SOUTH DAKOTA
Ground-Water Quality

Ground water provides 77 Mgal/d (million gallons per day) for about 77 percent of South Dakota's population of 690,000 people (fig. 1). The majority of the State's 934 community wells, 301 noncommunity wells, and 60,350 private wells are located near the more populated areas of South Dakota. There is no evidence of widespread human-induced contamination in the glacial-drift and alluvial aquifers, and the sedimentary bedrock aquifers (fig. 2). The principal water-quality concern in South Dakota is that the quality of water from large areas of the State commonly exceeds the U.S. Environmental Protection Agency's (EPA) (1986a,b) primary or secondary standards for drinking-water supplies. Dissolved solids, chloride, fluoride, nitrate, sulfate, iron, manganese, selenium, and radionuclides are constituents that most commonly exceed the standards. Although the concentrations of most of these constituents are due to the mineralogy of the aquifers within the State, elevated concentrations of dissolved solids and nitrate are known to result from human activities.

Although areas of ground-water contamination do exist within the State, most cases are isolated (fig. 3). Inorganic and organic nutrients resulting from feedlots, septic tanks, and improper handling and storage of fertilizers have contaminated several community and private water-supply wells. Additional inorganic contaminants affecting wells include dissolved solids resulting from leaking artesian aquifers, saltwater intrusion from saline lakes, brine spills, and leaking brine pits. Arsenic contamination of ground-water supplies in the Black Hills in western South Dakota is known to occur from mine tailings.

Organic contamination of ground water, primarily from pesticides and petroleum products, has been documented in South Dakota (South Dakota Department of Water and Natural Resources, 1984). However, areas of known contamination are limited to those downgradient of spills, leaky storage tanks, and landfills. A hazardous-waste site is present within the Whitewood Creek drainage in western South Dakota as a result of the movement of trace metals from mine tailings to the Whitewood Creek alluvium. Also, the Whitewood Creek site was identified as part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and is part of EPA's Superfund program. U.S. Department of Defense has identified 16 sites at one facility as having potential for ground-water contamination.

Data assessing organic contaminants in ground water in South Dakota are limited because no statewide ground-water-monitoring network exists and because analyses of organic chemicals are not part of routine water-quality analyses of samples from water-supply and observation wells. The potential for organic contamination is particularly great in shallow glacial-drift and alluvial aquifers. For example, the Big Sioux aquifer, a glacial-drift and alluvial aquifer, in eastern South Dakota, provides drinking water for more than 80 percent of the population in the Big Sioux River basin (about 26 percent of the State's population) and is especially vulnerable to contamination because of the shallow depth to water, the extension of permeable material to the land surface, and urban areas where organic materials are produced and stored overlying substantial parts of the aquifer.

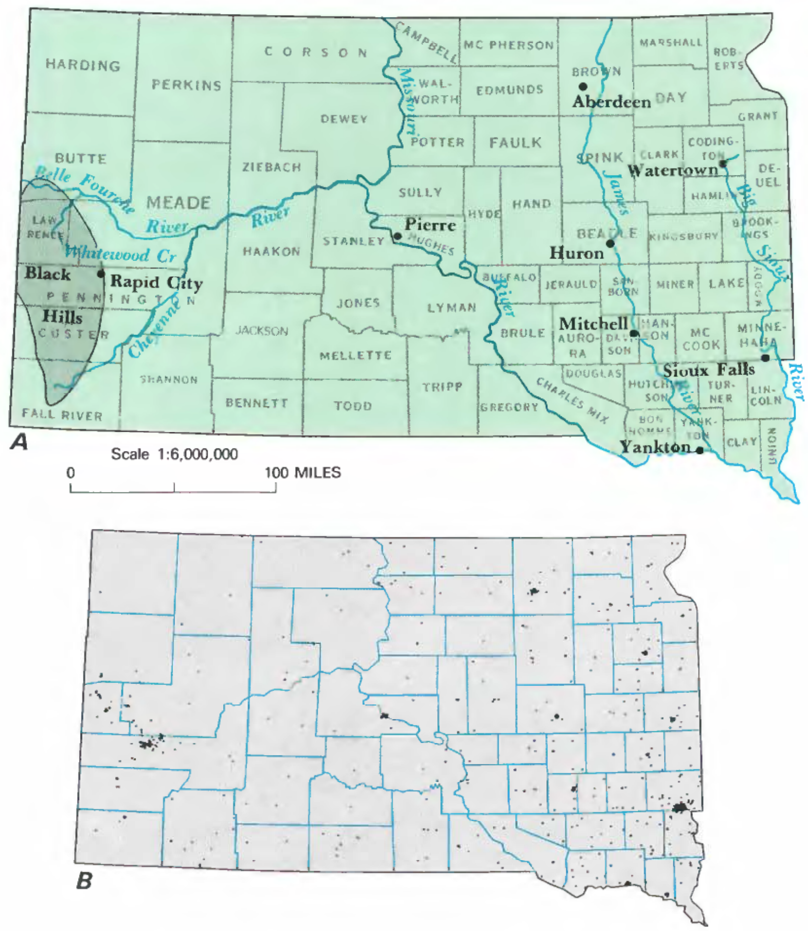

Figure 1. Selected geographic features and 1985 population distribution in South Dakota. *A*, Counties, selected cities, and major drainages. *B*, Population distribution, 1985; each dot on the map represents 1,000 people. (Source: *B*, Data from U.S. Bureau of the Census 1980 decennial census files, adjusted to the 1985 U.S. Bureau of the Census data for county populations.)

