# Adequately Analyzing Environmental Data (Newsletter)*

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Project objectors used to file permit application appeals based on the subjective, "we think ...," "we feel ...," "we believe ..." that the proposed project will harm ... (fill in the blank). Now a common allegation is that data supporting the application were not adequately analyzed.

"Adequately" is subjective and can halt the regulatory process until addressed. To refute this allegation demonstrate compliance with the "Hard Look Doctrine." Since "hard" is also subjective it is vital that the analyses be robust, technically sound, and legally defensible. Actively take this approach in preparing your application and reduce the likelihood of this challenge. Here is how to demonstrate taking a hard look.

Carefully define the question data are to answer. Do they establish baseline conditions? Are they looking for change over space, time, or both? Do they demonstrate compliance with permit conditions? Are there other concerns such as those expressed in scoping a project? Carefully defining the question applies to both new and existing data.

Methods used depend on the data: continuous or counts. Common statistical models do not work with most environmental data; these data are not normally distributed. This is, they cannot be modeled by reference to the familiar bell curve. Transformation, usually the logarithm of each number, frequently resolves this issue.

The first step is to describe the data; the box-and-whisker plot ("boxplot") is ideal. Boxplots show the five important parameters of the data distribution and permit quick visual comparison of multiple groups. Following this, apply appropriate models to answer the the question(s) of interest. Remember, associations (correlations) do not show cause and effect; regressions do. These results result in a hard look at the data.

Often, change over time needs to be assessed and explained. Time series analyses plot data and show trends and periodic variability. Periodic variability must be removed before the trend can be described and tested for difference from a flat line. Two or more trends can also be compared to determine if they significantly differ. Periodic variability can be tested with regression analyses to identify explanatory variables responsible for the variations. The most

common and familiar time series analyses fit data to a model requiring regular sampling. This is seen in stock market price reports and quarterly labor statistics. Most environmental data are not obtained on a regular schedule. For example, stream channels might be dry or inaccessible, and animal populations are not always easily observed. Often, environmental time series models must be fit to the data and accommodate varying times between data points. Doing this demonstrates compliance with the hard look doctrine.

Water chemistry analyses, particularly of metals, have analytical detection limits. All values less than that cannot be distinguished from zero. To demonstrate compliance with the hard look doctrine appropriate statistical models must be used. All arbitrary assignments of these values to zero, the detection limit, or somewhere in between are wrong and will produce erroneous summary statistics.

Water (and air) chemistry data are continuous. All biotic data are counts requiring much different, and more complex, statistical analyses.

If you take steps to comply with the hard look doctrine when planning, collecting, and analyzing data for your permit applications you might well pre-empt the challenge of data analysis inadequacy. The time and money you save can be very valuable.