

# Subsurface Depositional Environment of Ellsworth Air Force Base (AFB), South Dakota, and Its Role in Bioremediation Strategy

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**Background/Objectives.** Adequate understanding of subsurface stratigraphy within a robust hydrogeological framework is essential for determining contamination flow paths and supporting bioremediation strategy. Placement of in situ reductive treatment (IRT) walls at Ellsworth Air Force Base (AFB) based on a previous conceptual site model (CSM) was only partially successful in bioremediation of TCE plumes. This is because the assumptions made in understanding the plume shapes relied on a traditional lithostratigraphic approach that did not adequately account for the internal heterogeneity of the aquifer. This study offers a revised approach of stratigraphic interpretation based on modern techniques of facies analysis appropriate for the depositional environment to update the CSM for a more optimized placement of the IRT walls.

**Approach/Activities.** This analysis focuses on vertical and lateral trends in depositional environments at the site in a regional context, and evaluates the resulting facies changes through several detailed stratigraphic cross-sections. The principal sources of information used to recognize facies changes and geometries of the depositional units are detailed borehole lithology data. In parallel, a hydrogeological study was conducted, which divided the site into several hydrogeological basins. The stratigraphy of the site was integrated with this hydrogeological understanding to determine the true geometry of the transmissive units that control plume migration at the site.

**Results/Lessons Learned.** Ellsworth AFB is situated on the Sturgis Terrace developed during the Pleistocene in response to progressive regional base-level fall. Fluvial channel belts of the Sturgis time are represented as braided bars predominantly oriented from the northwest towards the southeast along hydrogeological boundaries, rather than from the west to the east as suggested by the previous CSM. These channel bars, interspersed by ancient floodplain deposits, are the predominant transmissive units at the site. The Cretaceous Pierre Shale is a continuous low-permeability unit, that serves as the confining bedrock of the braided channel sands, and also crops out locally between the channel belts. This better understanding of the subsurface stratigraphy at Ellsworth AFB provides a new opportunity to reevaluate the present configurations of the IRT walls and strategize for their more optimal placement.