GEOHYDROLOGY OF THE HIGH PLAINS AQUIFER SYSTEM

The U.S. Geological Survey has studied the High Plains aquifer both on a regional scale (Gutentag and others, 1984) and on a county scale (Lowry and Crist, 1967; Crist, 1980). Previous investigators considered the High Plains aquifer to be a single aquifer. However, this study indicates that the High Plains aquifer consists of several distinctive water-bearing units that have different hydraulic heads. The water in some units is confined (artesian conditions) and in some, unconfined (water-table conditions). Therefore, in this report the High Plains aquifer is considered to be an aquifer system in the Cheyenne area.

Geologic Setting

The Cheyenne area is on a broad tableland that forms part of the High Plains east of the Laramie Mountains (Mears, 1991, p. 450-452; Cooley, 1991, p. 453). The tableland is underlain by the upper Miocene Ogallala Formation that was deposited as an alluvial apron east of the Rocky Mountains (Johnson, 1901). Post-Ogallala erosion during Pliocene and Quaternary time has formed broad gravel-capped terraces and benches and shallow valleys of moderate relief that characterize the High Plains in southeastern Wyoming. These features include the valleys of Crow Creek and its tributaries and the Gang Plank, a series of dissected slopes between the Laramie Mountains and Cheyenne (fig. 3). In shallow canyons of Crow Creek and other streams along the flanks of the Gang Plank, all or most of the Ogallala Formation has been removed by erosion.

Cretaceous and older sedimentary rocks are sharply upturned along the eastern flank of the Laramie Mountains (fig. 4). Overlying rocks, in ascending order, are the Oligocene White River Group, which includes the Chadron and Brule Formations, and the Ogallala Formation. These Tertiary formations are gently upturned only near the mountains. At Cheyenne, the dips are 20 to 25 ft/mi to the east-northeast. Maximum thickness of the combined White River Group and Ogallala Formation in the study area is about 800 ft. Overlying the Ogallala are relatively thin Pleistocene to Holocene surficial deposits.

Description of Geologic Units

Near Cheyenne, the White River Group is present only in the subsurface. The exposed geologic units and their lithologic descriptions in the Cheyenne area are shown in figure 5 (sheet 3). These units are the Ogallala Formation and the overlying surficial deposits. Also included are areas underlain by artificial fill, formed as a result of urban development since 1867.

White River Group

In this report, the White River Group is undifferentiated; information is insufficient to differentiate the Brule and Chadron Formations. In exposures west of Cheyenne (fig. 3), the White River Group consists mostly of light-colored, thick-bedded units of indurated clay or clay containing silt and sand. Locally, the clay might be fractured, which gives the unit much secondary permeability. Also included are local units of sandstone and some conglomerate. These units are lenticular and generally are less than 30 ft thick. In exposures south and west of Cheyenne, the composition of sandstone and conglomerate units in the White River Group and Ogallala Formation is similar.

Ogallala Formation

In the Cheyenne area, the Ogallala Formation is primarily a clay to silt facies, noted originally by Morgan (1946, p. 10). At places, sandstone and conglomerate units in the Ogallala are separated by more than 100 ft of silt and clay that commonly contains very fine to fine sand. Typical vertical distribution of the sandstone and conglomerate units and clay to silt facies is shown by the lithologic log of well 14-66-26dcc02, which was drilled to a depth of 273 ft (fig. 6). Of the 45 test holes augered through the surficial deposits and into the Ogallala Formation in the Cheyenne area, 32 holes penetrated clay or silt at the top of the Ogallala Formation.

The lenticular sandstone and conglomerate units compose a small percentage of the Ogallala Formation. The units are exposed at only a few places and generally are concealed by surficial deposits or by urban construction. These units consist of weakly cemented sandstone to silty sandstone and firmly cemented sandstone and conglomerate; the cementing material is calcium carbonate. The weakly cemented units are generally less than 15 ft thick. At depths of more than 50 ft, most sandstone and conglomerate units are weakly cemented and easily drilled.

