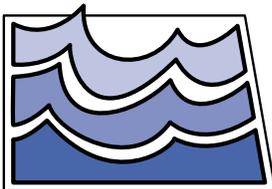


# Pressure Head Fluctuations of the Fox Hills-Hell Creek Aquifer in Billings, Golden Valley, and Slope Counties, North Dakota



PHOTO BY MERLYN SKALEY

By  
Rex P. Honeyman  
Hydrologist



Water Resources Investigation No. 42  
North Dakota State Water Commission  
2007

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North Dakota State Water Commission  
Office Memo

To: Project File #1442  
From: Rex Honeyman, Hydrologist  
Subject: Pressure Head Fluctuations of the Fox Hills-Hell Creek Aquifer in Billings, Golden Valley, and Slope Counties, North Dakota  
Date: May 30, 2007

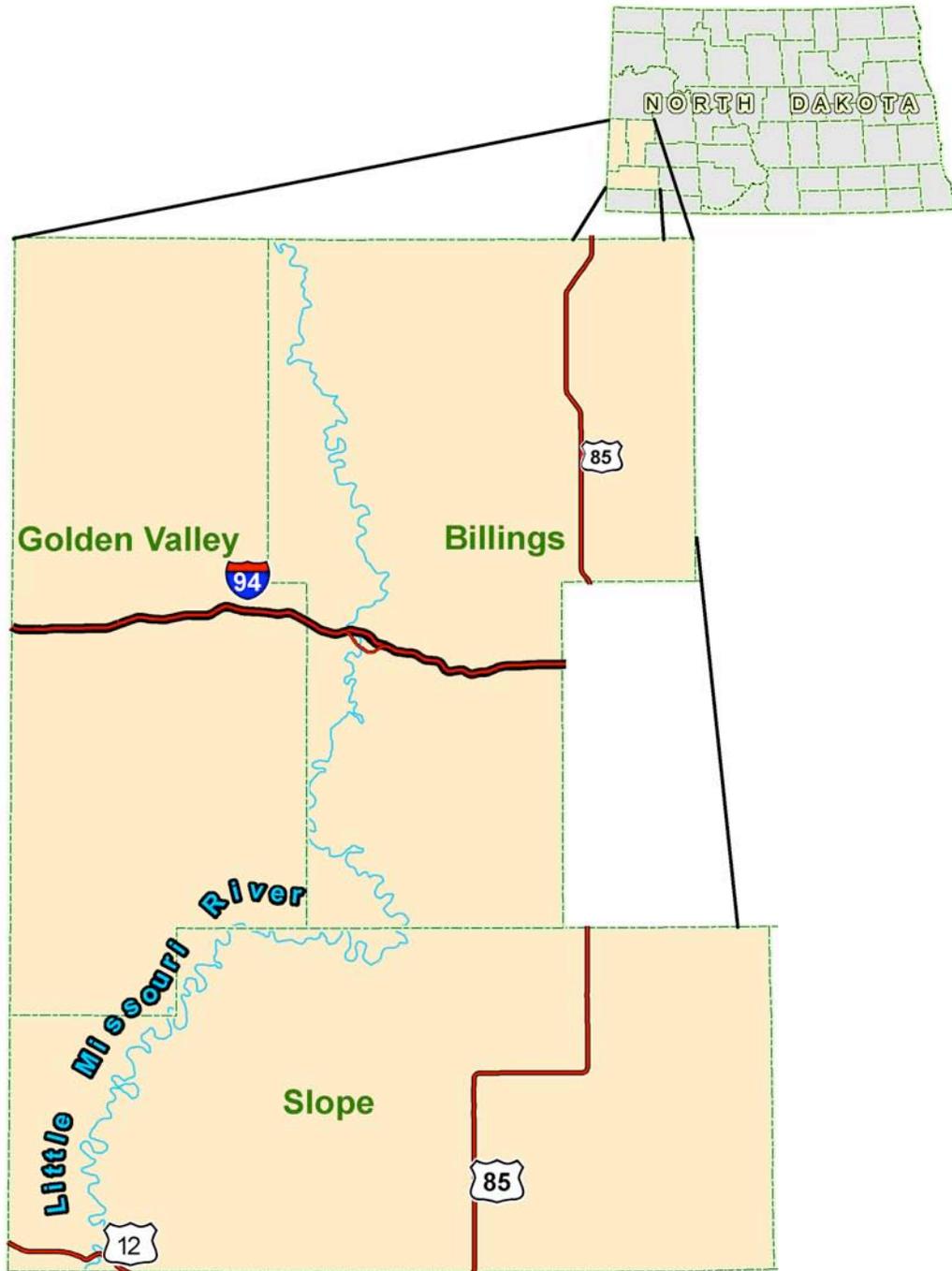
**Introduction:**

Under North Dakota Century Code §61-20-06, the State Engineer is responsible for monitoring decline, fluctuations, and permanence of artesian flowing aquifers. Once each decade the State Engineer selects representative wells to monitor the overall pressure head change and water quality of the Fox Hills-Hell Creek aquifer in western North Dakota. The results are published in three reports. One report compiles the pressure head results from wells in McKenzie County, a second report compiles the pressure head results from wells in the Knife River Basin in Oliver, Mercer, and Dunn Counties and a third report which is covered in this document compiles the pressure head results from wells in the Little Missouri River Basin in Billings, Golden Valley, and Slope Counties (Figure 1).

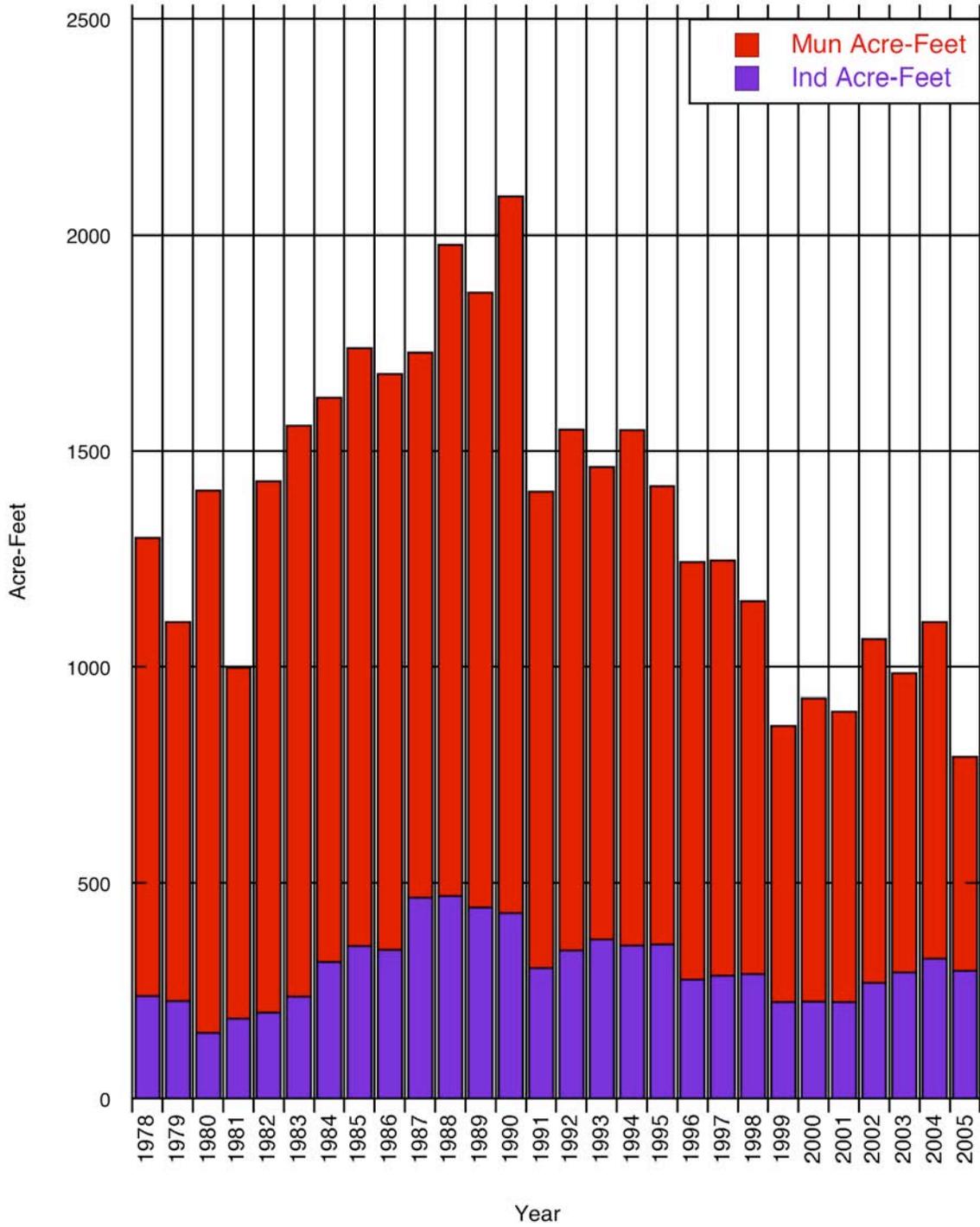
The purpose of the above listed studies is to promote conservation of water supplies and in doing so slow the decline in pressure head in the Fox Hills-Hell Creek aquifer, which is a valuable resource in western North Dakota. Many stockman, domestic users, municipalities and industrial users depend on the Fox Hills-Hell Creek aquifer for their water supply. Municipal water use from the aquifer has steadily declined from the mid 1990s and into the new millennium due to the advent of the Southwest Pipeline which is continually supplying more and more water users with Lake Sakakawea water (Figure 2). Industrial water use from the Fox Hills-Hell Creek aquifer fluctuates throughout the historical record (Figure 2). This fluctuation can be attributed to fluctuation in oil activity in western North Dakota, which uses fresh water for desalinization in oil wells.

The aquifer is referred to as the Fox Hills-Hell Creek aquifer, because it straddles the boundary between the marine Fox Hills Formation and the overlying

**Figure 1 -- Location of study area**



**Figure 2 -- Total reported water use from the Fox Hills aquifer for municipal and industrial purposes in North Dakota**



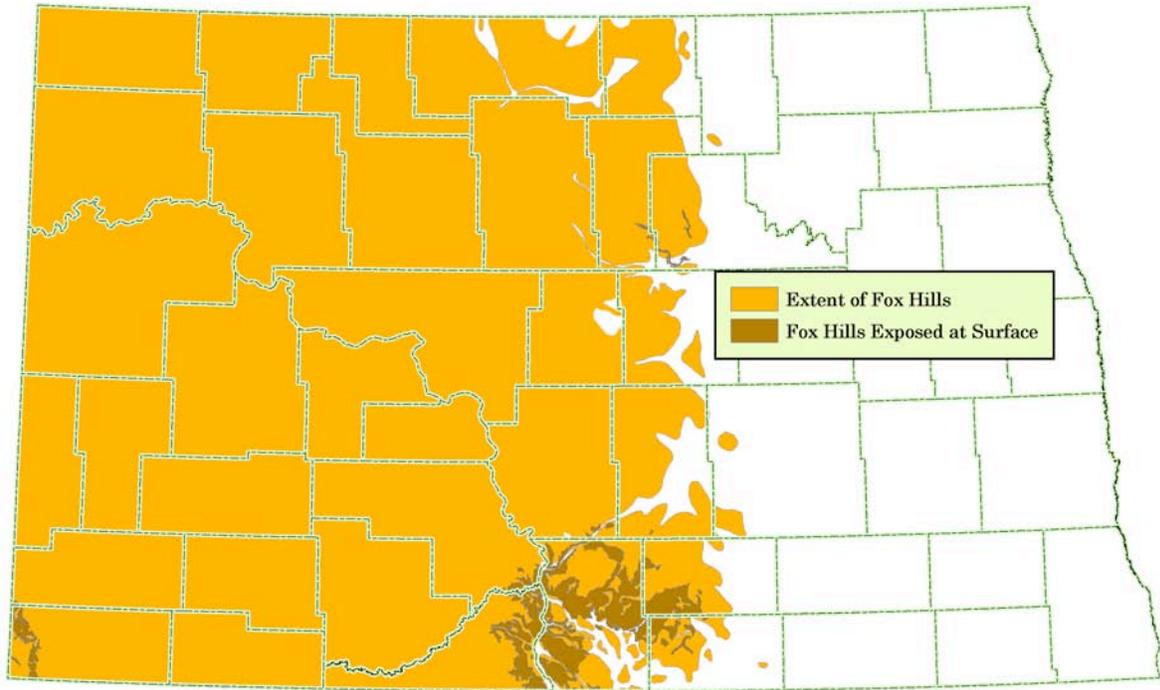
non-marine Hell Creek Formation. It was formed from sand deposits on beaches and river deltas along a sea receding to the east. The offshore deposits, with occasional marine fossils, are included in the Fox Hills Formation, while the back-beach and river flood plain landform deposits are included in the Hell Creek Formation. The somewhat unwieldy long name is often shortened to the Fox Hills aquifer. This report will refer to the Fox Hills-Hell Creek aquifer as the Fox Hills aquifer.

The Fox Hills Formation underlies the western half of North Dakota as illustrated in Figure 3. Recharge to the aquifer likely occurs in areas where the Fox Hills Formation is at or near the surface in southwestern North Dakota, northwestern South Dakota, southeastern Montana, and northeastern Wyoming (Figure 3). Well depths in the Fox Hills aquifer range from just below land surface in southwestern North Dakota to over 2,000 feet below land surface in northeastern Billings County, southeastern McKenzie County, and western Stark County (Figure 4).

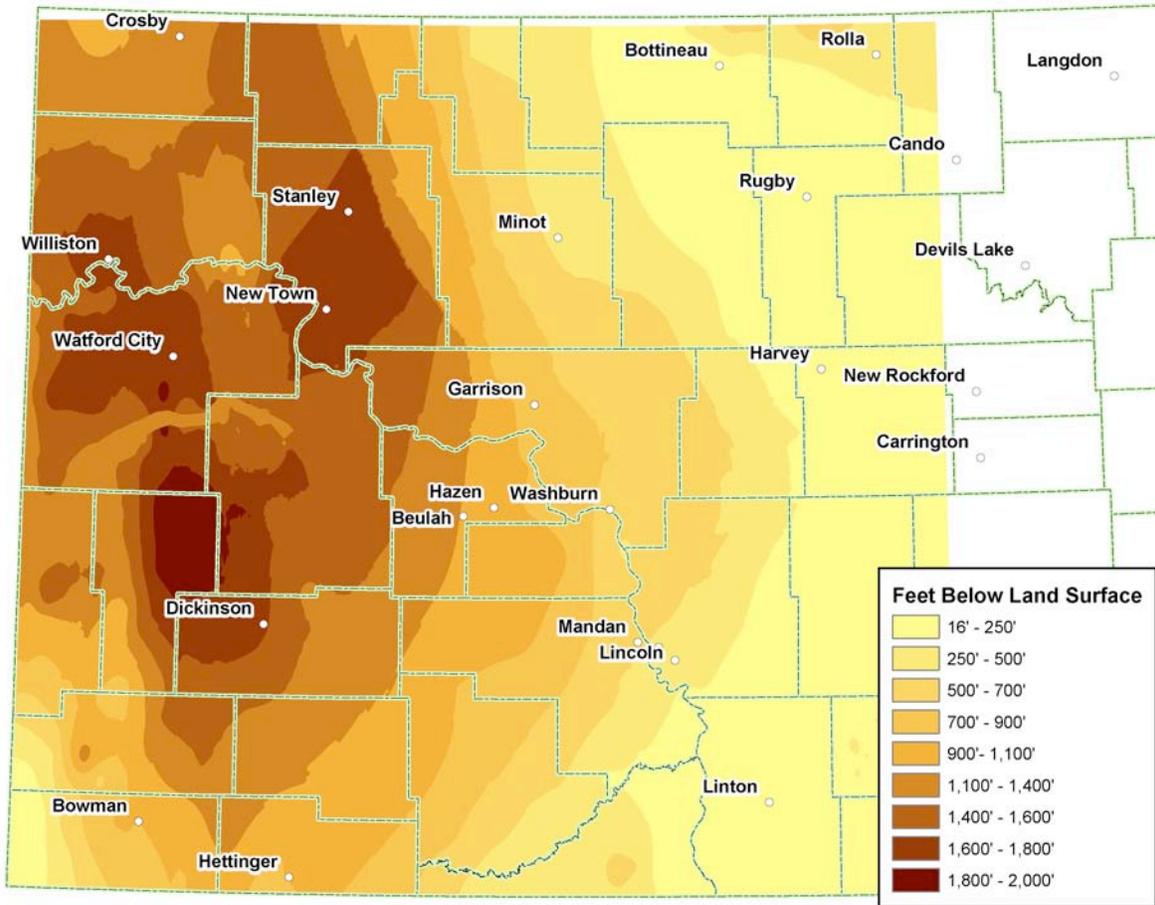
The pressure heads (water levels above the top of the aquifer) in the Fox Hills aquifer decline when the discharge is greater than the recharge. Recharge to the Fox Hills aquifer is very small and is easily exceeded by the discharge, which occurs mainly in the form of withdrawal of water from wells.

In 2006, 19 flowing stock and domestic wells screened in the Fox Hills aquifer were monitored within the Little Missouri Basin in Billings, Golden Valley, and Slope Counties. The locations of these wells are illustrated in Figure 5. Water samples for chemical analysis were collected from all 19 wells, while pressure head measurements were made in 17 of the 19 wells. The pressure head measurements were made to continue monitoring the rate of pressure head decline in the Fox Hills aquifer in an area where flowing wells discharge water from the aquifer. The monitoring took place between April 4, 2006 and May 16, 2006. Many of the wells were also monitored in 1995 and in 1986. Some of the wells were monitored as far back as the 1960s and 1970s.

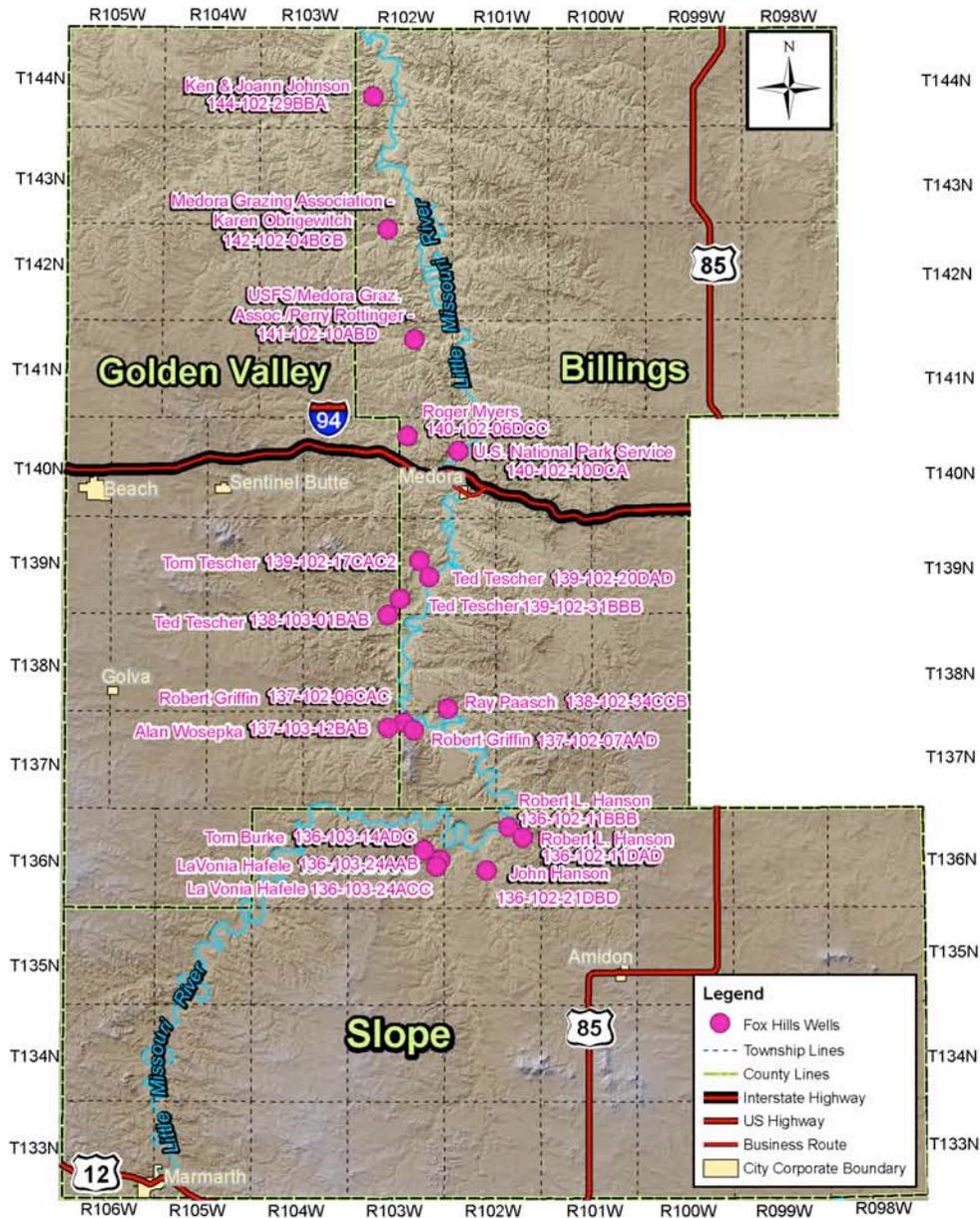
**Figure 3 -- Extent of the Fox Hills Formation in North Dakota**



**Figure 4 -- Average well depth of the Fox Hills aquifer based on screened intervals of 356 Fox Hills wells in North Dakota**



**Figure 5 -- Domestic and livestock wells monitored in 2006 - well owners and well names**



Due to concerns about well casing integrity, some of the wells were not pressurized in 2006. Also, the plumbing made it impossible to pressurize some of the wells. Thus, pressure head measurements were made on 13 of the 17 wells measured in 1995, while water samples for chemical analysis were collected from 15 of the 17 wells. The wells not measured in 2006 were substituted by other flowing wells in the same general area allowing for good coverage in the three counties.

