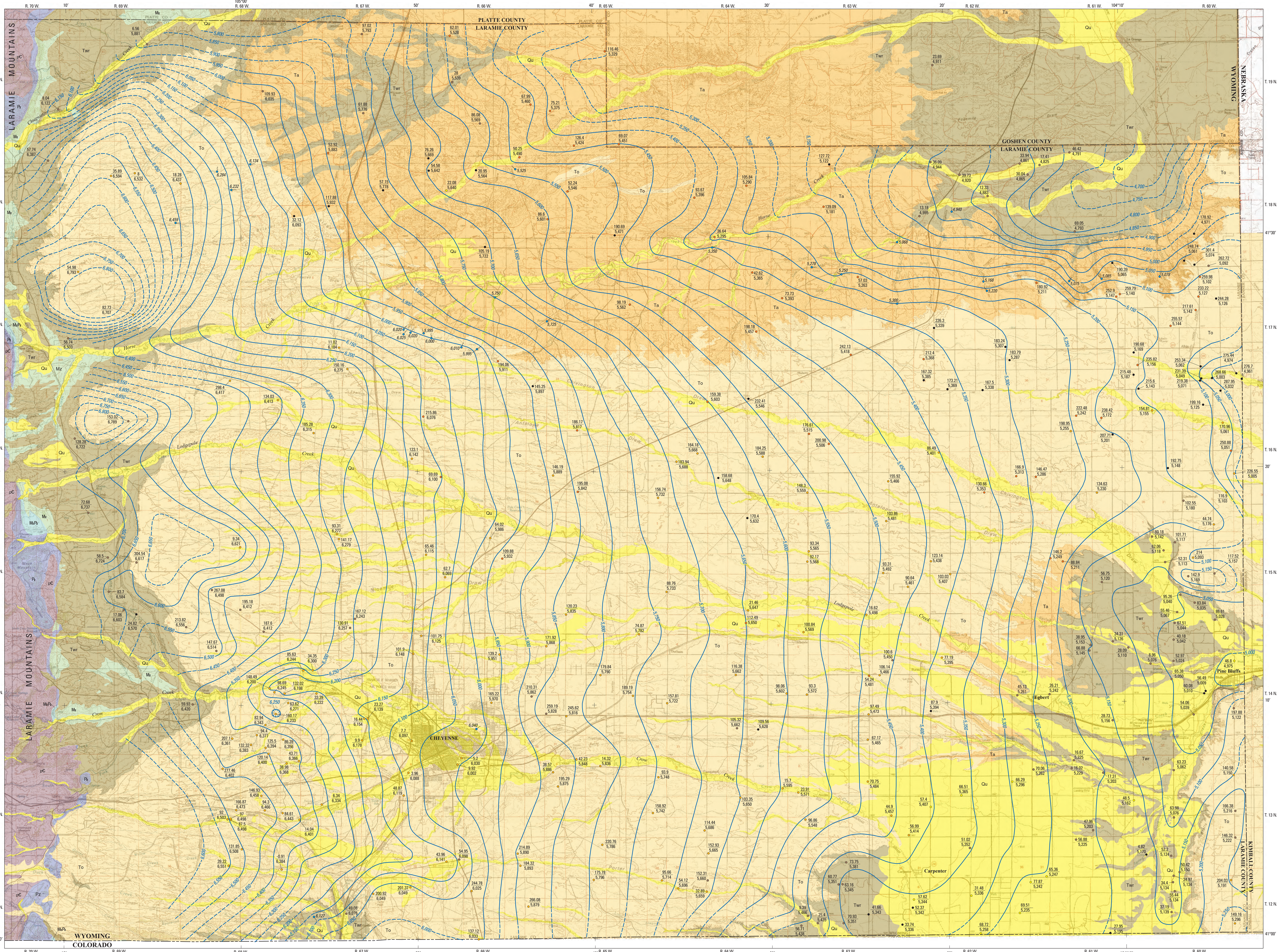


DESCRIPTION OF MAP UNITS

Geologic units

- Qu — **Quaternary unconsolidated deposits**—Locally part of High Plains aquifer system where saturated and hydraulically connected laterally or vertically to underlying Tertiary units
- To — **Tertiary Ogallala Formation**
- Ta — **Tertiary Arikaree Formation**
- Twr — **Tertiary White River Group or Formation**