The firmly cemented units generally are fine- to very coarse-grained sandstone that contain some pebbles; the conglomerate usually contains an abundance of pebbles and cobbles. Most of the large cobbles are present in the southwestern part of the Cheyenne area. The pebbles and cobbles are well rounded to subrounded and are composed of light-colored granite to granodiorite, quartz, feldspar, and other dense siliceous material, including some volcanic detritus (rhyolite and andesite). The source of the material was the mountains of northern Colorado to the southwest. Abundant detritus of pink granite from the Laramie Mountains in the Ogallala Formation is present only along the western edge of the Cheyenne area.

The firmly cemented units generally are found in north- to north-northeast-trending zones across the central and eastern parts of the Cheyenne area (fig. 7). These units, which are most common in the middle and basal parts of the Ogallala Formation (fig. 8), are characterized by conspicuous channeling and cross-stratification. Cross-stratification features indicate that the sandstone and conglomerate were deposited by streams that flowed north-northeastward.

Some of the sandstone and conglomerate units are apparent on aerial photographs taken in 1941 before accelerated urban development. The location of outcrops of these units is shown in figure 7; the geologic units represent mainly narrow, sinuous channels. At places, individual channels are less than 300 ft wide. The largest outcrop of sandstone and conglomerate is in the bluffs of Denver Hill along the south side of Crow Creek near Central Avenue.

Surficial Deposits

The surficial deposits consist principally of alluvial and terrace deposits, and subordinately of pediment deposits or a heterogeneous mixture of these deposits and colluvium referred to collectively as slope deposits (fig. 5, sheet 3). In the terraces and benches of the suburban uplands, brown gravelly deposits have been mapped separately. In much of the area, the surficial deposits have been modified substantially by urbanization, including the creation of artificial fill which has been mapped as separate units.

The surficial deposits included as part of the High Plains aquifer system are alluvium, undifferentiated (Qal); terrace alluvium (Qah); tan sandy deposits (Qn); deposits of the Fox Farm terraces (Qt1, Qt1A, Qt1B, and Qt1C); deposits of the Frontier Park terraces (Qt2); and deposits of the Denver hill terrace (Qt3) near the Cheyenne Municipal Airport. Surficial deposits above the aquifer system are alluvial-fan deposits (Qf), slope deposits (Qs), pediment deposits (Qp), remnants of the Denver hill terrace deposits (Qt3), and brown gravelly deposits (Qg).

Brown gravelly deposits

Locally widespread gravelly deposits, present only in the suburban uplands, were deposited before Crow Creek and its tributaries eroded their present valleys. These deposits cap much of the tableland near Cheyenne. At most places shown in figure 5, the deposits are less than 20 ft thick, but in a gravel pit along the bluffs south of Crow Creek, the thickness exceeds 75 ft. Conspicuous channeling and large cross-stratification features are exposed in gravel pits. Dark iron stains on deposits at the base of some of the channels and cross-stratification features are indications of past percolation of water through the deposits. Cross-stratification and imbrication studies indicate that streams flowing generally north-eastward from northern Colorado emplaced most of the gravelly deposits. The lithology of the gravel is the same as in the underlying Ogallala Formation. Locally, nonarable reddish-brown accumulations of clay and calcium carbonate are preserved at and near the top of the deposits, which indicates B and C soil horizons (Wayne and others, 1991, p. 455). In much of the area of outcrop younger arable gray soil overlies the deposits.

Terrace deposits

Deposits of the Fox Farm terrace, Frontier Park terrace, and Denver Hill terrace are at consistent altitudes ranging from 10 to about 100 ft above the bed of Crow Creek. These deposits range in thickness from 6 to about 25 ft and are distributed throughout the central part of the study area. The deposits are predominantly subangular, gravelly detritus of pink feldspar (orthoclase), quartz, and other igneous rocks transported by Crow Creek from the Laramie Mountains. Buried channels and cross-stratification features are present in exposures. These deposits, particularly the deposits of the Fox Farm terrace, are a principal source for sand and gravel used in construction materials. Soils with zones of clay and weakly cemented calcium carbonate are developed at the top of the terrace deposits. Gray arable soils occur on the Fox Farm and Frontier terraces, and locally a light reddish brown nonarable soil exists on the Denver Hill terrace. Gray soils similar to soils on the younger terraces also are developed over large areas of the Denver Hill terrace deposits.

