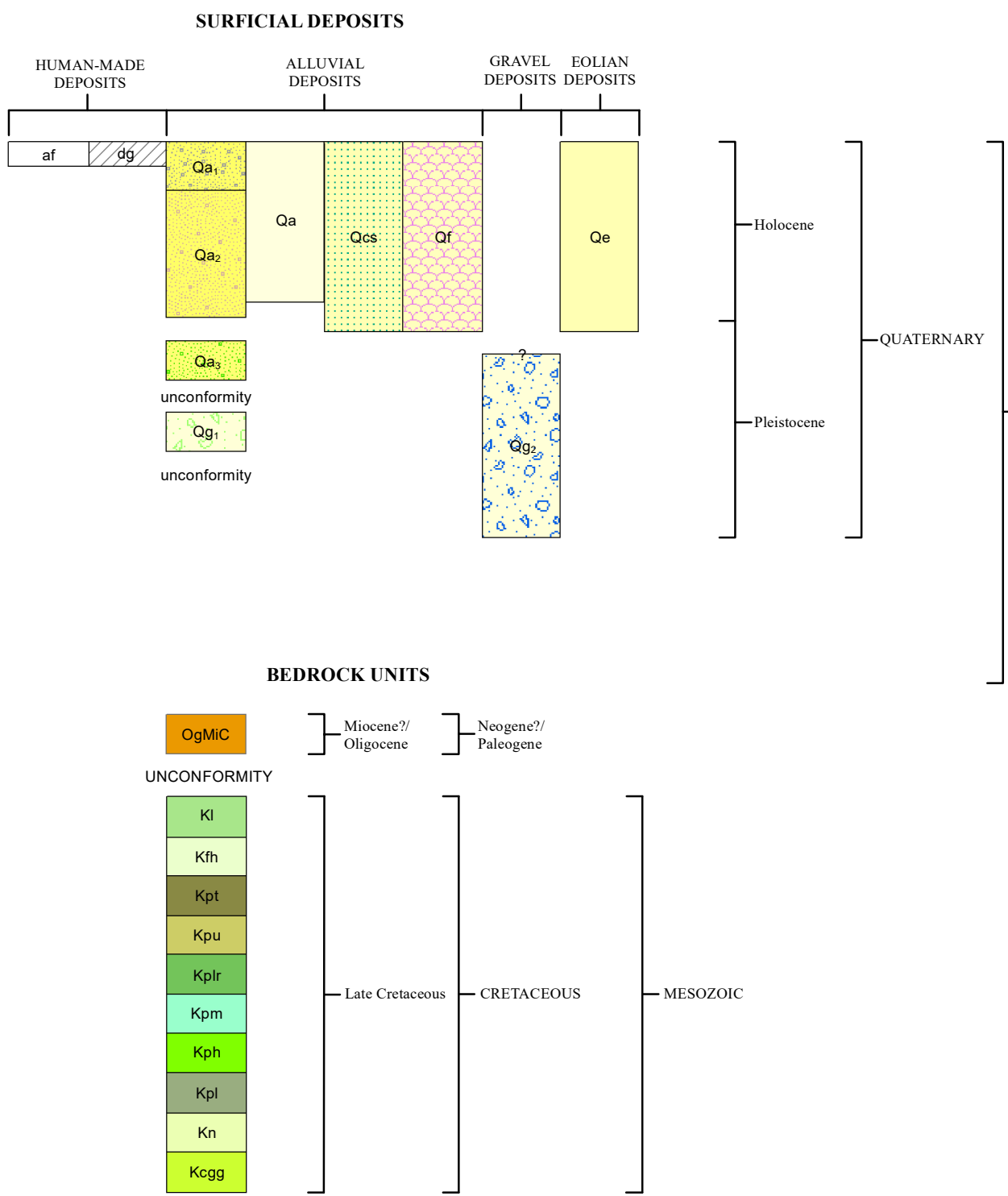
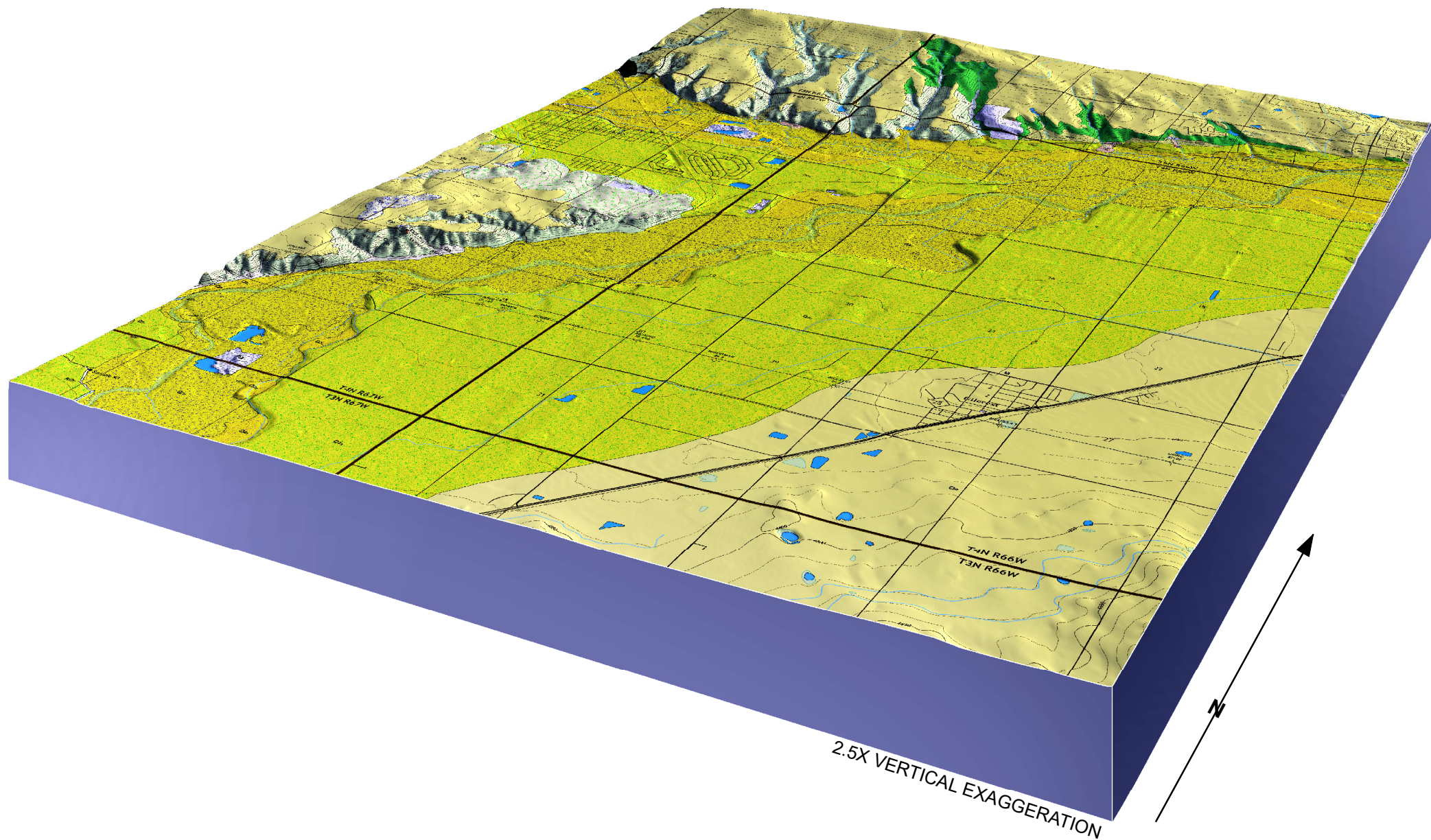


