Modeling of Arsenic Transport in Groundwater at Sunland Park, NM

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Abstract: This project investigated the transport of dissolved arsenic (As) in groundwater at a 10 hectare riparian rehabilitation site on the border of city of El Paso, Texas and Sunland Park, New Mexico near the Rio Grande (river). A finite element subsurface flow software designed to simulate groundwater flow and contaminant transport known as FEFLOW was used to model the As transport. The model results show As leaching from natural alluvial deposits is moving slowly towards an adjacent drainage canal and the Rio Grande.

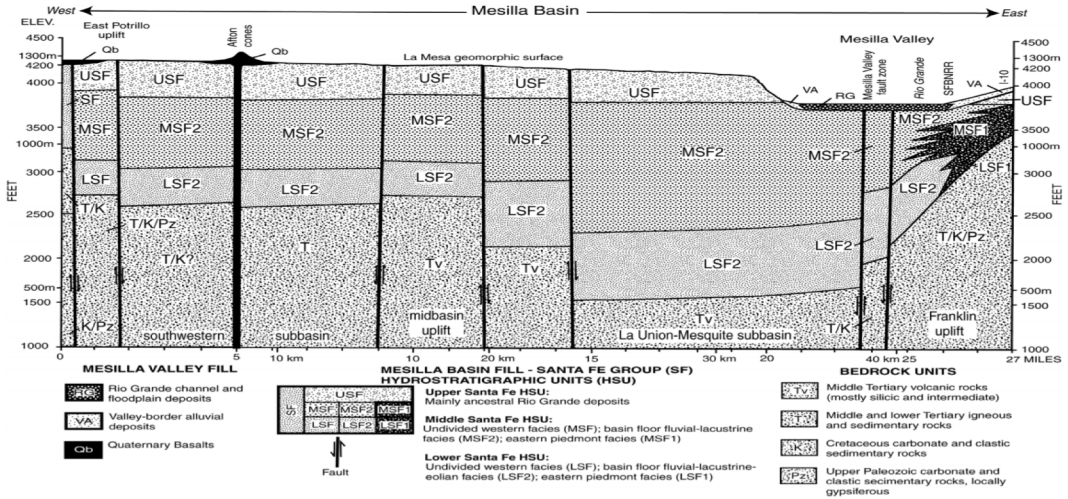

Figure 1: Stratigraphy of the Mesilla Valley Basin

Aquifer Characteristics: The Sunland Park aquifer is a part of the Mesilla Basin aquifer which is primarily composed of younger valley fill deposits from the Rio Grande. The aquifer consists of unconsolidated deposits of gravel, sand, silt, and clay. The Sunland Park aquifer is shallow and unconfined, It is tapering towards Rio Grande river.

Figure 2: Map showing Sunland Park Research Test-Bed

About the Test Site: The quality of groundwater tested at the study site from 9 shallow observation piezometers varied considerably. Salinity of groundwater varied from less than 1 ppt to 18.20 ppt with pH ranging from 6.6 to 9, and the As ranged from 4.6 micro-g/l to 423 micro-g/l. The Test-Bed site has some vegetation and receives about 203-229 mm/yr of precipitation.

Methods: The data needed for flow model application included physical parameters such as hydraulic conductivity, aquifer thickness, and recharge. Topographic maps, hydrogeological formations, and maps with observation wells were also collected. The area of the site was delineated using ArcMAP®. The model mesh was generated using the grid builder mesh-generation algorithm, with 2500 nodes and 1595 elements. The model boundary condition on the western side used a head contour line of 1141 m, the southern and eastern side used the first kind (Dirichlet) hydraulic head boundary conditions of 1139.9 m and 1139.89 m, respectively. The model was calibrated by adjusting the hydraulic conductivities. For more quantitative estimation of arsenic transport, the developed flow model was extended to the transport model.