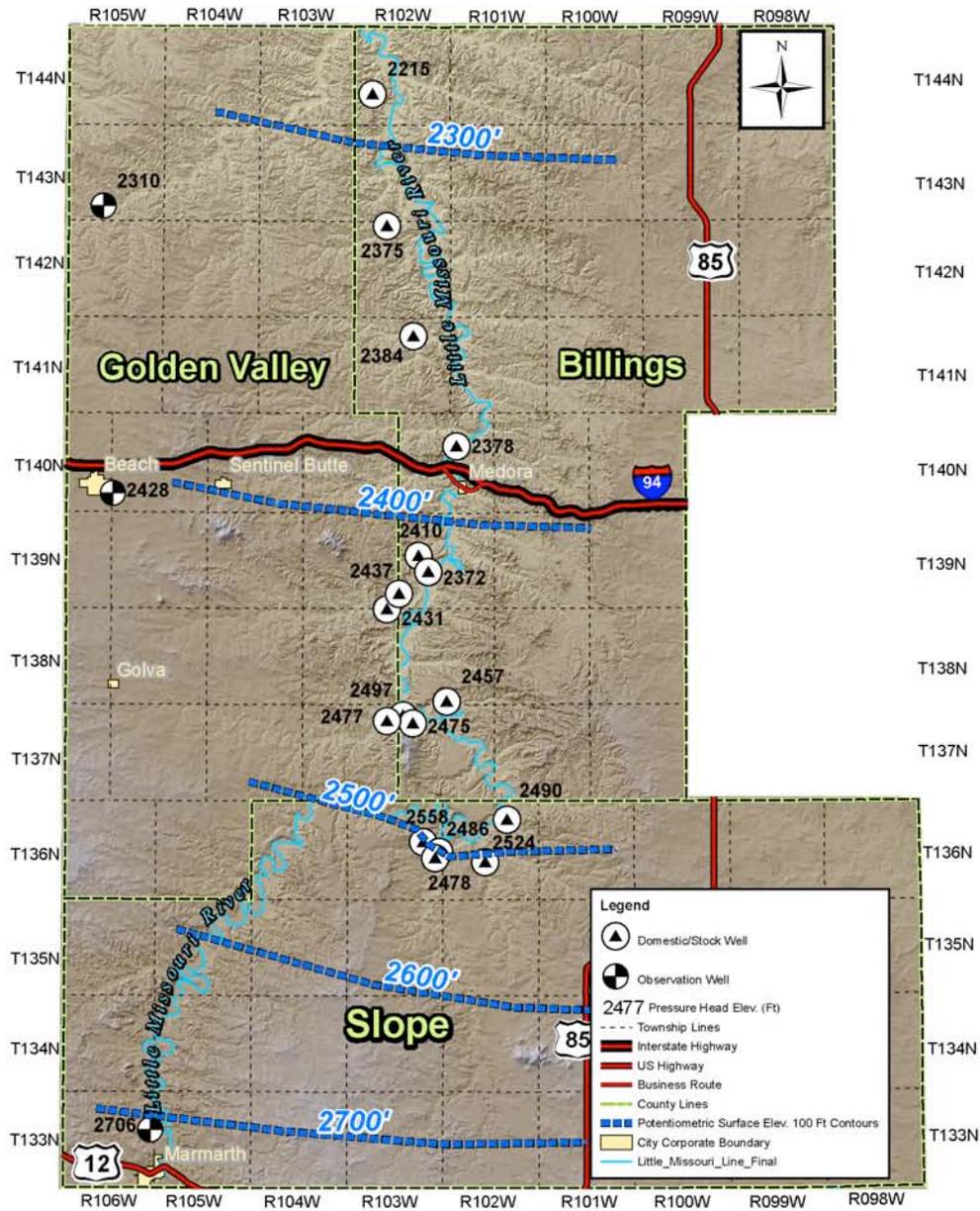
All the flowing wells are located in low-lying areas along the Little Missouri River and its tributaries where the land surface elevation is lower than the pressure head of the aquifer. Pressure head in 3 observation wells within the study area are measured periodically and have also been included within this report. The location of the observation wells is shown in Figure 6.

### **Well information:**

For each well visited the following information was compiled and included in the appendix of this report:

- Date the well was completed
- Land surface elevation
- Depth drilled
- Screened interval
- Purpose of well
- Casing diameter and material
- Source of information
- Well owner
- Owner's address
- Well location (a detailed description to aid in finding the well)
- Any available well completion information
- Description of the above ground portion of the well
- 2006 well discharge, or flow rate
- Description of pressure head recovery following well shut in
- Remarks

**Figure 6 -- 2006 potentiometric surface map of the Fox Hills aquifer**



- Lithologic log of the well, where available
- Table showing the long term pressure head measurements
- Table of 2006 shut in time vs. pressure head readings
- Well hydrographs
- Photographs of the well in 2006
- Water quality analyses

The following is a list of working papers and materials compiled during this study and previous studies, but are not included within the report:

- Highway map
- Atlas map
- Topographic map
- Photographs (1986 and 1995)
- County study well information
- Well driller's report
- Graph of shut in time vs. pressure head recovery (1986 and 1995)
- Previous hydrographs, for brochure, etc.
- Well-run sheet
- 1995 and 2006 field notes
- 1995 and 2006 water quality analysis
- Brochure titled: *Flowing Well Pressure Changes in the Little Missouri River Area* (1987 - Updated in 1995 & 2007)

### **Aquifer pressure head:**

The elevation of the pressure head of the Fox Hills aquifer, as measured in the 17 flowing wells and 3 observation wells monitored in 2006, is shown in Figure 6. The water level in the observation wells is below land surface. The potentiometric surface slopes to the north from an elevation of 2,558 feet in northern Slope County to an elevation of 2,215 feet in northern Billings County, for

a hydraulic gradient of 7.3 feet per mile. The measured pressure heads in the flowing wells ranged from 4 feet to 120 feet above land surface (Figure 7).

**Pressure head decline rate:**

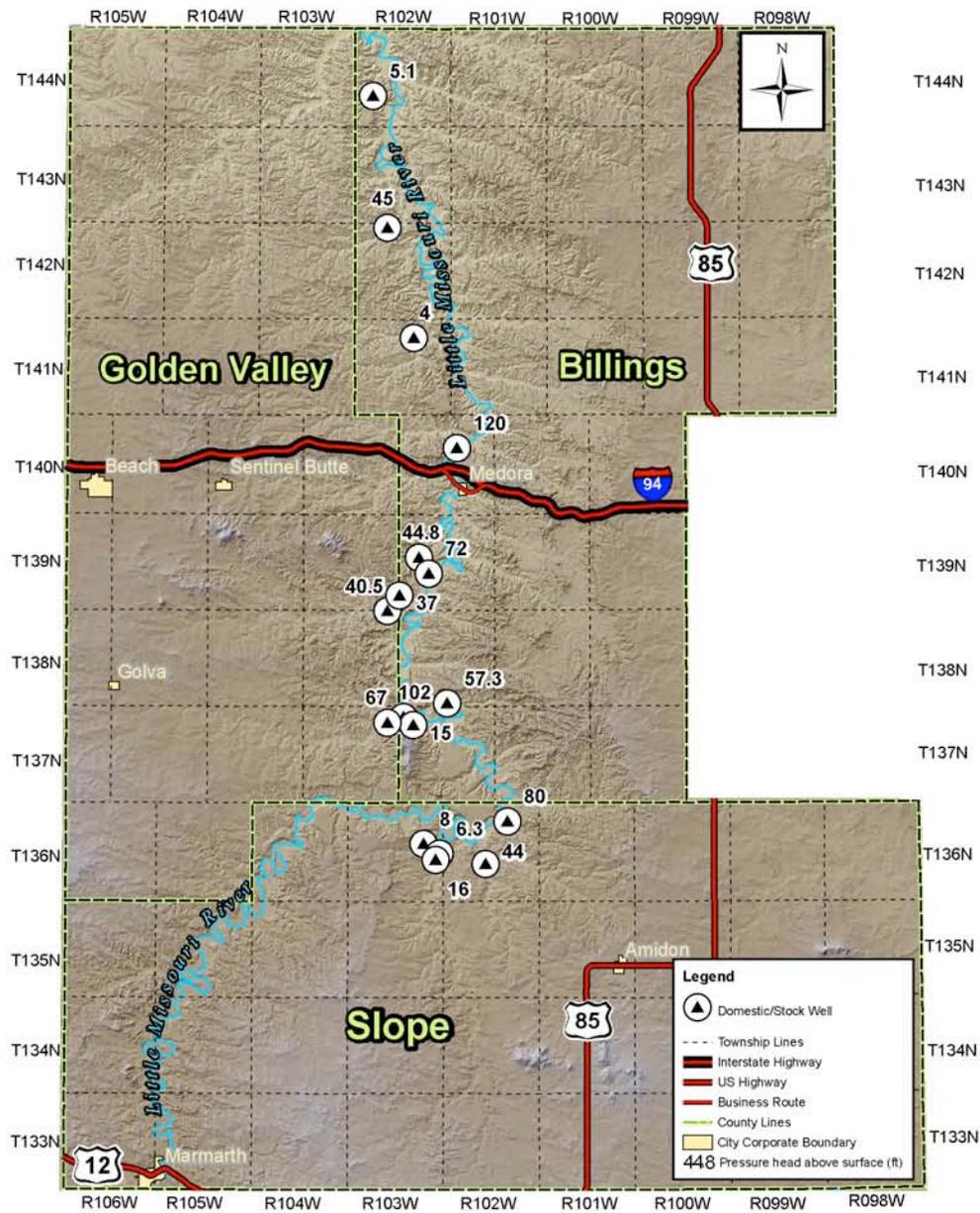
During the 1995 to 2006 period, the rate of change in pressure head in 13 flowing wells and 3 observation wells ranged from -4.1 to 0.8 feet per year with an average decline rate of 1.2 feet per year (Table 1). The previous decade (1986 to 1995) had an average decline rate of 0.4 feet per year. The average decline rate measured prior to 1986 in Billings, Golden Valley and Slope Counties was 1.2 feet per year. Figure 8 shows the current rate of decline for 1995 to 2006 period and the previous rate of decline for the 1986 to 1995 period.

Two wells had a pressure head increase from 1995 to 2006. The first is stock well, 136-102-11BBB, which showed a recovery of 0.8 feet per year. The previous decade showed a recovery of 2.9 feet per year. The second well is observation well,

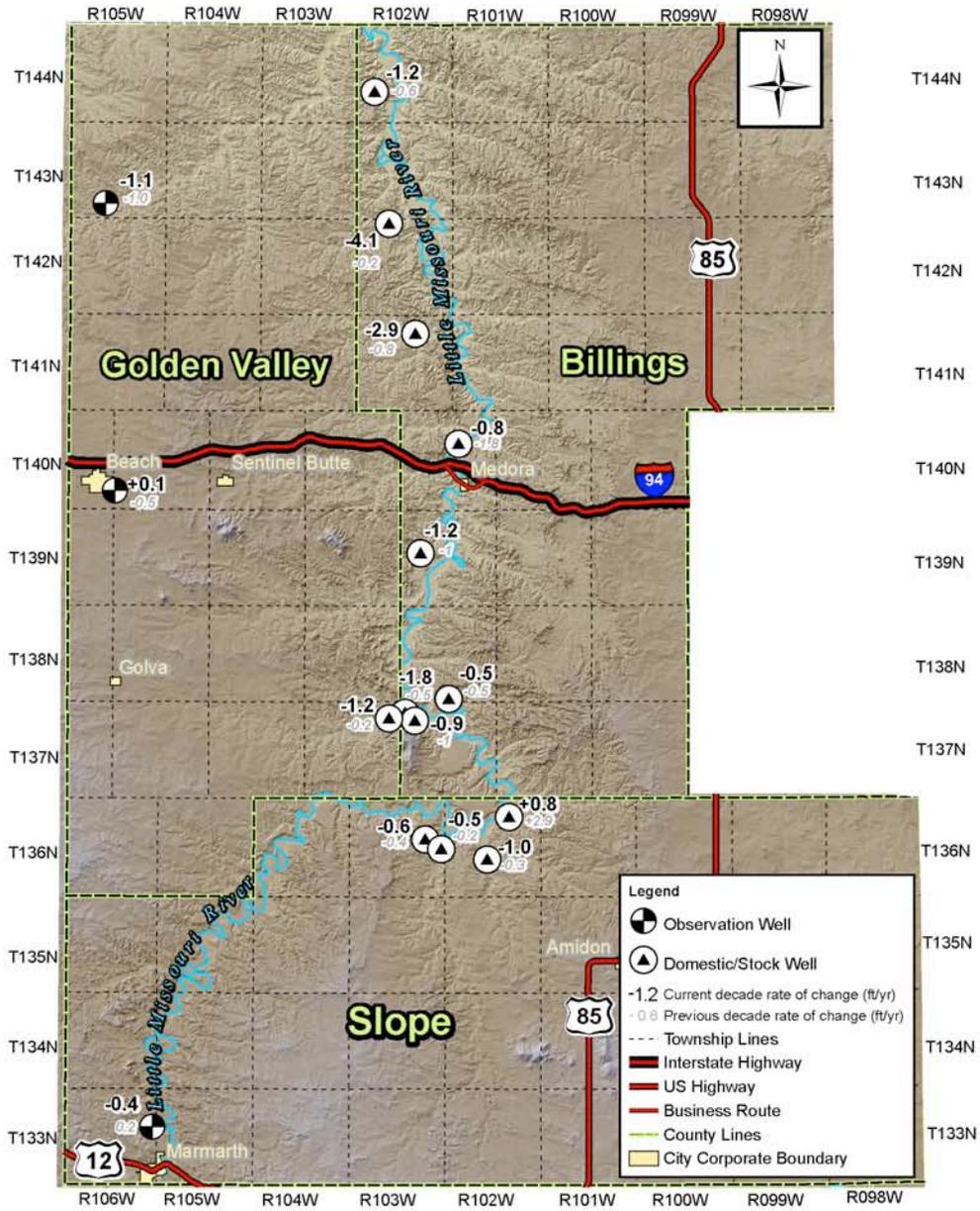
**Table 1 -- Pressure head rate of change based on the 1995 and 2006 measurements**

<b>Well Location</b>	<b>Aquifer</b>	<b>Purpose</b>	<b>Pressure head rate of change (ft/yr)</b>	<b>Flow rate (gpm)</b>
<b>133-106-13ADB2</b>	<b>Fox Hills</b>	<b>Observation Well</b>	<b>-0.4</b>	<b>NA</b>
<b>136-102-11BBB</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>+0.8</b>	<b>NA</b>
<b>136-102-21DBD</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-1</b>	<b>NA</b>
<b>136-103-14ADC</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-0.6</b>	<b>4</b>
<b>136-103-24AAB</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-0.5</b>	<b>0.75</b>
<b>137-102-6CAC</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-1.8</b>	<b>10</b>
<b>137-102-7AAD</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-0.9</b>	<b>NA</b>
<b>137-103-12BAB</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-1.2</b>	<b>NA</b>
<b>138-102-34CCB</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-0.5</b>	<b>10</b>
<b>139-102-17CAC2</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-1.2</b>	<b>10</b>
<b>140-102-10DCA</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-0.8</b>	<b>NA</b>
<b>140-105-30CCC6</b>	<b>Fox Hills</b>	<b>Observation Well</b>	<b>+0.1</b>	<b>NA</b>
<b>141-102-10ABD</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-2.9</b>	<b>NA</b>
<b>142-102-4BCB</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-4.1</b>	<b>4</b>
<b>143-105-33BAB</b>	<b>Fox Hills</b>	<b>Observation Well</b>	<b>-1.1</b>	<b>NA</b>
<b>144-102-29BBA</b>	<b>Fox Hills</b>	<b>Domestic/Stock Well</b>	<b>-1.2</b>	<b>1</b>

**Figure 7 -- Pressure head of the Fox Hills aquifer in feet above the land surface**



**Figure 8 -- Rate of pressure head change in the Fox Hills aquifer**



140-105-30CCC6, which showed a recovery of 0.1 feet per year from 1995 to 2006. However, the previous decade showed a decline of 0.5 feet per year. It is uncertain what is causing the recovery in the two wells. The recovery is likely a function of the well itself rather than what is occurring in the aquifer. The remaining wells had pressure head declines over the last decade. Based on the current pressure head decline rates (Figure 8) and the current pressure head above land surface (Figure 7), estimates of when each well monitored will stop flowing are shown in Figure 9.

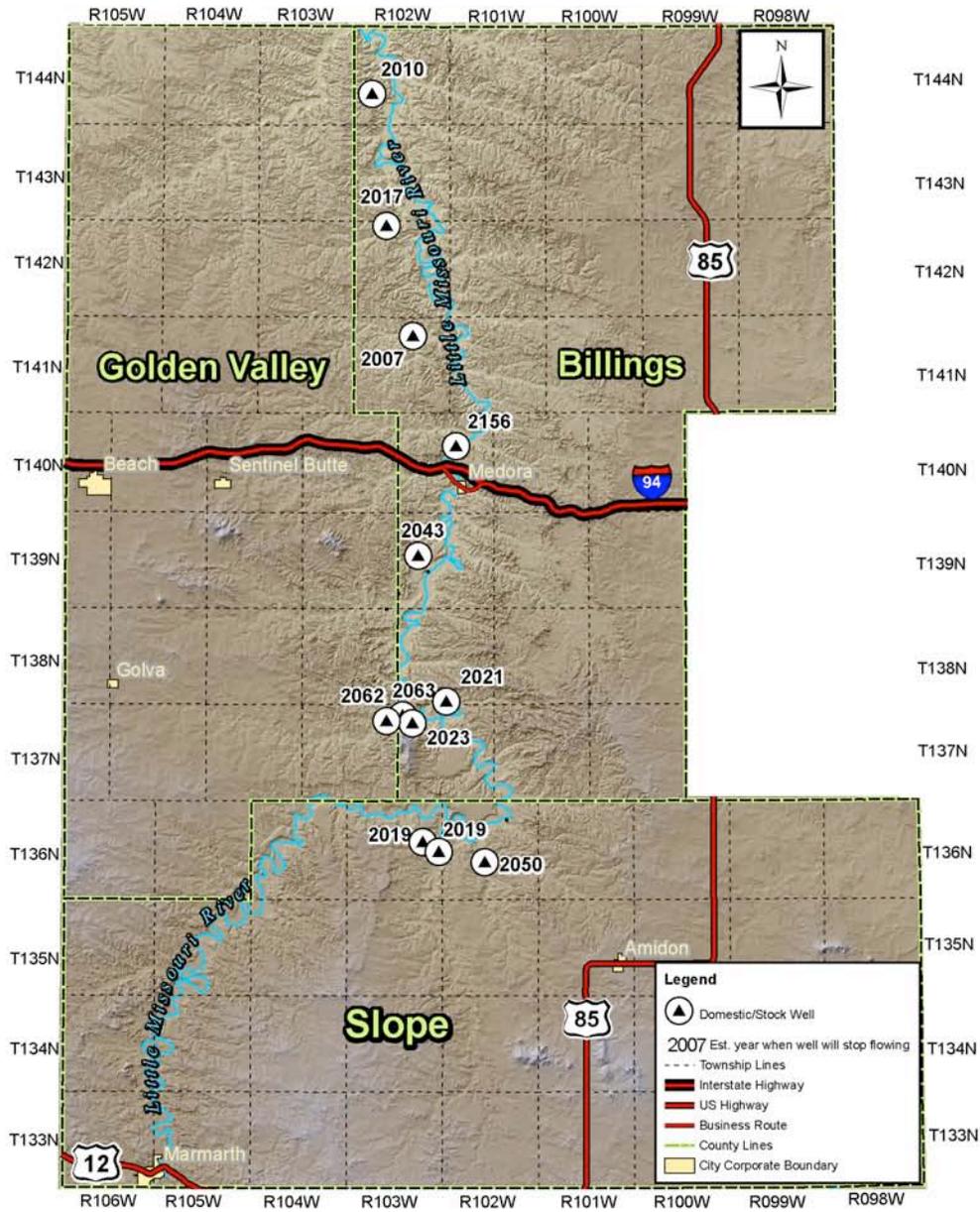
### **Flow rate:**

Prior to the pressure head measurement, an unrestricted flow rate measurement was taken before the wells were shut in. The flow rates from the wells in 2006 are listed in Table 1. The flow rates ranged from 0.75 to 10 gallons per minute. After the flow rate was measured the well was shut in, so the head could be measured with a pressure gage. Ultimately, the pressure head recovery was to be measured for 120 minutes after shut in, but in many cases the pressure head stabilized much earlier than this. Also, if the well serves a house, no water can be used while measurements were being made in which case, recovery was measured for a shorter period of time. The feet of pressure head recovery between the first and last pressure measurement are listed in Table 2. The lack of pressure head recovery in most wells when they are shut in suggests water may be leaking through a corroded well casing.

