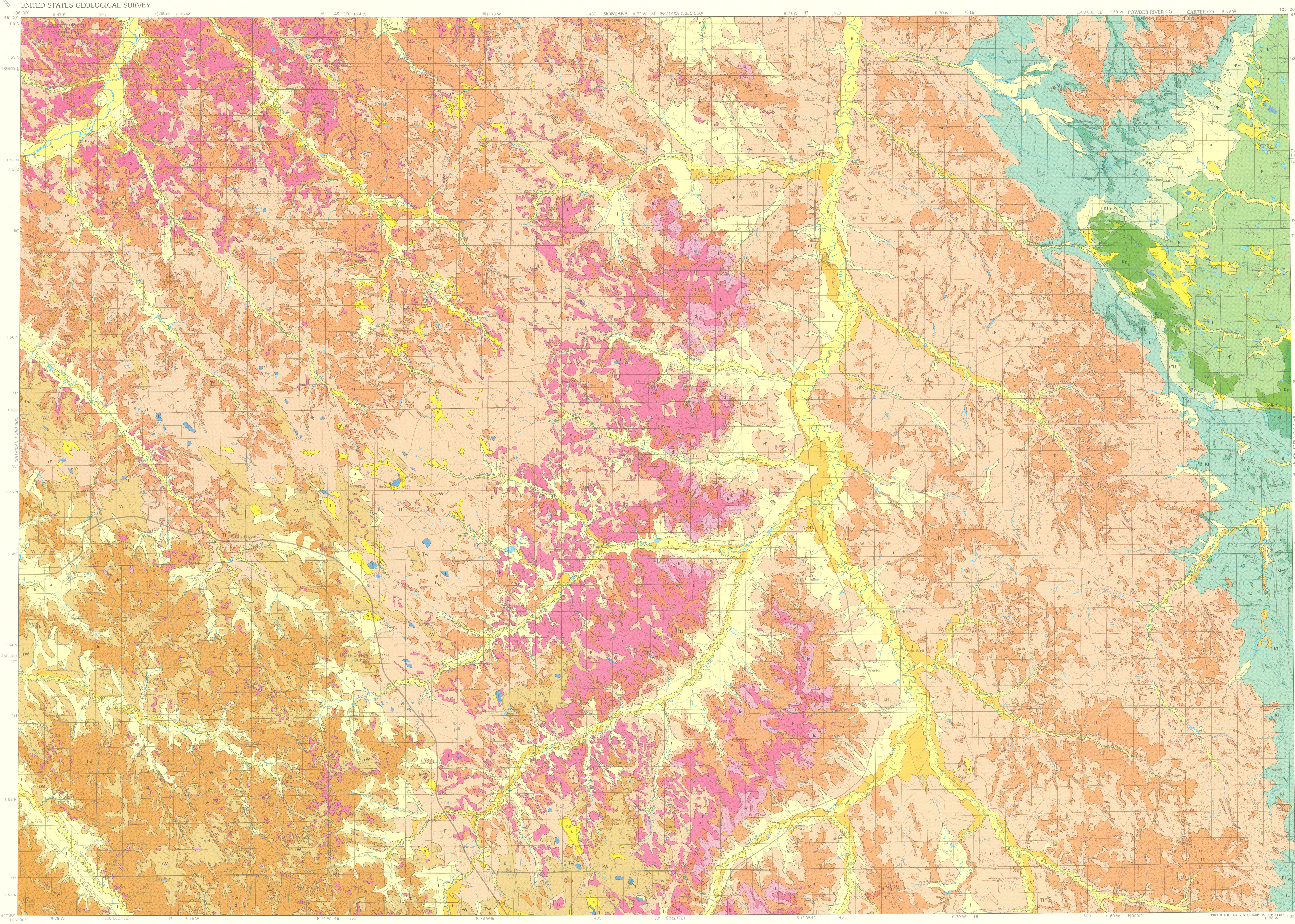
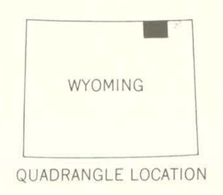


