South Dakota's Ground Water Quality Monitoring Network

Project Completion Report

Section 319 Nonpoint Source Pollution Program

By:

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Division of Financial and Technical Assistance
South Dakota Department of Environment and Natural Resources

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EXECUTIVE SUMMARY

This is the project completion report for the South Dakota Department of Environment and Natural Resources' four-year project entitled the *Expansion of a Permanent Ground Water Quality Monitoring Network.* The report also presents information on the two-year continuation of the project entitled *Work Plan Amendment for Expansion of a Permanent Ground Water Quality Monitoring Network*. Work began on the project in May 1995 and was performed by the Geological Survey Program, Division of Financial and Technical Assistance, Department of Environment and Natural Resources.

The goal of this project was to establish a network of permanent monitoring wells in many of South Dakota's shallow, sensitive aquifers. Prior to this project there were a limited number of monitoring sites established in only seven aquifers. As a result of this project, there are now a total of 145 monitoring wells at 80 sites in 25 of the state's shallow, sensitive aquifers. This permanent ground water quality monitoring network allows for the efficient collection of representative water samples, giving us the ability to assess the water quality in shallow aquifers across the state.

This project has been a cooperative effort between three state agencies – the Department of Environment and Natural Resources, the South Dakota Department of Agriculture, and the South Dakota Department of Health. The importance of the monitoring network and the water quality information gathered cannot be overstated. Uses of the monitoring network include:

- Assessment of the ambient quality of water in many of South Dakota's shallow, sensitive aquifers.
- Identification of water quality supply problems before public drinking water supplies are affected.
- Determination of ambient water quality for Source Water Protection efforts.
- Incorporated as the backbone of the monitoring component of the state's Pesticide Management Plan.
- Used as a "model" ground water quality monitoring program that other states in the United States have looked to for guidance in establishing their own monitoring programs.

The funding for this project was primarily through a 319 Grant from the U.S. Environmental Protection Agency and through South Dakota General Funds. During the first four years of this project, only about one-half of the estimated funds necessary for the project were expended; therefore, the project was extended for an additional two years.

The initial four-year project (*Expansion of a Permanent Ground Water Quality Monitoring Network*) project had the following four objectives:

1. to select appropriate monitoring sites,
2. to install the monitoring network,
3. to develop newly installed monitoring wells, and
4. to disseminate project information.

The two-year project continuation (*Work Plan Amendment for Expansion of a Permanent Ground Water Quality Monitoring Network*) added an additional objective:

5. expand the testing and reporting related to the monitoring network.

The Geological Survey Program regularly samples water from the entire monitoring network. The samples are being analyzed for general inorganic chemistry, trace metals, cyanide, radionuclides, volatile organic compounds, and pesticides by the South Dakota Department of Health. The current frequency of sampling is as follows. All monitoring sites are sampled once per year for examination of long-term trends in water quality. At present, eighteen of the monitoring sites are sampled an additional three times for nitrogen and/or pesticide compounds during the spring through fall months to examine possible short-term changes in water quality due to agricultural practices.

The initial four-year water quality monitoring study identified two monitoring sites as showing persistent water quality problems. One site located near Egan, South Dakota, had a relatively high rate of pesticide detections compared to the rest of the monitoring network. Another water quality monitoring site located near Wewela, South Dakota, had the highest nitrate concentrations observed in the network, with some concentrations exceeding 200 milligrams per liter. Because of the unique water problems identified at these sites, both of these sites were selected for additional study during the two-year project continuation. Six additional monitoring wells have been installed at each of these sites, and additional study is ongoing at both of these sites.

The monitoring network has been a great success. All of the original objectives, goals, and milestones laid out in the work plans have been accomplished, and in some cases even exceeded. Water quality information collected through the water quality monitoring network established by this project is a valuable asset to the state. This information is being used by federal, state, and local agencies, as well as the general public. The monitoring effort is a valuable, cost effective, and proactive approach to defining long-term and short-term trends in water quality in many of South Dakota's most sensitive aquifers.

INTRODUCTION

This is the project completion report for the South Dakota Department of Environment and Natural Resources' (DENR) four-year project entitled the *Expansion of a Permanent Ground Water Quality Monitoring Network.* The report also presents information on the two-year continuation of the project entitled *Work Plan Amendment for Expansion of a Permanent Ground Water Quality Monitoring Network*. Work began on the project in May 1995 and was performed by the Geological Survey Program, Division of Financial and Technical Assistance, DENR.

There were already 40 permanent ground water monitoring sites in the state prior to initiation of this project but they were limited to only seven aquifers. The goal of this project was to expand beyond those sites and establish a network of permanent monitoring wells in many of the shallow, sensitive aquifers throughout South Dakota.

Three state agencies – the DENR, the South Dakota Department of Agriculture, and the South Dakota Department of Health – have all worked together to plan this project and to keep it going. This project was also conducted concurrently with another effort being undertaken by DENR to sample and assess the water quality in shallow aquifers throughout much of the state. Newly established water quality monitoring wells were equipped with dedicated ground water purging/sampling equipment to provide consistency with the permanent monitoring sites already in existence and to allow efficient collection of representative water samples.

The objectives of the initial four-year project were:

1. select appropriate monitoring sites,
2. install the monitoring network,
3. develop newly installed monitoring wells, and
4. disseminate project information.

The two-year project continuation added a fifth objective to the project:

5. expand the testing and reporting related to the monitoring network. The monitoring network is designed to facilitate development of an understanding of water quality for a large geographic area that includes differing climatic conditions, geologic conditions, and land-use practices.

The importance of the monitoring network and the water quality information gathered cannot be overstated. Uses of the monitoring network include:

- Assessment of the ambient quality of water in many of South Dakota's shallow, sensitive aquifers.
- Identification of water quality supply problems before public drinking water supplies are affected.
- Determination of ambient water quality for Source Water Protection efforts.

- Incorporated as the backbone of the monitoring component of the state's Pesticide Management Plan.
- Used as a "model" ground water quality monitoring program that other states in the United States have looked to for guidance in establishing their own monitoring programs.

The monitoring network was the recipient of a 1998 United States Environmental Protection Agency (EPA) Region VIII Environmental Excellence Award. The award was for the design and implementation of a ground water quality monitoring program. The monitoring effort is a valuable, cost effective, and proactive approach to defining long-term and short-term trends in water quality in many of South Dakota's most sensitive aquifers.

PROJECT FUNDING

The initial four-year project was funded primarily through a 319 Grant from EPA and through State General funds appropriated to DENR. Funds provided by the grant were for installation of the monitoring network.

The 319 funding necessary to complete the initial four-year project was based on the estimated amount of time and materials needed to complete the field activities, time needed to complete the office portions of the project, and the availability of funds from other sources. Budget categories and the amount budgeted are shown in Table 1. Amounts debited against the 319 project funds are also shown on the table. Considerably less money was expended than originally anticipated. This is attributed to efficiencies realized as work progressed, less time spent in the field than originally expected, less drilling and fewer well installations than originally expected, and the use of approximately $40,860 of federal money from the FY96 Performance Partnership Grant (PPG) for personal services and employee benefits.

Well construction materials, such as well casing, screens, cement, and bentonite, were used from existing Geological Survey Program inventory. Therefore, costs for these materials were not debited against the project and the expenditure of state funds for supplies was less than budgeted. Also, depreciation of the drilling rig was not debited against the project.

The dedicated sampling systems which are installed in each water quality monitoring well were originally budgeted (capital assets) to be purchased using only 319 dollars. However, state classification of this equipment considered only the pumps to be capital assets with the rest of the system to be classified as supplies. In addition, approximately $8,140 in PPG funds were used to purchase the capital asset portion of the dedicated sampling systems. For these reasons, and because far fewer wells were installed than originally planned, the expenditure of 319 funds for the purchase of capital assets was less than expected.

As shown on Table 1, only $124,379 of the estimated $236,945 in federal dollars that would be necessary to complete the initial four-year project were expended. The reasons for lower than anticipated expenditures as explained above, resulted in over $112,000 of the original grant not being used. Therefore, the original four-year workplan was amended to include a two-year

continuation of the project. Budget categories and the amounts budgeted for the two-year project continuation are shown on Table 2. Not all of the available federal money was expended on the project continuation. This was mainly due to less time spent in the field than originally anticipated. Also, considerably more state funds were expended than originally anticipated. Most of the difference can be attributed to contractual costs associated with the laboratory analysis of water samples.

PROJECT DESCRIPTION

During previous studies, DENR identified areas of some shallow outwash aquifers that had nitrate-nitrogen concentrations in excess of the drinking-water standard. As a result of these findings, and because of growing concerns regarding the possible contamination of shallow ground water by pesticides, regular and systematic monitoring of shallow ground water was initiated by the DENR in 1988. Water quality has been regularly monitored in the Parker-Centerville and Vermillion-West-Fork aquifers since 1988, the Big Sioux and Bowdle aquifers since 1989, and the Delmont aquifer since 1992. This monitoring effort found nitrate-nitrogen and pesticides in shallow ground water that are attributable to nonpoint-source contamination.

The original project and the project continuation represent only one component of a larger plan to expand the systematic monitoring approach described above to 25 shallow, sensitive aquifers in the state. Sensitive aquifers are those that are likely to be impacted by human activities because of their near-surface occurrence. The monitoring plan for these aquifers includes the examination of: general inorganic chemistry, trace metals, cyanide, radionuclides, volatile organic compounds, and pesticides. Long-term monitoring of this type will allow for the best possible management of the state's water resources and for promulgation and implementation of sound and reasonable regulatory or voluntary restoration practices.

The goals of this project were:

1. establish a network of permanent monitoring wells in sensitive shallow aquifers in South Dakota,
2. equip the wells with dedicated ground water purging/sampling equipment, and
3. conduct a long-term statewide ground water quality monitoring program designed to evaluate water quality changes and determine the impact of nonpoint-source pollution.

Completion of this project has provided the physical system needed to begin assessing nonpoint-source pollution in South Dakota's shallow, sensitive aquifers. The area addressed by the project includes shallow aquifers over much of the state, exclusive of the bedrock aquifers in and around the Black Hills. The bedrock aquifers in the Black Hills area were excluded from this project because this area is being addressed through the Black Hills Hydrology Study.

The initial four-year project (*Expansion of a Permanent Ground Water Quality Monitoring Network*) project had the following four objectives:

1. to select appropriate monitoring sites,

2. to install the monitoring network,
3. to develop newly installed monitoring wells, and
5. to disseminate project information.

The two-year project continuation (*Work Plan Amendment for Expansion of a Permanent Ground Water Quality Monitoring Network*) added an additional objective:

5. expand the testing and reporting related to the monitoring network.

Past investigations in South Dakota have shown that nested wells are necessary for adequate examination of the shallow aquifer water quality. Therefore, project plans called for one water quality well to be installed at or near the water table and a second water quality well to be installed with the water-intake area located some distance below the water table. However, as the project progressed, it was determined that there was sometimes insufficient aquifer thickness to allow for the installation of nested wells. In such cases, one well was installed so that the water-intake area was at or near the water table. All of the monitoring sites were chosen to avoid known or suspected sources of point-source pollution.

The initial project plan called for the installation of approximately 128 four-inch diameter water quality monitoring wells to be installed at 64 sites across the state of South Dakota. This number of wells assumed two water quality wells at different depths (nested wells) at each site. During the project, 68 water quality monitoring wells were installed at 40 sites. Several reasons contributed to the establishment of fewer monitoring sites and wells than initially planned. Principle among these were field checking of aquifers and drilling at possible monitoring sites showed that some sites did not meet one or more of the site selection criteria described later in this report.

In addition to the four-inch water quality monitoring wells, there was a need for a two-inch diameter well for the measurement of water levels near each site. This type of well permits the regular measurement of water levels without threatening the integrity of the samples collected from the water quality wells. This type of well also allows for the installation of data loggers and pressure transducers for continuous measurement of water levels where the need arises. Wherever possible, existing wells controlled and maintained by the DENR's Water Rights Program were used for the measurement of water levels. Where these wells were not available, new two-inch diameter wells were installed. A total of 18 two-inch diameter wells were installed during the initial project segment.

Although the project continuation workplan included the establishment of additional monitoring sites, subsequent test-hole drilling did not encounter sufficient aquifer materials in which the wells could be installed. However, as a result of the project continuation, additional monitoring wells were installed in the general area of two monitoring sites that had shown unique water quality problems. These two sites will be discussed in a later section of this report.

AQUIFERS WITH PERMANENT MONITORING SITES PRIOR TO THIS PROJECT

Seven shallow, sensitive aquifers had a total of 40 permanent ground water monitoring sites prior to funding of this project by EPA. These aquifers are the Big Sioux, Skunk Creek, Parker-Centerville, Vermillion-West-Fork, Bowdle, Delmont, and Ogallala/Sand Hills (Figure 1). Additional monitoring sites were not planned through this project for the Big Sioux, Skunk Creek, and Ogallala/Sand Hills aquifers. However, additional monitoring sites were planned for the Parker-Centerville, Vermillion-West-Fork, Bowdle, and Delmont aquifers. Mention is made here of these aquifers with existing monitoring sites to illustrate how this project fits into a statewide effort.

For the sake of clarity, the following information is provided regarding the Skunk Creek aquifer. The DENR's electronic databases identify this aquifer as the Big Sioux aquifer, specifically, the Northern, Middle, and Southern Skunk Creek management units of the Big Sioux aquifer. However, this aquifer is commonly referred to as the Skunk Creek aquifer and will be referred to as such in this report.

AQUIFERS INITIALLY SELECTED FOR WELL INSTALLATION

The shallow aquifers addressed by this project are of three general types: glacial outwash, bedrock, and alluvial. The aquifers initially chosen for well installation are shown on Figure 2. Significant portions of these unconfined aquifers have shallow water tables. These aquifers are used to supply water for drinking and irrigation. Some of the aquifers receive limited use due to the sparse population of many areas of the state.

Most of the state's population relies on shallow ground water for drinking water. Deterioration of water quality in any of these aquifers to the point where they no longer meet drinking water standards would have a significant impact on those who use the water because there is often no other water source of equal quality which is economically accessible. The design of the monitoring network will provide an understanding of water quality for a large area that includes differing climatic conditions, geologic conditions, and land-use practices.

The Arikaree and Fox Hills bedrock aquifers in western South Dakota (Figure 2) are more extensive than shown. The illustrated portions of these aquifers represent only the areas where these two geologic units are exposed at land surface and considered to be most sensitive to contamination. Elsewhere, these aquifers are either absent or buried beneath other geologic units.

SELECTION OF SITES FOR WELL INSTALLATION

The number of monitoring sites initially planned for each aquifer is shown in Table 3. The quantity and locations of monitoring sites actually established in these aquifers were determined through performance of field work for this project. Four of the aquifers shown in Table 3 had permanent monitoring sites prior to funding of this project. These four aquifers are the: Parker-Centerville, Vermillion-West-Fork, Bowdle, and Delmont aquifers. Additional monitoring sites

were judged to be necessary for these aquifers because intensive agricultural/irrigation practices occur over the aquifers and the historic water quality data from these aquifers indicate that agricultural chemicals have been detected in some portions of these aquifers.

