A Seep Origin Story: Using Electrical Hydrogeology to Find Mysterious Deep LNAPL Source

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Background/Objectives. A refinery site utilized LNAPL saturated filter clay as fill material to generate additional land area adjacent to a waterway. After establishing the new coastline for the site, LNAPL seeps began to discharge, requiring remedial action. The fine-grained material was underlain by potentially coarse paleochannel materials and bedrock. Shallow and deep borings, direct imaging tools, and transport modeling efforts were undertaken to develop a conceptual site model (CSM). Thirty plus years of drilling, sampling, monitoring, and modeling of the site did not locate the source of or mitigate the seeps. Electrical hydrogeology integrating imaging with targeted, confirmation borings was utilized to better characterize the distribution of LNAPL and the mechanism(s) enabling the seeps.

Approach/Activities. Electrical imaging was performed in the waterway (aquatic surveys) and in the upland areas (surface surveys) to evaluate the electrical structure of the subsurface. Electrical imagery indicated that discrete permeable channels beneath the filter clay layer, transitioning to vertical flowpaths at the coast, were responsible for the seeps. Based on targets selected from the electrical images, deep sonic borings were advanced to 21 m (70 ft) below ground surface in the upland areas suspected to represent preferential flowpaths.

Results/Lessons Learned. The targeted borings were located within 10 m (30 ft) of historical sampling locations and yielded discrete channel deposits with up to 3 m (10 ft) of LNAPL at a depth of 10 m (30 ft) below the groundwater table. This process provided a robust, data dense CSM which confirmed horizontal LNAPL transport from upland refinery zones, followed by vertical upwelling at the coast to the seep areas. The scan-first-then-drill approach located the elusive, deeper source of the seeps, providing discrete target zones for more cost-effective remediation of the long-term seep issue for the site.