NACWA
A Clear Commitment to America's Waters

January 4, 2007

Brenda Shine
Environmental Engineer
Coatings and Chemicals Group
OAQPS-SPPD-CCG (E143-01)
Research Triangle Park, NC 27711
Via email: shine.brenda@epa.gov

Re: NACWA WATER9 Study Results

Dear Ms. Shine:

The National Association of Clean Water Agencies (NACWA, formerly known as AMSA) has completed a study of three fate and transport models, including WATER9, used to predict emissions of volatile organic compounds from wastewater collection systems. NACWA worked with EPA's Elaine Manning and RTI's Dr. Clark Allen over the last several years on this study, including a 2003 meeting in which NACWA presented preliminary results and obtained clarification on some of its questions. It is our understanding that you are now the EPA official responsible for the WATER9 model. Our study evaluated the accuracy of the WATER9, INTERCEPTOR, and TOXCHEM+ models as compared to field–measured data and to each other. The usability of the WATER9 model was also evaluated, and the compound properties and algorithms used by the three models were investigated. A draft report of the study results is attached.

The results of the study indicate that the WATER9 output is significantly different than the field-measured data and the output of the other two models. Other key findings from the study are that the WATER9 output was affected by the set-up and execution of the program and that there is a strong likelihood that errors will be created by professionals in the wastewater treatment industry because of inadequate documentation and the use of nomenclature unfamiliar to the wastewater industry. Improved documentation would help WATER9 users to achieve more accurate results when modeling their wastewater collection systems. NACWA therefore requests that EPA improve the WATER9 documentation for:

1. Model component selection, e.g., how to represent gravity-flow sewers in the model.
2. Model set-up and execution.
3. The algorithms used in the model, thereby allowing independent evaluation of model results.

National Association of Clean Water Agencies
1816 Jefferson Place, NW
Washington DC 20036-2505

p 202.833.2672 **f** 202.833.4657
www.nacwa.org · info@nacwa.org

The study compared model results to emissions field data for two collection system components: uniform gravity flow reaches and drop structures. The field data consists of published datasets containing measurements of various compounds emitted from wastewater collection systems. Within each dataset, the datapoints were screened for quality using mass closure criteria, and datapoints with apparent field sampling or analytical errors were eliminated. For reaches, WATER9 modeled the measured data less accurately than TOXCHEM+ but more accurately than INTERCEPTOR. Table 1 summarizes the results of the modeling study as the ratio of the model-predicted emissions to the field-measured emissions.

Table 1. Comparison of model results to field measurements.

		Average Ratio of Predicted to Measured Values				
Collection Component	No. of Datapoints	INTERCEPTOR	TOXCHEM+	WATER9	WATER9 Method 1	WATER9 Method 2
Reach	60	0.32	1.36	0.56	-	-
Drop Structure	68	0.94	0.64	-	2.03	2.08

Two methods were used to represent drop structures in WATER9, as recommended by Dr. Allen. Method 1 was a drop structure component and Method 2 was a lift station component. For both methods, the WATER9 model tended to significantly over-predict emissions. Although these average over-predictions are nearly identical, comparing the predictions of the two methods for the two sets of published field-measured data used in the study illustrates the large difference in predictions based on the model set-up. For one set of field data, Method 1 under-predicted by only 19%, while Method 2 over-predicted by 249%. For another set of field data, Method 1 over-predicted by 137%, while Method 2 over-predicted by 68%. The results of the WATER9 model are therefore significantly affected by the method used to represent drop structures.

A statistical analysis of the different model results using Duncan's Multiple Range Test showed that for reaches, WATER9 results were significantly different from the observed data and from the INTERCEPTOR and TOXCHEM+ results. For drop structures, two algorithms were used for the WATER9 model. The two algorithms were significantly different from each other, and both were significantly different from the INTERCEPTOR and TOXCHEM+ results. However, the WATER9 Algorithm 2 results were the only model results for drop structures that were not statistically different from the field-measured data. This result again illustrates the large effect that the model set-up can have on the output.

Different output also resulted when independent groups used identical input data in WATER9 to model the same conditions. The project evaluation team and the Los Angeles County Sanitation Districts (LACSD) used the same input parameters for both reaches and drop structures, yet their results were significantly different. An in-depth analysis of the input data revealed no differences in the parameters used in the model, indicating the importance of understanding the default data values for certain model-required parameters, such as model convergence parameters, that the user does not explicitly need to enter.

Other issues with the WATER9 model that arose during the study include the following:

- Program stability – the output seems to be different for repeated calculations and on different computers.
- Configuration – users do not have sufficient guidance to configure processes as the model writers intended.
- Nomenclature – the program does not use the widely accepted names for various processes and devices.
- Units of measure – the lack of a standardized measurement system increases the chance of user error.
- Calculation Documentation – there is no way to replicate the WATER9 calculations by hand for reaches or drops due to the absence of documentation for the calculations.

Most of the issues found with the accuracy and usability of WATER9 could be addressed with the suggested improvements to the model documentation. NACWA suggests that the documentation improvements be made and that the other issues mentioned above be addressed before WATER9 is used as a regulatory tool. Thank you for considering these improvements, and we appreciate all of the help EPA provided with this study. If you have any questions, please contact me at 202/296-9836 or *cfinley@nacwa.org*.

Sincerely,

Cynthia A. Finley
Director, Regulatory Affairs