Slope deposits

Generally fine-grained deposits underlie gentle, slightly dissected slopes that extend outward from escarpments and along the slopes of many ridges. The generally silty to sandy detritus that characterizes these deposits is derived mainly from the underlying Ogallala Formation. In most drainages slope deposits merge laterally with undifferentiated alluvium.

Pediment deposits

Gravelly deposits, often called bench deposits, are present only as remnants on slopes along escarpments or ridges or form the capping layer on benches and flat-topped ridges, particularly along the dissected slopes and benches of the Gang Plank. Much of the gravel in the pediment deposits has been eroded from the underlying conglomerate units of the Ogallala Formation.

Alluvial deposits

The generally fine-grained alluvial deposits are divided into undifferentiated alluvium, terrace alluvium, alluvial-fan deposits, and tan sandy deposits. The undifferentiated alluvium underlies the floodplains of Crow and Dry Creeks and their tributaries. Remnants of terrace alluvium adjoins the flood plain of Crow and Dry Creeks, but urban activity has masked much of this alluvium except in the eastern part of the study area. Small scattered outcrops of alluvial-fan deposits are present only along the bases of escarpments and ridges. Many of the fans are well shaped with apexes extending up small drainages. The tan sandy deposits occur as dissected alluvial remnants along Dry Creek, Allison Wash, and other tributaries of Crow Creek. They were deposited along these tributaries at the same time as the deposits of the Fox Farm terrace (Qt1) were deposited along Crow Creek.

Artificial fill

Rubble and other material, the products of construction and occupation since the city was founded in 1867, is distributed throughout Cheyenne (fig. 5, sheet 3). The artificial fill was mapped in three categories: (1) At miscellaneous sites (af); (2) in large residential developments (afr); and (3) in areas of extensive construction (afc). Lithology and compaction of the fill are variable. The fill generally is a mixture of surficial deposits near the fill area; however, in some places the fill has been transported a long distance or may contain different types of refuse from continuing urban activity. Mapping of these units is important to the interpretation of ground-water movement.

The Aquifer System

The aquifer system supplies water to hundreds of private wells in Cheyenne and adjoining suburban areas. Most private wells yield less than 25 gal/min and supply domestic water. Numerous shallow private wells are used solely for watering lawns in the city and some are used for the watering of stock.

The Ogallala Formation furnishes most of the water pumped (Lowry and Crist, 1967; Crist, 1980; Gutentag and others, 1984) from the High Plains aquifer system. The chief source of water for the public-supply wells in a city well field about 5 mi west of Cheyenne and large-capacity irrigation wells east of the city is from the Ogallala Formation. In parts of the study area, the Ogallala Formation is hydraulically connected to the overlying surficial deposits. Where the water table crosses the formation boundaries, the surficial deposits and the Ogallala Formation are considered to be the upper part of the aquifer system. The lower part of the aquifer system is generally at depths greater than 175 ft.

At Cheyenne, a few deep wells produce water from the White River Group in combination with the Ogallala Formation. Wells completed solely in the White River Group are in the valley of Crow Creek adjoining the Laramie Mountains and in the shallow canyons of the Gang Plank west of Cheyenne.

Water-Level Conditions

Local differences in the aquifer system are indicated by static water levels in wells that are close to each other. The clay to silt facies can function as a confining unit, thereby creating artesian conditions in lenticular water-bearing sandstone and conglomerate in most of the Ogallala Formation. For example, in two wells spaced 30 ft apart and drilled to different depths (fig. 9), water levels differ by 52 ft. Although the water level in the deeper well (14-66-26dcc02) represents a composite of the hydraulic heads of all the water-bearing zones penetrated, artesian conditions in the principal water-yielding zone near the bottom of the well enable the water level to stand about 190 ft above the sandstone and conglomerate unit.

Regionally, water in the Ogallala Formation is either unconfined or confined in the conglomerate facies, chiefly confined in the clay-to-silt facies, and chiefly unconfined in the sandstone facies (fig. 3). Numerous and widely scattered wells in Cheyenne and on the Gang Plank penetrate units that have hydraulic head high enough to cause wells to flow at land surface (figs. 3 and 7). These flowing wells, which range in depth from 100 to about 550 ft, are completed in the Ogallala Formation and the upper part of the White River Group. In Cheyenne, many of the wells completed before 1940 were reported to have flowed initially, but do not flow at present (1987); on the Gang Plank, however, most wells still flow.

