APPENDIX F

Methodology for Assessing Health Risk to Terrestrial, Avian, and Aquatic Wildlife Species

Terrestrial and Avian Species

Health risks were assessed for a group of wildlife species representative of those typically found in the Rocky Mountain Regions. These species represent a range of phylogenetic classes, body sizes, and diets for which biological parameters are generally available.

Typical and extreme acute herbicide dose estimates were determined for each representative species for each of the three major exposure routes -- inhalation, dermal, and ingestion. Because the herbicides show little tendency to bio-accumulate, long-term persistence in food chains and subsequent toxic effects were not examined in the risk analysis.

Herbicide doses for the representative species were calculated using conservative, simplified assumptions concerning routine application operations that give realistic (typical) dose estimates, as well as highly unlikely (extreme) dose estimates in which animals are directly sprayed with herbicide. In the typical case, the typical herbicide application rates were used, while in the extreme case the maximum herbicide application rates were used. For the risk assessment, all herbicide treatments were assumed to involve broadcast applications from aircraft -- however, aerial application of herbicides is not being considered for the ARNF & PNG.

For typical doses, dermal exposures were based on the levels likely to be found on vegetation leaf surfaces. The animals are assumed to seek cover during the spraying operation. Extreme dose levels were estimated by assuming that animals did not seek cover and thus received the full herbicide application rate over their entire body surface. The dermal penetration fractions used in the Human Health Exposure Analysis were used to determine mammalian wildlife dermal penetration -- that is, the amount of chemical that penetrates an animal's skin. This is a conservative assumption because the animal's fur is likely to decrease the amount of herbicide that actually reaches the skin. In both the typical and extreme exposure scenarios, mammals were assumed to receive an oral dose from grooming their fur and birds were assumed to receive an oral dose from preening their feathers. This amount was then subtracted from the amount they received as a dermal exposure.

Typical ingestion doses were calculated from a specified percentage of each animal's daily food intake of contaminated items, as determined by body size. Thus, the percentage of contaminated food intake decreased as body size increased because larger animals were assumed to be more far-ranging and, therefore, would be more likely to obtain part of their diet in an area outside of the treated site. In the extreme case, the animals were assumed to feed entirely on contaminated food. The contamination of water sources was also included in the calculation of ingestion doses. In the typical case, wildlife species were assumed to consume water from an on-site stream that had received a partial direct spray of herbicide through the forest canopy. Exposure estimates in the extreme case were based on the consumption of water from an on-site stream that had been directly sprayed with herbicide.

Inhalation doses were assumed to come from a hypothetical amount of airborne herbicide droplets forming a "cloud" that moves slowly off-site.

The total estimated dose to each animal was calculated as the sum of the doses received via the dermal, ingestion, and inhalation route.

It must be noted that there are very few toxicity studies on which to base toxicologic conclusions for wildlife species and even fewer for the listed TES species. Avian toxicity data are particularly rare for most of the herbicides. Several herbicides had only two or three laboratory animal LD_{50}* test to use in the analysis. However, the conservatism used in estimating the wildlife doses should compensate for much of the uncertainty.

For non-endangered terrestrial wildlife species, EPA assesses the risk of pesticide exposure according to the following scale:

Low Risk	Expected dose less than 1/5 dose LD_{50}*
Moderate Risk	Expected dose between 1/5 LD_{50} and LD_{50}
High Risk	Expected dose equal to or greater than LD_{50}

*LD_{50} -- median lethal dose, the single oral or dermal dose, calculated from a series of tested doses to be lethal to 50 percent of animals in a test population within 14 days of administration.

Aquatic Wildlife Species

Representative aquatic species typically found in the Rocky Mountain region were used to estimate risks to aquatic organisms. The analysis assumed that the aquatic organisms were exposed to herbicide residues by immersion in water bodies that had received varying levels of herbicide through drift or direct spraying.

Stream Scenario

In the stream scenario, the concentration of herbicide in water, or the estimated environmental concentration (EEC), was calculated for a 6-inch (0.153 meter) deep water body that received a direct spray of herbicide.

In the typical case, the stream was assumed to be partially shielded from a direct spray of herbicide by a forest canopy. Thus, the typical water concentration for all of the herbicides was 0.1471 mg/L for each pound of herbicide applied per acre. Also, the typical herbicide application rates were used in the typical case EEC calculations.

In the extreme case, the stream was assumed to occur in an open, unprotected area with no forest canopy. Thus, a direct spray of herbicide produced an extreme water concentration of 0.7356 mg/L for each pound of herbicide applied per acre. The maximum herbicide application rates were used in the extreme case EEC calculations.

Lake Scenario

In the lake scenario, the concentration of herbicide in water was calculated for a 6-foot (1.84 meter) deep water body that received a direct spray of herbicides.

In the typical case, the lake was assumed to occur in an open, unprotected area with no forest canopy. Thus, a direct spray of herbicide produced a water concentration of 0.06130 mg/L for each pound of herbicide applied per acre. The typical herbicide application rates were used in the typical case EEC calculations, and the maximum application rates were used in the extreme case EEC calculations..

EPA's ecological risk assessment analyzes potential risks to aquatic species by comparing the dose received by the animal, or the EEC, with the laboratory-determined LC_{50}** for the most closely related laboratory test species. Thus, the following risk categories were used to assess the vegetation management programs' effect on non-target aquatic species:

Low	EEC < 1/10 LC_{50}
Moderate	EEC between 1/10 LC_{50} and 1/2 LC_{50}
High	EEC > 1/2 LC_{50}

** LC_{50} -- median lethal concentration , the concentration of a substance in water or air which is lethal to 50 percent of the test animals within 14 days of administration.

SOURCE: USDA Forest Service, Risk Assessment for Herbicide Use in Forest Service Regions 1, 2, 3, 3, and 10 and on Bonneville Power Administration Sites, September 1992, Section III-G, Nontarget Species Exposure Analysis