

**WASTEWATER MANAGEMENT DIVISION  
THE SEWING BUILDING  
241-3822**

**M E M O R A N D U M**

**TO: RMS Policy & Procedures File**

**FROM: Ernie Kelley, Environmental Analyst**

**DATE: December 7, 2004**

**SUBJECT: revised application rate calculation model**

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In the spring of 2004, a new model (current version dated: Rev. 12-2-04) was developed for calculating the nitrogen based biosolids application rate. This new model supercedes the calculation as presented in the February 1989 draft Solid Waste Management Guidelines, that has been in use since the mid-1980s.

The new model has been adopted as an official procedure, and its use is required for application rate calculations commencing with the spring 2005 application season.

The new model differs from the old model in several key aspects:

- 1) The new model provides calculations for both spring and fall applications of biosolids, whereas the old calculation model only provided for a once per year application.

Under the old model, there was no effective means of determining plant available nitrogen under a management scenario utilizing both spring and fall applications of biosolids, although it did work for a single annual application event regardless of whether it occurred in the spring or the fall. In general, the old model could result in a significant over application of nitrogen in the two applications per year scenario.

The new model is designed to allow for accurate calculations of either 'spring or fall' or 'spring and fall' application events. In the 'spring and fall' calculation, the model accounts for the incomplete mineralization and plant uptake of organic nitrogen applied in the spring when making the calculation for the fall application event.

- 2) The new model incorporates different organic nitrogen mineralization factors than those upon which the old model was based. The selection of the new

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nitrogen mineralization factors is based upon recent research conducted by the Water Environment Research Federation [WERF Project #97-REM-3: "Estimating Plant-Available Nitrogen in Biosolids – Appendix A], and others, that more accurately reflect Vermont's climate and growing season. This research report may be accessed at:

[http://www.epa.state.vt.us/dsw/sludge/WERF\\_sludge\\_PAN\\_calcs.pdf](http://www.epa.state.vt.us/dsw/sludge/WERF_sludge_PAN_calcs.pdf)

The organic nitrogen mineralization factors have been reduced in the new model. A review of the latest research determined that because Vermont's climate is, on average, colder and wetter than the national norm, the mineralization of organic nitrogen occurs at a slower rate than was assumed in the old model. The nitrogen mineralization factors in the old model were based upon national average climate conditions. The old model therefore, would generally underestimate the amount of plant available nitrogen that would be realized from any given application of biosolids. The new model will result in slightly higher calculated application rates in order to make-up the plant available nitrogen deficiency.

- 3) The new model includes calculations for nitrogen contributed by past and present applications of manure. The manure calculations are derived from the UVM Agricultural Extension Service's manure model ["Nutrient Credits from Manure"] which is used by the Vermont Department of Agriculture, Food, & Markets in its manure management programs. This model may be accessed at:

<http://www.uvm.edu/extension/publications/nutrientrec/manure.htm>

While the old model did provide for nitrogen derived from manure applications, it simply assumed that manure contains 10 lbs nitrogen per ton, regardless of its moisture content (percent solids) or method of management. In reality, the plant available nitrogen content of manure varies significantly depending on factors such as percent solids, application method, soil drainage conditions, and time to incorporation. The Ag Extension's manure model accounts for nitrogen content and availability based upon these varying parameters.

- 4) The new model provides for an adjustment of the calculated application rate in cases where the annual pollutant loading rate for cadmium [as established in the Vermont Solid Waste Management Rules §6-702 (a)(3)] is exceeded if biosolids were to be applied at the originally calculated rate. This adjustment was not included in the old model.

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- 5) Similarly, the new model will accommodate calculations for biosolids in which the copper concentration is in the range 1000 mg/kg – 1500 mg/kg, dry weight. The federal EQ standard (40 CFR §503.13 – Table 3) is 1500 mg/kg, while the Vermont standard is 1000 mg/kg. In this one case, Vermont will allow the application of biosolids that have a copper concentration above the state standard, under the provision that the application rate is reduced such that the mass of copper applied does not exceed the mass of copper that would be applied if the concentration did equal 1000 mg/kg. This adjustment was not included in the old model.