

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

Colors are determined with the aid of Munsell soil color charts (Munsell Color, 1991). The description of soil-carbonate morphology is after Machette (1985).

HUMAN-MADE DEPOSITS

**af Artificial fill (uppermost Holocene)** — Artificial fill includes riprap and fill placed during the construction of roads, railroads, buildings, and dams. The unit generally consists of clay, silt, sand, and rock fragments. Scattered areas of artificial fill may exist in residential and commercial developments in the map area; however, these fill deposits are likely less than 1.5 m thick and difficult to delineate. Fill materials can vary in particle size and may locally include refuse of many types including household and industrial waste. Artificial fill may be subject to settlement, slumping, and erosion if not adequately compacted and (or) if it is placed on unstable slopes. The unit is as much as 7 m thick.

ALLUVIAL DEPOSITS

**Qa<sub>1</sub> Alluvium one (Upper Holocene)** — The unit is very dark grayish-brown (2.5Y 3/2) in color and consists of moderately to well-sorted silt to medium sand. Gravel lenses up to 3 cm thick are present locally with clasts up to 6 cm in diameter. Sand grains are subangular to round. Grain composition is 80 to 90% quartz with lesser amounts of feldspar and minor (<5 percent) mica and darker minerals. The unit underlies the active floodplains of the Cache la Poudre and South Platte rivers. A carbon-14 sample collected from unit Qa<sub>1</sub> of the Little Thompson River yielded an age estimate of 1,530 ± 30 years BP (Keller and others, 2017). The unit is correlative with parts of unit Qa of Boulder and Saint Vrain creeks (Madole, 2016). Most of the area underlain by unit Qa<sub>1</sub> has a 1% annual chance of flood (Zone A or Zone AE floodway) as mapped by the Federal Emergency Management Agency (FEMA, URL link in references). The unit is a potential source of sand and may be as much as 3 m thick.

**Qa<sub>2</sub> Alluvium two (Lower and Middle Holocene)** — The unit is exposed in a J-2 Contracting gravel quarry in SE ¼ sec. 7, T. 5 N., R. 64 W., along the southern bank of the South Platte River. The unit is brownish-yellow to pale-yellow in color (10YR 6/6 to 2.5YR 7/4). The uppermost 1.5 m of the unit is predominantly clast-supported gravel interbedded with fine to medium sand in beds and lenses up to 7 cm thick. Gravel is poorly sorted and weakly stratified. Clast composition includes vein quartz, metamorphic rocks, and sandstone. Clasts are subangular to subround and can reach as much as 15 cm in diameter. Carbonate rinds are not present on clasts and sand lenses do not effervesce when treated with 10% hydrochloric acid (HCl). Rip-up clasts of Pierre Shale as large as 7 cm long are present in some lenses. An irregular contact separates the upper gravel facies from an underlying, 2 m thick, sandy facies. The sandy facies is composed of alternating layers of planar bedded and cross bedded, pale-yellow to yellow (2.5YR 7/4 to 2.5YR 7/6), poorly to moderately sorted sand. Reddish-yellow (7.5YR 6/6 to 7.5YR 6/8) iron oxide staining is present in both the gravel and sand subunit. Bedding is up to 2 cm thick. Cross bedded and planar bedded sand facies are as much as 0.5 m thick. The unit is as much as 8 m thick.

Two carbon-14 samples (KY 5 and KY 4) were collected from a vertical section exposed in a cut bank along Crow Creek at N ½, SW ¼, sec. 1, T. 5 N., R. 64 W., along the southern bank of the South Platte River. The unit is comprised of sandy alluvium underlying a terrace. Sample KY 5 was taken approximately 0.9 m below ground surface and KY 4 was taken approximately 2 m below ground surface. The samples yielded age estimates of 1,714 ± 1,565 and 3,929 ± 3,817 cal years BP, respectively. Two samples collected unit Qa<sub>2</sub> of the Little Thompson River on the nearby Berthoud quadrangle yielded age estimates of 910 ± 30 and 2,930 ± 30 years BP (Keller and others, 2017). Some areas underlain by unit Qa<sub>2</sub> are mapped as Zone A or Zone AE (1% annual chance of flooding), or Zone AO (1% or greater annual chance of shallow flooding) by FEMA (URL link in references). The unit is a source of sand and gravel.