Base from U.S. Geological Survey, 1972
50,000-foot grid based on Wyoming coordinate system, east zone
Projection and 10,000-meter Universal Transverse Mercator grid, zone 13

APPROXIMATE MEAN DECLINATION, 1984

SCALE 1:100 000

CONTOUR INTERVAL 100 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



QUADRANGLE LOCATION

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1984—G83012

Geology compiled in 1979

CORRELATION OF MAP UNITS

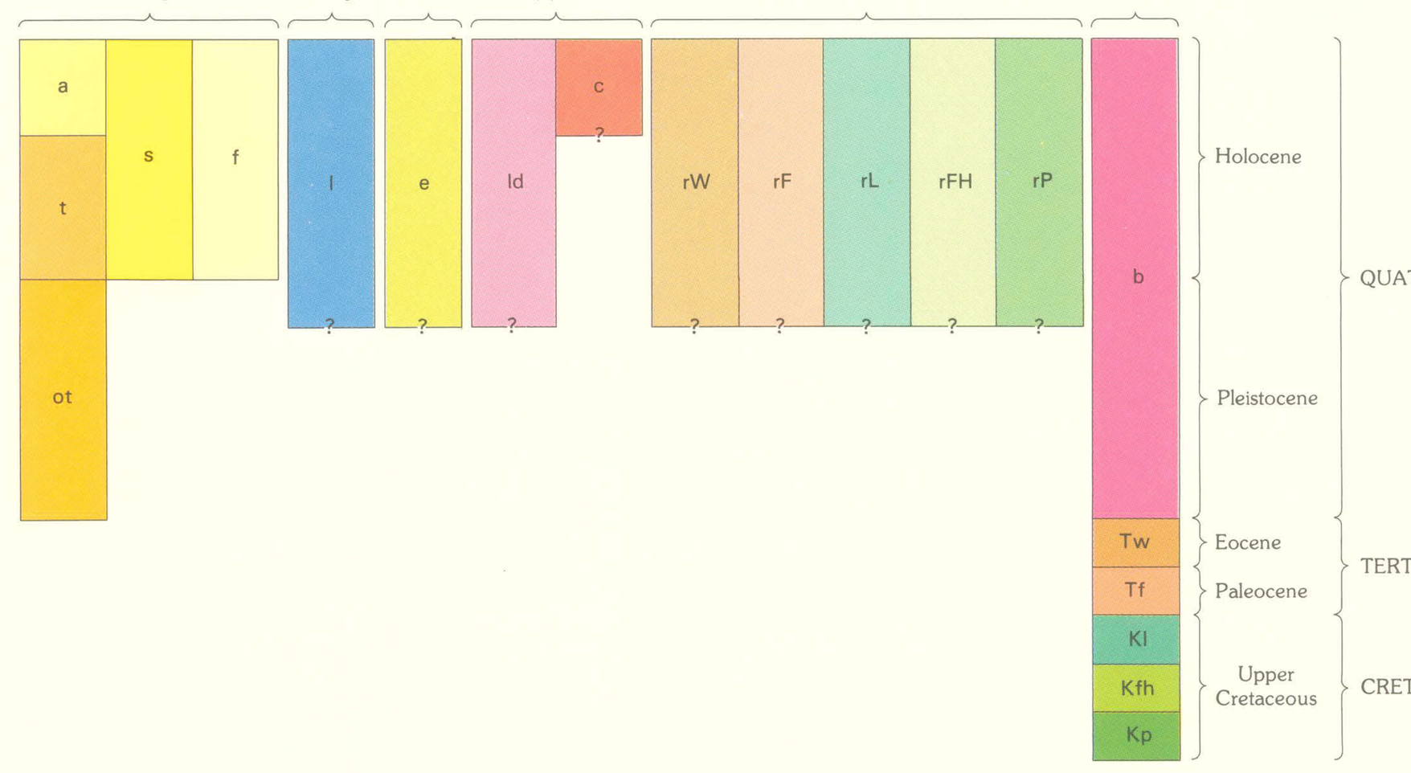


TABLE 1.—*Characteristics of map units*

Unit	Name and age of unit	Description of unit	Origin of unit	Typical position in landscape	Common thickness (m)	Common slope (percent)
		ALLUVIAL DEPOSITS				
a	FLOOD-PLAIN AND LOW TERRACE ALLUVIUM (HOLOCENE).	Silt and sand containing few pebbles of sandstone, ironstone, and baked and fused rock. Interbedded with clay or gravel in some places.	Fine sediment deposited adjacent to stream during flooding interfingers with coarse sediment deposited on stream beds. Stream incision through time has lowered average flood level below some older stream deposits so that they seldom receive deposition. Small remnants of these deposits have locally escaped erosion and are preserved as isolated terraces.	Floodplains and small terraces as high as 5 m above stream beds.	0.5 – 5	0 – 4
t	TERRACE ALLUVIUM (HOLOCENE).	Sand, silt, and clay containing few pebbles, mostly of baked and fused rock. May contain buried soil horizons rich in clay and organic material. Upper 1 m commonly indurated by clay and calcium carbonate.	Deposition of channel and overbank sediments by streams prior to formation of map unit a. Above level of present-day flooding. Many deposits of fan alluvium grade to surfaces of these terraces.	Highest terrace 5 – 10 m above stream beds. Commonly a nearly level surface at toe of alluvial fan.	1.5 – 8	0 – 4
s	SHEETWASH ALLUVIUM (HOLOCENE).	Sand, silt, and clay containing minor interbeds of gravel. Mostly reworked material derived from higher slopes. Includes small areas of residuum (rW, rF, rL, rFH, rP).	Deposition by unchanneled flow of water (sheetwash) on lower hillslopes and in depressions.	In gently sloping valley bottoms and in upland depressions.	1 – 3	0 – 10
f	FAN AND PEDIMENT DEPOSITS (HOLOCENE).	Upper 0.3 – 3 m sheetwash alluvium; grades down into alluvial deposits of sand and silt containing small lenses of angular to subangular gravel composed of baked and fused rock, sandstone, and ironstone.	Deposition by ephemeral streams and sheetwash. Fan-shaped surface was built primarily by deposition, but some areas were cut on bedrock and thinly veneered with alluvium. Ephemeral stream deposition on most fan surfaces is inactive because of entrenchment of streams, but active deposition occurs on some surfaces in the northwest corner of the quadrangle, along the Powder River.	Gently sloping, fan-shaped surfaces and underlying material at base of moderate to steep slopes.	1 – 16	0 – 15