(To, Ta and Twr: Regional geologic units of the High Plains aquifer system)

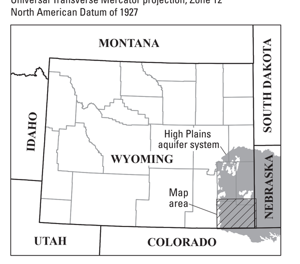
- Mz — **Mesozoic sedimentary rocks**
- MzPz — **Mesozoic and Paleozoic sedimentary rocks**
- Pz — **Paleozoic sedimentary rocks**
- p€ — **Precambrian granitic and metamorphic rocks**

EXPLANATION

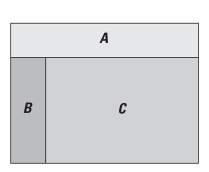
- 5,000 — **Potentiometric contour**—Shows altitude at which water level would have stood in tightly cased wells, March–June 2009. Dashed where inferred or approximately located. Hachures indicate depression. Contour interval 50 feet. Datum is National Geodetic Vertical Datum of 1929 (NGVD 29)
- 5,078 — **Spring and number**—Tail points in direction of flow. Number is altitude of land surface, in feet above NGVD 29
- 244.28 / 5,125.72 — **Well and number**—Number above bar is depth to water, in feet below land surface. Number below bar is altitude of water surface. Negative value indicates water level above land surface. Datum is NGVD 29

Well completed in:

- Quaternary unconsolidated deposits
- Tertiary Ogallala Formation
- Tertiary Arikaree Formation
- Tertiary White River Group or Formation
- Multiple geologic units of the High Plains aquifer system



Index map



A Love and Christiansen, 1985
B Ver Ploeg and others, 2000
C Ver Ploeg and others, 1998

Index to geologic mapping

Generalized Potentiometric Surface of the High Plains Aquifer System, March–June 2009, Laramie County, Wyoming

Introduction

The High Plains aquifer system, commonly called the High Plains aquifer in many publications, is a nationally important water resource that underlies a 111-million-acre area [173,000 square miles (mi^2)] in parts of eight States: Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming (McGuire and others, 2003). Through irrigation of crops with groundwater from the High Plains aquifer system, the area that overlies the aquifer system has become one of the world's major agricultural regions. In addition, the aquifer system also serves as the primary source of drinking water for most residents of the region. In 2000, the High Plains aquifer system had an estimated 2,980 million acre-feet of drainable water (water in the aquifer system that would drain by gravity and generally can be withdrawn by wells) in storage, making it one of the largest aquifers or aquifer systems in the world (McGuire and others, 2003).

The High Plains aquifer system underlies an area of 8,190 mi^2 in southeastern Wyoming (Gutentag and Weeks, 1980). Including Laramie County, the High Plains aquifer system is present in parts of five counties in southeastern Wyoming (see index map). The High Plains aquifer system underlies 8 percent of Wyoming, and 5 percent of the aquifer system is located within the State (Gutentag and Weeks, 1980). Based on withdrawals for irrigation, public supply, and industrial use in 2000, the High Plains aquifer system is the most utilized source of groundwater in Wyoming (Boughton and others, 2006, fig. 4).

With the exception of the Laramie Mountains in western Laramie County (areas shaded with green, blue, and purple on map, indicating Mesozoic and older rocks), the High Plains aquifer system is present throughout Laramie County. In Laramie County, the High Plains aquifer system is the predominant groundwater resource for agricultural (irrigation), municipal, industrial, and domestic uses. Withdrawal of groundwater for irrigation (primarily in the eastern part of the county) is the largest use of water from the High Plains aquifer system in Laramie County and southeastern Wyoming (Boughton and others, 2006).