Some confined water-bearing units might be extensive, but are not easily identified. At some places, wells that have similar depths or that are deeper than nearby flowing wells may penetrate confined aquifers, but have insufficient hydraulic head to flow at land surface (figs. 7 and 8). At other places, the depth to water and the water-level altitude in a deep well can be the same as in a nearby shallow well.

Unconfined conditions can be identified by general area. The Cheyenne urban area includes parts of three geohydrologic subdivisions: The broad metropolitan lowlands near Crow and Dry Creeks; the lower slopes of the Gang Plank in the southwestern part of the Cheyenne area; and the suburban uplands, principally north of Dry Creek valley (fig. 7). Confined conditions generally are prevalent in the suburban uplands, whereas unconfined and confined conditions are mixed in the other two subdivisions.

In the metropolitan lowlands near Crow and Dry Creeks, hydraulic connection between the surficial deposits and the adjacent part of the Ogallala Formation forms the upper part of the High Plains aquifer system. On the basis of the depth-to-water measurements, the water-yielding units seem to be hydraulically connected in most places to depths of about 100 ft and in some places to about 175 ft. Areas of saturation of the surficial deposits, principally the alluvial and terrace deposits are shown in figure 10 (sheet 4). The saturated thickness in the alluvial and terrace deposits near Crow Creek and in part of the Dry Creek valley may be as much as 10 ft, but generally is less than 5 ft.

Test drilling has indicated that in most of the area, particularly in central Cheyenne, water in the underlying Ogallala Formation is present generally 2 to 7 ft and as much as 15 ft below the base of the surficial deposits. The water level in many of the test holes was in the clay or silt units, and seepage into the test holes generally was slow. In excavations that exposed clay and silt units of the Ogallala Formation below terrace gravel, water seeped along bedding planes and fractures in the clay or silt units and along the base of the terrace gravel.

Along the lower slopes of the Gang Plank southwest of Crow Creek, the number of water-bearing sandstone and conglomerate units is larger than in other parts of the study area, on the basis of logs and surface exposures. Unconfined ground water is common near the land surface. At places, confined conditions are present at various depths and might be as shallow as 25 ft. Water levels are shallow beneath the lower slopes of the Gang Plank, as determined by a series of test wells drilled throughout the part of F.E. Warren Air Force Base south of Crow Creek (Crist, 1985; L.R. Larson, M.A. Crist, and M.L. Maderak, U.S. Geological Survey, written commun., 1987).

In the residential area of the suburban uplands north of Dry Creek, the delineation of the static water level is difficult even though the numerous wells produce water solely from the Ogallala Formation. Many of the wells are completed in multiple, weakly cemented zones of silty fine-grained sand that can have different hydraulic heads. Seasonal fluctuation of the water level in wells is as much as 30 ft (Wyoming State Engineer, 1987). In addition, local interference between wells that results from pumping can cause water-level fluctuations that prevent accurate delineation of the static water level.

Potentiometric Surfaces

The water levels that represent different potentiometric surfaces indicate that the water-bearing sandstone and conglomerate units are poorly connected. In general, the depths to water are greater in the deep wells than in shallow wells (fig. 10, sheet 3). The largest differences are in the area south of Crow Creek, where water-level data indicate as many as four potentiometric surfaces (fig. 11, sheet 4). Such hydrologic conditions are attributed to either of two conditions: (1) The lenticular sandstone and conglomerate units are separated stratigraphically and areally by relatively thick sequences of clay and silt, or (2) a lateral change in facies from sandstone and conglomerate to silty sandstone results in a decrease of the transmissive capacity of the unit.

Water-level data for wells less than 175 ft deep were used to prepare the potentiometric-surface map (fig. 10, sheet 4); most of these wells are less than 100 ft deep. Depth to water in most of the wells was less than 30 ft below land surface; in many wells, depth to water ranged from 10 to 20 ft. Water-level information also was obtained from shallow test holes and from trenches and other excavations. Depth to water in the test holes mainly ranged from 5 to 20 ft.

