

- DESCRIPTION OF MAP UNITS**
- Qal** ALLUVIUM OF MODERN CHANNELS AND FLOOD PLAINS (HOLOCENE) - Light brown and gray, well stratified and well sorted, deposited, clay silt, sand, and gravel. As much as 6 m (20 ft) thick under the flood plains of major creeks to less than a few meters thick under flood plains of tributaries/small streams. Unit limited to areas characterized by meander or braided pattern on aerial photographs. Surface of unit may be subject to occasional flooding. Thickness generally averages about 3 m (10 ft).
 - Qca** ALLUVIUM AND COLLUVIUM, UNDIVIDED (HOLOCENE) - Light brown and gray, poorly sorted and well stratified clay, silt, sand, and gravel deposited by gravitational movement and slope wash. Color and texture of the colluvium reflect uplope parent material. May interfinger with alluvium (Qal); includes alluvial fan deposits and much windblown clay, silt, and sand. Soil profiles vary from well developed to poorly developed silt, sand, granules, and pebbles. Thickness as much as 10 m (33 ft); generally less than 5 m (16 ft); locally less than 2-3 m (7-10 ft) thick.
 - Qe** EOLIAN DEPOSIT (HOLOCENE) - Light to moderate brown, windblown sand and silt. Mapped only where dunes were identified on aerial photographs or small contour-interval topographic maps. In other places, light brown to light gray clay, silt, and sand which includes granules and pebbles carried up into the eolian deposits by bioturbation. Present mainly as a veneer as much as 2 m (6 ft) thick on terraces and fans of sand and gravel deposits; may be thicker on older and higher sand and gravel deposits (QTal). Thickness as much as 5 m (16 ft); generally less than 2 m (6 ft).
 - Qls** LANDSLIDE DEPOSIT (HOLOCENE AND PLEISTOCENE) - Slumps and earthflows. Clast size ranges from clay and silt to boulders. Thickness as much as 12 m (40 ft), generally less than 5 m (16 ft); locally from 6 m (26 ft) to 1 m (3 ft).
 - Qat** ALLUVIAL TERRACE DEPOSIT (HOLOCENE AND PLEISTOCENE) - Light brown to light gray, well-stratified to poorly stratified, well-sorted to poorly sorted sand and gravel deposited on alluvial terraces of the Redwater River and its tributaries.
 - Qgl** GLACIAL TILL (PLEISTOCENE) - Light olive brown to pale yellow mixture of clay to boulder-sized materials. Estimated size distribution in percent: clay 15-20, silt 25-30, sand 35-40, granules 15-20, pebbles 5-10, cobbles 1, boulders 1. Centimeters small clasts of coal and clinker. Lenses of varved clay as thick as 4 m (13 ft) indicate deposition in a glacial lake. Thickness as much as 15 m (50 ft), generally less than 5 m (16 ft).
 - Cl** CLINKER (HOLOCENE TO PLEISTOCENE) - Red to orange baked shale, sandstone, and siltstone of the Fort Union Formation that was heat-metamorphosed by combustion of lignite to hard, dense porcellanite locally sediments fused and melted to form black, vesicular, glassy, scoriaceous rock called buchtie which forms linings of chimneys and veins in the porcellanite. Coal ash forms a gray or white layer as much as 60 cm (24 in) thick at the base of the porcellanite. Thickness as much as 12 m (40 ft), generally less than 3 m (10 ft); locally less than 2 m (6 ft).
 - QTal** ALLUVIAL TERRACE DEPOSIT (PLEISTOCENE AND/OR PLOICENE) - Light brown to light gray, generally well stratified, but rarely poorly stratified, well sorted to poorly sorted fluvial sand and gravel deposited on alluvial terraces of the paleo-Yellowstone River and its tributaries. Unit was considered Pliocene on 7.5' quadrangle source maps based on relation with the Miocene-dated Rimroad Formation and assumption of a steady rate of southward migration and downcutting by the Yellowstone River. Subsequently the Pleistocene-Pliocene boundary has been extended from 1.8 Ma to 2.56 Ma (Gibbard and others, 2009) so the unit is now designated as Quaternary and/or Tertiary. Unit generally limited to altitudes between 945 m (3,100 ft) and 760 m (2,500 ft). May contain thin Pleistocene sand and gravel deposits. Thickness as much as 12 m (40 ft), but generally less than 6-3 m (20-10 ft).
 - Tal** ALLUVIAL TERRACE DEPOSIT (MIOCENE) - Light brown to light gray, well stratified to poorly stratified, well sorted to poorly sorted sand and gravel deposited on terraces of the paleo-Yellowstone River (mapped as Tmg on 7.5' quadrangle sources). May include some small, thin, Pliocene and Pleistocene sand and gravel deposits. Local calcium carbonate cementation in the Lindsay SW 7.5' quadrangle. Thickness generally as much as 10 m (33 ft), but 24 m (80 ft) thick on Diamond G Butte in the Diamond G Butte 7.5' quadrangle.
 - Tm** RIMROAD FORMATION (MIOCENE) - Light brown to gray, well stratified, well sorted to poorly sorted, and well-stratified to poorly stratified sand and gravel deposited on the oldest alluvial terrace of the paleo-Yellowstone River. Deposits occur as remnants along the drainage divide between the Yellowstone River south of the quadrangle, and Redwater Creek in the northwestern part of the quadrangle. Gravel clasts are as large as 15 cm (6 in) in diameter. Clast composition dominantly quartzite, chert, and igneous rock, with scattered clasts of quartz, agate, silicified wood, and clinker (Howard, 1960). Zircon in the 4.3 m (14 ft) of volcanic ash within the Rimroad Formation have yielded a fission-track age of 7.1 +/- 1.4 Ma (Colton and others, 1983). The lower limit or base of the Rimroad deposit is at an altitude of approximately 975 m (3,200 ft). Map unit may also include some thin, younger gravel deposits. Thickness generally less than 20 m (66 ft).
 - Ttr** TONGUE RIVER MEMBER OF THE FORT UNION FORMATION (PALEOCENE) - Yellowish or light brown shale and sandstone contains numerous lignite beds. Estimated original thickness more than 990 m (3,200 ft), but eroded to as thin as 90 m (300 ft) (Collier and Knechtel, 1939).
- Correlation Diagram**
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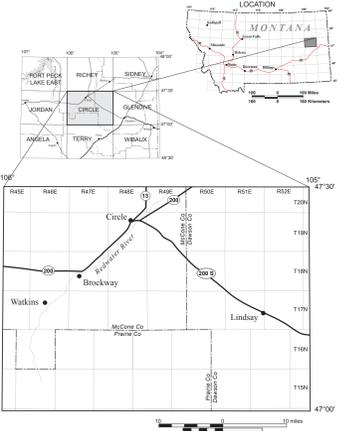
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Base from U.S. Geological Survey
Circle 30'x60' topographic quadrangle
Map date: 1982
Projection: UTM zone 13; 1927 NAD
UTM grid declination: 0°22' West
1982 Magnetic North Declination: 14° East