Groundwater-level declines, associated with localized high-use areas in the High Plains aquifer system in Laramie County, have been noted as far back as the 1940s (Lowry and Crist, 1967). In fact, in response to groundwater-level declines (primarily due to irrigation withdrawals) in some areas in southeastern Wyoming, special "areas" of the aquifer system were selected for increased groundwater regulation. In Laramie County, a specially regulated aquifer area known as the "Laramie County Control Area" was created in 1981 by the Wyoming Board of Control (JR Engineering LLC and others, 2008). The Laramie County Control Area (not shown) comprises much of the county, but generally includes the High Plains aquifer system from about Interstate 25 in west-central Laramie County eastward to the Wyoming-Nebraska State line. For the Laramie County Control Area, an Advisory Board reviews and makes water-administration recommendations to the Wyoming State Engineer's Office (WSEO) concerning any development of new wells, enlargements of existing permitted wells, or placement of new lands under irrigation within the Control Area.

Continued interest in groundwater levels in the High Plains aquifer system in Laramie County prompted a study by the U.S. Geological Survey (USGS) in cooperation with the WSEO to update the potentiometric-surface map of the aquifer system in Laramie County. Groundwater levels were measured in wells completed in the High Plains aquifer system and used to construct a map of the potentiometric surface of the High Plains aquifer system. The potentiometric surface of an aquifer

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measured wells, are available from the Groundwater Site Inventory database of the USGS National Water Information System database at *http://waterdata.usgs.gov/wy/nwis/gw*.

Groundwater moves from high altitudes to lower altitudes and generally in a direction that is perpendicular to the potentiometric contours in the direction of the slope of the potentiometric surface (hydraulic gradient). In the High Plains aquifer system in Laramie County, groundwater generally moves from west to east, but this pattern of flow is altered locally by groundwater divides, and by groundwater discharge to streams (see map). The altitude of the potentiometric surface declines from about 6,800 feet (ft) in western Laramie County to about 5,000 ft in eastern Laramie County. Discharge is by the movement of water to seeps and springs, streams, evapotranspiration, and withdrawal from wells. Some groundwater also flows out of the county as underflow

Era	System		Series	Geologic unit (map symbol in parentheses)	Thickness in Laramie County, in feet (from Lowry and Crist, 1967)		Hydrogeologic unit			Lithology	Water supply
Cenozoic	Quaternary		Holocene and Pleistocene	Alluvial and terrace deposits (Qu)	Alluvium	0–85	Alluvial and terrace-deposit aquifers[1]	Quaternary unconsolidated-deposit aquifers[1]	High Plains aquifer system[4]	Stream-laid deposits composed of varying amounts of gravel, sand, silt, and clay.	Terrace deposits yield small to large supplies to domestic and irrigation wells in southeastern Laramie County (Carpenter-Egbert-Pine Bluffs area), Wyo. Except for southeastern Laramie County, terrace deposits generally are topographically high and drained of water.
					Terrace deposits	0–200					
	Tertiary	Upper	Miocene	Ogallala Formation (To)	0–330		Ogallala aquifer	Upper Tertiary aquifers		Primarily heterogeneous mixture of unconsolidated and (or) weakly to firmly cemented gravel, sand, silt, and clay.	Yields small to large supplies to domestic, stock, public supply (municipal), irrigation, and industrial wells. Most utilized aquifer of the High Plains aquifer system in Laramie County.
				Arikaree Formation (Ta)	0–450		Arikaree aquifer			Primarily massive and cross-stratified, moderately cemented, very fine to fine-grained sandstone, with beds of siltstone and thin beds of volcanic ash. Locally, a coarse conglomerate occurs at base.	Yields small to moderate supplies to domestic, stock, and irrigation wells. Unit generally is less permeable than Ogallala Formation.
		Lower	Oligocene[2]	White River Group[3] or Formation (Twr)	0–500		White River aquifer/ confining unit[4]	Lower Tertiary aquifer/ confining unit[4]		Primarily massive, weakly to moderately cemented siltstone with claystone. Local beds of sandstone, conglomerate, and volcanic ash.	Yields small supplies to domestic and stock wells in some areas. Yields large supplies to domestic, stock, public supply (municipal), irrigation, and industrial wells locally in areas with coarse-grained deposits (sandstone and conglomerate) or secondary permeability development. Unit is principal bedrock aquifer in southeastern Laramie County.