The planned number of monitoring sites per aquifer (Table 3) was subjectively determined by DENR. Factors considered were (1) aquifer size, (2) water use, (3) land use, (4) availability of personnel and equipment for the installation, development, and sampling of the wells, (5) probable laboratory costs for analyses of the water, and (6) the number of existing monitoring sites, if any, available in a particular aquifer.

The four criteria used in the selection of specific monitoring sites are listed below. The site must:

1. be representative of typical land use over the aquifer,
2. not be near any known or suspected point source of pollution,
3. if possible, be over a part of the aquifer that is thick enough to accommodate nested wells, and
4. be readily accessible to the drilling equipment of the Geological Survey Program and must be reasonably accessible in inclement weather for future sampling.

In addition, where multiple monitoring sites were planned for an aquifer and when hydrogeologic conditions permitted, sites were chosen which represented a broad geographic area of an aquifer and varied land use practices over the aquifer. Other information considered when selecting monitoring locations came from a network of more than 1,500 monitoring wells maintained by DENR's Water Rights Program. These wells are used primarily for the measurement of water levels and are not usually suitable for the collection of water samples. Some of them are located in the aquifers addressed in the Statewide Ground Water Quality Monitoring Network. Also considered was a database containing more than 32,000 lithologic logs. In an effort to reduce the amount of exploratory drilling needed to locate a suitable monitoring site, records of existing wells and test holes were used to help guide the site selection process.

MONITORING SITES ESTABLISHED FOR THE INITIAL PROJECT

Monitoring sites established in federal fiscal years 1995, 1996, 1997, and 1998, the first four years of the project, are shown on Figure 3 and are listed in Table 3. As a result of this project, additional monitoring sites were established in all of the aquifers identified in the workplan except: the Crow Creek, Delmont, Elm Creek, Fox Hills, and Little White River. These additional monitoring sites, along with the pre-existing monitoring sites have resulted in a monitoring network which consists of 145 wells at 80 sites in 25 different aquifers (Figure 4 and Table 4). Diagrams of all of the monitoring sites currently in the network can be found in Appendix A.

RESULTS OF THE TWO-YEAR PROJECT CONTINUATION

The initial water quality monitoring study identified two monitoring sites as showing persistent water quality problems. One site located near Egan, South Dakota, consisting of monitoring wells R20-89-49 and R20-89-50, (Figure 5) had a relatively high rate of pesticide detections compared to the rest of the monitoring network. Because of the relatively high rate of pesticide detections at this site, it was selected for further water quality investigation. A plan was developed that called for the installation of six additional two-inch monitoring wells. All six of the additional wells were installed in the area (Figure 6), and eight water samples were collected for pesticide and pesticide metabolite (breakdown/degradation products of pesticides) analyses. Seven of the eight samples had pesticide and/or pesticide metabolite detections. Additional study is ongoing in this area.

The water quality monitoring site located near Wewela, South Dakota, consisting of monitoring wells R20-94-40 and R20-94-41, (Figure 5) had the highest nitrate concentrations observed in the network, with some concentrations exceeding 200 milligrams per liter (mg/L). Therefore, this site was also selected for further hydrogeologic investigation. A plan was developed that called for the installation of six additional two-inch monitoring wells. The two original monitoring wells and the six newly installed monitoring wells (Figure 7) at this site have been sampled several times in the last two years. Results of the sampling indicate that the area of elevated nitrate concentrations appears to be restricted to the general area of the original monitoring wells. The source of the nitrates is presently unknown. Additional study of the area is ongoing.

RESULTS OF RECENT WATER QUALITY SAMPLING

The South Dakota Ground Water Quality Monitoring Network presently consists of 145 wells at 80 sites in 25 shallow aquifers, not including the additional monitoring wells installed at Egan and Wewela. The first year in which all 80 of the monitoring sites were sampled was 1999. The table shown below lists the number of samples collected from the monitoring network during the time period covered by this report – federal fiscal years 1995 through 2000.

Federal Fiscal year	1995	1996	1997	1998	1999	2000
Number of samples collected	242	199	196	211	247	254

The results of this comprehensive monitoring have been fairly consistent and shown that the overall "health" of South Dakota's shallow, sensitive aquifers is rated as good. However, some of the monitoring sites have shown elevated nitrate concentrations that are at or above EPA's Maximum Contaminant Level (MCL) of 10 mg/L. Pesticide detections have also occurred at some of the monitoring sites. Two samples contained concentrations of cyanazine in excess of the Lifetime Health Advisory (LTHA) of 1.0 micrograms per liter (µg/L). No other samples contained had pesticide concentrations in excess of their MCL or LTHA. A summary of nitrate and pesticide detections for the last four years of this project is shown below.

Federal Fiscal year	1997	1998	1999	2000
Number of sites sampled	68	73	80	80
Percent of sites where pesticides were detected	21	19	16	24
Percent of sites having nitrate concentrations $\geq$ 10 mg/L	22	21	24	23

A comprehensive report that describes the monitoring network and the water quality results in detail is available through the Internet by accessing DENR's Geological Survey Program webpage at www.sdgs.usd.edu.

SUMMARY AND CONCLUSIONS

The monitoring sites established by this project, together with the sites that existed prior to this project, have provided South Dakota the base to begin assessing the general health of many of the state's shallow aquifers. The extent of the monitoring network as it presently exists is shown on Figure 4. The network may be downsized, expanded, or sites within the network relocated in the future based on information gathered from the network and by information needs that arise in the future.

Diagrams of the construction of all water quality wells and the generalized subsurface conditions at each monitoring site are presented in Appendix A. Water levels on various dates are also indicated on these diagrams. The water level is measured each time a water sample is collected. Measured water levels through the 1997 sampling season are presented in Appendix B. Records such as these will aid in the interpretation of trends in water quality that may become evident over time.

The Geological Survey Program regularly samples water from the network. The samples are being analyzed for general inorganic chemistry, trace metals, cyanide, radionuclides, volatile organic compounds, and pesticides by the South Dakota Department of Health. The current frequency of sampling is as follows. All monitoring sites are sampled once per year for examination of long-term trends in water quality. At present, eighteen of the monitoring sites are sampled an additional three times for nitrogen and/or pesticide compounds during the spring through fall months to examine possible short-term changes in water quality due to agricultural practices.

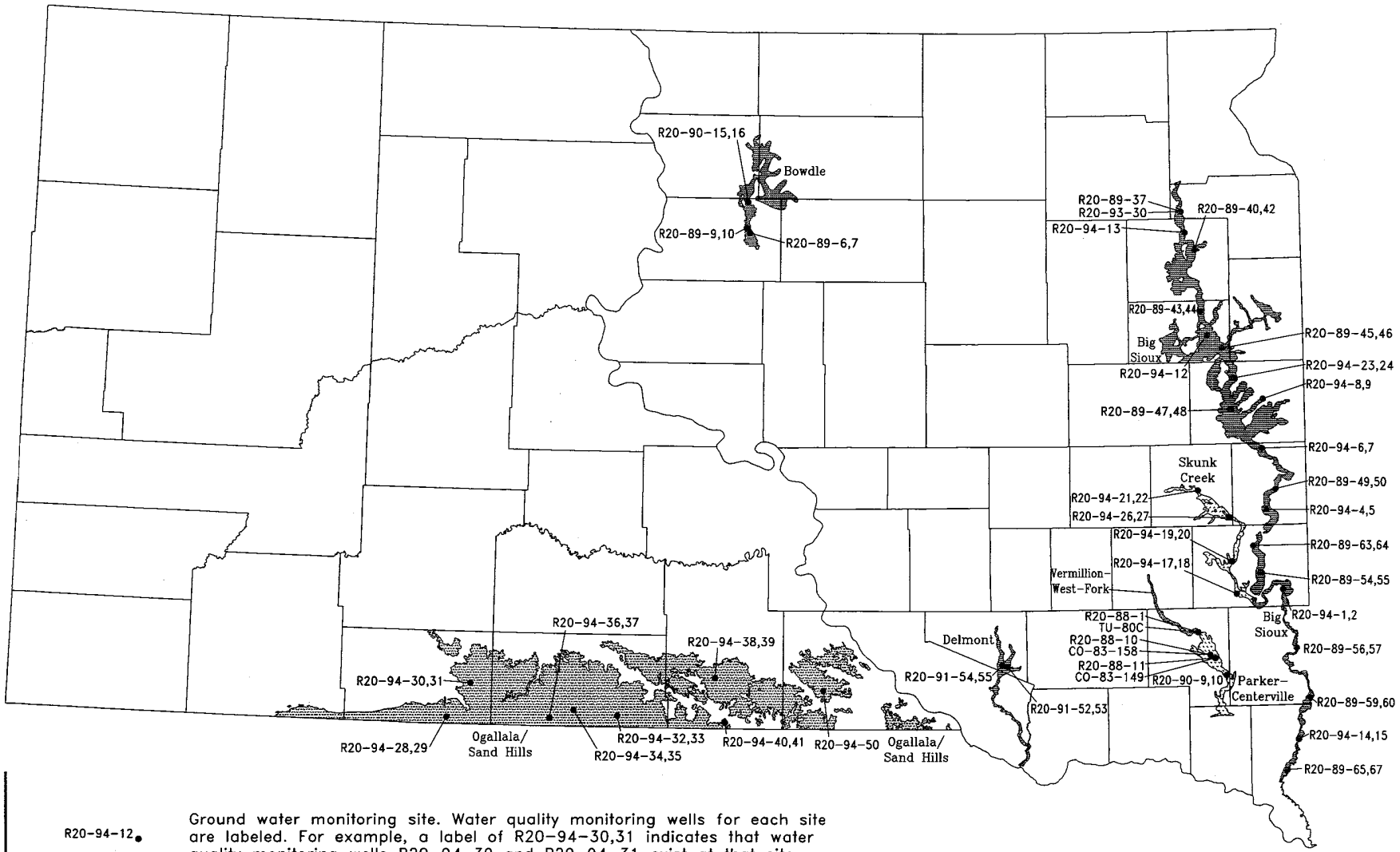
The monitoring results have shown that the overall "health" of South Dakota's shallow, sensitive aquifers is rated as good. However, some of the monitoring sites have shown nitrate concentrations above the MCL. Some of the monitoring sites have also had pesticide detections, two of which exceeded the LTHA for cyanazine. Additional study of the areas with these types of water quality problems is ongoing.

The importance of the monitoring network itself and the water quality information gathered from it cannot be overstated. The monitoring network has been a great success. All of the original objectives, goals, and milestones laid out in the work plans have been accomplished, and in some cases even exceeded. The network allows South Dakota to begin assessing the ambient quality of water in many shallow, sensitive aquifers in the state. The network allows for the identification of

water quality problems before public drinking water supplies are affected. Information from the network can be used in Source Water Protection efforts as a basis for determination of ambient water quality. The monitoring network and associated activities are the backbone of the monitoring component of the state's Pesticide Management Plan. The monitoring network also serves as a "model" ground water quality monitoring program that other states in the U.S. have looked to for guidance in establishing monitoring programs. The monitoring network was the recipient of a 1998 EPA Region VIII Environmental Excellence Award. The award was for the design and implementation of a ground water quality monitoring program. The monitoring effort is a valuable, cost effective, and proactive approach for defining long and short term trends in water quality in many of South Dakota's most sensitive aquifers.

Based on our present findings, further assessment of the water in the state's shallow, sensitive aquifers is warranted. This effort should include continued monitoring of existing wells and an ongoing evaluation of the parameters currently being analyzed. In addition, new monitoring sites could be developed to further evaluate areas where contamination is suspected on the basis of previous monitoring.

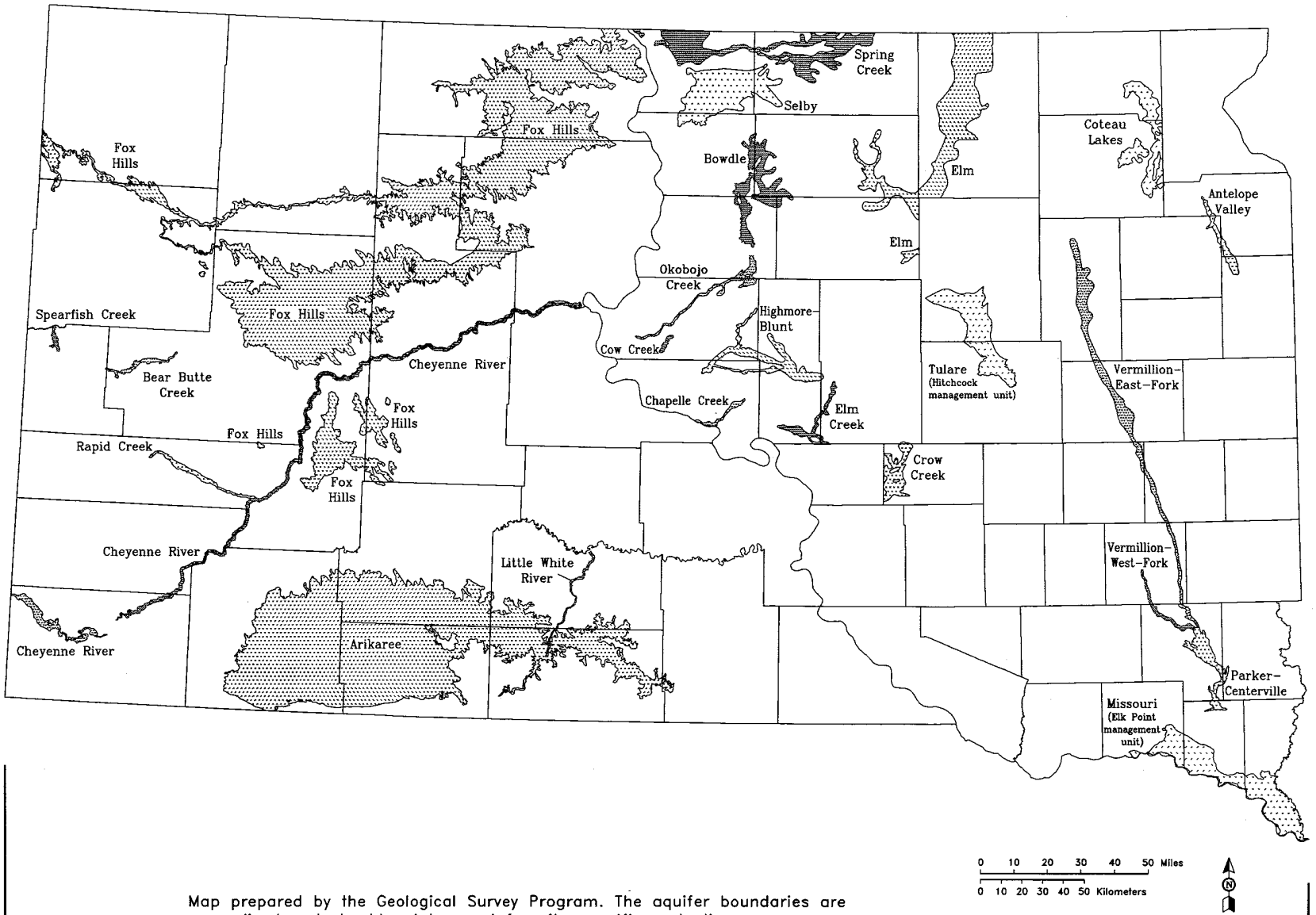
Federal agencies, state agencies, local governments, and the public have all utilized data collected from the monitoring network. The results of this monitoring have been presented at both local and regional conferences/meetings. Yearly summary reports have been sent to water development districts, conservation districts, county agents, water superintendents, tribal officials, rural water systems, and natural resources conservation service offices. Also, a comprehensive report that describes the monitoring network and the water quality results in detail is available through the Internet by accessing DENR's Geological Survey Program webpage at www.sdgs.usd.edu. If additional information is required, contact the Geological Survey Program, Department of Environment and Natural Resources, 414 East Clark, Vermillion, South Dakota 57069 (phone 605-677-5227). Information on lithology, well construction, and water quality is available in either hard copy or electronic form.



