Why More Investigation Is Needed West of the MEW Plume
An Introduction to Groundwater and its Contamination Pathways

Center for Public Environmental Oversight

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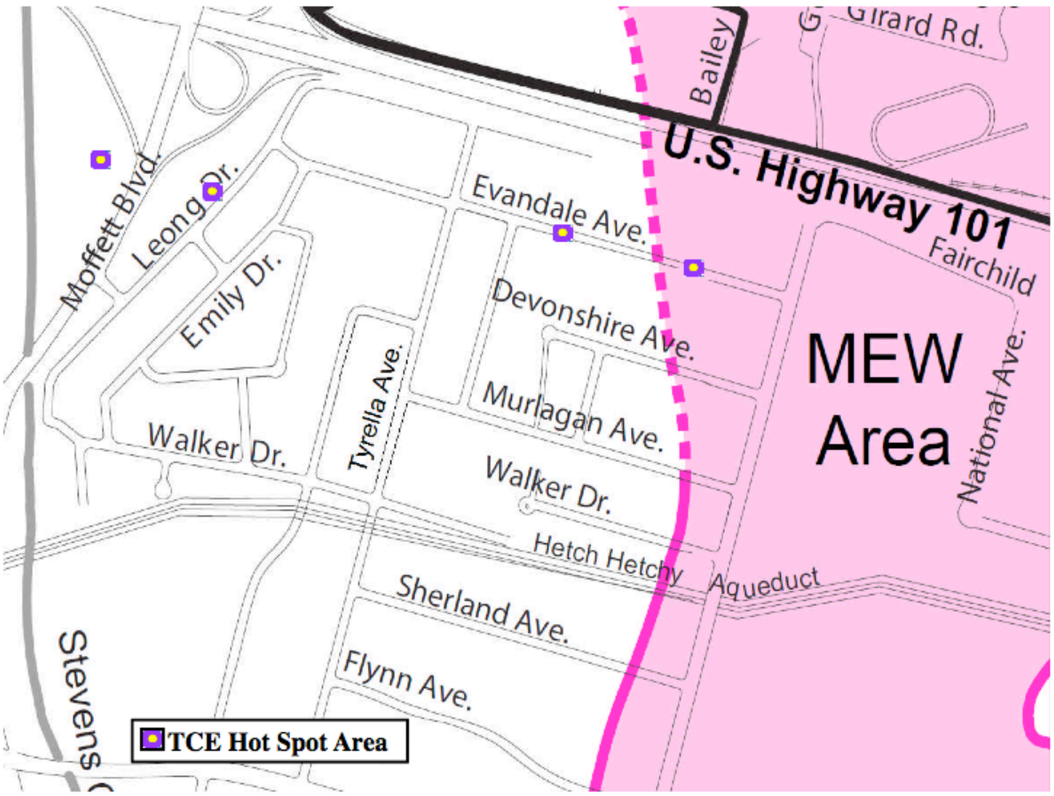
U.S. EPA is conducting an investigation to determine if trichloroethylene (TCE) hotspots west of the MEW Superfund plume were caused by the migration of contamination through sewer lines or other preferential pathways. CPEO believes that similar pathways might have spread contamination elsewhere in the neighborhood, and we have asked EPA to evaluate that possibility. To help our neighbors understand the complex ways groundwater contamination moves, we offer this introductory fact sheet.



The four known TCE hotspots along a sewer line emanating from the MEW Area

The subsurface is made up of multiple levels of different types of soil, such as sand, silt, clay, bedrock, and fractured bedrock. The more permeable soils, such as sand and silt, often contain water. This is what one finds when one drills a well. In this area, there are multiple levels of groundwater, called aquifers, separated by less permeable layers (such as clay) called aquitards. The soil above the water table (the topmost extent of groundwater) is called the vadose zone.