ot	OLDER TERRACE ALLUVIUM (PLEISTOCENE).	Gravel and sand containing minor silt. Units higher than 25 m above present Powder River contain gravel of sandstone, chert, chalcedony, fossil wood, and quartz, and well-rounded igneous and metamorphic rocks from the Bighorn Mountains. At lower elevations, clasts of baked and fused rock increase in abundance as river level is approached. Locally cemented and crusted with iron and manganese oxides or calcium carbonate.	Deposited by Powder River and Little Powder River when landscape was less dissected; now perched above stream level.	Caps hills and ridges near Powder River and Little Powder River.	0.5 – 6	2 – 10
		LAKE DEPOSITS				
l	LAKE SEDIMENTS (HOLOCENE AND PLEISTOCENE?).	Massive gray clay and silt; alkaline in some places.	Deposition of sediments carried by wind and sheetwash in ephemeral lakes.	Natural closed depressions in gentle terrain, commonly associated with eolian deposits.	0.5 – 7	0 – 15
		EOLIAN DEPOSITS				
e	EOLIAN DEPOSITS (HOLOCENE AND PLEISTOCENE?).	Sand and silt in dunes or in irregular sheets. Massive to faintly bedded.	Eroded from poorly cemented outcrops of Wasatch Formation (Tw) and Fox Hills Sandstone (Kfh) and deposited downwind in low dunes, now stabilized by grass.	Downwind from sandstone deposits.	0.5 – 7	0 – 15
		MASS-WASTING DEPOSITS				
c	COLLUVIUM (HOLOCENE).	Angular bedrock fragments, mostly of baked and fused rock, ranging in size from granules to boulders, in an unsorted matrix of sand, silt, and clay. Locally includes small areas of baked and fused rock (b), residuum (rW, rF), and small indistinct landslide deposits (1d).	Movement downslope by rockfall and sliding over moderate to steep slopes.	Steep slopes flanking hills or plateaus capped by baked and fused rock.	1 – 7	10 – 75
ld	LANDSLIDE DEPOSITS (HOLOCENE AND PLEISTOCENE).	Blocks of sandstone, siltstone, and baked and fused rock that have been moved, broken, and mixed with finer sediments. Characterized by hummocky terrain bounded upslope by crescentic scarps and downslope by lobate toes.	Movement downslope through slumping and earthflow. Some older landslides are stabilized; fresh scarps and lack of vegetation suggest that many are still active.	Steep slopes adjacent to narrow valley bottoms, or below scarps that skirt uplands of baked and fused rock. Most common just west of Little Powder River.	7 – 33	10 – 50