R20-94-12● Ground water monitoring site. Water quality monitoring wells for each site are labeled. For example, a label of R20-94-30,31 indicates that water quality monitoring wells R20-94-30 and R20-94-31 exist at that site.

Map prepared by the Geological Survey Program. The aquifer boundaries are generalized and should not be used for site-specific evaluations.

Figure 1. Aquifers with permanent ground water monitoring sites prior to this project.



Map prepared by the Geological Survey Program. The aquifer boundaries are generalized and should not be used for site-specific evaluations.

Figure 2. Aquifers initially selected for well installation.

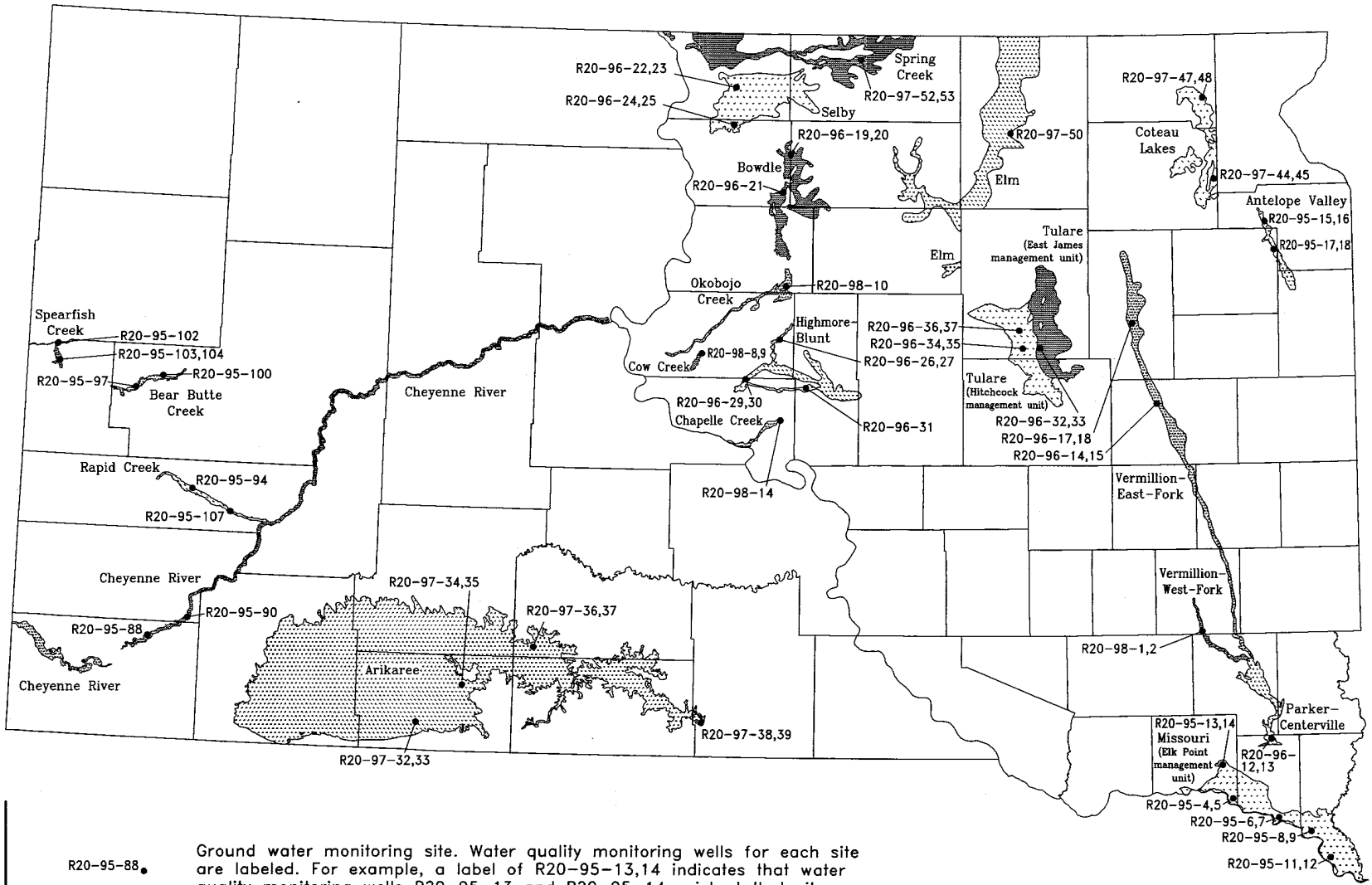
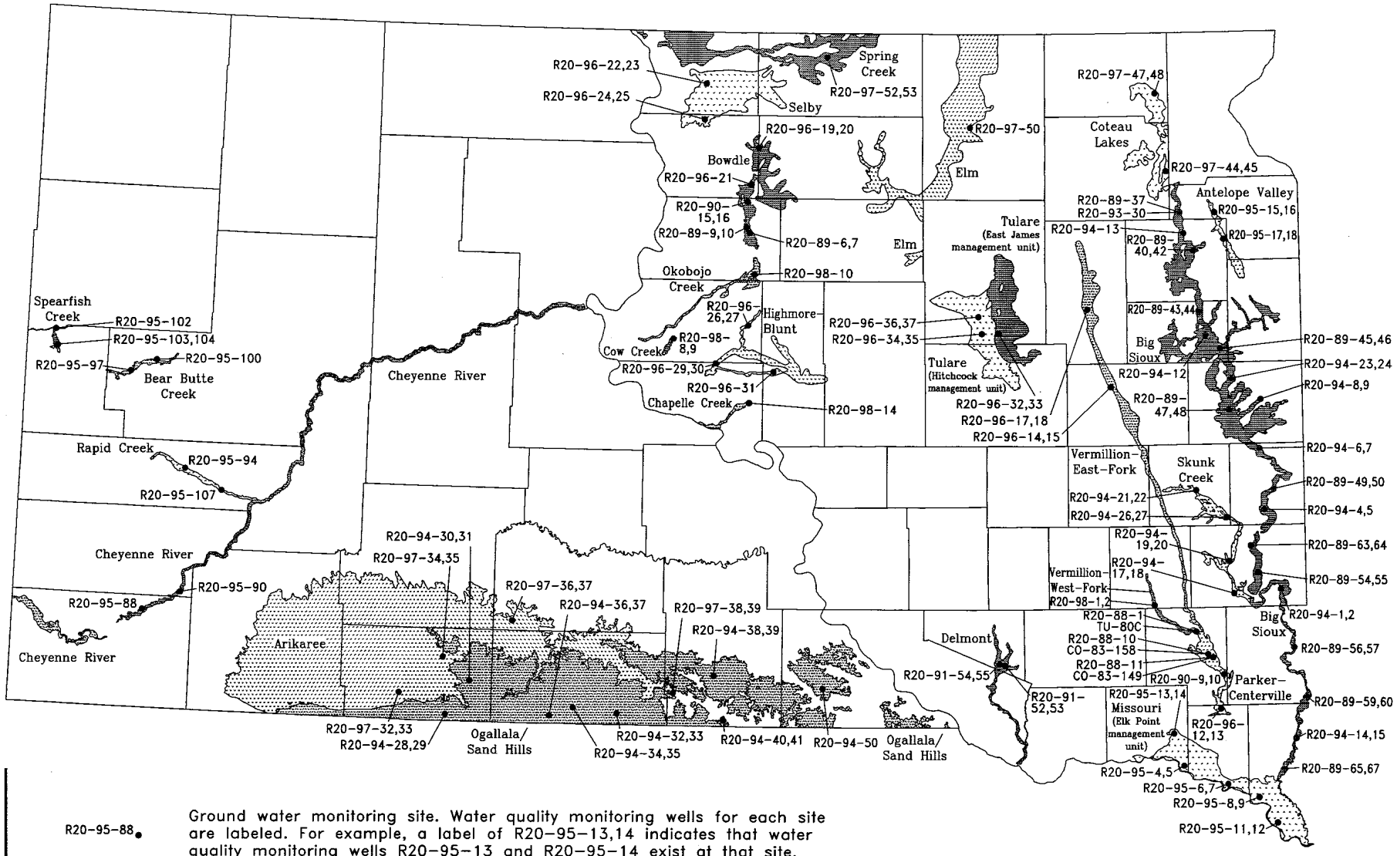


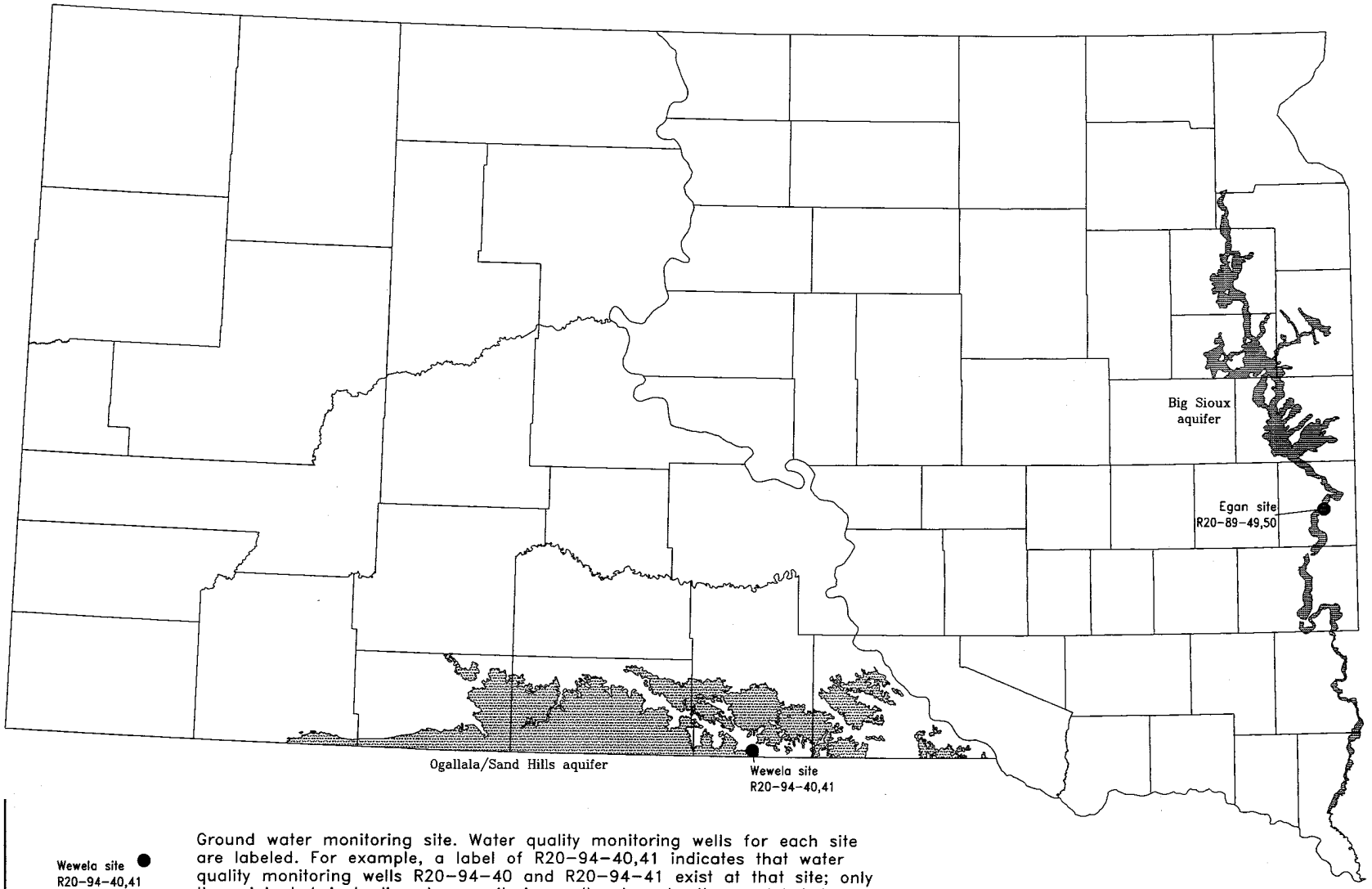
Figure 3. Locations of monitoring sites established in federal fiscal years 1995, 1996, 1997, and 1998.



R20-95-88 ● Ground water monitoring site. Water quality monitoring wells for each site are labeled. For example, a label of R20-95-13,14 indicates that water quality monitoring wells R20-95-13 and R20-95-14 exist at that site.

Map prepared by the Geological Survey Program. The aquifer boundaries are generalized and should not be used for site-specific evaluations.

Figure 4. Locations of all monitoring sites in the Statewide Ground Water Quality Monitoring Network.



Ground water monitoring site. Water quality monitoring wells for each site are labeled. For example, a label of R20-94-40,41 indicates that water quality monitoring wells R20-94-40 and R20-94-41 exist at that site; only the original 4-inch diameter monitoring wells at each site are labeled.

Map prepared by the Geological Survey Program. The aquifer boundaries are generalized and should not be used for site-specific evaluations.

Figure 5. Locations of the Egan and Wewela monitoring sites.