Depths to water in wells deeper than 175 ft differ substantially (fig. 10, sheet 4) because the water levels represent variable confined conditions. For this reason, potentiometric contours could not be constructed from the information available for these wells.

Some measured water levels might have been affected by recent or nearby pumping. Prior pumping conditions of the measured well and nearby wells were not always known at the time of measurement. Small-yielding wells generally had slow recovery rates and thus water levels might have been affected by nearby pumping. Locally, interference between wells is known to cause differences in water levels of as much as 5 ft.

Separate potentiometric surfaces were mapped in Dry Creek valley (fig. 10, sheet 4) and in a larger area to the south. Substantial differences in the altitudes between two potentiometric surfaces are indicated along the southern edge of Dry Creek valley northwest of U.S. Highway 30. Near the Cheyenne Municipal Airport, differences of 40 to 50 ft exist between the mapped potentiometric surfaces. A test hole augered near the west end of the long runway at the Cheyenne Municipal Airport (on Denver Hill terrace) was dry to a depth of 18 ft (altitude 6,133 ft), which is lower than the potentiometric surface in the terrace deposits. This dry test hole helps to substantiate separate potentiometric surfaces in Dry Creek valley and in the area south of the test hole.

Several small lakes or ponds are thought to intersect the upper part of the High Plains aquifer system and their levels were used as control for contouring of the potentiometric surfaces shown in figure 10 (sheet 4). The surface-water features whose levels are considered to represent ground-water levels in part of the aquifer system are Sloan Lake and nearby lakes, Lake Minnehaha, ponds in gravel pits along Fox Farm Road, and artificial ponds along Dry Creek.

Perched-Water Zones

Ground water is present in perched zones above the level of the mapped potentiometric surfaces of the upper part of the High Plains aquifer system. Perched water can be permanent or temporary and can be present as a result of sustained periods of precipitation or lawn watering. Temporary saturated zones might be as thick as 2.5 ft (J.G. Rankl, U.S. Geological Survey, oral commun., 1987). The perched-water zones are local phenomenal features, even though they are present throughout the Cheyenne area, as indicated by residents having sump pumps in their basements or having seepage around foundations, into basements, or in crawlways under structures. Perched-water zones are known to exist near the contact between the Ogallala Formation and overlying surficial deposits or artificial fill. A concentration of perched water zones occurs in the area near the paleo-drainage extending northward through Denver Hill (fig. 7).

Several perched-water zones are present along the north side of Dry Creek valley between Ridge Road and Dodge Hill just west of Interstate Highway 25, as indicated by water levels in wells and test holes and by springs (fig. 10, sheet 4). A large perched-water zone is near the Buffalo Ridge School where a shallow perched-water zone is about 10 ft above the potentiometric surface shown in figure 10 (sheet 4). Water levels in several shallow test holes, in a stilling well at a streamflow-gaging station (06756040), and a seep (14-66-21cca) in the artificial channel of a small drainage indicate the presence of perched-water zones. Much of this water is derived from sandstone and conglomerate units of the Ogallala Formation.

A series of perched zones is present in sandstone and conglomerate units that form a ridge-like bench (including Denver Hill) extending southwestward from Crow Creek between Orchard Valley and Clear Creek. The perched zones are indicated mainly by springs and seeps along the sides of the bench. Spring 13-67-12ddd, the largest spring in the Cheyenne area, is near the summit of the bench.

Some perched water was observed moving into trenches excavated in the Ogallala Formation along water and sewer lines in the south-central part of sec. 27, T. 14 N., R. 66 W. Perched water also was observed in artificial fill during augering of the test hole 13-66-17bad (fig. 10, sheet 4). A local perched water area also is indicated near Carey Junior High School where hydraulic heads indicate different potentiometric surfaces (fig. 10, sheet 4).

Recharge, Movement, and Discharge of Water

The recharge area of the High Plains aquifer system near Cheyenne principally adjoins the Laramie Mountains. The conglomerate facies of the Ogallala Formation enhances recharge in its exposures on the Gang Plank and in uplands north of Crow Creek (figs. 3 and 4). The brown gravelly deposits mapped in the suburban uplands are not known to yield water to wells or springs in the study area. However, these deposits are favorable recharge areas to the underlying Ogallala Formation. Where the clay to silt facies is present, water recharged to the Ogallala is limited, owing to the small areal extent of the exposed sandstone and conglomerate units that are present in the facies. However, considerable recharge to surficial deposits from direct precipitation and from lawn watering and other urban activities, helps to maintain the water supply in the upper part of the aquifer system. Lawn watering is the principal source of recharge in residential areas built on surficial deposits, particularly the terrace and alluvial deposits, and on artificial fill.