CORRELATION OF MAP UNITS



3-D OBLIQUE VIEW OF GEOLOGIC MAP



GEOLOGIC HISTORY

The Milliken quadrangle is in the northern Front Range urban corridor, located approximately 40 miles (64 km) north of metropolitan Denver and approximately 24 miles (39 km) southeast of Fort Collins. The area is located within the Colorado Piedmont physiographic province, an erosional area devoid of Neogene rocks that is bounded by the Front Range to the west and the High Plains to the east and north (Fenneman, 1931). Two regionally extensive unconformities may define the onset of piedmont deformation and uplift: a late Eocene unconformity concurrent with the end of the Laramide orogeny, and an early Miocene unconformity that separates the Ogallala Formation from older strata below (Leonard, 2002). Bedrock within the Milliken quadrangle consists of Upper Cretaceous (66-100 Ma) sedimentary rocks that were deposited during transgressive and regressive episodes of the Western Interior Seaway (WIS), a large epicritic sea that existed in the Late Cretaceous. The beginning of the Laramide orogeny at ~70 Ma (Weimer, 1996) is roughly coeval with the final regression of the WIS in Colorado. This final regressive pulse of the WIS defines the near-surface stratigraphy in the quadrangle and is comprised of the Pierre Shale, Niobrara Formation, and Fox Hills Sandstone. As the Laramide orogeny progressed, sediments eroded from the uplifting Rocky Mountains, filling the downwarped foreland basin to the east with detritus. This structural basin, known as the Denver Basin, is strongly asymmetric, with steeply dipping strata along its western flank and gently dipping strata along its eastern flank.