WATER QUALITY IN PRINCIPAL AQUIFERS

South Dakota has two principal types of aquifers (fig. 2*A*)—glacial-drift and alluvial aquifers, and sedimentary bedrock aquifers (U.S. Geological Survey, 1985, p. 385). Glacial-drift aquifers underlie most of the State east of the Missouri River and alluvium occurs along major streams throughout the State. Glacial-drift aquifers and alluvial aquifers consist of unconsolidated sand and gravel. Water from the glacial-drift and alluvial aquifers is fresh to slightly saline and is suitable for domestic, livestock, and irrigation uses. Water from shallow glacial-drift and alluvial aquifers contains predominately calcium, bicarbonate, and sulfate ions. Water from deeper glacial-drift aquifers contains predominately calcium, sodium, and sulfate ions. The Big Sioux aquifer, a glacial-drift and alluvial aquifer within the Big Sioux River basin, is the most im-

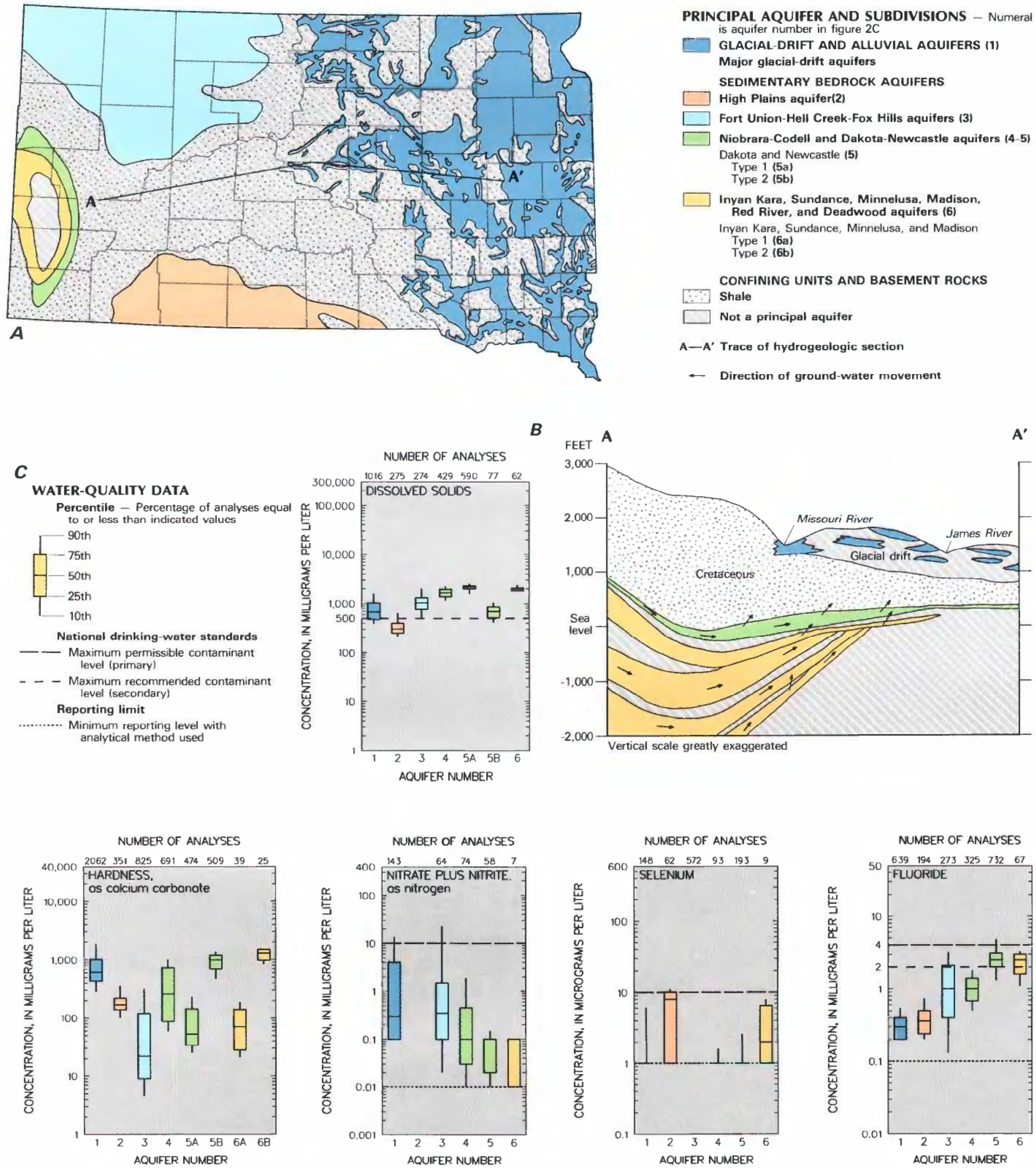

