



Why Target PFAS Source Zones?

PFAS Source

Aqueous Film Forming Foams (AFFF) are a known source of PFAS contamination of soils¹ and groundwater, particularly associated with fire training facilities, fire suppression installations, or on actual fire incident response locations.

Discharge to the ground

Losses of AFFF to the ground can be the result of training, incident response or spillage. The discharge may consist of a variety of PFAS compounds and be localised or widespread on the site surface. Sites impacted by AFFF discharges include airports, military bases, chemical manufacturing facilities, refineries and bulk storage facilities.

Vertical migration

Once discharged to the surface, PFAS will move downward through the soil column by dissolution into infiltrating precipitation (rainfall). During transport PFAS will bind to the soils and typically, a significant portion of the PFAS mass will be found near the surface at the discharge location^{1,2}. However, further vertical migration is driven by continued mass influx from above, combined with dissolution or 'leaching' of the sorbed contamination back into the infiltrating water. The migration may be very gradual and rates will vary considerably based upon PFAS type, soil characteristics and amount of precipitation^{1,2}. Over time, downward migration will result in discharge to the groundwater.

1. **M. Brusseau et al.** "PFAS concentrations in soils: Background levels versus contaminated sites" *Science of the Total Environment* 740 (2020): 140017 <https://doi.org/10.1016/j.scitotenv.2020.140017>

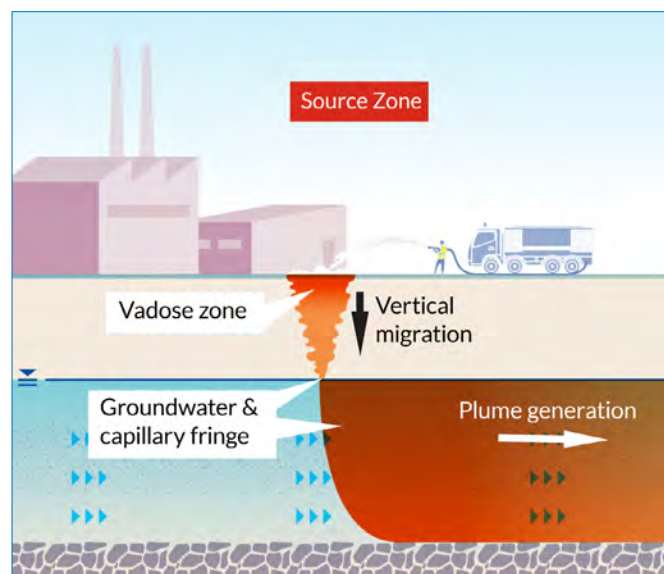
2. **B. Guo et al.** "A screening model for quantifying PFAS leaching in the vadose zone and mass discharge to groundwater" *Advances in Water Resources* 160 (2022): 104102 <https://doi.org/10.1016/j.advwatres.2021.104102>

PFAS Source Area: Vadose Zone

High residual concentrations of PFAS in vadose zone soils can be mainly attributed to air-water interface accumulation and soil sorption. Due to their surfactant nature, PFAS tend to accumulate at air-water interfaces. As PFAS become concentrated, they can further form hemi-micelles and micelles at air-water and/or air-soil interfaces. PFAS interactions with soil are complex, and can take place via electrostatic, hydrophobic, and other surface interactions³. Multiple soil properties, including soil organic carbon, ion exchange capacity, and surface charge can influence PFAS retention on soil particles. Given the complexity of PFAS transport in vadose zones the development of site-specific in-situ soil treatments is best.

PFAS source area: Capillary fringe and groundwater

When the PFAS enters the capillary fringe accumulation again occurs at the air water interfaces due to the surface-activated nature of the PFAS molecules. Continued vertical influx and accumulation drives dissolution into the groundwater creating high concentrations of dissolved phase PFAS close to the discharge point.



3. Sharifan, Hamidreza, et al. "Fate and transport of per- and polyfluoroalkyl substances (PFASs) in the vadose zone." *Science of The Total Environment* 771 (2021): 145427

Long-term contaminant sources

Accumulation of PFAS in the soil creates significant reservoirs of contaminant mass. Continued or seasonal vertical movement of PFAS creates the ongoing potential of discharge to the groundwater, causing the development and expansion of contaminant plumes.

These plumes represent a risk to downgradient environmental and human receptors such as potable drinking water wells, surface water bodies and the aquifer itself. These risks generate potentially significant liabilities for the landowners on which the source areas are located.

The mobility of PFAS compounds, combined with the toxicity of longer chain compounds means that these source areas can create and maintain widespread environmental risk for many decades, long after discharge events have occurred ^{1,2}.