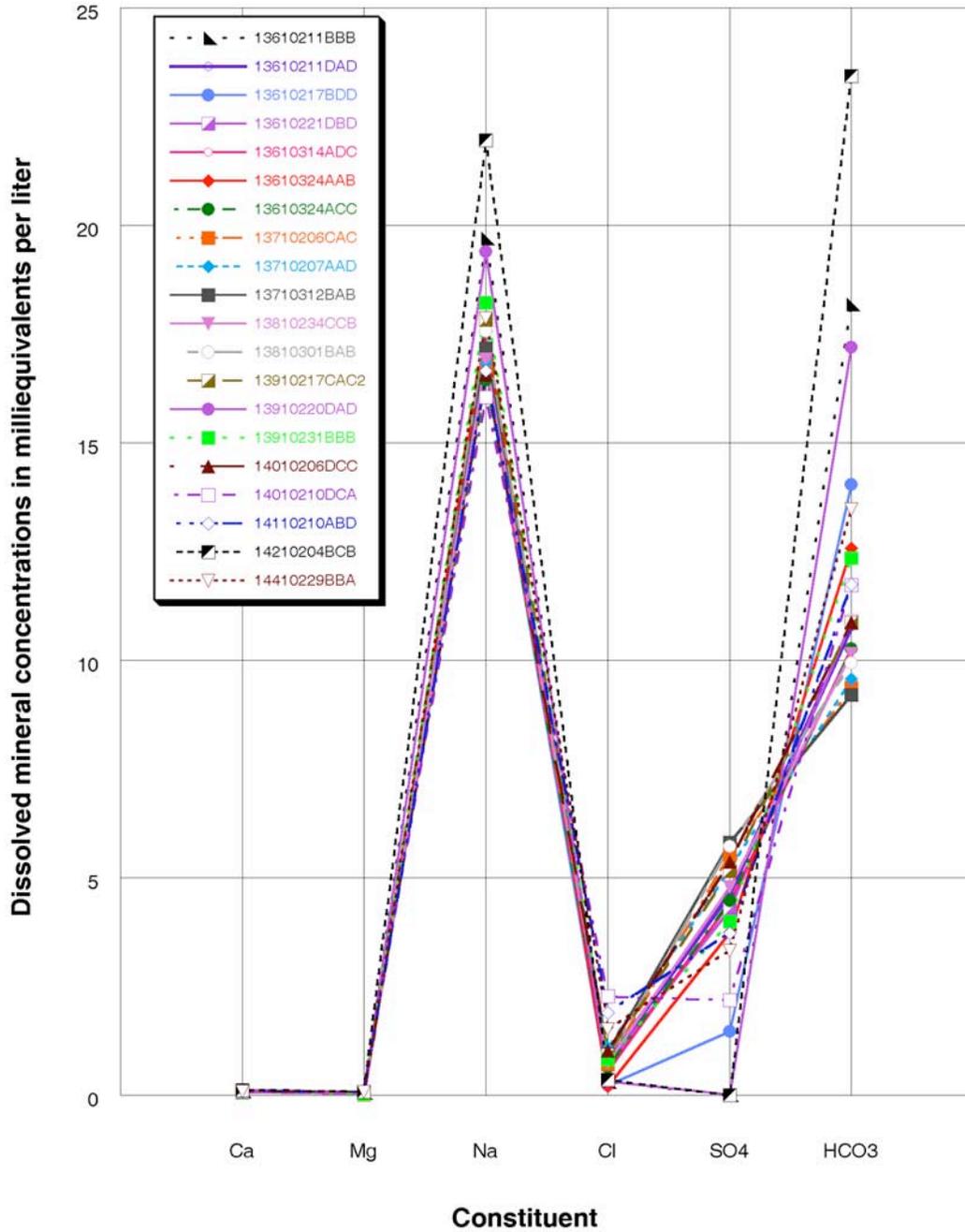
### **Water Quality:**

Water samples were collected for chemical analysis from each of the 19 flowing head wells and 2 observation wells visited in 2006. Concentrations of the major dissolved minerals are shown in Table 3. Chemical analyses indicate the water is predominantly a sodium-bicarbonate type that generally has less dissolved constituents than water in the overlying formations (Figure 10).

**Figure 9 -- The estimated year when flowing wells will cease to flow**



**Figure 10 -- Major dissolved constituents in samples collected from the Fox Hills aquifer in 2006**



**Table 2 -- Pressure head recovery between the first and last measurements after the well was shut-in**

<b>Well</b>	<b>Recovery (feet)</b>	<b>Shut-in Time (minutes)</b>
<b>136-102-11BBB</b>	10	120
<b>136-102-21DBD</b>	-1.25	50
<b>136-103-14ADC</b>	1	60
<b>136-103-24AAB</b>	0.25	60
<b>136-103-24ACC</b>	8.5	120
<b>137-102-6CAC</b>	0	60
<b>137-102-7AAD</b>	0.25	60
<b>137-103-12BAB</b>	0	60
<b>138-102-34CCB</b>	0.25	60
<b>138-103-01BAB</b>	0.75	60
<b>139-102-17CAC2</b>	0	60
<b>39-102-20DAD</b>	17	120
<b>139-102-31BBB</b>	1	60
<b>140-102-10DCA</b>	2	60
<b>141-102-10ABD</b>	1	60
<b>142-102-4BCB</b>	25	60
<b>144-102-29BBA</b>	4.1	60

Table 3 also lists the maximum contaminant level (MCL) and the secondary maximum contaminant level (SMCL) defined by the United States Environmental Protection Agency (EPA). MCLs are primary standards that are legally enforceable standards that apply to public water systems. Primary standards protect public health by limiting the levels of contaminants in drinking water. SMCLs are non-enforceable recommended standards and are not considered a health hazard. Two water samples collected during this study exceed the Maximum Contaminant Level, while 15 samples exceed the Secondary Maximum Contaminant Level (SMCL) for fluoride (Table 3). According to the EPA, elevated levels of fluoride can cause bone disease (pain and tenderness of the bones); children may get mottled teeth. All the samples collected during this study exceed the SMCL for total dissolved solids and bicarbonate.

The concentrations of TDS decreased in 2006 when compared to the previous samples collected in 1995. However, the results of water quality samples are very

**Table 3 -- Concentrations of selected ions and total dissolved solids in sampled wells**

<b>Location</b>	<b>Date Sampled</b>	<b>Sodium (mg/L)</b>	<b>Fluoride (mg/L)</b>	<b>Bicarbonate (mg/L)</b>	<b>Chloride (mg/L)</b>	<b>TDS (mg/L)</b>
<b>133-106-13ADB2</b>	5/15/06	518	0.160	625	6.11	1510
<b>136-102-11BBB</b>	4/04/06	453	3.95	1110	17	1070
<b>136-102-11DAD</b>	4/10/06	398	2.09	657	27.9	1040
<b>136-102-21DBD</b>	4/10/06	393	2.44	665	25.3	1020
<b>136-103-14ADC</b>	4/12/06	384	2.44	627	19.7	1000
<b>136-103-24AAB</b>	4/12/06	404	5.13	768	7.38	1030
<b>136-103-24ACC</b>	4/10/06	378	2.25	627	23.1	986
<b>137-102-6CAC</b>	4/11/06	385	1.8	572	25.8	1030
<b>137-102-7AAD</b>	4/11/06	387	1.96	584	38.6	1030
<b>137-103-12BAB</b>	4/11/06	395	1.65	562	34	1050
<b>138-102-34CCB</b>	4/12/06	389	2.21	620	27.0	1010
<b>138-103-01BAB</b>	4/11/06	404	2.36	607	29.5	1070
<b>139-102-17CAC2</b>	4/11/06	410	2.52	663	32.8	1080
<b>139-102-20DAD</b>	4/11/06	446	3.66	1050	11.5	1080
<b>139-102-31BBB</b>	4/11/06	419	3.23	754	29.5	1080
<b>140-102-06DCC</b>	5/16/06	381	2.91	664	36.4	1100
<b>140-102-10DCA</b>	5/16/06	369	3.36	716	42	1050
<b>141-102-10ABD</b>	5/16/06	383	3.57	717	67.5	1100
<b>142-102-4BCB</b>	5/16/06	505	2.69	1430	12.8	1340
<b>143-105-33BAB</b>	10/13/06	468	3.41	783	39.2	1130
<b>144-102-29BBA</b>	5/16/06	411	4.08	822	53.9	1130
MCL	N/A	N/A	4.0	NA	N/A	N/A
SMCL	N/A	N/A	2.0	250	250	500

similar to the previous decade. There is an average of 3% decrease in TDS in samples collected in 2006 versus 1995.

Temporal variations in water quality may be attributed to the amount of water pumped prior to sample collection, differences in sampling protocol between sampling events, and casing failure in wells. However, there is no relationship between the amount of water withdrawn from the Fox Hills aquifer and its water chemistry.

Most of the wells were flowing prior to the field visit, which allowed for the collection of representative samples from the aquifer. The length of time the wells had been flowing prior to sampling is unknown. However, a few wells had been shut in for an extended period of time prior to the field visit, so collecting a fresh water sample from the aquifer in a timely manner was not possible. Depending on the flow rate of the well and the depth of the well, it could take anywhere from a few hours to several days to evacuate enough water to remove a full casing volume. A full casing volume of water was not evacuated prior to sampling observation wells, which have a pressure head below the land surface. Variations in pumping time prior to sampling could cause variations in the water quality, because representative samples may not always be obtained.

Failed well casings could also cause temporal variations in water quality. This would allow poorer quality water from overlying formations, to mix with the Fox Hills aquifer water. In this situation, the analysis will indicate the water quality of the Fox Hills aquifer is deteriorating when in fact the well is deriving some of its water from other formations.

In general, the concentration of total dissolved solids increases to the north within the study area, away from the recharge area. The full suite of water quality information is included in the Appendix under each individual well.

### **Summary:**

The pressure heads (water levels above the top of the aquifer) in the Fox Hills aquifer decline when the discharge is greater than the recharge. Recharge to the Fox Hills aquifer is very small and is easily exceeded by the discharge, which occurs mainly in the form of withdrawal from wells.

The pressure head in Fox Hills wells in the Little Missouri River basin continues to decline at an average rate of 1.2 feet per year. From 1986 to 1995 there was an average decline rate of 0.4 feet per year. Prior to 1986, the average pressure head rate of decline was 1.2 feet per year. The potentiometric surface

slopes to the north, which follows the general surface landscape. The hydraulic gradient is approximately of 7.3 feet per mile.

The water quality from samples collected in 2006 reflects slightly better water quality than the samples collected in 1995. There is an average of 3% decrease in total dissolved solids (TDS) in samples collected in 2006 versus 1995. There is no relationship between the amount of water withdrawn from the Fox Hills aquifer and its water chemistry. Temporal variations in water quality may be attributed to the amount of water pumped prior to sample collection, differences in sampling protocol between sampling events, and casing failure in wells. Two water samples collected during this study exceed the Maximum Contaminant Level while 15 samples exceed the Secondary Maximum Contaminant Level (SMCL) for fluoride. According to the EPA, elevated levels of fluoride can cause bone disease (pain and tenderness of the bones); children may get mottled teeth. Total dissolved solids and bicarbonate exceeded the SMCL established by the EPA. SMCLs are not considered a health hazard.

## **Appendix -- Well Information**

**136-102-11BBB**

*Date Completed:* NA *Purpose:* Stock Well  
*L.S. Elevation (ft):* 2410' *Well Type:* 1.25 Steel  
*Depth Drilled (ft):* 1060' *Aquifer:* Fox Hills-Hell Creek  
*Screened Interval (ft):* NA *Source:* Bill, G.V., Slo. Co. Study

*Owner:* Robert L. Hanson  
*Address:* 15104 57th Street SW, Bowman, ND 58623  
*Telephone #:* 701-279-5702 (Rhame exchange) or son, John: 279-5501  
*Farmstead location:* Logging camp ranch 9 west & 8 north of Amidon Hwy 85 corner  
*Well Location:* Trail along L. Mo. R. about 6 miles NE of Logging Camp Ranch  
*Directions to well:* 0.4 mi. NW from Burning Coal Vein turnoff, take trail N & W around scoria capped butte/hill, past corral about 500 ft NE  
*Wellhead description: (casing & plumbing)* 1.25 inch casing extends 2.8 feet above ground, elbow & horizontal foot to plastic pipe to small stock tank

*Water Sample* Conductivity: 1,640 micromhos/cm, Temperature: 12.6° C.  
 Collected 12:21 PM 4 April 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25	30	35	40
Pressure head (feet)	70	72	73	73	73	73	74	75	75	76	76	76	76	76

Shut in time (minutes)	50	60	70	80	100	120
Pressure head (feet)	77	77	77	78	80	80

**Long term pressure head measurements  
(in feet above land surface)**

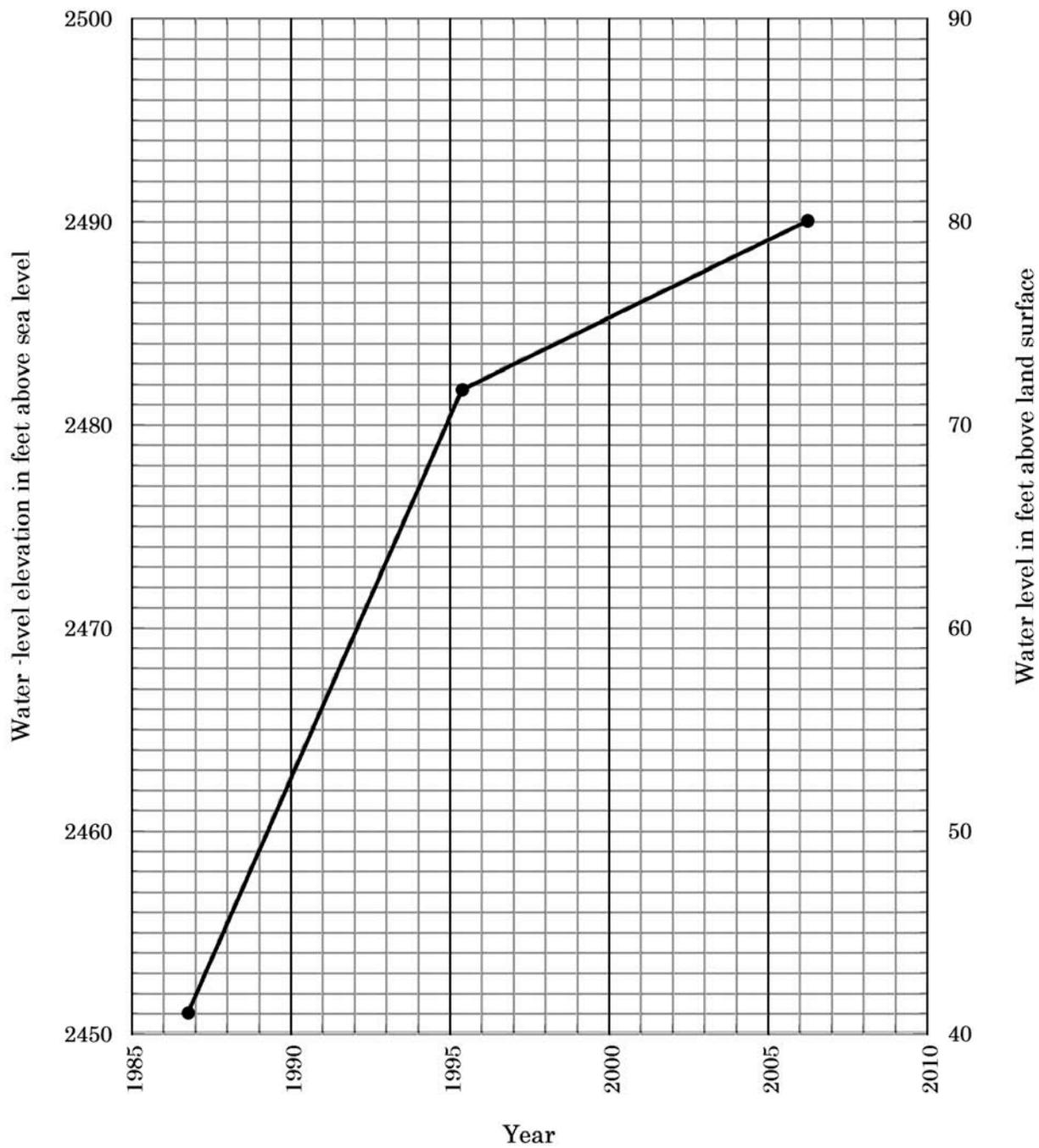
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
19 Oct. 1986	2.5 gpm	2 hours	+41.0 ft.		Allen Comeskey
1 June 1995	0.7 gpm	2 hours	+71.7 ft.	+3.6 ft/yr	Alan Wanek
10 April 2006	NA	2 hours	+80.0 ft.	+0.8 ft/yr	Merlyn Skaley

**136-102-11BBB**

Lithologic Log

No lithologic log available

Water-level fluctuations in Hanson well 136-102-11BBB



## **Water quality**

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Well location	136-102-11BBB
Owner	Robert L. Hanson
Date sampled	4 April 2006
Water temperature	12.6 degrees Celsius
Lab conductivity	1730 micromhos/cm
pH	8.38
Calcium	2 milligrams per liter
Magnesium	0.7 milligrams per liter
Potassium	2.33 milligrams per liter
Sodium	453 milligrams per liter
Iron	0.17 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	3.95 milligrams per liter
Bicarbonate	1110 milligrams per liter
Carbonate	17.0 milligrams per liter
Sulfate	<0.3 milligrams per liter
Chloride	11.0 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1070 milligrams per liter
Hardness	8 milligrams per liter
Sodium adsorption ratio	70.2
Residual sodium carbonate	19 Equivalent/liter
Percent sodium	99.2

Robert Hanson well at 136-102-11BBB



View looking south



View looking southeast

**136-102-11DAD**

<i>Date Completed:</i>	1969	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2460'	<i>Well Type:</i>	1.25" Steel
<i>Depth Drilled (ft):</i>	1120'	<i>Aquifer:</i>	Fox Hills-Hell Creek
<i>Screened Interval (ft):</i>		<i>Source:</i>	Bill, G.V., Slo. Co. Study

---

*Owner:* Robert Hanson

*Address:* 15104 57th Street SW, Bowman, ND 58623

*Telephone #:* 701-279-5702 (Rhome exchange) or son, John: 279-5501

*Farmstead location:* From Amidon corner, 9 west & 8 north (Logging Camp Ranch)

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*Well Location:* 1 mile SE of 11BBB well, burning coal area

*Directions to well:* Burning Coal Vein road off East River Road .7 mi., 500 ft. past draw to south, slight trail off road to north to creek, well far side of valley, across creek, along fence line

*Wellhead description: (casing & plumbing)* 1.25 inch casing extending 3 feet out of ground, elbow to horizontal pipe to stock tank, rusted out

*Water Sample* Conductivity: 1,688 micromhos/cm, Temperature: 18.6° C.  
Collected 11:19 AM, 10 April 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25	30	35	40
Pressure head (feet)	NA													

