4	35.20	88.70	1027
13808010AAADA	7/12/2007	17:02	0.0	32.4	34.84	88.70	1026
13707828DCC3	7/15/2007	9:00	296.2	194.0	70.65	69.80	1018

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

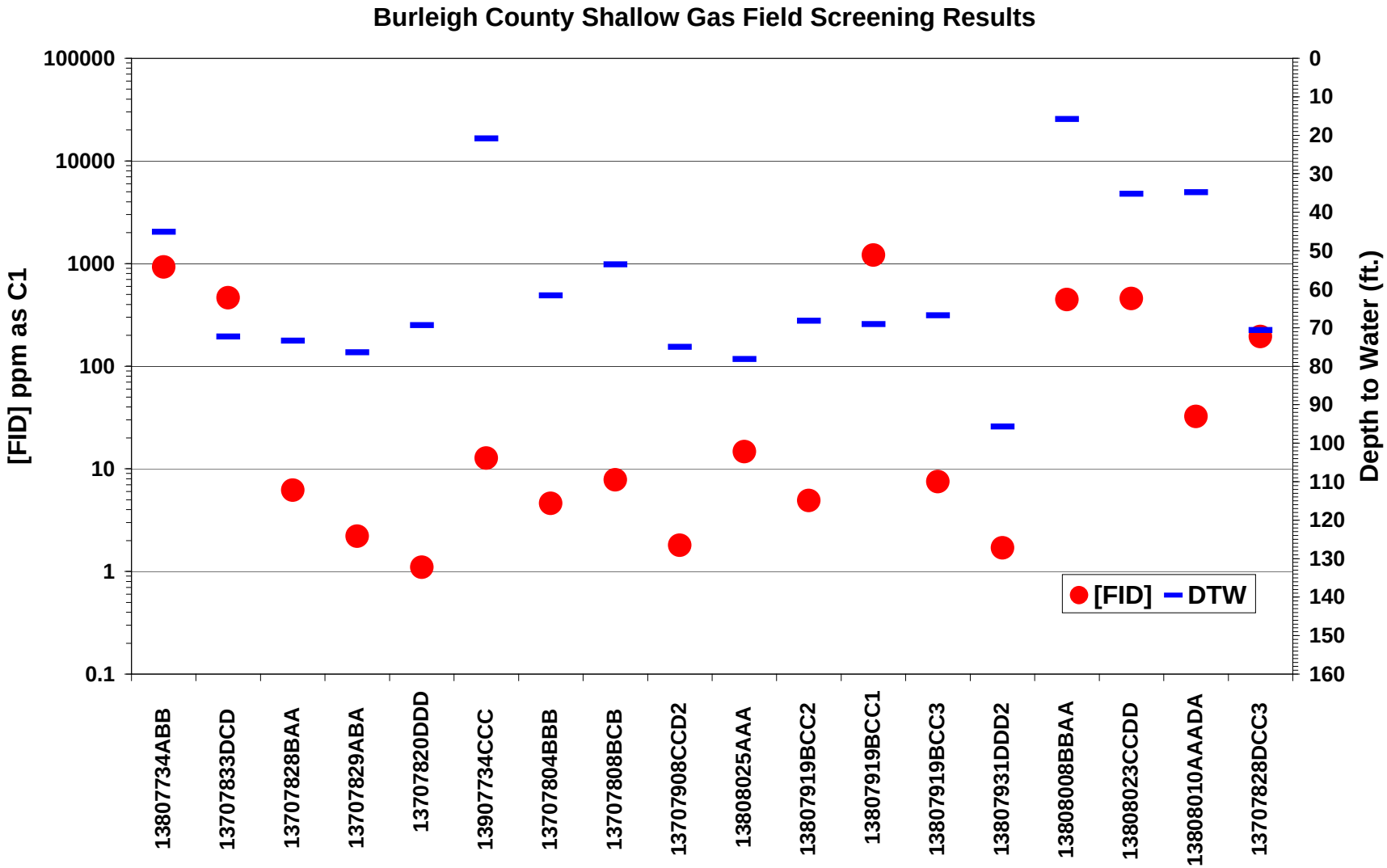

Figure 17. Shallow gas field screening results in Burleigh County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Kidder County

Field screening in Kidder County was conducted over an 11, non-consecutive day period from July 16 - 19, and August 2, 7, 9, 10, and 14, 2007. 451 observation wells were reviewed prior to field investigation which resulted in 374 observation wells being field screened. Of these, 63 wells returned positive FID responses (Table 9), ranging from 0.2 to 840.5 ppm as C1 (Figure 18); 310 of the wells showed no response. 29 observation well sites were not found during the investigation. The occurrence of FID responses are variably distributed throughout the monitoring network in the central portion of the county trending from northeast to southwest following the general trend of the monitoring wells completed in the Kidder County Aquifer (Appendix I).

Ward County

Field screening was conducted in Ward County over a four day period from July 23 to 26, 2007. 151 observation wells were reviewed prior to investigation, which resulted in 79 observation wells being field screened. Of these, 27 returned positive FID responses (Table 10), ranging from 0.2 to >50,000 ppm (5%) as C1 (Figure 19); 52 of the wells showed no response. Four wells were found to have a detectable concentration of C1 at the TOC: Well 154-82-3CDC5 had an FID response of 7.5 ppm, well 154-82-3BCCA2 had an FID response of 1.7 ppm, well 155-83-13-CBDC had an FID response of 1.4 ppm, and well 154-82-03BCC returned a trace reading at 0.1 ppm. 72 observation well sites were not found. The occurrence of FID responses are concentrated within wells that are associated with the Minot, Sundre, and Souris Valley aquifers located within the Souris River valley in the Minot area (Appendix I).

McHenry County

Field screening was conducted in McHenry County over a seven, non-consecutive day period on July 31, and September 12, 13, 14, 18, 19, and 20, 2007. A total of 433 observation wells were reviewed prior to field investigation which resulted in 350 observation wells being field screened. Of these, 55 returned positive FID responses (Table 11), ranging from 0.2 to 2,329 ppm as C1 (Figure 20); 295 of the wells showed no response. 43 observation well sites were not found. The occurrence of FID responses are variably distributed throughout the monitoring network in the central portion of the county trending from northeast to southwest following the general trend of monitoring wells completed in the Souris Valley, New Rockford, and Karlsruhe Aquifers.

Barnes County

Field screening was conducted in Barnes County, North Dakota over a two-day period on August 14 & 15, 2007. 51 observation well sites were reviewed prior to the field investigation which resulted in 50 well sites being visited. A total of 28 observation wells were field screened which resulted in five returning positive FID responses (Table 12), ranging from 0.3 to 2,897 ppm as C1 (Figure 21); 23 of the wells showed no response. Two nested wells (141-61-21DDD1&2) were found to have detectable concentrations of C1 at the TOC of 3.5 ppm and 2897 ppm, respectively. However, based on field observations, it appears that these wells were recently underwater, and as such, the results may be suspect. 22 observation well sites were not found during the

Table 9. Field screening information collected from ground-water observation wells in Kidder County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
13907004DDA1	7/16/2007	14:40	0.0	2.3	16.35	80.1	1015
13907005DDC1	7/16/2007	15:03	0.0	3.1	25.00	82.7	1014
14307029BBB2	7/18/2007	13:46	0.0	12.1	79.80	91.6	1017
13907231DDC1	7/19/2007	15:16	0.0	6.7	41.08	79.2	1024
13907231DDC2	7/19/2007	15:16	0.0	0.8	NM	79.2	1024
14107005BBB2	8/2/2007	13:03	0.0	0.5	35.90	79.1	1019
14107006BAA4	8/2/2007	13:36	0.0	0.7	73.32	79.7	1019
14107006BAA5	8/2/2007	13:39	0.0	0.7	73.64	79.7	1019
14207113DDD1	8/2/2007	14:33	0.0	59.5	27.43	82.1	1020
14207121AAA	8/2/2007	15:00	0.0	1.5	20.56	83.3	1021
14107119CBC	8/2/2007	15:56	0.0	3.7	36.65	91.7	1021
13807217AAA3	8/7/2007	8:36	0.0	5.8	12.60	65.5	1014
13807210BBB2	8/7/2007	8:59	0.0	0.2	30.30	68.3	1014
13807202CDD4	8/7/2007	9:32	0.0	68.1	DRY	70.5	1013
13807202CDD5	8/7/2007	9:34	0.0	1.8	84.44	70.5	1013
13807203DAD2	8/7/2007	11:10	0.0	7.8	85.54	75.9	1013
13807203DAD1	8/7/2007	11:12	0.0	63.0	48.30	75.9	1013
13807203AAA5	8/7/2007	11:38	0.0	10.2	69.65	82.1	1014
13807203AAA6	8/7/2007	11:38	0.0	8.4	38.30	82.1	1014
13907235DDD4	8/7/2007	12:11	0.0	20.7	66.02	97.1	1013
13907235DDD5	8/7/2007	12:18	0.0	29.4	33.92	97.1	1013
13807203BAA3	8/7/2007	13:15	0.0	2.9	65.35	91.8	1013
13807207AAA1	8/7/2007	13:50	0.0	2.5	47.25	90.4	1014
13907231AAA2	8/7/2007	15:11	0.0	840.5	61.83	90.0	1012
13907231AAA1	8/7/2007	15:14	0.0	4.1	64.92	90.0	1012
13907216BAA	8/7/2007	15:50	0.0	145.1	78.97	89.9	1012
13907208DBD	8/7/2007	16:12	0.6	464.2	59.62	89.5	1012
13907129CCC1	8/7/2007	17:42	0.0	6.5	25.32	89.0	1011
13907224BBB4	8/7/2007	18:50	0.0	13.8	67.67	87.0	1011
13907120ABB2	8/7/2007	19:23	0.0	0.7	20.68	82.1	1011
13907121AAA	8/7/2007	19:48	0.0	1.9	36.06	82.0	1011
14107018CDD	8/9/2007	10:43	0.0	4.3	137.70	82.1	1012
14207016BAD2	8/9/2007	12:05	0.0	6.2	28.80	89.5	1014
14207134BAA	8/9/2007	14:17	0.0	47.5	36.84	92.0	1015
14207132CDD2	8/9/2007	15:12	0.0	91.5	21.51	95.3	1016
14207135DDD1	8/9/2007	15:57	0.0	13.1	40.38	92.8	1016

Table 9 Contd. Field screening information collected from ground-water observation wells in Kidder County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
14107109DDA2	8/9/2007	16:43	0.0	8.9	74.65	97.2	1015
14107122AAA	8/9/2007	18:25	0.0	0.2	58.18	87.8	1015
14107125BBB2	8/9/2007	19:18	0.0	5.1	114.74	88.7	1014
14107125BBB1	8/9/2007	19:20	0.0	2.6	113.00	88.7	1014
14107120DDD1	8/9/2007	19:47	0.0	4.6	84.22	83.9	1015
14007030CCC	8/9/2007	21:21	0.0	0.6	29.83	73.8	1014
14007228DDD2	8/10/2007	9:34	0.0	5.7	32.75	80.1	1018
14007216DDD3	8/10/2007	9:34	0.0	5.7	32.75	80.1	1018
13907202DDD	8/10/2007	10:25	0.0	0.5	45.50	89.1	1015
13907103BBB2	8/10/2007	11:00	0.0	9.0	18.85	88.3	1014
14007135DDD2	8/10/2007	11:02	0.0	1.6	40.23	88.6	1020
14007123CCC2	8/10/2007	12:02	0.0	0.9	47.90	92.7	1013
14007123BBB2	8/10/2007	12:36	0.0	0.8	49.30	91.0	1013
14007128BAB	8/10/2007	13:18	0.0	0.8	32.20	87.1	1014
14007129DDD3	8/10/2007	14:03	0.0	0.9	34.4	88.8	1014
14007131AAA2	8/10/2007	14:13	0.0	26.0	25.09	86.5	1014
14007119DDD2	8/10/2007	14:24	0.0	2.0	31.09	87.1	1014
14007119DDD1	8/10/2007	14:26	0.0	241.8	47.43	87.1	1014
13907203DDD3	8/10/2007	15:05	0.0	29.2	17.60	76.5	1013
13907203DDD1	8/10/2007	15:10	0.0	33.5	57.00	76.5	1013
14007234AAA	8/14/2007	9:09	0.0	6.4	37.7	66.9	1023
14007235DDD2	8/14/2007	9:27	0.0	62.5	30.66	64.5	1022
14007235DDD1	8/14/2007	9:29	0.0	33.9	51.25	64.5	1022
14007236BBA2	8/14/2007	9:48	0.0	61.7	24.63	65.6	1022
14007236BBA3	8/14/2007	9:51	0.0	94.4	20.48	65.6	1022
14007224CCC2	8/14/2007	10:07	0.0	5.0	28.38	66.5	1022
14007224CCC1	8/14/2007	10:10	0.0	1.7	28.05	66.5	1022

