species within a segment. This method assumes contaminants are additive in their actions on organisms, which is not necessarily the case but is a conservative default approach recommended by EPA (1993). Species with the highest score would therefore be most at risk from exposure to contaminants. This analysis in presented in Figure 4.21 for terrestrial species and Figure 4.22 for aquatic species. These results were then qualified (as discussed earlier) according to whether unfiltered versus filtered pore water was used to estimate exposures for the dermal uptake pathway for aquatic organisms (and the resulting changes in dietary exposures for higher trophic-level organisms) to produce a species-by-segment risk plot (Figure 4.23) similar to the chemical-by-segment plot shown in Figure 4.20.

Terrestrial species that are potentially most affected by contaminants in the study area are American coots, Canada geese, harvest mice, mallards, raccoons, and swallows. However, risk within the study

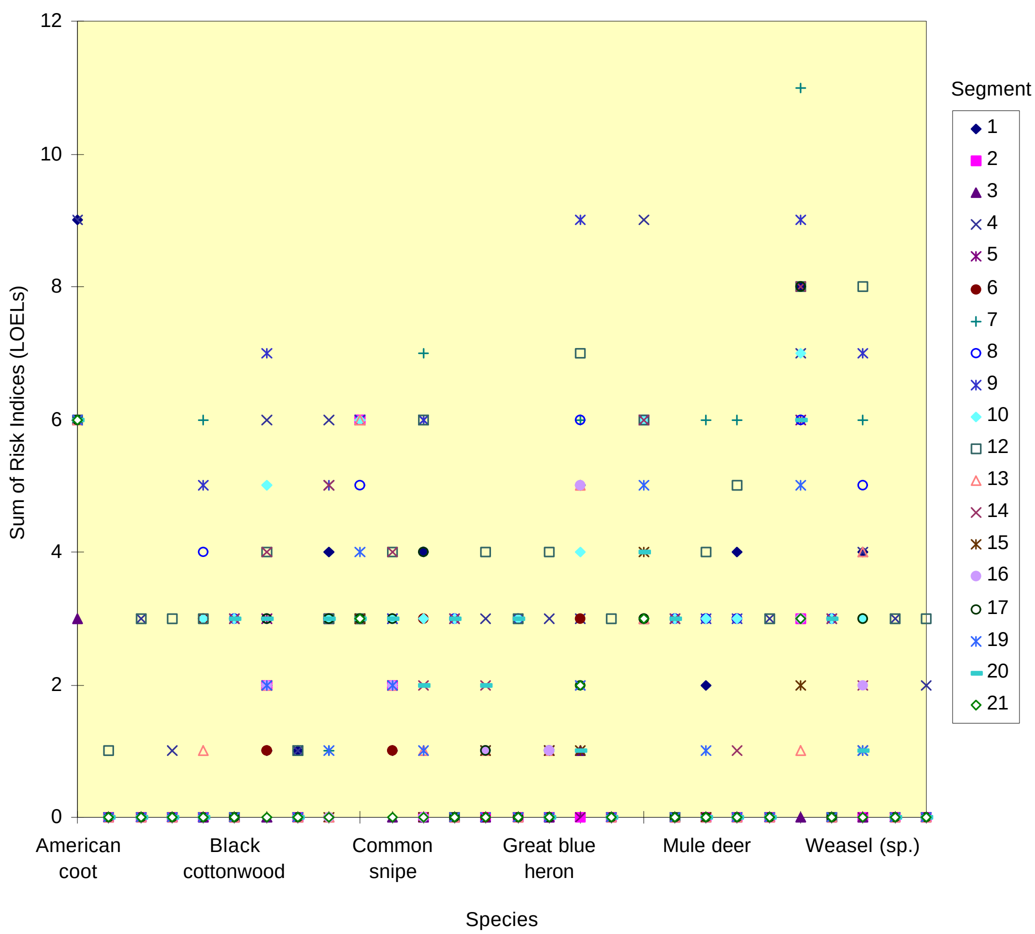

Figure 4.21. Relative Risks for Terrestrial Species Based on Summing Risk Indices Across All Contaminants Within a Segment