Shut in time (minutes)	50	60	70	80	100	120
Pressure head (feet)	NA	NA	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

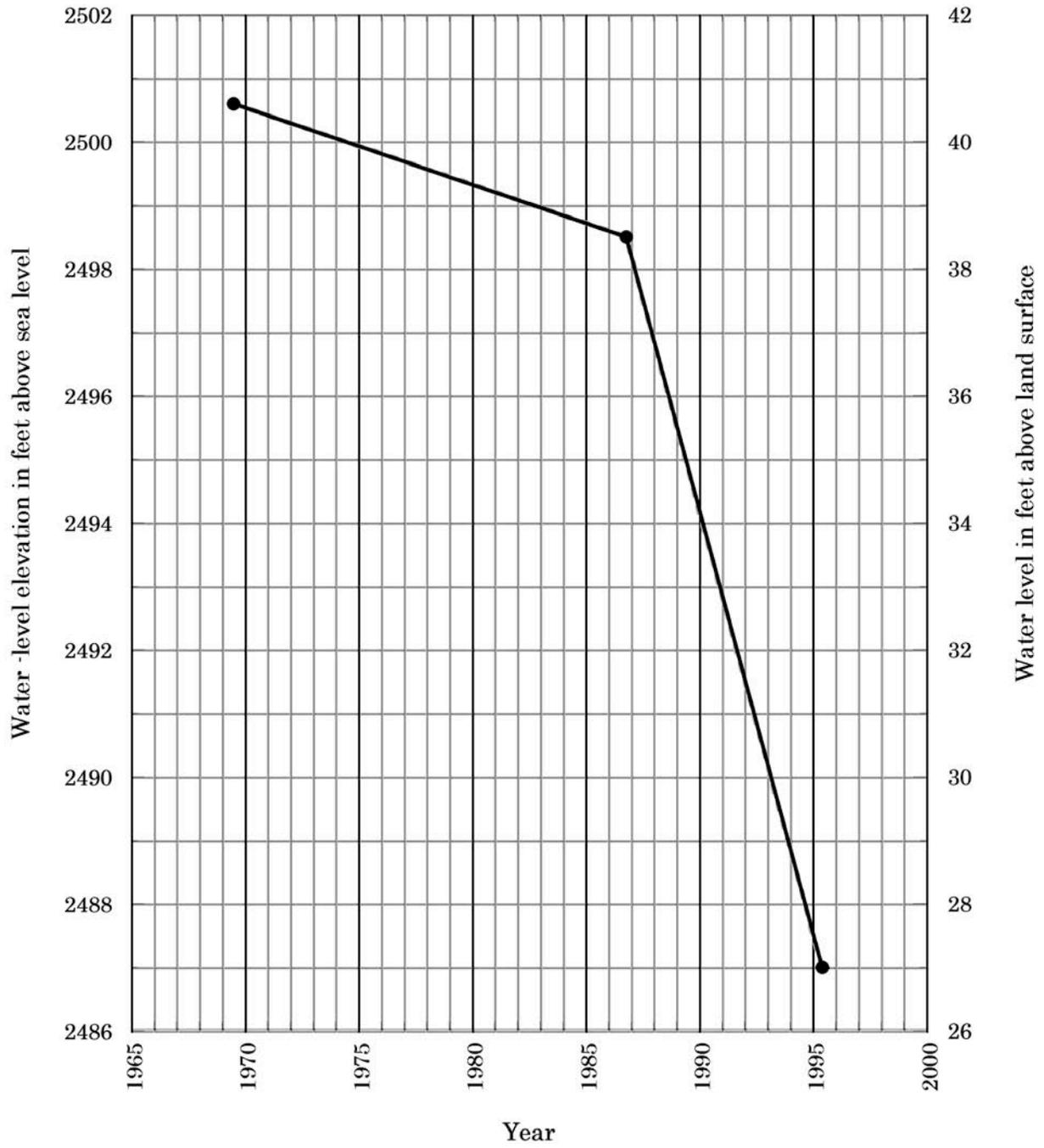
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
2 July 1969			+40.6 ft.		Lawrence Anna
20 Oct. 1986	5.3 gpm	100 min.	+38.5 ft.	-0.1 ft/yr	Allen Comeskey
1 June 1995	4.8 gpm	100 min.	+27.0 ft.	-1.4 ft/yr	Alan Wanek

**136-102-11DAD**

Lithologic Log

No lithologic log available

### Water-level fluctuations in Hanson well 136-102-11DAD



## **Water quality**

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Well location	136-102-11DAD
Owner	Robert Hanson
Date sampled	10 April 2006
Water temperature	18.6 degrees Celsius
Lab conductivity	1680 micromhos/cm
pH	8.77
Calcium	1.65 milligrams per liter
Magnesium	0.5 milligrams per liter
Potassium	1.57 milligrams per liter
Sodium	398 milligrams per liter
Iron	0.053 milligrams per liter
Manganese	0.5 milligrams per liter
Fluoride	2.09 milligrams per liter
Bicarbonate	657 milligrams per liter
Carbonate	40 milligrams per liter
Sulfate	223 milligrams per liter
Chloride	27.9 milligrams per liter
Nitrate	0.09 milligrams per liter
Total dissolved solids	1040 milligrams per liter
Hardness	6 milligrams per liter
Sodium adsorption ratio	69.6
Residual sodium carbonate	12 Equivalent/liter
Percent sodium	99.3

Robert Hanson at 136-102-11DAD



View looking west



View looking north

**136-102-21DBD**

<i>Date Completed:</i>	1969	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2480'	<i>Well Type:</i>	?" Steel
<i>Depth Drilled (ft):</i>	1100'	<i>Aquifer:</i>	Fox Hills-Hell Creek
<i>Screened Interval (ft):</i>		<i>Source:</i>	Bill,. G.V., Slo. Co. Study

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*Owner:* John & Jennifer Hanson operate the LCR Cabins, nearby

*Address:* 5705 151st Street SW, Bowman, ND 58623

*Telephone #:* 701 279-5501

*Farmstead location:* From curve west of Amidon, 9 miles west & 8 miles north

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*Well Location:* Sand Creek, 1.5 south & 1 east of Logging Camp Ranch

*Directions to well:* Logging Camp Ranch (LCR) Cabins road one mile east, by newly built house go east to old coral/mobile home stock shelter, well in 5 ft X 5 ft X 5 ft pit to the SW of shelter, hydrant 10 ft NE

*Wellhead description: (casing & plumbing)* Well T with black plastic line to faucet and white line to house and cabins, valved

*Water Sample* Conductivity: 1585 micromhos/cm, Temperature: 16.7° C.  
Collected 2:51 PM, 10 April 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25	30	35	40
Pressure head (feet)	45.25	45.25	45	44	44	44	44	44	44	44	44	44	44	44

Shut in time (minutes)	50	60	70	80	100	120
Pressure head (feet)	44	44	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

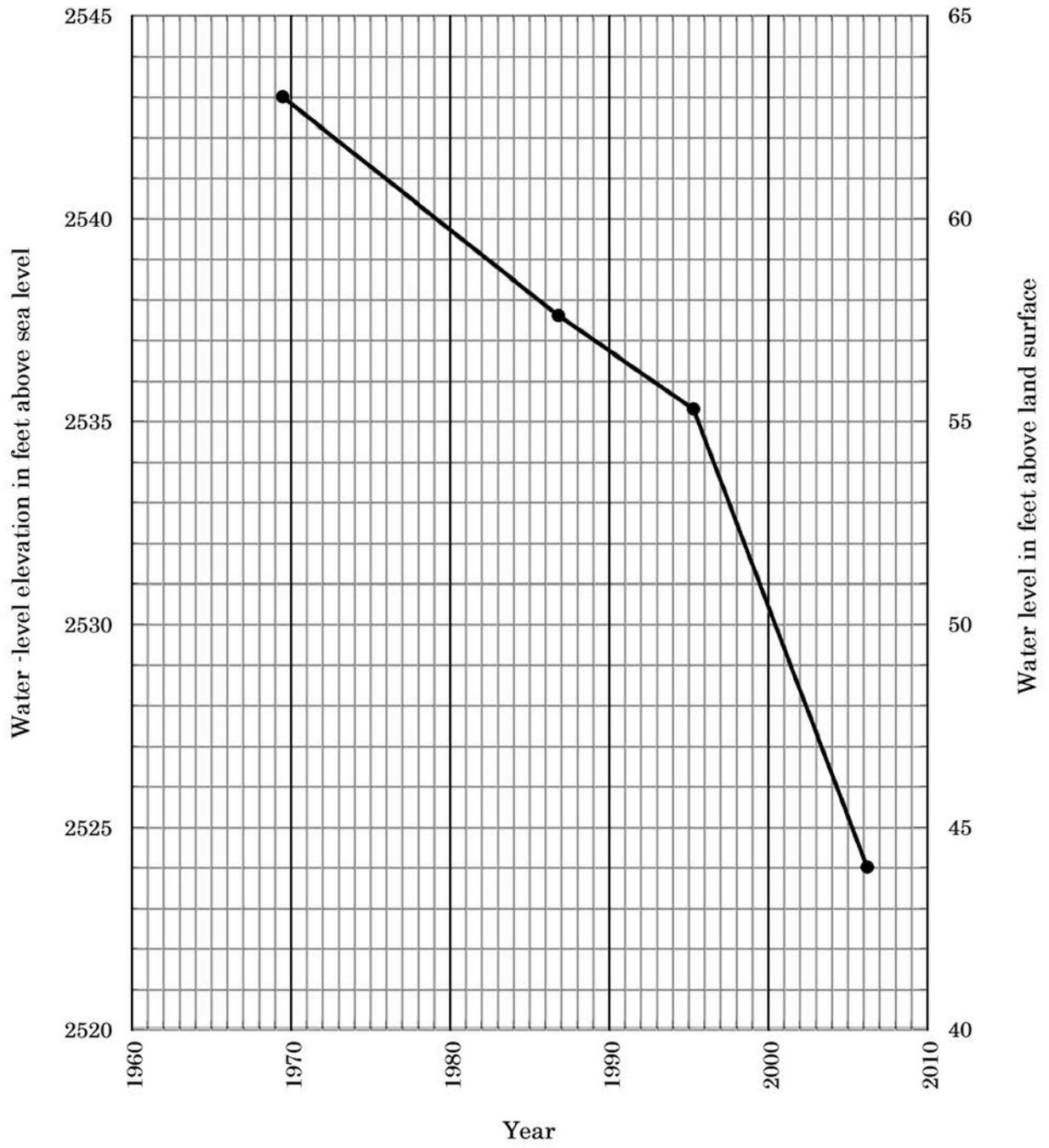
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
3 July 1969			+63.0 ft.		Lawrence Anna
? Nov. 1986		45 min.	+57.6 ft.	-0.3 ft/yr	Allen Comeskey
31 May 1995	shut in	2 hours	+55.3 ft.	-0.3 ft/yr	Alan Wanek
10 April 2006	NA	1 hour	+44.0 ft.	1.0	Merlyn Skaley

**136-102-21DBD**

Lithologic Log

No lithologic log available

Water-level fluctuations in Hanson well 136-102-21DBD



## **Water quality**

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Well location	136-102-21DBD
Owner	John Hanson
Date sampled	10 April 2006
Water temperature	16.7 degrees Celsius
Lab conductivity	1650 micromhos/cm
pH	8.77
Calcium	1.56 milligrams per liter
Magnesium	0.5 milligrams per liter
Potassium	1.5 milligrams per liter
Sodium	393 milligrams per liter
Iron	0.044 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	2.44 milligrams per liter
Bicarbonate	665 milligrams per liter
Carbonate	38 milligrams per liter
Sulfate	205 milligrams per liter
Chloride	25.3 milligrams per liter
Nitrate	0.09 milligrams per liter
Total dissolved solids	1020 milligrams per liter
Hardness	6.0 milligrams per liter
Sodium adsorption ratio	70
Residual sodium carbonate	12
Percent sodium	99.3

Robert Hanson 136-102-21DBD



View looking west



View looking west

**136-103-14ADC**

<i>Date Completed:</i>	1969	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2550'	<i>Well Type:</i>	1.25" Steel
<i>Depth Drilled (ft):</i>	840'	<i>Aquifer:</i>	Fox Hills-Hell Creek
<i>Screened Interval (ft):</i>		<i>Source:</i>	Bill,. G.V., Slo. Co. Study

*Owner:* Tom Burke  
*Address:* 7306 149th Avenue SW, Bowman, ND 58623  
*Telephone #:* 701-523-5738 (Bowman exchange)  
*Farmstead location:* 15 miles away

*Well Location:* 1 mile north & 1 mile west of Hafele ranch (des. was 14ADA)  
*Directions to well:* 1/2 mile west of Hafele ranch, just past sec. line, right (north) on ridge road, into valley, meets e-w road, right (east) 1/2 mi. to trailers/camp, well north of creek, SE corner of trailer, by tank  
*Wellhead description: (casing & plumbing)* 1.25 inch casing extending 2 feet out of ground, garden hose through trailer & back to stock tank  
*Water Sample* Conductivity: 1473 micromhos/cm, Temperature: 14.2<sup>o</sup> C.  
 Collected 1:35 PM, 12 April 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25	30	35	40
Pressure head (feet)	7.0	7.25	7.5	7.5	7.5	7.5	7.5	7.5	7.75	7.75	8	8	8	8

Shut in time (minutes)	50	60	70	80	100	120
Pressure head (feet)	8	8	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

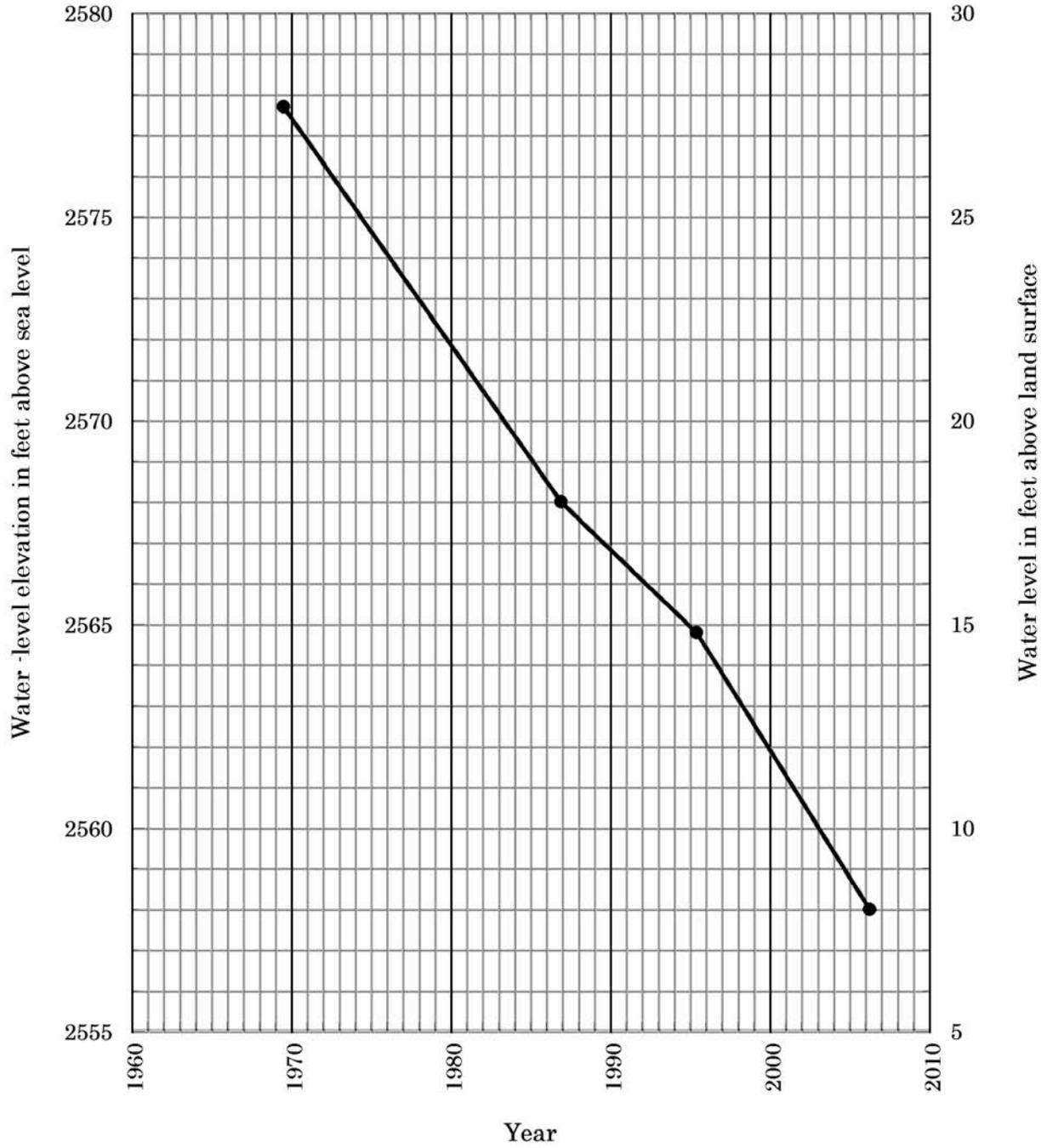
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
3 Jul. 1969			+27.7 ft.		Lawrence Anna
2 Dec. 1986		2 hours	+18.0 ft.	-0.6 ft/yr	Allen Comeskey
25 May 1995	0.57 gpm	2 hours	+14.8 ft.	-0.4 ft/yr	Alan Wanek
12 April 2006	0.75 gpm	1 hour	+8.0 ft	-0.6 ft/yr	Merlyn Skaley

**136-103-14ADC**

Lithologic Log

No lithologic log available

### Water-level fluctuations in Burke well 136-103-14ADC



## **Water quality**

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Well location	136-103-14ADC
Owner	Tom Burke
Date sampled	12 April 2006
Water temperature	14.2 degrees Celsius
Lab conductivity	1620 micromhos/cm
pH	8.76
Calcium	1.58 milligrams per liter
Magnesium	0.4 milligrams per liter
Potassium	1.6 milligrams per liter
Sodium	384 milligrams per liter
Iron	0.048 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	2.44 milligrams per liter
Bicarbonate	627 milligrams per liter
Carbonate	38 milligrams per liter
Sulfate	213 milligrams per liter
Chloride	19.7 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1000 milligrams per liter
Hardness	6 milligrams per liter
Sodium adsorption ratio	70.6
Residual sodium carbonate	11 Equivalent/liter
Percent sodium	99.3

Tom Burke well at 136-103-14ADC



View looking east



View looking north

**136-103-24AAB**

<i>Date Completed:</i>	1969	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2480'	<i>Well Type:</i>	1.25" Steel
<i>Depth Drilled (ft):</i>	840'	<i>Aquifer:</i>	Fox Hills-Hell Creek
<i>Screened Interval (ft):</i>	800' - 840'	<i>Source:</i>	Bill, G.V., Slo. Co. Study

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*Owner:* LaVonia Hafele

*Address:* 5704 154th Avenue SW, Bowman, ND 58623

*Telephone #:* 701-279-5796 (Rhame exchange)

*Farmstead location:* 2 mi NW at Logging Camp Ranch fork

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*Well Location:* 1/2 mile north northeast of ranch. Another stock well at abandoned farm along east sec. line, north of 1/4 line, decided the well at AAB was probably the one AEC visited in 1986.