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

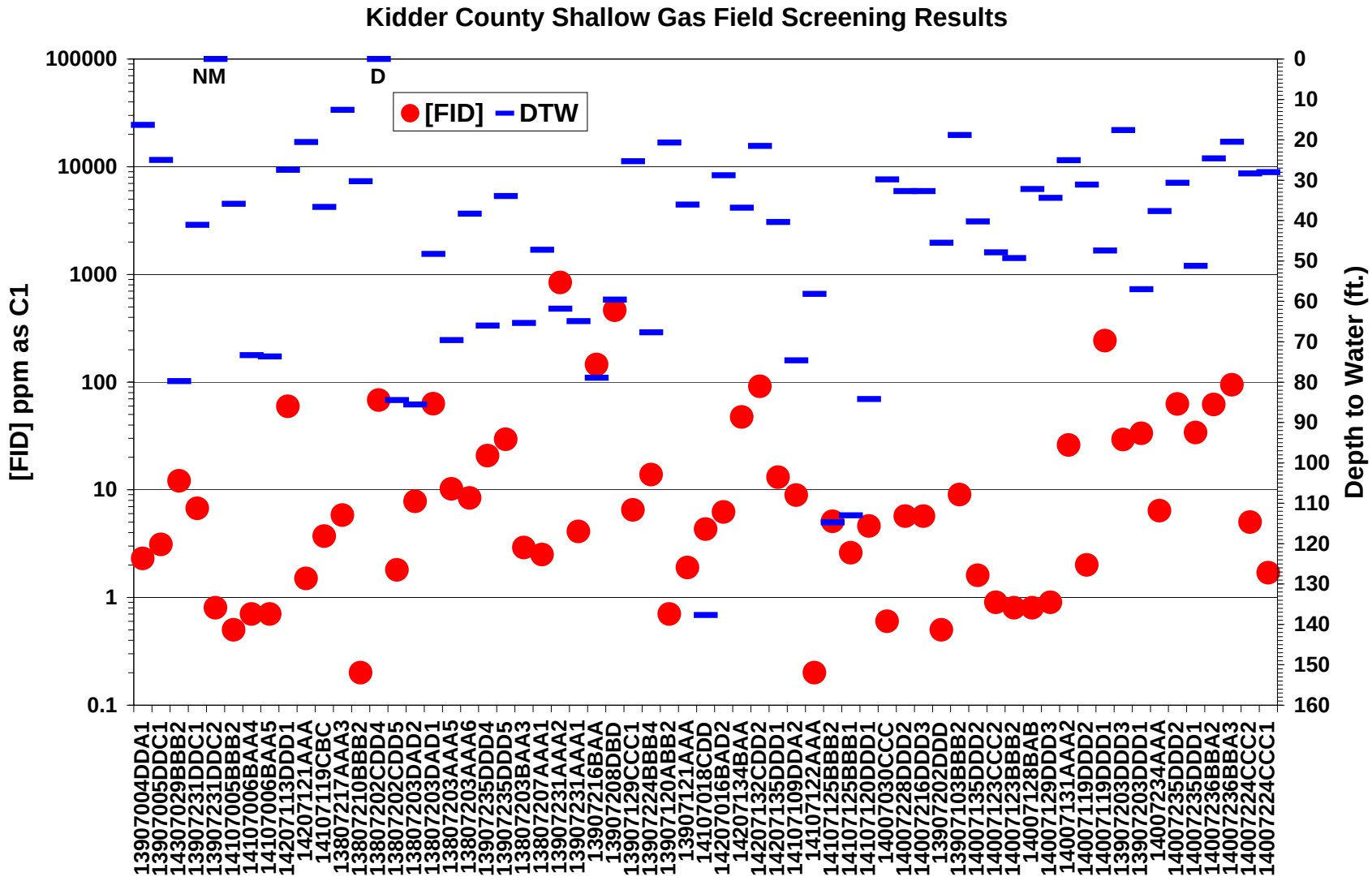

Figure 18. Shallow gas field screening results in Kidder County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. Wells where a water level was not measured (NM) or were dry (DRY) are highlighted.

Table 10. Field screening information collected from ground-water observation wells in Ward County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
15408204ABA1	7/23/2007	15:00	0.0	1.9	70.26	104.6	1023
15408210BBB1	7/24/2007	15:24	0.0	14.1	66.78	103.9	1019
15408210BBB2	7/24/2007	15:26	0.0	21.8	66.60	103.9	1019
15408203BCD2	7/24/2007	17:27	0.0	0.4	80.35	99.4	1018
15408203BCCA2	7/24/2007	18:23	1.7	7573.0	77.55	97.5	1017
15408203BCCA1	7/24/2007	18:25	0.0	2.0	80.45	97.5	1017
15408203BCC	7/24/2007	18:30	0.1	2829.0	80.23	100.1	1017
15408203CBAA2	7/25/2007	8:31	0.0	1.4	42.63	86.2	1019
15408203CBAA3	7/25/2007	8:32	0.0	1.0	64.44	86.2	1019
15408203CBCA3	7/25/2007	9:42	0.0	0.3	72.90	84.1	1019
15408203CBA4	7/25/2007	10:40	0.0	0.6	80.40	90.7	1019
15408203CDBD2	7/25/2007	10:59	0.0	2.4	38.05	93.2	1018
15408203CDC5	7/25/2007	11:23	7.5	2986.0	37.94	88.8	1018
15508322DDB	7/25/2007	16:23	0.0	2.9	25.94	83.8	1021
15508323BAC1	7/25/2007	17:07	0.0	2.4	64.33	77.6	1021
15508323BCA	7/25/2007	17:40	0.0	10.1	65.92	80.7	1021
15508323BDD2	7/25/2007	17:55	0.0	1.4	63.69	82.1	1021
15508323BDD3	7/25/2007	17:57	0.0	0.2	17.95	82.1	1021
15508314CDA2	7/25/2007	18:35	0.0	0.3	64.65	79.8	1020
15508314DBA3	7/25/2007	19:02	0.0	0.2	68.16	78.6	1020
15508314DDD6	7/25/2007	19:23	0.0	0.8	55.45	76.9	1020
15508314DDD5	7/25/2007	19:25	0.0	0.5	66.49	76.9	1020
15508313CBDC3	7/26/2007	8:40	0.0	14.3	60.48	71.8	1026
15508313CBDC2	7/26/2007	8:45	0.0	31.3	59.97	71.8	1026
15508313CBDC	7/26/2007	8:50	1.4	>50000	59.42	71.8	1026
15508313DCB2	7/26/2007	10:18	0.0	8.0	57.83	77.7	1027
15508324ADDA1	7/26/2007	11:48	0.0	15.6	56.08	80.1	1027

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

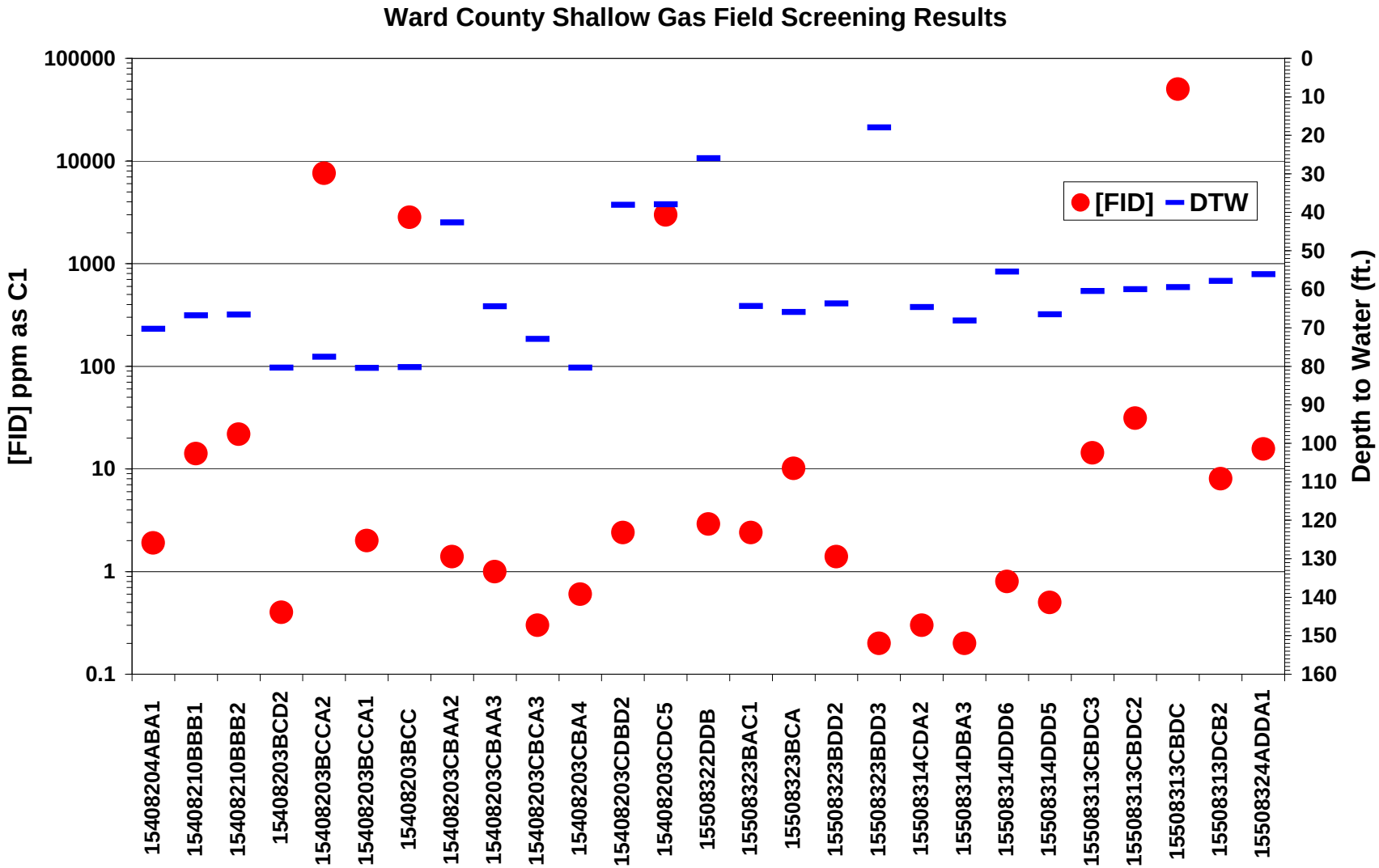

Figure 19. Shallow gas field screening results in Ward County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Table 11. Field screening information collected from ground-water observation wells in McHenry County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
15807614CDC	9/12/2007	14:37	0.0	17.8	9.68	78.1	1035
15807613BCB	9/12/2007	14:55	0.0	111.3	13.40	79.0	1035
15807613DDD2	9/12/2007	15:10	0.0	2.8	7.42	79.5	1034
15807528CDC	9/12/2007	16:10	0.0	0.7	9.35	81.3	1033
15807520CCC2	9/12/2007	17:38	0.0	173.0	9.04	80.9	1033
15707520BBB1	9/12/2007	18:20	0.0	20.0	36.06	74.8	1032
15607608AAB	9/13/2007	8:52	0.0	565.0	6.30	43.5	1039
15607713CCB1	9/13/2007	9:19	0.6	799.0	5.33	45.3	1039
15607713CCB2	9/13/2007	9:23	0.0	7.5	6.65	45.3	1038
15607724CCC	9/13/2007	9:40	0.0	31.5	8.54	44.7	1043
15607722CCC	9/13/2007	9:52	0.0	6.2	6.88	46.7	1043
15607710BBB	9/13/2007	10:19	0.0	6.4	7.06	47.2	1042
15707602BB	9/13/2007	11:15	0.0	0.9	6.81	49.3	1044
15408020BBB	9/13/2007	16:36	0.0	1.4	88.49	50.9	1043
15407929ABA	9/13/2007	16:51	0.0	141.7	76.05	48.4	1043
15107511BAA	9/14/2007	9:02	0.0	55.8	58.78	37.3	1050
15207536BBB2	9/14/2007	9:20	0.0	152.8	12.80	43.4	1050
15207533ABA	9/14/2007	9:37	0.0	8.7	NM	43.4	1050
15307613DDD	9/14/2007	11:40	0.0	16.2	11.00	51.2	1052
15307612DDD2	9/14/2007	11:47	0.0	0.9	8.70	52.1	1052
15307603DDD	9/18/2007	11:46	0.0	0.4	14.10	53.2	1039
15407621CCC2	9/18/2007	12:48	0.0	1.7	7.50	67.3	1039
15407621CCC	9/18/2007	12:53	0.0	56.5	8.10	67.3	1039
15407604CCC	9/18/2007	13:18	0.0	44.5	5.52	72.6	1037
15507726BAA	9/18/2007	14:27	0.5	294.2	7.40	66.7	1040
15407712ADD	9/18/2007	15:34	0.0	225.4	7.00	67.7	1040
15307608DCD	9/19/2007	8:45	0.0	5.7	22.30	46.0	1049
15307802CAA3	9/19/2007	9:09	0.0	64.0	14.75	62.7	1046
15407727ADD	9/19/2007	11:12	0.0	13.6	43.77	66.7	1050
15407728ADD1	9/19/2007	11:51	0.0	12.5	33.94	65.2	1050
15407722CCC	9/19/2007	12:10	0.0	0.5	31.70	67.3	1050
15407728DCD	9/19/2007	12:35	0.0	0.5	54.34	71.7	1050
15307708ABA1	9/19/2007	13:34	0.0	0.7	13.48	68.2	1049
15307708DDA3	9/19/2007	14:02	0.0	15.4	13.83	72.6	1047
15407729BBB	9/19/2007	15:42	0.0	53.4	42.50	69.9	1048
15407717CCC	9/19/2007	16:17	0.0	2.3	68.66	67.7	1046

