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DESCRIPTION OF MAP UNITS FOR PRELIMINARY GEOLOGIC MAP OF THE GASS PEAK SW QUADRANGLE, CLARK COUNTY, NEVADA

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This information should be considered preliminary.
It has not been edited or checked for completeness or accuracy.

SURFICIAL DEPOSITS

Qe **Eolian deposits—**Well-sorted eolian sand, typically forming stabilized, vegetated dunes (coppice dunes) up to 5 m high. Minimal to no soil development. Middle to late Holocene age.

Qtf **Tufa deposits—**Dark brown, dense calcareous tufa forming linear or curvilinear alignments of cauliflowerlike masses (Haynes, 1967). Spring deposits interbedded within Qtse, possibly resulting from spring discharge along faults.

Alluvial-fan Deposits

Coarse-grained alluvial-fan gravels derived from the Las Vegas Range in the northern part of the quadrangle and the Spring Mountains to the west of the quadrangle. Generally poorly to moderately sorted, subangular to subrounded, sandy pebble-cobble gravels dominated by Paleozoic carbonate lithologies. Fan-unit nomenclature follows that of Sowers (1985, 1986); Sowers and others (1988), and Bell and others (1998, 1999).

Qfa **Alluvium in recently active fan washes—**Dominantly sandy pebble-cobble gravels and pebbly sand; locally bouldery near fan heads. Poorly to moderately sorted. No soil development. Inset only slightly into older surfaces over most of the map area, but generally confined to entrenched washes near fan heads.

Qf4 **Middle to Late Holocene fan deposits—**Fan remnants characterized by subdued to nearly fully smoothed surfaces, incipient to moderately packed desert pavement, weak to moderate rock varnish, and slight etching of surface carbonate clasts. Only slightly separated from Qfa surfaces over most of the map area, but typically 0.5 to 1 m higher than Qfa near fan heads. Soils are typically A-C profiles with an eolian cap (vesicular A horizon) up to 5 cm thick, and stage I $CaCO_3$ development (clast coatings less than 1 mm thick).

Qf3 **Late Pleistocene to Early Holocene fan deposits—**Fan remnants characterized by fully

smoothed surfaces, tightly packed desert pavement, dark rock varnish, and moderate etching of surface carbonate clasts. Generally separated only slightly from younger surfaces, except near fan heads where separation varies from less than 1 m to 10 m or more. Dominates the piedmont flanking the Las Vegas Range, but more recent flow has occurred over much of the piedmont surface in broad, anastamosing channel networks and much of the area shown as Qf3 includes undifferentiated Qfa and Qf4 deposits.

Qf3b Latest Pleistocene to Early Holocene fan deposits—Fully smoothed surfaces with carbonate-clast etching of up to a few mm. Soils typically include an eolian cap (vesicular A horizon) up to 5 cm thick, moderately reddened Bw horizon, and stage I $CaCO_3$ development.

Qf3a Late Pleistocene fan deposits—Fully smoothed surfaces generally indistinguishable from Qf3b, although locally having carbonate-clast etching of several mm. Soils typically include an eolian cap (vesicular A horizon) 5 cm or more thick, prominently reddened Bw to Btj horizon, and stage I to II $CaCO_3$ development.

Qf2 Middle to Late Pleistocene fan deposits—Fan remnants characterized by fully smoothed surfaces with erosionally rounded margins, tightly packed desert pavement, dark rock varnish, and strong etching (up to several cm) of surface carbonate clasts. Appears lighter toned than Qf3 surfaces due to abundant carbonate litter. Separation from younger surfaces increases toward fan heads. Soils typically include an eolian cap more than 5 cm thick, a prominently reddened and well-structured Bt horizon, and a 0.5 to 2 m thick Bkqm horizon. Upper soil horizons are locally stripped.

Qf1 Early to Middle Pleistocene fan deposits—Fan terrace remnants exposed only as small fan remnants near the front of the Las Vegas Range and as highly dissected terrace deposits preserved on the sides of steep canyon walls in the lower reaches of canyons in the Las Vegas Range; typically separated from active washes by several tens of meters. Fan surfaces are whitish from abundant carbonate litter; terrace remnants in canyons of the Las Vegas Range are typically mantled by thin deposits of younger colluvium. Soils typically include massively cemented Bkqm horizons 3 m or more thick; upper soil horizons are generally stripped.