[1]Considered part of High Plains aquifer system only where saturated and hydraulically connected laterally or vertically to underlying Tertiary aquifers. In this report, terrace deposits include older alluvial fan deposits in areas east of Carpenter.
[2]Chadron Formation of White River Group likely late Eocene in age, based on dating of rocks north of Laramie County (Prothero and Swisher, 1992).
[3]Divided into Brule and Chadron Formations in parts of Laramie County.
[4]White River Group or Formation considered an aquifer and part of High Plains aquifer system only where permeable (coarse-grained deposits or zones of secondary permeability). Functions as lower confining unit to High Plains aquifer system where impermeable.

Modified from Lowry and Crist, 1967; Crist and Borchert, 1972; Crist, 1980; Gutentag and Weeks, 1980; Cooley and Crist, 1981, 1994; Libra and others, 1981; Weeks and Gutentag, 1981; Gutentag and others, 1984; and Whitehead, 1996

Figure 1. Relation of geologic units to hydrogeologic units, High Plains aquifer system, Laramie County, Wyoming.

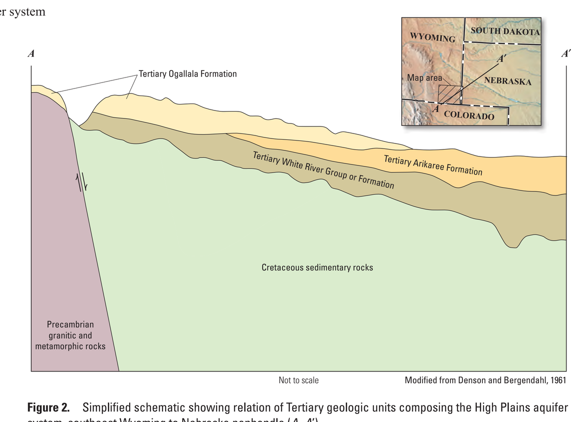

Figure 2. Simplified schematic showing relation of Tertiary geologic units composing the High Plains aquifer system, southeast Wyoming to Nebraska panhandle (*A*–*A′*).

Table 1. Summary of groundwater-level measurements and well depths, High Plains aquifer system, March–June 2009, Laramie County, Wyoming.

[NGVD 29, National Geodetic Vertical Datum of 1929]

Characteristic	Number of measurements	Minimum	Median	Maximum
All aquifers				
Water level[1], in feet below land surface	330	[2]-0.91	93.50	304.54
Water-level altitude, in feet above NGVD 29	330	4,790.58	5,499.60	6,793.02
Well depth, in feet below land surface	292	15.5	200	815
Quaternary unconsolidated-deposit aquifers				
Water level[1], in feet below land surface	14	4.82	57.51	77.87
Water-level altitude, in feet above NGVD 29	14	4,975.20	5,277.00	5,639.92
Well depth, in feet below land surface	14	30	93.50	205
Ogallala aquifer				
Water level[1], in feet below land surface	135	[2]-0.91	98.69	298.40
Water-level altitude, in feet above NGVD 29	135	4,973.56	5,888.81	6,793.02
Well depth, in feet below land surface	112	15.5	208	575
Arikaree aquifer				
Water level[1], in feet below land surface	76	20.95	168.95	287.95
Water-level altitude, in feet above NGVD 29	76	4,961.30	5,366.49	6,100.31
Well depth, in feet below land surface	68	55	268.26	500
White River aquifer/confining unit				
Water level[1], in feet below land surface	105	6.56	60.08	304.54
Water-level altitude, in feet above NGVD 29	105	4,790.58	5,215.62	6,788.98
Well depth, in feet below land surface	98	22	132.50	815

[1]Measurements were made with a calibrated steel or electrical tape (Cunningham and Schalk, 2011).
[2]Negative value indicates water level above land surface.