In Situ Source Treatment

The PFAS source-plume system can be treated through a targeted application in the source zone. This would comprise mixing in a site-specific blend of amendments including activated carbon, permeability modifiers and SourceStop. The result is a prevention of leaching from- and infiltration through the soils, coupled with sorption and retardation of PFAS within the groundwater. This dramatically reduces the contaminant influx feeding the plume, providing enhanced attenuation of the contamination.

This is in line with ITRC guidance:

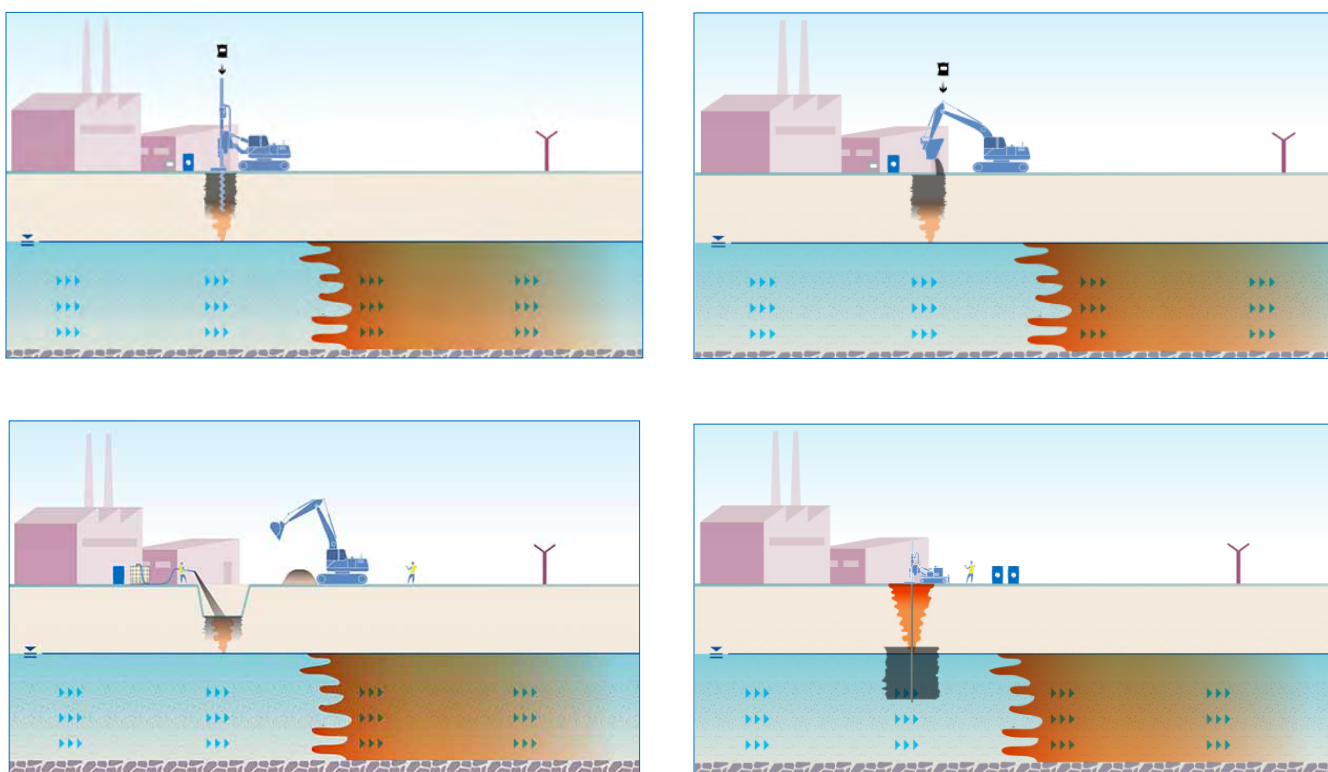
“Enhanced Attenuation is any type of intervention that might be implemented in a source-plume system to increase the magnitude of attenuation by natural processes beyond that which occurs without intervention. Enhanced attenuation is the result of applying an enhancement that sustainably manipulates a natural attenuation process, leading to an increased reduction in mass flux of contaminants.”⁴

4. Interstate Technology & Regulatory Council (ITRC). Enhanced Attenuation: Chlorinated Organics (EACO). www.itrcweb.org. Published online 2008.

The treatment thereby reduces or removes the risk to downgradient receptors. This matches the ITRC definition of remediation:

“the process used to reduce or eliminate the risk for humans and the environment that may result from exposure to harmful chemicals.”⁵

Source treatment can be completed using a range of methods dependent on the site requirements and can be used alone or coupled with in situ injectable barriers if immediate downgradient protection is required.



For more information, please visit <https://regenesisc.com/eur/pfas-source-treatment/>

5. Interstate Technology and Regulatory Council (ITRC). PFAS Remediation.; 2020. Accessed October 29, 2021. <https://www.youtube.com/watch?v=2OEeJ9qR9nA>