Alluvial Deposits of Las Vegas Wash

Fine- to coarse-grained alluvium reworked from alluvial-fan gravels, fine-grained deposits of Tule Springs, and eolian material. Subangular to subrounded; poorly to well sorted; locally well stratified and crossbedded. Generally less than 3 m thick. Inset into fine-grained deposits along upper Las Vegas Wash and forming a broad anastomosing channel network across Gilcrease Flat.

Qa Alluvium in recently active washes—Pebble to cobble gravel and sand in wash bottoms. No soil development. In part correlative to Unit G of Haynes (1967).

Qlv4 Mid- to Late Holocene alluvium—Pebble to cobble gravel and sand. Characterized by subdued to nearly fully smoothed surfaces, incipient to moderately packed desert pavement, weak to moderate rock varnish, and slight etching of surface carbonate clasts. Along upper Las Vegas Wash, forms gravel-dominated stream-terrace remnants typically 0.5 to 1 m higher than recently active wash channels; across Gilcrease Flat, dominately fine-grained deposits forming broad anastomosing channel networks. Generally correlative with Unit F of Haynes (1967).

Qlv3 **Latest Pleistocene to early Holocene alluvium—**Pebble to cobble gravel. Characterized by fully smoothed surfaces, tightly packed desert pavement, dark rock varnish, and moderate etching of surface carbonate clasts. Soils similar to Qf3.

Qlv3b **Latest Pleistocene to early Holocene alluvium—**Surface characteristics and soils similar to Qf3b. Inset relations vary by several meters, ranging from being only slightly inset below Qlv3a to about 1 m higher than Qlv4, indicating deposition during a period of rapid dissection of upper Las Vegas Wash.

Qlv3a **Latest Pleistocene alluvium—**Surface characteristics and soils similar to Qf3a, although Qf3a locally stronger indicating a broader age range. Commonly forms a sinuous capping deposit on Qtse.

Fine-grained deposits of Tule Springs

Basin fill comprised of fine sand, silt and clay forming broad flats in upper Las Vegas Valley. Paleospring, paludal, and fluvial deposits related to paleospring discharge during Late Pleistocene pluvial periods. Generally poorly exposed except along upper Las Vegas Wash and in the dissected upthrown side of the Eglington fault scarp. Nomenclature follows that of Haynes (1967) and Bell and others (1998, 1999). Most of Haynes' (1967) type localities are at his Tule Springs Site, which is located in the central part of the quadrangle.

Qtse **Unit E of Haynes, 1967—**Whitish to light brown silt and fine sand, with minor light-gray or greenish clay; generally well sorted; thinly bedded to massive. Divided into two subunits (E1 and E2) by Haynes (1967). Typically 1 to 3 m thick; locally up to 5 m thick where filling paleospring cauldrons or channels cut into older units. Base of unit, especially the bottoms of filled channels, commonly contains abundant rounded to subrounded carbonate nodules reworked from older units (primarily Qtsd). Weak soil development generally limited to a 20- to 30-cm-thick horizon with weak structure and forming a slightly resistant cap; locally armored by a thin layer of light gray platy carbonate, probably deposited by localized paleospring discharge. Commonly contains gray to dark gray organic horizons (black mats) a few to several cm thick. Contains abundant mollusk shells and large vertebrate bones (including bison, mammoth, horse, and camel). Numerous radiocarbon ages cluster between 9.5 and 14.5 ^{14}C ka (Haynes, 1967; Bell and others, 1998, 1999; Quade and others, 2003).

Qtsd **Unit D of Haynes, 1967—**Light brown to yellowish silt and fine sand, and light green clay. Commonly capped by a prominent 30- to 50-cm-thick massively cemented petrocalcic horizon and characterized by surface rubble consisting of carbonate nodules and cemented cicada burrows. Radiocarbon ages range from about 18 to 30 ^{14}C ka (Haynes, 1967; Bell and others, 1998, 1999; Quade and others, 2003), indicating correlation with marine isotope stage 2. Similar to Qtse, contains abundant mollusk shells and large vertebrate bones. Qtsd dominates the broad area of Gilcrease Flat, albeit commonly mantled by younger fluvial deposits (mainly Qlv4); relatively minor, unmapped remnants of Qtse and Qtsc also outcrop on the flat.

Qtsc **Unit C of Haynes, 1967—**Light brown to brown silt and fine sand. Typically well sorted and massive to thick bedded. Forms characteristic resistant cliffs along wash walls. Generally lacking fossils, and likely reflecting drier conditions than during deposition of Qtsd and Qtsb. Age poorly constrained, but spatial correlation and relatively weak soil development indicate deposition closely predated Qtsd.