Lakes are concentrated in natural depressions on the Frontier Park terrace; the largest are Sloan and Kiwanis Lakes. These lakes are maintained by natural and artificial inflow. Part of the natural inflow might be through fractures or more permeable facies in the Ogallala Formation into the terrace deposits, permitting discharge from deep confined aquifers in the lower part of the aquifer system. Water from the lakes contributes recharge to the ground water in the shallow aquifer which moves toward the south and southeast.

Water in the High Plains aquifer system in southeastern Wyoming generally moves eastward from the recharge areas near the Laramie Mountains, as documented by potentiometric maps prepared by Lowry and Crist (1967, pl. 2) and by Crist (1980, pl. 3). Near Cheyenne, the general direction of water movement in the lower part of the aquifer system is eastward. Locally in the Cheyenne area, water in the upper part of the aquifer system moves toward the stream valleys of Crow Creek, its principal tributaries, and to small springs and seeps.

Much of the ground water moving through the Cheyenne area discharges at places in eastern Laramie County or farther east in Nebraska. It also helps maintain perennial flow in Crow, Clear, and Diamond Creeks, and in some swampy areas of bottomland along Clear Creek. Some ground water from the area discharges to Dry Creek; however, the discharge is small and Dry Creek is perennial only in local reaches. A series of measurements of Crow Creek from January through May 1986 indicate that streamflow increased slightly across the Cheyenne area (table 1). The increase ranged from 1.0 to 4.1 ft^3/s. Most of this increase is from ground-water discharge. Another source would be inflow from storm sewers, which at various times of the year is more than the ground-water discharge. The sequences of clay and silt in the Ogallala Formation limit upward movement of water to these streams from the lower part of the aquifer system.

Several springs and seeps, originally noted by long-time residents (Jones, 1983, p. 184), issue from a ridge-like bench (including Denver Hill) that extends southwestward between Orchard Valley and Clear Creek. A few seeps discharge to the valley of Dry Creek (fig. 10, sheet 3). A small quantity of water was observed entering the north side of a trench, excavated in the SW 1/4 sec. 20, T. 14 N., R. 66 W., from one of the sandstone and conglomerate units that underlies surficial deposits.

Water also is discharged by hundreds of wells completed in various water-yielding units of the aquifer system. The pumpage from wells in the Cheyenne area was estimated to be about 5 Mgal/d (J.R. Schuetz, U.S. Geological Survey, oral commun., 1987). This quantity includes water obtained from the Cheyenne well field, which is about 5 mi west of the city.

Table 1.--Discharge and specific-conductance values for streamflow

[ft^3/s, cubic feet per second; µS/cm, microsiemens per centimeter at 25 degrees Celsius; --, indicates no measurement]

Station number and location[1]	1986 January Discharge (ft^3/s)	January Specific conductance (µS/cm)	February Discharge (ft^3/s)	February Specific conductance (µS/cm)	March Discharge (ft^3/s)	March Specific conductance (µS/cm)	April Discharge (ft^3/s)	April Specific conductance (µS/cm)	May Discharge (ft^3/s)	May Specific conductance (µS/cm)
Crow Creek										
1 Round Top Rd.	9.0	460	3.6	500	1.8	500	2.4	485	0.76	460
2 College Dr.	11	760	5.5	660	3.9	--	6.5	840	1.9	900
Dry Creek										
3 Dell Range Blvd. at Powder House	--	1,350	.03	1,120	.02	1,000	.09	860	.06	1,000
4 Dell Range Blvd. bridge	--	800	.10	1,000	--	--	.12	780	.10	900
5 Control between Ridge Rd. and College Dr.	.08	1,000	.03	1,020	.01	750	.04	800	.06	790
6 Rock Springs Ave.	.14	980	.14	1,000	.06	950	.29	1,010	.17	1,100
7 Pershing Blvd.	.26	860	.17	1,000	.10	1,090	.13	960	.06	950
Diamond Creek										
8 Round Top Rd.	.53	540	.37	520	.20	475	.20	500	.25	500
9 Near mouth	.57	620	.41	610	.31	500	.43	585	.37	575
Clear Creek										
10 Near mouth	.41	1,300	.05	1,025	.16	1,025	.41	1,200	.16	1,250
Henderson Drain January 22, 1989										
11 Nationway	[2].10	730								
12 Union Pacific Railroad	--	1,020								
13 Near mouth	--	1,120								

