Synthesizing surface geophysical investigations to EVALUATE SUBSURFACE, HYDROGEOLOGY, STRUCTURE, AND GROUNDWATER movement at Edwards Air Force Base, California

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The bedrock and alluvial aquifer system in the Air Force Research Laboratory (AFRL) area of Edwards Air Force Base (EAFB) in the Mojave Desert of California is geologically complex with structures and stratigraphy affecting groundwater flow. To understand how this complex geology affects groundwater flow and movement of contaminants, a three-dimensional hydrogeologic framework model (HFM) of the northern part of the AFRL was created. Interpretations of regional and local surface geophysical data constituted most of the input data for the HFM. Specifically, between 2015 and 2022, surface geophysical investigations using five surface geophysical methods were conducted by the U.S. Geological Survey at the AFRL. The five methods included (1) relative gravity measurements, (2) electrical resistivity tomography surveys, (3) time-domain electromagnetic surveys, (4) horizontal-to-vertical spectral ratio surveys, and (5) a seismic imaging survey. Relative gravity measurements were used to estimate the depth-to-bedrock in the region and derive the top of bedrock unit, which represents the contact between the bedrock and alluvium hydrogeologic units. Electrical resistivity tomography surveys, time-domain electromagnetic surveys, horizontal-to-vertical spectral ratio surveys, and a seismic imaging survey were then used to locally evaluate the top of the bedrock. These local evaluations refined the geometry and depth of the top of the bedrock unit, and along with borehole lithology information, provided evidence for the presence of a zone of weathered bedrock above the bedrock unit, which could influence groundwater movement. The surface geophysical data were also used in conjunction with groundwater-level data to identify and define the geometry and extent of several previously unmapped faults and potential barriers or conduits to groundwater flow and transport. The resulting HFM has two-layers, alluvium, which includes the zone of weathered bedrock, and bedrock, and quantifies the geometry of the contact between the units and the geometry and extent of subsurface structures and faults. The HFM and the underlying surface geophysical data can be used to evaluate groundwater movement in the AFRL and provide tools that stakeholders could use for groundwater remediation.