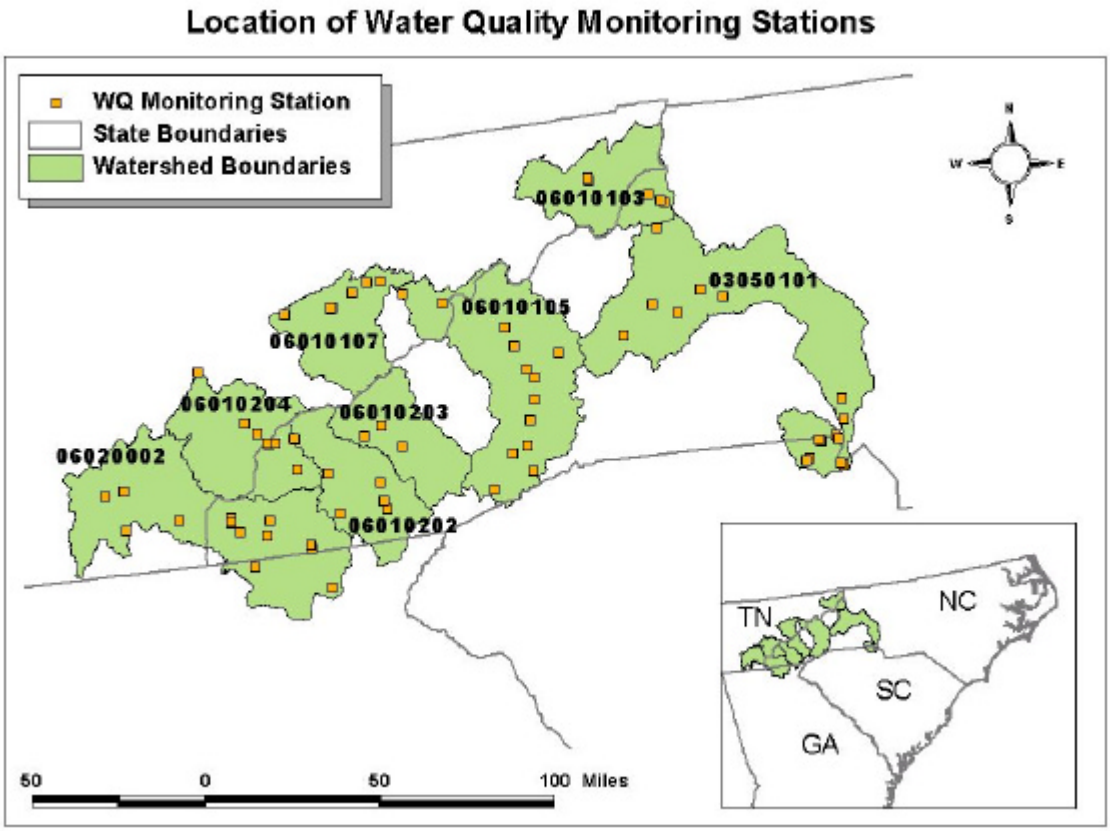
Appendix G

Water Quality and Flow Data from Selected Streamgage Stations in NC

EPA performed a detailed analysis of stream pollutant background concentrations for several watersheds in Western North Carolina to assess the appropriateness of the water quality modeling assumptions. Specifically, EPA determined whether the ranges of stream background concentrations used in the prototype model account for a variety of other feasible watershed conditions, such as varying levels of population, land uses, and point sources, that might exist for the watersheds of streams on which concentrated aquatic animal production (CAAP) facilities might be located. Eight watersheds in the Western North Carolina area were selected for review of in-stream water quality monitoring information during 1995-1997. These watersheds were chosen because they contained at least one CAAP facility that reported to PCS. All of the dischargers reporting in PCS within each of the eight watersheds were also summarized according to type of SIC code. EPA reviewed land use data for these watersheds to determine the presence of water quality monitoring stations located in urban areas, forested, and agricultural areas. A map of the analyzed watersheds is provided in Figure G-1.

Figure G-1

Location of Water Quality Monitoring Stations



EPA selected representative water quality parameters, including BOD_5, total suspended solids, ammonia, dissolved phosphorus, and dissolved oxygen to compare actual watershed conditions with model stream background conditions. EPA found 86 water quality monitoring stations in these watersheds for the statistical analysis.

