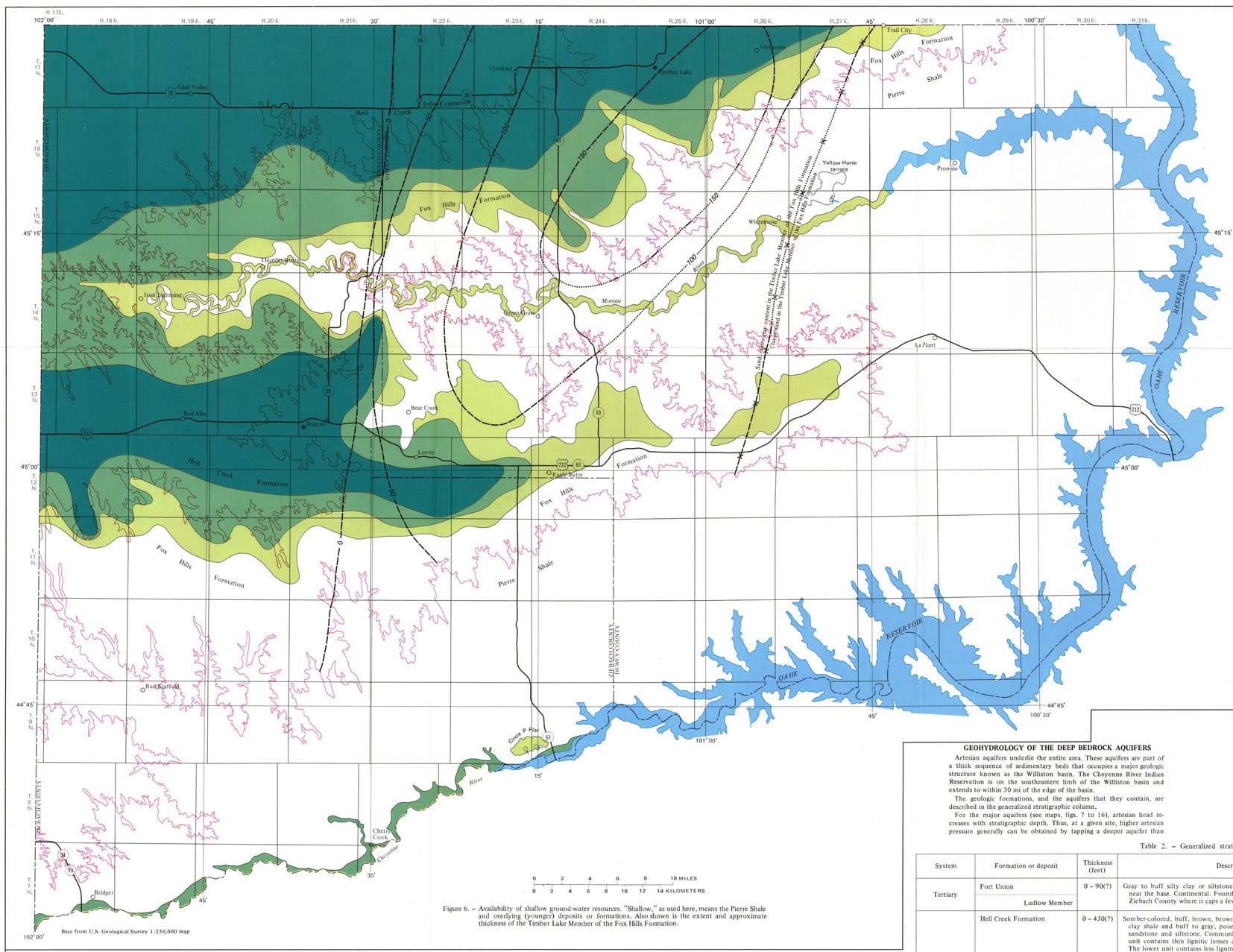

Figure 6. – Availability of shallow ground-water resources. "Shallow," as used here, means the Pierre Shale and overlying (younger) deposits or formations. Also shown is the extent and approximate thickness of the Timber Lake Member of the Fox Hills Formation.

EXPLANATION

Probability of obtaining a water supply

- Good – Well yields may range from 2 to 10 gallons per minute, locally may be larger
- Fair – Well yields may range from 2 to 10 gallons per minute. Greater chance that any water found will be of poor quality
- Fair to Poor – Locally possible to obtain well yields of 1 to 5 gallons per minute, perhaps more. Water commonly is of poor quality
- Very Poor – Low probability of obtaining water. Any water found is likely to be of very poor quality
- Contact between the Hell Creek Formation and the underlying Fox Hills Formation
- Contact between the Fox Hills Formation and the underlying Pierre Shale
- Approximate location of lines of equal thickness, (in feet) of the Timber Lake Member of the Fox Hills Formation. Dotted at inferred preerosional location where formation now is not present. From Waage (1968)
- Approximate location of a major change in lithology and permeability of the Timber Lake Member of the Fox Hills Formation. Dotted at inferred preerosional location where formation now is not present. Modified from Waage (1968)
- Permanent spring

SHALLOW GROUND-WATER RESOURCES

SHALLOW GROUND-WATER RESOURCES

The possibility of obtaining adequate supplies of good quality water from surficial deposits generally is limited to areas where both the Hell Creek and Fox Hills Formations are present, to where the Fox Hills Formation is at least 150 to 200 ft thick, to parts of a few terraces, and to some of the alluvium along the Cheyenne and Moreau Rivers.