Figure 2. Principal aquifers and related water-quality data in South Dakota. *A*, Principal aquifers. *B*, Generalized hydrogeologic section. *C*, Selected water-quality constituents and properties, as of 1930-85. (Sources: *A*, U.S. Geological Survey; 1985; Bardwell, 1984. *B*, Modified from Swenson, 1968. *C*, Analyses compiled from U.S. Geological Survey files; national drinking-water standards from U.S. Environmental Protection Agency, 1986 b,c.)

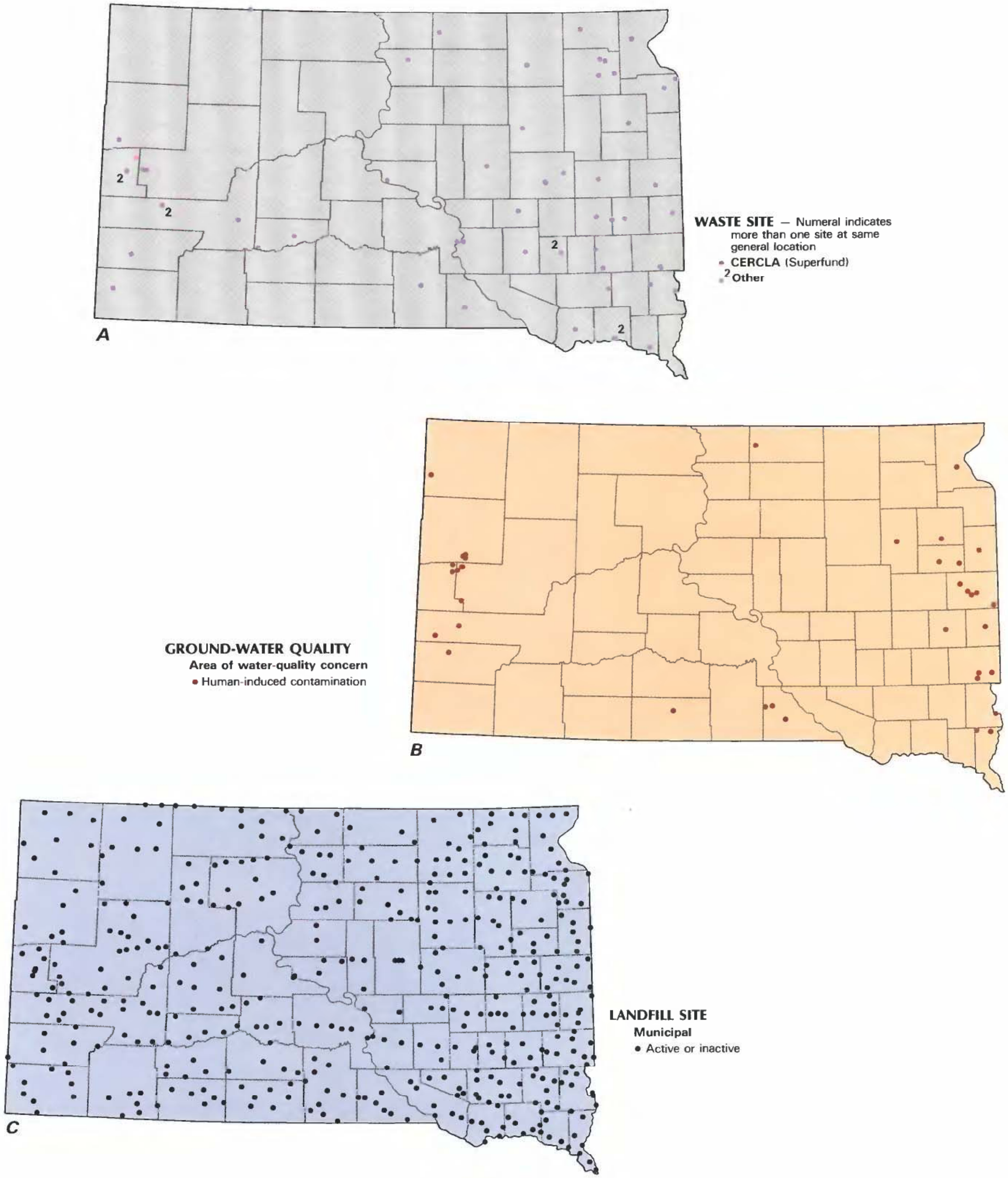

Figure 3. Selected waste sites and ground-water-quality information in South Dakota. *A*, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites, as of 1986; and other selected waste sites, as of 1986. *B*, Areas of human-induced contamination, as of 1985. *C*, Municipal landfills, as of 1986. (Sources: *A*, Jeanne Goodman, South Dakota Department of Water and Natural Resources, written commun., 1986. *B*, William Markley, South Dakota Department of Water and Natural Resources, written commun., 1985. *C*, Jeanne Goodman, South Dakota Department of Water and Natural Resources, written commun., 1986.)