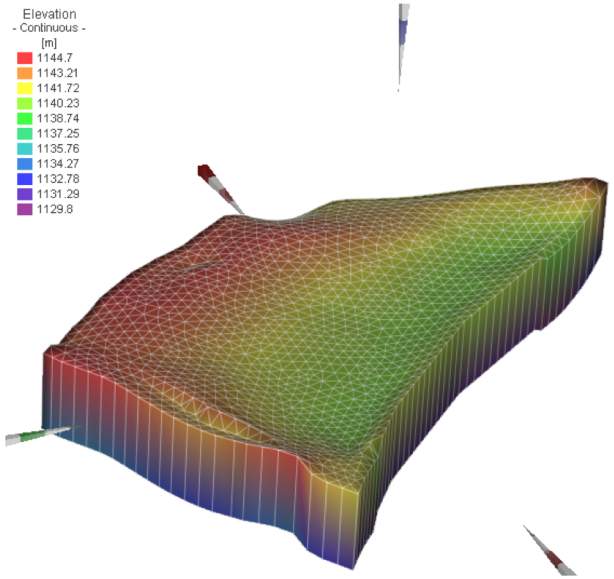

Figure 3. Elevation model by FEFLOW

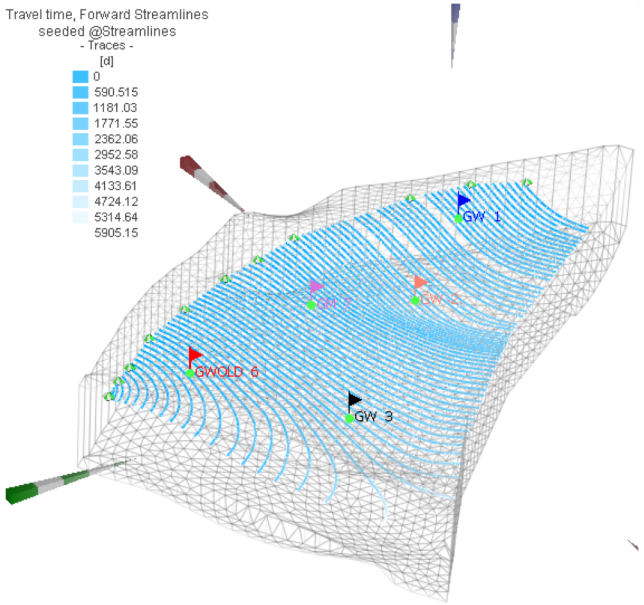

Figure 4. Flow streamlines simulated by FEFLOW

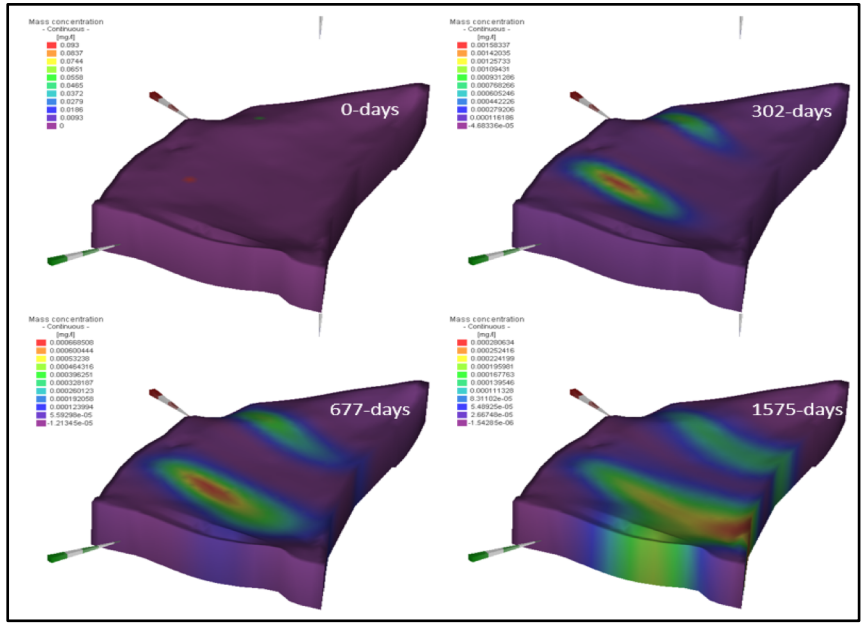

Figure 5. Simulated arsenic transport at Sunland Park, NM ReNUWIt Test-Bed

Results: The groundwater flow simulated by the FEFLOW is shown in **Figure 4**. Flow is moving towards the drainage canal and towards the Rio Grande. Similarly, the model show As leaching from natural alluvial deposits is moving slowly towards drainage canal and the Rio Grande (**Figure 5**).

Conclusion and Recommendation: Arsenic transport at ReNUWIT Sunland Park Test-Bed was simulated using FEFLOW to better understand the direction and concentration of As leaching through the soil for riparian vegetation rehabilitation purposes. The study concludes that As is moving towards the drainage canal and Rio Grande. Arsenic adsorption by metal oxides was not considered in this modeling efforts and a further study is needed.