SCALE 1:100 000
1 CENTIMETER ON THIS MAP REPRESENTS 1 KILOMETER ON THE GROUND
CONTOUR INTERVAL 30 METERS



- Map Symbols**
- Contact
 - Linear feature
 - Strike and dip of inclined beds
 - Structure contours in feet on top of Pierre (Bearpaw) Shale; data from Smith (1999). Contour interval: 100 feet. Hachured line indicates depression. Datum: mean sea level
 - 1155 Water or petroleum well. Number is elevation of top of Pierre Shale in feet above sea level.
 - Volcanic ash bed in Rimroad Formation
 - Extent of Glacial Lake Circle; thin deposits not mapped
- To convert feet to meters multiply by 0.3048
To convert meters to feet multiply by 3.2808

Circle 30' x 60' quadrangle
Index of 7.5' quadrangles and map sources

| | | | | | | | |
|---------------------|-------------|-----------------------|-----------------|--------------------|--------------------|----------------------|--------------------------|
| 2 | 1 | 2 | 2 | 2 | 3 | 2 | 3 |
| Johnson Coulee East | Brockway NE | Youngquist Mine | Circle | Woodworth Hill | Olson Coulee North | Johnson Reservoir NW | Johnson Reservoir NE |
| 88-610 | 88-631 | 88-627 | 88-630 | 88-626 | 88-620 | 88-613 | 88-611 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| Beauty Creek | Brockway | Circle SW | Quick Reservoir | Mount Antelope | Olson Coulee South | Deer Creek Church | Johnson Reservoir |
| 88-636 | 88-623 | 88-629 | 88-616 | 88-616 | 88-621 | 88-628 | 88-609 |
| 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 |
| Berry School | Watkins | Big Sheep Mountain NW | Bearshack Creek | Diamond G Butte NW | Union School | Lindsay | Woodrow |
| 88-632 | 93-0521 | 88-622 | 88-634 | 88-607 | 88-617 | 88-614 | 88-625 |
| 2 | 1 | 2 | 1 | 2 | 2 | 2 | 2 |
| Heitz School | Watkins SE | Big Sheep Mountain | Becker Dam | North Coulee | Diamond G Butte | Lindsay SW | Upper Cracker Box School |
| 88-608 | 88-624 | 93-529 | 88-633 | 88-619 | 88-635 | 88-616 | 88-612 |

U.S. Geological Survey Open-File Report number indicated at bottom of each 7.5' quadrangle.
Map sources:
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Montana Bureau of Mines and Geology
Open-File 597
Geologic Map of the Circle 30' x 60' Quadrangle
Dawson, McCone, And Prairie Counties
Eastern Montana

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2011

Map and text compiled with modification by S.M. Vuke and P.A. Hargrave from thirty-two 7.5' quadrangle geologic maps by R.B. Colton and others; structure contours added by L.N. Smith.

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Maps may be obtained from
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