		RESIDUAL DEPOSITS				
rW	RESIDUUM (HOLOCENE AND PLEISTOCENE) ON WASATCH FORMATION.	Gray to brown, sandy and silty weathered material containing variable amounts of clay. Grades down into unweathered Wasatch Formation (Tw). Locally contains sheetwash alluvium (s) in upper 1 m and includes small areas of Wasatch bedrock and colluvium (c).	In-place weathering of Wasatch Formation; may be affected by sheetwash and soil creep.	Flat to moderately steep dissected terrain.	1 – 5	0 – 15
rF	RESIDUUM (HOLOCENE AND PLEISTOCENE) ON FORT UNION FORMATION.	Gray to brown, silty and sandy weathered material containing variable amounts of clay. Grades down into unweathered Fort Union Formation (Tf). In places contains sheetwash alluvium (s) in upper 1 m. Locally includes small areas of Fort Union bedrock and colluvium (c).	In-place weathering of Fort Union Formation; may be affected by sheetwash and soil creep.	Flat to moderately steep dissected terrain.	0.3 – 2	0 – 20
rL	RESIDUUM (HOLOCENE AND PLEISTOCENE) ON LANCE FORMATION.	Dark-gray to brown, clayey and silty weathered material containing variable amounts of clay. Grades down into unweathered Lance Formation (K1). Locally contains sheetwash alluvium (s) near surface and includes small areas of Lance bedrock.	In-place weathering of Lance Formation; may be affected by sheetwash and soil creep.	Flat to gently rolling terrain on eastern side of map area.	0.3 – 5	0 – 5
rFH	RESIDUUM (HOLOCENE AND PLEISTOCENE) ON FOX HILLS SANDSTONE.	Light-brown to tan, sandy and silty weathered material containing variable amounts of clay. Grades down into unweathered Fox Hills Sandstone (Kfh). In places contains sheetwash alluvium (s) near surface and includes small areas of Fox Hills Sandstone.	In-place weathering of Fox Hills Sandstone; may be affected by sheetwash and soil creep.	Rolling to moderately steep, dissected terrain in northeastern part of map area.	0.3 – 3	4 – 15
rP	RESIDUUM (HOLOCENE AND PLEISTOCENE) ON PIERRE SHALE.	Dark-brown, gray, or black, clayey and silty weathered material. Commonly contains bentonitic swelling clays. Grades down into unweathered Pierre Shale (Kp). Locally contains sheetwash alluvium (s) near surface and includes small areas of Pierre bedrock.	In-place weathering of Pierre Shale; may be affected by sheetwash and soil creep.	Rolling dissected terrain in northeastern corner of map area.	0.3 – 5	2 – 10
		BEDROCK				