Pierre Shale has almost no potential as a source of potable water. The Pierre usually will not yield water to wells, but where water can be obtained, usually the quantity is meager and quality is very poor. Some zones in the shale have high concentrations of soluble selenium compounds (see table 3). Colluvium and alluvium along streams draining areas where shale is at the surface commonly are composed of clay or silty clay and are relatively impermeable; where water can be obtained the quality usually is very poor.

The lowest member of the Fox Hills Formation is relatively impermeable and is a poor source of water. The most permeable part of the Fox Hills is the Timber Lake Member; this silty fine to medium sand is the source of water tapped by the Trail City and Glencross Water Association to supply their rural water distribution system. Though a large amount of water is stored in this aquifer, the generally fine grain of the aquifer material makes it difficult to construct high capacity (more than 100 gal/min) wells. The "Bullhead and Colgate lithofacies" of the uppermost Iron Lightning Member probably are the best potential sources of water in the Fox Hills west of the edge of the "Timber Lake sand," although adequate stock and domestic supplies are or have been obtained locally from the lower part of the Fox Hills north and west of the Cheyenne River Indian Reservation.

The Hell Creek Formation can yield supplies of good quality water adequate for stock and domestic use throughout most of its extent in the two-county area, particularly where it is more than 100 ft thick.

Where both the Hell Creek and Fox Hills Formations are present, they probably form a hydrologic unit. The regional water table lies from 40 to 120 ft below the surface of the rolling uplands. This depth to the water table is the result of both climate and topography. Relatively low precipitation [about 16 in. per year] and fairly high potential evaporation [about 37 in. per year] result in a low rate of recharge to the aquifer. Most recharge occurs from March to early June. Fairly high relief at the edges of the rolling uplands permits rapid discharge of ground water. Perched water-table zones are common; they occur where downward moving water is intercepted by less permeable layers or by lenses of clay. The water then moves laterally to the edge of the confining layer where it again moves downward toward the regional water table. Wells tapping a perched water-table zone have a very limited "reservoir" of water from which to develop a supply. Consequently such wells commonly can yield water only at low rates of pumping, or may yield usable quantities of water for only part of the year, or, if pumpable at fairly high rates, may yield water for only a few days or weeks. Examples of all three types are common in the report area.

Where alluvial deposits contain recoverable water, it is derived from two sources: infiltration of rainfall on the alluvium and of runoff from adjacent higher areas; and by infiltration of water from the stream with which the alluvial deposit is associated. Thus, availability of water from alluvium is localized because infiltration of precipitation and runoff not only is small but also is "channeled" to topographic lows on the shale surface underlying the alluvium, and because permeable deposits seldom extend below the level of the present-day stream beds. The most persistently available source of water from alluvium is along the Cheyenne River.

The potential of terrace deposits as sources for water supplies is much less, even, than that of alluvium. All the terrace deposits are topographically higher than the associated streams. Also, the terraces commonly are underlain by steeply dipping shale surfaces; as a result, infiltrating water can easily and rapidly drain out of the terraces. In at least two places (Yellow Horse and Circle P Flat) the topography of the shale surface underlying the terraces and the structure of the clay, sand, and gravel beds that make up the terraces are such as to form ground-water reservoirs that discharge through permanent springs. On Circle P Flat, the three permanent springs have an aggregate minimum annual discharge of about 20 gal/min of excellent quality water.

The quality of water from deposits overlying the Pierre Shale varies widely, often within short distances. Well owners have reported large and rapid changes in water quality in a given well. In general, the poorest quality water comes from thin alluvial deposits overlying the Pierre Shale and from small permeable lenses in the Fox Hills and (to a lesser extent) the Hell Creek Formations. Except for the Circle P springs, the best quality ground water generally comes from the Hell Creek Formation and from the Fox Hills Formation where it is more than 200 ft thick.

GEOHYDROLOGY OF THE DEEP BEDROCK AQUIFERS

GEOHYDROLOGY OF THE DEEP BEDROCK AQUIFERS

Artesian aquifers underlie the entire area. These aquifers are part of a thick sequence of sedimentary beds that occupies a major geologic structure known as the Williston basin. The Cheyenne River Indian Reservation is on the southeastern limb of the Williston basin and extends to within 30 mi of the edge of the basin.

The geologic formations, and the aquifers that they contain, are described in the generalized stratigraphic column.