*Directions to well:* .2 mi. east of house take trail north 1/2 mile to north side of valley, trail bears northeast through low to well, tan stock tank

*Wellhead description: (casing & plumbing)* 1.25 inch casing extends two feet out of ground, to elbow to flexible tubing, runs into stock tank along fence line

*Water Sample* Conductivity: 1,495 micromhos/cm, Temperature: 13.8° C.  
Collected 03:00 PM, 12 April 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20
Pressure head (feet)	6	6	6.25	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Shut in time (minutes)	25	30	35	40	50	60	70	80	100	120
Pressure head (feet)	6.25	6.25	6.25	6.25	6.25	6.25	NA	NA	NA	NA

**Long-term pressure head measurements  
(in feet above land surface)**

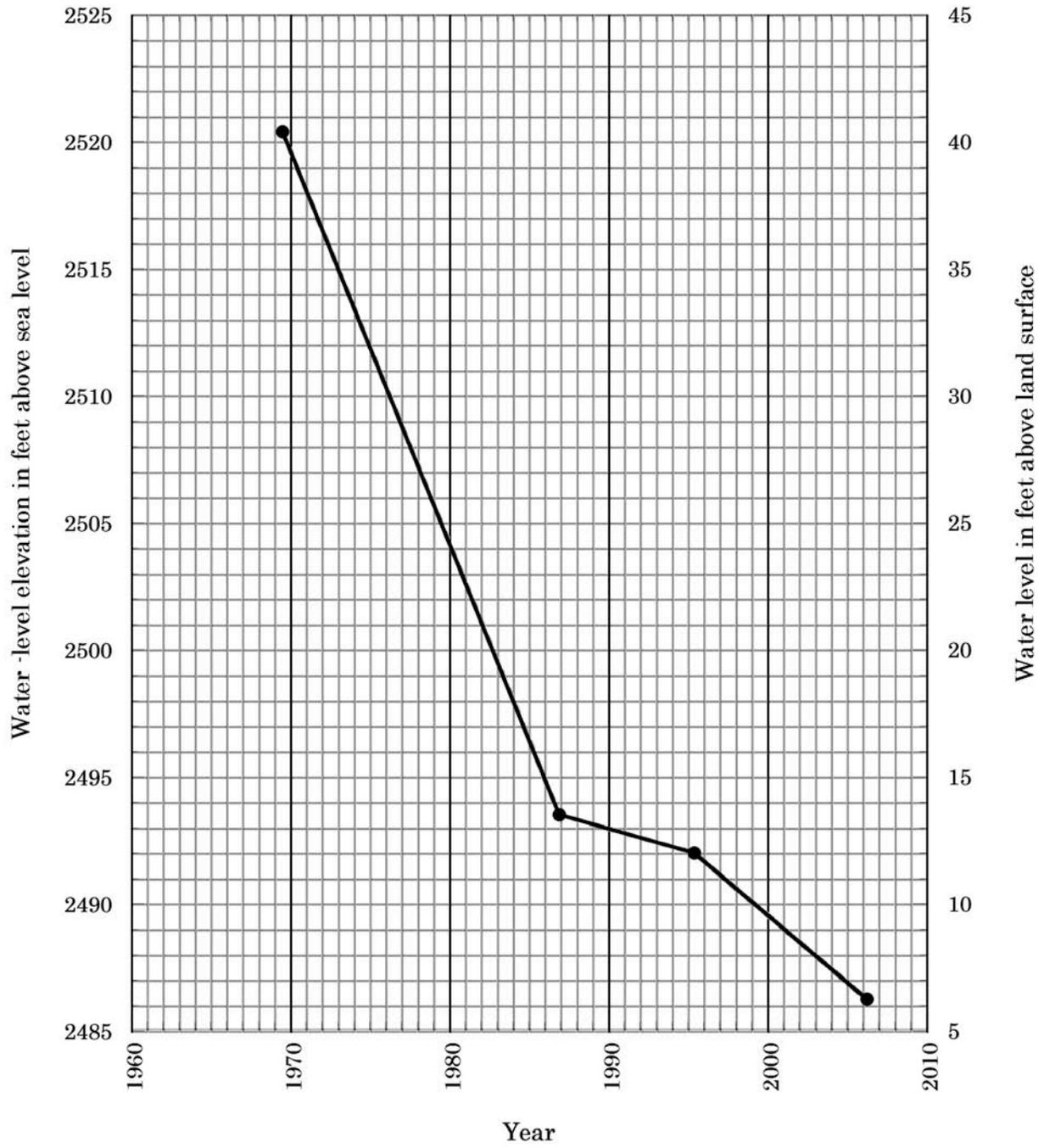
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
3 Jul. 1969			+40.4 ft.		Lawrence Anna
3 Dec. 1986	0.8 gpm	70 min. ?	+13.5 ft.	-1.5 ft/yr	Allen Comeskey
25 May 1995	1.28 gpm	40 min.	12.0 ft.	-0.2 ft/yr	Alan Wanek
10 April 2006	0.75 gpm	60 min	6.25 ft.	-0.5 ft/yr	Merlyn Skaley

**136-103-24AAB**

Lithologic Log

No lithologic log available

Water-level fluctuations in Hafele well 136-103-24AAB



### Water quality

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Well location	136-103-24AAB
Owner	LaVonia Hafele
Date sampled	12 April 2006
Water temperature	13.8 degrees Celsius
Lab conductivity	1660 micromhos/cm
pH	8.65
Calcium	1.79 milligrams per liter
Magnesium	0.9 milligrams per liter
Potassium	1.87 milligrams per liter
Sodium	404 milligrams per liter
Iron	0.028 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	5.13 milligrams per liter
Bicarbonate	768 milligrams per liter
Carbonate	35 milligrams per liter
Sulfate	180 milligrams per liter
Chloride	7.38 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1030 milligrams per liter
Hardness	8 milligrams per liter
Sodium adsorption ratio	61.4
Residual sodium carbonate	14 Equivalent/liter
Percent sodium	99.1

LaVonia (Ken) Hafele well at 136-103-24AAB



View looking north



View looking south

**136-103-24ACC**

*Date Completed:* NA *Purpose:* Domestic/Stock Well  
*L.S. Elevation (ft):* 2460' *Well Type:* 1.25" Steel  
*Depth Drilled (ft):* NA *Aquifer:* NA  
*Screened Interval (ft):* *Source:*

*Owner:* LaVonia Hafele  
*Address:* 5704 154th Avenue SW, Bowman, ND 58623  
*Telephone #:* 701-279-5796 (Rhame exchange)  
*Farmstead location:* 2 mi NW at Logging Camp Ranch fork

*Well Location:* By coral west house

*Wellhead description:*  
*(casing & plumbing)*

*Water Sample* Conductivity: 1524 micromhos/cm, Temperature: 16.6° C.  
 Collected 04:20 PM, 10 April 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25	30
Pressure head (feet)	7.5	9	10.5	12	13	13.5	13.75	13.75	14	15	15	15

Shut in time (minutes)	35	40	50	60	70	80	100	120
Pressure head (feet)	15.25	15.5	15.5	16	16	16	16	16

**Long term pressure head measurements  
 (in feet above land surface)**

Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
10 April 2006	2 gpm	2 hours	16.0 ft	NA	Merlyn Skaley

**136-103-24ACC**

Lithologic Log

No lithologic log available

### Water quality

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Well location	136-103-24ACC
Owner	LaVonia Hafele
Date sampled	10 April 2006
Water temperature	16.60 degrees Celsius
Lab conductivity	1590 micromhos/cm
pH	8.78
Calcium	1.48 milligrams per liter
Magnesium	0.4 milligrams per liter
Potassium	1.49 milligrams per liter
Sodium	378 milligrams per liter
Iron	0.085 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	2.25 milligrams per liter
Bicarbonate	627 milligrams per liter
Carbonate	37 milligrams per liter
Sulfate	215 milligrams per liter
Chloride	23.1 milligrams per liter
Nitrate	0.09 milligrams per liter
Total dissolved solids	986 milligrams per liter
Hardness	5 milligrams per liter
Sodium adsorption ratio	71.1
Residual sodium carbonate	11 Equivalent/liter
Percent sodium	99.4

LaVonia (Ken) Hafele well at 136-103-24ACC



View looking south



View looking west

**187-102-6CAC**

*Date Completed:* about 1964, owner says      *Purpose:* Stock Well  
*L.S. Elevation (ft):* 2395'      *Well Type:* 1.25" Steel  
*Depth Drilled (ft):* 940'      *Aquifer:* Fox Hills-Hell Creek  
*Screened Interval (ft):*      *Source:* Bill,. G.V., Slo. Co. Study

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*Owner:* Robert (Bud) Griffin  
*Address:* Box 485, Medora, ND 58645  
*Telephone #:* 701 623-4460 (Medora exchange)  
*Farmstead location:* North of Bullion Butte, 1 mi. south of south end of West Riv. Rd.

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*Well Location:* Ranch, formerly designated 6CBD  
*Directions to well:* 100 feet NW of house, by burn barrels, drive through farmyard gate SW of house & around to well  
*Wellhead description: (casing & plumbing)* Casing extends two feet out of ground elbow, faucet, elbow back underground to house and stock tank SW of house. Four inch surface casing extends 8 inches out of ground  
*Water Sample* Conductivity: 1,562 micromhos/cm, Temperature: 19.10° C.  
 Collected 3:10 PM, 11 April 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25
Pressure head (feet)	102	102	102	102	102	102	102	102	102	102	102

Shut in time (minutes)	30	35	40	50	60	70	80	100	120
Pressure head (feet)	102	102	102	102	102	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

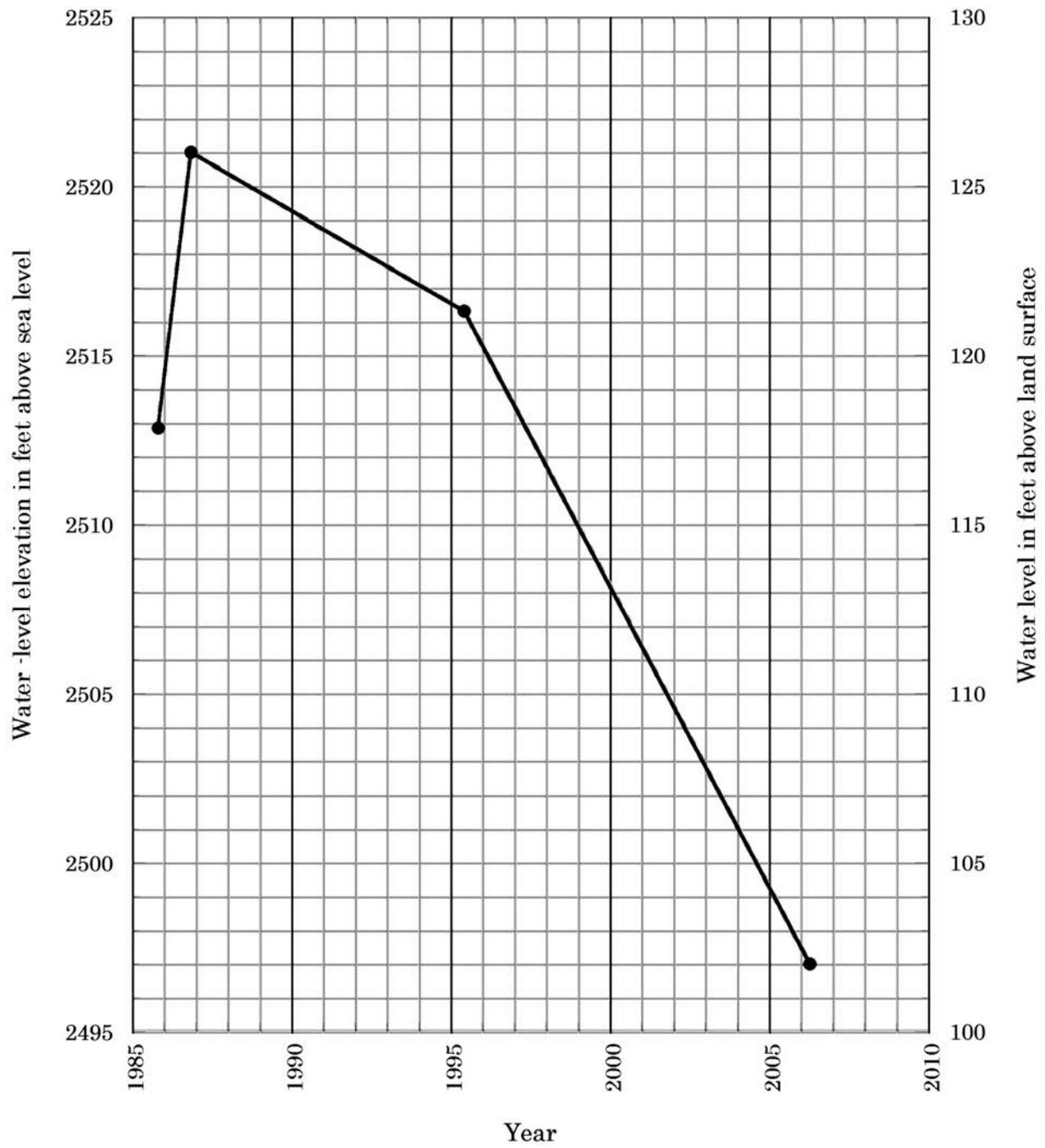
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
30 Oct. 1985			117.86 ft.		Allen Comeskey
4 Nov. 1986			126.0 ft.	+8.0 ft/yr	Allen Comeskey
7 June 1995		2 hours	121.3 ft.	-0.6 ft/yr	Alan Wanek
11 April 2006	10	1 hour	102.0 ft	-1.8 ft/yr	Merlyn Skaley

**137-102-06CAC**

**Lithologic Log**

<u>Unit</u>	<u>Description</u>	<u>Depth (ft.)</u>
GRAVEL	With scoria	0-30
CLAY	With some lignite	30-240
SAND		240-280
CLAY		280-560
SAND		560-600
CLAY		600-700
LIGNITE		700-710
SAND		710-720
CLAY		720-750
SAND		750-780
CLAY		780-820
SAND		820-830
CLAY		830-840
SAND		840-860
SHALE		860-900
SAND		900-940

Water-level fluctuations in Griffin well 137-102-06CAC



### Water quality

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Well location	137-102-6CAC
Owner	Robert Griffin
Date sampled	11 April 2006
Water temperature	19.10 degrees Celsius
Lab conductivity	1660 micromhos/cm
pH	8.75
Calcium	1.50 milligrams per liter
Magnesium	0.3 milligrams per liter
Potassium	1.77 milligrams per liter
Sodium	385 milligrams per liter
Iron	0.062 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	1.8 milligrams per liter
Bicarbonate	572 milligrams per liter
Carbonate	38 milligrams per liter
Sulfate	266 milligrams per liter
Chloride	25.8 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1030 milligrams per liter
Hardness	5 milligrams per liter
Sodium adsorption ratio	75
Residual sodium carbonate	11 Equivalent/liter
Percent sodium	99.4

Robert (Bud) Griffin well at 137-102-06CAC



View looking south



View looking northeast

**187-102-7AAD**

<i>Date Completed:</i>	29 Sep. 1980	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2440'	<i>Well Type:</i>	1.25" Steel
<i>Depth Drilled (ft):</i>	1040'	<i>Aquifer:</i>	Fox Hills-Hell Creek
<i>Screened Interval (ft):</i>	1010' - 1040'	<i>Source:</i>	H & H Service Co.

---

*Owner:* Robert (Bud) Griffin

*Address:* Box 485, Medora, ND 58645

*Telephone #:* 701-623-4460 (Medora exchange)

*Farmstead location:* North of Bullion Butte, south end of West River Road

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*Well Location:* 3/4 mile SE of house, prev. des. 7AAA

*Directions to well:* West Riv. Rd. south from house, cross bridge, uphill, just before cattle guard take right & follow trail .8 mile

*Wellhead description: (casing & plumbing):* 1.25 inch casing extends 2.5 feet out of ground, elbow, casing runs 35 feet to blue stock tank near fence & corral

*Water Sample* Conductivity: 1,535 micromhos/cm, Temperature: 13.2<sup>0</sup> C.  
Collected 4:33 PM, 11 April 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25
Pressure head (feet)	14.75	14.90	15	15	15	15	15	15	15	15	15

Shut in time (minutes)	30	35	40	50	60	70	80	100	120
Pressure head (feet)	15	15	15	15	15	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

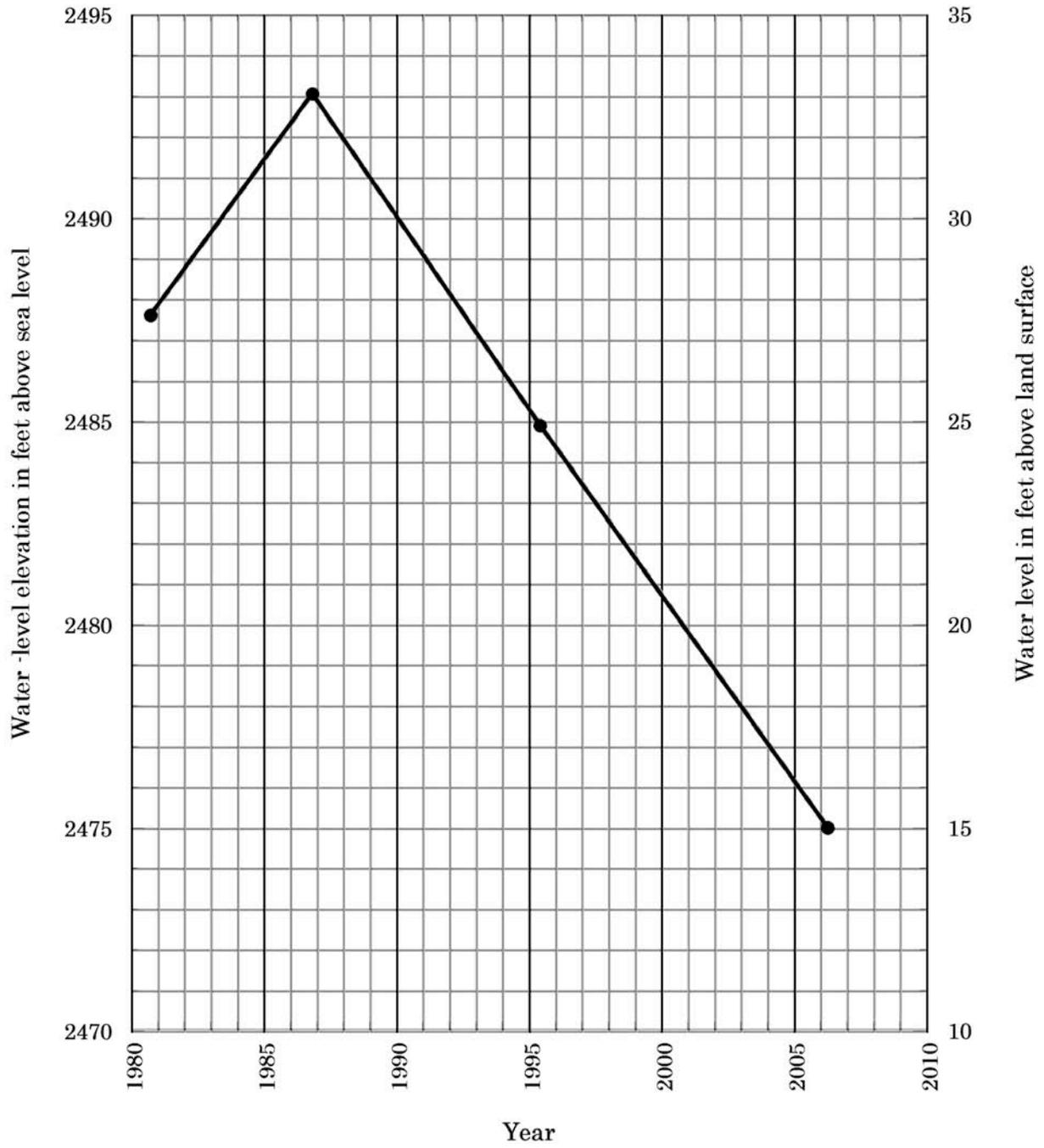
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
29 Sep. 1980			27.6		B. Heimbaugh
4 Nov. 1986	1.14 gpm	20 min.	33.05	+0.8 ft/yr	Allen Comeskey
7 June 1995	1.15 gpm	2 hours	24.9	-1.0 ft/yr	Alan Wanek
11 April 2006	NA	1 hour	15.0	-0.9 ft/yr	Merlyn Skaley

**137-102-07AAD**

**Lithologic Log**

<u>Unit</u>	<u>Description</u>	<u>Depth (ft.)</u>
SAND		0-141
CLAY	With coal lenses	141-151
SAND	Gray, very fine	151-340
CLAY		240-347
LIGNITE		347-365
CLAY		365-560
CLAY	Sandy	560-590
CLAY		590-835
CLAY	Silty, with sand stringers	835-940
CLAY		940-970
SAND		970-1040

Water-level fluctuations in Griffin well 137-102-07AAD



## **Water quality**

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Well location	137-102-7AAD
Owner	Robert Griffin
Date sampled	11 April 2006
Water temperature	19.30 degrees Celsius
Lab conductivity	1660 micromhos/cm
pH	8.77
Calcium	1.58 milligrams per liter
Magnesium	0.3 milligrams per liter
Potassium	1.84 milligrams per liter
Sodium	387 milligrams per liter
Iron	0.033 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	1.96 milligrams per liter
Bicarbonate	584 milligrams per liter
Carbonate	39 milligrams per liter
Sulfate	250 milligrams per liter
Chloride	38.6 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1030 milligrams per liter
Hardness	5 milligrams per liter
Sodium adsorption ratio	73.9
Residual sodium carbonate	11 Equivalent/liter
Percent sodium	99.4

Robert (Bud) Griffin well at 137-102-07AAD



View looking south



View looking southeast

**137-103-12BAB**

*Date Completed:* Early 1960's (owner)      *Purpose:* House & Stock Well  
*L.S. Elevation (ft):* 2410'      *Well Type:* 1.25" Steel  
*Depth Drilled (ft):* 950'      *Aquifer:* Fox Hills-Hell Creek  
*Screened Interval (ft):*      *Source:* Bill,. G.V., Slo. Co. Study

