Disturbed areas (Holocene) - Areas disturbed by human activity; embankments, dams, dumps.

Talus and colluvium (Quaternary) - Talus and colluvium

Active Alluvium (Holocene) - Active alluvium

Older alluvium (Quaternary) - Alluvium in terraces incised more than 3m.

Gila Conglomerate (Miocene) - Boulder-cobble-pebble, clast-supported conglomerate and pebbly sandstone. Conglomerate occurs in fairly massive to very thick-bedded units with stratification defined by grain-size variations. Clasts are sub-angular to sub-rounded, but also range to well-rounded. Assemblages range from monomict to oligomict with a wide variety of possible clasts, all derived from local sources. Clasts, in general order of abundance are: phenocryst-rich ash-flow tuff, arkosic sandstone, argillite, quartz sandstone and quartzite, limestone, andesitic volcanics, and two kinds of granitoid (Proterozoic, and late Cretaceous). Each of these are locally very abundant.

Unit of North Canyon (Miocene Gila Group) - Oligomict to polymict conglomerate. Clasts of arkose and ash-flow tuff dominate in most areas, but this conglomerate also contains clasts of white porphyry (ranging from phenocryst-rich quartz-phyric to feldspar-phenocryst-poor), limestone, quartzite, and granodiorite.

Unit of Adobe Tank (Miocene Gila Group) - Monomict to oligomict conglomerate dominated by clasts of arkose (Bisbee Group), and ash-flow tuff (rhyolite of Mt Fagan) in the west. To the east this conglomerate also contains, locally, light-colored granitoid clasts that match the Empire Mts Granite (Upper Cretaceous).

Older Conglomerate (Miocene - Oligocene) - Pebble-cobble, Rounded to well-rounded conglomerate, sub-angular to sub-rounded volcaniclastic pebble-cobble, rare boulder conglomerate with sparse well-rounded siliciclastic clasts, mudstone, massive breccia. Clasts are nearly identical to those found in the underlying Fort Crittenden with one important and diagnostic exception. White quartz porphyry (TKq) and lesser amounts of phenocryst-poor porphyry (Tp) and ash-flow tuff (Kr) are sparsely present.

Quartz porphyry (Tertiary - Upper Cretaceous) - Felsic porphyry containing 10-30% quartz and feldspar phenocrysts (1-3mm), and sparse biotite in a fine-grained light-colored matrix, locally flow-foliated. Forms dikes and sills, and a plug-like stock in the northwest corner of the map area.
**Felsic tuff (Tertiary – Upper Cretaceous)** - Moderately phenocryst-rich ash-flow tuff containing 10-25% quartz and feldspar phenocrysts with biotite. Tuff contains 5-30% lithic lapilli and is closely associated with a plug of the quartz porphyry (TKq) in the northwest corner of the map area.

**Fine-grained felsic porphyry (Tertiary – Upper Cretaceous)** - Fine-grained porphyry felsic porphyry containing less than 5% feldspar and sparse quartz phenocrysts in a fine-grained light-colored matrix, typically strongly flow-foliated. Forms dikes and sills.

**Diorite (Tertiary – Upper Cretaceous)** - Fine-grained biotite diorite, locally plagioclase porphyritic. Forms dikes and sills.

**Solero Group (Upper Cretaceous)**

**Rhyolite of Mt Fagan (Upper Cretaceous)** - Quartz-feldspar-biotite ash-flow tuff, lithic-rich ash-flow tuff, and tuff breccia. The tuff contains 15-30% phenocrysts of quartz (1-5mm), sanidine (1-4mm), plagioclase (1-3mm) and biotite 1-3mm. The tuff contains abundant lithic-rich zones (mesobreccia) with 10->50% lithic lapilli and blocks up to several meters. Some of the lithic-rich zones are exceptionally coarse-grained with blocks larger, and in some areas much larger than 100s of meters. Lithic material of three types dominate: arkosic or quartzose sandstone and mudstone (Bisbee Group), conglomerate and conglomerate mixed with volcanic breccia (Fort Crittenden Formation), and andesitic lava.