**Qa<sub>3</sub> Alluvium three (Lower Holocene and Upper Pleistocene)** — The unit is best exposed in a J-2 Contracting gravel quarry in SE ¼ sec. 7, T. 5 N., R. 64 W., along the southern bank of the South Platte River. Color of the unit ranges from dark-brown (10YR 3/3), very dark-brown (10YR 7/4), yellowish-brown (10YR 5/6), and dark, yellowish-brown (10YR 4/6) and consists of poorly sorted gravelly sand and sandy gravel. Gravel clasts are subround to round and up to 4 cm in diameter. Clast composition is predominantly quartz and granitic rocks with a minor amount of metamorphic clasts. Pierre Shale rip-up clasts up to 7 cm long are present locally. In gravelly layers, the matrix is chiefly fine to coarse sand with a minor amount of silt and clay. In sandier layers, grains are predominantly fine to medium sand, with higher amounts of silt and clay. Sand grains are subangular to round. Quartz accounts for the majority of grain composition in both sandy and gravelly layers while feldspar comprise 10 to 15 percent. There is a subordinate proportion of opaque grains. Sandy layers may be cross bedded or planar bedded and less than 1 m thick; bedding is as much as 2 cm thick. Carbonate rinds are absent from clasts; however, parts of the unit effervesced slightly when treated with HCl. Borehole data from the Colorado Division of Water Resources (DWR) indicates the unit may be as much as 21 m thick within the quadrangle.

Three samples (KY 1, KY 2, and KY 3) were collected in the J-2 Contracting gravel quarry. The youngest of the three samples, KY 3 (13,510 ± 1,375 years BP), was collected approximately 16.5 m below ground surface. The age estimate is roughly correlative with the end of the Pinedale Glaciation, units formerly mapped as “Broadway Alluvium”, and unit Qa<sub>3</sub> of recent geologic mapping by the Colorado Geological Survey (Hunt, 1954; Scott, 1960; Madole, 1991). The age of the Broadway Alluvium is considered to be 30 to 12 ka (summarized in Kellogg and others, 2008). Haynes and others (1998) argues the terrace in the quadrangle was abandoned by the South Platte River about 11,000 years BP on the basis of archaeological evidence, mammoth and bison bones, and radiocarbon ages of sediment. Two samples collected from unit Qa<sub>3</sub> along Boulder and Saint Vrain creeks yielded age estimates of 12,025 ± 45 and 12,460 ± 30 years BP (Madole, 2016). Two additional samples reported by Madole (2016) from the Hygiene quadrangle yielded age estimates of 11,980 ± 155 and 12,640 ± 70 years BP. An OSL sample collected from unit Qa<sub>3</sub> of the Little Thompson River yielded an age estimate of 10,940 ± 660 years BP (Keller and others, 2017).

The two other samples (KY 1 and KY 2) were collected from 25.3 m and 21 m below ground surface, respectively, in sandy alluvium. Optically stimulated luminescence analysis yielded age estimates of 86,980 ± 4,090 and 75,540 ± 4,020 years BP, respectively. These ages may correlate with a period of time when the climate experienced higher runoff prior to the onset of the earliest Pinedale advances (Sharpe and Bright, 2014; Sturchio and others, 1994; Pierce and others, 2011; Dahms, 2004). Samples collected on the Gowanda quadrangle were analyzed by OSL and yielded age estimates of 151,360 ± 5,800, >56,305, 54,480 ± 5,540, and 42,285 ± 3,730 yr BP (Keller and others, 2019). The oldest is correlative with the end of the Bull Lake glaciation in Colorado (Schweinsberg and others, 2020). The others may be correlative with the earlier stages of the Pinedale glaciation (Sturchio and others, 1994; Pierce and others, 2011; Dahms, 2004). It is unclear whether samples KY 1 and KY 2 are associated with the Pinedale Glaciation and unit Qa<sub>3</sub> but are summarized here because they were collected in vertical succession from the same location and there is no separate, mappable unit.

**Qg<sub>1</sub> Gravel (Pleistocene)** — Shown in cross section only. Gravel units are not mapped separately because they were only identified in DWR borehole data.

EOLIAN DEPOSITS

**Qe Eolian sediment (Holocene)** — The unit ranges in color from light-brown (7.5YR 6/3, 7.5YR 6/4), reddish-yellow (7.5YR 7/6), brown (7.5YR 5/4), dark-brown to dark yellowish-brown (10YR 3/3 to 10YR 3/4), and pale brown to light yellowish-brown (10YR 6/3 to 6/4). Brownish-yellow to yellowish-brown (10YR 6/8 to 5/8) textures are present locally. In nearby quadrangles, eolian sand and loess have been mapped as separate units. Eolian deposits in eastern Colorado can reach as much as 40 m (Madole and others, 2005). In areas where the unit is poorly sorted, grain size ranges from silt to medium sand with minor clay and coarse sand. In moderately sorted deposits, the unit is silt to fine sand or fine to medium sand. Grains are predominantly quartz (as much as 80 percent), with up to 15% feldspar and <5% opaque grains. Sand grains are subround to round. In hand sample, some exposures are slightly plastic when wetted, indicating minor amounts of silt and perhaps clay. Salt is precipitated locally, especially where the unit is underlain by Pierre Shale. The unit overlies most of the area in the northern part of the quadrangle. Eolian sediment mantles multiple terrace levels associated with the paleovalley of Lone Tree Creek. The unit also partially mantles an additional paleovalley that the modern Crow Creek occupies on the east side of the mapped area. Bedrock may be as shallow as 2 m below ground surface and the unit is as much as 4 m thick.