portant surficial aquifer in the State. There are 14 sedimentary bedrock aquifers in South Dakota (fig. 2*A*). These aquifers are the only source of ground water west of the Missouri River, except for a few small ares of alluvium along major streams. Although commonly very mineralized, except for the High Plains aquifer, and found at relatively great depth away from the Black Hills, water from these aquifers is used extensively for rural-domestic and stock supply. Several of the bedrock aquifers extend into eastern South Dakota beneath the glacial drift (fig. 2*A*).

BACKGROUND WATER QUALITY

A graphic summary of selected water-quality variables compiled from the U.S. Geological Survey's National Water Data Storage and Retrieval System (WATSTORE) data base is presented in figure 2*C*. The summary is based on dissolved-solids, hardness, nitrate-plus-nitrite (as nitrogen), selenium, and fluoride analyses of water samples collected from 1930 to 1985 from the principal aquifers in South Dakota. Percentiles of these variables are compared to national standards that specify the maximum concentration or level of a contaminant in drinking-water supply as established by the U.S. Environmental Protection Agency (1986b,c). The primary maximum contaminant level standards are health related and are legally enforceable. The secondary maximum contaminant level standards apply to esthetic qualities and are recommended guidelines. The primary drinking-water standards include a maximum concentration of 10 mg/L (milligrams per liter) nitrate (as nitrogen), 10 μg/L (micrograms per liter) selenium, and 4 mg/L fluoride. The secondary drinking-water standards include maximum concentrations of 500 mg/L dissolved solids and 2 mg/L fluoride.

Glacial-Drift and Alluvial Aquifers

Glacial-drift aquifers consist of unconsolidated sand and gravel deposited by meltwaters from glaciers. Alluvial aquifers consist of unconsolidated sand and gravel deposited by streams.

The water within the shallow glacial-drift and alluvial aquifers had a median dissolved-solids concentration of 670 mg/L; dissolved solids in about 75 percent of the samples exceeded the national drinking-water standard of 500 mg/L. Water from deeper glacial-drift aquifers had a median dissolved-solids concentration of 1,250 mg/L. Whereas dissolved solids provide an indication of the total mineral content of the water, hardness (as calcium carbonate) provides a general indication of the calcium and magnesium content. The median hardness of water from the glacial-drift and alluvial aquifers was 605 mg/L; hardness in 75 percent of the samples was less than 1,000 mg/L (fig. 2*C*). Although uncommon, maximum dissolved-solids and hardness concentrations were as much as 8,300 and 5,000 mg/L, respectively. Calcium and magnesium are the major components of the dissolved-solids concentration in water from the glacial-drift and alluvial aquifers.

Concentrations of nitrate plus nitrite (as nitrogen) in water from the glacial-drift and alluvial aquifers tended to differ somewhat, with a median concentration of 0.3 mg/L. Nitrate plus nitrite in about 10 percent of the samples exceeded the national drinking-water standard of 10 mg/L, with concentrations ranging between 13 and 143 mg/L. Water from many domestic water-supply wells contained large concentrations of nitrate plus nitrite primarily because such wells are downgradient from septic drainage fields, feedlots, or barnyards. In addition, excessive nitrate-plus-nitrite concentrations have been detected downgradient from fertilizer storage areas.

Seventy-five percent of the samples analyzed for selenium contained concentrations less than the detection limit of 1.0 μg/L. Although uncommon, selenium concentrations have exceeded the national drinking-water standard of 10 μg/L. Fluoride concentrations in water from the glacial-drift and alluvial aquifers were less than 0.60 mg/L in 90 percent of the samples. The maximum national drinking-water standard for fluoride concentration is 4.0 mg/L.

High Plains Aquifer

The High Plains aquifer in south-central South Dakota primarily is composed of unconsolidated and slightly consolidated sandstone of the Ogallala and Arikaree Formations. The High Plains aquifer generally is a water-table aquifer in South Dakota, but may be confined in places within the Arikaree Formation. Water in the High Plains aquifer predominately is a calcium-bicarbonate type, and is suitable for domestic, livestock, and irrigation uses; about 90 percent is used for irrigation.

The High Plains aquifer generally contains the least mineralized water of any aquifer in the State although water from the Arikaree Formation tends to contain relatively large concentrations of sodium. Dissolved-solids concentrations generally are less than 400 mg/L (fig. 2*C*) but have been as much as about 1,400 mg/L. The hardness concentration also is smaller than other aquifers in the State with a median value of 170 mg/L and a range of 100 to 770 mg/L. The water generally is hard to very hard. No water samples from the High Plains aquifer have been analyzed for nitrate in South Dakota.