When liquid chlorinated solvents such as TCE were released from leaking underground storage tanks, pipes, and other sources, they descended into the ground, though if exposed to air a portion volatilized (evaporated) and spread into the indoor or outdoor air. Some of the contamination attached, or sorbed, to soil in the vadose zone, and the rest descended into the groundwater. Some of it dissolved into the groundwater, but more of it mixed without dissolving. Because TCE is denser (heavier) than water, it tends to sink to the bottom of an aquifer. Some of the TCE found a pathway (such as a sandy gap in the clay) through the aquitard underlying the shallow aquifer and contaminated one or more aquifers below.

Some of the TCE has degraded into other compounds, but in the absence of human intervention (such as the injection of chemicals to promote biodegredation or chemical transformation), that process is very slow.

Mountain View gets most of its municipal water supply from the Hetch-Hetchy Aqueduct, which originates in Yosemite, but a fraction comes from local groundwater wells. Because the upper aquifers in northern Mountain View are close to the San Francisco Bay, they are subject to saltwater intrusion if there is extensive pumping. For that reason, Mountain View's wells extract water from a deeper aquifer. Contamination has reached Mountain View groundwater aquifer, "downhill" (downgradient) from municipal extraction wells, in only two known instances, through old agricultural wells. In the 1980s those wells were sealed, and the contamination was pumped out of the deep aquifer.

Groundwater tends to flow slowly underground. In Mountain View the rate is somewhere around 200 feet per year in the upper aquifers. It moves downgradient underground, in a direction generally parallel to surface contours. However, there are subsurface paleochannels, the sandy remnants of ancient streams, which sometimes meander and allow groundwater to move in unexpected directions for short distances.

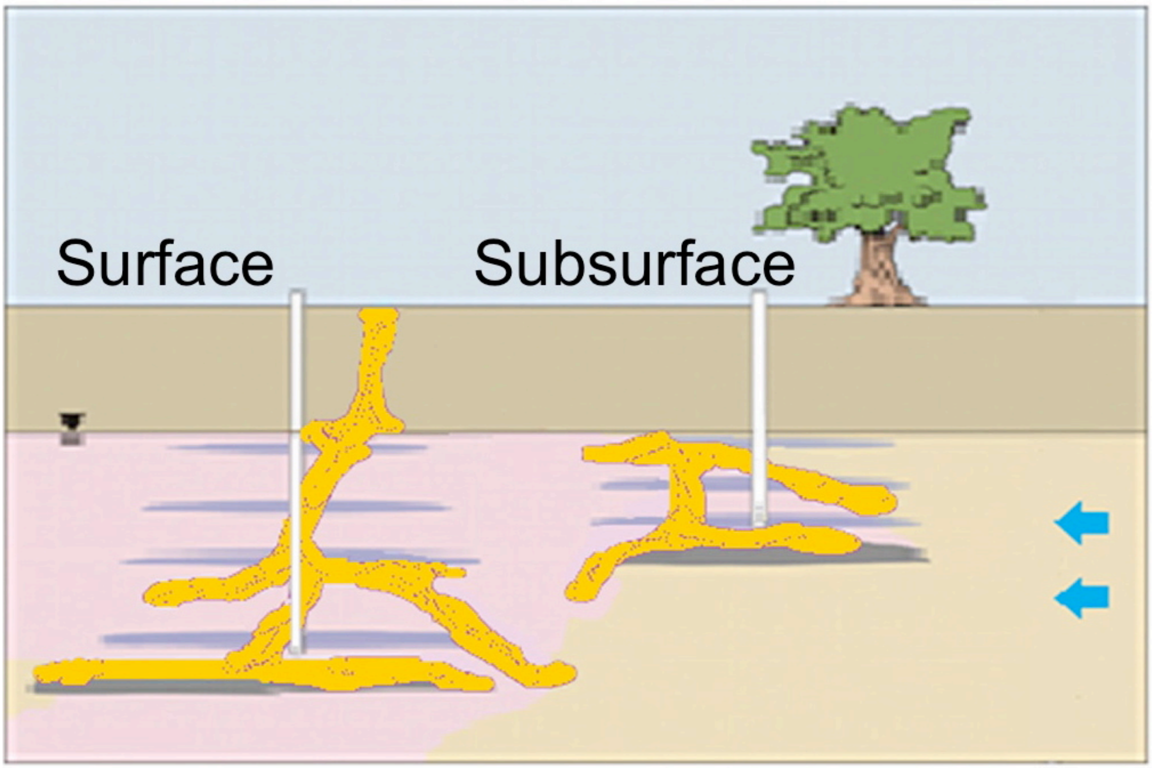
TCE and its degradation products tend to move with the groundwater. In a process called advection, moving groundwater picks up particles of the chemical. Very little moves sideways. Some contamination remains below the source, while other contamination moves downgradient, forming an oblong shape normally called a plume. The Regional Plume for the MEW Study Area and Moffett Field is actually the commingling of plumes from many sources, all flowing in the same general direction: toward the Bay.