Table 11. Contd. Field screening information collected from ground-water observation wells in McHenry County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
15407718CCC2	9/19/2007	16:45	0.0	0.5	69.30	67.4	1046
15407824DDD	9/19/2007	17:08	0.0	1.0	80.90	72.2	1045
15407825ADA	9/19/2007	17:25	0.0	0.5	40.64	69.2	1046
15407825ADA2	9/19/2007	17:28	0.0	0.2	23.69	66.0	1045
15407730BCB	9/19/2007	17:39	0.0	2.8	27.46	67.8	1046
15407730CBB3	9/19/2007	17:50	0.0	0.3	30.77	66.2	1046
15407730CBB	9/19/2007	17:53	0.0	1.2	30.57	66.2	1046
15407836AAA3	9/19/2007	18:30	98.4	2329	31.68	64.5	1046
15407836AAA5	9/19/2007	18:35	0.0	1790	28.36	64.5	1046
15407836AAA4	9/19/2007	18:39	0.0	120.5	27.34	64.5	1046
15407826DAA	9/20/2007	9:20	0.0	0.5	44.10	54.5	1045
15407826DAA6	9/20/2007	9:25	0.0	0.5	41.36	54.5	1045
15407825BCB2	9/20/2007	9:38	0.0	1.0	89.46	57.2	1043
15407825BCB3	9/20/2007	9:40	0.0	2.5	86.46	57.2	1043
15407825BCB4	9/20/2007	9:44	0.0	1.8	90.50	57.2	1043
15407823ADD1	9/20/2007	10:14	0.0	0.3	65.00	60.5	1043
15407810ADD	9/20/2007	10:36	0.0	60.1	11.13	64.2	1045
15407826BBC1	9/20/2007	11:00	0.0	0.6	87.85	64.8	1043
15407731BAA7	9/20/2008	13:23	0.0	1.2	32.97	68.9	1042

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
NM = Not Measured
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

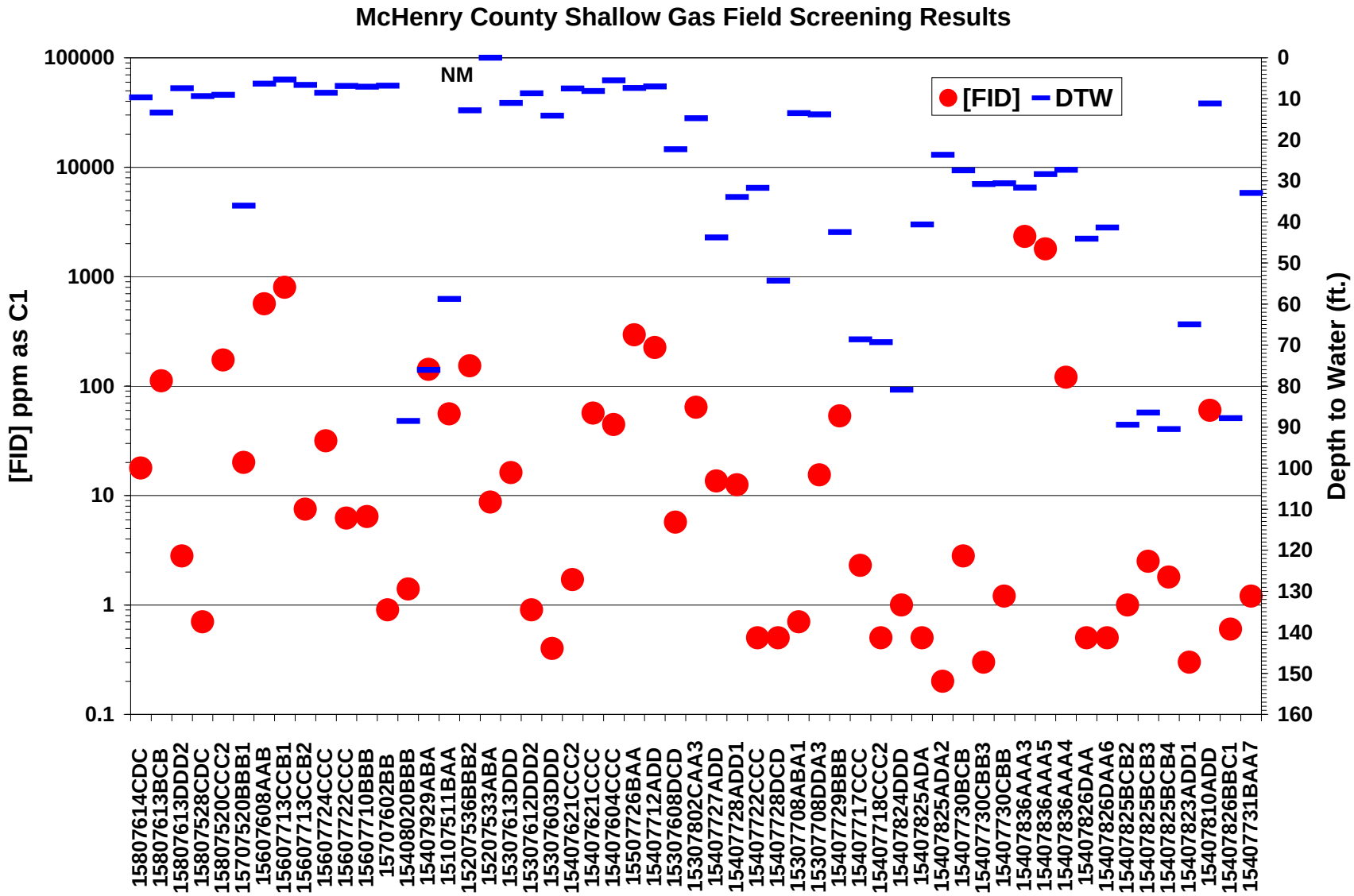

Figure 20. Shallow gas field screening results in McHenry County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Table 12. Field screening information collected from ground-water observation wells in Barnes County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
13906108CCC	8/14/2007	17:17	0.0	21.5	18.63	67.2	1031
14206010CCC2	8/15/2007	12:20	0.0	0.3	22.58	78.4	1026
14106121DDD2	8/15/2007	14:15	1.2	2360	36.45	81.4	1026
14106121DDD1	8/15/2007	14:19	3.5	2500	36.90	81.4	1026
14006104AAA	8/15/2007	16:00	36.2	77.3	35.54	79.0	1026

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

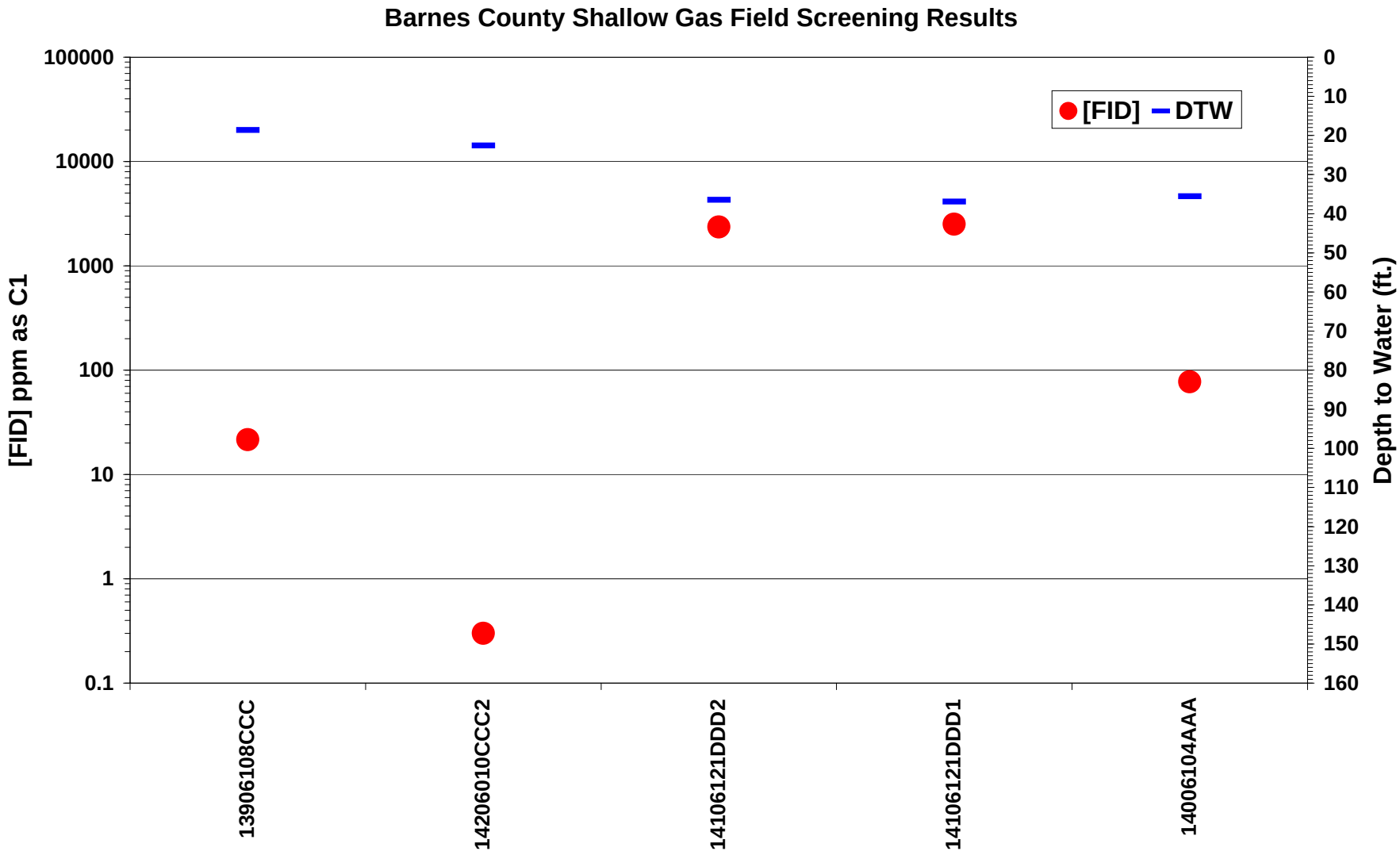

Figure 21. Shallow gas field screening results in Barnes County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. Well with no measurable water level (D) highlighted.

investigation. The occurrence of FID responses are widely distributed primarily in the northwestern portion of the county within wells completed in the Spiritwood Aquifer.

LaMoure County

The investigation of shallow natural gas occurrences within existing ground-water observation wells in Pierce County was conducted over a five, non-consecutive day period on August 15, 16, 21, 22, and September 26, 2007. 287 observation wells were reviewed prior to field investigation which resulted in 264 well sites being visited in the field. 198 observation wells were field screened which resulted in 49 wells returning positive FID responses (Table 13), ranging from 0.4 to 3,712 ppm as C1 (Figure 22); 149 of the wells showed no response. One well was found to have a detectable concentration of C1 at the TOC: Well 133-60-23-ABB had an FID response of 12.3 ppm. 66 observation well sites were not found during the investigation, suggesting that these wells have either been abandoned or destroyed. The occurrence of FID responses are distributed throughout the central portion of the county trending from northwest to southeast following the general trend of the Spiritwood Aquifer (Appendix I).

Morton County

Field screening in Morton County was conducted over a three-day period from August 28 - 30, 2007. 48 observation wells were reviewed prior to field investigation which resulted in 31 wells being visited in the field. 29 observation wells were field screened, which returned 12 positive FID responses (Table 14), ranging from 1.1 to 2,347 ppm as C1 (Figure 23) with 17 wells showing no response. One well (138-81-9-ABB1) recorded an FID concentration of 173 ppm C1 at the TOC. 17 observation well sites were not found.

Pierce County

Field screening was conducted in Pierce County over a two-day period on September 24 & 25, 2007. 160 observation well sites were reviewed prior to field investigation, which resulted in 117 observation wells being field screened. Of these, eight wells returned positive FID responses (Table 15), ranging from 1.7 to 71.7 ppm as C1 (Figure 24); 109 of the wells showed no response. One well was found to have a detectable concentration of C1 at the TOC: Well 157-74-22-DDA had an FID response of 16.4 ppm. 26 observation well sites were not found. The occurrence of FID responses are distributed in the north-central, western, and southeastern portions of the county coincident with the monitoring wells being completed in the New Rockford and Pleasant Lake Aquifers (Appendix I).

