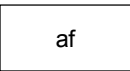


DESCRIPTION OF MAP UNITS

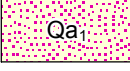
SURFICIAL DEPOSITS

HUMAN-MADE DEPOSITS



Artificial fill (latest Holocene) — Rip rap, engineered fill, and refuse placed during construction of roads, railroads, buildings, dams, and landfills. Generally consists of unsorted silt, sand, clay, and rock fragments. The average thickness of the unit is less than 20 feet. Artificial fill may be subject to settlement, slumping, and erosion if not adequately compacted. Extensive areas of artificial fill exist in the urbanized eastern half of the quadrangle. Accurate mapping of the actual extent of fill in these heavily developed areas was problematic and the mapped extents represent a conservative estimation.

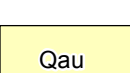
ALLUVIAL DEPOSITS



Alluvium one (late Holocene) — Tan to pale-brown, poorly to moderately sorted, poorly to moderately consolidated, sand, gravel, silt, and minor clay and sparse boulders in the currently active stream channels or in low stream-terrace deposits less than 5 feet higher than the current stream channel. Clasts are subrounded to well rounded and the dominant sediment is sandy gravel with a sandy silt matrix. The unit correlates with the post-Piney Creek alluvium described by Hunt (1954) in the Denver area and of Maberry and Lindvall (1972). Mapped extents of Qa may include Qa₂ deposits of limited extent. The unit is subject to frequent flooding and is a source of sand and gravel. Maximum exposed thickness of the unit locally exceeds 5 feet.



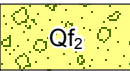
Alluvium two (late Holocene) — Dark-gray to brown, poorly to well-sorted, moderately to well-consolidated, silt, sand, gravel, and minor clay and sparse boulders in stream-terrace deposits approximately 6-12 feet higher than the modern flood plain or as non-terrace forming alluvium in valley headwaters. Clasts are subrounded to well rounded and the dominant sediment is sandy gravel with a silty sand matrix. Thinly-bedded (1-4 inches thick) clay seams are present in the lower parts of the unit. The unit is generally correlative, by virtue of height and soil characteristics, with the Piney Creek alluvium described by Hunt (1954) in the Denver area and of Maberry and Lindvall (1972). The unit is subject to occasional flooding and is a potential source of sand and gravel. Maximum exposed thickness of the unit locally exceeds 20 feet.



Alluvial deposits, undivided (Holocene to late Pleistocene) — Gray-brown to tan-brown, poorly sorted sand and fine gravel in valley heads in the upper parts of drainages and in main trunk streams where differentiation of specific alluvial units was not possible due to poor exposure. The unit includes sheetwash and stream-deposited alluvium that are undivided. The unit may be overlain by thin laminae of eolian sand. Maximum exposed thickness of the unit locally exceeds 15 feet.



Alluvial fan deposit one (late Holocene) — Tan to pale-brown, poorly to moderately sorted, poorly consolidated clay, silt, sand, and gravel deposited as alluvial fans at the mouths of perennial streams. Deposits have a fan-like shape and consist of subangular to well-rounded clasts of varied lithology that are derived from local surficial deposits; however, sand and gravel derived from the Dawson Arkose and Denver Formation are major constituents. These deposits are similar to and positionally related to unit Qa₂. Sediments are deposited primarily by streams with significant input from sheetwash, debris flows, and hyperconcentrated flows. Deposits locally exceed 10 feet in thickness. Areas mapped as alluvial fans are subject to future flash floods and debris flow events. Deposits may be prone to collapse, hydrocompaction, or slope failure when wetted or loaded. Deposit is a potential source of sand and gravel.



Alluvial fan deposit two (late Holocene) — Dark-gray to brown, poorly to moderately sorted, poorly consolidated clay, silt, sand, and gravel deposited as alluvial fans at the mouths of perennial streams. Deposits consist of subangular to well-rounded clasts of varied lithology that are derived from local surficial deposits; however, sand and gravel derived from the Dawson Arkose and Denver Formation are major constituents. These deposits are similar to and positionally related to unit Qa₂. They have a fan-like shape, but are more dissected than younger Qf₁ deposits. Sediments are deposited primarily by streams with significant input from sheetwash, debris flows, and hyperconcentrated flows. The apex of the fan is as much as 15 feet higher than modern streams. Deposit locally exceeds 15 feet in thickness. Areas mapped as alluvial fans are subject to future flash floods and debris flow events. Deposits may be prone to collapse, hydrocompaction, or slope failure when wetted or loaded. Deposit is a potential source of sand and gravel.

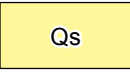


Gravel deposits (Pleistocene) — Yellowish-brown to grayish-brown, poorly sorted, pebble, cobble, and boulder gravel with a fine to coarse sand matrix. Clasts are subrounded to well rounded. Matrix typically consists of feldspar and quartz sand likely derived from the local bedrock. Clast types within the gravel are predominantly pink granite, white vein quartz, quartzite, and granitic gneiss, with lesser amounts of red sandstone, intermediate volcanic rocks, chert, and limestone. Top of the unit is 60 to 70 feet higher than main stem creeks. The unit is 10 to 15 feet in thickness. The deposit forms a stable building surface, but excavations may be prone to slumping. The unit is a potential source of sand and gravel.