For the major aquifers (see maps, figs. 7 to 16), artesian head increases with stratigraphic depth. Thus, at a given site, higher artesian pressure generally can be obtained by tapping a deeper aquifer than by tapping a shallower one.

Development of artesian aquifers in Dewey and Ziebach Counties is slight – so far as is known, only 16 wells have ever been drilled, only 14 of these are now (1974) in use, and of these, 3 are on standby status. Although high cost is an important factor, the principal reason development has been slight is the moderate to high salinity of the water – from 1,500 to more than 100,000 mg/L of dissolved solids. The Madison Group probably contains the best quality artesian water, in which the dissolved solids content ranges from 1,500 mg/L in the southwestern corner of Ziebach County to a maximum of about 6,000 mg/L at the Corson County line in the north-central part of the Reservation. The current severe drought, which began in 1973, has prompted some ranchers in the southern half of the area to plan cooperative development of wells to tap the Madison Group or Minnelusa Formation for stock water.

All of the artesian aquifers yield warm to hot water; temperature ranges from 86°F (30°C) for the cooler part of the Dakota Formation to at least 163°F (73°C), reported on a geophysical log of an oil test that penetrated the Red River Formation. Maximum temperature in the Red River or Deadwood Formation may be more than 212°F (100°C).

Table 2. – Generalized stratigraphic column describing the bedrock units, some of their hydrologic characteristics, and the quality of the water.

