

For the surface disposal scenario, EPA defined RME as exposure to a rural family living near a sewage sludge lagoon. EPA assumed these individuals are exposed to constituents of sewage sludge through ingestion of groundwater from a nearby residential well and by inhalation from showering.

Affected wildlife included invertebrate and vertebrate animals that may be exposed to contaminants through land application of sewage sludge. It was assumed that the ecological receptors, both aquatic and terrestrial, are exposed in the crop and pasture and in and around a farm pond. The representative terrestrial and aquatic wildlife species were selected based on their living, feeding, and foraging habitat. We included animals that derive a significant portion of their diet from a farm, as well as those that live in or feed in and around farm ponds.

The Agency did not assess exposure pathways for wildlife in the sewage sludge lagoon scenario (as a surface disposal unit) or the incineration scenario, only the land application

scenario. EPA estimates that less than one percent of the sewage sludge produced annually in the United States is disposed of in surface disposal units and approximately 17 percent is disposed of by combustion in sewage sludge incinerators. Thus, these disposal methods involve a relatively small proportion of total sewage sludge produced compared to land application of sewage sludge. In addition, surface disposal sites generally are areas with poor ecological habitat. Most of the sewage sludge produced in the U.S. goes to land application to fertilize crop or as a soil amendment. Therefore, the Agency did not assess aquatic and terrestrial wildlife exposure associated with surface disposal or incineration for this screen. We deem the land application scenario, which includes the treated agricultural crop and pasture land and farm pond, to be more representative of wildlife habitat, and thus, where ecological exposures are most likely to happen. Therefore, EPA believes that the agricultural land application scenario is a good indicator of ecological hazard.

C. Exposure Assessment Modeling

Human exposures may occur as a result of sewage sludge disposal in a lagoon or incinerator, or as the result of application of sewage sludge to agricultural land. The human exposure pathways modeled for the sewage sludge lagoon scenario are presented in Table 2. It was assumed that a resident family lives near a facility with a sewage sludge lagoon and breathes the ambient air at that location. It was also assumed that the family has a residential well that supplies tap water to the household for drinking water and showering. Ambient air exposures and the inhalation of contaminants during showering were estimated by the average daily air concentrations of vapors to which an individual might be exposed. Exposure via drinking water was estimated by multiplying the modeled concentrations of the pollutants in groundwater by the drinking water consumption rate of the individual.

TABLE 2.—HUMAN EXPOSURE PATHWAYS FOR THE SEWAGE SLUDGE LAGOON SCENARIO

Receptor	Inhalation of ambient air	Inhalation of shower air (groundwater source)	Ingestion of drinking water (groundwater source)
Adult Resident	x	x	x
Child Resident	x	x	x

In the agricultural land application scenario, more exposure routes are

considered in the assessment. The exposure pathways considered for the

farm family are presented in the Table 3.

TABLE 3.—HUMAN EXPOSURE PATHWAYS FOR THE AGRICULTURAL LAND APPLICATION SCENARIO

Receptor	Inhalation of ambient air	Inhalation of shower indoor air (groundwater or surface water)	Ingestion of drinking water (groundwater or index reservoir)	Ingestion of soil	Ingestion of produce	Ingestion of beef and dairy products	Ingestion of fish (farm pond)
Adult Farmer	x	x	x	x	x	x	x
Child Farm Resident	x	x	x	x	x	x	x

Although all of the ingestion pathways (ingestion of food and water) were aggregated in the exposure model to estimate total ingestion hazards to humans in this screening assessment, EPA did not aggregate the ingestion and inhalation pathways. The Agency aggregates oral and inhalation pathways under certain circumstances (e.g., as required by the Food Quality Protection Act, OPP adds together the ingestion and inhalation pathways for pesticides that have similar toxicological endpoints for both pathways). For

purposes of this screening assessment, a pathway providing exposure approximately three orders of magnitude lower than the predominating pathway (i.e., ingestion, and in particular ingestion of drinking water) need not be aggregated. In this screening assessment for sewage sludge, exposure to humans via inhalation for the pollutants that have reference concentration (RfC) values is negligible, as shown by the results of the TBD. The inhalation HQs are several orders of magnitude lower than ingestion HQs;

thus, aggregating these two pathways would not add meaningful results.²

For the ecological screening assessment, exposure concentrations were calculated for both direct contact and ingestion pathways. The exposure pathways assessed include direct contact with treated sewage sludge applied to agricultural land and indirect exposure through ingestion of contaminated food and soil or ingestion of, or contact with, surface water that

² There were no ingestion pathways considered for the sewage sludge incineration scenario.