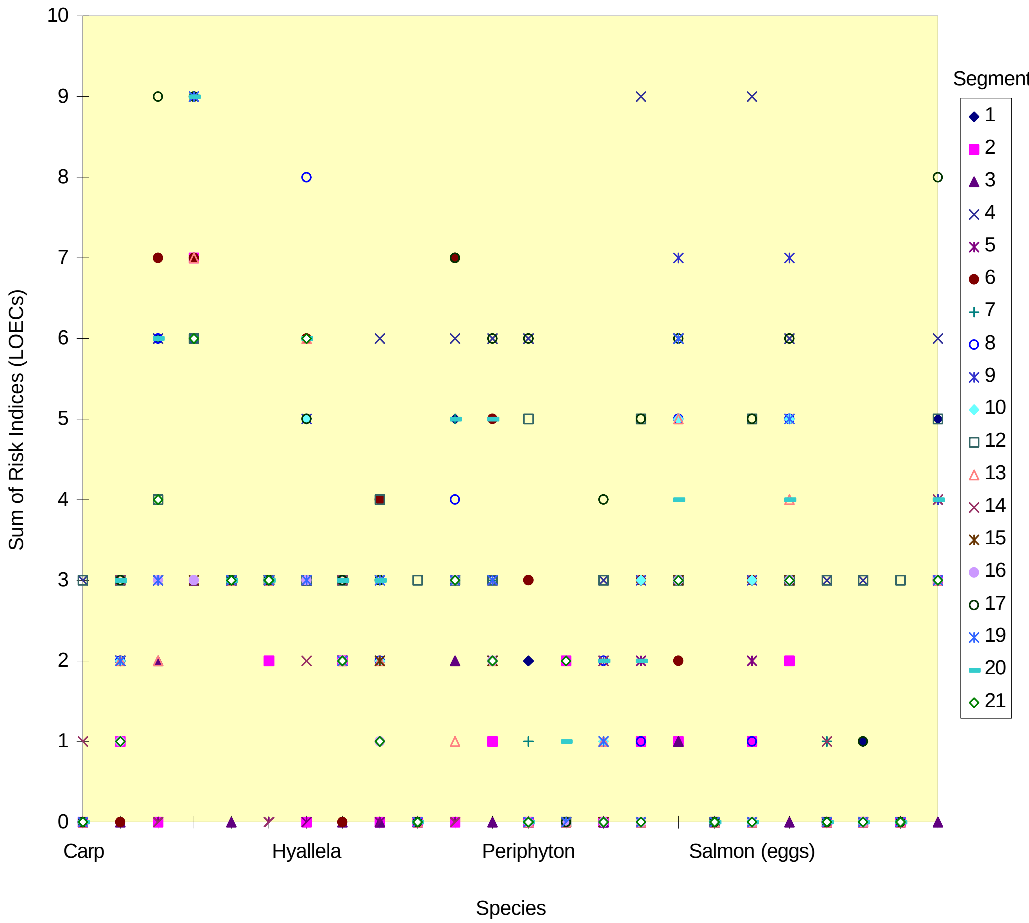

Figure 4.22. Relative Risks for Aquatic Species Based on Summing Risk Indices Across All Contaminants Within a Segment

area that is above reference levels is limited to only a few locations within the study area (Figure 4.3). The other species, including bald eagles, had relatively low risk in both absolute and relative (to reference) terms.

Relatively high risk was estimated for many species in Segment 4, primarily on the basis of zinc, copper, and chromium. Most of this risk was due to ingestion of prey with high levels of these contaminants in tissue, which ultimately arises from high concentrations of contaminants in the pore water in these segments. However, the samples in which these analytes were measured were unfiltered. The measurement reflects particulate as well as dissolved metal. On average, filtered concentrations of copper and zinc were 70 percent and 62 percent of the unfiltered concentrations, respectively. Consequently, the estimated risk these contaminants pose to organisms in Segment 4 remains suspect pending availability of filtered pore water samples or their surrogates in these segments.