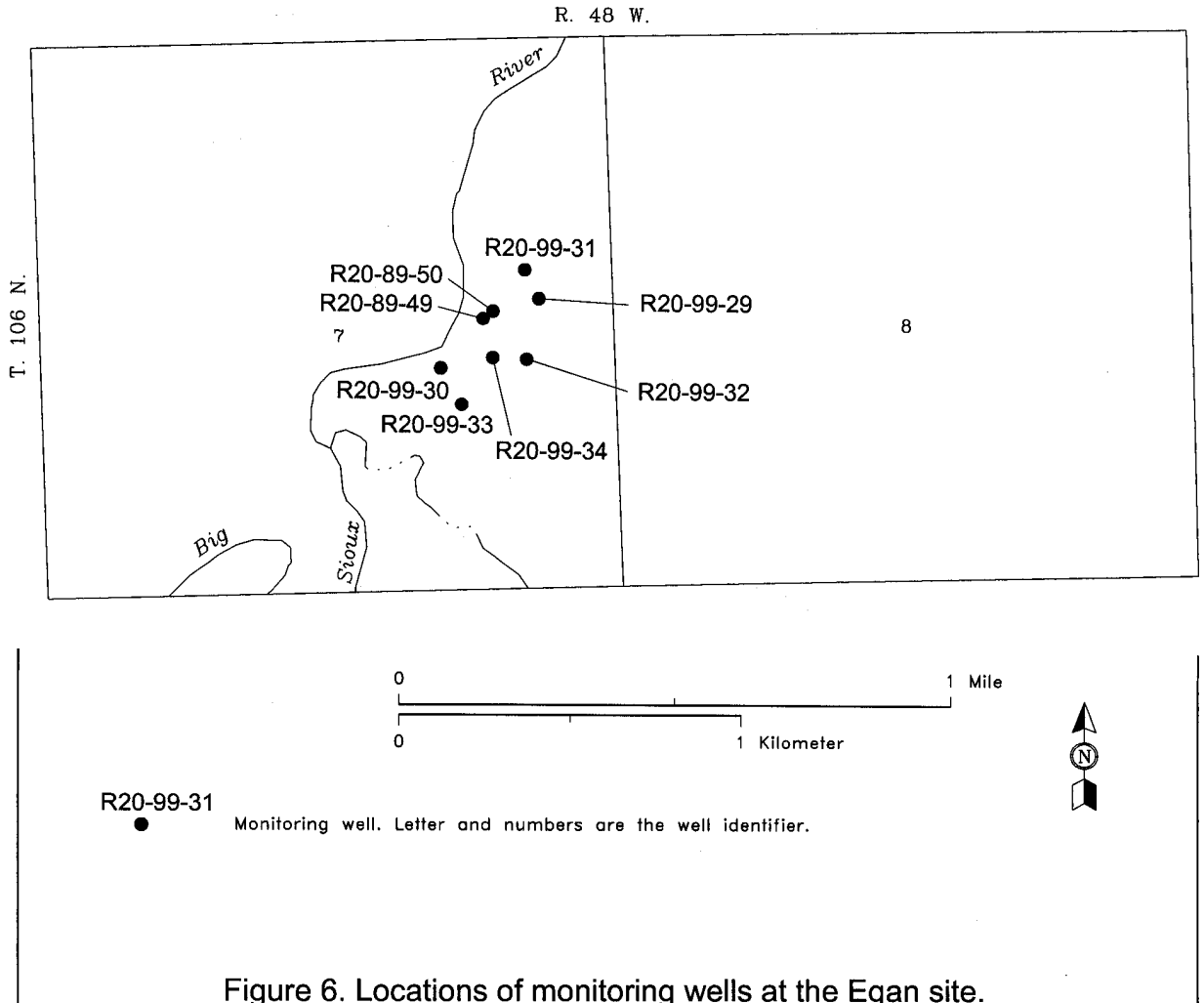


Figure 6. Locations of monitoring wells at the Egan site.

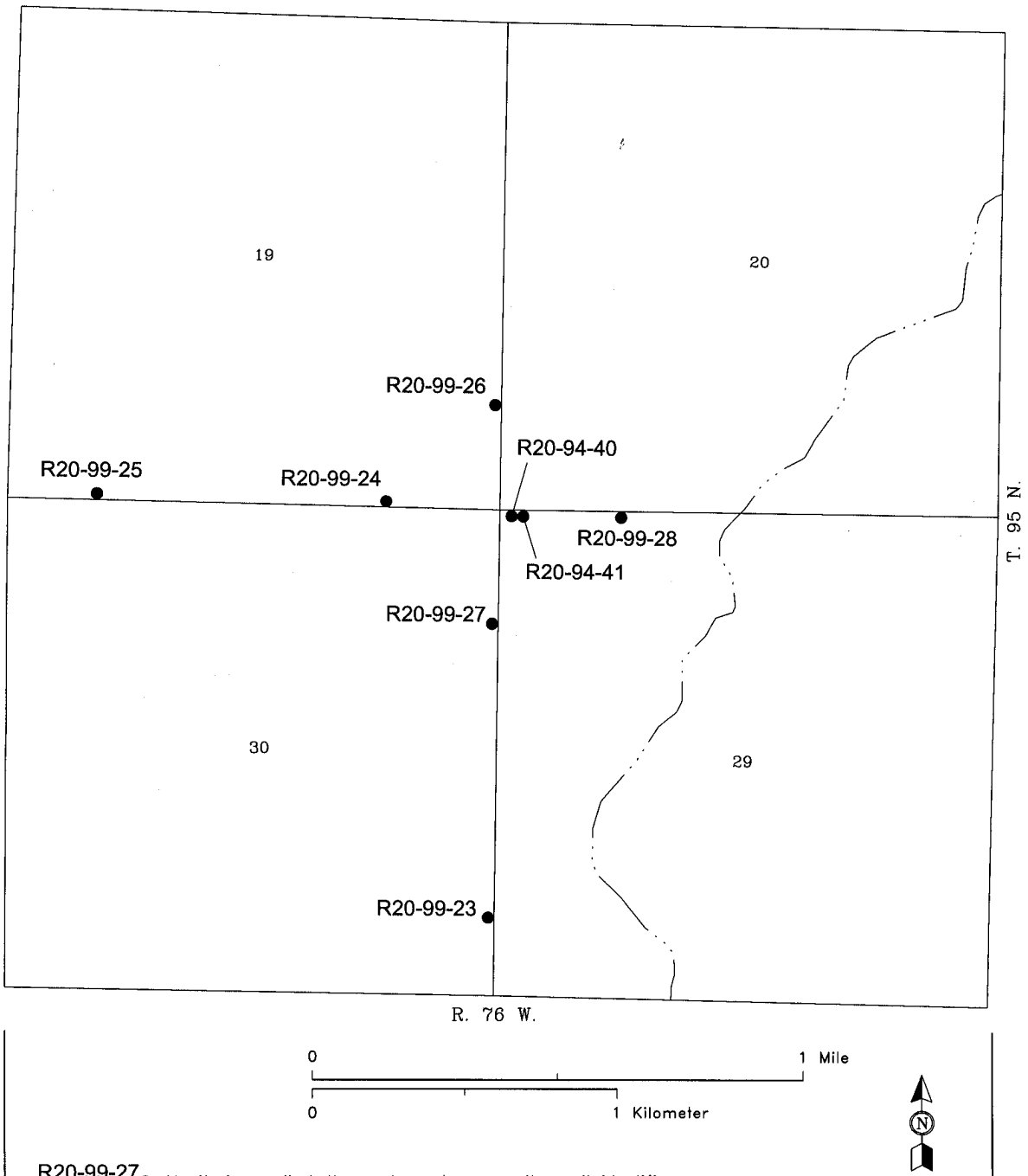


Figure 7. Locations of monitoring wells at the Wewela site.

Table 1. Project budget summary for the initial four-year study (federal fiscal years 1995, 1996, 1997, and 1998)

	Amount budgeted	Amount expended
STATE FUNDS		
Personal Services	$60,567.69	$34,999.57
Employee Benefits	included above	6,400.54
Travel	38,407.52	25,178.68
Contractual	0.00	171.09
Supplies/Materials	58,058.07	511.56
Depreciation of drilling rig	25,287.94	0.00
Capital Assets	0.00	0.00
Indirect Costs	0.00	7,389.09
Total State	$182,321.22	$74,650.53
FEDERAL 319 FUNDS		
Personal Services	$90,079.77	$52,500.78
Employee Benefits	included above	9,609.71
Travel	7,770.00	2,596.47
Contractual	0.00	949.53
Supplies/Materials	33,231.11	18,546.94
Depreciation of drilling rig	0.00	0.00
Capital Assets	105,864.28	29,091.72
Indirect Costs	0.00	11,083.64
Total Federal 319	$236,945.16	$124,378.79

Table 2. Project budget summary for the two-year project continuation (federal fiscal years 1999 and 2000)

	Amount budgeted	Amount expended
STATE FUNDS		
Personal Services	$3243.00	$16,552.32
Employee Benefits	included above	3,336.63
Printing/Postage	500.00	0.00
Contractual	77,500.00	$129,755.37
Supplies/Materials	4,340.00	$4,885.54
Depreciation of drilling rig	0.00	0.00
Capital Assets	2,000.00	0.00
Sample Shipment	4,740.00	3631.50
Indirect Costs	0.00	5872.43
Total State	$92,323.00	$164,033.79
FEDERAL 319 FUNDS		
Personal Services	$96,765.00	$62,502.96
Employee Benefits	included above	12,981.83
Printing/Postage	0.00	0.00
Contractual	0.00	0.00
Supplies/Materials	0.00	0.00
Depreciation of drilling rig	0.00	0.00
Capital Assets	0.00	0.00
Sample Shipment	0.00	0.00
Indirect Costs	15,322.00	8,808.64
Total Federal 319	$112,087.00	$84,293.43

Table 3. Aquifers selected for well installation

Aquifer type	Aquifer name	Number of initially planned monitoring sites	Number of monitoring sites established	Number of 4-inch dia. wells installed	Number of 2-inch dia. wells installed
Glacial outwash	Antelope Valley	2	2	4	0
	Bowdle	2	2	3	0
	Chapelle Creek	1	1	1	0
	Coteau Lakes	3	2	4	1
	Cow Creek	1	1	2	0
	Crow Creek	2	0	0	0
	Delmont	1	0	0	0
	Elm	3	1	1	1
	Elm Creek	2	0	0	1
	Highmore-Blunt	3	3	5	1
	Missouri (Elk Point management unit)	5	5	10	1
	Okobojo Creek	2	1	1	0
	Parker-Centerville	2	1	2	1
	Selby	3	2	4	0
	Spring Creek	3	1	2	1
	Tulare (East James management unit)	0	1	2	0
	Tulare (Hitchcock management unit)	2	2	4	0
	Vermillion-East-Fork	4	2	4	0
	Vermillion-West-Fork	1	1	2	0
Bedrock	Arikaree	6	4	8	4
	Fox Hills	6	0	0	0
Alluvial	Bear Butte Creek	2	2	2	2
	Cheyenne River	2	2	2	1
	Little White River	2	0	0	0
	Rapid Creek	2	2	2	2
	Spearfish Creek	2	2	3	2
	Totals	64	40	68	18

Table 4. Total number of monitoring sites and monitoring wells in the Statewide Ground Water Quality Monitoring Network.

Aquifer type	Aquifer name	Total number of monitoring sites	Total number of monitoring wells
Glacial outwash	Antelope Valley	2	4
	Big Sioux	19	36
	Bowdle	5	9
	Chapelle Creek	1	1
	Coteau Lakes	2	4
	Cow Creek	1	2
	Delmont	2	4
	Elm	1	1
	Highmore-Blunt	3	5
	Missouri (Elk Point management unit)	5	10
	Okobojo Creek	1	1
	Parker-Centerville	4	8
	Selby	2	4
	Skunk Creek	4	8
	Spring Creek	1	2
	Tulare (East James management unit)	1	2
	Tulare (Hitchcock management unit)	2	4
	Vermillion-East-Fork	2	4
	Vermillion-West-Fork	2	4
Bedrock	Arikaree	4	8
	Ogallala/Sand Hills	8	15
Alluvial	Bear Butte Creek	2	2
	Cheyenne River	2	2
	Rapid Creek	2	2
	Spearfish Creek	2	3
	Totals	**80**	**145**

APPENDIX A

Monitoring well construction diagrams and hydrostratigraphic cross sections for permanent monitoring sites

This appendix includes the following aquifers, in alphabetical order:

Antelope Valley
Arikaree
Bear Butte Creek
Big Sioux
Bowdle
Chapelle Creek
Cheyenne River
Coteau Lakes
Cow Creek
Delmont
Elm
Highmore-Blunt
Missouri
Ogallala
Okobojo Creek
Parker-Centerville
Rapid Creek
Sand Hills
Selby
Skunk Creek
Spearfish Creek
Spring Creek
Tulare
Vermillion-East-Fork
Vermillion-West-Fork

Appendix B

Water levels compiled through the 1997 sampling season for all monitoring sites in the Statewide Ground Water Quality Monitoring Network

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Antelope Valley	R20-95-15	7/9/96	15.02
	R20-95-15	7/7/97	15.51
	R20-95-16	7/9/96	14.88
	R20-95-16	7/7/97	15.36
	R20-95-17	7/9/96	7.13
	R20-95-17	7/7/97	8
	R20-95-18	7/9/96	6.99
	R20-95-18	7/7/97	7.87
Bear Butte Creek	R20-95-100	6/11/96	10.26
	R20-95-100	4/14/97	11.24
	R20-95-100	6/10/97	10.12
	R20-95-100	8/4/97	10.64
	R20-95-100	9/23/97	11.5
	R20-95-97	6/11/96	14.9
	R20-95-97	6/10/97	16.18
Big Sioux	R20-89-37	9/12/89	19.03
	R20-89-37	11/7/89	19.09
	R20-89-37	3/12/90	19.12
	R20-89-37	4/23/90	18.98
	R20-89-37	5/14/90	18.87
	R20-89-37	6/27/90	18.42
	R20-89-37	7/16/90	21.7
	R20-89-37	5/15/91	18.42
	R20-89-37	8/12/91	16.82
	R20-89-37	1/14/92	17.38
	R20-89-37	5/19/92	17.15
	R20-89-37	7/27/92	16.03
	R20-89-37	8/24/92	19.76
	R20-89-37	5/24/93	15.93
	R20-89-37	6/21/93	16.14
	R20-89-37	7/19/93	14.89
	R20-89-37	8/30/93	15.89
	R20-89-37	5/24/94	15.56
	R20-89-37	7/5/94	18.51
	R20-89-37	8/2/94	16.57
	R20-89-37	9/6/94	16.97
	R20-89-37	12/5/94	17.47
	R20-89-37	2/27/95	18.02
	R20-89-37	3/29/95	17.43
	R20-89-37	4/24/95	16.29
	R20-89-37	5/22/95	15.38