Saturated Thickness

References

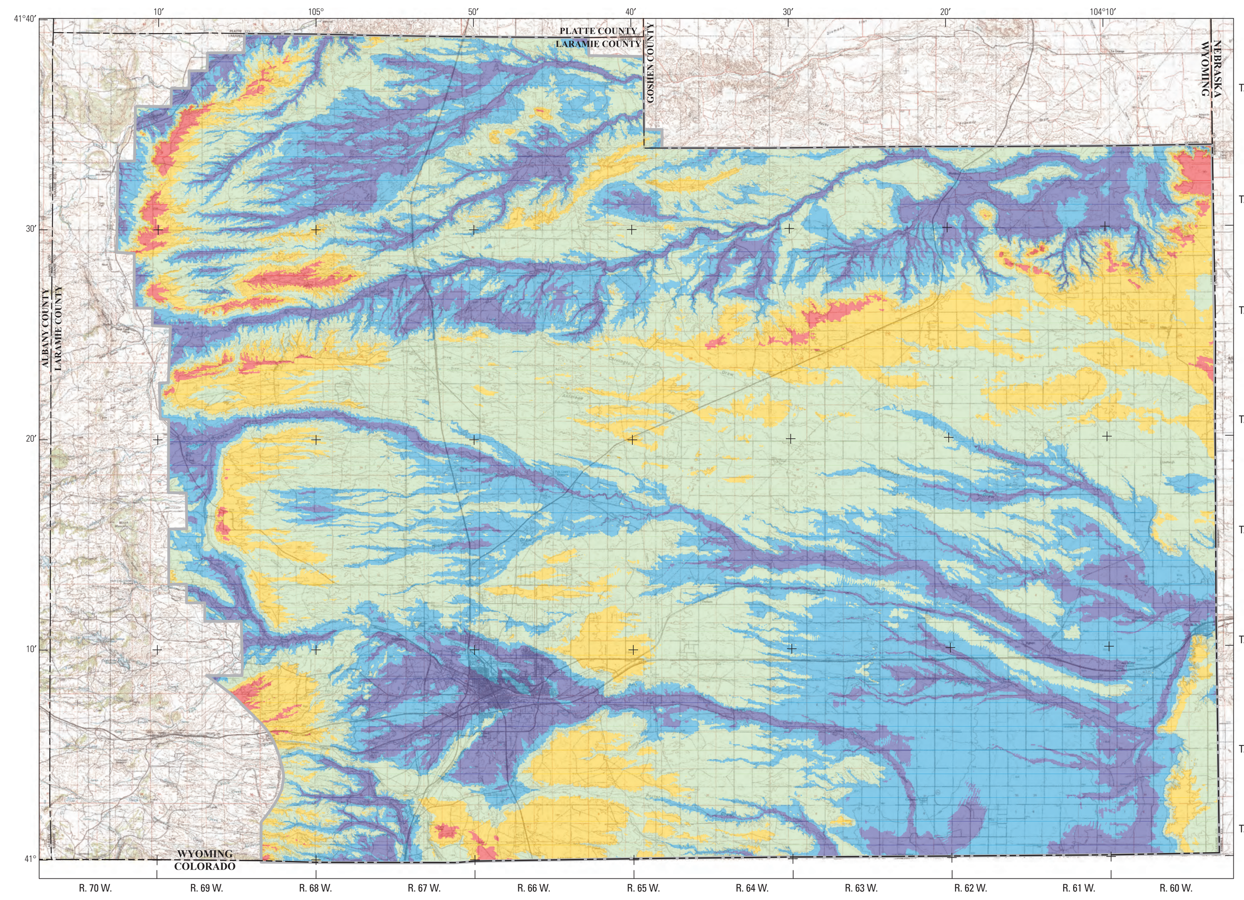

Figure 3. Estimated depth to water in the High Plains aquifer system, March–June 2009, Laramie County, Wyoming.