Table 13. Field screening information collected from ground-water observation wells in LaMoure County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
13305920ABB	8/15/2007	8:50	0.0	7.5	45.88	61.3	1037
13305930CDD	8/15/2007	9:43	0.0	45.4	47.50	64.8	1037
13305935ABB	8/15/2007	19:15	0.0	9.4	--	75.9	1030
13305934AAA2	8/15/2007	19:35	0.0	1.2	21.10	75.8	1030
13305929DCC	8/15/2007	20:06	0.0	2.5	--	75.1	1029
13305915AAA	8/15/2007	20:35	0.0	2835	20.85	74.8	1031
13305915CCC	8/16/2007	8:27	0.0	1849	37.20	70.5	1037
13305921BAA	8/16/2007	8:43	0.0	14.9	32.50	63.4	1037
13306036DDD1	8/16/2007	10:08	0.0	1.7	45.95	69.8	1037
13306025BBB	8/16/2007	11:25	0.0	1.6	56.40	71.4	1037
13306023ABB	8/16/2007	12:25	12.3	663.7	60.23	74.6	1036
13306002CDD3	8/16/2007	13:48	0.0	3.4	34.52	78.7	1036
13306002CDD1	8/16/2007	13:51	0.0	4.7	68.15	78.7	1036
13305907BAA2	8/16/2007	14:30	0.0	2.7	37.25	80.8	1036
13305907BAA1	8/16/2007	14:35	0.0	5.1	38.76	80.8	1036
13305905CDD1	8/16/2007	14:50	0.0	1.9	41.20	75.5	1036
13305904DCC	8/16/2007	15:10	0.0	11.7	44.52	82.4	1036
13306005DAA1	8/16/2007	16:47	0.0	0.6	72.72	83.3	1035
13606230DDD2	8/21/2007	9:20	0.0	2.1	12.85	70.3	1030
13606429ADA	8/21/2007	10:54	NM	548.5	19.96	62.8	1024
13406422ABA	8/21/2007	12:47	0.0	0.5	4.58	72.0	1023
13606310BBB	8/21/2007	15:26	0.0	3.2	134.30	79.2	1025
13606311BBB	8/21/2007	15:56	0.0	14.4	38.54	83.7	1025
13606302AAA	8/21/2007	16:15	0.0	171.0	112.44	90.7	1029
13606206DDD	8/21/2007	16:45	0.0	5.1	59.40	86.7	1025
13506202BBA	8/22/2007	10:43	0.0	8.5	139.20	76.6	1030
13506216AAA	8/22/2007	10:58	0.0	19.3	139.10	83.3	1030
13506313AAA	8/22/2007	11:23	0.0	3.2	134.00	84.0	1029
13506312BBB	8/22/2007	11:40	0.0	6.5	>150.00	87.4	1030
13506324DDD	8/22/2007	12:55	0.0	4.9	NM	83.7	1030
13506216CCC	8/22/2007	13:49	0.0	5.8	91.90	89.0	1030
13506236DDD	8/22/2007	15:08	0.0	2.5	115.56	89.6	1028
13506225DCB3	8/22/2007	16:09	0.0	2.5	35.12	92.1	1034
13306106AAA3	8/22/2007	17:28	NM	3712.0	45.30	86.2	1030
13406221DDA	8/22/2007	18:03	0.0	17.9	78.26	87.3	1029
13406029AAA	8/22/2007	19:19	0.0	0.4	52.25	80.1	1031

Table 13 Contd. Field screening information collected from ground-water observation wells in LaMoure County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
13406016CCC	8/22/2007	19:25	0.0	6.2	25.16	79.7	1030
13406026BBB	8/22/2007	19:50	0.0	0.4	70.06	77.0	1031
13406026DCC1	8/22/2007	20:14	0.0	38.8	56.31	74.8	1031
13406104DDD	9/26/2007	8:48	0.0	0.7	89.21	57.9	1053
13406104AAA	9/26/2007	9:00	0.0	4.6	111.30	59.1	1053
13406124DCC1	9/26/2007	10:12	0.0	2.0	84.28	62.0	1054
13406124DAA	9/26/2007	10:25	0.0	0.9	64.74	67.7	1053
13406113DAD2	9/26/2007	10:36	0.0	0.9	66.15	67.9	1053
13406128CDD	9/26/2007	11:33	0.0	5.9	21.61	67.1	1056
13306110CCC2	9/26/2007	11:55	0.0	9.3	50.44	67.2	1054
13306110CCC1	9/26/2007	11:58	0.0	0.4	NM	67.1	1054
13306029DDD1	9/26/2007	13:08	0.0	2252	7.14	71.0	1057
13306008DDD	9/26/2007	14:19	0.0	24.8	24.12	74.2	1056

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
NM = Not Measured
-- = No water level measured in well (Dry).
>150.00 = Depth to water greater than 150-ft.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

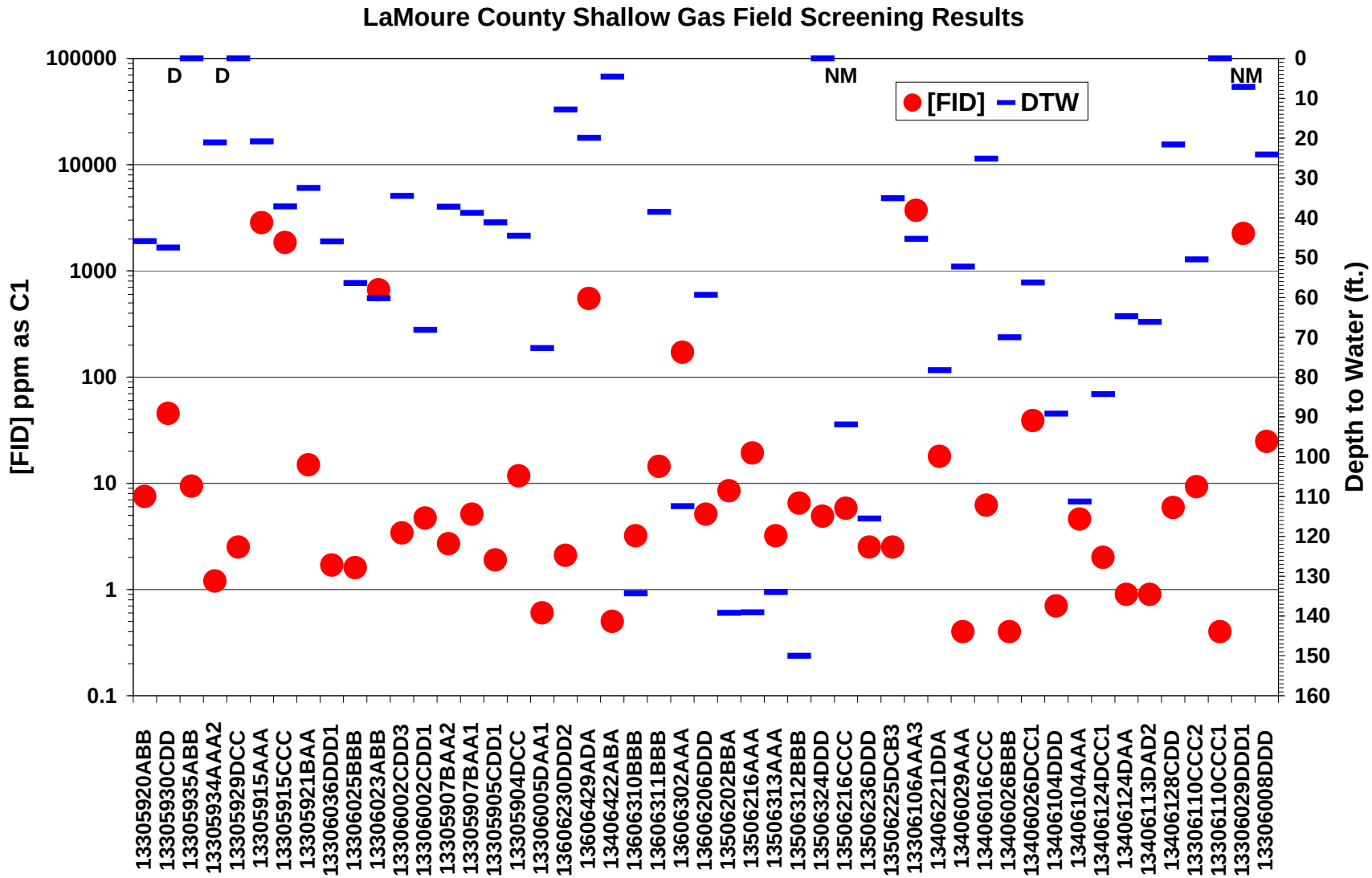

Figure 22. Shallow gas field screening results in LaMoure County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. Wells where a water level was not measured (NM) or were dry (DRY) are highlighted.

Table 14. Field screening information collected from ground-water observation wells in Morton County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
13808611DDB	8/28/2007	10:47	0.0	28.1	10.00	72.5	1024
13908635CBC	8/28/2007	14:20	0.0	465.7	22.02	71.4	1020
13908530AAB1	8/28/2007	15:15	0.0	9.8	52.05	71.2	1019
13508421DDD2	8/29/2007	12:30	0.0	66.5	7.72	78.8	1029
13508416ABA	8/29/2007	12:50	0.0	1.1	58.20	80.2	1028
13508416ABB	8/29/2007	13:09	0.0	3.2	29.44	82.6	1028
13608107DDC2	8/29/2007	15:56	0.0	90.8	49.27	81.0	1029
13608107DDC1	8/29/2007	16:00	0.0	209.7	48.09	81.5	1029
13808109ABB1	8/30/2007	10:30	173.7	2347.0	85.63	77.9	1028
13808109ABB2	8/30/2007	10:35	0.0	11.9	100.30	77.9	1028
13808109ABB4	8/30/2007	10:40	0.0	4.9	106.40	77.9	1028

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

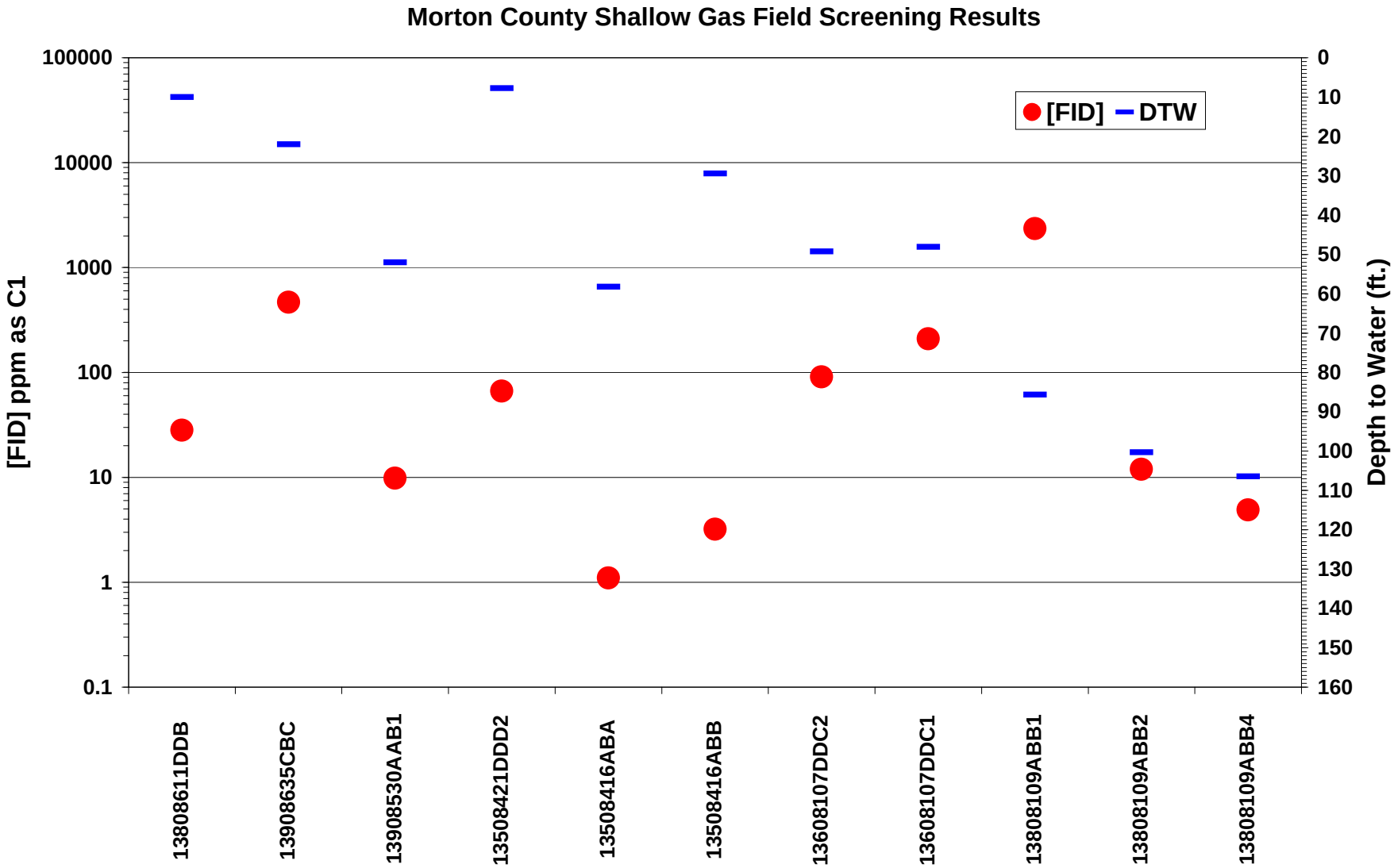

Figure 23. Shallow gas field screening results in Morton County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Table 15. Field screening information collected from ground-water observation wells in Pierce County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
15707422DDA	9/24/2007	12:28	16.4	NM	16.40	58.7	1048
15507432CCB	9/24/2007	13:22	0.0	1.7	13.16	63.9	1048
15107233BBB1	9/24/2007	16:46	0.0	2.5	85.68	61.8	1047
15107236AAA2	9/24/2007	17:18	0.0	2.8	27.79	60.6	1047
15707135BAA	9/25/2007	13:55	0.0	15.9	12.68	61.1	1057
15707134DAA	9/25/2007	14:39	0.0	71.7	19.87	61.3	1050
15707121DCC	9/25/2007	15:38	0.0	5.6	9.90	64.7	1048
15707122CDD	9/25/2007	16:10	0.0	31.2	7.47	67.0	1049