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-37	6/26/95	16.18
	R20-89-37	7/24/95	18.27
	R20-89-37	8/28/95	16.81
	R20-89-37	9/25/95	15.42
	R20-89-37	10/25/95	15
	R20-89-37	11/30/95	14.8
	R20-89-37	12/20/95	15.46
	R20-89-37	1/30/96	16.36
	R20-89-37	2/26/96	16.7
	R20-89-37	3/27/96	16.2
	R20-89-37	4/23/96	15.9
	R20-89-37	5/20/96	15.74
	R20-89-37	7/22/96	18
	R20-89-37	8/27/96	17.67
	R20-89-37	4/21/97	13.7
	R20-89-37	5/20/97	14.58
	R20-89-37	7/21/97	18.2
	R20-89-37	8/25/97	18.68
	R20-89-38	11/7/89	19.05
	R20-89-38	3/12/90	18.97
	R20-89-38	4/23/90	18.83
	R20-89-38	5/14/90	18.69
	R20-89-38	6/27/90	18.31
	R20-89-38	7/17/90	21.58
	R20-89-38	5/15/91	18.26
	R20-89-38	8/12/91	16.7
	R20-89-38	1/14/92	17.22
	R20-89-38	2/26/92	17.23
	R20-89-38	3/31/92	17.16
	R20-89-38	4/28/92	16.3
	R20-89-38	5/19/92	17
	R20-89-38	6/30/92	17.34
	R20-89-38	7/27/92	15.91
	R20-89-38	8/24/92	19.85
	R20-89-38	9/29/92	17.5
	R20-89-38	10/28/92	17.4
	R20-89-38	11/24/92	17.27
	R20-89-38	12/28/92	17.35
	R20-89-38	1/27/93	17.52
	R20-89-38	2/19/93	17.51
	R20-89-38	3/30/93	16.83
	R20-89-38	4/27/93	15.6
	R20-89-38	5/24/93	15.79
	R20-89-38	6/21/93	16
	R20-89-38	7/19/93	14.73
	R20-89-38	8/30/93	15.28
	R20-89-38	9/28/93	16.07
	R20-89-38	10/27/93	16.24
	R20-89-38	11/30/93	16.62

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-38	12/30/93	16.78
	R20-89-38	1/24/94	17.04
	R20-89-38	2/24/94	17.15
	R20-89-38	3/29/94	15.5
	R20-89-38	4/27/94	15.41
	R20-89-38	5/24/94	15.41
	R20-89-38	7/5/94	18.45
	R20-89-38	8/2/94	16.37
	R20-89-38	9/14/94	16.77
	R20-89-38	12/5/94	17.28
	R20-89-38	1/31/95	17.62
	R20-89-38	2/27/95	17.83
	R20-89-38	3/29/95	17.24
	R20-89-38	4/24/95	16.1
	R20-89-38	5/22/95	15.19
	R20-89-38	6/26/95	15.99
	R20-89-38	7/24/95	18.2
	R20-89-38	8/28/95	16.62
	R20-89-38	9/25/95	15.23
	R20-89-38	10/25/95	14.83
	R20-89-38	11/30/95	14.61
	R20-89-38	12/20/95	15.28
	R20-89-38	1/30/96	16.17
	R20-89-38	2/26/96	16.51
	R20-89-38	3/27/96	16.02
	R20-89-39	9/11/89	17.44
	R20-89-39	11/6/89	19.22
	R20-89-39	3/12/90	19.24
	R20-89-39	4/23/90	19.07
	R20-89-39	5/14/90	18.98
	R20-89-39	7/16/90	22.34
	R20-89-39	5/15/91	18.54
	R20-89-39	8/12/91	16.98
	R20-89-39	1/14/92	17.51
	R20-89-39	5/19/92	17.29
	R20-89-39	7/27/92	16.13
	R20-89-39	8/24/92	19.82
	R20-89-39	5/24/93	16.08
	R20-89-39	6/21/93	16.27
	R20-89-39	7/19/93	15.05
	R20-89-39	8/30/93	15.58
	R20-89-39	5/24/94	15.72
	R20-89-39	7/5/94	18.56
	R20-89-39	9/14/94	17.06
	R20-89-39	12/5/94	17.56
	R20-89-40	9/13/89	14.23
	R20-89-40	11/6/89	14.54
	R20-89-40	3/13/90	15.27
	R20-89-40	4/24/90	15.52

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-40	5/15/90	15.63
	R20-89-40	6/26/90	15.88
	R20-89-40	7/17/90	16.02
	R20-89-40	5/15/91	17.05
	R20-89-40	8/13/91	7.47
	R20-89-40	1/7/92	10.32
	R20-89-40	5/18/92	10.83
	R20-89-40	7/28/92	7.7
	R20-89-40	8/25/92	8.45
	R20-89-40	5/25/93	6.8
	R20-89-40	6/22/93	6.37
	R20-89-40	7/20/93	5.29
	R20-89-40	8/31/93	6.88
	R20-89-40	8/2/94	7
	R20-89-40	7/24/95	6.38
	R20-89-40	7/22/96	7.9
	R20-89-40	7/21/97	8.39
	R20-89-41	9/12/89	14.98
	R20-89-41	11/6/89	15.24
	R20-89-41	3/13/90	15.98
	R20-89-41	4/24/90	16.19
	R20-89-41	5/15/90	16.34
	R20-89-41	6/26/90	16.59
	R20-89-41	7/17/90	16.8
	R20-89-41	5/15/91	17.89
	R20-89-41	8/13/91	8.34
	R20-89-41	1/8/92	11.01
	R20-89-41	5/18/92	11.53
	R20-89-41	7/28/92	8.38
	R20-89-41	8/25/92	9.14
	R20-89-41	5/25/93	7.46
	R20-89-41	6/22/93	6.99
	R20-89-41	7/20/93	5.94
	R20-89-41	8/31/93	7.56
	R20-89-42	9/13/89	15.04
	R20-89-42	11/6/89	15.33
	R20-89-42	3/13/90	16.05
	R20-89-42	4/24/90	16.29
	R20-89-42	5/15/90	16.43
	R20-89-42	6/26/90	16.7
	R20-89-42	7/17/90	16.84
	R20-89-42	5/15/91	17.88
	R20-89-42	8/13/91	8.32
	R20-89-42	1/8/92	11.11
	R20-89-42	2/26/92	11.38
	R20-89-42	3/31/92	11.63
	R20-89-42	4/28/92	11.65
	R20-89-42	5/18/92	11.66
	R20-89-42	6/30/92	9.33

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-42	7/28/92	8.47
	R20-89-42	8/25/92	9.23
	R20-89-42	9/29/92	9.1
	R20-89-42	10/28/92	9.66
	R20-89-42	11/24/92	9.96
	R20-89-42	12/28/92	10.31
	R20-89-42	1/27/93	10.68
	R20-89-42	2/19/93	10.99
	R20-89-42	3/30/93	8.76
	R20-89-42	4/27/93	6.75
	R20-89-42	5/25/93	7.48
	R20-89-42	6/22/93	6.98
	R20-89-42	7/20/93	5.96
	R20-89-42	8/31/93	7.62
	R20-89-42	9/28/93	7.8
	R20-89-42	10/27/93	8.4
	R20-89-42	11/30/93	8.95
	R20-89-42	12/30/93	9.28
	R20-89-42	1/24/94	9.63
	R20-89-42	3/29/94	6.06
	R20-89-42	4/27/94	6.56
	R20-89-42	5/25/94	7.34
	R20-89-42	7/6/94	6.93
	R20-89-42	8/2/94	7.72
	R20-89-42	9/14/94	8.42
	R20-89-42	12/6/94	9.7
	R20-89-42	2/27/95	10.67
	R20-89-42	3/29/95	9.13
	R20-89-42	4/24/95	6.28
	R20-89-42	5/22/95	6.45
	R20-89-42	6/26/95	7.22
	R20-89-42	7/24/95	7.7
	R20-89-42	8/28/95	7.96
	R20-89-42	9/25/95	8.35
	R20-89-42	10/26/95	7.7
	R20-89-42	11/30/95	7.48
	R20-89-42	12/20/95	8.17
	R20-89-42	7/22/96	8.65
	R20-89-42	7/21/97	9.16
	R20-89-43	9/13/89	5.98
	R20-89-43	11/13/89	6
	R20-89-43	3/13/90	6.16
	R20-89-43	4/24/90	6.03
	R20-89-43	5/15/90	6.04
	R20-89-43	6/26/90	5.13
	R20-89-43	7/17/90	5.63
	R20-89-43	5/15/91	5.62
	R20-89-43	8/13/91	5.36
	R20-89-43	1/14/92	5.46

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-43	5/20/92	5.31
	R20-89-43	7/28/92	4.34
	R20-89-43	8/25/92	5.11
	R20-89-43	5/19/93	2.99
	R20-89-43	6/22/93	2.98
	R20-89-43	7/20/93	2.57
	R20-89-43	8/31/93	3.27
	R20-89-43	8/3/94	3.44
	R20-89-43	7/25/95	3.05
	R20-89-43	7/23/96	4.8
	R20-89-43	7/22/97	3.27
	R20-89-44	9/13/89	6.61
	R20-89-44	11/13/89	6.4
	R20-89-44	3/13/90	6.54
	R20-89-44	4/24/90	6.41
	R20-89-44	5/15/90	6.47
	R20-89-44	6/26/90	5.56
	R20-89-44	7/17/90	5.94
	R20-89-44	5/15/91	6
	R20-89-44	8/13/91	5.7
	R20-89-44	1/14/92	5.84
	R20-89-44	5/20/92	5.71
	R20-89-44	7/28/92	4.73
	R20-89-44	8/25/92	5.54
	R20-89-44	5/19/93	3.39
	R20-89-44	6/22/93	3.4
	R20-89-44	7/20/93	2.98
	R20-89-44	8/31/93	3.69
	R20-89-44	8/3/94	3.91
	R20-89-44	7/25/95	3.53
	R20-89-44	7/23/96	5.3
	R20-89-44	7/22/97	3.79
	R20-89-45	9/18/89	8.97
	R20-89-45	11/13/89	11.33
	R20-89-45	3/13/90	11.93
	R20-89-45	4/24/90	11.64
	R20-89-45	5/15/90	11.66
	R20-89-45	6/26/90	8.15
	R20-89-45	7/18/90	9.26
	R20-89-45	5/20/91	8.48
	R20-89-45	8/13/91	9.14
	R20-89-45	1/13/92	10.31
	R20-89-45	5/20/92	9.86
	R20-89-45	7/27/92	7.73
	R20-89-45	8/26/92	8.44
	R20-89-45	5/19/93	7.5
	R20-89-45	6/22/93	5.24
	R20-89-45	7/20/93	7.21
	R20-89-45	8/31/93	8.4

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-45	8/3/94	9.47
	R20-89-45	7/25/95	9.42
	R20-89-45	7/23/96	9.8
	R20-89-45	7/22/97	9.33
	R20-89-46	9/19/89	9.81
	R20-89-46	11/13/89	10.79
	R20-89-46	3/13/90	11.4
	R20-89-46	4/24/90	11.09
	R20-89-46	5/15/90	11.1
	R20-89-46	6/26/90	7.6
	R20-89-46	7/18/90	8.74
	R20-89-46	5/20/91	8
	R20-89-46	8/13/91	8.61
	R20-89-46	1/13/92	9.74
	R20-89-46	5/20/92	9.29
	R20-89-46	7/27/92	7.19
	R20-89-46	8/26/92	7.91
	R20-89-46	5/19/93	6.94
	R20-89-46	6/22/93	4.71
	R20-89-46	7/20/93	6.76
	R20-89-46	8/31/93	7.85
	R20-89-46	8/3/94	8.91
	R20-89-46	7/25/95	8.88
	R20-89-46	7/23/96	9.25
	R20-89-46	7/22/97	8.79
	R20-89-47	9/19/89	8.05
	R20-89-47	11/15/89	9.02
	R20-89-47	3/14/90	7.68
	R20-89-47	4/18/90	7.73
	R20-89-47	5/16/90	7.36
	R20-89-47	6/26/90	4.78
	R20-89-47	7/18/90	6.13
	R20-89-47	5/20/91	5.29
	R20-89-47	8/14/91	6.17
	R20-89-47	1/13/92	7.03
	R20-89-47	5/19/92	6.13
	R20-89-47	7/29/92	4.17
	R20-89-47	8/26/92	3.75
	R20-89-47	5/19/93	3.68
	R20-89-47	5/25/93	3.68
	R20-89-47	6/22/93	2.45
	R20-89-47	7/20/93	3.51
	R20-89-47	8/31/93	4.25
	R20-89-47	8/10/94	4.58
	R20-89-47	7/26/95	4.41
	R20-89-47	7/24/96	6.34
	R20-89-47	7/23/97	6.23
	R20-89-48	9/19/89	7.35
	R20-89-48	11/15/89	8.31

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-48	3/14/90	6.86
	R20-89-48	4/18/90	6.97
	R20-89-48	5/16/90	6.6
	R20-89-48	6/26/90	3.98
	R20-89-48	7/18/90	5.36
	R20-89-48	5/20/91	4.56
	R20-89-48	8/14/91	5.5
	R20-89-48	1/13/92	6.28
	R20-89-48	5/19/92	5.37
	R20-89-48	7/20/92	3.42
	R20-89-48	8/26/92	2.99
	R20-89-48	5/19/93	2.93
	R20-89-48	6/22/93	1.78
	R20-89-48	7/20/93	2.79
	R20-89-48	8/31/93	3.51
	R20-89-48	8/10/94	3.82
	R20-89-48	7/26/95	3.62
	R20-89-48	7/24/96	5.51
	R20-89-48	7/23/97	5.41
	R20-89-49	9/19/89	14.98
	R20-89-49	11/14/89	16.47
	R20-89-49	3/22/90	14.89
	R20-89-49	4/17/90	14.82
	R20-89-49	5/22/90	13.75
	R20-89-49	6/25/90	10.96
	R20-89-49	7/25/90	12.7
	R20-89-49	5/16/91	13.97
	R20-89-49	8/14/91	13.51
	R20-89-49	1/9/92	14.49
	R20-89-49	5/13/92	13.61
	R20-89-49	7/22/92	12.05
	R20-89-49	8/19/92	12.81
	R20-89-49	5/26/93	10.22
	R20-89-49	6/23/93	2.39
	R20-89-49	7/21/93	7.38
	R20-89-49	9/1/93	9.95
	R20-89-49	5/25/94	11.6
	R20-89-49	6/29/94	7.94
	R20-89-49	8/10/94	11.85
	R20-89-49	9/6/94	11.44
	R20-89-49	12/7/94	12.95
	R20-89-49	4/24/95	4.38
	R20-89-49	5/22/95	7.85
	R20-89-49	7/17/95	9.83
	R20-89-49	8/29/95	10.95
	R20-89-49	4/23/96	10.73
	R20-89-49	5/20/96	10.43
	R20-89-49	7/15/96	11.65
	R20-89-49	8/27/96	12.8

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-49	4/21/97	4.58
	R20-89-49	5/19/97	8.11
	R20-89-49	7/15/97	11.36
	R20-89-49	8/25/97	11.55
	R20-89-50	9/20/89	15.94
	R20-89-50	11/14/89	16.27
	R20-89-50	3/22/90	16.91
	R20-89-50	4/17/90	15.85
	R20-89-50	5/22/90	14.84
	R20-89-50	6/25/90	12.07
	R20-89-50	7/25/90	13.82
	R20-89-50	5/16/91	14.98
	R20-89-50	8/14/91	14.52
	R20-89-50	1/9/92	15.5
	R20-89-50	5/13/92	14.61
	R20-89-50	7/22/92	13.06
	R20-89-50	8/19/92	13.8
	R20-89-50	5/26/93	11.13
	R20-89-50	6/23/93	3.08
	R20-89-50	7/21/93	8.29
	R20-89-50	9/1/93	10.83
	R20-89-50	5/25/94	12.14
	R20-89-50	6/29/94	7
	R20-89-50	8/10/94	12.81
	R20-89-50	9/6/94	12.46
	R20-89-50	12/7/94	13.94
	R20-89-50	4/24/95	5.4
	R20-89-50	5/22/95	8.83
	R20-89-50	7/17/95	10.79
	R20-89-50	8/29/95	11.89
	R20-89-50	4/23/96	11.76
	R20-89-50	5/20/96	11.47
	R20-89-50	7/15/96	12.6
	R20-89-50	8/27/96	13.76
	R20-89-50	4/21/97	5.56
	R20-89-50	5/19/97	9.02
	R20-89-50	7/15/97	12.28
	R20-89-50	8/25/97	12.52
	R20-89-54	9/5/89	12.78
	R20-89-54	11/14/89	13.39
	R20-89-54	3/20/90	14.07
	R20-89-54	4/17/90	13.78
	R20-89-54	5/22/90	13.47
	R20-89-54	6/25/90	13.25
	R20-89-54	7/25/90	12.58
	R20-89-54	5/8/91	12.1
	R20-89-54	8/6/91	7.57
	R20-89-54	1/21/92	8.66
	R20-89-54	5/12/92	5.96

