Innovative In-Situ Remediation Approach to Treat PFAS-Impacted Groundwater (Pilot Scale Design and Implementation)

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Aqueous film forming foam (AFFF), utilized for suppressing fires involving petroleum-based products, has been stored, spilled, and used at various military and civilian airports across the country for decades. Our site is a Canadian Forces Base in Ontario, where AFFF was identified as the main source of per-and polyfluoroalkyl substances (PFAS) contamination in soil, groundwater, surface water and sediment. Due to proximity of the site to a significant water body (hydraulically downgradient of identified impacts), there may be a potential risk of adverse effects to human and the aquatic receptors, therefore an effective remediation approach is required to prevent PFAS-impacted groundwater from discharging to surface water.

There are currently few technically and/or economically feasible remedial options for PFAS-impacted groundwater. Most current active remediation systems for PFAS utilize "pump and treatment", an ex-situ technology. Although pump and treatment systems can be effective in some applications, most require laborious long-term, and perhaps perpetual, operation and maintenance, and they can result in non-uniform remediation. Injection of treatment materials (in a slurry form) is a more-recently developed in-situ remediation technology for PFAS, but the materials only stabilize the PFAS in the injection zone; the PFAS are not removed from the environment. The longevity of these media to stabilize PFAS is uncertain, and if media eventually desorb the PFAS, a secondary contaminant source will arise.

Given the above constraints with current remediation technologies, an innovative pilot scale in-situ remediation technique was developed for the site consisting of an in-situ treatment train (ISTT) in the form of a "funnel and gate" permeable reactive barrier (PRB). The impermeable concrete cut-off funnel walls direct impacted groundwater toward the ISTT-PRB's high permeability treatment gate in a rather conventional approach. However, for the pilot system, the gate structure was constructed with three separate chambers running simultaneously in parallel, and each chamber contains two reactive cells running simultaneously in series. Each lead cell contains modified clay and each lag cell contains bituminous granular activated carbon, thus creating treatment trains. The use of multiple types of media enables a wider range of PFAS to be captured than any single media. The lead and lag treatment cells each contain different but specific mixtures of media/sand, and each are monitored separately to enable assessment of the effectiveness of the different concentrations of media to treat the groundwater. The system was designed to permit removal and replacement of the media as they become exhausted, thus physically removing PFAS mass from the site and prolonging the life of the ISTT-PRB.

The pilot scale system's design was completed in summer 2021 and was constructed at the site during the winter of 2022. Monitoring of the system is ongoing and is expected to continue for a year in a quarterly basis. This presentation will highlight the advantages of this remediation approach and the challenges encountered during the construction. Lessons learned from the construction within a hot spot of a PFAS-impacted soil and groundwater will be presented.

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Mr. Matt Pourabadehei, Ph.D., P.Eng. is a senior environmental engineer and project manager with more than eleven years of experience in the assessment and remediation of contaminated sites. His areas of expertise are in phased environmental site assessments, remedial option analysis, and remediation of impacted soil and groundwater. Dr. Pourabadehei is a PFAS technical expert with SNC-Lavalin and has worked on site assessment and remediation projects for PFAS impacted sites in several federally owned locations in Ontario, Yukon, and British Colombia.