System	Formation or deposit	Thickness (feet)	Description	Hydrologic significance [1]	Quality of water
Tertiary	Fort Union Ludlow Member	0 – 90(?)	Gray to buff silty clay or siltstone; thin carbonaceous or lignitic beds near the base. Continental. Found only in the northwestern corner of Ziebach County where it caps a few buttes and hills.	None	
Cretaceous	Hell Creek Formation	0 – 430(?)	Somber-colored, buff, brown, brownish-gray, and black, soft, bentonitic clay shale and buff to gray, poorly indurated, coarse to fine-grained sandstone and siltstone. Commonly divided into two units; the upper unit contains thin lignitic lenses and some black carbonaceous shale. The lower unit contains less lignite and less carbonaceous shale and is more sandy and silty. Continental.	Where it is more than 100 feet thick, the Hell Creek is an aquifer that can yield supplies of fresh to saline water adequate for stock and domestic use. Small lenses of water-bearing sand and small perched water-table aquifers are common. On a regional basis it probably forms a single hydrologic unit with the Fox Hills Formation.	Dissolved solid concentration ranges from about 800 mg/L to more than 4,400 mg/L. Water is mostly of sodium sulfate type but becomes sodium bicarbonate type near the Corson County line north and west of Glad Valley. East of Glad Valley the water is of calcium magnesium sulfate type. Chloride, flouride, and boron tend to increase with well depth or with distance from the limit of outcrop. Hardness, lithium, and strontium tend to decrease with increasing distance from the limit of the outcrop. Only two samples exceeded U.S. Environmental Protection Agency (1975) limit on selenium; both wells sampled apparently are receiving fertilizer or feedlot runoff (anomalously high nitrate contents).
	Fox Hills Formation	0 – 400	Dark-gray and greenish-gray to light-gray silty and sandy clay, clayey silt, and very fine-grained sandstone; overlain, in part, by dark-gray to yellowish-orange, poorly consolidated, very fine-grained sandstone. The upper part of the formation is a thinly bedded clay, silt, and very fine sand sequence ("banded beds") that contains discontinuous beds of silica-cemented very fine-grained sandstone. The members of this formation commonly have gradational contacts and are, in part, lateral facies. Marine. The contacts with the overlying Hell Creek Formation and underlying Pierre Shale commonly are gradational.	Where it is more than 100 to 150 feet thick, the Fox Hills is an aquifer capable of yielding supplies of fresh to saline water adequate for stock and domestic use. Small lenses of water-bearing sand and small perched water-table aquifers are common.	South of the Moreau River, water from the Fox Hills Formation contains from 500 mg/L to more than 4,000 mg/L dissolved solids. North of the Moreau River the dissolved solids concentration generally is lower, ranging from about 300 mg/L to 3,300 mg/L. Higher salinities most commonly are from wells tapping the lower part of the formation, or from wells located where the formation is thin. Salinity tends to increase to the west. Halide concentrations tend to increase and strontium concentrations to decrease from east to west. Water is of sodium bicarbonate type except in the area of outcrop near the Moreau River east of Thunder Butte Village, where the water is of sodium sulfate type.
	Pierre Shale	250(?) – 1400	Gray, brown, and black, tough, gummy to friable shale, noncalcareous to highly calcareous; contains widely persistent zones of bentonite and of limestone or iron-manganese concretions. Marine. Silty and sandy in its upper part in southwestern Ziebach County.	Relatively impermeable; a barrier to the movement of water.	
	Niobrara Formation	100 – 260	Tannish to bluish-gray and light to dark-gray highly calcareous shale; contains abundant microfossils. Marine.	Relatively impermeable; a barrier to the movement of water. Apparently contains no water-yielding zone in Dewey and Ziebach Counties, although it does contain an important aquifer in the James River valley of eastern South Dakota.	
	Carlile Shale	340 – 540	Light-blue or light-gray to black shale, generally noncalcareous; contains one or more sandstone or sandy or silty intervals (probably equivalent to the Codell Sandstone Member found elsewhere) in the top half. Marine.	Relatively impermeable; a barrier to the movement of water. The Codell Sandstone Member, an aquifer in much of eastern South Dakota, either is missing, or (more likely) is represented by relatively impermeable silty and sandy shale.	
	Greenhorn Limestone	110 – 210	Buff to bluish, white, or gray, highly calcareous shale; commonly marly and fossiliferous. May be interbedded with thin limestone layers. Marine.	Though locally an aquifer in some parts of South Dakota, the Greenhorn is not known to yield water in Dewey and Ziebach Counties.	
	Graneros Shale	190 – 390	Medium- to dark-gray, noncalcareous shale. Calcareous concretions and pyrite and marcasite crystals common. Generally divided into two units by a widely persistent bentonite bed. The upper unit contains many thin bentonite beds; the lower unit is more siliceous and may contain thin sandstone or very sandy or silty beds. Marine.	Relatively impermeable; a barrier to the movement of water.	
	Dakota Formation (Newcastle Sandstone)	40 – 260	White, tan, or light-gray sandstone, very fine to medium-grained, loose to tightly cemented; interbedded with dark-colored shale. Thins to the northwest where it is mostly shale that contains sandy or silty beds. The shaley phase is almost indistinguishable from the overlying Graneros and underlying Skull Creek Shales. Deltaic to nearshore marine.	Relatively impermeable and not an aquifer in the northern half of Ziebach County and the northwestern quarter of Dewey County. Elsewhere the Dakota can yield moderately saline to very saline water. Artesian head in the aquifer ranges from about 2,100 feet above sea level near the Meade County line west of Dupree to about 1,800 feet above sea level in the northeastern corner of Dewey County.	Throughout most of its extent in the report area, the aquifer yields sodium chloride type water than contains 5,000 to 8,000 mg/L dissolved solids. The salinity is lower in the southwestern corner of Ziebach County where water from the basal part of the aquifer may contain as little as 2,500 mg/L of dissolved solids; also, in that area, the water is of sodium bicarbonate type. Water temperature ranges from 30° to more than 50°C (86° to more than 122°F).
	Skull Creek Shale	140 – 230	Dark bluish-gray shale. Marine.	Relatively impermeable; a barrier to the movement of water.	
