APPENDIX K

Cumulative Effects Monitoring Contingencies for Unforeseen Events

(guidelines for determining monitoring locations)

Cumulative effects on aquatic resources could include impacts to water quality and aquatic organisms. The Risk Assessment for Herbicide Use (USDA, 1992) defines risk of impacts to non-target aquatic species according to categories that compare the estimated environmental concentration (EEC) with the lethal concentration that kills 50% of organisms after a designated period of time (usually 96 hours).

LOW RISK	EEC $< 1/10\ LC_{50}$
MODERATE RISK	EEC between $1/10\ LC_{50}$ and $1/2\ LC_{50}$
HIGH RISK	EEC $\geq 1/2\ LC_{50}$

Under typical case application conditions for streams and lakes, estimated environmental concentrations of dicamba, glyphosate, picloram and 2,4D are all expected to be below 1/10 LC50 for trout and aquatic invertebrates, so no additional dilution should be necessary to avoid most adverse effects from short term exposure. However, under extreme case application conditions, such as those that might result from treatment by multiple parties within the same watershed, expected environmental concentrations for these herbicides may exceed $1/10\ LC_{50}$ and even $1/2\ LC_{50}$ levels (see Table YY). In those cases, additional dilution would be necessary to reduce cumulative effects levels that would avoid adverse effects from short-term exposure, and dilution effects must be taken into consideration when designing monitoring activities. In both typical and extreme cases, effects of long-term exposure to levels below $1/10\ LC_{50}$ are not known.

The amount of additional dilution necessary to reduce adverse short term effects to low levels can only be estimated, because actual application rates, season, precipitation, herbicide characteristics, watershed size, site conditions, stream flow diversions and base flow levels will all combine to influence the actual environmental concentration. However, we have used the following scenario to determine the level of dilution that might be needed under conditions that could occur on the Forest.

Using true 6th level watersheds (not mainstem stream complexes) as the basis for our analysis, average stream length is approximately 10 miles within a watershed of approximately 14,000 acres (22 square miles). Most of these streams are 4th order and have average summer flows of approximately 21 cfs at the mouth of the 6th level watershed. The relationship of watershed area to average August flow is:

$$Q_{aug} = [199.360 + 21.041\ (A)]\ /\ 31$$

where Q_{aug} is the average daily stream flow in cubic feet per second (cfs), and A is the watershed area in square miles (adapted from Troendle and Porth 1999). August flow was selected for use because it most closely matches the likely season of herbicide application. Using this relationship and estimated environmental concentrations from herbicide application, it is possible to estimate how much additional watershed area would be needed to produce flows adequate to dilute herbicide concentrations to levels below 1/10 LC_{50}. Based on the ratio of highest EEC to lowest 1/10LC_{50}, the number of times existing flow needs to be multiplied by to dilute flows can be calculated.

Table YY: Dilution factors related to lethal concentrations of herbicides most likely to be used.

Herbicide and Level of Low Risk Effect			Stream Scenario		Lake Scenario		Dilution Factors
	Trout 1/10 LC50	Aquatic Invertebrate 1/10 LC50	Typical EEC	Extreme EEC	Typical EEC	Extreme EEC	Needed Flows to be < Lowest 1/10 LC50*
2,4 D	1.0*	0.56	0.2942	2.942**	0.1226	0.2452	2.942x
Dicamba	2.8	1.1*	0.2942	2.942**	0.1226	0.2452	2.674x
Glyphosate	3.8*	78	0.2942	2.942	0.1226	0.2452	None
Picloram	1.25*	38	0.2942	2.207**	0.1226	0.1839	1.766x

TABLE NOTES: *The lowest aquatic 1/10 LC50 is used for this analysis as part of the most conservative case scenario.
**Mitigative dilution needed to reduce concentrations to levels below low risk for short term impacts.

The resulting dilution value can then be related to the additional watershed size needed to provide diluting flows for site-specific situations. This information can be used in combination with local knowledge to determine mitigative dilution and/or the distance downstream below which monitoring for herbicide levels would most likely *not* be effective. However, it is critical to note that depending on the location of weed treatment in the watershed, distance downstream will vary widely. If treatment is in the uppermost portions of the watershed, several miles of stream may be affected by measurable herbicide levels. If treatment is in the middle or lower portions of the watershed, dilution may occur immediately below the confluence with higher order streams, and only more site-specific monitoring may be effective. Site-specific design of monitoring activities is necessary to ensure appropriate location and duration.