Sustainable Thermally Enhanced LNAPL Attenuation

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Abstract. Extensive bodies of light non-aqueous phase liquids (LNAPLs) are commonly found beneath large petroleum facilities. The potential for lateral spreading of LNAPL bodies is a common concern. Recent studies have shown that natural losses of LNAPL can be on the order of thousands of gallons per acre per year. Ongoing researches at Colorado State University (CSU) have shown that temperature is a primary factor controlling rates of natural losses. Results of lab and field experiments at CSU suggest that systems close to 20ºC can have loss rates that are an order of magnitude greater than systems at temperatures less than 18ºC. The vision that has emerged from recent work is that passive thermal management strategies could enhance natural losses of LNAPL and significantly reduce the longevity of LNAPL. Owing to this new understanding, preliminary plans were developed for a small-scale demonstration of Sustainable Thermally Enhanced LNAPL Attenuation (STELA) at Chevron's former refinery near Casper, Wyoming. The overarching objective of the STELA initiative is to develop a new technology for LNAPLs that is more effective, faster, more sustainable, and/or lower cost than current options. Specific objectives for the Casper field demonstration include collecting data needed to evaluate cost and performance, advance our understanding of processes governing natural losses of LNAPL, and provide a basis for evaluating STELA as a remedy at field sites. To achieve this purposes ten heater wells, including submersible heat trace wire wrapped around 7.6 cm ID PVC pipe, have been installed at the up gradient of a 10m by 10m target to deliver heat to sustain the warm season at the subsurface. Moreover, by coupling MT3DMS with MODFLOW, a heat transfer model has been developed and calibrated with the field data to model concurrent advective and conductive heat transport. The results of STELA have shown that by using 2000W of energy, subsurface temperature could be rise up to 8 ºC in the cold season, and heat could be transferred near 10m at the subsurface. The field data from the pilot were in consistent with the output of the heat transfer model.

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