EPA performed a statistical analysis of the available data from the 86 water quality stations to obtain a range of concentrations to compare to the original stream background concentrations used in the prototype model. Each of the five parameters was analyzed in the same manner, with the weighted mean, standard deviation of the weighted mean, and the minimum and maximum concentrations calculated for each.

Every station reported the number of samples taken (i.e., the number of observations) and the mean concentration of those observations. The number of observations differs for each station; some stations

reported the average concentration from two observations while other stations monitored their streams continuously, resulting in a much larger number of observations. Because the means are based upon different numbers of observations, the weighted mean was calculated for each station. The weighted mean varies the contribution of an individual station's mean value proportionally according to the number of sample points that make up the individual station mean. Thus, a station mean value with 10 observations carries less weight than a station with several hundred observations.

EPA calculated the weighted means by multiplying the station's mean by the number of observations that the respective station recorded. These values were then added together for all of the stations that reported data; and lastly, the resulting value was divided by the total number of observations for the particular parameter, thereby producing the weighted mean. The standard deviation for the weighted mean was also calculated in order to better understand the spread of the data for each parameter. Finally, the range (minimum and maximum values) of the mean concentrations reported by the stations was found for each parameter. This range was then used to support the range that was used for modeling purposes.

The results of the statistical analysis are available in Table G-1, along with the original stream background concentrations used in the prototype model. The results show that the weighted means for the stream observations fall within the range of values used in the water quality modeling for BOD_5, ammonia, and dissolved phosphorus. The range of in-stream BOD values falls within the range of values used in the water quality modeling. The range of in-stream ammonia values is wider than the water quality modeling values. The range of in-stream phosphorus values falls within the range of values used in the modeling. The weighted mean for TSS was lower than the range of values for the prototype case study stream. However, the range of values for the case study stream was narrower than the range of the monitored streams for TSS. The value for dissolved oxygen used in the modeling fell within the range of in-stream values and was slightly greater than the weighted mean value.

Table G-1
Comparison of Background Concentrations

	BOD_5 (mg/L)	**TSS (mg/L)**	**NH_3 (mg N/L)**	**Dissolved P (mg P/L)**	**DO (mg/L)**
Range used to represent background flows in prototype case study stream	0.4 – 3.86	15 – 45	0.04 - 0.28	0.001 – 0.159	6.63
Water Quality Station Analysis (from eight watersheds)					
No. of Water Quality Stations	6	39	39	2	69
Total No. of Observations	149	1,094	1,160	15	61,803
Weighted Mean	1.970	12.903	0.118	0.051	5.711
Standard Deviation of Weighted Means	0.701	12.764	0.315	0.346	3.221
Parameter Range (Min and Max)	1.343 - 1.636	0.300 - 64.918	0.014 - 1.789	0.0412 - 0.087	3.629 - 10.584

To assess the stream flow characteristics of the model system, USGS stream flow gages located in eight watersheds in the North Carolina mountains were reviewed. These watersheds are the same ones used in the analysis of stream background concentrations. A map of the analyzed watersheds and tributaries is provided in Figure G-2 below. AAP facilities identified in BASINS were present in these watersheds and are located primarily on tributaries of the RF1 stream coverage. Therefore, all USGS stream gages located on tributaries, or starting stream reaches of RF1, were selected from the collection of gages under review. The stream gages were checked to assure locations below lakes were not included, since such obstructions to the natural stream flow would affect results from the analysis. Two additional gages were removed from analysis because of location at a main stem river reach juncture with a tributary. Of the remaining 29 stream gages, the 7Q10 flows ranged from 0.71 to 43.20 cubic feet per second (cfs) and the mean flow ranged from 10.62 to 285.48 cfs. The same stream gages were also reviewed for summer flow, which is considered as July 1 through September 30 for this analysis. Of the original 29 stream gages, 28 gages provided values for summer flow. The resulting average summer flow was 58.96 cfs. A summary of the flow data, including ranges, means, and standard deviations, is provided in Table G-2.

Table G-2

Summary of Flow Data

Flows	Minimum	Maximum	Mean	Standard Deviation
7Q10 Flow (cfs)	0.71	43.20	14.1	11.42
Mean Flow (cfs)	10.62	285.48	94.43	66.71
Summer Flow (cfs)	5.14	192.72	58.96	40.38

Figure G-2

Location of USGS Gages