Qtsb **Unit B of Haynes, 1967—**Light brown silt and fine sand, and pale green clay. Commonly contains gravel lenses near base of unit. Divided into three subunits by Haynes (1967); basal unit (B1) typically consists of light brown silts with interbedded gravels common; middle unit (B2) typically consists of pale green to brown clays and contains abundant fossils; and upper unit (B3) typically consists of light brown to whitish silts, often massively cemented. Age poorly constrained, although TL dating indicates an age of 89 to 144 150 ka (Page and others, 2005), and Quade and others (2003) infer that the unit correlates with marine isotope stage 6.

Qtsa **Unit A of Haynes, 1967—**Light brown to reddish brown, hard, calcareous silt and clay; strong prismatic structure. Commonly has a mottled appearance from irregular deposition of light gray to whitish secondary carbonate. At the Tule Springs Site, exposed only in a few locations at the bottom of wash cuts. Comprises a significant portion of the area here mapped as Qtsu in the dissected upthrown side of the Eglington fault scarp. Here mapped only in cross section. A single TL date indicates an age of 131 to 225 ka (Page and others, 2005).

Qtsu **Undivided fine-grained alluvium—**Fine-grained deposits spanning a broad age range exposed in the dissected footwall of the Eglington fault scarp. Generally corresponds to areas mapped as Unit A by Haynes (1967). Page and others (2005) recognized the presence of younger deposits and mapped these as Qab. In this study, we found that the few remaining exposures of these deposits include significant remnants of all of the units defined by Haynes (1967). At least one extensive wash exposure of Qtsa is preserved, although no surface outcrop of Qtsa was found during this mapping. Locally includes minor exposures of older, massively cemented fine-grained deposits (described as pre-unit A by Haynes, 1967); these poorly exposed deposits are significantly older than Unit A.

PALEOZOIC ROCKS

PMb **Bird Spring Formation, undivided (Chesterian to Leonardian, Upper Mississippian to Lower Permian)—**Mostly limestone, dolostone, and minor quartzite and variegated shale. Limestone is medium gray, light gray, and yellowish gray, silty, bioclastic, and thin- to thick-bedded. Dolostone is medium gray, yellowish gray, and light gray, silty, and thin- to thick-bedded. Abundant layers and nodules of dark-gray and dusky-yellowish-brown chert; some parts of member contain more than 50 percent chert. Contains *Syringapora* corals, solitary rugose corals, *chaetetes* corals, brachiopods, bryozoans, and pelmatozoan stems. Basal part of formation is Upper Mississippian (late Chesterian) in region (Webster, 1969). Contact with underlying Indian Springs Formation is conformable and gradational. Forms stair-step ledges; only lower 300 to 500 m of formation exposed in quadrangle and probably includes mostly Pennsylvanian-age units equivalent to member PMb1 of the Bird Spring Formation as mapped by Lundstrom and others (1998) in the adjacent Valley quadrangle. Maximum thickness of the Bird Spring Formation in this part of the Las Vegas Range is estimated at 2,500 m (Lundstrom and others, 1998, Page and others, 2005).

Mis **Indian Springs Formation (Upper Mississippian)—**In order of decreasing abundance, consists of limestone, shale, and quartzite. Limestone is medium gray, grayish red, and moderate yellowish brown to grayish brown, fine to coarsely crystalline, and mostly thin bedded. Shale is dusky red, grayish red purple, grayish orange, and grayish black, and is mostly in the lower part of the formation. Quartzite is olive gray, light gray, and moderate brown;

composed of fine, subrounded, and moderately sorted quartz grains. Beds range from 0.5 to 1.0 m thick and show planar laminations. Fossils include *Rhipidomella nevadensis*, spiriferid and productid brachiopods, solitary rugose corals, pelmatozoan stems, and bryozoans; *Stigmaria* compressions present at the base of the formation. Formation is late Chesterian in age (Webster, 1969). Formation forms slope. About 60 m thick.

Mbw **Battleship Wash Formation (Upper Mississippian)—**Consists of limestone and minor quartzite. Limestone is arenaceous and bioclastic, medium dark gray to light olive gray, mostly coarsely crystalline, and thin bedded. Basal 1.5 m of formation consists of quartzite and sandy limestone. Quartzite is calcareous, medium light gray, and thin bedded. Fossils in formation include solitary rugose corals, pelmatozoan stems, and spiriferid brachiopods. Conodonts collected in the adjacent Gass Peak NE quadrangle, indicate that the formation is no older than late Meramecian and no younger than early Chesterian (Harris and others, 2005). The upper contact of the formation is usually covered, but where exposed, shale or quartzite units of the Indian Springs Formation overlie bioclastic limestone units of the Battleship Wash Formation; Webster (1969) interpreted the contact as disconformable on the basis of conspicuous lithologic and faunal changes between the two formations. Forms ledgy cliffs; about 20-40 m thick.

