Appendix B (part 1)

Nitrate Sensitivity Analysis: Cumulative Effects Information and Example

This Appendix describes how to use the individual and cumulative nitrate sensitivity analysis spreadsheets in Appendix A. It also includes an example cumulative effects calculation.

DESCRIPTION OF APPENDIX A SPREADSHEETS

General Information
Appendix A includes three spreadsheets: one for calculating single nitrate mixing zone concentrations, one for calculating cumulative nitrate impacts between 2 or more drainfields, and one for the example cumulative calculation provided below.

Individual Nitrate Spreadsheet
The blue cells in the spreadsheets are entered by the user, the red cells are formulas and should not be altered. The user-supplied variables are described in Chapter 2 of the Circular.

Cumulative Nitrate Spreadsheet
The blue cells in the spreadsheets are entered by the user, the red cells are formulas and should not be altered. The user-supplied variables are described in Chapter 2 of the Circular.

If any part of two or more drainfields (absorption systems) overlap, as measured in the direction of ground-water flow, cumulative impacts calculations shall be conducted (the 5° dispersion widening in ARM 17.30.517(1)(d) is not accounted for when determining overlap of absorption systems for cumulative effects analysis). The amount of overlap between two or more absorption systems is not used in the calculations; whether that overlap is a fraction of the absorption systems width or the entire absorption system width, impacts must be evaluated. For completing calculations in Appendix A spreadsheets, the full width of each absorption system as measured perpendicular to groundwater flow shall be used.

The cumulative nitrate spreadsheet contains two tables. Table 1 is used to determine the correct background nitrate concentrations (Ng) for each cumulative absorption system in Table 2. The spreadsheet will automatically populate the background nitrate (Nb and Ng) for Tables 1 and 2 as the values for each successive absorption system are entered. The spreadsheet will also populate the final cumulative nitrate concentration (Nt) at the end of each mixing zone in Table 2. Note that the nitrate concentrations (Nb) calculated in Table 1 are only for determining background nitrate concentrations in downgradient drainfields and are not used for determining compliance with the nondegradation criteria. The (Nt) values in Table 2 are used for compliance purposes.

Cumulative Nitrate Example
Refer to both Appendix A and Appendix B part 2 diagram for the example discussion.

In the example diagram (see Appendix B part 2) nitrate from absorption system A will raise the background nitrate concentration in the ground water beneath absorption systems B and C. In addition, nitrate from absorption system B will raise the background concentration in the ground water beneath absorption system C. The example procedure below describes how to utilize the

spreadsheet to calculate the background nitrate concentrations and the final mixing zone nitrate concentration for absorption systems A, B, and C.

Table 1 and 2 (Appendix A)

1. Determine the background groundwater nitrate concentration (Ng), see Chapter 2 of the Circular. This is 0.3 mg/L in the example. This will be the only nitrate concentration input by the user. All other background and mixing zone nitrate concentrations are calculated by the spreadsheet.
2. User enters the background nitrate concentration (Ng) for the most upgradient absorption system in the cumulative effects analysis in Table 1. This is absorption system A in the example.
3. Other than the values for (L), user enter all parameter values with blue cells in Tables 1 and 2 for all absorption systems included in the cumulative analysis (absorption systems A, B and C in the example).
4. Measure distance from absorption system A to the end of the last mixing zone in the cumulative effects analysis (absorption system C in the example). User enters that distance into the "Distance to end of last (most downgradient) mixing zone" (L) cell for absorption system A in Table 1. This is 525 feet in the example (see Appendix B part 2 diagram). Note that the actual mixing zone length for absorption system A (100 feet) does not change, it is just lengthened in the calculation to determine the background nitrate concentration for absorption system B.
5. Spreadsheet automatically calculates and populates the resulting background nitrate concentration (Nb) for the next downgradient absorption system in Table 1 (absorption system B in the example). That same concentration is also automatically entered as the background concentration (Ng) for absorption system B in Table 2. This is 2.50 mg/L in the example (see Tables 1 and 2).
6. Measure distance from absorption system B to the end of the last mixing zone in the cumulative effects analysis (absorption system C in the example). User enters that distance into the "Distance to end of last (most downgradient) mixing zone" (L) cell for absorption system B in Table 1. This is 375 feet in the example (see Appendix B part 2 diagram). Note that the actual mixing zone length for absorption system B (100 feet) does not change, it is just lengthened in the calculation to determine the background nitrate concentration for absorption system C.
7. Spreadsheet automatically calculates and populates the resulting background nitrate concentration (Nb) for the next downgradient absorption system in Table 1 (absorption system C in the example). That same concentration is also automatically entered as the background concentration (Ng) for absorption system C in Table 2. This is 4.93 mg/L in the example (see Tables 1 and 2).
8. After the background nitrate concentrations (Ng) are calculated for each absorption system in the cumulative effects analysis, the final nitrate concentrations at the end of each mixing zone are automatically calculated and populated as (Nt) in Table 2. The (Nt) concentration for each mixing zone in Table 2 must be equal to or less than the required concentration (Section 2.11.1 of the Circular) for the cumulative analysis to demonstrate nonsignificant degradation.