Draft Assessment and Listing Methodology for interpreting the chloride WQS

New Chloride WQS:

	Magnitude	Duration	Frequency
Acute	860 mg/l	Not more than a 1 hour average	Not more than once per 3 years
Chronic	230 mg/l	Not more than a 4 day average	Not more than once per 3 years

Need

With the addition of chloride to the Vermont Water Quality Standards (WQS) and the growing spotlight on water quality impacts of deicing salt application on our waterways there is now a need to develop a rigorous and transparent assessment method. This method will ultimately be used to determine the aquatic life uses support status with regard to chloride which, in turn will inform listing of impaired waters on the 303(d) Impaired Waters List. This document describes the Watershed Management Division's proposed assessment methodology in light of the newly promulgated chloride standard as well as the data requirements necessary to make use support determinations.

This proposed assessment methodology is currently proposed only for chloride, as opposed to other toxics identified in Appendix C of the WQS. There are a couple of reasons for this. The first is the relative prevalence of chloride in the environment compared to nearly all of the other Appendix C parameters. With the nearly ubiquitous application of deicing salt in Vermont, there is a steady source of chlorides that results in a continuum of concentrations across many waters except those in completely undeveloped watersheds. The rigorous method proposed herein enables identification of the truly impaired waters as opposed to merely those which may be stressed by chloride. Second, the well accepted surrogate of conductivity enables a confident application of the duration/frequency components of the WQS by utilizing in situ probes and dataloggers. This readily available continuous monitoring capability is not available for other parameters. It's anticipated that the majority of chloride assessments will utilize automated technology as presented herein. Therefore, this unique method is not only appropriate to employ, but necessary to describe.

Use Support Decisions

Waters will be assessed against both the acute and chronic criteria simultaneously and the level of aquatic life use support (full support, stressed, or non-support) will be determined based on the methodology described below. In order for the waterbody to achieve a higher assessment, it must fully comply with the assessment criteria of the next lowest use support condition. For example, to achieve a "full support" assessment, the waterbody must meet the conditions for the "stressed" assessment category.

Full support:

No exceedances in excess of chronic criterion of 230 mg/l.

- Rationale: full support waters should have chloride levels consistently below the chronic criterion. This is protective for both the chronic and acute criteria.

Stressed:

One or more exceedances of the chronic criterion for any given 3 year period or evidence of consistently elevated chloride levels. The determination of "elevated chloride levels" will be assessed on a case by case basis. Where available, biomonitoring information will be evaluated to assist in the aquatic life use assessment. The water will be assessed as stressed and flagged for follow-up monitoring, likely the development a continuous dataset.

- Rationale: Presuming any exceedances of the chronic criteria don't indicate "non-support" as described below, a few exceedances of the chronic criterion are allowable in any given 3 year period. However, exceedances or elevated chloride levels may represent conditions that need further evaluation.

Non-support:

Chronic criterion

Grab Samples: Given the duration and frequency terms of the chronic criteria, limited numbers of chloride grab samples will rarely be sufficient to document the four-day average over a three year period. Surface waters with multiple samples above the criterion will direct the need for follow-up monitoring, using a continuous dataset. However, if a sufficiently large chloride dataset exists to confidently calculate any unique 4-day average exceeding the criterion, then the water will be assessed in non-support.

- Rationale: To confidently calculate the 4-day duration aspect of this criterion, a fairly robust dataset needs to be developed, which rarely occurs with grab samples. It takes more than a few samples in the course of a day to calculate any given day's average chloride concentrations because, under certain conditions, levels can fluctuate relatively quickly. By flagging the water as needing a more complete dataset, a more confidant assessment determination can be made.

Continuous Monitoring Using Conductivity: Where continuous monitoring datasets indicate an average chloride concentration in excess of 230 mg/L for more than one four day period in a three-year period, the waterbody will be assessed in non-support.

Acute Criterion

Grab Samples: A minimum of 2 samples, separated by one hour, that exceed 860 mg/L for any given 3-year period.

- Rationale: This assumes that a single grab sample adequately represents a one-hour average and that multiple samples over two hours represent non-support of the acute criterion.

Continuous Monitoring Using Conductivity: Where continuous monitoring datasets indicate an average chloride concentration in excess of 860 mg/L for more than one hour in a three-year period, the waterbody will be assessed in non-support.

Impaired Waters Delisting

To be most protective, and to ensure confidence that a previously impaired waterbody has come into compliance, a continuous dataset will be required. So that the most critical conditions for chloride impairment are sufficiently represented, the following sampling criteria need to be met:

1. an adequately representative dataset needs to be developed between June 1 and September 30 when baseflow has the greatest likelihood of showing impacts due to groundwater loading, and
2. an adequately representative dataset needs to be developed between December 1 and March 15 when the melt of managed snow from paved areas is likely to contain the highest chloride concentrations.

No more than 1 exceedance of the chronic or acute criterion in any 3 year period shall be detected.