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*Owner:* Alan Wosepka (Albert former owner)  
*Address:* Box 183, Medora, ND 58645  
*Telephone #:* 701-623-4341 (Medora exchange)  
*Farmstead location:* North of Bullion Butte, south end of West River Road

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*Well Location:* At ranch  
*Directions to well:* 40 feet south and 20 feet west of corner of house  
*Wellhead description: (casing & plumbing)* 1.25 inch casing in 5 inch surface casing extends 2.5 feet out of ground, elbow, faucet, elbow underground to house & on to stock tank north of house  
*Water Sample* Conductivity: 1,564 micromhos/cm, Temperature: 18.9<sup>o</sup> C.  
 Collected 6:10 PM, 11 April 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25
Pressure head (feet)	67	67	67	67	67	67	67	67	67	67	67

Shut in time (minutes)	30	35	40	50	60	70	80	100	120
Pressure head (feet)	67	67	67	67	67	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

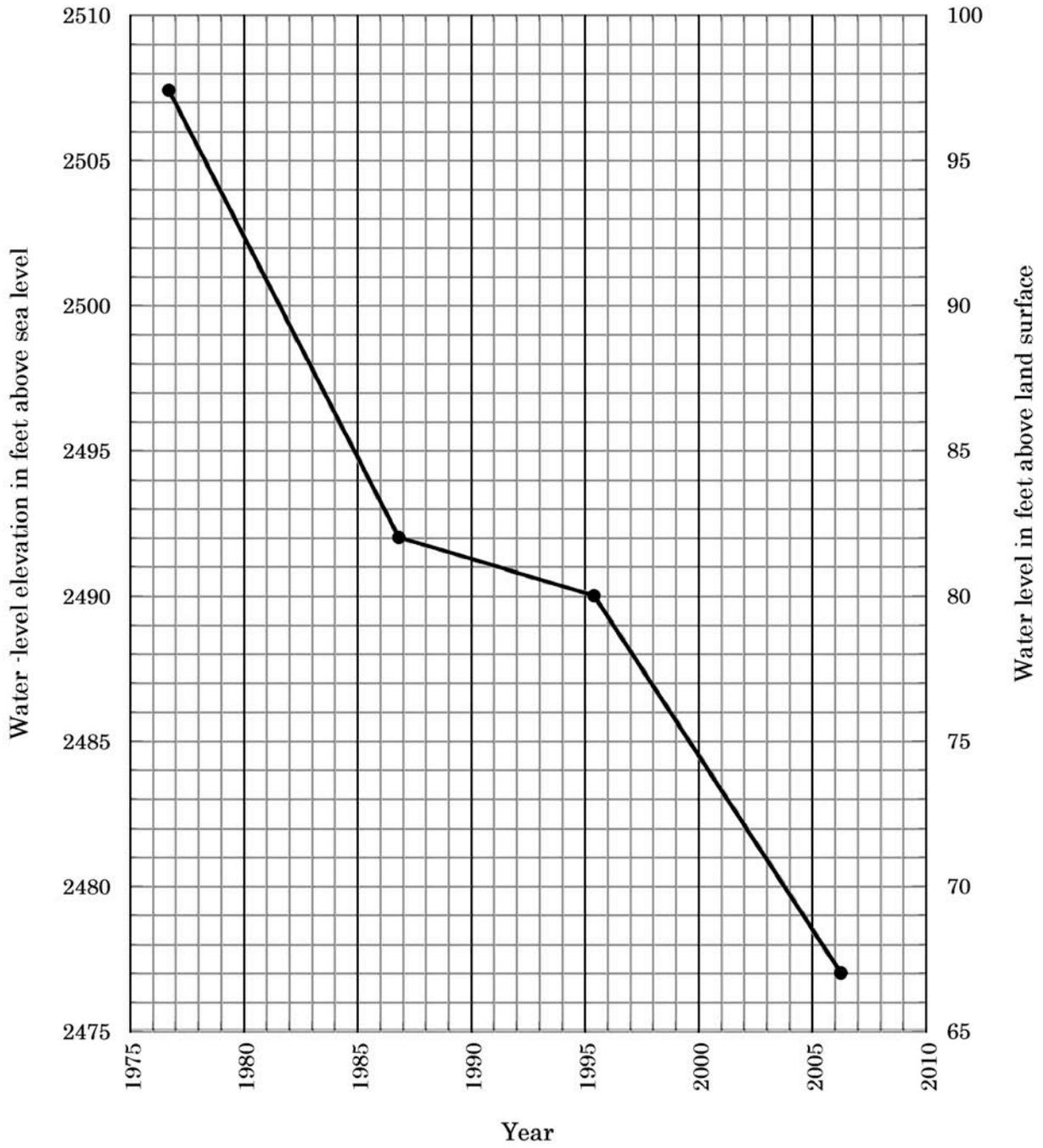
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
21 Sep. 1976			+97.4 ft.		Lawrence Anna
5 Nov. 1986			+82.0 ft.	-1.5 ft/yr	Allen Comeskey
6 June 1995	7.5 gpm	40 min.	+80.0 ft.	-0.2 ft/yr	Alan Wanek
11 April 2006	NA	1 hour	+67.0 ft.	-1.2 ft/yr	Merlyn Skaley

**137-103-12BAB**

Lithologic Log

No lithologic log available

Water-level fluctuations in Wosepka well 137-103-12BAB



### Water quality

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Well location	137-103-12BAB
Owner	Alan Wosepka
Date sampled	11 April 2006
Water temperature	18.9 degrees Celsius
Lab conductivity	1690 micromhos/cm
pH	8.78
Calcium	1.5 milligrams per liter
Magnesium	0.4 milligrams per liter
Potassium	1.88 milligrams per liter
Sodium	395 milligrams per liter
Iron	0.051 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	1.65 milligrams per liter
Bicarbonate	562 milligrams per liter
Carbonate	39 milligrams per liter
Sulfate	279 milligrams per liter
Chloride	34 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1040 milligrams per liter
Hardness	5 milligrams per liter
Sodium adsorption ratio	73.9
Residual sodium carbonate	10 Equivalent/liter
Percent sodium	99.4

Alan Wosepka well at 137-103-12BAB



View looking west



View looking east

**138-102-34CCA (AEC) -34CCB (Co. study)**

*Date Completed:* 7 July 1972                      *Purpose:* Stock Well  
*L.S. Elevation (ft):* 2400'                              *Well Type:* 1.25" Steel  
*Depth Drilled (ft):* 1020'                              *Aquifer:* Fox Hills-Hell Creek  
*Screened Interval (ft):* 955' - 997'                      *Source:* Bill,. G.V., Slo. Co. Study

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*Owner:* David and Renee Paasch  
11075 33rd Street SW, Dickinson, ND 58601  
*Telephone #:* 701-227-3609  
*Farmstead location:* L. Mo. Valley NE of Bullion Butte

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*Well Location:* Along Bear Creek, a mile NE of ranch, pre. des. 34CCA  
*Directions to well:* About one mile west of East River Road, before hill & road bears left (south) take trail north (right) around east side of hill, by grain bin & corral area, NW off terrace to Bear Creek valley near cut bank - blue, covered stock tank  
*Wellhead description: (casing & plumbing):* 1.25 inch casing extends 2 feet out of ground 2 elbows & water runs vertically into stock tank  
*Water Sample* Conductivity: 1511 micromhos/cm, Temperature: 16.40° C.  
Collected 11:20 AM, 12 April 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25
Pressure head (feet)	57	57	57	57	57	57	57	57	57	57.25	57.25

Shut in time (minutes)	30	35	40	50	60	70	80	100	120
Pressure head (feet)	57.25	57.25	57.25	57.25	57.25	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

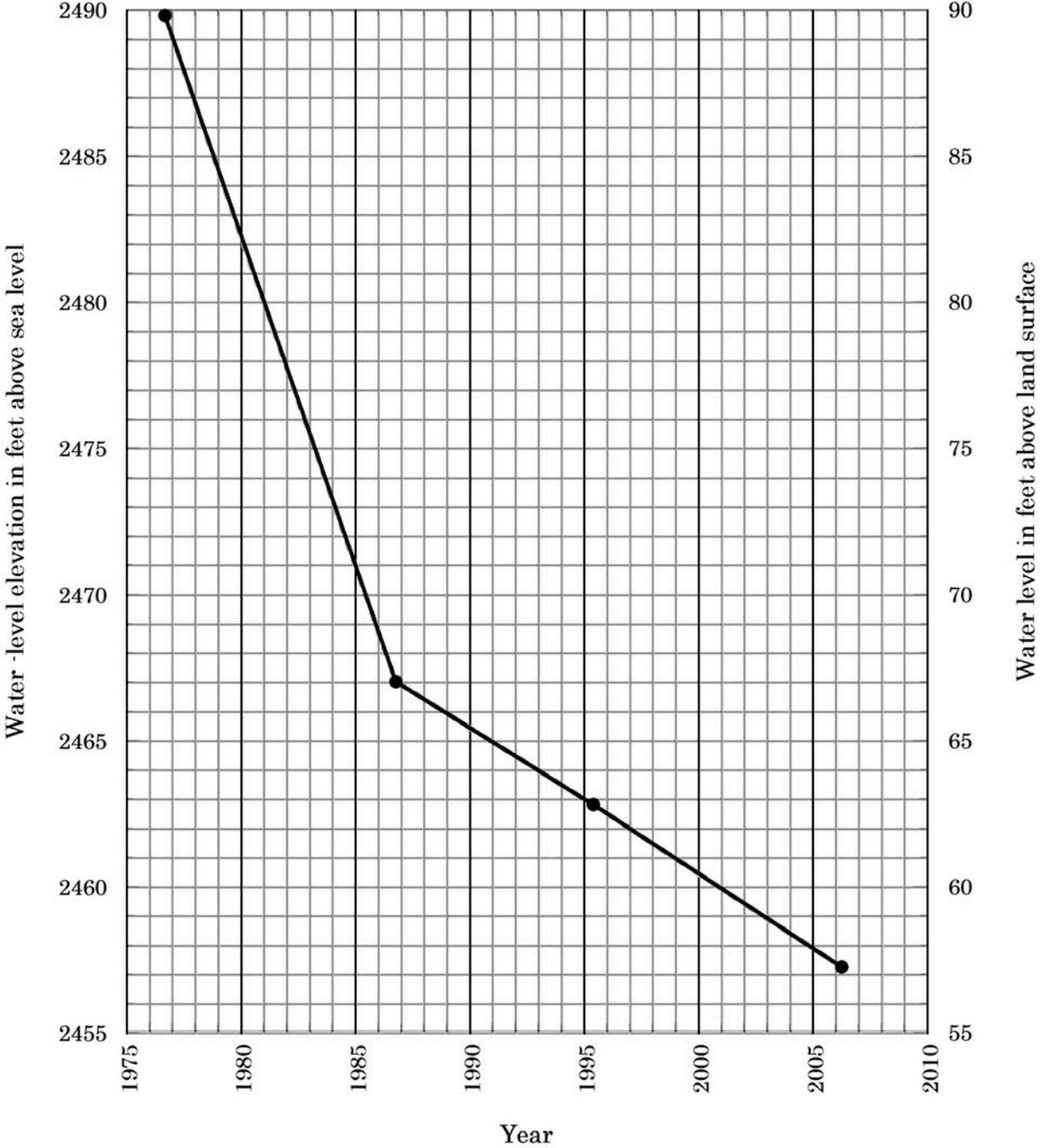
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
9 Sep. 1976			+89.8 ft.		Lawrence Anna
19 Oct. 1986		50 min.	+67.0 ft.	-2.2 ft/yr	Allen Comeskey
2 June 1995	1.22 gpm	2 hours	+62.8 ft.	-0.5 ft/yr	Alan Wanek
12 April 2006	10 gpm	1 hour	+57.25 ft.	-0.5 ft/yr	Merlyn Skaley

**138-102-34CCB**

**Lithologic Log**

<u>Unit</u>	<u>Description</u>	<u>Depth (ft.)</u>
CLAY		0-18
GRAVEL		18-25
CLAY		25-80
SAND		80-125
CLAY		125-360
SAND		360-400
CLAY		400-480
LIGNITE		480-500
CLAY		500-540
SAND		540-560
CLAY		560-750
SAND		750-780
CLAY		780-940
SAND		940-1020

Water-level fluctuations in Paasch well 138-102-34CCA



## **Water quality**

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Well location	138-102-34CCB
Owner	Ray Paasch
Date sampled	12 April 2006
Water temperature	16.40 degrees Celsius
Lab conductivity	1630 micromhos/cm
pH	8.74
Calcium	1.50 milligrams per liter
Magnesium	0.4 milligrams per liter
Potassium	1.71 milligrams per liter
Sodium	389 milligrams per liter
Iron	0.079 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	2.21 milligrams per liter
Bicarbonate	620 milligrams per liter
Carbonate	41 milligrams per liter
Sulfate	230 milligrams per liter
Chloride	27 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1010 milligrams per liter
Hardness	5 milligrams per liter
Sodium adsorption ratio	72.8
Residual sodium carbonate	11 Equivalent/liter
Percent sodium	99.4

Ray Paasch well at 138-102-34CCB



View looking west



View looking southeast

**138-103-01BAB**

<i>Date Completed:</i>	NA	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2390'	<i>Well Type:</i>	NA
<i>Depth Drilled (ft):</i>	NA	<i>Aquifer:</i>	NA
<i>Screened Interval (ft):</i>	NA	<i>Source:</i>	

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*Owner:* Ted Tescher  
Po Box 228, Medora, ND 58645

*Telephone #:* 701-623-4349

*Farmstead location:* 16 miles from the city limits of Medora follow West River Road

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*Well Location:* Adjacent to creek bed with trees

*Directions to well:* 1/2 mile SW of the intersection of West River Road and Garner Creek Road

*Wellhead description: (casing & plumbing):* NA

*Water Sample* Conductivity: 1609 micromhos/cm, Temperature: 14.50° C.  
Collected 1:21 PM, 11 April 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25
Pressure head (feet)	39.75	39.90	39.90	40	40	40	40	40	40.5	40.5	40.5

Shut in time (minutes)	30	35	40	50	60	70	80	100	120
Pressure head (feet)	40.5	40.5	40.5	40.5	40.5	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
11 April 2006	5 gpm	1 hour	+40.50	NA	Merlyn Skaley

**138-103-01BAB**

Lithologic Log  
No lithologic log available

## Water quality

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Well location	138-103-01BAB
Owner	Ted Tescher
Date sampled	11 April 2006
Water temperature	14.50 degrees Celsius
Lab conductivity	1720 micromhos/cm
pH	8.72
Calcium	1.60 milligrams per liter
Magnesium	0.4 milligrams per liter
Potassium	1.58 milligrams per liter
Sodium	404 milligrams per liter
Iron	0.065 milligrams per liter
Manganese	0.4 milligrams per liter
Fluoride	2.36 milligrams per liter
Bicarbonate	607 milligrams per liter
Carbonate	35 milligrams per liter
Sulfate	275 milligrams per liter
Chloride	29.5 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1070 milligrams per liter
Hardness	6 milligrams per liter
Sodium adsorption ratio	73.9
Residual sodium carbonate	11 Equivalent/liter
Percent sodium	99.4

Ted Tescher well at 138-103-01BAB



View looking north



View looking east

**139-102-17CAC2**

*Date Completed:* 25 Jul. 1973                      *Purpose:* House & stock Well  
*L.S. Elevation (ft):* 2365'                              *Well Type:* 1.25" Steel  
*Depth Drilled (ft):* 1125'                              *Aquifer:* Fox Hills-Hell Creek  
*Screened Interval (ft):* 1054' - 1125'              *Source:* Bill,. G.V., Slo. Co. Study

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*Owner:* Tom Tescher (formerly Adolph Burkhardt)  
*Address:* Box 245, Medora, ND 58645  
*Telephone #:* 701-623-4338 (Medora exchange)  
*Farmstead location:* 5 miles south of Medora

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*Well Location:* At ranch  
*Directions to well:* Behind (north of) new house, about 70 feet away  
*Wellhead description:* 1.25 inch casing extends about 2 feet out of ground, elbow, valve, (casing & plumbing) elbow (actually T) to faucet and house, then on to stock well, Brochure well #2  
*Water Sample* Conductivity: 1674 micromhos/cm, Temperature: 15.20° C.  
 Collected 8:06 AM, 11 April 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15
Pressure head (feet)	44.75	44.75	44.75	44.75	44.75	44.75	44.75	44.75	44.75

Shut in time (minutes)	20	25	30	35	40	50	60	70	80	100
Pressure head (feet)	44.75	44.75	44.75	44.75	44.75	44.75	44.75	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

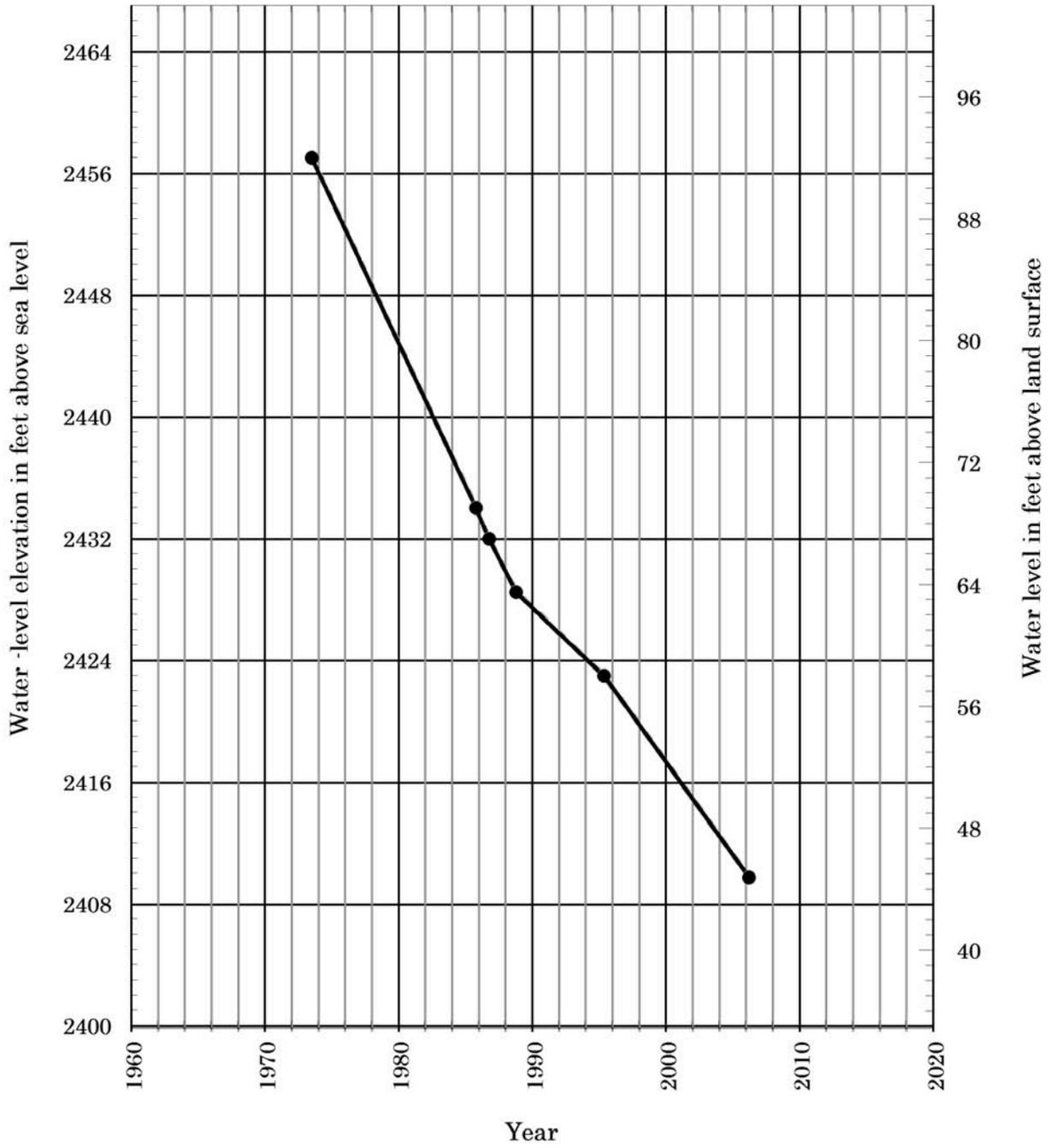
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
25 July 1973			+92.0 ft.		Lawrence Anna
Nov. 1985			+69 ft.	-1.9 ft/yr	Allen Comeskey
4 Nov. 1986			+67.0 ft.	-2.1 ft/yr	Allen Comeskey
10 Nov. 1988			+63.5 ft.	-1.7 ft/yr	Allen Comeskey
8 June 1995	2.61 gpm	1 hour	+58.0 ft.	-0.8 ft/yr	Alan Wanek
11 April 2006	10	1 hour	+44.75	-1.2 ft/yr	Merlyn Skaley