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-54	7/21/92	4.2
	R20-89-54	8/19/92	4.67
	R20-89-54	5/18/93	3.49
	R20-89-54	6/29/93	0.79
	R20-89-54	7/27/93	3.19
	R20-89-54	8/24/93	4.42
	R20-89-54	8/9/94	6
	R20-89-54	7/18/95	6.27
	R20-89-54	7/16/96	5.15
	R20-89-54	4/22/97	1.87
	R20-89-54	5/19/97	4.54
	R20-89-54	7/16/97	4.08
	R20-89-54	8/26/97	7.13
	R20-89-55	9/5/89	12.75
	R20-89-55	11/14/89	13.36
	R20-89-55	3/20/90	14.07
	R20-89-55	4/17/90	13.8
	R20-89-55	5/22/90	13.49
	R20-89-55	6/25/90	13.18
	R20-89-55	7/25/90	12.65
	R20-89-55	5/8/91	12.15
	R20-89-55	8/6/91	7.64
	R20-89-55	1/21/92	8.71
	R20-89-55	5/12/92	6.01
	R20-89-55	7/21/92	4.23
	R20-89-55	8/19/92	4.72
	R20-89-55	5/18/93	3.51
	R20-89-55	6/29/93	0.85
	R20-89-55	7/27/93	3.19
	R20-89-55	8/24/93	4.47
	R20-89-55	8/9/94	6.06
	R20-89-55	7/18/95	6.28
	R20-89-55	7/16/96	5.25
	R20-89-55	4/22/97	1.88
	R20-89-55	5/19/97	4.58
	R20-89-55	7/16/97	4.1
	R20-89-55	8/26/97	7.17
	R20-89-56	9/25/89	12.23
	R20-89-56	11/3/89	12.37
	R20-89-56	3/20/90	11.86
	R20-89-56	4/16/90	12.07
	R20-89-56	5/21/90	11.2
	R20-89-56	7/24/90	10.4
	R20-89-56	8/20/90	8.58
	R20-89-56	5/7/91	10.84
	R20-89-56	8/6/91	11.31
	R20-89-56	1/21/92	11.2
	R20-89-56	5/12/92	10.69
	R20-89-56	7/21/92	7.49

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-56	8/18/92	8.11
	R20-89-56	5/17/93	2.88
	R20-89-56	7/26/93	0.25
	R20-89-56	8/25/93	3.95
	R20-89-56	8/9/94	9.68
	R20-89-56	7/18/95	6.96
	R20-89-56	7/17/96	9.2
	R20-89-56	7/14/97	8.82
	R20-89-57	9/25/89	12.06
	R20-89-57	11/3/89	12.23
	R20-89-57	3/22/90	11.74
	R20-89-57	4/16/90	12.07
	R20-89-57	5/21/90	11.32
	R20-89-57	6/25/90	7.98
	R20-89-57	7/24/90	10.18
	R20-89-57	5/7/91	10.87
	R20-89-57	8/6/91	11.2
	R20-89-57	1/21/92	11.17
	R20-89-57	2/27/92	8.25
	R20-89-57	3/30/92	9.43
	R20-89-57	4/27/92	9.3
	R20-89-57	5/12/92	10.49
	R20-89-57	6/29/92	5.7
	R20-89-57	7/21/92	16.13
	R20-89-57	8/18/92	7.77
	R20-89-57	10/27/92	9.75
	R20-89-57	11/23/92	9.14
	R20-89-57	12/29/92	9.69
	R20-89-57	1/28/93	10.21
	R20-89-57	2/18/93	10.12
	R20-89-57	4/28/93	4.67
	R20-89-57	5/17/93	2.75
	R20-89-57	7/26/93	0.28
	R20-89-57	8/25/93	3.68
	R20-89-57	9/29/93	6.25
	R20-89-57	10/27/93	8.29
	R20-89-57	11/29/93	8.84
	R20-89-57	12/28/93	7.69
	R20-89-57	1/25/94	9.31
	R20-89-57	2/23/94	5.63
	R20-89-57	3/28/94	3.54
	R20-89-57	4/26/94	5.75
	R20-89-57	5/25/94	7.61
	R20-89-57	6/27/94	2.42
	R20-89-57	8/9/94	9.51
	R20-89-57	9/14/94	9.28
	R20-89-57	12/13/94	9.72
	R20-89-57	2/28/95	9.03
	R20-89-57	3/28/95	3.61

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-57	5/23/95	3.42
	R20-89-57	6/27/95	6.52
	R20-89-57	7/18/95	6.84
	R20-89-57	8/29/95	8.3
	R20-89-57	9/26/95	9.52
	R20-89-57	10/26/95	7.23
	R20-89-57	11/29/95	8.48
	R20-89-57	12/21/95	8.63
	R20-89-57	7/17/96	9
	R20-89-57	7/14/97	8.7
	R20-89-58	9/6/89	16.53
	R20-89-58	11/3/89	15.93
	R20-89-58	3/19/90	16.23
	R20-89-58	4/16/90	16.21
	R20-89-58	5/21/90	16.24
	R20-89-58	6/20/90	15.1
	R20-89-58	7/24/90	14.82
	R20-89-58	5/6/91	16.02
	R20-89-58	8/6/91	17.64
	R20-89-58	1/23/92	16.7
	R20-89-58	5/11/92	16.03
	R20-89-58	7/20/92	15.18
	R20-89-58	8/18/92	14.93
	R20-89-58	5/17/93	12.22
	R20-89-58	6/28/93	10.46
	R20-89-58	7/26/93	9.67
	R20-89-58	8/23/93	10.36
	R20-89-59	9/6/89	16.08
	R20-89-59	11/2/89	15.46
	R20-89-59	3/19/90	15.79
	R20-89-59	4/16/90	15.73
	R20-89-59	5/21/90	15.78
	R20-89-59	6/20/90	14.73
	R20-89-59	7/24/90	14.38
	R20-89-59	5/6/91	15.52
	R20-89-59	8/6/91	17.24
	R20-89-59	1/23/92	16.22
	R20-89-59	5/11/92	15.55
	R20-89-59	7/20/92	14.71
	R20-89-59	8/18/92	14.45
	R20-89-59	5/17/93	11.76
	R20-89-59	6/28/93	9.99
	R20-89-59	7/26/93	9.28
	R20-89-59	8/23/93	9.9
	R20-89-59	5/23/94	11.33
	R20-89-59	6/27/94	11.56
	R20-89-59	8/8/94	13.74
	R20-89-59	9/7/94	12.86
	R20-89-59	4/26/95	12.5

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-59	5/24/95	11.6
	R20-89-59	7/19/95	11.2
	R20-89-59	8/30/95	12.21
	R20-89-59	4/24/96	13.25
	R20-89-59	5/22/96	13.45
	R20-89-59	7/17/96	13.5
	R20-89-59	8/28/96	13.98
	R20-89-59	7/14/97	11.83
	R20-89-60	9/7/89	15.92
	R20-89-60	11/2/89	15.33
	R20-89-60	3/19/90	15.57
	R20-89-60	4/16/90	15.58
	R20-89-60	5/21/90	15.64
	R20-89-60	6/20/90	14.59
	R20-89-60	7/24/90	14.28
	R20-89-60	5/6/91	15.36
	R20-89-60	8/6/91	17
	R20-89-60	1/23/92	16.11
	R20-89-60	2/25/92	15.98
	R20-89-60	3/30/92	15.59
	R20-89-60	4/27/92	15.58
	R20-89-60	5/11/92	15.43
	R20-89-60	6/29/92	15.15
	R20-89-60	7/20/92	14.59
	R20-89-60	8/18/92	14.34
	R20-89-60	9/29/92	14.26
	R20-89-60	10/26/92	13.32
	R20-89-60	11/23/92	13.3
	R20-89-60	12/29/92	13.51
	R20-89-60	1/28/93	13.71
	R20-89-60	2/18/93	13.78
	R20-89-60	3/29/93	12.83
	R20-89-60	4/28/93	12.1
	R20-89-60	5/17/93	11.63
	R20-89-60	6/28/93	9.86
	R20-89-60	7/26/93	9.07
	R20-89-60	8/23/93	9.77
	R20-89-60	9/30/93	10.32
	R20-89-60	10/28/93	10.74
	R20-89-60	11/29/93	11.24
	R20-89-60	12/29/93	11.55
	R20-89-60	1/25/94	11.75
	R20-89-60	2/22/94	11.62
	R20-89-60	3/28/94	11.23
	R20-89-60	4/26/94	11.38
	R20-89-60	5/23/94	11.22
	R20-89-60	6/27/94	11.44
	R20-89-60	8/8/94	13.6
	R20-89-60	9/7/94	12.74

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-60	2/28/95	13.31
	R20-89-60	3/28/95	13.15
	R20-89-60	4/26/95	12.37
	R20-89-60	5/24/95	11.47
	R20-89-60	6/27/95	10.78
	R20-89-60	7/19/95	11.07
	R20-89-60	8/30/95	12.08
	R20-89-60	9/26/95	12.08
	R20-89-60	10/26/95	12.21
	R20-89-60	11/29/95	12.36
	R20-89-60	12/21/95	12.51
	R20-89-60	4/24/96	13.12
	R20-89-60	5/22/96	13.33
	R20-89-60	7/17/96	13.4
	R20-89-60	8/28/96	13.87
	R20-89-60	7/14/97	11.72
	R20-89-62	9/20/89	14.85
	R20-89-62	11/8/89	15.28
	R20-89-62	3/20/90	15.75
	R20-89-62	4/17/90	42.5
	R20-89-62	5/22/90	15.56
	R20-89-62	6/25/90	15.15
	R20-89-62	7/23/90	13.18
	R20-89-62	5/8/91	14.58
	R20-89-62	8/7/91	11.35
	R20-89-62	1/22/92	13.99
	R20-89-62	5/13/92	10.21
	R20-89-62	7/22/92	7.63
	R20-89-62	8/19/92	7.51
	R20-89-62	5/18/93	4.92
	R20-89-62	6/29/93	4.7
	R20-89-62	7/27/93	4.7
	R20-89-62	8/24/93	6.38
	R20-89-63	9/20/89	14.35
	R20-89-63	11/8/89	14.79
	R20-89-63	3/20/90	15.24
	R20-89-63	4/17/90	15.24
	R20-89-63	5/22/90	15.06
	R20-89-63	6/25/90	14.61
	R20-89-63	7/23/90	12.68
	R20-89-63	5/8/91	14.1
	R20-89-63	8/7/91	10.84
	R20-89-63	1/22/92	13.5
	R20-89-63	2/27/92	12.08
	R20-89-63	3/31/92	10.37
	R20-89-63	4/28/92	9.63
	R20-89-63	5/13/92	9.73
	R20-89-63	6/29/92	9.75
	R20-89-63	7/22/92	7.15

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-63	8/19/92	7.05
	R20-89-63	9/29/92	7.72
	R20-89-63	10/27/92	7.43
	R20-89-63	11/23/92	6.92
	R20-89-63	12/30/92	7.86
	R20-89-63	1/27/93	8.73
	R20-89-63	2/19/93	9.17
	R20-89-63	3/30/93	6.65
	R20-89-63	4/28/93	5.43
	R20-89-63	5/18/93	4.53
	R20-89-63	6/29/93	4.28
	R20-89-63	7/27/93	4.29
	R20-89-63	8/24/93	5.93
	R20-89-63	9/29/93	7.02
	R20-89-63	10/27/93	7.83
	R20-89-63	11/30/93	8.22
	R20-89-63	12/29/93	8.41
	R20-89-63	1/25/94	9.16
	R20-89-63	2/23/94	8.68
	R20-89-63	3/28/94	6.92
	R20-89-63	4/26/94	5.43
	R20-89-63	5/23/94	5.96
	R20-89-63	6/27/94	6.33
	R20-89-63	8/10/94	9.08
	R20-89-63	9/6/94	10.02
	R20-89-63	12/12/94	11.04
	R20-89-63	1/31/95	11.49
	R20-89-63	2/28/95	11.25
	R20-89-63	3/28/95	7.8
	R20-89-63	4/26/95	4.19
	R20-89-63	5/23/95	4.85
	R20-89-63	6/26/95	6.11
	R20-89-63	7/18/95	6.79
	R20-89-63	8/29/95	8.99
	R20-89-63	9/25/95	10.1
	R20-89-63	10/25/95	9.18
	R20-89-63	11/29/95	8.24
	R20-89-63	12/20/95	8.62
	R20-89-63	1/29/96	9.63
	R20-89-63	2/27/96	9.5
	R20-89-63	3/28/96	9.45
	R20-89-63	4/24/96	8.53
	R20-89-63	5/21/96	7.07
	R20-89-63	7/15/96	8
	R20-89-63	8/28/96	9.9
	R20-89-63	4/22/97	4.43
	R20-89-63	5/19/97	4.81
	R20-89-63	7/16/97	7.51
	R20-89-63	8/26/97	9.89

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-64	9/20/89	14.29
	R20-89-64	11/8/89	14.72
	R20-89-64	3/20/90	15.18
	R20-89-64	4/17/90	15.15
	R20-89-64	5/22/90	14.97
	R20-89-64	6/25/90	14.57
	R20-89-64	7/23/90	12.62
	R20-89-64	5/20/91	13.66
	R20-89-64	8/7/91	10.83
	R20-89-64	1/22/92	13.44
	R20-89-64	2/27/92	12.02
	R20-89-64	3/31/92	10.31
	R20-89-64	4/28/92	9.57
	R20-89-64	5/13/92	9.68
	R20-89-64	6/29/92	9.7
	R20-89-64	7/22/92	7.11
	R20-89-64	8/19/92	7.02
	R20-89-64	9/29/92	7.7
	R20-89-64	10/27/92	7.4
	R20-89-64	11/23/92	6.88
	R20-89-64	12/30/92	7.83
	R20-89-64	1/27/93	8.7
	R20-89-64	2/19/93	9.12
	R20-89-64	3/30/93	6.63
	R20-89-64	4/28/93	5.4
	R20-89-64	5/18/93	4.5
	R20-89-64	6/29/93	4.26
	R20-89-64	7/27/93	4.29
	R20-89-64	8/24/93	5.9
	R20-89-64	9/29/93	6.98
	R20-89-64	10/27/93	7.79
	R20-89-64	11/30/93	8.18
	R20-89-64	12/29/93	8.37
	R20-89-64	1/25/94	9.13
	R20-89-64	2/23/94	8.65
	R20-89-64	3/28/94	6.87
	R20-89-64	4/26/94	5.38
	R20-89-64	5/23/94	5.93
	R20-89-64	6/27/94	6.29
	R20-89-64	8/10/94	9.06
	R20-89-64	9/6/94	9.98
	R20-89-64	12/12/94	11
	R20-89-64	1/31/95	11.43
	R20-89-64	2/28/95	11.2
	R20-89-64	3/28/95	7.72
	R20-89-64	4/26/95	4.17
	R20-89-64	5/23/95	4.84
	R20-89-64	6/26/95	6.09
	R20-89-64	7/18/95	6.76

