Role of Sequence Stratigraphy for Evaluating Topographic Pathways Impacting Distribution of PFAS

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Background/Objectives. It is well established that surface water collection points accumulate released PFAS; however, the configuration of geologic depressions and their downgradient subsurface pathways are seldom understood or characterized. Further complicating geologic pathways is over pumping of aquifers resulting in subsidence, changes in topography, and in some cases earth fissures. Characterization of geology by depositional processes and facies analysis within a sequence stratigraphic framework can determine the interaction between surface water infiltration points and subsurface hydrogeologic pathway heterogeneity. The objective of this work was to show the benefit of using sequence stratigraphy to address PFAS contamination pathways through surface water and groundwater with case studies from two Air Force installations, Luke and Davis-Monthan.

Approach/Activities. Site characterization was completed by reviewing and interpreting existing regional publications, site data (i.e., topographic maps, boring logs, geophysical logs) and developing a sequence stratigraphic framework. The practice of sequence stratigraphy is well-established in the shallow marine setting; however, the application of its core principles (i.e., interplay between sedimentation rate and space available for deposition) and facies analysis can be utilized in all sedimentary environments to predict lateral and vertical geologic heterogeneities. This approach assisted in identifying natural changes within hydrogeologic pathways and location of earth fissures induced by a declining aquifer.

Results/Lessons Learned. The sequence stratigraphic analysis of the sites provided focus areas where PFAS was collecting at the surface and infiltrating and migrating within the subsurface. At Davis-Monthan Air Force Base, PFAS-impacted surface waters within ditches delivered relatively little impacted groundwater to the subsurface until reaching a source-distant unlined retention pond. Ephemeral surface waters drove the constituents vertically through the vadose zone to the groundwater table where a stratigraphic analysis showed that migration was focused within a single alluvial fan lobe. This review offered the client a targeted area of remediation for surficial soils and groundwater. At Luke Air Force Base, PFAS-impacted ditches were intersected by earth fissures caused by aquifer settling from the declining groundwater table. The stratigraphic review of the site identified the location of the compacting aquifer adjacent to a stationary salt body resulting in earth fissures. The earth fissures delivered impacted surface waters to alluvial fan deposits whose deposit orientation and locations were defined by the stratigraphic analysis. This review identified the surface water to subsurface transition of the constituents and informed the client of which surface and subsurface hydrogeologic pathways were impacted from that infiltration location.