[Questions: Is monitoring data from both of these flow conditions necessary? What is an adequate monitoring period within these periods…weeks, months?]

Continuous Conductivity Datasets

Chloride is a unique parameter when it comes to measuring it in the aquatic environment. Not only can you measure it directly in the laboratory from grab samples, but specific conductance has been shown to be a reliable surrogate for measuring it in the field. By using modern water quality probes and dataloggers, continuous estimates of chloride can be obtained for weeks or months at a time. Simple regression equations relate specific conductance measurements to chloride concentrations and recent studies in the Chittenden County region of Vermont have successfully employed these techniques The continuous datasets make it easier to make assessments relating the 3 aspects of the WQS: magnitude, duration and frequency, and are particularly useful in assessing the 4-day duration aspects of the chronic criterion.

Where adequate continuous conductivity datasets exist, they will be assessed based on the duration of exposure and the frequency of exceedance criteria as described below:

Acute Criterion Dataset

Continuous dataset means specific conductance samples taken at least every 15 minutes for a duration that equals or exceeds the duration that the acute criteria (i.e. 1 hour). The arithmetic average chloride concentrations estimated from specific conductance measurements, taken over the 1 hour, shall be compared to the acute criterion to determine compliance or noncompliance.

Chronic Criteria Dataset

Continuous datasets means specific conductance samples taken at least every hour for a duration that equals or exceeds the duration that the chronic criteria (i.e., 4 days). The arithmetic average chloride

concentrations, estimated from specific conductance measurements, taken over the 4 days shall be compared to the chronic criterion to determine compliance or noncompliance.

For a continuous dataset to be considered complete and comparable to the criteria, samples must have been collected over a time period that encompass the exposure period that the criteria is based on (i.e., 1 hour for acute and 96 hours for chronic criteria).

Rolling averages are calculated for all possible blocks of 1 hour (acute criteria) or 96 hours (chronic criteria). The time blocks overlap. For example, the 1 hour average value is calculated if four specific conductance measurements were made within the hour at 15 minute increments and the 96 hour average value was calculated if 384 specific conductance measurements were made over the four day period.

For comparison of continuous datasets to the frequency component of the standard, the average of either the acute or chronic exceedences shall not exceed the frequency of exceedance (i.e. an average of no more than 1 exceedence every 3 years).

Specific Conductivity as a Chloride Surrogate

Specific conductance can be used as a surrogate for chloride samples. When specific conductivity is used as a surrogate for chloride, it is necessary to collect at least 2 chloride samples within each time period that the specific conductance to chloride relationship is to be used. These samples will be used to confirm that the site fits the statewide specific conductance to chloride relationship. If confirmation samples do not adequately fit the statewide relationship, a site-specific relationship can be developed (see discussion below).

Conductivity/Chloride Relationship

The Watershed Management Division is currently in the process of developing a state-wide conductivity/chloride regression to be used to estimate chloride concentrations from conductivity data.

The Division anticipates that the final regression equation will be sufficient in most cases to accurately estimate chloride concentrations when site specific regressions are not available. However, where site specific data is sufficient, a site-specific regression may be preferred.

Criteria for Using the State-Wide Chloride Regression

Study Areas without a Site-Specific Chloride Regression

If the organization/researcher has not developed a site-specific chloride regression that is equal to or better than the WSMD state-wide chloride regression, the organization/researcher should use the WSMD state-wide chloride regression. The organization/researcher should follow the steps listed below to verify that the state-wide regression is acceptable for their study area.

1. The organization/researcher will collect at least 2 data pairs of chloride concentration and specific conductivity on water samples collected from the study area. If possible, the data pairs should be collected during different flow conditions and seasons.

2. If the data pairs consistently fall outside the 95th percentile confidence interval for the regression, then the organization/researcher should question whether the WSMD state-wide regression is appropriate for their study area.

Study areas with Site-Specific Chloride Regressions

If the organization/researcher has developed a site-specific chloride regression that is equal to or better than the WSMD state-wide chloride regression, the organization/researcher should use the site-specific regression. The following guidance should be used to determine if the site-specific regression is superior to the state-wide regression.

1. The chloride-specific conductance data pairs should be representative of the study area in terms of seasons and flow conditions. In particular, the data pairs should have the following characteristics:

- If the organization/researcher collects specific conductance data during the winter season (Nov-Mar), the data pairs should be collected during the winter season. If the organization collects specific conductance data during the summer season (Jun-Sept), the data pairs should be collected during the summer season. If the organization collects specific conductance data in both seasons, the data pairs should be collected from each season.

- Some of the data pairs should be collected during low flow conditions and some from high flow conditions in each season.

- Some of the data pairs should be for water samples with "high" conductance readings relative to the maximum specific conductance measured in the study area. The maximum conductance in a calibration data pair should not be less than 75% of the maximum conductance measured in the study area.

2. The 95th percentile confidence limit for predictions should be less than the error in the WSMD statewide chloride regression.