	Inyan Kara Group	30 – 250	White to light-gray or tan sandstone and siltstone; contains beds of gray to black and reddish to buff shale. Continental to marginal marine.	An artesian aquifer than can yield moderately saline to very saline water. Artesian head is more than 2,200 feet above sea level and probably is above land surface throughout the report area. Total amount of water in storage in the report area is estimated as 8 million acre-feet.	In the northwestern two-thirds of Dewey County and in northeastern Ziebach County the aquifer yields sodium chloride type water that contains 4,000 to 8,000 mg/L dissolved solids. In eastern and southern Dewey and southeastern Ziebach Counties the water is sodium sulfate type and contains from 2,000 to 4,000 mg/L dissolved solids. In the rest of Ziebach County, the water contains from 2,000 to 4,000 mg/L dissolved solids, the dominant cation is sodium, but the anions are bicarbonate and chloride, chloride and sulfate, and bicarbonate, sulfate, and chloride. Water temperature ranges from 32° to more than 50°C (90° to more than 122°F).
Jurassic	Sundance Formation	100 – 340	Gray, green, and brown shale, interbedded with white, buff, dark-pink, or red, glauconitic, fine-grained sandstone and siltstone. May contain limestone concretions and thin beds of coquinoid or oolitic limestone in the upper part. Marine.	The aquifer consists of sandstone beds that can yield moderately saline to very saline water. Artesian head is more than 2,200 feet above sea level and probably is above land surface throughout the report area. The shale beds are relatively impermeable, and are barriers to the movement of water. Total amount of water in storage in the report area may exceed 15 million acre-feet.	In the southeastern third of the area the water contains from 2,000 to 7,600 mg/L dissolved solids; the dominant ions are sodium and sulfate or sodium, sulfate, and chloride. No information is available for the rest of the area. Probably, in the area north of Dupree, the water contains more than 8,000 mg/L dissolved solids and is of sodium chloride type. In the southwestern half of Ziebach County, the dissolved solids may decrease to 2,000 mg/L or less, and the dominant ions probably are sodium and sulfate, but may include significant proportions of bicarbonate or chloride. Water temperature ranges from 33° to more than 50°C (91° to more than 122°F).
	Piper Formation	0 – 145	Limestone and green or gray shale. Where the formation is thickest, in the northwestern part of the area, some "red-bed" shale and gypsum beds may overlie and underlie the limestone and green shale unit. The Piper Formation underlies approximately the northwestern half of the report area. Marine.	Hydrologic potential unknown, but probably poor.	No information available. Any water probably is highly mineralized, because the formation contains disseminated grains and beds of evaporite minerals.
Triassic	Spearfish Formation	0 – 60	Orange, brick-red, green, and gray shale and soft siltstone and sandstone; interbedded with anhydrite, gypsum, and halite. Also may contain thin limestone beds. Marine. Underlies the western third of the report area.	Hydrologic potential unknown; but the evaporite and shale beds are barriers to the movement of water and the sandstone and siltstone beds are so fine-grained as to be, at best, only poorly permeable.	If any water can be obtained from the Spearfish, such water probably is very saline because of contact with evaporite minerals.
Permian	Minnekahta Formation	0 – 35	Gray and white to lavender, fine-grained, dense, thin-bedded, dolomitic limestone. Marine. Underlies about the western quarter of the report area.	Hydrologic potential unknown; probably not an aquifer and may be a barrier to the movement of water.	
	Opeche Formation	0 – 90	Brick-red to purple and orange silty shale and fine-grained, soft, slabby sandstone. Marine. Extent is somewhat less than that of the overlying Minnekahta Limestone.	Hydrologic potential unknown; probably a barrier to the movement of water.	
	Minnelusa Formation	320 – 820	A complex sequence of predominantly marine beds. In part of the area, the base is the "basal laterite marker" red shale, overlain by five major sandstone zones separated by limestone, dolomite, shale, and anhydrite beds. Sandstones are white to yellow to red; carbonates are white to brown to gray; shales are brick-red to orange, green, or black. A prominant "red marker" shale is above the middle of the formation. This bed commonly is interpreted as marking the top of the Pennsylvanian beds; its top is the base of Permian strata.	A major ground-water reservoir. The thicker sandstone beds and some of the carbonate beds form an aquifer that can yield saline to very saline water. The evaporite and shale beds are barriers to the movement of water. Most wells tapping the Minnelusa probably will flow; the minimum artesian head is higher than 2,200 feet above sea level. Total amount of water in storage in the report area may be as much as 50 million acre-feet.	Based upon scanty information: Salinity is lowest along the southern edge of the report area, ranging from about 1,500 mg/L dissolved solids near the Meade County line, to about 2,000 mg/L near the Missouri River. This is very hard, calcium magnesium sulfate type water. To the north and west of this band, the water increases in salinity and in the proportions of sodium and chloride. The maximum salinity may exceed 75,000 mg/L of sodium chloride type water near the Dewey-Ziebach County line at the northern boundary of the report area. Locally, the water may be even more saline because it may be in contact with evaporite beds. Water temperature ranges from 33° to more than 60°C (91° to more than 140°F).
Pennsylvanian					
Mississippian	Madison Group (Includes: Charles Formation and the Mission Canyon and Lodgepole Limestones)	390 – 950	White to tan, brown, and gray limestone and dolomite; interbedded with brown shale and light-blue to white and light-brown anhydrite. some halite. Marine.	May be the most important bedrock aquifer in South Dakota. Can yield hard, saline water throughout its extent in the report area. Artesian head in the aquifer is above land surface throughout most or all of the area. The Madison probably recharges overlying bedrock aquifers east and southeast of the report area. The Madison is recharged in the Black Hills and in other areas of outcrop farther west. Total amount of water in storage in the report area is estimated to be 40 million acre-feet.	Generally is calcium magnesium sulfate type water, but the proportion of sodium increases in a north to north-westerly direction; along the north-central edge of the report area, the water may be of sodium sulfate type. The salinity may vary widely between various permeable horizons at the same geographic site due to contact between water and evaporite beds. At an oil test hole in Perkins County, the dissolved solids concentration of water ranged from 3,100 mg/L to 124,000 mg/L. In general the water is least saline (about 1,500 mg/L) in southwestern Ziebach County, gradually increases in salinity to the east (about 2,200 mg/L at the Missouri River) and north. North of Dupree (2,300 mg/L) and Eagle Butte (2,100 mg/L), salinity increases more rapidly, reaching about 6,000 mg/L dissolved solids near the center of the northern boundary of the Reservation. Water temperature ranges from about 40° to more than 64°C (104° to more than 147°F).