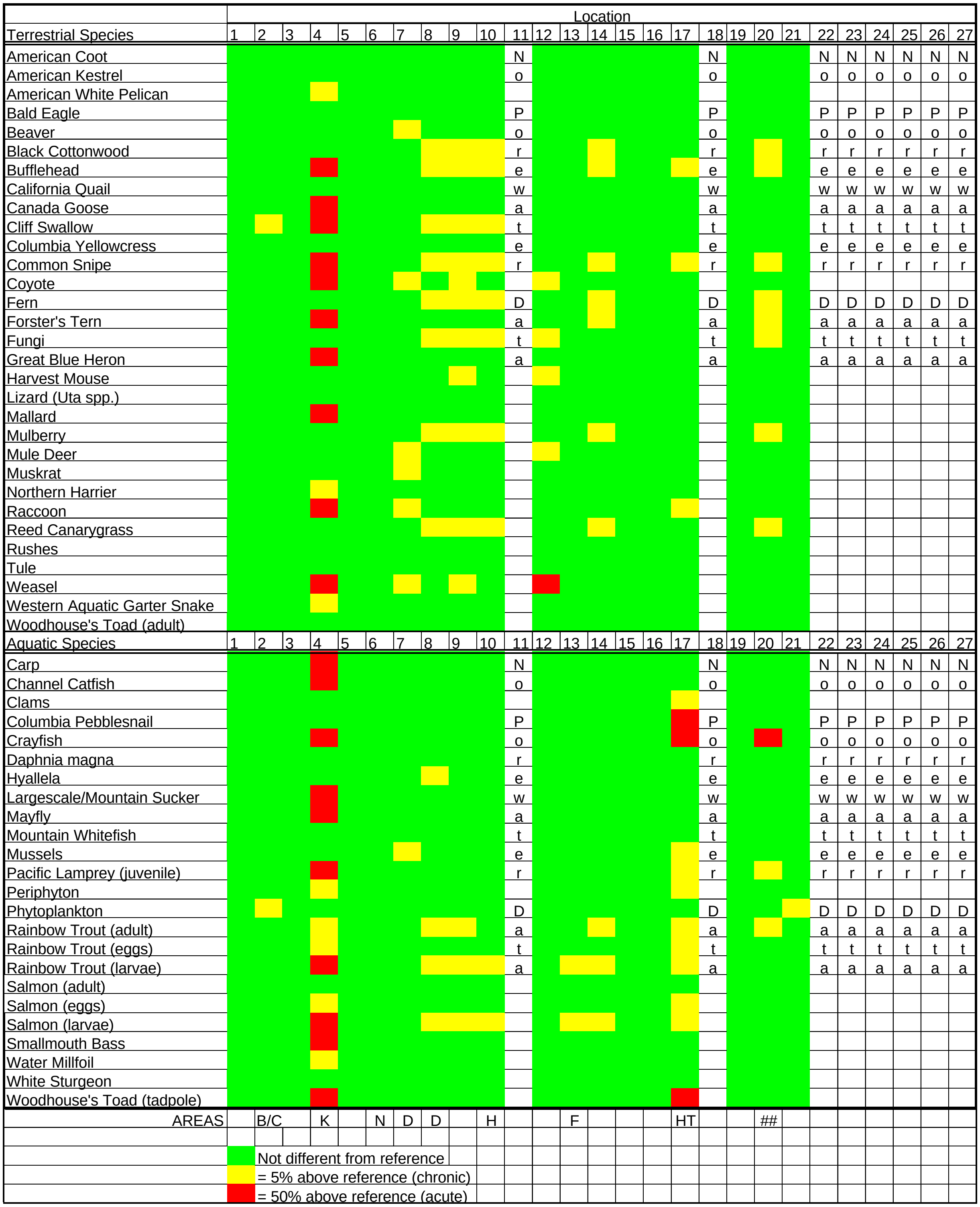

Figure 4.23. Levels of Ecological Risk Above Reference for Species in Study Area Segments for Terrestrial and Aquatic Organisms