b	BAKED AND FUSED ROCK (HOLOCENE AND PLEISTOCENE).	Bedrock altered by burning of coal beds. Mostly hard, dense, red-to-orange baked shale and siltstone (porcellanite). Black, bubbly, sometimes glassy rock (buchite); resembles volcanic rocks and slag formed by melting of rocks. Gray or white coal ash occurs as layer 5 – 30 cm thick at base of or within porcellanite zone. Locally includes small areas of colluvium (c).	Baking of overlying rocks by burning of coal beds in the Wasatch and Fort Union Formations (Tw, Tf).	Thick layer caps relatively flat upland surfaces on the Fort Union Formation; occurs as narrow hillside bands and knolls on Wasatch Formation.	3 – 33	5 – 50
Tw	WASATCH FORMATION (EOCENE).	Yellowish-gray to light-brown fine-grained sandstone, light-gray siltstone and shale, brown carbonaceous shale, and coal. Poorly consolidated except for a few well-cemented sandstone beds. In places includes small areas of residuum (rW), colluvium (c), and sheetwash alluvium (s).	Deposition in streams, swamps, and lakes; later consolidated by deep burial; now exposed by erosion.	Hilltops and steep hillslopes.	[1]0 – 600	0 – 40
Tf	FORT UNION FORMATION (PALEOCENE).	Light-gray to yellowish-brown, fine-grained sandstone, light-gray siltstone, mudstone, and shale, brown carbonaceous shale, and coal. Locally includes small areas of residuum (rF), colluvium (c), and sheetwash alluvium (s).	Deposition in streams, swamps, and lakes; later consolidated by deep burial; now exposed by erosion.	Hilltops and steep hillslopes.	0 – 1465	0 – 100
Kl	LANCE FORMATION (UPPER CRETACEOUS).	Dark-gray to brown shale and drab, massive, lenticular concretionary sandstone. Locally includes small areas of residuum (rL).	Deposition in streams and lakes; later consolidated by deep burial; now exposed by erosion.	Flat to rolling, dissected terrain on eastern side of map area.	0 – 760	0 – 15
Kfh	FOX HILLS SANDSTONE (UPPER CRETACEOUS).	White to light-gray sandstone and gray, sandy shale, containing marine fossils. In places includes small areas of residuum (rFH).	Deposition near edge of shrinking ocean; later consolidated by deep burial; now exposed by erosion.	Rolling to steep, dissected terrain in northeastern part of map area.	0 – 60	10 – 40
Kp	PIERRE SHALE (UPPER CRETACEOUS).	Dark-gray to black, concretionary marine shale containing fossils. Commonly contains bentonitic swelling clays. In places includes small areas of residuum (rP).	Deposition in ocean basin; later consolidated by deep burial; now exposed by erosion.	Rolling dissected terrain in northeastern part of map area.	0 – 625	2 – 10