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

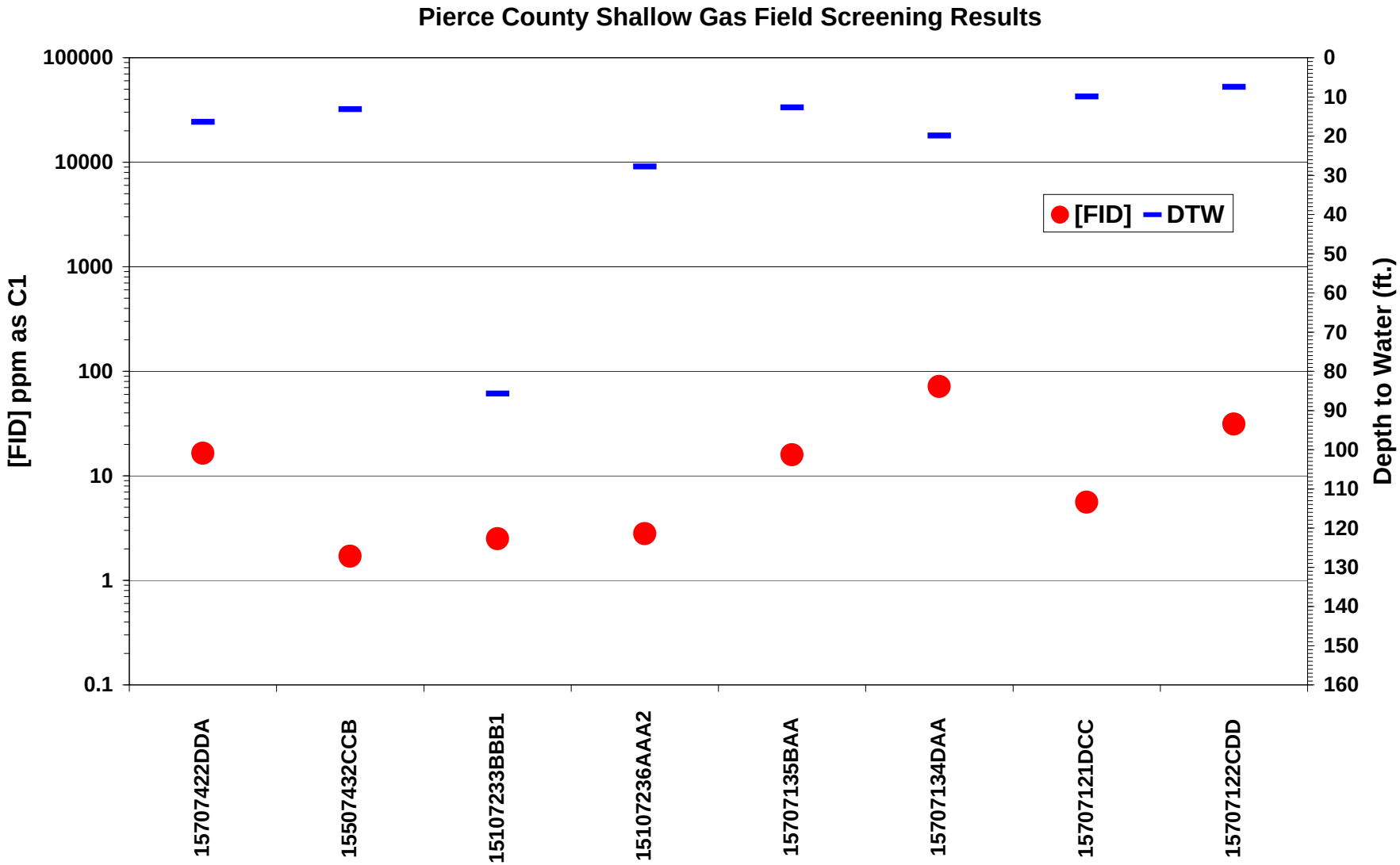

Figure 24. Shallow gas field screening results in Pierce County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Shallow Gas Field Screening Conducted in 2008

After completion of the second round of field screening on selected counties in 2007, it was decided to continue the field screening program into three additional counties in central and eastern North Dakota. Building on the counties completed in 2006 and 2007, three additional counties: Sheridan, Benson, and Logan, were selected for continued field investigation. During the 2008 field season, seven days were used for continued shallow gas field screening. During this time 539 wells were investigated with FID field screening being completed at 209 wells. FID instrument responses consistent with a shallow gas occurrence were found at 23 wells with 186 wells showing no response. Over 330 wells were not found in the field and were presumed to be abandoned or destroyed. A discussion of results for each county investigated in 2008 is provided below.

Sheridan County

Field screening in Sheridan County was conducted on July 24, 2008. 71 observation well sites were reviewed prior to field investigation. Nine of these observation wells were visited in the field as the remaining 62 well locations were of undetermined status (likely to be destroyed or abandoned) and, as such, were chosen not to be visited. A total of seven wells were field screened which resulted in two wells (146-74-21CCC & 148-78-20BBA) returning positive FID responses (Table 16) of 1.0 and 538.3 ppm as C1, respectively (Figure 25). Five of the wells showed no response. Two wells were not found. The occurrences of FID responses were located in the eastern and westernmost portions of the county.

Benson County

Field screening was conducted in Benson County over a four-day period from July 29 - 31, and on August 4, 2008. 341 observation wells were reviewed prior to field investigation, which resulted in 239 wells being visited in the field. The remaining 103 well locations were not visited due to time and/or access constraints. 127 observation wells were field screened which resulted in nine wells returning positive FID responses (Table 17) ranging from 0.5 to 223.7 ppm as C1 (Figure 26). 118 of the wells showed no response. 112 wells were not found. The occurrences of FID responses are dominantly located in the northwest part of the county near Pleasant Lake, southwest near Warwick and just south of Devils Lake. This is due, in part, to the spatial distribution of observation wells completed in the Spiritwood, Pleasant Lake, and Warwick Aquifers (Appendix I).

Table 16. Field screening information collected from ground-water observation wells in Sheridan County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
14607421CCC	7/24/2008	16:50	0.0	1.0	7.92	86.0	1008
14807820BBA	7/29/2008	11:25	0.0	538.3	15.62	82.7	1007

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

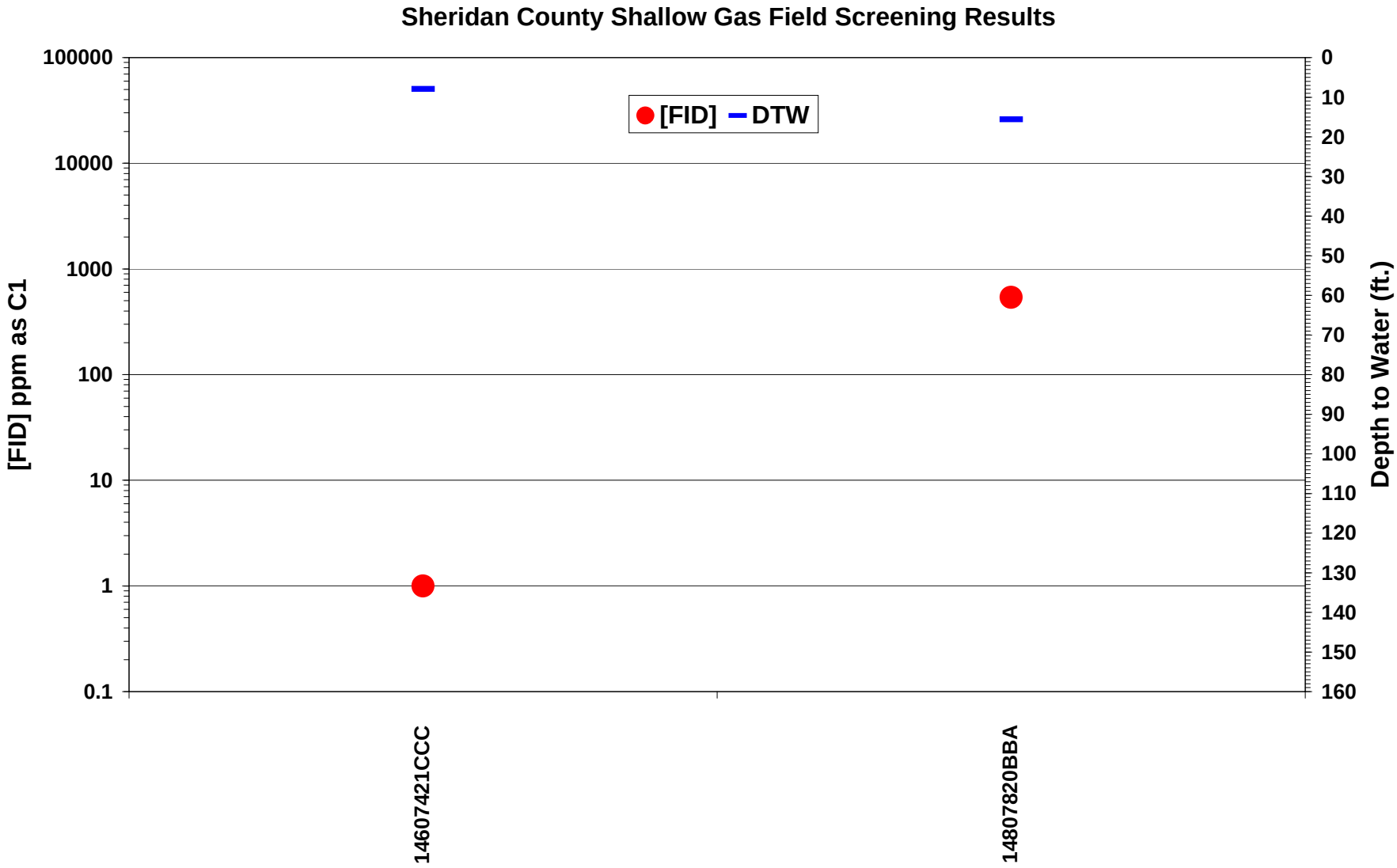

Figure 25. Shallow gas field screening results in Sheridan County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Table 17. Field screening information collected from ground-water observation wells in Benson County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
15107132ABB	7/29/2008	16:25	0	7.8	87.37	91.2	1016
15607106DDA	7/30/2008	10:20	0	2.5	7.87	84.0	1018
15607105AAA	7/30/2008	10:44	0	223.7	10.50	84.0	1018
15607104CBDC	7/30/2008	11:00	0	11.1	15.67	84.0	1017
15607117CDA	7/30/2008	12:57	0	137.7	30.87	86.2	1017
15406801AAA	7/30/2008	15:10	0	2.5	98.45	86.8	1018
15106711BBA	7/30/2008	18:23	0	21.5	4.20	84.5	1017
15106335CCC	7/31/2008	16:39	0	8.2	9.55	90.0	1022
15106335DCC	7/31/2008	16:54	0	0.5	7.40	90.0	1022

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

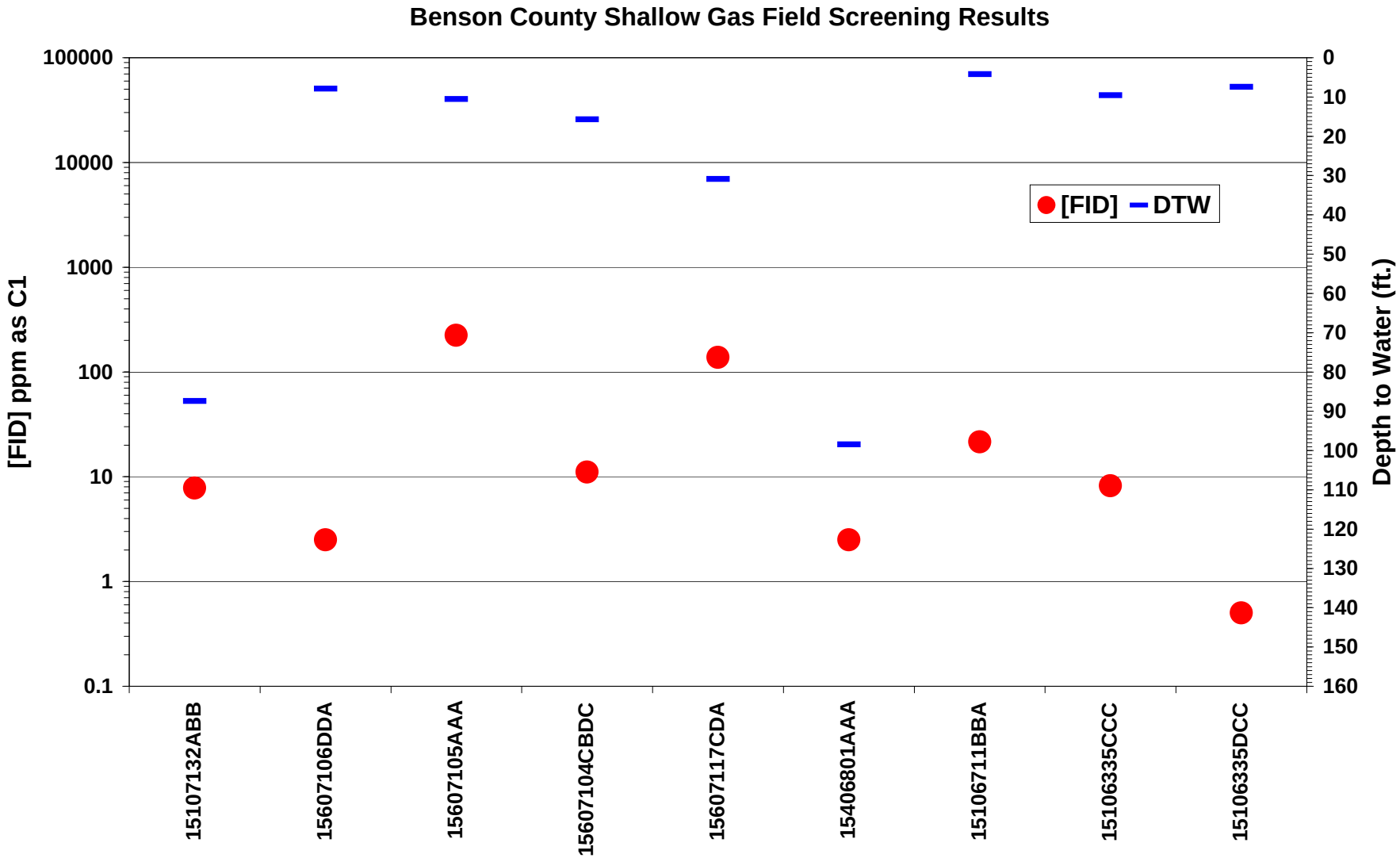

Figure 26. Shallow gas field screening results in Benson County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis.