Devonian	Sedimentary rocks undifferentiated (Includes: Bakken, Three Forks, Birdbear, Duperow, Souris River Formations and, Ashern (?) Formation of Baillie, 1950)	170 – 420	Gray to brown, rarely pink, limestone and dolomite; interbedded with anhydrite, red to gray, fine to medium-grained sandstone and siltstone, and black, red, gray, or green shale. Marine.	Hydrologic potential unknown. Evaporite and shale beds are barriers to the movement of water, but sandstone and carbonate-rock beds probably are artesian aquifers. Total amount of water in storage in the report area may be as much as 12 million acre-feet.	No direct information is available. About 40 miles to the east and to the southeast of the report area, water from Devonian strata contains 2,000 to 2,200 mg/L dissolved solids and is of calcium magnesium sulfate type. Drill stem tests about 15 miles west and 35 miles northwest of the report area yielded water of sodium chloride type that contained 102,000 and 19,000 mg/L dissolved solids, respectively. Contact with evaporite beds and higher water temperatures probably are responsible for the high salinity. Water temperature ranges from about 44° to more than 64°C (111° to more than 147°F).
Silurian	Interlake Formation	0 – 150	Light-tan to brown dolomite, anhydrite, and calcareous sandstone. Marine. Underlies the northwestern quarter of the report area.	Hydrologic potential unknown, but probably is an aquifer. Total amount of water in storage in the report area is estimated as half a million acre-feet.	No direct information is available; probably saline. Drill stem tests in Perkins County showed between 6,000 and 8,000 mg/L of calcium magnesium sulfate water and of sodium chloride water.
Ordovician	Stonewall Formation of Kindle, 1914	0 – 80	Light-tan to yellowish dolomite and arenaceous shale, locally sandy. Marine. Underlies the northwestern third of the report area.	Hydrologic potential unknown, but the limestone beds may be an artesian aquifer(s).	No information available.
	Stony Mountain Formation	0 – 80	Brown to gray dolomitic limestone; commonly divided into two units. The lower unit contains sandstone, siltstone, and shale near the base. Marine. Underlies all but the southeastern corner of the report area.	Hydrologic potential unknown, but the sandstone and limstone beds may constitute one or more artesian aquifers.	No information available.
	Red River Formation	290 – 570	An upper unit of pale-red, pink, buff, or light-brown fossiliferous dolomite and lower unit of light-gray to pinkish, clay-streaked dolomitic limestone. Can be divided into three units on geophysical well logs. Marine.	A major artesian aquifer. Data are scanty, but oil well tests seem to show very permeable horizons. Total amount of water in storage in the report area may exceed 25 million acre-feet.	In the Lantry area, water contains from 2,200 to 2,900 mg/L dissolved solids and is of calcium magnesium sulfate type; however, at least one horizon in the formation yields sodium chloride type water that contains more than 12,000 mg/L dissolved solids. To the east, south, and southwest of Lantry, water is of calcium magnesium sulfate type and probably contains less dissolved solids, particularly to the southwest. To the northeast, north, and northwest of Lantry the proportions of sodium and chloride increase and the salinity increases, particularly to the north. The dissolved solids concentration may exceed 60,000 mg/L near the Corson County line. Water temperature ranges from about 46° to more than 73°C (115° to more than 163°F). One questionable measurement of 102°C (216°F) has been reported.
	Winnipeg Formation	0 – 130	Thick middle unit of green to gray, bentonitic shale that contains black phosphate nodules; thin upper unit of siltstone; and lower unit of white, well-sorted, medium to fine-grained, quartz sandstone. Basal sandstone is missing throughout most of the report area. Marine.	Relatively impermeable, a barrier to the movement of water. The basal sand, where and if present, probably is an aquifer.	No information is available; but if any Winnipeg sandstone is present, the water probably is similar in quality to that in the underlying Deadwood Formation.
Cambrian	Deadwood Formation	0 – 550(?)	White to buff to reddish-orange, light-gray, grayish-red, and brownish-red sandstone, siltstone, flaggy dolomite and limestone, and limestone-pebble conglomerate; contains beds and partings of greenish-gray and gray glauconitic shale. Sandstone, commonly conglomeritic, at the base. Marine. The top of the Deadwood may be Early Ordovician in age. Formation underlies all of the Reservation except for a few square miles near the mouth of the Cheyenne River.	The sandstone and conglomerate beds probably constitute one or more major artesian aquifers. Total amount of water in storage in the report area may be as much as 15 million acre-feet.	No direct information is available. The water probably contains less than 2,500 mg/L dissolved solids in the southern half of the report area. Salinity increases to the north and may exceed 10,000 mg/L at the north-central boundary. Water probably is of sodium chloride type in the north; the proportions of calcium, magnesium, and sulfate increase to the south, possibly to the extent that they become the dominant ions in the central or southern part of the Reservation. Water temperature ranges from about 46° to more than 80°C (115° to more than 176°F).
Cambrian(?) and Precambrian(?)	Transgressive facies of clastic rocks	0 – 50	Sandstone and conglomerate, generally coarse-grained, but ranges from fine-grained to gravelly. Composition reflects the lithology of underlying and nearby Cambrian and Precambrian rocks. This is a coarse clastic facies that overlies the Precambrian surface throughout much of South Dakota.	Probably a major aquifer. Is a major conduit for transmission of water upward through the stratigraphic column because it is in physical and hydraulic contact with other aquifers where they pinch out against the Precambrian surface. Locally known as "wash" and "granite wash."	No information is available; but probably is the same as water from the Deadwood Formation.
Precambrian	Igneous and metamorphic rocks		Various colored granite, gneiss, schist, and other igneous and metamorphic rocks.	Impermeable. Locally might yield water from fractures or joints.	No information is available, but probably is the same as water from whatever aquifer immediately overlies, or is in nearby contact with, the Precambrian surface.