About 25 percent of the selenium concentrations exceeded the national drinking-water standard of 10 μg/L. The median selenium concentration was 8 μg/L. Ground-water samples from some areas have contained selenium concentrations as large as 5,600 μg/L. Selenium concentrations tend to be largest where the Ogallala Formation overlies the Pierre Shale, and the smallest where the Ogallala overlies the Arikaree.

Fort Union, Hell Creek, and Fox Hills Aquifers

The Fort Union, Hell Creek, and Fox Hills aquifers in northwestern South Dakota mostly are confined aquifers but may be unconfined in certain areas. These aquifers are composed of very fine unconsolidated sandstone (U.S. Geological Survey and U.S. Bureau of Reclamation, 1975). Water from these aquifers generally is fresh to slightly saline. Major ions in the water are predominately sodium, sulfate, and bicarbonate. The water is used for public water supplies and agricultural and domestic purposes. Molybdenum is known to be associated with uranium in lignite deposits in the Fort Union and Hell Creek aquifers at concentrations large enough to cause molybdenosis in cattle (Meyer, 1984a). Methane or hydrogen sulfide or both occur in water from some wells completed in the Hell Creek aquifer (Thorstensen and others, 1979).

Water quality within the Fort Union, Hell Creek, and Fox Hills aquifers tends to be significantly different than that in either the glacial-drift and alluvial or the High Plains aquifers. Dissolved-solids concentrations were mostly less than 2,000 mg/L with a median of about 1,050 mg/L (fig. 2*C*), but have been as much as about 8,500 mg/L. The hardness of water from Fort Union, Hell Creek, and Fox Hills aquifers differs. The hardness of most samples was less than 120 mg/L (moderately hard), with a median of 22 mg/L (soft). Although not common, hardness concentrations of 2,000 mg/L have been recorded. The water contains a large amount of sodium, with less calcium and magnesium.

Nitrate plus nitrite (as nitrogen) concentrations differed in these aquifers. Although 75 percent of the samples contained less than 1.5 mg/L, the maximum nitrate plus nitrite concentration was 180 mg/L. The median concentration was 0.35 mg/L The source of the larger nitrate plus nitrite concentrations is not known.

Selenium concentrations were mostly less than the detection limit of 1.0 μg/L, although the maximum concentration was 15 μg/L. Fluoride concentrations in about 75 percent of the samples were less than 2.0 mg/L. The median fluoride concentration was 1.0 mg/L. Concentrations in about 18 percent of the samples were more than 2.4 mg/L.

Niobrara and Codell Aquifers

The Niobrara and Codell aquifers in eastern South Dakota primarily are confined, and composed of shale, chalk, and fine-grained quartz sandstone (U.S. Geological Survey and U.S. Bureau of Reclamation, 1975). The water is slightly saline and contains predominately sodium and sulfate ions. The water is used for domestic and livestock purposes but generally is too mineralized for irrigation use.

The median dissolved-solids concentration in water from the Niobrara and Codell aquifers was 1,670 mg/L (fig. 2*C*). Eighty percent of the samples from these aquifers contained dissolved solids concentrations between 1,150 and 2,250 mg/L. The maximum dissolved-solids concentration was 9,140 mg/L. The hardness of water from these aquifers generally ranged between about 90 mg/L (moderately hard) and 730 mg/L (very hard) with a median value of 260 mg/L (very hard). However, the maximum hardness concentration was 2,900 mg/L.

The concentrations of nitrate plus nitrite generally were less than 1.0 mg/L, but the maximum concentration was 35 mg/L. The median concentration was 0.1 mg/L. The cause of nitrate plus nitrite concentrations greater than 10 mg/L in ground water is not known.

Selenium concentrations generally were less than the detection limit (fig. 2*C*), although water from several wells contained concentrations of about 10 μg/L. Fluoride concentrations were less than the national drinking-water standard in water from most wells. The median concentration was 1.0 mg/L; concentrations in 90 percent of the samples were less than 1.8 mg/L. Fluoride concentrations were as much as 3.2 mg/L.

Dakota and Newcastle Aquifers

The Dakota and Newcastle aquifers, which underlie most of South Dakota (fig. 2*C*), are confined and composed of sandstone interbedded with shale and siltstone (U.S. Geological Survey and U.S. Bureau of Reclamation, 1975). The water is slightly to moderately saline and contains predominately sodium, chloride, and sulfate ions. The water is used primarily for livestock, but is too mineralized for irrigation use and commonly is not used for human consumption.

Two water types were identified within the Dakota and Newcastle aquifers. Type 2 water occurs in southeastern South Dakota, and type 1 water occurs elsewhere in the State. Type 1 had a median dissolved-solids concentration of 2,170 mg/L, which is larger than water from the previously described aquifers (fig. 2*C*). Ninety percent of the dissolved-solids concentrations were less than 2,550 mg/L. Type 2 water had a median dissolved-solids concentration of 690 mg/L. Ninety percent of the dissolved-solids concentrations in the type 2 water were less than 1,060 mg/L. In some areas in Brown County, the Dakota aquifer is being recharged by underlying aquifers that contain freshwater under greater pressure; this recharge has resulted in a decrease in chloride concentration from 200 to 160 mg/L from 1938 to 1963 (Koch and Bradford, 1976).