Monte Cristo Group (Upper and Lower Mississippian)—From top to base, subdivided into Yellowpine Limestone, Bullion Limestone, Anchor Limestone, and Dawn Limestone; series and stage designations are mostly from Harris and others (2005). Thickness of group is as much as 510 m.

Mmy **Yellowpine Limestone (lower Meramecian and upper Osagean)—**Medium-dark-gray to light-olive-gray, medium-crystalline, and mostly thick-bedded limestone; contains sparse nodules of medium-dark-gray and dusky-yellowish-brown chert. Formation distinct from other units of the Monte Cristo Group because it contains unusually-large solitary rugose corals (as much as 25 cm long). Also contains pelmatozoan stems, *syringopora*, and *Lithostrotionella* biostrome at top of unit; also contains middle to late Osagean conodont *Eotaphrus burlingtonensis* near base of unit in adjacent Valley quadrangle (Harris and others, 2005). Yellowpine forms massive cliffs; about 80 m thick.

Mmb **Bullion Dolomite (lower Meramecian to middle Osagean)—**Medium-dark-gray to medium-light-gray encrinitic limestone; finely to medium crystalline, and thick-bedded; contains discontinuous layers of dusky-yellowish-brown chert in beds 7-10 cm thick that have planar laminations and small-scale trough crossbeds. Fossils include abundant pelmatozoan stems, sparse brachiopods, and solitary corals. Conodonts collected in the adjacent Valley quadrangle are representative of the *anchoralislatus* Zone, indicating much of the formation is middle Osagean (Harris and others, 2005). The contact between Bullion and Yellowpine limestones is arbitrary, but it was mapped following Langenheim and others (1962) in the Arrow Canyon area. They placed the contact at the base of an interval of limestone beds that are darker gray, thinner bedded, and contains more solitary rugose corals as compared to underlying limestone beds of the Bullion. Bullion forms massive cliffs; about 100-180 m thick.

Mma **Anchor Limestone (Osagean)—**Alternating beds of thin-bedded limestone and chert. Limestone is medium dark gray to light olive gray and finely crystalline. Chert is medium gray to dark gray and dusky yellowish brown. Unit contains brachiopods, solitary and syringoporid corals, and pelmatozoan stems. Conodonts collected from formation in

adjacent Valley quadrangle (Harris and others, 2005) include elements from *G. typicus* Zone through *S. anchoralis-D. latus* Zone (early through middle Osagean). Formation forms ledgy slope; about 140-180 m thick.

Mmd **Dawn Limestone (lower Osagean and Kinderhookian)—**Limestone and some chert; limestone is dark gray to light olive gray, and aphanic to finely crystalline, and oolitic; chert is moderate-brown- to dusky-yellowish-brown and forms discontinuous layers and nodules. Abundant macrofossils consist of solitary rugose corals, *Lithostrotionella* corals, gastropods, brachiopods, bryozoans, and pelmatozoan stems. Conodonts collected in the adjacent Valley quadrangle indicate the formation is Kinderhookian to Osagean in age (Harris and others, 2005). Formation is disconformable with underlying unit. Forms ledgy cliffs; about 70 m thick.

MDu **Mississippian to Devonian rocks, undivided (Lower Mississippian and Upper Devonian)—** Mostly medium-dark-gray, finely crystalline limestone; thin to thick bedded. Limestone beds are sandy and some contain abundant ooids and gastropod fragments. Upper part locally contains thin beds of brown-weathering sandy limestone, and yellowish-gray to grayish-brown, burrowed, sandy dolostone. Conodonts collected in adjacent Valley quadrangle from the upper 40 m of unit are latest Devonian (Famennian) in age (Harris and others, 2005). Unit equivalent with Mississippian-Devonian Crystal Pass Limestone and upper part of Devonian Guilmette Formation. Although the upper part of unit occupies the stratigraphic position of Crystal Pass Limestone (which occurs below the Dawn Limestone and above the Guilmette Formation in the region), lithologic characteristics are atypical for the Crystal Pass, suggesting that (1) Crystal Pass Limestone is absent and the Dawn Limestone rests directly on the Guilmette Formation, or (2) Crystal Pass equivalent rocks are present and represent different facies (Page and others, 2005). Unit forms massive cliffs; about 160 to 180 m thick.

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