[1]Thickness preserved in study area.

PREPARATION AND USE OF THIS MAP

Knowledge of the distribution and properties of unconsolidated surficial materials is essential to the making of appropriate decisions on land use. Surficial materials in the Recluse quadrangle region are derived primarily from local bedrock, composed mainly of soft shale, sandstone, and coal beds. Most of these parent materials weather to fine-grained sediments, but the properties of the sediments depend not only on parent materials, but also on variations in the processes of chemical and mechanical weathering, transportation, and redeposition.

Information on this map was compiled from several sources. Geologic contacts were taken from sources listed in "Sources of data." Contacts were extrapolated from areas that were field checked in detail across the rest of the map area primarily through interpretation of 1:65,000-scale black-and-white and 1:24,000-scale color aerial photographs. Extrapolated contacts were then field checked and adjusted where necessary.

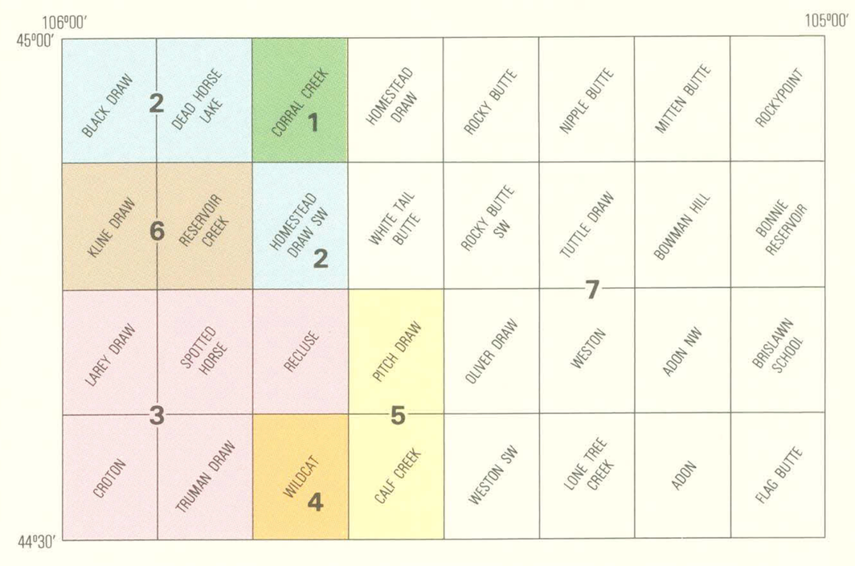
Descriptions of most map units were modified from published (see "References") and unpublished (see "Sources of data") maps by V. S. Williams and D. S. Fullerton. Descriptions of the Lance Formation (unit Kl), the Fox Hills Sandstone (unit Kfh), and the Pierre Shale (unit Kp) were modified from Love and others (1978). Descriptions of the surficial and bedrock units, and of the processes that formed them, are in table 1. Special characteristics and limitations of these units, such as suitability for agriculture or road metal, or potential problems which may be incurred by surface disturbance, are shown in table 2.

TABLE 2.—*Use-related characteristics and limitations of map units*
[A, in most places; B, locally; leaders (---), in few or no places]

Unit	Suitable for road metal or aggregate	Potential source of sand	Subject to seasonal flooding or high water table	Forms deep gumbo when wet	Contains swelling soils	Generally rough terrain	Arable land for hay and grain	Steep slopes likely to be unstable	Subject to wind erosion if disturbed	Difficult to excavate
a	---	---	A	B	---	---	B	---	---	---
t	---	---	---	---	---	---	A	---	---	---
s	---	---	B	B	---	---	B	---	---	---
f	---	---	B	---	---	---	A	---	---	---
ot	B	B	---	---	---	---	---	---	---	---
1	---	---	A	A	---	---	---	---	---	---
e	---	A	---	---	---	---	B	---	A	---
c	B	---	---	---	---	A	---	A	---	---
1d	---	---	---	---	---	A	---	A	---	---
rW	---	B	---	---	---	B	B	B	B	---
rF	---	---	---	---	---	B	B	B	---	---
rL	---	---	---	A	---	---	B	---	B	---
rFH	---	B	---	---	---	---	B	---	B	---
rP	---	---	---	A	A	---	B	---	---	---
b	A	---	---	---	---	A	---	A	---	A
Tw	---	B	---	---	---	B	---	A	B	B
Tf	---	---	---	---	---	A	---	A	---	B
Kl	---	---	---	A	B	---	B	---	B	---
Kfh	---	A	---	---	---	---	---	---	---	B
Kp	---	---	---	A	A	---	---	---	---	---