Eolian sediment in the region is derived from stream alluvium (Madole and others, 2005). This may contribute to the overall coarser sediment fraction of analyzed samples as finer sediments remain in suspension over longer transport distances in fluvial systems. Muhs and others (2014) defines loess as eolian deposits with 60 to 90% silt (50-200 µm diameter). Sand dune fields exist east of the mapped area. Dune crests indicate a prevailing wind direction from the northwest.

Samples of eolian sediment collected in nearby quadrangles yield age estimates ranging from Late Pleistocene to Holocene (Madole and others, 2005). Two samples yielded luminescence radiocarbon ages of 9,550 ± 130 BP and 9,650 ± 130 BP (Haynes and Haas, 1974). However, the eolian sediment mapped within the Kersey quadrangle is likely Holocene in age because they overlay alluvial units that are as old as Early Holocene. Outcrops of unit Qe are non-reactive to very reactive when treated with HCl, even though there is little or no visible secondary calcium carbonate development, indicating parts of the unit have remained active.

Dunes, predominantly parabolic dunes, are present in the southern and eastern parts of the mapped area (Madole and others, 2005). Extensive dune fields exist east of the mapped area. Dune crests indicate a prevailing wind direction from the northwest. The unit may be subject to wind erosion and deposition in areas with little to no vegetation. Eolian sediment may be prone to collapse when wetted and placed under load. The unit may be a source of industrial sand.

BEDROCK GEOLOGY

**Klf Laramie Formation and Fox Hill Sandstone, undivided (Upper Cretaceous)** — Shown in cross section only. Tan colored sandstone, shale and interbedded coal (Laramie Formation). Approximately 90 to 180 m.

**Kp Pierre Shale (Upper Cretaceous)** — Shown in cross section only. Dark-grey shale interbedded with sandstones and veins of gypsum. Total thickness of the unit is approximately 1800-2100 m thick.

**Kn Niobrara Formation (Upper Cretaceous)** — Shown in cross section only. Interbedded layers of chalk and limestone. Approximately 60-100 m thick.