Sheetwash alluvium (Holocene to late Pleistocene) — Light-grayish-brown, pale-brown to brown, poorly sorted sand, silty and clayey sand, and minor amounts of gravel including some cobbles. Unit consists chiefly of local materials transported on moderate slopes (~10 percent grade) by sheet flow but also includes some sediment delivered by runoff in rills and minor gullies. Maximum exposed thickness is 20 feet.

EOLIAN DEPOSITS



Eolian sand deposits (Holocene to late Pleistocene) — Yellowish-brown to tan, fine- to coarse-grained, frosted sand and silt deposited by wind or sheetflow. Typically this unit is faintly stratified and non-cohesive; dune forms are not present. The lower, older parts of the unit are weakly cemented by calcium carbonate and can hold a face where recently excavated. The unit is likely deposited as a sand sheet by winds capable of moving granules and very small pebbles. These sand deposits are moderately compacted, easily excavated; however, they can hold surface water. This unit may be prone to hydrocompaction. Unit locally may exceed 10 feet in thickness.

MASS-WASTING DEPOSITS



Soil slip deposit (Holocene) — Areas where the surface soil has detached and migrated downhill, exposing bedrock within the detachment zone. The slip surfaces are typically parallel to the slope and less than 3 feet below the surface. These features commonly form where water seeps are exiting the slope causing the soil to become saturated and to flow under gravity. Areas mapped as soil slips are prone to future movement if saturated by runoff or precipitation. Thickness of soil slip deposits is typically less than 5 feet.

BEDROCK

Denver Basin Group

Dawson Arkose (Paleocene to Eocene) — White and tan, thick to massive, cross-bedded arkoses, pebbly arkoses, and arkosic pebble-cobble conglomerates. Contains beds of white and tan fine- to medium-grained feldspathic cross-bedded friable sandstone that is poorly sorted, has high clay contents, and is commonly thin or medium bedded. The unit also contains sparse interbeds of thin-bedded gray claystone and sandy claystone or dark-brown, organic-rich siltstone to coarse sandstone. The interbeds contain fossilized plant fragments. Two- to five-foot thick zones of pebble-cobble conglomerate consist of rounded to subrounded clasts of granite and milky quartz with lesser amounts of gneiss, red sandstone, grayish-blue quartzite, and intermediate volcanic rocks. Thickness of the Dawson Arkose may reach 1000 feet in the Monument area; however, the exposed thickness in the Piney Creek quadrangle is approximately 530 feet. The unit is prone to swelling when wet. Residuum is commonly developed on the surface of the Dawson Arkose; residuum was not mapped due to poor exposures and variations in thickness. The Dawson Arkose is described in detail by Thorson (2011).

Within the Piney Creek quadrangle, the Dawson Arkose is separated from the underlying Denver Formation by a distinct zone of gray to pink to dark red clays up to 40 feet thick, interpreted to represent a paleosurface of soil formation which also approximates the Paleocene–Eocene boundary (Raynolds, 2002; Thorson and Madole, 2002; Thorson, 2003). The distinctly different weathered colors and clay-rich content between the coarser grained Dawson Arkose and the finer grained Denver Formation make this zone recognizable. This zone also contains abundant root casts, has a distinct mottled and banded character, and has economic use as brick-making clay. A pollen sample identified as *Homopolis wyomingensis* (*Brosipollis* sp.) J. O'Keefe, Morehead State Univ., personal commun., 2015) was collected near the base of the palcosol at UTM location N525,908.80 E4,385,158.92 and is likely indicative of pollen zone P6 (uppermost Paleocene).

Bryant and others (1981) described two crystal tuff locations within the northeastern and northwestern parts of the mapped area; the most reliable age date as determined from biotite yielded a late Paleocene-early Eocene age of 56.5 +/- 1.9 Ma.

Denver Formation (Upper Cretaceous to Paleocene) — The Denver Formation consists of tan, brown, and gray cross-bedded arkosic sandstone and greenish-gray sandy claystone. The sandstones are poorly sorted and contain abundant clay. They can be thin or medium bedded with ripple cross laminations. Some zones below the paleosol contain discontinuous pebbly conglomerate lenses of pink granite and vein quartz that are commonly less than 1 foot thick and typically weather out of deteriorated outcrops. Exposed thickness in the mapped area is less than 130 feet.

Laramie Formation (Upper Cretaceous) — Shown on cross section only

Fox Hills Sandstone (Upper Cretaceous) — Shown on cross section only

Pierre Shale (Upper Cretaceous) — Shown on cross section only

Contact—Approximately located

Strike and dip of inclined bedding—Showing direction and angle of dip

Conglomeratic sandstone lenses—Zones of coarse gravel and cobbles within the Dawson Arkose that represent high-discharge flooding events

Well—Plugged and abandoned

Anticlinal fold axis—Approximately located and queried

Alignment of cross section

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