

contaminant concentration within the tank, however, is assumed to be equal to the effluent dissolved phase concentration (*i.e.*, liquid is well mixed). The time series of emissions for vapors is utilized along with air dispersion modeling results to estimate ambient air concentrations.

Biological treatment occurs in treatment tanks due to both aerobic and anaerobic biodegradation. As noted above for the landfill partition model, we lacked biodegradation rates for seven constituents. Thus, as described previously, we used surrogates to estimate aerobic and anaerobic biodegradation rates for these constituents.

(ii) Predicting Transport of Constituents. *Air Dispersion Model* The air dispersion model uses information on meteorology (*e.g.*, wind speed, wind direction, temperature) to estimate the movement of constituents associated with contaminant releases through the atmosphere and the constituent concentrations in the air at the locations of potential receptors. The air concentrations for this analysis are based on the air dispersion factors from the Industrial Waste Air (IWAIR) model. These dispersion factors were calculated based on national distributions of location, waste management unit surface areas, and distance to receptors. As noted above, releases through volatilization are unlikely to lead to significant deposition and food chain uptake, and thus, deposition was not considered.

The calculated air concentrations were then averaged over the exposure duration. For the exposure duration, we used a time period centered around the occurrence of the peak concentration. These average concentrations were used to determine the receptor's exposure and risk.

*Groundwater Model* We used the EPA Composite Model for Leachate Migration with Transformation Products (EPACMTP) to model the subsurface fate and transport of contaminants that leach from the waste management units (landfills and surface impoundments) and migrate to a residential drinking water well. We assume that the soil and aquifer are uniform porous media and that flow and transport is described by Darcy's law and the advection-dispersion equation, respectively.

EPACMTP accounts for the following processes affecting contaminant fate and transport: Advection, hydrodynamic dispersion, equilibrium sorption by the soil and aquifer solids (both in the unsaturated and saturated zones), and contaminant hydrolysis. EPACMTP does not account for preferential

pathways such as fractures, macropores, or facilitated transport (*i.e.*, any chemical process that has the potential to speed the transport of a pollutant beyond what is expected), which may increase the migration of constituents. Conversely, while the model has the capability of modeling biodegradation in groundwater, we do not have any appropriate coefficients to apply in the subsurface, so we do not account for the potential decrease in constituent migration.

The groundwater pathway consists of two components: Flow and transport in the vadose zone (the unsaturated zone directly below the unit), and flow and transport in the saturated zone. The primary transport mechanisms are downward movement along with infiltrating water flow in the unsaturated zone and movement along with ambient groundwater flow in the saturated zone. The advective movement in the unsaturated zone is one-dimensional, while the saturated zone module accounts for three-dimensional flow and transport. The model also considers mixing due to hydrodynamic dispersion in both the unsaturated and saturated zones.

In the unsaturated zone, flow is gravity-driven and prevails in the vertically downward direction. Therefore, the flow is modeled in the unsaturated zone as one-dimensional in the vertical direction. It is also assumed that transverse dispersion (both mechanical dispersion and molecular diffusion) is negligible in the unsaturated zone. This assumption is based on the fact that lateral migration due to transverse dispersion is negligible compared with the horizontal dimensions of the WMUs. In addition, this assumption is environmentally protective because it allows the leading front of the constituent plume to arrive at the water table with greater peak concentration.

In the saturated zone, the movement of constituents is primarily driven by ambient groundwater flow, which in turn is controlled by a regional hydraulic gradient and hydraulic conductivity in the aquifer formation. The model does take into account the effects of infiltration from the waste source as well as regional recharge into the aquifer. The effect of infiltration from the waste source is to increase the horizontal and vertical spreading of the plume, while the effect of regional recharge outside of the waste source is to cause a downward dip in the movement of the plume as it moves in the down gradient groundwater flow direction.

In addition to advective movement along with groundwater flow, the model simulates mixing of contaminants with groundwater due to hydrodynamic dispersion, which acts in the longitudinal, (*i.e.*, along the groundwater flow direction), as well as in horizontal and vertical transverse directions. The rate of movement of contaminants is strongly affected by chemical-specific sorption reactions in both the unsaturated and saturated zone.

#### e. What Are the Human Health Toxicities of the Constituents of Concern?

To characterize the risk from human exposures to the constituents of concern, toxicity information on each constituent of concern was integrated with the results of exposure assessment. Chronic human health benchmarks were used in this risk assessment to evaluate potential noncancer and cancer risks. We use reference doses (RfDs) and reference concentrations (RfCs) to evaluate noncancer health impacts from oral and inhalation exposures, respectively. Oral cancer slope factors (CSFs), inhalation unit risk factors, and inhalation CSFs are used to evaluate risk for carcinogens. The benchmarks are chemical-specific and do not vary between receptors (*i.e.*, residents, farmers, recreational fishers) or age groups. We used several sources to obtain human health benchmarks.

Health benchmarks for this risk assessment were obtained primarily from the most recent Integrated Risk Information System (IRIS) and from provisional benchmarks approved by EPA's Office of Research and Development. Other sources included EPA's most recent Health Effects Assessment Summary Tables (HEAST), Agency for Toxic Substances and Disease Registry minimal risk levels, California Environmental Protection Agency (CalEPA) chronic inhalation reference exposure levels, and CalEPA cancer potency factors. For lead, we used EPA's drinking water action level for lead of 0.015 mg/L for the groundwater pathway. We also used a drinking water action level for the groundwater pathway analysis for copper since an ingestion benchmark was not available.

Section 7 of the Risk Assessment Background Document contains the toxicological information used in our analysis. The studies used as the basis for each of these benchmarks have been reviewed, along with reference to the complete studies, and are presented in section 7 of the Risk Assessment Background Document.