Hardness concentrations were the major difference between the two water types. Type 1 water is soft to moderately hard, whereas type 2 is classified as very hard. The median hardness concentration of type 1 is 53 mg/L, with 90 percent of the concentrations less than 230 mg/L. Type 2 water had a median hardness concentration of 990 mg/L, with 90 percent of the concentrations less than 1,400 mg/L. Type 1 water has a large proportion of sodium to calcium and magnesium. Type 2 water has a large proportion of calcium and magnesium to sodium.

A differentiation between water types was not made for nitrate plus nitrite, selenium, or fluoride concentrations because their differences were minimal. Seventy-five percent of the nitrate plus nitrite concentrations were less than 0.1 mg/L. The median concentration was also 0.1 mg/L. The maximum nitrate plus nitrite concentration was 1.1 mg/L. Seventy-five percent of the selenium concentrations were less than the detection limit of 1 μg/L. The maximum selenium concentration was 35 μg/L, which exceeded the national drinking-water standard of 10 μg/L. Fluoride concentrations in water from the Dakota and Newcastle aquifers tend to be more than 2.4 mg/L. The median fluoride concentration in water from these aquifers was 2.5 mg/L, with 90 percent of the concentrations less than 4.8 mg/L. The maximum fluoride concentration in water from this aquifer was 26 mg/L. These large fluoride concentrations were caused by naturally occurring minerals in the aquifers.

Inyan Kara, Sundance, Minnelusa, Madison, Red River, and Deadwood Aquifers

The Inyan Kara is a confined aquifer composed of sandstone interbedded with shale and siltstone; the Sundance aquifer also is confined but composed of shale interbedded with limestone, sandstone, and shale. The Minnelusa aquifer is confined and is composed of sandstone interbedded with limestone, dolomite, and shale; the Madison aquifer also is a confined aquifer but composed of limestone and dolomite interbedded with shale, anhydrite, and halite (U.S. Geological Survey and U.S. Bureau of Reclamation, 1975).

Water in the Inyan Kara, Sundance, Minnelusa, and Madison aquifers is a sodium-sulfate type in western South Dakota and a calcium-sulfate type in eastern parts of the State. The least mineralized water occurs where these aquifers are exposed at land surface in the western part of the State. In some areas, water from the Inyan Kara and Madison aquifers have concentrations of radium-226 and gross alpha that exceed national primary drinking-water standards [5 and 15 pCi/L (picocuries per liter), respectively]. Uranium concentrations also are greater than background concentrations but do not exceed national standards (South Dakota Department of Water and Natural Resources, 1984). Water is used for public supply, domestic, and livestock purposes and is suitable for irrigation use in some areas, particularly within the Black Hills.

Water from the Red River and Deadwood aquifers appears to be markedly different from water in other sedimentary bedrock aquifers within the State. Water from the Red River aquifer is predominately a sodium-chloride type. Water from the Deadwood aquifer is fresh within the Black Hills. These aquifers generally are undeveloped, and their potential for development is unknown.

The differences of dissolved-solids concentration for this group of aquifers appear to be very small except for the Red River and Deadwood aquifers. The median dissolved-solids concentration for the group was 1,996 mg/L and 90 percent of the concentrations were less than 2,400 mg/L (fig. 2*C*). The maximum dissolved-solids concentration was 4,300 mg/L. Nearly all water samples from these aquifers had dissolved-solids concentrations greater than the national drinking-water standard of 500 mg/L. Water from the Red River aquifer had a maximum dissolved-solids concentration of 25,000 mg/L. Water from the Deadwood aquifer had a minimum dissolved-solids concentration of 400 mg/L.

The hardness concentrations for the Inyan Kara, Sundance, Minnelusa, and Madison aquifers can be grouped into two water types. Type 1 water is soft to moderately hard. The median hardness concentration was 71 mg/L, and 90 percent of the concentrations were less than 190 mg/L. The maximum hardness concentration for type 1 water was 219 mg/L. Type 2 water is hard to very hard. The median hardness concentration was 1,300 mg/L. Eighty percent of the concentrations were between 840 and 1,600 mg/L. Type 1 water has a large proportion of sodium to calcium and magnesium; whereas type 2 water has a large proportion of calcium and magnesium to sodium.

Water types were not differentiated for nitrate plus nitrite, selenium, and fluoride concentrations because their differences were minimal. Seventy-five percent of the nitrate plus nitrite concentrations were less than 0.1 mg/L. The median concentration was 0.01 mg/L as nitrogen.