Logan County

Field screening in Logan County was conducted over a two-day period on August 7 & 8, 2007. 127 observation wells were reviewed prior to field investigation, which resulted in 120 observation well sites being visited in the field. A total of 75 observation wells were field screened with 12 returning positive FID responses (Table 18), ranging from 3.4 to 42.5 ppm as C1 (Figure 27); 63 of the wells showed no response. Well 135-72-9-AAD recorded a concentration of 42.5 ppm at the TOC. 45 observation well sites were not found. The occurrence of FID responses are variably distributed in wells throughout the northwestern and east-northeastern portion of the county, which are completed in the Fox Hills and Napoleon aquifers (Appendix I).

Table 18. Field screening information collected from ground-water observation wells in Logan County, North Dakota where shallow gas was detected using a portable Flame-Ionization Detector.

Location	Shallow Gas Field Screening Field Data					[2]Atmospheric Conditions	
	Date	Time	FID @ TOC (ppm)	FID @ GWI (ppm)	[1]Depth to Water (ft)	Temp. (^{o}F)	Pressure (mB)
13607322AAA	8/6/08	12:10	0.0	23.8	89.05	83.8	1014
13607316CBC1	8/6/08	12:50	0.0	23.8	30.64	94.8	1016
13507309ABB	8/6/08	13:24	0.0	21.9	7.50	85.5	1016
13507311BBB	8/6/08	13:36	0.0	7.8	17.45	89.1	1015
13507301AAB2	8/6/08	14:13	0.0	5.7	53.41	91.7	1014
13507209AAD	8/6/08	15:07	10.7	42.5	29.84	88.1	1013
13307031DAA	8/6/08	20:47	0.0	3.4	25.15	75.0	1009
13406920DDD2	8/7/08	08:50	0.0	9.7	17.52	68.7	1017
13506706DCD2	8/7/08	12:09	0.0	5.1	41.73	90.0	1017
13606714CBC2	8/7/08	12:55	0.0	22.7	15.70	88.1	1017
13606810DDD	8/7/08	13:23	0.0	18.1	69.02	87.6	1017
13607005AAD2	8/7/08	15:17	0.0	10.8	--	84.3	1018

TOC = Top of Casing
GWI = Groundwater-Atmospheric Interface
(ppm) = FID instrument reading as calibrated to C1 in air.
-- = No water level measured in well (Dry).
[1]Measured from top of well casing.
[2]Atmospheric conditions (temperature & pressure) measured outside the well at the well site.

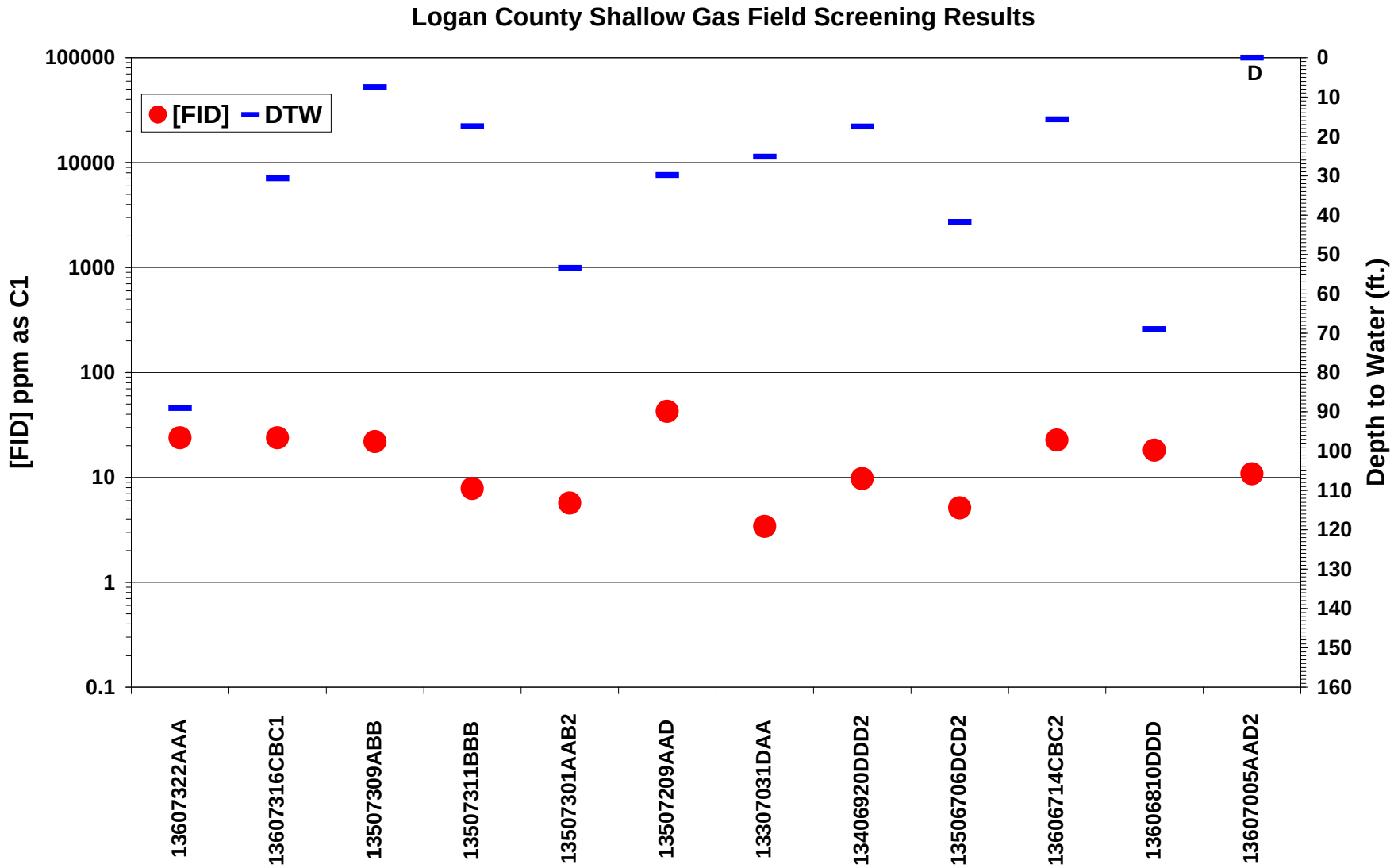

Figure 27. Shallow gas field screening results in Logan County. FID response [FID] in ppm as C1 plotted on the logarithmic scale on the primary y-axis. Depth to water measurements are plotted on the secondary y-axis. Dry wells (D) are highlighted.

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Appendix I
Observation Well Construction Information* Summary

Location/Well ID	Date Well Drilled	Screened Interval		Total Well Depth (ft.)	Aquifer	Geographic Coordinates[1]	
		Top (ft.)	Bottom (ft.)			Latitude	Longitude
Steele Co.							
14505413DDD3	10/20/04	75	80	100	Page	47.36918	-97.47561
14505604DDD	06/14/06	50	60	60	Till	47.39861	-97.79533
14505422AAA2	06/29/06	74	79	106	Page	47.36749	-97.51810
Bottineau Co.							
15908205BBA	8/22/1979	225	228	320	Glenburn	48.63157	-101.29574
15908221AAA	8/18/1977	148	151	300	Glenburn	48.58817	-101.25755
15908111BBB	12/23/1965	0	20	20	Till	48.61713	-101.10225
16008214AAA1	10/17/1980	190	193	321	Glenburn	48.68945	-101.21375
16208116CCC	10/21/1980	53	56	221	--	48.85079	-101.18973
16208315CCD	9/12/1979	235	238	272	--	48.85106	-101.42767
16108323DDD	9/20/1978	444	450	700	Fox Hills	48.74964	-101.38926
15908205CCD	8/21/1979	220	223	280	Glenburn	48.61894	-101.29571
15908227AAD	8/9/1977	159	162	200	Glenburn	48.57189	-101.23547
15908234DDC	11/29/1977	238	241	400	Glenburn	48.54658	-101.23829
16007623DDD	10/10/1980	77	80	141	--	48.66201	-100.43036
Renville Co.							
16208516CCD	00/00/00	--	--	--	--	48.85114	-101.71132
16208427AAA	5/16/1977	54	57	60	--	48.83497	-101.54179
16108424DDD	8/30/1979	470	488	662	Fox Hills	48.74989	-101.49792
Emmons Co.							
13007603CBB	12/20/1972	357	369	480	Strasburg	46.10838	-100.19009
12907508CCC1	10/21/1977	395	398	420	Strasburg	46.00133	-100.10730
13207720CCC2	11/30/1972	77	83	--	Strasburg	46.23366	-100.35470
13207726BCC1	8/16/1989	315	327	510	Strasburg	46.22636	-100.29200
13307836DCC	9/8/1971	127	133	200	Strasburg	46.28486	-100.43042
13207733CCC	11/21/1972	127	133	260	Strasburg	46.20471	-100.33369
13607716AAD	10/18/1972	197	203	320	Long Lake	46.60171	-100.35761
13207813ADD	8/24/1989	138	143	320	Strasburg	46.25542	-100.37840
13207728DDD	11/8/1972	77	83	120	Strasburg	46.21909	-100.31540
13107714AAA	12/1/1972	237	243	380	Strasburg	46.17375	-100.27441
13207631DDD	5/29/1973	278	284	420	Strasburg	46.20455	-100.23386
13207729DDD	11/8/1972	62	68	160	Strasburg	46.21912	-100.33631
Stutsman Co.							
14206922ADD	10/25/1977	53	56	80	Marstonmoor Plain	47.10396	-99.39840
14106907DDD2	10/26/1977	43	46	--	Marstonmoor Plain	47.03882	-99.46136
14106908CDD	9/18/1985	41	46	52	Marstonmoor Plain	47.03887	-99.45085
14006202CCC1	6/4/1975	158	161	280	Spiritwood	46.96603	-98.48081
14006216DDD1	6/4/1975	213	216	240	Spiritwood	46.93681	-98.50418
14006222BDC	00/00/00	252	257	--	Spiritwood	46.92956	-98.49623
14006222AAA2	7/16/1973	228	234	260	Spiritwood	46.93507	-98.48285
14006224CBB	8/9/1983	235	240	311	Spiritwood	46.92782	-98.45922
14006226AAA1	8/9/1983	285.9	290.5	297	Spiritwood	46.92051	-98.46182
13906212AAD	11/6/1975	113	116	140	Spiritwood	46.87511	-98.44064
14006227CCC1	5/29/1975	258	264	280	Spiritwood	46.90764	-98.50159
14006229CCC2	7/20/1982	155	160	182	Midway	46.90762	-98.54386
13706226DDD	7/28/1970	157	163	240	Spiritwood	46.64658	-98.46145
13706229CDD	7/27/1970	157	163	--	Spiritwood	46.64638	-98.53523
13706230BBB1	8/6/1982	217	220	--	Spiritwood	46.65882	-98.56423
14006223AAB	6/4/1975	258	261	340	Spiritwood	46.93514	-98.46451
13706205DDD	7/22/1970	197	203	360	Spiritwood	46.70434	-98.52478
13706203DDD1	11/4/1981	218	223	280	Spiritwood	46.70445	-98.48260
13706212ABB	7/31/1980	177	180	--	Spiritwood	46.70275	-98.44819
13806231CCC1	6/9/1983	121	126	143	Spiritwood	46.71879	-98.56427
13806217AAA	7/21/1970	177	183	240	Spiritwood	46.77510	-98.52487
Rolette Co.							
16307311CCC1	8/22/1978	406	412	715	Fox Hills	48.95113	-100.09433
16007124DDD	9/25/1980	100	103	141	Shell Valley	48.66171	-99.75546
16007128AAA	10/1/1980	38	44	81	Shell Valley	48.65999	-99.82103
16007212DDD	10/16/1980	38	41	80	Shell Valley	48.69083	-99.88559
16007212ADD	11/10/1980	36	39	121	Shell Valley	48.69807	-99.88559
16007203BBC	11/12/1980	68	71	--	Shell Valley	48.71597	-99.94847