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-64	8/29/95	8.86
	R20-89-64	9/25/95	10.06
	R20-89-64	10/25/95	9.11
	R20-89-64	11/29/95	8.2
	R20-89-64	12/20/95	8.57
	R20-89-64	1/29/96	9.58
	R20-89-64	2/27/96	9.45
	R20-89-64	4/24/96	8.49
	R20-89-64	5/21/96	7.04
	R20-89-64	7/15/96	8
	R20-89-64	8/28/96	9.86
	R20-89-64	4/22/97	4.42
	R20-89-64	5/19/97	4.81
	R20-89-64	7/16/97	7.48
	R20-89-64	8/26/97	9.86
	R20-89-65	8/30/89	12
	R20-89-65	11/2/89	14.64
	R20-89-65	3/19/90	13.98
	R20-89-65	4/16/90	14.12
	R20-89-65	5/21/90	13.34
	R20-89-65	6/20/90	11.34
	R20-89-65	7/24/90	11.85
	R20-89-65	5/6/91	13.34
	R20-89-65	8/5/91	12.93
	R20-89-65	1/16/92	14.01
	R20-89-65	2/25/92	12.02
	R20-89-65	3/30/92	11.02
	R20-89-65	4/27/92	10.86
	R20-89-65	5/11/92	11.75
	R20-89-65	6/29/92	9.57
	R20-89-65	7/20/92	6.98
	R20-89-65	8/17/92	8.33
	R20-89-65	9/28/92	11.97
	R20-89-65	10/26/92	9.29
	R20-89-65	11/23/92	9.41
	R20-89-65	12/29/92	10.75
	R20-89-65	1/28/93	11.32
	R20-89-65	2/18/93	11.65
	R20-89-65	3/29/93	3.4
	R20-89-65	4/28/93	4.66
	R20-89-65	8/23/93	3.63
	R20-89-65	9/30/93	7.04
	R20-89-65	10/28/93	8.82
	R20-89-65	11/29/93	9.42
	R20-89-65	12/28/93	9.27
	R20-89-65	1/25/94	10.36
	R20-89-65	2/22/94	6.54
	R20-89-65	3/28/94	4.91
	R20-89-65	5/26/94	7.91

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-65	7/6/94	5.23
	R20-89-65	8/8/94	10.16
	R20-89-65	9/14/94	10.32
	R20-89-65	12/14/94	11.76
	R20-89-65	2/28/95	11.26
	R20-89-65	3/30/95	4.63
	R20-89-65	4/26/95	2.11
	R20-89-65	5/24/95	3.72
	R20-89-65	6/27/95	6.77
	R20-89-65	7/19/95	7.28
	R20-89-65	8/30/95	9.11
	R20-89-65	9/26/95	10.27
	R20-89-65	10/26/95	7.85
	R20-89-65	11/29/95	8.96
	R20-89-65	12/21/95	9.21
	R20-89-65	7/17/96	7.4
	R20-89-65	7/14/97	8.36
	R20-89-66	8/30/89	12
	R20-89-66	11/2/89	14.88
	R20-89-66	3/19/90	14.18
	R20-89-66	4/16/90	14.42
	R20-89-66	5/21/90	13.59
	R20-89-66	6/20/90	11.57
	R20-89-66	7/24/90	12.07
	R20-89-66	5/6/91	13.59
	R20-89-66	8/5/91	13.26
	R20-89-66	1/16/92	14.26
	R20-89-66	5/11/92	12.02
	R20-89-66	7/20/92	7.25
	R20-89-66	8/17/92	8.61
	R20-89-66	8/23/93	3.88
	R20-89-67	8/30/89	12
	R20-89-67	9/25/89	14.83
	R20-89-67	11/2/89	15.08
	R20-89-67	3/19/90	14.46
	R20-89-67	4/16/90	14.66
	R20-89-67	5/21/90	13.82
	R20-89-67	6/20/90	11.74
	R20-89-67	7/24/90	12.32
	R20-89-67	5/6/91	13.84
	R20-89-67	8/5/91	13.87
	R20-89-67	1/16/92	14.5
	R20-89-67	5/11/92	12.23
	R20-89-67	7/20/92	7.46
	R20-89-67	8/17/92	8.8
	R20-89-67	8/23/93	4.15
	R20-89-67	8/8/94	10.62
	R20-89-67	7/19/95	7.77
	R20-89-67	7/17/96	7.85

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-89-67	7/14/97	8.8
	R20-93-30	8/30/93	15.14
	R20-93-30	9/28/93	15.93
	R20-93-30	10/27/93	16.11
	R20-93-30	11/30/93	16.46
	R20-93-30	12/30/93	16.63
	R20-93-30	1/24/94	16.92
	R20-93-30	2/24/94	16.99
	R20-93-30	3/29/94	15.35
	R20-93-30	4/27/94	15.26
	R20-93-30	5/24/94	15.27
	R20-93-30	7/5/94	18.21
	R20-93-30	8/2/94	16.11
	R20-93-30	9/6/94	16.49
	R20-93-30	12/5/94	17.02
	R20-93-30	1/31/95	17.35
	R20-93-30	2/27/95	17.56
	R20-93-30	3/29/95	16.97
	R20-93-30	4/24/95	15.82
	R20-93-30	5/22/95	14.93
	R20-93-30	6/26/95	15.72
	R20-93-30	7/24/95	18.8
	R20-93-30	8/28/95	16.36
	R20-93-30	9/25/95	14.98
	R20-93-30	10/25/95	14.57
	R20-93-30	11/30/95	14.35
	R20-93-30	12/20/95	15.02
	R20-93-30	1/30/96	15.92
	R20-93-30	2/26/96	16.24
	R20-93-30	3/27/96	15.74
	R20-93-30	4/23/96	15.41
	R20-93-30	5/20/96	15.28
	R20-93-30	7/22/96	17.5
	R20-93-30	8/27/96	17.21
	R20-93-30	4/21/97	13.26
	R20-93-30	5/20/97	14.12
	R20-93-30	7/21/97	17.72
	R20-93-30	8/25/97	18.3
	R20-94-01	6/28/94	4.59
	R20-94-01	8/9/94	10.75
	R20-94-01	9/28/94	11.37
	R20-94-01	12/13/94	11.73
	R20-94-01	7/18/95	8.47
	R20-94-01	7/16/96	10.15
	R20-94-01	7/16/97	10.34
	R20-94-02	6/28/94	4.73
	R20-94-02	8/9/94	10.9
	R20-94-02	9/28/94	11.53
	R20-94-02	12/13/94	12.03

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-94-02	7/18/95	8.76
	R20-94-02	7/16/96	10.2
	R20-94-02	7/16/97	10.46
	R20-94-04	6/28/94	10.04
	R20-94-04	8/4/94	10.76
	R20-94-04	9/28/94	11.11
	R20-94-04	12/12/94	11.16
	R20-94-04	7/17/95	9.32
	R20-94-04	7/15/96	10.05
	R20-94-04	7/15/97	9.89
	R20-94-05	6/28/94	9.4
	R20-94-05	8/4/94	10.07
	R20-94-05	9/28/94	10.42
	R20-94-05	12/12/94	10.47
	R20-94-05	7/17/95	8.8
	R20-94-05	7/15/96	8.4
	R20-94-05	7/15/97	9.25
	R20-94-06	7/6/94	5.17
	R20-94-06	8/4/94	7.69
	R20-94-06	9/27/94	8.84
	R20-94-06	12/7/94	10.12
	R20-94-06	7/17/95	4.21
	R20-94-06	7/15/96	7.35
	R20-94-06	7/15/97	8.04
	R20-94-07	7/6/94	5.03
	R20-94-07	8/4/94	7.56
	R20-94-07	9/27/94	8.7
	R20-94-07	12/7/94	9.99
	R20-94-07	7/17/95	4.57
	R20-94-07	7/15/96	7.2
	R20-94-07	7/15/97	7.89
	R20-94-08	6/29/94	18.89
	R20-94-08	8/3/94	20.01
	R20-94-08	9/27/94	20.21
	R20-94-08	12/7/94	20.32
	R20-94-08	7/26/95	18.84
	R20-94-08	7/24/96	19.4
	R20-94-08	7/23/97	20.48
	R20-94-09	6/29/94	19.13
	R20-94-09	8/3/94	20.24
	R20-94-09	9/27/94	20.45
	R20-94-09	12/7/94	20.56
	R20-94-09	7/26/95	19.06
	R20-94-09	7/24/96	19.95
	R20-94-09	7/23/97	20.71
	R20-94-12	7/6/94	8.22
	R20-94-12	8/3/94	8.82
	R20-94-12	9/27/94	9.42
	R20-94-12	12/6/94	10.07

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Big Sioux – continued.	R20-94-12	7/25/95	8.54
	R20-94-12	1/30/96	10.1
	R20-94-12	2/26/96	10.29
	R20-94-12	3/27/96	10.17
	R20-94-12	7/23/96	8.2
	R20-94-12	4/21/97	8.64
	R20-94-12	5/20/97	8.71
	R20-94-12	7/22/97	8.91
	R20-94-12	8/25/97	8.08
	R20-94-13	7/5/94	5.67
	R20-94-13	8/2/94	6.1
	R20-94-13	9/27/94	6.79
	R20-94-13	12/6/94	7.32
	R20-94-13	7/24/95	5.56
	R20-94-13	7/22/96	6.25
	R20-94-13	7/21/97	6.27
	R20-94-14	6/28/94	8.59
	R20-94-14	8/8/94	12.99
	R20-94-14	9/28/94	14.49
	R20-94-14	12/13/94	15.35
	R20-94-14	7/19/95	10.79
	R20-94-14	7/17/96	12.4
	R20-94-14	7/14/97	11.37
	R20-94-15	6/28/94	8.18
	R20-94-15	8/8/94	12.6
	R20-94-15	9/28/94	14.1
	R20-94-15	12/13/94	14.95
	R20-94-15	7/19/95	10.39
	R20-94-15	7/17/96	12.25
	R20-94-15	7/14/97	10.98
	R20-94-23	6/29/94	3.73
	R20-94-23	8/3/94	6.08
	R20-94-23	9/27/94	6.31
	R20-94-23	12/6/94	6.69
	R20-94-23	7/25/95	5.43
	R20-94-23	7/24/96	6.15
	R20-94-23	7/22/97	5.87
	R20-94-24	6/29/94	4.04
	R20-94-24	8/3/94	6.39
	R20-94-24	9/27/94	6.62
	R20-94-24	12/6/94	7
	R20-94-24	7/25/95	5.75
	R20-94-24	7/24/96	6.5
	R20-94-24	7/22/97	6.19
Bowdle	R20-89-10	8/31/94	9.9
	R20-89-10	9/13/95	8.7
	R20-89-10	9/11/96	10.11
	R20-89-10 (L-5B)	9/10/97	9.33

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Bowdle – continued.	R20-89-6	5/17/94	22.59
	R20-89-6	6/21/94	22.69
	R20-89-6	7/26/94	22.37
	R20-89-6	8/31/94	22.33
	R20-89-6	11/30/94	22.35
	R20-89-6	5/1/95	21.7
	R20-89-6	6/6/95	20.04
	R20-89-6	8/14/95	18.59
	R20-89-6	9/13/95	19.04
	R20-89-6	5/2/96	20.57
	R20-89-6	6/5/96	20.39
	R20-89-6	8/14/96	20.81
	R20-89-6	9/10/96	21.06
	R20-89-6	9/10/97	18.91
	R20-89-7	5/17/94	22.75
	R20-89-7	6/21/94	22.85
	R20-89-7	7/26/94	22.63
	R20-89-7	8/31/94	22.59
	R20-89-7	11/30/94	22.6
	R20-89-7	5/1/95	21.97
	R20-89-7	6/6/95	20.29
	R20-89-7	8/14/95	18.86
	R20-89-7	9/13/95	19.31
	R20-89-7	5/2/96	20.83
	R20-89-7	6/5/96	20.66
	R20-89-7	8/14/96	21.04
	R20-89-7	9/10/96	21.32
	R20-89-7	9/10/97	19.18
	R20-89-9	8/31/94	10.2
	R20-89-9	9/13/95	9
	R20-89-9	9/11/96	10.43
	R20-89-9 (L-5A)	9/10/97	9.66
	R20-90-15	5/17/94	38.4
	R20-90-15	6/21/94	38.78
	R20-90-15	7/26/94	39.25
	R20-90-15	8/31/94	40.21
	R20-90-15	11/29/94	39.28
	R20-90-15	5/2/95	38.15
	R20-90-15	6/5/95	37.6
	R20-90-15	8/15/95	38.05
	R20-90-15	9/13/95	38.37
	R20-90-15	5/1/96	36.48
	R20-90-15	6/4/96	36.31
	R20-90-15	8/13/96	37.67
	R20-90-15	9/11/96	38.36
	R20-90-15 (L-8B)	4/29/97	35.75
	R20-90-15 (L-8B)	6/4/97	35.28
	R20-90-15 (L-8B)	8/13/97	36.65
	R20-90-15 (L-8B)	9/10/97	37.25