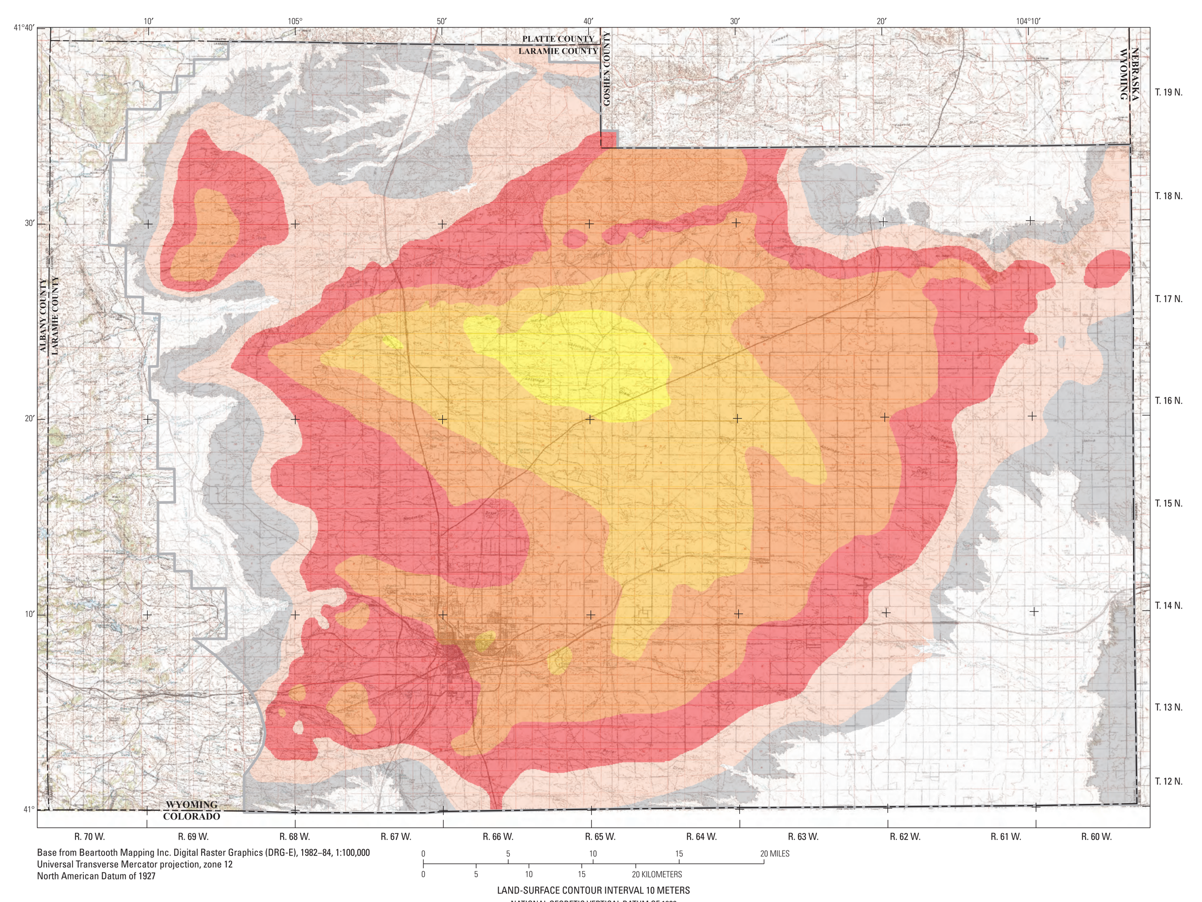

Figure 4. Estimated saturated thickness of the combined Quaternary unconsolidated-deposit, Ogallala, and Arikaree aquifers in the High Plains aquifer system, March–June 2009, Laramie County, Wyoming.