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Location/Well ID	Date Well Drilled	Screened Interval		Total Well Depth (ft.)	Aquifer	Geographic Coordinates[1]	
		Top (ft.)	Bottom (ft.)			Latitude	Longitude
16007205ADD	12/10/1980	98	101	--	Shell Valley	48.71242	-99.97300
16107129DAD	10/8/1980	17	25	--	Shell Valley	48.73763	-99.87761
16107116DCD1	10/14/1980	25	28	60	Shell Valley	48.76281	-99.86117
16107109ADD	6/5/1979	38	48	--	Shell Valley	48.78472	-99.85562
Towner Co.							
16106711CCC1	7/8/1980	282	288	382	--	48.77708	-99.30529
15706618DDD1	9/3/1981	252	262	341	--	48.41514	-99.21144
16306718AAA1	7/18/1980	252	258	282	--	48.94874	-99.37381
15706630ABB2	6/12/1980	38	44	282	--	48.39877	-99.21979
16206716CCC	7/15/1980	201	204	302	--	48.84941	-99.34923
16106711CCC2	7/8/1980	98	101	102	--	48.77708	-99.30529
Burleigh Co.							
13807734ABB	7/27/1978	58	64	100	McKenzie	46.73481	-100.38332
13707833DCD	7/9/1979	178	181	217	Glencoe Channel	46.63561	-100.52892
13707828BAA	7/12/1979	178	184	244	Glencoe Channel	46.66280	-100.53384
13707829ABA	5/11/2005	158	163	180	Glencoe Channel	46.66292	-100.54964
13707820DDD	5/11/2005	176	181	200	Glencoe Channel	46.66470	-100.54420
13907734CCC	7/7/1978	198	201	260	McKenzie	46.80902	-100.39277
13707804BBB	5/10/2005	207	217	260	Glencoe Channel	46.72072	-100.54119
13707808BCB	7/17/1962	191	216	240	Glencoe Channel	46.70296	-100.56243
13707908CCD2	5/23/2002	150	155	180	Soo Channel	46.69504	-100.68622
13808025AAA	3/22/1983	163	168	220	Soo Channel	46.75026	-100.71205
13807919BCC2	6/3/1983	153	158	180	Apple Creek, Lower	46.75921	-100.70922
13807919BCC3	1/28/1983	125	135	150	Apple Creek, Lower	46.75921	-100.70922
13807919BCC1	6/2/1983	189	194	200	Apple Creek, Lower	46.75921	-100.70922
13807931DDD2	5/22/2002	138	143	160	Soo Channel	46.72304	-100.69121
13808008BBAA	10/3/1979	37	40	40	Bismarck	46.79430	-100.81084
13808023CCDD	10/5/1979	98	101	120	Bismarck	46.75163	-100.74815
13808010AAADA	10/10/1979	109	112	140	--	46.79360	-100.75257
13707828DCC3	6/6/1983	209	212	240	Glencoe Channel	46.65009	-100.53121
Ward Co.							
15408204ABA1	11/6/1963	80	100	210	Sundre	48.19559	-101.21609
15408210BBB1	7/14/1969	138	141	300	Sundre	48.18126	-101.20791
15408210BBB2	10/2/1969	206	212	220	Sundre	48.18126	-101.20791
15408203BCD2	9/25/1984	230	235	242	Sundre	48.19020	-101.20527
15408203BCCA2	9/19/1984	150	155	160	Sundre	48.19065	-101.20729
15408203BCCA1	9/18/1984	195	200	230	Sundre	48.19065	-101.20729
15408203BCC	10/8/1968	217	223	280	Sundre	48.19020	-101.20797
15408203CBAA2	9/17/1984	154.5	159.5	160	Sundre	48.18886	-101.20457
15408203CBAA3	9/17/1984	94	99	105	Sundre	48.18886	-101.20457
15408203CBCA3	9/25/1984	105	110	120	Sundre	48.18707	-101.20726
15408203CBA4	7/25/1968	148	151	280	Souris Valley-Sundre	48.18841	-101.20524
15408203CDBD2	9/12/1984	44	49	60	Souris Valley	48.18438	-101.20187
15408203CDC5	9/11/1978	38	44	60	Souris Valley	48.18304	-101.20254
15508322DDB	7/21/1992	110	115	140	Minot	48.22867	-101.32322
15508323BAC1	7/20/1992	118	123	150	Minot	48.23699	-101.31063
15508323BCA	7/21/1992	118	123	127	Minot	48.23550	-101.31358
15508323BDD2	5/18/1993	108	113	140	Minot	48.23387	-101.30928
15508323BDD3	5/18/1993	28	33	40	Souris Valley	48.23389	-101.30914
15508314CDA2	6/29/1992	138	143	200	Minot	48.24234	-101.30905
15508314DBA3	5/24/1993	138	143	200	Minot	48.24548	-101.30312
15508314DDD6	5/25/1993	75	85	90	Souris Valley	48.24096	-101.29725
15508314DDD5	6/22/1992	128	133	300	Minot	48.24096	-101.29720
15508313CBDC3	5/25/1993	115	120	120	Minot	48.24417	-101.29302
15508313CBDC2	5/23/1993	178	183	200	Minot	48.24414	-101.29303
15508313CBDC	10/21/1992	238	241	274	Minot	48.24409	-101.29303
15508313DCB2	10/22/1992	182	193	197	Minot	48.24273	-101.28422
15508324ADDA1	7/22/1992	118	123	180	Minot	48.23482	-101.27527
McHenry Co.							
15807614CDC	11/2/1977	28	34	60	Souris Valley	48.50241	-100.44320
15807613BCB	9/21/1976	155	161	300	--	48.51129	-100.42699
15807613DDD2	6/3/2003	5	10	20	Lake Souris	48.50227	-100.40808

Appendix I
Observation Well Construction Information* Summary

Location/Well ID	Date Well Drilled	Screened Interval		Total Well Depth (ft.)	Aquifer	Geographic Coordinates[1]	
		Top (ft.)	Bottom (ft.)			Latitude	Longitude
15807528CDC	6/4/2003	22	27	40	Lake Souris	48.47322	-100.35670
15807520CCC2	5/29/2003	7	12	20	Lake Souris	48.48799	-100.38430
15707520BBB1	9/22/1976	170	176	240	--	48.41387	-100.38404
15607608AAB	10/14/1970	22	25	80	Souris Valley	48.35433	-100.45718
15607713CCB1	7/29/1975	123	126	160	Denbigh	48.32898	-100.51835
15607713CCB2	7/29/1975	53	56	60	Denbigh	48.32895	-100.51835
15607724CCC	7/29/1975	48	51	140	Denbigh	48.31269	-100.51842
15607722CCC	7/30/1975	78	81	100	Fox Hills	48.31268	-100.56186
15607710BBB	9/12/1978	156	159	180	Denbigh	48.35547	-100.56118
15707602BB	--	--	--	--	--	48.45616	-100.44761
15408020BBB	9/25/1970	157	163	280	Sundre	48.15210	-100.99260
15407929ABA	11/14/1977	102	108	140	New Rockford	48.13818	-100.84818
15107511BAA	8/9/1990	228	233	300	New Rockford	47.91967	-100.23071
15207536BBB2	8/25/1976	90	95	100	New Rockford	47.94698	-100.21965
15207533ABA	8/13/1990	75	80	340	New Rockford	47.94857	-100.26995
15307613DDD	9/28/1976	118	124	280	New Rockford	48.06554	-100.36744
15307612DDD2	9/28/1976	44	50	50	Lake Souris	48.08020	-100.36743
15307603DDD	5/12/1976	38	41	120	Lake Souris	48.09472	-100.41045
15407621CCC2	8/20/1997	8	13	16	Lake Souris	48.13797	-100.45318
15407621CCC	5/12/1976	33	39	80	Lake Souris	48.13797	-100.45303
15407604CCC	10/27/1977	30	36	100	Lake Souris	48.18249	-100.45194
15507726BAA	11/8/1977	73	76	90	Lake Souris	48.22413	-100.53012
15407712ADD	6/8/1993	26	31	100	Lake Souris	48.17525	-100.49772
15307608DCD	9/30/1970	157	163	280	New Rockford	48.08032	-100.46015
15307802CAA3	10/10/1976	0	39	--	Karlsruhe	48.10067	-100.65903
15407727ADD	5/7/1976	78	84	120	New Rockford	48.13106	-100.54026
15407728ADD1	5/11/1976	177	180	260	New Rockford	48.13163	-100.56189
15407722CCC	11/1/1978	230	233	250	New Rockford	48.13826	-100.56148
15407728DCD	6/25/2002	48	53	60	Till	48.12388	-100.56741
15307708ABA1	5/23/2001	55	60	70	Karlsruhe	48.09462	-100.59034
15307708DDA3	7/21/1999	17.5	20	25	Karlsruhe	48.08358	-100.58347
15407729BBB	5/13/1976	202	208	260	New Rockford	48.13818	-100.60473
15407717CCC	5/17/1976	137	143	280	New Rockford	48.15304	-100.60501
15407718CCC2	8/3/2000	125	130	156	Till	48.15328	-100.62625
15407824DDD	6/8/1994	211	216	313	New Rockford	48.13843	-100.62649
15407825ADA	8/2/2000	138	143	180	New Rockford	48.13443	-100.62652
15407825ADA2	6/18/2002	22	27	40	Karlsruhe	48.13448	-100.62661
15407730BCB	8/3/2000	35	40	120	Karlsruhe	48.13287	-100.62623
15407730CBB3	5/24/2001	35	40	50	Karlsruhe	48.13079	-100.62623
15407730CBB	5/20/1985	67	72	140	Karlsruhe	48.13086	-100.62623
15407836AAA3	7/31/2000	282	292	400	Fox Hills	48.12371	-100.62676
15407836AAA5	8/2/2000	107	112	120	Hell Creek	48.12372	-100.62661
15407836AAA4	8/1/2000	211	221	230	Hell Creek	48.12286	-100.62747
15407826DAA	8/8/2000	86	91	160	Karlsruhe	48.13084	-100.64816
15407826DAA6	5/27/2003	108	113	140	Karlsruhe	48.13014	-100.64899
15407825BCB2	5/21/2001	109	114	120	Karlsruhe	48.13380	-100.64783
15407825BCB3	5/22/2001	93	98	105	Karlsruhe	48.13385	-100.64783
15407825BCB4	5/22/2001	76	83	87	Karlsruhe	48.13389	-100.64783
15407823ADD1	6/19/2002	78	83	100	Karlsruhe	48.14603	-100.64808
15407810ADD	11/9/1977	85	88	100	Souris Valley	48.17450	-100.66975
15407826BBC1	6/20/2002	93	98	120	Karlsruhe	48.13487	-100.66959
15407731BAA7	3/13/1981	112	132	134	Karlsruhe	48.12327	-100.61590
Pierce Co.							
15707422DDA	00/00/00	0	0	78	Fox Hills	48.40295	-100.19067
15507432CCB	5/26/1981	144	150	300	Kilgore Channel	48.19873	-100.21405
15107233BBB1	5/28/1969	257	263	340	New Rockford	47.86107	-99.89704
15107236AAA2	10/31/1967	74	77	92	New Rockford	47.86085	-99.81326
15707135BAA	7/17/1975	98	101	140	Pleasant Lake	48.38533	-99.78792
15707134DAA	7/23/1975	54	57	140	Pleasant Lake	48.37800	-99.79884
15707121DCC	8/18/1975	112	115	140	Pleasant Lake	48.40032	-99.83051
15707122CDD	8/18/1975	70	73	100	Pleasant Lake	48.40098	-99.81018
Kidder Co.							

