

Texas Commission on Environmental Quality

Development of Nutrient Criteria in the Texas Surface Water Quality Standards

This method is similar to that used to develop criteria for total dissolved solids (TDS), chlorides, and sulfates. Currently these criteria are developed from ambient data for each individual segment. For TDS, chlorides, and sulfates, the criteria were recalculated from time to time to reflect the expanding data base. If recalculations are performed, care must be taken to ensure that a pollution source is not responsible for increased concentrations of these parameters. The actual criteria are derived by a formula which utilizes the arithmetic mean, standard deviation and Student's t value for the number of data values used for each calculation. Water quality standards attainment is evaluated as an assessment period mean of at least ten samples taken on different dates not to exceed the derived criterion. The assessment period must be at least one year.

The calculation is based on the minimum value for the assessment period mean that chlorophyll a , total phosphorus, or total nitrogen would have to attain such that a Student's t test would reject the null hypothesis. The null hypothesis is that the assessment period mean and the mean of the baseline data were drawn from the same population with a probability of 0.01 (one-tailed). The calculations assume that the assessment period mean is based on at least ten samples and the variances of the baseline data set and data used for calculating the assessment period mean are the same.

Calculated as follows:

$$\text{Criterion} = \bar{X}_1 + t_{(1)(0.01)} \left(s_{\bar{X}_1 - \bar{X}_2} \right)$$

Where: criterion = the value the assessment period mean should not exceed
 \bar{X}_1 = mean of the baseline data set
 $t_{(1)(0.01)}$ = critical value of the t distribution where $\alpha = 0.01$ one tailed at $n_1 + n_2 - 2$ degrees of freedom
 $\left(s_{\bar{X}_1 - \bar{X}_2} \right)$ = standard error for the difference of two means

$$\left(s_{\bar{X}_1 - \bar{X}_2} \right) = s_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

Where: n_1 = number of samples in baseline data set
 $n_2 = 10$ = number of samples used to calculate the assessment period mean
 $s_p = s$
 s = standard deviation of the baseline data
 s_p = standard deviation of the pooled data

Reference: Moore, D. S. and G. P. McCabe. 1993. The pooled two-sample t procedures. pp 542-549. *In Introduction to the practice of statistics*. W. H. Freeman and Company, New York.