A fraction of the TCE in the shallow aquifer volatilizes, forming TCE soil gas. That is, it releases vapors into the vadose zone. This happens most when the water table moves up and down due to intermittent rains. Where the vapor pressure at the surface—such as in a building—is lower than the vapor pressure in the soil, the TCE gas migrates toward the surface. Where there is a pathway into a building, such as a hole, crack, or even a permeable slab of concrete, vapor intrusion occurs. Thus, it is possible for TCE to be released in one location, descend into groundwater, move with the groundwater, and rise into buildings at a new location decades later.

Groundwater extraction and treatment (pump-and treat) systems are designed not only to remove contamination from the groundwater, but also to reduce its movement. Once the full-scale Regional Plume pump-and-treat systems began operation in 1998, relatively little horizontal migration continued.

So most people were somewhat surprised when, in the last several years, four TCE hotspots, with high levels of TCE in groundwater, were found west of the Regional Plume. *That is, the normal migration of groundwater contamination from known source areas, as explained above, did not explain the location of those hotspots.*

Low TCE levels between the Regional Plume and the hotspots suggests that they are separate, and the absence of soil contamination above the hotspots indicates that they are not in source areas. EPA and the City of Mountain View have been investigating these hotspots, and it appears that the source of all four is a horizontal preferential pathway. Such pathways may include storm drains, steam tunnels (such as at Moffett Field), or even paleochannels, but the most likely explanation is a release through city's sanitary sewer lines.



EPA diagram showing the difference between contamination released at the surface and contamination from a subsurface pathway. The vertical bars represent monitoring wells.

Decades ago it was common for Silicon Valley industries to dump TCE, acids, and other chemicals down the drain into the wastewater lines that generally traverse under our streets. Some of those chemicals found or even created holes and released contamination at low points in the sewer lines, forming localized hotspots—that is, the greatest contamination was confined to very small areas laterally. In some of those localized areas, groundwater movement was minimal, and the hotspots remained.

Since four major hotspots are found along Evandale Avenue and Leong Drive, where sewer lines emanate from the historic MEW industrial area, the sewer-line preferential-pathway hypothesis seems like a good explanation of those hotspots. However, additional investigation into the timing of sewer-line operation, historic wastewater flows, and measurements of contamination at various depths has been necessary to evaluate this hypothesis, and EPA has not yet concluded its investigation.

Though the hotspots are small, TCE in soil gas can easily move 100 feet laterally underground before rising to the surface. Thus, these hotspots represent a potential for vapor intrusion away from the Regional Plume.

There is another hotspot in the neighborhood, the Silva Well between Sherland Avenue and the Hetch-Hetchy Aqueduct right-of-way. When it was discovered in the early 1980s, the MEW companies pumped out the contamination and released it into the sanitary sewers. We believe the Silva Well contamination may have been caused by leaks in other sewer lines coming from the MEW area, and we are concerned that there may be other unidentified hotspots in the neighborhood.

We therefore call upon EPA to evaluate the potential for other TCE releases in the Whisman neighborhood from sewer lines and storm drains emanating from the MEW Area. Additional groundwater sampling may be necessary to determine whether more TCE is under or near homes and whether additional residents, previously believed safe because of their distance from known groundwater plumes, are potentially at risk from vapor intrusion.

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