**Andesite lava of Jules Mountain (Upper Cretaceous)** - Andesite lava and lava breccia containing 5-15% 1-3mm plagioclase, and lesser typically altered <2mm mafic phenocrysts.

**Fort Crittenden Formation, Solero Group conglomerate undifferentiated (Upper Cretaceous)** - Pebble-cobble conglomerate, pebbly sandstone, sandstone and mudstone, volcaniclastic breccia and minor, thin volcanic flows and tephra layers. Conglomerate ranges from well-rounded and clast-supported with clasts dominated by quartz sandstone, and arkosic sandstone, with lesser argillite, limestone, and granitoid to felsic to intermediate volcaniclastic breccia with angular to sub-rounded clasts. The clast types are present in highly variable amounts, and the assemblages accordingly range from monmict through polymict. In general, the polymict have more rounded clasts, and thinner bed sets. Monomict to oligomict deposits are typically massive, commonly matrix-supported, and contain angular to sub-rounded, very poorly sorted clasts (silt through boulders).

**Bisbee Group (Lower Cretaceous)**

**Turney Ranch Formation (Lower Cretaceous)** - Quartzose sandstone and mudstone. This unit consists of alternating sandstone-rich and mudstone-rich sequences on the order of 5-50m. Mudstone-rich intervals are typically red to purple, and to a lesser degree green and includes only rare intervals of pure shale or claystone. Pedogenic carbonate as nodules and in discrete, poorly organized beds and lenses up to 2m thick is common. Sandstone is quartzose, typically cross-stratified, and ranges from thin- to thick-bedded, and fine- to coarse-grained. The base of the formation is defined by the fairly abrupt, first appearance of quartzose sandstone (older sandstones are arkosic and lithic-rich).

**Shellburnet Formation (Lower Cretaceous)** - Arkosic sandstone, mudstone, rare pebbly sandstone. Sandstone beds are thin- to thick-bedded, typically massive or weakly plane-bedded or cross-stratified, argillaceous, arkosic to lithic, and fine- to coarse-grained. Sandstone also occurs in fairly thick, ripple-laminated beds. Mudstone, making up slightly more than half the formation is almost exclusively dark olive green. Mudstone is mostly silty with relatively sparse pure shale or claystone intervals.
Bisbee Group (continued)

Lower Shellenburger Formation (Lower Cretaceous) - Arkosic sandstone and mudstone capped by a distinctive, resistant bed of oyster packstone limestone unit <5m thick that defines the top of this map unit. Sandstones of this unit are fine- to medium-grained arkosic to lithic and argillaceous. Mudstone is mostly silty with relatively sparse pure shale or claystone intervals.

Apache Canyon Formation (Lower Cretaceous) - Arkosic sandstone, mudstone, limestone, and rare pebbly sandstone. The Apache Canyon is distinguished from other units of the Bisbee by its signature lithology; dark, typically laminated, nonfossiliferous micritic limestone. The limestone, making up as much as 50% of the formation, occurs in laminae, and thin- to medium-bedded, rarely thick-bedded sequences of amalgamated laminated to thin-laminated black limestone interlayered with dark mudstone and shale. Sandstone occurs in thin- to thick-bedded units that display bed-scale cross-stratification, but also, and more commonly, graded beds, either massive or plane-bedded stratified. Ripple-laminated sequences are common in individual thin beds and laminae, and as gradational tops to the graded beds. The mudstone, which dominates the formation, occurs in sets that range up to 10m thick. The mudstone is also mostly shale or claystone with sparse silty laminae and thin beds.

Willow Canyon Formation (Lower Cretaceous) - Arkosic sandstone, mudstone, conglomerate. Sandstone occurs in thin- to thick-beds of fine- to coarse-grained, and granule, moderately poorly sorted arkose and lithic arkose. Beds are massive or plane-bedded and cross-stratified. The pebbles and cobbles are typically rounded to well-rounded, but locally sub-angular to sub-rounded. To the south, up to 50% or more of the clasts are intermediate volcanic or hypabyssal igneous. Mudstone, which makes up more than half of the formation in most areas, is fairly silty with only sparse shale or claystone. Its color is dark olive gray except for the lower part which is deep red.