**139-102-17CAC2**

**Lithologic Log**

<u>Unit</u>	<u>Description</u>	<u>Depth (ft.)</u>
CLAY	Yellow, sandy	0-35
LIGNITE	Coal slack & scoria sand	35-45
CLAY	Yellow	45-70
SAND	Fine grained, with scoria	70-80
CLAY	Blue	80-130
SAND	Blue	130-135
SHALE	With layers of coal	135-450
CLAY	Sandy, fine grained	450-530
SHALE	Layers of coal and rock	530-710
SAND	Fine	710-725
SHALE		725-930
SAND	Fine w/water	930-950
SHALE		950-990
SAND	Brown, fine grained	990-1030
SHALE		1030-1075
SAND		1075-1100
SHALE		1100-1125

### Water-level fluctuations in Tescher well 139-102-17CAC2



### Water quality

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Well location	139-102-17CAC2
Owner	Tom Tescher
Date sampled	11 April 2006
Water temperature	15.20 degrees Celsius
Lab conductivity	1740 micromhos/cm
pH	8.64
Calcium	251 milligrams per liter
Magnesium	0.5 milligrams per liter
Potassium	1.82 milligrams per liter
Sodium	410 milligrams per liter
Iron	0.02 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	2.52 milligrams per liter
Bicarbonate	663 milligrams per liter
Carbonate	32 milligrams per liter
Sulfate	248 milligrams per liter
Chloride	32.8 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1080 milligrams per liter
Hardness	8 milligrams per liter
Sodium adsorption ratio	61.8
Residual sodium carbonate	12 Equivalent/liter
Percent sodium	99.1

Tom Tescher well at 139-102-17CAC2



**139-102-20DAD**

<i>Date Completed:</i>	NA	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2300'	<i>Well Type:</i>	NA
<i>Depth Drilled (ft):</i>	NA	<i>Aquifer:</i>	NA
<i>Screened Interval (ft):</i>	NA	<i>Source:</i>	

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*Owner:* Ted Tescher  
Po Box 228, Medora, ND 58645

*Telephone #:* 701-623-4349

*Farmstead location:* NA

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*Well Location:* Adjacent to trail

*Directions to well:* 11.5 miles from the city limits of Medora following West River Road,  
1.3 miles east on trail off of West River Road to well

*Wellhead description:* NA  
(casing & plumbing)

*Water Sample* Conductivity: 1666 micromhos/cm, Temperature: 13.40° C.  
Collected 9:32 AM, 11 April 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25
Pressure head (feet)	55	56.5	57.5	58.5	60	61	62	63	63.75	65	65.25

Shut in time (minutes)	30	35	40	50	60	70	80	100	120
Pressure head (feet)	66.5	66.5	66.75	67	68	69	70	72	72

**Long term pressure head measurements  
(in feet above land surface)**

Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
11 April 2006	NA	2 hours	+72.00	NA	Merlyn Skaley

**139-102-20DAD**

Lithologic Log  
No lithologic log available

## Water quality

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Well location	139-102-20DAD
Owner	Ted Tescher
Date sampled	11 April 2006
Water temperature	13.40 degrees Celsius
Lab conductivity	1750 micromhos/cm
pH	8.55
Calcium	1.64 milligrams per liter
Magnesium	0.6 milligrams per liter
Potassium	1.79 milligrams per liter
Sodium	446 milligrams per liter
Iron	0.079 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	3.66 milligrams per liter
Bicarbonate	1050 milligrams per liter
Carbonate	34 milligrams per liter
Sulfate	1.07 milligrams per liter
Chloride	11.5 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1080 milligrams per liter
Hardness	7 milligrams per liter
Sodium adsorption ratio	75.7
Residual sodium carbonate	1 Equivalent/liter
Percent sodium	99.4

Ted Tescher well at 139-102-20DAD



View looking south



View looking north

**139-102-31BBB**

<i>Date Completed:</i>	NA	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2400'	<i>Well Type:</i>	NA
<i>Depth Drilled (ft):</i>	NA	<i>Aquifer:</i>	NA
<i>Screened Interval (ft):</i>	NA	<i>Source:</i>	

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*Owner:* Ted Tescher  
Po Box 228, Medora, ND 58645

*Telephone #:* 701-623-4349

*Farmstead location:* NA

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*Well Location:* Adjacent to trail

*Directions to well:* 14.5 miles from the city limits of Medora following West River Road, 0.3 miles north on trail off of West River Road to well

*Wellhead description: (casing & plumbing):* NA

*Water Sample* Conductivity: 1661 micromhos/cm, Temperature: 16.50° C.  
Collected 12:08 PM, 11 April 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25
Pressure head (feet)	36	36	36	36	36	36	36	36	36	36	36.5

Shut in time (minutes)	30	35	40	50	60	70	80	100	120
Pressure head (feet)	37	37	37	37	37				

**Long term pressure head measurements  
(in feet above land surface)**

Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
11 April 2006	NA	2 hours	+37.00	NA	Merlyn Skaley

**139-102-31BBB**

Lithologic Log  
No lithologic log available

## Water quality

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Well location	139-102-31BBB
Owner	Ted Tescher
Date sampled	11 April 2006
Water temperature	16.50 degrees Celsius
Lab conductivity	1740 micromhos/cm
pH	8.70
Calcium	1.52 milligrams per liter
Magnesium	0.4 milligrams per liter
Potassium	1.49 milligrams per liter
Sodium	419 milligrams per liter
Iron	0.048 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	3.23 milligrams per liter
Bicarbonate	754 milligrams per liter
Carbonate	42 milligrams per liter
Sulfate	192 milligrams per liter
Chloride	29.5 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1080 milligrams per liter
Hardness	5 milligrams per liter
Sodium adsorption ratio	78.1
Residual sodium carbonate	14 Equivalent/liter
Percent sodium	99.4

Ted Tescher well at 139-102-31BBB



View looking north



View looking west

**140-102-06DCC**

*Date Completed:* *Purpose:* House & Stock Well  
*L.S. Elevation (ft):* 2390' *Well Type:* 1.25" Steel  
*Depth Drilled (ft):* 1250' *Aquifer:* Fox Hills-Hell Creek  
*Screened Interval (ft):* *Source:* Bill,. G.V., Slo. Co. Study

*Owner:* Roger Myers  
*Address:* Box 126, Medora, ND 58645  
*Telephone #:* 701-623-4457 (Medora exchange)  
*Farmstead location:* 6 miles NW of Medora

*Well Location:* 100 feet NW of new house, 50 feet north of old house  
*Directions to well:* Along front yard fence line  
*Wellhead description:* T at 3 feet below surface 5 ft. horizontal, elbow vertical to 3 ft. above ground, elbow, faucet, elbow & below surface to house & on to stock tank, dug up & will be changed  
*Water Sample* Conductivity: 1643 micromhos/cm, Temperature: 16.70° C.  
 Collected 11:00 AM, 16 May 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20	25	30	35	40
Pressure head (feet)	NA													

Shut in time (minutes)	50	60	70	80	100	120
Pressure head (feet)	NA	NA	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
9 Aug 1968			+49.7 ft.		Lawrence Anna
5 Nov. 1986		18 min.	+18.75 ft.	-1.7 ft/yr	Allen Comeskey
9 June 1995	1.2 gpm*	2 hours	+7.4	-1.3 ft/yr	Alan Wanek
*15 May 2006	NA	NA	NA	NA	NA

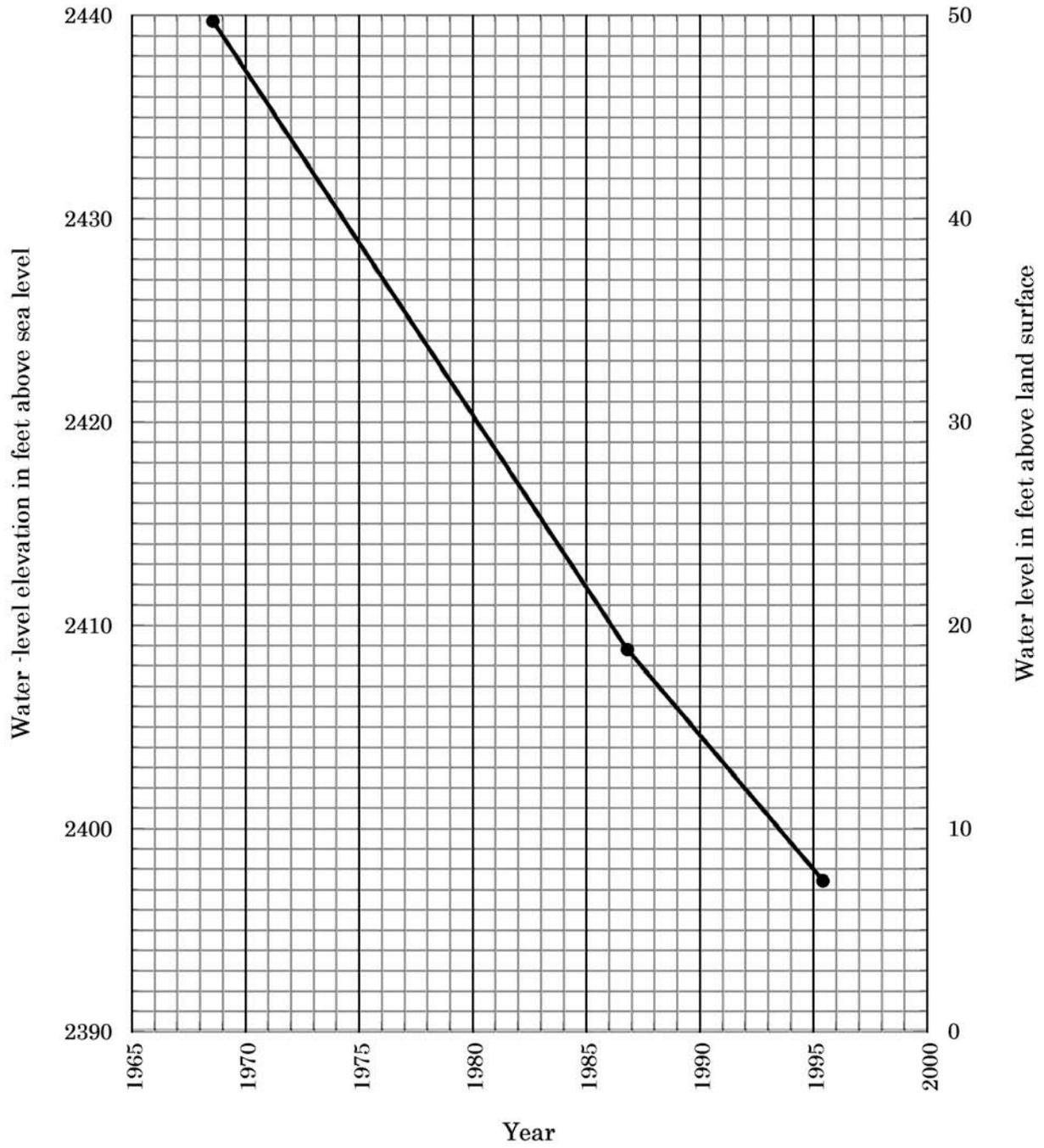
\* No way to pressurize well

**140-102-06DCC**

Lithologic Log

No lithologic log available

Water-level fluctuations in Myers well 140-102-06DCC



### Water quality

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Well location	140-102-06DCC
Owner	Roger Myers
Date sampled	16 May 2006
Water temperature	16.70 degrees Celsius
Lab conductivity	1780 micromhos/cm
pH	8.71
Calcium	<2 milligrams per liter
Magnesium	<1 milligrams per liter
Potassium	<1 milligrams per liter
Sodium	381 milligrams per liter
Iron	0.176 milligrams per liter
Manganese	0.011 milligrams per liter
Fluoride	2.91 milligrams per liter
Bicarbonate	664 milligrams per liter
Carbonate	41 milligrams per liter
Sulfate	258 milligrams per liter
Chloride	36.4 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1100 milligrams per liter
Hardness	9 milligrams per liter
Sodium adsorption ratio	54.9
Residual sodium carbonate	12 Equivalent/liter
Percent sodium	98.9

Roger Myers well at 140-102-06DCC



View looking east



View looking down hole

**140-102-10DCA**

*Date Completed:* 21 June 1984      *Purpose:* Park Svc. Camp gnd. well  
*L.S. Elevation (ft):* 2257'      *Well Type:* 8" Steel  
*Depth Drilled (ft):* 1385'      *Aquifer:* Fox Hills-Hell Creek  
*Screened Interval (ft):* 1155' - 1280'      *Source:* Gregory Drilling

*Owner:* National Park Service, Attn: Keith Butler (Mel Haynes)  
*Address:* 315 2nd Avenue, TR National Park, Medora, ND 58645  
*Telephone #:* 701-623-4466 (Medora exchange)  
*Park HQ location:* Northeast Medora

*Well Location:* Billings Co., Cottonwood Campground #2, north of Medora  
*Directions to well:* Park HQ, Park road through maintenance area to Cottonwood Campground, just north of rangers house, north of entrance, pump house and well north of pump house, gage in pump house  
*Wellhead description: (casing & plumbing)* Green top 8 inch well in 14 inch surface casing, plumbed into pump house  
*Water Sample* Conductivity: 1577 micromhos/cm, Temperature: 12.90° C.  
 Collected 9:38 AM, 16 May 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15
Pressure head (feet)	118	120	120	120	120	120	120	120	120

Shut in time (minutes)	20	25	30	35	40	50	60	70	80	100
Pressure head (feet)	120	120	120	120	120	120	120	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

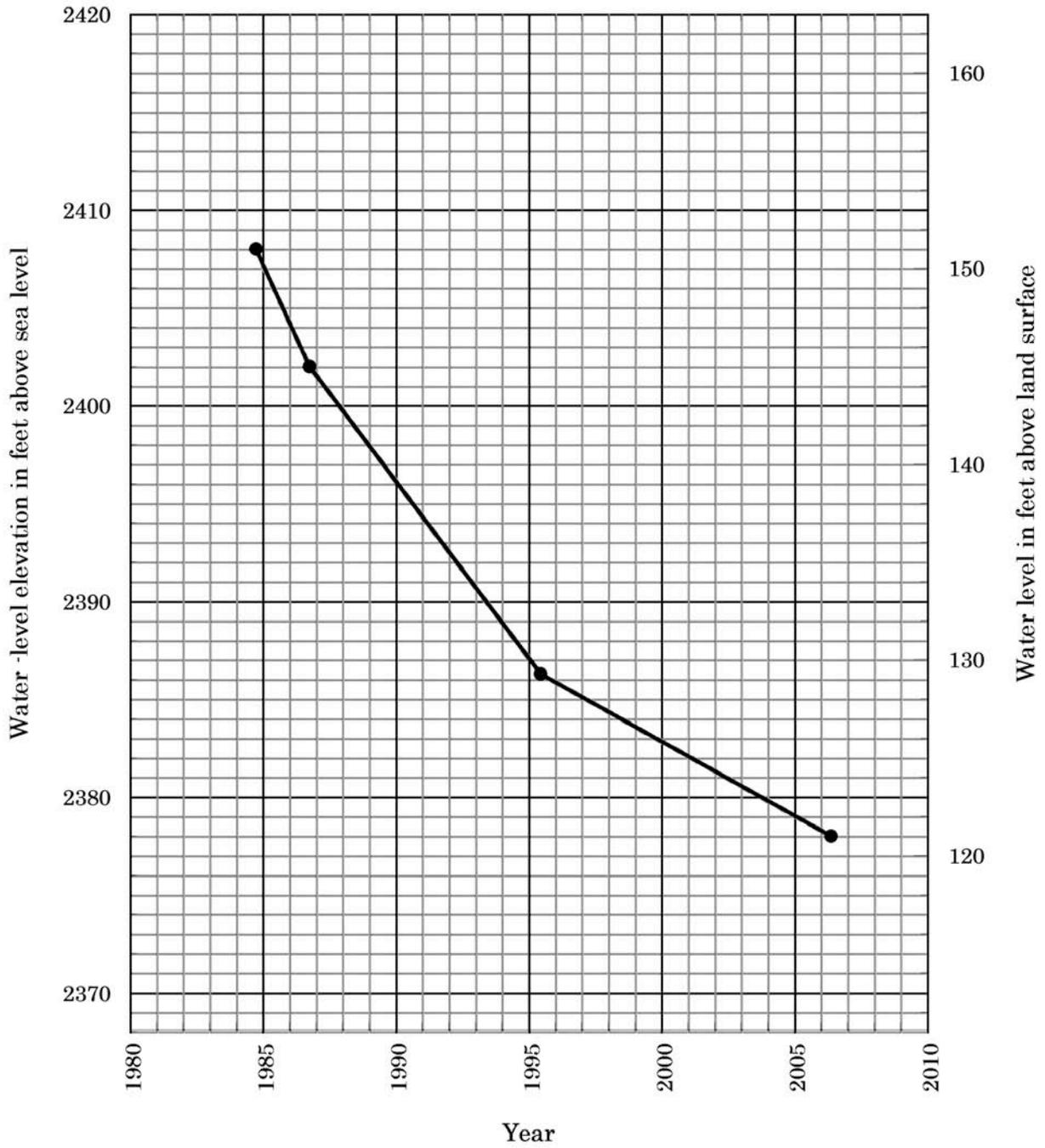
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
2 Oct. 1984			+150.0 ft.		Lawrence Anna
1 Oct. 1986			+144.0 ft.	-3.0 ft/yr	Allen Comeskey
14 Jun. 1995	shut in	hours	+128.3 ft.	-1.9 ft/yr	Alan Wanek
16 May 2006	NA	1 hour	+120.0 ft.	-0.8 ft/yr	Merlyn Skaley

**140-102-10DCA**

**Lithologic Log**

<u>Unit</u>	<u>Description</u>	<u>Depth (ft.)</u>
SAND	Brown	0-18
CLAY	Sandy, (Old river bed, pieces of wood logs)	18-35
LIGNITE	Coal	35-37
SHALE	Sandy	37-40
SHALE	Gray	61-90
SAND	Soft	90-120
SHALE		120-150
LIGNITE		150-180
SHALE		180-212
SAND		212-225
SHALE	Occasional indurated zones, sandy 515-525, 592-605, 675-702, 890-907, 938-953, 978-987, 995-1005, 1065-1080, 1096-1121, 1131-1151	225-1173
LIGNITE	Coal	1173-1186
SHALE	Sandy	1186-1268
SANDSTONE		1268-1269
SHALE	Sandy	1269-1274
LIMESTONE		1274-1275
SHALE	Sandy	1275-1284
LIGNITE	Coal	1284-1286
SHALE	Dark brown	1286-1292

# Water-level fluctuations in the National Park Service well 140-102-10DCA



## Water quality

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Well location	140-102-10DCA
Owner	US National Park Service
Date sampled	16 May 2006
Water temperature	12.9 degrees Celsius
Lab conductivity	1690 micromhos/cm
pH	8.73
Calcium	<2 milligrams per liter
Magnesium	<1 milligrams per liter
Potassium	<1 milligrams per liter
Sodium	369 milligrams per liter
Iron	.240 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	3.36 milligrams per liter
Bicarbonate	716 milligrams per liter
Carbonate	42 milligrams per liter
Sulfate	105 milligrams per liter
Chloride	80.7 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1050 milligrams per liter
Hardness	9 milligrams per liter
Sodium adsorption ratio	53.1
Residual sodium carbonate	13 Equivalent/liter
Percent sodium	98.9

\*\*\*No photos taken in 2006\*\*\*

**141-102-10ABD**

<i>Date Completed:</i>	16 Aug. 1979	<i>Purpose:</i>	Domestic Well?
<i>L.S. Elevation (ft):</i>	2320'	<i>Well Type:</i>	1.25" Steel
<i>Depth Drilled (ft):</i>	1440'	<i>Aquifer:</i>	Fox Hills-Hell Creek
<i>Screened Interval (ft):</i>	1365' - 1428'	<i>Source:</i>	Boyce Drilling

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*Owner:* US Forest Svc./Medora Grazing Assoc./Cecil Adams  
*Address:* Box 108, Medora, ND 58645/ PO Box 792, Beach ND 58621  
*Telephone #:* 701-623-4336 (Medora ex) (grazing assoc.)/872-3900 Adams  
*Farmstead location:* Cecil Adams lives in Beach