All total selenium concentrations were less than the National drinking-water regulation of 10 μg/L; the median concentration was 2 μg/L. Fluoride concentrations in water from these aquifers tended to be greater than the national drinking-water standard of 2 mg/L. The median fluoride concentration was 2.5 mg/L, and 80 percent of the concentrations were between 1.1 and 3.3 mg/L. The maximum fluoride concentration was 7.2 mg/L.

EFFECTS OF LAND USE ON WATER QUALITY

As of 1986, there was no evidence of widespread contamination of ground water in South Dakota. However, ground water has been contaminated in local areas due to the effects of flowing wells, releases of petroleum products and agricultural chemicals, wastewater-disposal systems, feedlots, mining activities, and oil and gas activities (South Dakota Department of Water and Natural Resources, 1984). The contamination of ground-water supplies for about 15,000 people, about 2.6 percent of the 586,000 people served by ground water, has been documented (fig. 3*B*). Contamination of most water wells in the State is associated with chemical spills, feedlots, and septic systems. Commonly, the wells are contaminated with one or more of the following: nitrate, bacteria, hydrocarbons, or pesticides.

There are 58 permitted solid-waste facilities (fig. 3*A*) and about 350 municipal landfills (fig. 3*C*) in South Dakota. Contamination of potable water supplies at or near these facilities and landfills has not been documented. As of September 1985, 16 hazardous waste-sites at 1 facility in South Dakota had been identified by the U.S. Department of Defense (DOD) as part of their Installation Restoration Program (IRP) as having potential for contamination (U.S. Department of Defense, 1986). The IRP, established in 1976, parallels the EPA Superfund program under CERCLA. EPA presently ranks these sites under the hazard ranking system and may include them in the National Priorities List (NPL).

Flowing Wells

Shallow glacial-drift aquifers in the James River basin have been contaminated by saline water from flowing wells completed in bedrock aquifers. Flowing wells completed in bedrock aquifers have discharged billions of gallons of saline water onto the land surface during the last 70 years (Koch and Bradford, 1976). Today (1986), the casing in many of these wells has corroded, and saline water is leaking directly into the glacial-drift aquifers. Saline water from about 15,000 wells completed in bedrock aquifers is contaminating overlying aquifers (South Dakota Department of Water and Natural Resources, 1984).

Petroleum Products and Agricultural Chemicals

Releases of petroleum products and agricultural chemicals can occur as leaks from storage tanks, as improper disposal of rinse water, or as spills during transport. Petroleum products are the most common material involved in releases and are responsible for the contamination of 16 water-supply wells and about 6.1 mi^2 (square miles) of land (Jeanne Goodman, South Dakota Department of Water and Natural Resources, written commun., 1986).

Agricultural chemicals account for the remainder of the contamination problems. Leaking tanks, improper disposal of rinse water, and improper storage of the chemicals and associated equipment have resulted in the contamination of 22 water-supply wells and about 4.23 mi^2 of land (Jeanne Goodman, South Dakota Department of Water and Natural Resources, written commun., 1986)

Wastewater Disposal Systems

According to the 1980 census (U.S. Bureau of the Census, 1982), there were 72,000 individual wastewater-disposal systems serving 185,600 people in South Dakota. More than 443,000 people are served by about 350 centralized wastewater-disposal systems. Individual systems, mostly septic tanks, have caused nitrate and bacterial contamination in domestic water wells because the systems commonly are near domestic wells. However, contamination caused by septic tanks usually is localized.

The majority of the municipal wastewater-disposal systems are stabilization ponds. Localized ground-water degradation has occurred near some of the ponds as a result of leakage. No known water-supply wells have been affected.

Feedlots

Nitrate-plus-nitrite concentrations in excess of 10 mg/L as nitrogen are common in water from wells in or near feedlots. An undetermined number of domestic water wells have been contaminated by feedlot wastes. The extent of ground water contaminated by feedlots is not defined because of the numerous feedlots throughout the State, the diffused movement of nitrogen compounds from feedlots, and the effects of septic systems and improper storage of fertilizers on the nitrate concentrations in ground water. Shallow glacial-drift and alluvial aquifers are particularly susceptible to contamination by feedlots.

Mining Activities

Gold-mining in the Black Hills for about 100 years has produced large quantities of tailings that were discharged directly into Whitewood Creek. This resulted in arsenic and mercury contamination of the alluvial sediments along the creek and identification of the site as part of the EPA's Superfund program (CERCLA, fig. 3*A*). Arsenic concentrations have exceeded the national drinking-water standard of 50 μg/L in water from 10 water-supply wells. At least 5 mi^2 of land have been contaminated (Jeanne Goodman, South Dakota Department of Water and Natural Resources, written commun., 1986). The construction of new water wells in the alluvial aquifer along Whitewood Creek is prohibited in some areas.

Oil and Gas Activities

Oil and gas production in South Dakota is limited to two areas in the western part of the State. These activities have caused increases in dissolved-solids concentrations in ground water, mostly as a result of increases in chloride and sodium concentrations. These increases commonly are associated with leakage from unlined mud pits and from brine-disposal pits. Contamination has been documented (Meyer, 1984a), but no potable water supplies are known to be affected.