[1] Terms used for relative salinity have the following ranges of value for dissolved solids

Fresh	Less than 1,000 mg/L
Saline	More than 1,000 mg/L
Moderately saline	2,000 to 6,000 mg/L
Very saline	More than 6,000 mg/L

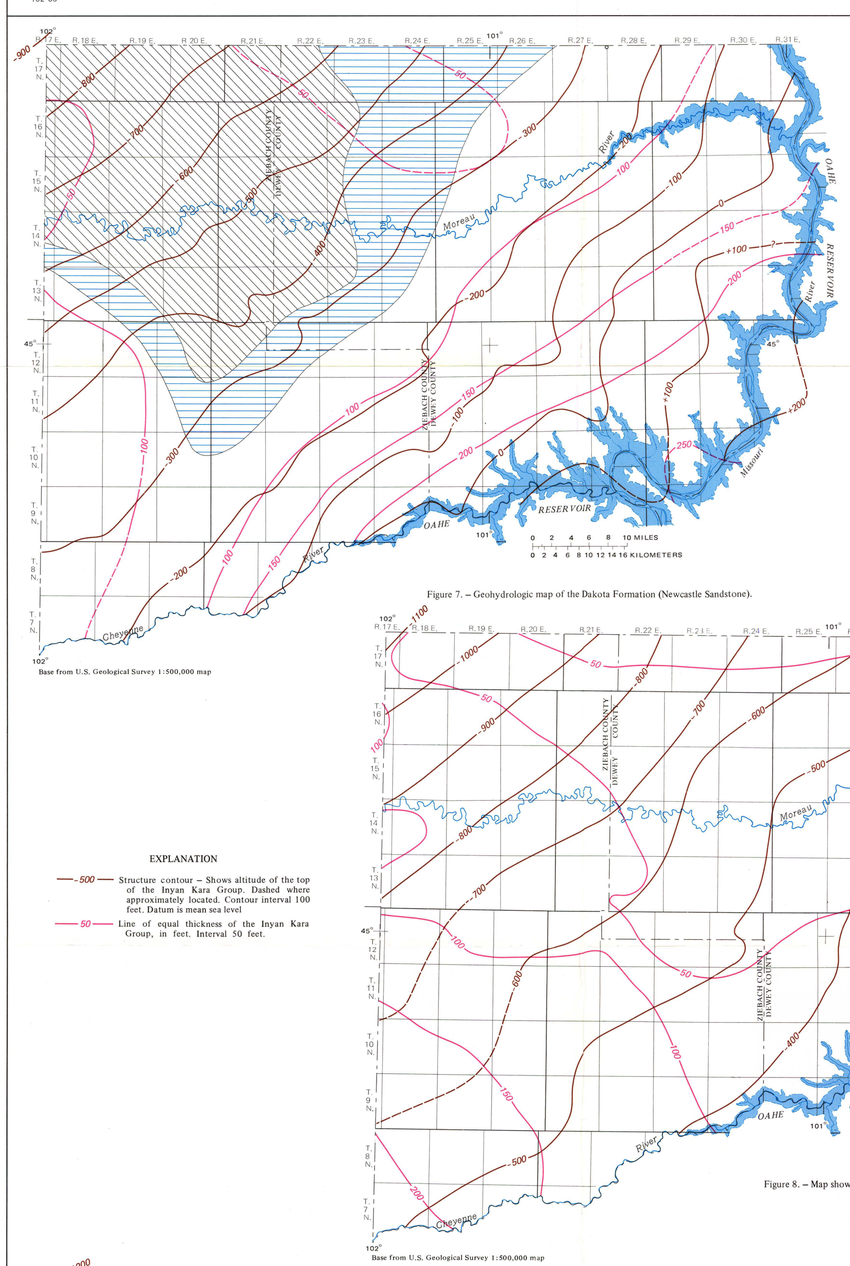

Figure 7. – Geohydrologic map of the Dakota Formation (Newcastle Sandstone).

