ESTABLISHING TOTAL MAXIMUM DAILY LOADS FOR DEICING FLUIDS

The Total Maximum Daily Load (TMDL) is a term used to describe the maximum amount of pollution a water body can receive without violating water quality standards. A true load is a measurement of mass per unit time, such as a calculation resulting in units of pounds per day. In order to determine this value for a pollutant, two items are required: a flow value from the source of the pollutant (such as a wastewater treatment plant) plus the allowable concentration of the pollutant in that flow. In the case of a pollutant being mixed with storm water runoff created by an infinite variety and magnitude of possible storms comprised of rain, sleet, snow and a combination of these occurring over varying periods of time and temperatures, it is not possible to assign a specific flow value. Thus assigning a TMDL in terms of a single load is also not feasible. The task remains, however, to describe in some manner the maximum amount of pollution the water can receive and to apply some margin of safety for these calculations.

In order to achieve this goal, it is first necessary to determine the water quality parameters of concern and the pollutants responsible for causing these problems. In the case of deicing fluids, the water quality parameters of concern are dissolved oxygen, ammonia toxicity, and nuisance growths of *Sphaerotilus* bacteria. As per Kentucky water quality regulations, dissolved oxygen shall be maintained at a minimum concentration of 5 mg/L daily average, the concentration of un-ionized ammonia shall not be greater than 0.05 mg/L at any time instream after mixing, and nuisance conditions are prohibited. To protect water quality, maximum concentrations are needed for BOD_5 and ammonia, which are the main attributes of deicing fluids that cause these water quality problems.

The KDOW and Dames and Moore consulting engineers, who were retained by the airport to work on these issues, conducted water quality modeling of Elijahs and Gunpowder creeks using the QUAL2E water quality model. QUAL2E is commonly used by the KDOW to establish effluent limits for wastewater treatment facilities. Specific modeling procedures and assumptions used by the KDOW have been approved by the U.S. EPA and are fully documented (4). The model was run under several scenarios, testing possible effluent values from airport runoff flow amounts of 50,000 gallons per day (gpd), 100,000 gpd, and one million gpd. These were chosen to simply provide a wide range of possible runoff volumes. Both summer and winter conditions were tested and effluent limits were established for both periods. Summer conditions were tested because the data presented in the previous section of this report indicated possible contamination during this period. Temperatures applied in the model were 25° centigrade (C.) for summer conditions and 16° for winter conditions.

These are the same as those applied by the KDOW during routine modeling. Results from modeling found that summer concentrations of 70 mg/L BOD_5 and 4 mg/L ammonia and winter concentrations of 150 mg/L BOD_5 and 10 mg/L ammonia will protect the dissolved oxygen and ammonia stream criteria in Elijahs Creek. Corresponding summer allowable loads in Elijahs Creek are 29.2 pounds per day (lbs/day) of BOD_5 and 1.67 lbs/day of ammonia at a runoff flow of 50,000 gpd, 58.4 lbs/day of BOD_5 and 3.34 lbs/day of ammonia at a runoff flow of 100,000 gpd, and 584 lbs/day BOD_5 and 33.4 lbs/day of ammonia at a runoff flow of one million gpd. Allowable loads for winter conditions are 62.5 lbs/day of BOD_5 and 4.17 lbs/day of ammonia at a runoff flow of 50,000 gpd, 125 lbs/day of BOD_5 and 8.34 lbs/day of ammonia at 100,000 gpd, and 1252 lbs/day of BOD_5 and 83.4 lbs/day of ammonia at one million gpd. Values for Gunpowder Creek are 50 mg/L BOD_5 and 4 mg/L ammonia during summer conditions and 85 mg/L BOD_5 with 10 mg/L ammonia for winter conditions. The corresponding summer allowable loads in Gunpowder Creek are 20.8 lbs/day of BOD_5 and 1.67 lbs/day of ammonia at a runoff flow of 50,000 gpd, 41.7 lbs/day of BOD_5 3.34 lbs/day of ammonia at 100,000 gpd, and 417 lbs/day and 33.4 lbs/day of ammonia at one million gpd. Allowable loads for winter conditions are 35.4 lbs/day of BOD_5 and 4.17 lbs/day of ammonia at a runoff flow of 50,000 gpd, 70.9 lbs/day of BOD_5 and 8.34 lbs/day of ammonia at 100,000 gpd, and 709 lbs/day of BOD_5 and 83.4 lbs/day at one million gallons per day.

The KDOW has not found from a literature search a specific numeric “TMDL” for any constituent whereby nuisance growths of *Sphaerotilus* can be avoided. The TMDL for this problem then becomes the qualitative narrative language found in Kentucky regulation 401 KAR 5:031, Section 2(1)(e) whereby nuisance growths are prohibited. Implementation of this narrative plus the numerical values determined above are described in the next section of this report.

Margins of Safety: The TMDL process requires that various margins of safety be employed when establishing permit limits to better ensure water quality protection. Two significant safety factors were incorporated in the water quality modeling. First is the assumption that no flow was available in the streams for dilution of airport runoff. In reality, there will most likely always be flow in these streams during deicing operation since this activity occurs as a result of snow/rain/sleet conditions. The second is that the model was operated at 25^{o} C summer and 15^{o} C winter temperatures. Deicing activities actually occur at much lower temperatures. This provides a margin of safety because streams are able to assimilate more biodegradable wastes at lower temperatures due to the various physical and biological processes that occur. A third margin of safety applied to the airport is the permit condition that if nuisance growths of *Sphaerotilus* continue to occur, then the effluent limits will be reduced further and/or other control measures will be applied as necessary.

IMPLEMENTATION OF THE TOTAL MAXIMUM DAILY LOADS

The KDOW has implemented two actions to ensure that deicing fluids do not continue to create water quality problems in Elijahs and Gunpowder creeks. A new permit was issued to the airport in February 1997 (Appendix I) to implement the TMDL values discussed in the previous section, and a formal enforcement action resulted in an Agreed Order (AO) between the state and the airport filed March 28, 1997 (Appendix II). In addition to the margins of safety applied through the conservative model assumptions, the permit and AO outline several items to provide additional margins of safety and ensure water quality protection. These are:

1. The permit specifies in Part III, Section B(2) that "If nuisance growths continue, the Division of Water reserves the right to impose additional/modified limitations/ requirements in order to achieve compliance with applicable water quality standards." This was implemented as a means of recognizing that the effluent values calculated from modeling may not be sufficient to inhibit nuisance growths and provides a mechanism to rectify these limits if necessary.

2. Both the permit and the AO require the airport to establish a Best Management Practices (BMP) control plan to contain deicing fluids and all hazardous materials from reaching local waterways. This plan has been submitted and approved by the KDOW. The airport reports that over 5 million dollars has been spent on implementing this plan, which includes elaborate deicing pads and collection systems.

3. The AO required the airport to submit a Groundwater Protection Plan. This plan also has been submitted and approved.

4. The AO describes penalties that were assessed the airport from previous violations. The state agreed to forego $50,000 in penalties and credit that amount toward the purchase of a vacuum sweeper truck. The truck has been operational since late December 1997 and should help control deicing fluid runoff from runways and other paved areas.

5. AO condition number 10 required the airport to submit an update to the "Master Plan, De-Icing Fluid Containment and Runoff Control for the Cincinnati/Northern Kentucky International Airport." This updated plan describes actions already taken to control de-icing fluid runoff and outlines future work to better define and control this problem. This plan was submitted to the Division in November 1997.