[1] Locations are shown in figure 12.
[2] Estimated.

Specific Conductance of Water

Water in the High Plains aquifer system near Cheyenne is suitable for most uses. The water generally is hard and of a calcium bicarbonate type.

During this investigation, water samples were collected from wells, streams, lakes, and ponds. All these samples were measured for specific conductance, which is an indicator of the dissolved-solids content of the water. Dissolved-solids concentration, in milligrams per liter, of the water can be approximated by multiplying the specific conductance, in microsiemens per centimeter (µS/cm) at 25 degrees Celsius, by 0.6. Specific conductance of water from wells deeper than 175 ft commonly ranges from 350 to 600 µS/cm. However, specific-conductance values of water from wells less than 175 ft deep commonly range from 500 to 1,500 µS/cm. Water from one well 72 ft deep (14-66-26dcc01) had a specific conductance of 4,000 µS/cm, which probably is indicative of contamination from the land surface.

Specific-conductance values commonly are larger for water from wells in the metropolitan lowlands, where the surficial deposits are partly saturated (fig. 10, sheet 4), than for water from wells where the saturation is below the surficial deposits. For example, in Dry Creek valley in the southern half of sec. 26, T. 14 N., R. 66 W., specific-conductance values at 19 wells, measured in 1986, decrease with increased well depth as indicated below:

Depth of well below land surface (ft)	Specific conductance (µS/cm)
less than 80	1,500 - 2,000
80 - 200	800 - 1,100
more than 200	330 - 525

Also, mainly in the part of sec. 27, T. 14 N., R. 66 W. southwest of Dry Creek, specific conductance of water in most wells less than 175 ft deep and of water in excavated trenches ranged from 950 to 1,500 µS/cm. The specific conductance of water in wells deeper than 175 ft in this area generally is less than 500 µS/cm.

Specific-conductance measurements of streamflow along Crow Creek in the study area indicates a general increase in dissolved-solids concentrations in a downstream direction (table 1). Specific conductance of streamflow draining the lower slopes of the Gang Plank is about 500 µS/cm, as indicated by measurements in Diamond Creek at Round Top Road (table 1). Near the mouth of Diamond Creek, specific conductance is somewhat larger, which indicates some contamination from urban activity. In addition, urban contamination is indicated along the downstream reaches of Clear Creek near its mouth, where specific-conductance values ranged from 1,020 to 1,300 µS/cm. In the upstream reaches of this creek and other creeks draining the Gang Plank, specific-conductance values are about 500 µS/cm. The increase in specific conductance between stream measurement sites 11 and 12 on Henderson drain (fig. 12, sheet 4) indicates contamination in the lower reach.

The largest variation in specific conductance of streamflow is along Dry Creek (fig. 12, sheet 4 and table 1). Some ground-water inflow to the creek in sec. 27, T. 14 N., R. 66 W., is indicated by an increase in the specific conductance at stream-measurement site 6 at Rock Springs Avenue.

Measurements of specific conductance also were made at selected lakes and ponds in the study area during May 3-5, 1985. The specific-conductance values are as follows:

Name or number of lake or pond (fig. 10)	Specific conductance (µS/cm)	Remarks
Kiwanis Lake	285	Water in lakes is maintained from natural sources and from Cheyenne municipal water system.
Lake Absarraca	290	
Sloan Lake	465	
Lake Minnehaha	600	
Pond 14-67-24abd	530	Along Dry Creek.
Pond 13-66-9aba	1,400	In operating gravel pit.
Pond 13-66-9abc	1,800	In unused gravel pit partly filled by artificial fill.

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