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*Well Location:* Along Wannagan Creek, 3 miles west of L. Mo. R.  
*Directions to well:* 500 feet south of trail where trail bows south, well on west side of draw, NE of hill, blue tank, triangular bracing  
*Wellhead description: (casing & plumbing):* 5 inch surface casing, 1.25 inch casing to water tank, T w/line into ground, valved  
*Water Sample* Conductivity: 1636 micromhos/cm, Temperature: 11.10° C.  
 Collected 12:28 AM, 16 May 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15
Pressure head (feet)	3	3.25	3.50	3.50	3.75	3.75	3.75	3.75	3.75

Shut in time (minutes)	20	25	30	35	40	50	60	70	80	100
Pressure head (feet)	3.75	3.75	4	4	4	4	4	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

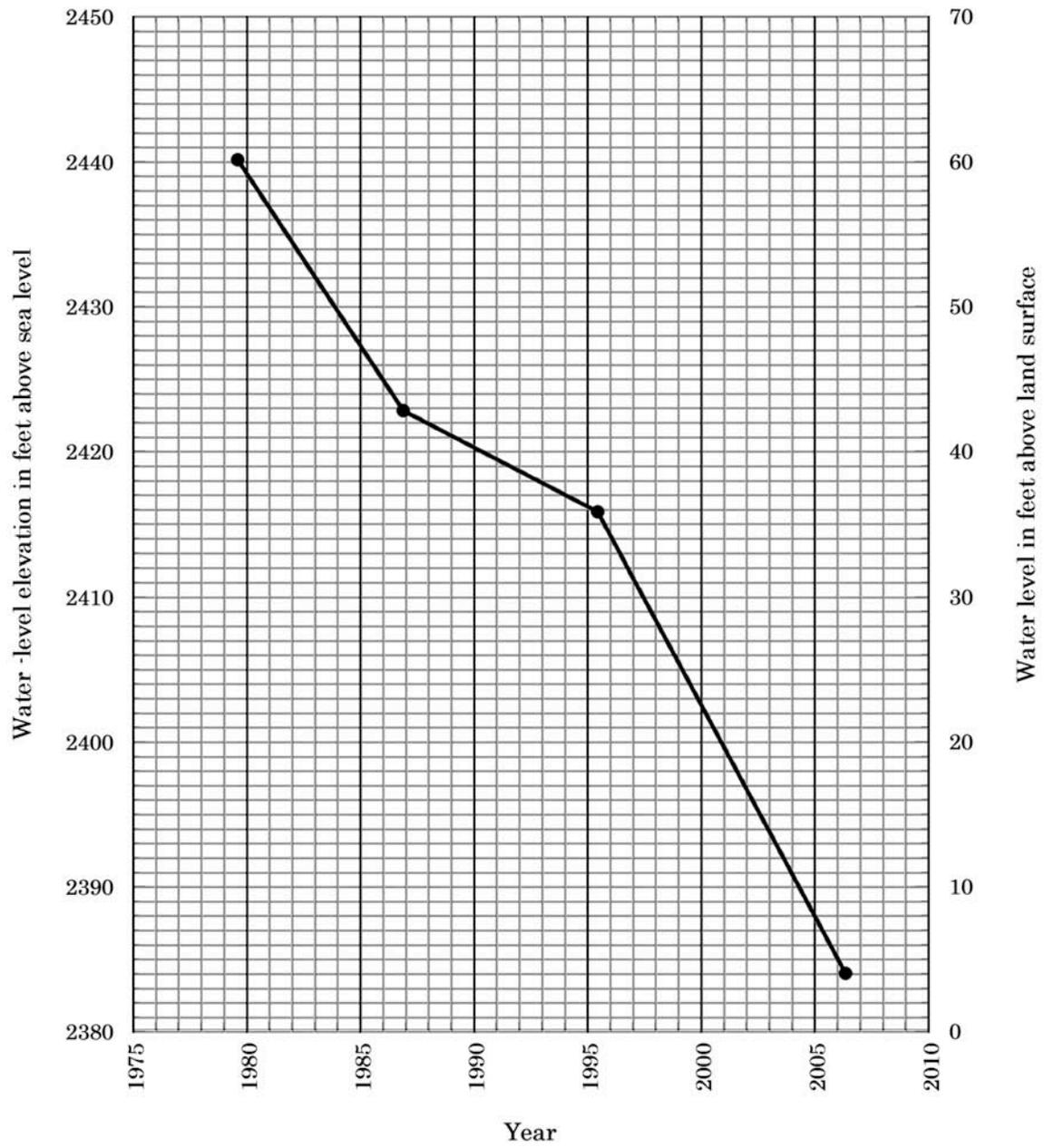
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
16 Aug. 1979			+60.1 ft		Lawrence Anna
4 Dec. 1986		1 hour	+42.8 ft.	-2.4 ft/yr	Allen Comeskey
21 June 1995	2.86 gpm	2 hours	+35.8 ft.	-0.9 ft/yr	Alan Wanek
16 May 2006		1 hour	+4.0 ft.	-2.9 ft/yr	Merlyn Skaley

**141-102-10ABD**

**Lithologic Log**

<u>Unit</u>	<u>Description</u>	<u>Depth (ft.)</u>
CLAY	Brown, sandy	0-45
CLAY	Gray	45-110
LIGNITE		110-120
CLAY	Gray	120-130
LIGNITE		130-145
CLAY	Gray	145-250
SAND	Gray, fine grained	250-335
CLAY	Gray with layers of lignite	335-355
SANDSTONE		355-358
CLAY	Gray with layers of lignite	378-454
SANDSTONE		474-480
CLAY	Gray	480-650
SANDSTONE		650-653
CLAY	Gray	653-754
SANDSTONE		754-759
CLAY	Gray	759-915
SAND	Fine grained	915-935
CLAY	Gray with layers of lignite	935-1350
SANDSTONE		1350-1352
CLAY		1352-1358
SAND	Gray, water bearing	1358-1440

# Water-level fluctuations in the US Forest Service/Cecil Adams well 141-102-10ABD



## Water quality

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Well location	141-102-10ABD
Owner	USFS/Medora Grazing Assoc.
Date sampled	16 May 2006
Water temperature	11.10 degrees Celsius
Lab conductivity	1780 micromhos/cm
pH	8.71
Calcium	<2 milligrams per liter
Magnesium	<1 milligrams per liter
Potassium	<1 milligrams per liter
Sodium	383 milligrams per liter
Iron	0.184 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	3.57 milligrams per liter
Bicarbonate	717 milligrams per liter
Carbonate	41 milligrams per liter
Sulfate	179 milligrams per liter
Chloride	67.5 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1100 milligrams per liter
Hardness	9 milligrams per liter
Sodium adsorption ratio	55.2
Residual sodium carbonate	13 Equivalent/liter
Percent sodium	98.9

Perry Rottinger/Forest Service/Grazing Association well at 141-102-10ABD



**142-102-4BCB**

*Date Completed:* NA *Purpose:* Stock Well  
*L.S. Elevation (ft):* 2230' *Well Type:* 1.25" Steel  
*Depth Drilled (ft):* NA *Aquifer:* Fox Hills-Hell Creek.  
*Screened Interval (ft):* \*817' *Source:* Bill, G.V., Slo. Co. Study

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*Owner:* US Forest Service/Karen Obrigewitch/Box 314, Wibaux, MT 59353  
*Address:* 161 West 21st Street, Dickinson, ND 58601  
*Telephone #:* Karen - 701-225-5151/Dey Obrigewitch (son) - 565-2369

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*Farmstead location:*

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*Well Location:* Roosevelt Creek, 2 miles west of L. Mo. Valley  
*Directions to well:* Take improved trail west from road about 3/4 mile, cross 10 ft dia. culvert at draw, 100 ft SW of culvert take approach to well 200 ft to the south  
*Wellhead description: (casing & plumbing)* 1.25 inch casing extends 2 ft, T to stock tank, other line to vertical  
*Water Sample* Conductivity: 1947 micromhos/cm, Temperature: 17.90° C.  
 Collected 2:17 PM, 16 May 2006

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**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20
Pressure head (feet)	20	22	25	27	28	30	32	38	39	41
Shut in time (minutes)	25	30	35	40	50	60	70	80	100	120
Pressure head (feet)	41	42	45	45	45	45	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
30 Aug. 1968			+130.5 ft.		Lawrence Anna
Dec. 1986		2 hours	+91.5 ft.	-2.1 ft/yr	Allen Comeskey
15 Jun. 1995	.75 gpm	2 hours	+89.8 ft.	-0.2 ft/yr	Alan Wanek
16 May 2006	4 gpm	1 hour	+45.0 ft.	-4.1 ft/yr	Merlyn Skaley

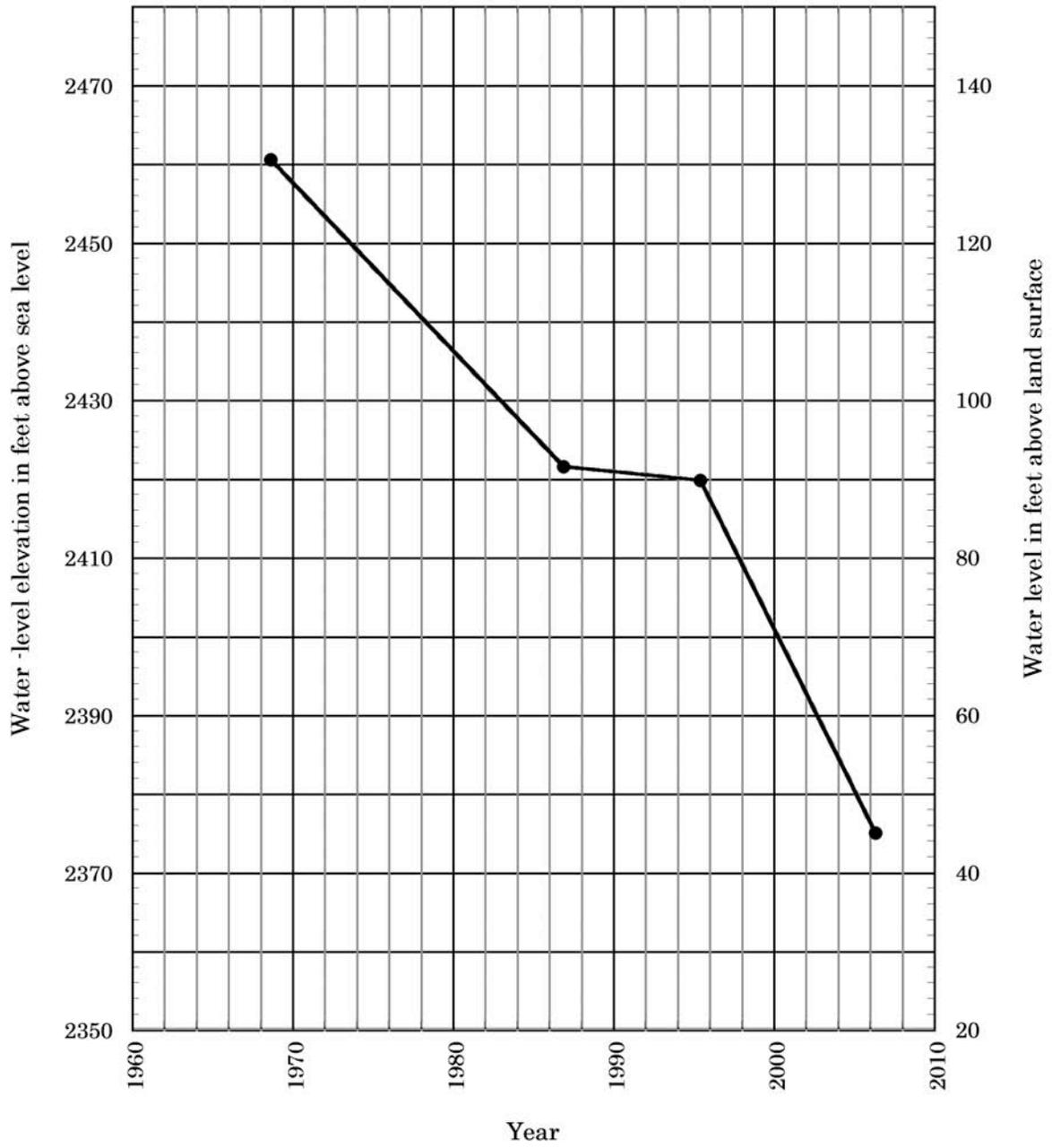
\*Depth of well is 400 feet above where the Fox Hills aquifer is usually encountered. However, the pressure head falls right in with other Fox Hills wells. It is assumed the depth of the well is incorrect.

**142-102-4BCB**

Lithologic Log

No lithologic log available

Water-level fluctuations in Medora Grazing Ass./Obrigewitch well 142-102-04BCB



## Water quality

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Well location	142-102-4BCB
Owner	Medora Grazing Assoc.
Date sampled	16 May 2006
Water temperature	17.90 degrees Celsius
Lab conductivity	2160 micromhos/cm
pH	8.38
Calcium	2.43 milligrams per liter
Magnesium	1 milligrams per liter
Potassium	1.31 milligrams per liter
Sodium	505 milligrams per liter
Iron	0.109 milligrams per liter
Manganese	0.010 milligrams per liter
Fluoride	2.69 milligrams per liter
Bicarbonate	1430 milligrams per liter
Carbonate	18 milligrams per liter
Sulfate	0.45 milligrams per liter
Chloride	12.8 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1340 milligrams per liter
Hardness	10 milligrams per liter
Sodium adsorption ratio	68.8
Residual sodium carbonate	24 Equivalent/liter
Percent sodium	99.1

Karen Obrigewitch/Grazing Association well at 142-102-04BCB



View looking east

**144-102-29BBA**

<i>Date Completed:</i>	1 Oct. 1960	<i>Purpose:</i>	Stock Well
<i>L.S. Elevation (ft):</i>	2210'	<i>Well Type:</i>	1.25" Steel
<i>Depth Drilled (ft):</i>	1200'	<i>Aquifer:</i>	Fox Hills-Hell Creek
<i>Screened Interval (ft):</i>	NA	<i>Source:</i>	Bill,. G.V., Slo. Co. Study

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*Owner:* Ken Johnson

*Address:* 10296 Highway 32, Walhalla, ND 58282

*Telephone #:* 701-565-2288 (Squaw Gap exchange)

*Farmstead location:* Elkhorn Ranch area

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*Well Location:* Billings Co., 2 miles NW of ranch

*Directions to well:* Trail in from south, right at Morgan Draw, bear right around oil well, about 800 feet down draw to well, along fence

*Wellhead description: (casing & plumbing):* Casing extends 2 feet, elbow, faucet, to old wooden stock tank, with tan tank inside

*Water Sample* Conductivity: 1,642 micromhos/cm, Temperature: 16.30° C.  
 Collected 4:18 PM, 16 May 2006

**Shut in time vs. pressure head: 2006 measurements**

Shut in time (minutes)	1	2	3	4	5	7	9	12	15	20
Pressure head (feet)	4	4.5	4.75	4.9	5	5	5	5	5.1	5.1

Shut in time (minutes)	25	30	35	40	50	60	70	80	100	120
Pressure head (feet)	5.1	5.1	5.1	5.1	5.1	5.1	NA	NA	NA	NA

**Long term pressure head measurements  
(in feet above land surface)**

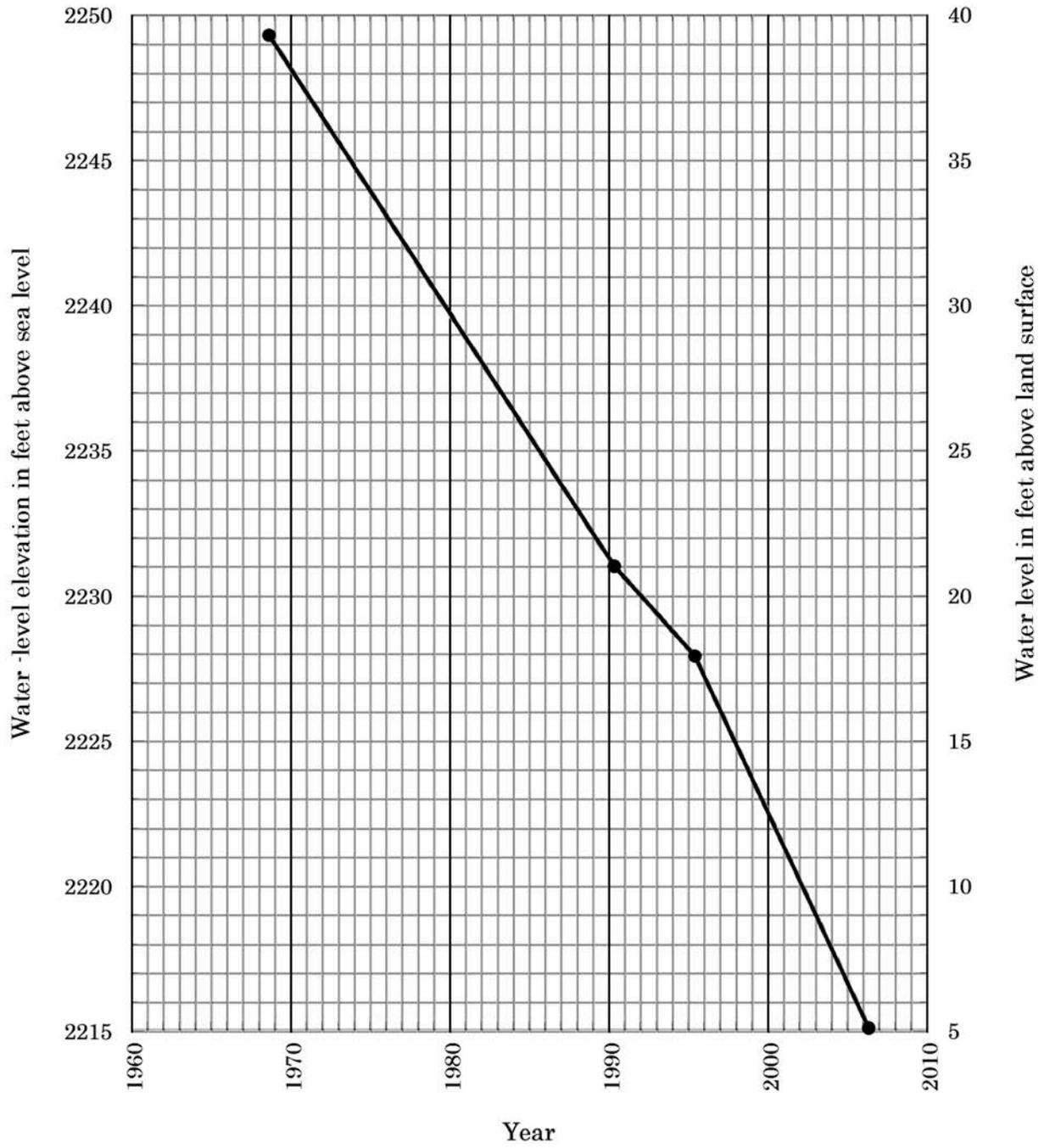
Date	Flow rate	Shut-in time	Pressure head	Rate of change	Measurement made by
30 Aug. 1968			+39.3 ft.		Lawrence Anna
15 May 1990		5 min.	+21.0 ft.	-0.8 ft/yr	Alan Wanek
15 Jun. 1995	1.74 gpm	2 hours	+17.9 ft.	-0.6 ft/yr	Alan Wanek
16 May 2006	1 gpm	1 hour	+5.1 ft.	-1.2 ft/yr	Merlyn Skaley

**144-102-29BBA**

Lithologic Log

No lithologic log available

Water-level fluctuations in Johnson well 144-102-29BBA



## **Water quality**

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Well location	144-102-29BBA
Owner	Ken Johnson
Date sampled	16 May 2006
Water temperature	16.30 degrees Celsius
Lab conductivity	1830 micromhos/cm
pH	8.54
Calcium	<2 milligrams per liter
Magnesium	<1 milligrams per liter
Potassium	1.04 milligrams per liter
Sodium	411 milligrams per liter
Iron	0.019 milligrams per liter
Manganese	<0.01 milligrams per liter
Fluoride	4.08 milligrams per liter
Bicarbonate	822 milligrams per liter
Carbonate	36 milligrams per liter
Sulfate	160 milligrams per liter
Chloride	53.9 milligrams per liter
Nitrate	<0.09 milligrams per liter
Total dissolved solids	1130 milligrams per liter
Hardness	9 milligrams per liter
Sodium adsorption ratio	59.2
Residual sodium carbonate	14 Equivalent/liter
Percent sodium	99

Ken Johnson well at 144-102-29BBA