POTENTIAL FOR WATER-QUALITY CHANGES

Shallow, near-surface aquifers are susceptible to contamination by human activities because of the thin, permeable soils overlying the aquifers and shallow depth to water. An example is the Big Sioux aquifer (a glacial drift and alluvial aquifer) in eastern South Dakota, which supplies water to about 26 percent of the State's population. Numerous gasoline, fertilizer, and agricultural-chemical spills have occurred in recent years. Such spills, coupled with a shallow water table, create a situation that increases the likelihood of ground-water contamination. Deeper aquifers usually are protected by upward pressure gradients under predevelopment or moderate development conditions and by overlying confining units of clay or shale.

The major land use in the State is agriculture. Although ground-water contamination from nonpoint sources has not been documented as a problem, the current trend toward the increased use of fertilizers and pesticides may degrade or contaminate ground water in some areas. The Oakwood Lake-Poinsett Rural Clean Water Program is a current (1986) ground-water-monitoring project designed to determine the effects of fertilizers and pesticides on receiving ground water as a result of land-use management practices. Contamination of ground water by point sources, such as accidental spills and feedlots, is expected to continue. However, only local areas are expected to be affected by such contamination.

It is estimated that South Dakota has more than 10,000 buried tanks containing petroleum products (Jeanne Goodman, South Dakota Department of Water and Natural Resources, 1980). Because many of the tanks have been buried for a long time, it is expected that isolated instances of ground-water contamination will occur because of petroleum products leaking from the tanks.

The potential for ground-water contamination will probably increase in the Black Hills along with the recent increase in gold-mining activities. Cyanide heap leaching (the leaching of gold from crushed ore using a cyanide solution) is being used at one mining operation and has been proposed for use at two other mining operations. These renewed activities will increase the potential for cyanide and arsenic contamination of local aquifers. However, ground-water-monitoring systems required by the State should detect any aquifer contamination caused by the leaching process.

GROUND-WATER-QUALITY MANAGEMENT

Ground-water management and implementation of the ground-water-quality strategy for prevention, control, and abatement of ground-water contamination are functions of the South Dakota Department of Water and Natural Resources (DWNR). The various aspects of ground-water policies are the responsibility of divisions within that department.

The Division of Water Quality (DWQ) has the primary responsibility in dealing with ground-water contamination and is responsible for development of ground-water-quality strategy. Through this office, Federal Construction Grants, National Pollution Discharge Elimination Systems, and Underground Injection Control permits are reviewed, although U.S. Environmental Protection Agency maintains primacy in some cases. The RCRA Subtitle I-Underground Storage Tanks and remedial action also are administered by this office.

The Division of Drinking Water (DDW) monitors public drinking-water supplies under the Federal Safe Drinking Water Act. Suspected domestic-well contamination may be investigated by this division.

The Division of Environmental Quality (DEQ) coordinates activities to protect ground-water quality. The Division's Office of Air Quality and Solid Waste is responsible for the management of solid and hazardous wastes in the State. This includes administering the majority of the Federal RCRA regulations within the State in addition to issuing disposal-permit applications and conducting some ground-water monitoring. State hazardous-waste regulations are based on RCRA requirements.

The State Division of Water Rights (DWR) regulates water use, well construction, and well-driller licensing. Approval of water-use permits is the responsibility of a seven-member Water Management Board appointed by the Governor. The Board's duties include establishment of general well-construction standards and water-quality functions, which were revised in 1985.

The Division of the Geological Survey (DGS) conducts ground-water investigations involving quality, quantity, and contamination of ground water. Some investigations are conducted in cooperation with the U.S. Geological Survey.

Various divisions within DWNR are taking remedial actions to abate or eliminate reported ground-water contamination. Information on ground-water quality collected through the existing programs does not indicate widespread ground-water contamination; however, background water-quality data are needed for some areas.

The initiation of elements necessary for establishing a State ground-water quality strategy date back to 1979 when the Big Sioux Aquifer Water Quality Study began. A network of monitoring wells was established by the U.S. Geological Survey in cooperation with DGS (Leibbrand, 1985). Monitoring wells were installed in areas of large nitrate concentrations around landfills, in areas of petroleum spills, and around a municipal wastewater-treatment lagoon. Water samples from a group of municipal wells and numerous domestic wells were analyzed for contaminants on the EPA's priority pollutant list (U.S. Environmental Protection Agency, 1986a). A nitrogen-isotope study also was conducted in an attempt to identify sources of nitrate contamination.

DWNR, in cooperation with the U.S. Army Corps of Engineers, is evaluating selected aspects of ground-water resources in eastern and western South Dakota. Among the information compiled under this effort are: (1) A comprehensive bibliography of ground-water-related references; (2) characterization of water-quality suitability by aquifer for specific uses; (3) estimates of recharge rates; (4) compilation and computerization of available water-quality, well-construction, and aquifer data; (5) preparation of ground-water-quality maps and charts; and (6) determination of water use by aquifer.

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