

produced foods derived from land on which sewage sludge has been applied.

TABLE 1.—RISKS AND DAILY EXPOSURE FOR HIGHLY EXPOSED INDIVIDUALS FOR ALL EXPOSURE PATHWAYS
[Q1*= 1.56×10^{-4} (pg TEQ/kg-d⁻¹)

Percentile	Adult *		Child **	
	Risk	Daily exposure, pg TEQ/kg-d	Risk	Daily exposure, pg TEQ/kg-d
50th	1×10^{-6}	0.0086	1×10^{-6}	0.0094
75th	4×10^{-6}	0.026	3×10^{-6}	0.021
90th	1×10^{-5}	0.064	7×10^{-6}	0.042
95th	2×10^{-5}	0.11	1×10^{-5}	0.062

* Initial exposure begins in adulthood.

* Initial exposure begins during childhood.

As Table 1 shows, the median exposed HEI (at the 50th exposure percentile), even with the conservative assumptions built into the definition of the HEI, has a one in a million excess lifetime risk of cancer. An HEI at the high end of the exposure distribution (*i.e.*, one at the upper 5 percent exposed or the 95th percentile) has a 2 in 100,000 excess lifetime cancer risk from exposure to dioxins in land-applied sewage sludge. Both the lifetime and annual excess cases of cancer are considered conservative based on the assumptions used to model the HEI. EPA's reference to the 95th percentile exposure scenario and risk estimate is accompanied by the understanding that only five percent of the total number of individuals modeled in the HEI population (estimated to be 80 to 560 individuals nationwide) has an estimated lifetime cancer risk of 2 in 100,000 or greater. This risk estimate is considered to be unlikely based on the conservative assumptions used in constructing the HEI in a farm family. The remainder of the modeled HEI population will have a lower potential cancer risk because they are less exposed to dioxins than at the 95th percentile exposure scenario.

Certain commenters expressed concern that the 1999 human health risk assessment was limited to characterization of cancer risks, stating that the non-cancer health effects of dioxins may be a more serious concern than cancer because non-cancer health effects may occur at lower doses and may affect more body systems. Commenters recommended that non-cancer endpoints be considered in Round 2 or that draft reference doses be used to evaluate non-cancer endpoints.

EPA based the revised risk assessment for dioxin-like constituents in sewage sludge applied to agricultural land and its decision not to regulate dioxins in land-applied sewage sludge on the

cancer endpoint because it is the most scientifically well-established and well-supported endpoint. Although EPA and others have been studying non-cancer human health effects from exposure to dioxins, a methodology to adequately assess those risks has not yet been established. Details of this assessment and developments in the study of assessing non-cancer risks are discussed further in section VII. Discussion of Scientific Information Presented in the NODA.

C. Findings Concerning Ecological Effects

In response to public and peer review comments received on the 1999 proposal, EPA performed a screening ecological risk analysis (SERA) (USEPA, 2003a). The SERA used a two-phased approach that includes: (1) an initial screening assessment to determine whether the dioxins concentrations in land-applied sewage sludge warranted further assessment. This effort was an initial bounding estimate to assess the upper bound potential for ecological effects at the high end of exposure, and (2) a more refined assessment using a combination of higher end central tendency exposure assumptions regarding environmental media concentrations, receptor-specific dietary preferences, and ecological benchmarks. EPA used a hazard quotient (HQ) approach to assess the potential for adverse ecological effects. For the SERA, the HQ was the ratio of the modeled exposure and an exposure (an ecological benchmark) that is expected to be without adverse ecological effects. When HQs are greater than one, exposures exceed ecological benchmarks, suggesting the potential exists for adverse ecological effects. When HQs are less than one, exposures are less than ecological benchmarks, suggesting that there is minimal potential for adverse ecological effects.

In the SERA, EPA determined that all HQs were less than one.

In the NODA, EPA discussed the SERA and requested comments on the methodology, the data used, and the results derived from the SERA. As with the revised cancer risk assessment, the SERA used the concentrations of dioxins obtained from new sampling data in the 2001 Dioxin Update (USEPA, 2002b) of the National Sewage Sludge Survey (NSSS). As explained in section V.D., the 2001 dioxin update survey data consist of sewage sludge samples obtained from 94 municipal wastewater treatment facilities, and are considered a nationally representative sample.

The SERA addresses risks to mammals and birds, the receptors that are expected to have the highest exposure to dioxins. The assessment does not address risks to other receptor groups such as invertebrates and plants. The potential for dioxins to bioaccumulate in wildlife receptors is specifically addressed through analysis of the ingestion pathway. The analysis includes receptors exposed through ingestion of both aquatic and terrestrial food items and thus addresses the potential for bioaccumulation of dioxins from soil, surface water, and sediment.

The bioaccumulation factors (BAFs) for terrestrial invertebrates used in the analysis were derived from empirical data and assume a linear relationship between the concentrations of dioxins in soil and in food items. However, the BAFs are relatively conservative, and EPA considers them adequate for a screening level analysis.

There was disagreement among commenters concerning the adequacy of the SERA and whether dioxins in land-applied sewage sludge posed a risk to wildlife. Some commenters agreed with EPA's conclusion that there was no serious ecological risk, while others said that the uncertainty in the model's applications, and the many "average"