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Bowdle – continued.	R20-90-16	5/17/94	38.59
	R20-90-16	6/21/94	38.96
	R20-90-16	7/26/94	39.55
	R20-90-16	8/31/94	40.51
	R20-90-16	11/29/94	39.58
	R20-90-16	5/2/95	38.47
	R20-90-16	6/5/95	37.92
	R20-90-16	8/15/95	38.37
	R20-90-16	9/13/95	38.68
	R20-90-16	5/1/96	36.78
	R20-90-16	6/4/96	36.61
	R20-90-16	8/13/96	37.97
	R20-90-16	9/11/96	38.68
	R20-90-16 (L-8A)	4/29/97	36.06
	R20-90-16 (L-8A)	6/4/97	35.57
	R20-90-16 (L-8A)	8/13/97	36.96
	R20-90-16 (L-8A)	9/10/97	37.56
	R20-96-19	9/9/97	9.8
	R20-96-20	9/9/97	9.99
	R20-96-21	9/9/97	9.32
Cheyenne River	R20-95-88	6/10/96	9.33
	R20-95-88	6/10/97	8.75
	R20-95-90	6/10/96	12.73
	R20-95-90	6/10/97	10.2
Delmont	R20-91-52	8/30/94	13.84
	R20-91-52	6/21/95	7.19
	R20-91-52	6/17/96	10.85
	R20-91-52 (DC-1B)	6/16/97	7.11
	R20-91-53	8/30/94	13.95
	R20-91-53	6/21/95	7.3
	R20-91-53	6/17/96	10.98
	R20-91-53 (DC-1C)	6/16/97	7.24
	R20-91-54	8/30/94	9.52
	R20-91-54	6/21/95	5.53
	R20-91-54	6/17/96	8.65
	R20-91-54 (DC-2A)	5/12/97	7.95
	R20-91-54 (DC-2A)	6/16/97	5.65
	R20-91-54 (DC-2A)	7/28/97	7.13
	R20-91-54 (DC-2A)	9/15/97	8.03
	R20-91-55	8/30/94	10.16
	R20-91-55	6/21/95	6.55
	R20-91-55	6/17/96	9.28
	R20-91-55 (DC-2B)	5/12/97	8.56
	R20-91-55 (DC-2B)	6/16/97	6.62
	R20-91-55 (DC-2B)	7/28/97	7.76
	R20-91-55 (DC-2B)	9/15/97	8.66

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Highmore-Blunt	R20-96-26	4/30/97	11.46
	R20-96-27	4/30/97	11.58
	R20-96-29	4/30/97	4.17
	R20-96-30	4/30/97	4.17
	R20-96-31	4/30/97	4.08
Missouri	R20-95-04	5/29/96	14.13
	R20-95-04	5/27/97	12.48
	R20-95-05	5/29/96	14.73
	R20-95-05	5/27/97	13.08
	R20-95-06	5/29/96	16.77
	R20-95-06	5/28/97	14.63
	R20-95-07	5/29/96	17.44
	R20-95-07	5/28/97	15.3
	R20-95-08	5/29/96	19.77
	R20-95-08	5/28/97	16.51
	R20-95-09	5/29/96	20.17
	R20-95-09	5/28/97	16.91
	R20-95-11	5/29/96	15.36
	R20-95-11	5/28/97	12.71
	R20-95-12	5/29/96	15.57
	R20-95-12	5/28/97	12.91
	R20-95-13	5/28/96	10.26
	R20-95-13	5/27/97	6.57
	R20-95-14	5/28/96	9.8
	R20-95-14	5/27/97	6.1
Ogallala	R20-94-30	5/8/95	27.14
	R20-94-30	8/8/95	26.2
	R20-94-30	5/6/96	25.96
	R20-94-30	5/5/97	24.7
	R20-94-31	5/8/95	27.72
	R20-94-31	8/8/95	26.75
	R20-94-31	5/6/96	26.53
	R20-94-31	5/5/97	25.26
	R20-94-32	5/9/95	12.56
	R20-94-32	8/9/95	11.33
	R20-94-32	5/7/96	11.41
	R20-94-32	5/6/97	10.76
	R20-94-33	5/9/95	12.4
	R20-94-33	8/9/95	11.22
	R20-94-33	5/7/96	11.28
	R20-94-33	5/6/97	10.6
	R20-94-34	5/16/95	19.23
	R20-94-34	6/19/95	18.45
	R20-94-34	8/7/95	18.16
	R20-94-34	9/18/95	18.09
	R20-94-34	5/7/96	17.78
	R20-94-34	6/18/96	17.66

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Ogallala – continued.	R20-94-34	7/29/96	17.72
	R20-94-34	9/16/96	17.83
	R20-94-34	5/6/97	17.23
	R20-94-35	5/16/95	19.16
	R20-94-35	6/19/95	18.33
	R20-94-35	8/7/95	18.02
	R20-94-35	9/18/95	18.04
	R20-94-35	5/7/96	17.73
	R20-94-35	6/18/96	17.47
	R20-94-35	7/29/96	17.54
	R20-94-35	9/16/96	17.66
	R20-94-35	5/6/97	17.1
	R20-94-36	5/9/95	23.76
	R20-94-36	8/9/95	22.52
	R20-94-36	5/14/96	22.32
	R20-94-36	5/13/97	21.88
	R20-94-37	5/9/95	24.02
	R20-94-37	8/9/95	22.84
	R20-94-37	5/14/96	22.63
	R20-94-37	5/13/97	21.99
	R20-94-38	5/10/95	2.73
	R20-94-38	6/20/95	3.43
	R20-94-38	8/7/95	4.45
	R20-94-38	9/19/95	6.01
	R20-94-38	5/13/96	3.14
	R20-94-38	5/12/97	3.16
	R20-94-38	6/17/97	3.29
	R20-94-38	7/29/97	4.78
	R20-94-38	9/16/97	5.47
	R20-94-39	5/10/95	4.65
	R20-94-39	6/20/95	4.17
	R20-94-39	8/7/95	5.4
	R20-94-39	9/19/95	6.71
	R20-94-39	5/13/96	3.81
	R20-94-39	5/12/97	3.85
	R20-94-39	6/17/97	5.03
	R20-94-39	7/29/97	5.03
	R20-94-39	9/16/97	7.16
	R20-94-40	5/16/95	33.86
	R20-94-40	8/10/95	32.13
	R20-94-40	5/13/96	31.74
	R20-94-40	6/17/96	31.6
	R20-94-40	7/29/96	31.62
	R20-94-40	9/17/96	31.63
	R20-94-40	5/12/97	30.87
	R20-94-40	6/16/97	30.73
	R20-94-40	7/28/97	30.77
	R20-94-40	9/16/97	30.78
	R20-94-41	5/16/95	33.65

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Ogallala – continued.	R20-94-41	8/10/95	31.76
	R20-94-41	5/13/96	31.36
	R20-94-41	6/17/96	31.25
	R20-94-41	7/29/96	31.2
	R20-94-41	9/17/96	31.25
	R20-94-41	5/12/97	30.47
	R20-94-41	6/16/97	30.37
	R20-94-41	7/28/97	30.39
	R20-94-41	9/16/97	30.41
	R20-94-50	5/17/95	3.72
	R20-94-50	8/10/95	7.37
	R20-94-50	5/13/96	4.29
	R20-94-50	5/12/97	3.56
Parker-Centerville	CO-83-149	5/18/94	4.73
	CO-83-149	6/22/94	5.6
	CO-83-149	7/27/94	7.13
	CO-83-149	9/8/94	8.13
	CO-83-149	12/1/94	8.99
	CO-83-149	5/3/95	3.65
	CO-83-149	6/7/95	3.01
	CO-83-149	8/16/95	5.16
	CO-83-149	9/11/95	7.11
	CO-83-149	4/30/96	7.73
	CO-83-149	6/3/96	6.76
	CO-83-149	8/12/96	7.61
	CO-83-149	9/9/96	8.4
	CO-83-149(TU-10A)	9/8/97	7.85
	CO-83-158	5/25/94	8.72
	CO-83-158	6/22/94	9.09
	CO-83-158	7/27/94	9.71
	CO-83-158	9/7/94	10.43
	CO-83-158	11/30/94	11.12
	CO-83-158	6/7/95	7.78
	CO-83-158	8/16/95	9.04
	CO-83-158	9/11/95	9.75
	CO-83-158	4/30/96	10.58
	CO-83-158	6/3/96	10.55
	CO-83-158	8/12/96	11.5
	CO-83-158	9/9/96	11.01
	CO-83-158	4/28/97	9.71
	CO-83-158 (TU-9A)	6/2/97	9.26
	CO-83-158 (TU-9A)	8/11/97	9.95
	CO-83-158 (TU-9A)	9/8/97	10.42
	R20-88-10	5/25/94	9.77
	R20-88-10	6/22/94	10.15
	R20-88-10	7/27/94	10.77
	R20-88-10	9/7/94	11.49
	R20-88-10	11/30/94	12.19

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Parker-Centerville – continued.	R20-88-10	6/7/95	8.85
	R20-88-10	8/16/95	10.1
	R20-88-10	9/11/95	10.81
	R20-88-10	4/30/96	11.63
	R20-88-10	6/3/96	11.61
	R20-88-10	8/12/96	11.68
	R20-88-10	9/9/96	12.05
	R20-88-10 (TU-9B)	4/28/97	10.77
	R20-88-10 (TU-9B)	6/2/97	10.31
	R20-88-10 (TU-9B)	8/11/97	11
	R20-88-10 (TU-9B)	9/8/97	11.48
	R20-88-11	5/18/94	5.3
	R20-88-11	6/22/94	6.19
	R20-88-11	7/27/94	7.61
	R20-88-11	9/8/94	8.61
	R20-88-11	12/1/94	9.48
	R20-88-11	5/3/95	4.15
	R20-88-11	6/7/95	3.5
	R20-88-11	8/16/95	5.65
	R20-88-11	9/11/95	7.58
	R20-88-11	4/30/96	8.24
	R20-88-11	6/3/96	7.25
	R20-88-11	8/12/96	8.07
	R20-88-11	9/9/96	8.85
	R20-88-11 (TU-10B)	9/8/97	8.3
	R20-90-10	9/8/94	8.09
	R20-90-10	9/12/95	7.25
	R20-90-10	9/9/96	7.36
	R20-90-10 (TU-13A)	9/8/97	7.84
	R20-90-9	9/8/94	6.37
	R20-90-9	9/12/95	5.53
	R20-90-9	9/9/96	5.64
	R20-90-9 (TU-13B)	9/8/97	8.04
	R20-96-12	9/8/97	7.7
	R20-96-13	9/8/97	6.97
Rapid Creek	R20-95-107	6/11/96	11.16
	R20-95-107	6/11/97	10.99
	R20-95-94	4/16/96	2.53
	R20-95-94	6/12/96	3.77
	R20-95-94	8/5/96	6.1
	R20-95-94	9/23/96	4.96
	R20-95-94	6/11/97	3.52
Sand Hills	R20-94-28	5/17/95	12.25
	R20-94-28	8/8/95	11.4
	R20-94-28	5/6/96	11.72
	R20-94-28	5/5/97	9.7
	R20-94-29	5/17/95	11.2

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Sand Hills – continued.	R20-94-29	8/8/95	10.7
	R20-94-29	5/6/96	11.28
	R20-94-29	5/5/97	8.94
Selby	R20-96-22	8/13/97	6.79
	R20-96-23	8/13/97	6.85
	R20-96-24	8/14/97	5.68
	R20-96-25	8/14/97	5.67
Skunk Creek	R20-94-17	4/25/95	14.99
	R20-94-17	5/23/95	12.5
	R20-94-17	7/12/95	10.94
	R20-94-17	9/7/95	12.28
	R20-94-17	4/22/96	15.42
	R20-94-17	5/21/96	15.5
	R20-94-17	7/8/96	15.03
	R20-94-17	8/26/96	16.4
	R20-94-17	4/23/97	14.78
	R20-94-17	5/21/97	14.82
	R20-94-17	7/8/97	14.84
	R20-94-17	8/26/97	13
	R20-94-18	4/25/95	14.75
	R20-94-18	5/23/95	12.31
	R20-94-18	7/12/95	10.77
	R20-94-18	9/7/95	12.13
	R20-94-18	4/22/96	15.24
	R20-94-18	5/21/96	15.31
	R20-94-18	7/8/96	14.86
	R20-94-18	8/26/96	16.25
	R20-94-18	4/23/97	14.61
	R20-94-18	5/21/97	14.69
	R20-94-18	7/8/97	14.7
	R20-94-18	8/26/97	12.82
	R20-94-19	4/25/95	2.58
	R20-94-19	5/23/95	3.06
	R20-94-19	7/13/95	3.68
	R20-94-19	9/7/95	4.96
	R20-94-19	4/22/96	4.4
	R20-94-19	5/21/96	4.21
	R20-94-19	7/8/96	4.56
	R20-94-19	8/26/96	6.15
	R20-94-19	4/23/97	2.55
	R20-94-20	4/25/95	2.67
	R20-94-20	5/23/95	3.16
	R20-94-20	7/13/95	3.77
	R20-94-20	9/7/95	5.06
	R20-94-20	4/22/96	4.51
	R20-94-20	5/21/96	4.32
	R20-94-20	7/8/96	4.68

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Skunk Creek – continued.	R20-94-20	8/26/96	6.27
	R20-94-20	4/23/97	2.66
	R20-94-21	4/25/95	6.12
	R20-94-21	9/6/95	7.47
	R20-94-21	4/22/96	8.89
	R20-94-21	4/23/97	3.38
	R20-94-22	4/25/95	6.3
	R20-94-22	9/6/95	7.65
	R20-94-22	4/22/96	9.07
	R20-94-22	4/23/97	3.56
	R20-94-26	4/25/95	6.47
	R20-94-26	9/6/95	7.5
	R20-94-26	4/22/96	7.22
	R20-94-26	4/23/97	5.59
	R20-94-27	4/25/95	6.12
	R20-94-27	9/6/95	7.14
	R20-94-27	4/22/96	6.86
	R20-94-27	4/23/97	5.24
Spearfish Creek	R20-95-102	6/11/96	6.3
	R20-95-102	4/14/97	5.99
	R20-95-102	6/9/97	6.47
	R20-95-102	8/4/97	6.43
	R20-95-102	9/22/97	6.19
	R20-95-103	4/16/96	14.7
	R20-95-103	6/11/96	11.57
	R20-95-103	8/5/96	10.69
	R20-95-103	9/23/96	10.78
	R20-95-103	6/9/97	11.88
	R20-95-104	4/16/96	15.06
	R20-95-104	6/11/96	11.88
	R20-95-104	8/5/96	11.04
	R20-95-104	9/23/96	11.07
	R20-95-104	6/9/97	12.2
Tulare	R20-96-32	6/3/97	23.06
	R20-96-34	6/3/97	2.88
	R20-96-35	6/3/97	3.32
	R20-96-36	6/3/97	18.41
	R20-96-37	6/3/97	18.53
Vermillion-East-Fork	R20-96-14	7/8/97	21.5
	R20-96-15	7/8/97	21.32
	R20-96-17	7/8/97	4.63
	R20-96-18	7/8/97	5.41
Vermillion-West-Fork	R20-88-1 (TU-1B)	9/7/94	14.85
	R20-88-1 (TU-1B)	9/11/95	14.4
	R20-88-1 (TU-1B)	9/9/96	17.14

Aquifer	Well name	Date	Depth to water from top of casing (feet)
Vermillion-West-Fork – continued.	R20-88-1 (TU-1B)	4/28/97	15.11
	R20-88-1 (TU-1B)	6/2/97	15.39
	R20-88-1 (TU-1B)	8/11/97	16.02
	R20-88-1 (TU-1B)	9/9/97	16.29
	TU-1A	4/28/97	15.35
	TU-1A	6/2/97	15.61
	TU-1A	8/11/97	16.24
	TU-1A	9/9/97	16.5
	TU-80C	9/7/94	15.07
	TU-80C	9/11/95	14.61
	TU-80C	9/9/96	17.36