Glance Conglomerate (Lower Cretaceous - Upper Jurassic) - Limestone pebble-cobble conglomerate, mostly clast-supported and containing a few % quartz sandstone and argillite clasts.

Gardner Canyon Formation (Jurassic - Triassic) - Red mudstone, arkosic sandstone, limestone, conglomerate, quartz sandstone, and ash-flow tuff. The Gardner Canyon Formation is a heterogeneous unit dominated by red, and to a lesser degree green, commonly strongly cleaved mudstone with subordinate, yet abundant arkosic sandstone beds ranging from fine to granule, and thin- to thick-bedded. Rare felsic ash-flow tuffs and/or ash-fall tuff up to 3m thick occur in some areas (Empire Ranch and Mt Fagan quadrangles). Pedogenic carbonate lenses and nodules are common within red mudstone, but dark gray, recrystallized, probable packstone-grainstone limestone beds up to 30cm thick are also present in some areas.

Naco Group (Permian - Pennsylvanian)

Rainvalley Formation (Permian) - Medium- to thick-bedded dolostone and limestone interbedded with minor quartzose sandstone and siliceous shale. Dolostone is micritic, light to dark gray, weathered light to medium gray, and is locally laminated. Limestone is medium to dark gray lime mudstone and wackestone, containing chert nodules and brachiopod or pelecypod fragments. Fine- to medium-grained quartz sandstone is light gray to yellowish, is weathered light orange-pink, and forms intervals up to 3 m thick. Sandstone locally exhibits bimodal grain size (very-fine- and medium-grained), and some intervals display flaser bedding. ~100m thick.

Concha Limestone (Permian) - Dark to medium gray, thick- to medium-bedded, fossiliferous limestone commonly containing chert nodules 10-30 cm across. Lime mudstone and wackestone are predominant, with minor skeletal packstone. Fossils include brachiopods, gastropods, pelecypods, rugose corals, crinoid columnal fragments, sponge spicules and echinoid spines. 120-220m thick.
Naco Group (continued)

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**Sherrer Formation (Permian)** - A unit dominated by white to pink, fine-grained, planar-laminated, quartzose sandstone. The unit is subdivided into lower and upper subdivisions. The lower subdivision (Ps) consists entirely of quartzose sandstone. The upper subdivision (Psu) is marked by medium- to thick-bedded micritic dolostone up to 25 m thick, overlain by more quartz arenite. 100-180 m thick.

**Epitaph Formation (Permian)** - A mixed siliciclastic-carbonate unit consisting of white to medium gray, thin- to thick-bedded limestone and dolostone, and thin- to medium-bedded siltstone, mudstone, and fine-grained sandstone. The carbonate and siliciclastic components are metamorphosed to fine-grained marble and light green hornfels. 150-200 m thick.

**Colina Limestone (Permian)** - Medium- to thick-bedded, white to light gray, micritic limestone. The unit is characterized by tabular beds, creamy white to tan weathered surfaces (locally pinkish gray, rarely medium or dark gray), and lack of resistant-weathered siliciclastic layers. 80-110 m thick.

**Earp Formation (Permian – Pennsylvanian)** - A mixed siliciclastic-carbonate unit consisting of light reddish brown to light green, thin- to medium-bedded, planar-laminated mudstone, siltstone, and very fine-grained sandstone, interbedded with subordinate light gray to pinkish gray micritic limestone and skeletal wackestone. The siliciclastic components are commonly metamorphosed to light green or orange-pink hornfels. The limestone is locally dolomitic and is commonly metamorphosed to fine-grained marble. 90-110 m thick.

**Horquilla Limestone, Naco Group (Pennsylvanian)** - Light gray, thin- to thick-bedded, cherty limestone with interbeds of dark gray to green silty mudstone and shale that become more abundant up-section. 200-300 m thick.