DEFINITION OF ALLUVIAL VALLEY FLOORS

The Surface Mining Control and Reclamation Act (U.S. Congress, 1977) defines "alluvial valley floors," for the purposes of the Act, as "the unconsolidated stream laid deposits holding streams where water availability is sufficient for subirrigation or flood irrigation agricultural activities but does not include upland areas which are generally overlain by a thin veneer of colluvial deposits composed chiefly of debris from sheet erosion, deposits by unconcentrated runoff or slope wash, together with talus, other mass movement accumulation and windblown deposits." On this map, most of unit a is within this definition of alluvial valley floors. Some of the higher terraces as well as some of the valley bottoms of ephemeral streams included in unit a may not fit the above definition. Although this map provides an indication of where "alluvial valley floors" may exist, detailed on-site mapping in accord with the legal definition rather than the geologic definition would be required in order to delineate such boundaries for regulatory purposes.



INDEX TO TOPOGRAPHIC AND GEOLOGIC MAPPING OF THE RECLUSE QUADRANGLE

SOURCES OF DATA

SURFICIAL GEOLOGY
1. Fullerton (1977).
2. D. S. Fullerton, unpub. data, 1976.
3. Williams (1978a – e).
4. Williams and McElwain (1978).
5. V. S. Williams, unpub. data, 1976.
6. M. C. Reheis, aerial photographic interpretation; baked and fused bedrock contacts from Intrasearch, Inc. (1978a,b).
7. M. C. Reheis, aerial photographic interpretation and field checking.

BEDROCK GEOLOGY
Kent and Berlage (1980), entire map area.
Love and others (1978), entire map area
Robinson and others (1964), Mitten Butte, Rockypoint, Bowman Hill, Bonnie Reservoir, Brislawn School, and Flag Butte quadrangles.

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Fullerton, D. S., 1977, Surficial geologic map of the Corral Creek quadrangle, Campbell County, Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF – 919, scale 1:24,000.
Hinrichs, E. N., 1980, Engineering geologic map of the Recluse 1/2° x 1° quadrangle, Campbell and Crook Counties, Wyoming: U.S. Geological Survey Coal Investigations Map C – 81 – E, scale 1:100,000.
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________1978b, Coal resource occurrence and coal development potential of the Reservoir Creek quadrangle, Campbell County, Wyoming: U.S. Geological Survey Open-File Report 78 – 832, scale 1:24,000.
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Robinson, C. S., Mapel, W. J., and Bergendahl, M. H., 1964, Stratigraphy and structure of the northern and western flanks of the Blacks Hills uplift, Wyoming, Montana, and South Dakota: U.S. Geological Survey Professional Paper 404, 134 p.
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Williams, V. S., 1978a, Surficial geologic map of the Croton quadrangle, Campbell County, Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF – 946, scale 1:24,000.
________1978b, Surficial geologic map of the Larey Draw quadrangle, Campbell County, Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF – 949, scale 1:24,000.
________1978c, Surficial geologic map of the Recluse quadrangle, Campbell County, Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF – 988, scale 1:24,000.
________1978d, Surficial geologic map of the Spotted Horse quadrangle, Campbell County, Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF – 952, scale 1:24,000.
________1978e, Surficial geologic map of the Truman Draw quadrangle, Campbell County, Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF – 953, scale 1:24,000.
Williams, V. S., and McElwain, Paul, 1978, Surficial geologic map of the Wildcat quadrangle, Campbell County, Wyoming: U.S. Geological Survey Miscellaneous Field Studies Map MF – 989, scale 1:24,000.

SURFICIAL GEOLOGIC MAP OF THE RECLUSE 30′ x 60′ QUADRANGLE, WYOMING AND MONTANA

By
Marith C. Reheis and Van S. Williams

1984