Aquatic species most likely affected by acutely and chronically toxic effects from contaminants of Hanford Site origin are clams, Columbia pebblesnail, crayfish, *Hyallela*, mussels, salmon/trout larvae, suckers, water fleas, and Woodhouse's toad (tadpole). Other species with potential chronic risk included carp, clams, and mussels. The principal reason for the high relative risk of these aquatic species is their exposure to pore water and sediment. Most of these organisms have a benthic life style. They spend all or a high proportion of their life either in direct contact with the sediment or pore water. Thus, pore water concentrations are driving their estimated tissue burdens, and any exposure scenario that decreases the amount of time they spent exposed to 100 percent pore water would lower their risk accordingly. The acute risk shown for Segments 4 and 17 would be further mitigated if data from filtered water samples were used. Overall, the data suggest that some risk is present for aquatic organisms (mainly benthic species) and that this risk is limited mainly to the portion of the Columbia River adjacent to the 100-K Area, 100-D/H Areas, the old Hanford townsite, and the 300 Area.

The answers to the previously posed questions then are as follows. Contaminants of interest pose potential hazards to some plants, herbivores, omnivores consuming riverine organisms (especially insects as prey), and weasels in some areas. The primary contaminants driving the risk are cobalt-60, chromium, cesium-137, mercury, lead, zinc, and technetium-99. The media contributing most to risk are pore water and sediment.

For aquatic species, the organisms most at risk are benthic species or life stages. Contaminants contributing to their risk are cyanide, chromium, copper, mercury, lead, and zinc. The media contributing most to this risk are pore water and sediment, with pore water most significant.

The segments presenting the greatest potential risk are Segment 2 (chromium and lead at the 100-B/C Area), Segment 4 (chromium, copper, mercury, and zinc at the 100-K Area), Segment 5 (chromium and lead), Segment 6 (cobalt-60 and mercury at the 100-N Area), Segment 7 (cesium-137, cobalt-60, lead, and zinc at the 100-D Area), Segment 8 (cobalt-60, mercury, and technetium-99), Segment 9 (chromium, cobalt 60, lead, and mercury), Segment 10 (cesium-137, chromium, mercury, and technetium-99 at the 100-H Area), Segment 12 (cesium-137, cobalt-60, and mercury), Segment 13 (cobalt-60, lead, and mercury at the 100-F Area), Segment 14 (mercury and technetium-99), Segment 16 (cobalt-60 and mercury), Segment 17 (lead but results suspect and zinc), Segment 19 (lead and mercury), Segment 20 (cyanide, lead, mercury, technetium-99, and zinc at the 300 Area—all results suspect) and Segment-21 (cyanide and lead).

Segments with potential acute risk are Segment 4 (chromium and zinc), Segment 5 (lead), Segment 8 (mercury), Segment 9 (chromium, lead, and mercury), Segments 10 and 14 (mercury), Segment 13 (lead and mercury), Segment 17 (lead), and Segment 20 (copper and zinc). Data were insufficient to assess risk of any contaminant in Segments 11, 18, and 22-27. Risk from nitrite, sulfate, and phosphate was not evaluated because of the general lack of toxicity benchmarks. They present no risk from food-chain exposure, however, because they are readily metabolized. Risk from neptunium-237 and carbon-14 was not evaluated because of the lack of pore water data. Surface water data for europium-152 were absent in Segments 1-18, so risk from this isotope was not estimated in those segments. Risk from certain other contaminants was not evaluated in the central portion of the study area due to missing pore water data (see Figure 4.20).