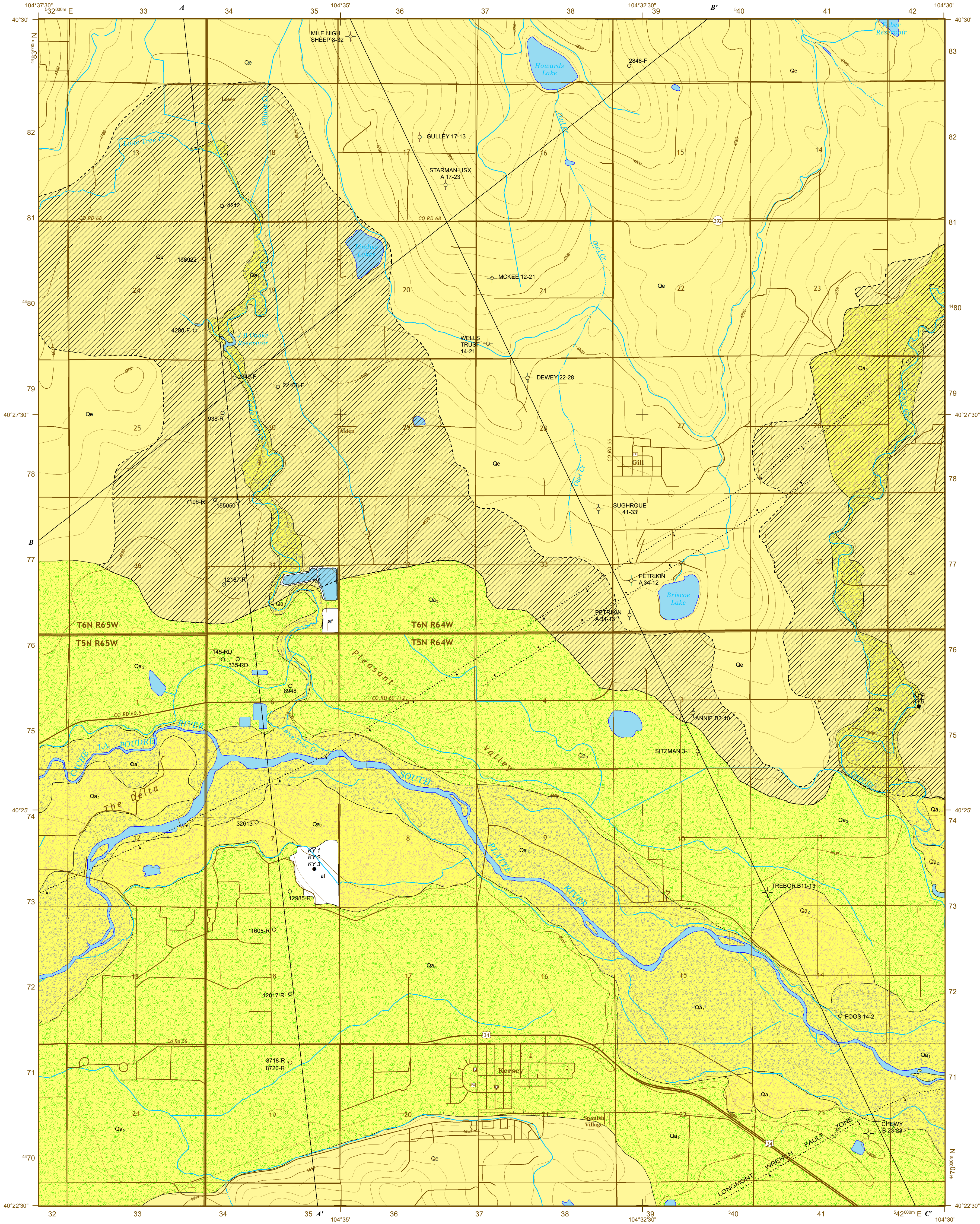
**Kcgg Colorado Group, undivided (Upper Cretaceous)** — Shown in cross section only. Includes the Carlile Shale (shale and near-shore sand), Graneros Shale (predominantly shale interbedded with sandstone), and Greenhorn Limestone (shale, chalky-shale, and limestone). Approximately 120-140 m thick.

MAP SYMBOLS

- Contact — Approximately located
- High-angle fault — Existence certain, location concealed, ball and bar on downthrown side
- Oblique-slip, right lateral offset fault — Existence certain, location concealed, ball and bar on downthrown side
- Oil and gas well (Well name shown on map)
- Water well (Division of Water Resources permit number shown on map)
- Age-date Sample
- Alignment of cross sections
- Paleovalley — approximately located

ACKNOWLEDGMENTS

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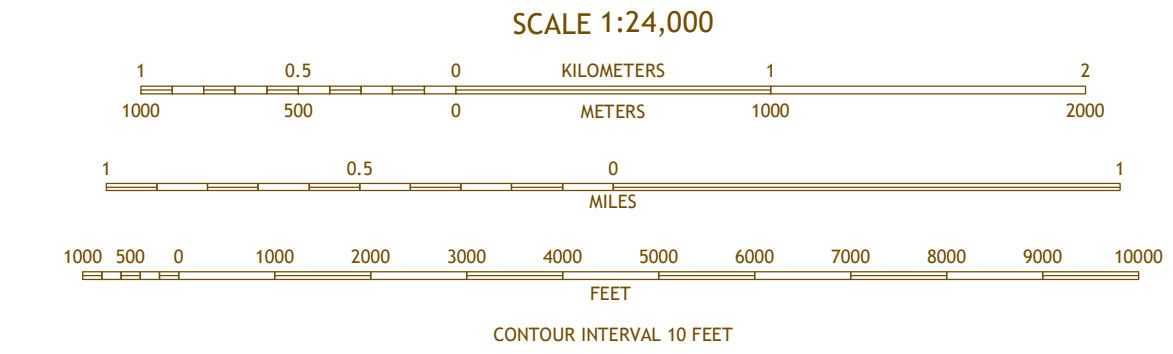


Coordinate System: NAD 1983 UTM Zone 13N  
Projection: Transverse Mercator  
Datum: North American 1983

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Roads.....U.S. Census Bureau, 2015-2016  
Names.....GNS, 2016  
Hydrography.....National Hydrography Dataset, 2013  
Boundaries.....National Elevation Dataset, 2007  
Public Land Survey System.....BLM, 2011



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GEOLOGIC MAP OF THE KERSEY QUADRANGLE, WELD COUNTY, COLORADO

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