Appendix I
Observation Well Construction Information* Summary

Location/Well ID	Date Well Drilled	Screened Interval		Total Well Depth (ft.)	Aquifer	Geographic Coordinates[1]	
		Top (ft.)	Bottom (ft.)			Latitude	Longitude
13907231AAA2	7/18/1980	107	113	120	Kidder County	46.82028	-99.80754
13907208DBD	10/20/1997	78	83	120	Kidder County	46.86910	-99.79126
14007119DDD1	8/20/1970	117	123	400	Kidder County	46.92341	-99.68028
13907216BAA	9/1/1999	167	172	200	Kidder County	46.86365	-99.77554
14007236BBA3	7/16/1980	35	38	40	Kidder County	46.90719	-99.71703
14207132CDD2	7/2/1980	68	71	80	Kidder County	47.06848	-99.70456
13807202CDD4	5/25/2006	48	53	60	Kidder County	46.79291	-99.73385
13807203DAD1	5/4/1977	133	136	240	Kidder County	46.79659	-99.74448
14007235DDD2	5/5/1977	88	91	100	Kidder County	46.89444	-99.72236
14007236BBA2	7/16/1980	78	81	90	Kidder County	46.90719	-99.71703
14207113DDD1	6/27/1980	155	161	260	Kidder County	47.11178	-99.60935
14207134BAA	8/2/2005	158	163	220	Kidder County	47.08107	-99.66223
14007235DDD1	5/5/1977	178	181	200	Kidder County	46.89444	-99.72236
13907203DDD1	5/4/1977	170	173	200	Kidder County	46.87996	-99.74384
13907235DDD5	11/9/2006	78	83	100	Kidder County	46.80748	-99.72322
13907203DDD3	7/16/1980	44	47	50	Kidder County	46.87996	-99.74384
14007131AAA2	7/15/1980	80	83	90	Kidder County	46.90706	-99.68057
13907235DDD4	11/8/2006	135	140	150	Kidder County	46.80748	-99.72322
13907224BBB4	6/19/2001	150	155	160	Kidder County	46.84919	-99.72002
14207135DDD1	8/18/1970	177	183	260	Kidder County	47.06835	-99.63047
14307029BBB2	6/26/1980	99	102	120	Kidder County	47.18225	-99.58574
13807203AAA5	11/7/2006	148	153	180	Kidder County	46.80566	-99.74442
13907103BBB2	7/15/1980	32	38	40	Kidder County	46.89229	-99.63588
14107109DDA2	5/5/1982	185.7	190.7	200	Kidder County	47.04049	-99.67230
13807203AAA6	11/8/2006	83	88	100	Kidder County	46.80566	-99.74442
13807203DAD2	5/4/1977	83	86	100	Kidder County	46.79659	-99.74448
13907231DDC1	9/1/1970	338	344	400	Kidder County	46.80747	-99.81005
13907129CCC1	8/28/1970	142	148	160	Kidder County	46.82182	-99.67869
14007234AAA	7/16/1980	137	140	200	Kidder County	46.90721	-99.74338
14207016BAD2	6/27/1980	69	75	80	Kidder County	47.12263	-99.55669
13807217AAA3	11/16/2006	118	123	140	Kidder County	46.77677	-99.78719
14007216DDD3	7/6/2000	37	42	50	Kidder County	46.93800	-99.76401
14107125BBB2	8/15/2001	208	213	220	Kidder County	47.00954	-99.62877
14007224CCC2	5/13/1976	102	105	140	Kidder County	46.92339	-99.71944
14107120DDD1	5/12/1977	158	164	200	Kidder County	47.00988	-99.69290
14107018CDD	7/1/1980	399	405	450	Kidder County	47.02492	-99.59867
13907231AAA1	9/2/1970	157	163	200	Kidder County	46.82028	-99.80754
14107119CBC	7/3/1980	137.5	143.5	180	Kidder County	47.01463	-99.73441
13907005DDC1	7/11/1980	107	110	160	Kidder County	46.87939	-99.53561
13807203BAA3	7/18/1980	238	244	274	Kidder County	46.80557	-99.75495
14107125BBB1	8/14/2001	252	257	280	Kidder County	47.00954	-99.62883
13807207AAA1	8/31/1970	137	143	300	Kidder County	46.79126	-99.80777
13907004DDA1	7/10/1980	116	119	180	Kidder County	46.88096	-99.51174
13907121AAA	5/11/1977	53	58	180	Kidder County	46.84909	-99.63878
13807202CDD5	--	--	--	--	--	46.79291	-99.73384
14007224CCC1	9/17/1971	177	183	280	Kidder County	46.92339	-99.71944
14007135DDD2	7/14/1980	68	71	80	Kidder County	46.89405	-99.59621
14207121AAA	6/25/1980	69	72	160	Kidder County	47.11067	-99.67225
14007123CCC2	6/20/2001	58	63	80	Kidder County	46.92313	-99.61419
14007129DDD3	10/28/1997	78	83	100	Kidder County	46.90875	-99.65930
13907231DDC2	9/1/1970	157	163	180	Kidder County	46.80747	-99.81005
14007123BBB2	7/20/1980	51	54	60	Kidder County	46.93587	-99.61407
14007128BAB	6/21/2001	75	80	120	Kidder County	46.92135	-99.65132
14107006BAA4	7/18/2003	138	143	170	Kidder County	47.06657	-99.59877
14107006BAA5	7/21/2003	98	103	120	Kidder County	47.06657	-99.59877
13907120ABB2	6/20/2001	35	40	40	Kidder County	46.84900	-99.66794
14107005BBB2	5/15/2003	138	143	150	Kidder County	47.06657	-99.58590
13907202DDD	8/31/1999	168	173	200	Kidder County	46.88000	-99.72262
14007201ABB2	8/10/2001	48	53	60	Kidder County	46.97983	-99.70830
13807210BBB2	6/16/2000	70	75	221	Kidder County	46.79119	-99.76284
14107122AAA	11/20/1998	168	173	260	Kidder County	47.02380	-99.65082
14007030CCC	7/14/1980	88	91	140	Kidder County	46.90846	-99.57197

Appendix I
Observation Well Construction Information* Summary

Location/Well ID	Date Well Drilled	Screened Interval		Total Well Depth (ft.)	Aquifer	Geographic Coordinates[1]	
		Top (ft.)	Bottom (ft.)			Latitude	Longitude
14007119DDD2	5/5/1977	83	86	100	Central Dakota	46.92340	-99.68027
Barnes Co.							
13906108CCC	11/6/1975	138	141	300	Spiritwood	46.86443	-98.41669
14206010CCC2	6/1/1987	145	150	160	Spiritwood	47.12556	-98.27661
14106121DDD2	7/27/1982	109.5	114.5	120	Spiritwood	47.00937	-98.40532
14106121DDD1	7/21/1982	258	263	340	Spiritwood	47.00937	-98.40532
14006104AAA	7/27/1982	158	163	200	Spiritwood	46.97878	-98.37712
LaMoure Co.							
13305920ABB	8/12/1981	197	200	221	Spiritwood	46.32531	-98.12712
13305930CDD	8/19/1982	214	219	240	Spiritwood	46.29818	-98.15083
13305935ABB	8/19/1981	162	165	201	Spiritwood	46.29632	-98.06455
13305934AAA2	8/17/1982	168	173	200	Spiritwood	46.29641	-98.07754
13305929DCC	8/19/1982	198	203	240	Spiritwood	46.29820	-98.12720
13305915AAA	8/14/1981	167	170	181	Spiritwood	46.33982	-98.07751
13305915CCC	9/24/1975	188	191	240	Spiritwood	46.32716	-98.09581
13305921BAA	8/11/1981	231	234	380	Spiritwood	46.32536	-98.10890
13306036DDD1	9/23/1975	212	215	260	Spiritwood	46.28366	-98.16159
13306025BBB	6/6/1979	218	221	230	--	46.31085	-98.17980
13306023ABB	8/14/1981	211	214	241	Spiritwood	46.32537	-98.19027
13306002CDD3	8/23/1984	117	122	125	Till	46.35618	-98.19266
13306002CDD1	7/27/1983	255	260	282	Spiritwood	46.35618	-98.19266
13305907BAA2	7/25/1983	197	202	210	Spiritwood	46.35437	-98.15089
13305907BAA1	7/25/1983	292	297	402	Spiritwood	46.35437	-98.15089
13305905CDD1	7/21/1983	197	202	242	Spiritwood	46.35617	-98.13005
13305904DCC	7/20/1983	205	210	242	Spiritwood	46.35617	-98.10651
13306005DAA1	8/2/1983	217	222	262	Spiritwood	46.36156	-98.24506
13606230DDD2	8/16/1982	35	40	42	Spiritwood	46.55935	-98.51668
13606429ADA	10/17/1976	140	143	160	--	46.56838	-98.74748
13406422ABA	6/21/1973	23	26	40	Edgeley	46.41251	-98.71049
13606310BBB	10/23/1974	179	182	215	Spiritwood	46.61541	-98.59817
13606311BBB	11/5/1975	92	95	120	Spiritwood	46.61542	-98.57710
13606302AAA	8/9/1982	191	194	222	Spiritwood	46.63002	-98.55857
13606206DDD	10/24/1974	193	196	240	Spiritwood	46.61743	-98.51674
13506202BBA	8/18/1982	227	232	262	Spiritwood	46.54304	-98.44826
13506216AAA	10/30/1974	228	231	280	Spiritwood	46.51413	-98.47439
13506313AAA	11/4/1975	221	224	280	Spiritwood	46.51386	-98.53794
13506312BBB	7/14/1983	220	225	263	Spiritwood	46.52836	-98.55640
13506324DDD	7/12/1983	225	230	293	Spiritwood	46.48673	-98.53805
13506216CCC	6/27/1983	257	262	313	Spiritwood	46.50138	-98.49284
13506236DDD	7/7/1980	248	251	260	Spiritwood	46.45783	-98.41177
13506225DCB3	7/18/2006	128	133	140	Spiritwood	46.47407	-98.41963
13306106AAA3	11/5/1974	90	93	100	Ellendale	46.36907	-98.39130
13406221DDA	7/27/1983	243	248	290	Spiritwood	46.40172	-98.47467
13406029AAA	7/10/1980	238	241	260	Spiritwood	46.39791	-98.24500
13406016CCC	10/14/1976	212	215	240	Spiritwood	46.41417	-98.24238
13406026BBB	10/13/1976	218	222	260	Spiritwood	46.39789	-98.20046
13406026DCC1	10/13/1976	198	201	240	Spiritwood	46.38524	-98.18992
13406104DDD	6/5/1979	256	259	280	Spiritwood	46.44333	-98.34937
13406104AAA	8/27/1982	263	266	282	Spiritwood	46.45599	-98.34930
13406124DCC1	5/28/1979	228	231	280	Spiritwood	46.39968	-98.29427
13406124DAA	8/15/1983	217	222	282	Spiritwood	46.40516	-98.28642
13406113DAD2	8/28/1984	132	137	140	Spiritwood	46.41783	-98.28632
13406128CDD	9/1/1982	68	73	302	Ellendale	46.38534	-98.35983
13306110CCC2	9/8/1982	77	82	85	Ellendale	46.34186	-98.34695
13306110CCC1	9/8/1982	248	253	302	--	46.34186	-98.34695
13306029DDD1	6/24/1982	38	43	140	Lamoure	46.29811	-98.24505
13306008DDD	11/15/1974	42	45	60	--	46.34166	-98.24506
Morton Co.							
13808611DDB	6/4/1974	67	70	160	--	46.77793	-101.49355
13908635CBC	5/23/1974	97	103	180	--	46.80853	-101.50973
13908530AAB1	5/24/1974	950	962	--	Fox Hills	46.83215	-101.45256
13508421DDD2	9/5/1973	64	70	70	Elm Creek	46.48827	-101.23799

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Location/Well ID	Date Well Drilled	Screened Interval		Total Well Depth (ft.)	Aquifer	Geographic Coordinates[1]	
		Top (ft.)	Bottom (ft.)			Latitude	Longitude
13508416ABA	6/7/1974	290	296	315	Elm Creek	46.51530	-101.24331
13508416ABB	7/6/1974	158	164	300	Elm Creek	46.51528	-101.24591
13608107DDC2	10/9/1974	357	369	380	--	46.60395	-100.90674
13608107DDC1	10/8/1974	445	457	560	--	46.60395	-100.90674
13808109ABB1	7/16/1974	525	537	762	--	46.79148	-100.91068
13808109ABB2	7/17/1974	336	348	362	--	46.79148	-100.91068
13808109ABB4	7/17/1974	153	159	162	--	46.79148	-100.91068
Sheridan Co.							
14607421CCC	10/6/1977	399	405	642	--	47.44421	-100.11707
14807820BBA	9/6/1978	35	41	140	Lake Nettie	47.63127	-100.64737
Benson Co.							
15107132ABB	6/3/1969	257	263	340	--	47.86082	-99.77862
15607106DDA	7/22/1999	48	53	60	Pleasant Lake	48.35785	-99.82785
15607105AAA	7/23/1975	54	57	120	Pleasant Lake	48.37068	-99.80625
15607104CBDC	8/22/2000	44	49	100	Pleasant Lake	48.35883	-99.80121
15607117CDA	7/24/1975	73	76	100	--	48.32844	-99.81643
15406801AAA	5/21/1970	197	203	230	Spiritwood	48.19397	-99.33077
15106711BBA	1/1/1955	0	50	--	Oberon	47.91889	-99.20748
15106335CCC	1/1/1968	19	24	26	Warwick	47.84838	-98.69343
15106335DCC	1/1/1968	33	38	51	Warwick	47.84834	-98.68264
Logan Co.							
13607322AAA	11/3/1978	197	203	342	Fox Hills	46.58707	-99.83294
13607316CBC1	6/12/1979	158	164	179	Fox Hills	46.59253	-99.87237
13507309ABB	11/7/1978	13	16	142	Napoleon	46.52939	-99.86208
13507311BBB	11/7/1978	28	31	--	Napoleon	46.52917	-99.83062
13507301AAB2	11/13/2007	108	113	--	Napoleon	46.54337	-99.79370
13507209AAD	6/14/1979	138	144	167	Fox Hills	46.52718	-99.72816
13307031DAA	10/25/1979	38	41	80	--	46.28950	-99.52009
13406920DDD2	5/30/1979	20	23	42	Hillsboro	46.39989	-99.37338
13506706DCD2	7/24/1979	101	104	107	--	46.53051	-99.14802
13606714CBC2	7/31/1979	97	100	107	--	46.59277	-99.07685
13606810DDD	8/1/1979	138	141	167	--	46.60279	-99.20522
13607005AAD2	11/7/1983	11.5	16	13	Streeter	46.62895	-99.49782

***Well construction information compiled from online databases of the NDSWC: www.swc.state.nd.us.**

[1]Geographical coordinates in decimal degrees. West longitude values shown as a negative (e.g., -100.11707).

-- Data unavailable.