Abstract

Evaluating Vapor Intrusion at a Bay Area School

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Due to the presence of a sensitive receptor population, schools are of particular concern for indoor air quality. This investigation focuses on a bay area school that lies within a groundwater plume of volatile organic compounds (VOCs). The school occupies a series of twelve buildings, from which over 80 indoor air samples have been collected. This paper presents a comparison of the observed indoor air concentrations across the site and an evaluation of the differences caused by building design, ventilation, and occupational use.

At the start of the investigation, a series of soil-gas samples were collected at the site to identify target buildings for indoor air monitoring. Although several areas of the site were screened out due to low or nondetectable soil-gas concentrations, the soil-gas concentrations near the school buildings indicated the potential for vapor intrusion. Therefore, the work plan was initiated to directly monitor the indoor air in the school buildings.

Sampling activities were coordinated with the schools, and over a period of a few months, samples were collected from each of the twelve buildings during summer and winter seasons. Concurrently, samples were also collected from outdoor locations at the site and at selected offsite locations to evaluate background conditions. All samples were analyzed using EPA Method TO-15 selective ion mode for eleven compounds found in the groundwater at the site.

Considering that most of the buildings are similar in design, and overlay similar groundwater concentrations, the indoor air concentrations show a surprising amount of variability across the site. By comparing the building characteristics and the indoor air concentrations, the influence of certain factors can be evaluated. An inspection of the building ventilation systems was conducted for each building, and a survey of occupational chemical use was also conducted. Using this information, certain cause and effect relationships become evident.

In one building, a recent remodeling effort appeared to have a significant impact on the indoor air quality. The remodeling activities included removing certain walls and installing new carpet in some areas of the building. To quantify the effect of the remodeling activities, a second round of air monitoring was conducted several weeks after the remodeling was completed. The results of the second round were over 400 times lower than the previous round. Due to the absence of any other significant differences between the sampling events, this change in concentration was attributed to the remodeling activities.

For another building with elevated indoor concentrations, the identical approach was taken, but the conclusion differed. A second round of sampling was conducted to determine whether a temporary internal source may have caused the elevated concentrations. For this building, the second round results were similar to the first. Therefore the difference could not be caused by a temporary source. However, the inspection of the ventilation system revealed some significant differences in this building. In general, the ventilation units in this building were older and operating at less than 50% of their original handling capacity. In addition, the outdoor air intakes were closed, and the air filters were nearly completely clogged with dust. These factors yielded a substandard ventilation environment in which chemicals have a significantly increased residence time in the building. As a mitigation measure, a new ventilation unit will be installed for this building, and another round of indoor air sampling will be conducted after the new system is functional.

Other than these two buildings, most of the buildings displayed similar indoor air concentrations. The results were compared to Regional Water Quality Control Board Environmental Screening Levels and Environmental Protection Agency Preliminary Remediation Goals for residential scenarios to evaluate the potential health impacts of the indoor air concentrations. With the exception of the two buildings discussed above, the concentrations were below these standards. Therefore, no additional mitigation work has been planned for the other buildings.