EXPLANATION

- 400 — Structure contour – Shows altitude of the top of the Dakota Formation. Dashed where approximately located. Contour interval 100 feet. Datum is mean sea level
- 300 — Line of equal thickness of the Dakota Formation, in feet. Dashed where approximately located. Interval 50 feet

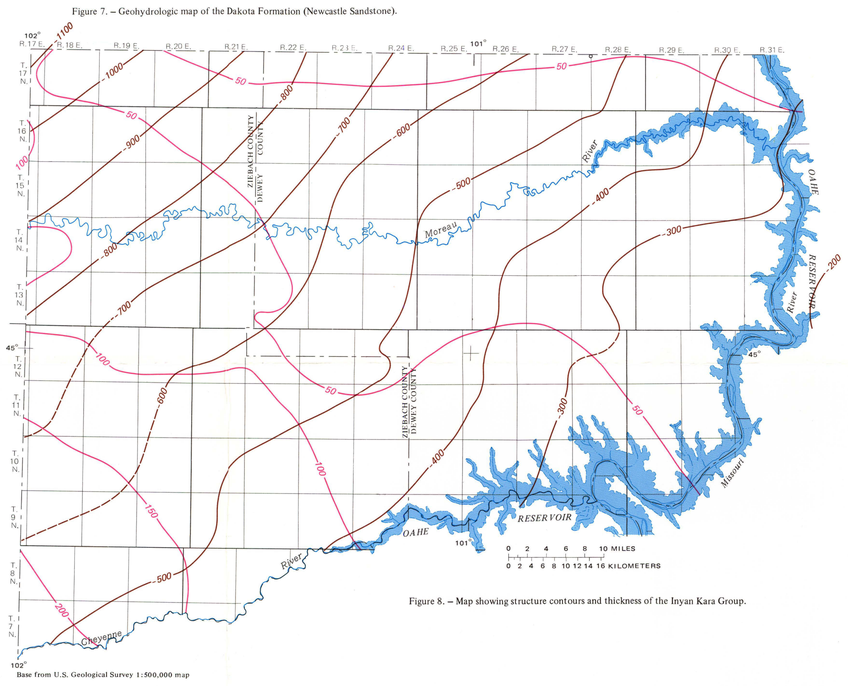

Figure 8. – Map showing structure contours and thickness of the Inyan Kara Group.

EXPLANATION

- 500 — Structure contour – Shows altitude of the top of the Inyan Kara Group. Dashed where approximately located. Contour interval 100 feet. Datum is mean sea level
- 50 — Line of equal thickness of the Inyan Kara Group, in feet. Interval 50 feet.

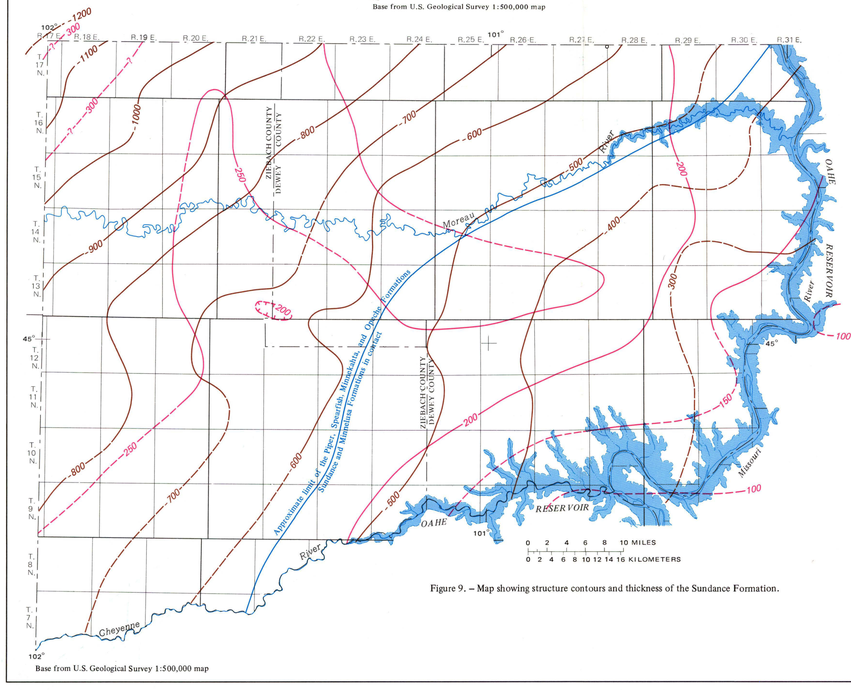

Figure 9. – Map showing structure contours and thickness of the Sundance Formation.

EXPLANATION

- 600 — Structure contour – Shows altitude of the top of the Sundance Formation. Dashed where approximately located. Contour interval 100 feet. Datum is mean sea level
- 250 — Line of equal thickness of the Sundance Formation, in feet. Dashed where approximately located. Interval 50 feet

Line showing the approximate eastern extent of any beds in the sequence: Piper Formation, Spearfish Formation, Minnekahata Limestone, and Opeche Shale. East of this line the Sundance Formation directly overlies the Minnelusa Formation and could be receiving recharge from the Minnelusa

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GEOHYDROLOGY OF THE CHEYENNE RIVER INDIAN RESERVATION, SOUTH DAKOTA

By
Lewis Howells

1979