Bedrock exposures in the quadrangle are primarily limited to bluffs along the Big Thompson River and the South Platte River, as well as the gullies of intermittent streams that feed these systems during heavy rains. Extensive outcrops of Cretaceous-aged Fox Hills Sandstone (Kth) occur on the quadrangle, in significantly greater abundance than surrounding areas of the Eastern Plains. The Fox Hills Sandstone is a white to beige, massive, friable sandstone serving as a gradational member between the thick shales of the Pierre and the Laramie Formation. At Wildcat Mound in the southwest corner of the quadrangle, a small exposure of conglomerate exists that may be correlative with the Ogallala Formation found extensively on the High Plains to the east. In the subsurface, the Longmont Wrench fault zone (LWFZ) (Weimer, 1996) runs through the quadrangle. The LWFZ is covered by quaternary sediments in the area, and can only be seen on some geophysical logs. Many of the strata are important aquifers for communities along the Front Range in addition to being productive oil and gas reservoirs.

In the west-central part of the Milliken quadrangle, upper Pleistocene (126 ka-11.7 ka) gravel (Qg₁) underlies a terrace west of the confluence of the Big Thompson River and the South Platte River. Middle Pleistocene (781 ka-126 ka) gravel (Qg₂) caps a hill in the same area, coinciding with a northwest-southeast trending band of gravel deposit two (Qg₃) in the adjacent Johnstown quadrangle. Approximately 43 percent of the Milliken quadrangle is covered by eolian sediment (mainly loess and sand) deposited during the Late Pleistocene (126 ka-11.7 ka) and continued through the Holocene (<11.7 ka). During the Pinedale Glaciation (~30 ka-10 ka), strong northwesterly winds were responsible for the vast area of eolian deposition in the northern Front Range (Madole, 2016), and covered most of the Late and Middle Pleistocene alluvial gravels, leaving only the highest terraces exposed in the area. After widespread eolian deposition, incision of the windblown deposits and subsequent alluvial deposition (Qa₁, Qa₂, and Qa₃) by the Big Thompson River, the South Platte River and St. Vrain Creek began in the Late Pleistocene/early Holocene and has persisted through present time. In addition to sediment derived from crystalline rocks in the Front Range, alluvial deposits contain lesser amounts of detritus derived from sedimentary rocks in the Denver Basin, as well as reworked eolian sediment.

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ACKNOWLEDGEMENTS

The authors would like to thank the landowners of the Milliken region for their permission to access the necessary areas for the completion of this map. Specifically, we would like to thank Bret Hall of Lot Holding Investments, Jason VonLemke of United Water and Sanitation District, Dave Bernhardt of Bernhardt Farms, Jeff Hemphill of Sequel Energy Group, Glen Nishimoto of Xcel Energy, Carey Rinehager with the Town of Milliken, and Western Equipment and Truck Co. We would also like to thank Mark Schmitz and Marion Lytle of Boise State University for analyzing zircons; Adam Hudson of the USGS for performing U-Th age estimates of carbonate rinds; Shannon Mahon of the USGS for performing OSL age estimates; and Beta Analytic Inc. for performing radiocarbon dating. We are extremely grateful to Caitlin Bernier of Pangaea Geospatial for performing the digital cartography and map production, and to Steve Keller for thoughtful discussion on the geology of the Milliken area. This publication benefitted greatly from the review of Rich Madole and Karen Berry.

GEOLOGIC MAP OF THE MILLIKEN QUADRANGLE, WELD COUNTY, COLORADO
CORRELATION OF MAP UNITS, 3-D OBLIQUE VIEW, GEOLOGIC HISTORY, AND CROSS SECTION

By Martin Palkovic, Kassandra O. Lindsey, and Matthew L. Morgan
2018