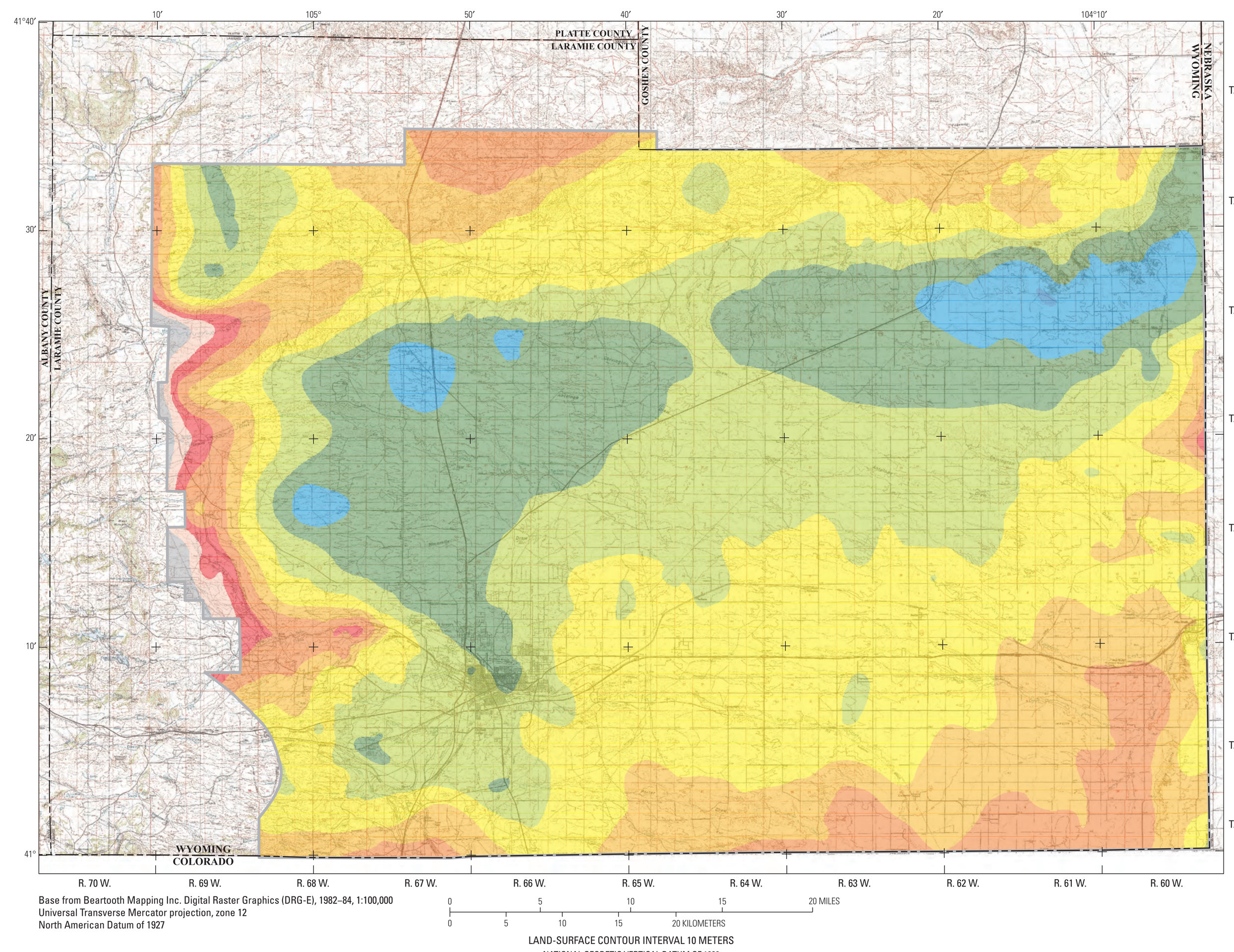

Figure 5. Estimated saturated thickness of the combined Quaternary unconsolidated-deposit, Ogallala, and Arikaree aquifers, and White River aquifer/confining unit in the High Plains aquifer system, March–June 2009, Laramie County, Wyoming.

Generalized Potentiometric Surface, Estimated Depth to Water, and Estimated Saturated Thickness of the High Plains Aquifer System, March–June 2009, Laramie County, Wyoming

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2011