# Iowa DNR Toolbox for Chloride Limits Compliance

## A. Introduction

The Iowa DNR adopted the current chloride criteria on November 11, 2009 to replace the site-specific total dissolved solid (TDS) general standard. The change came as the result of the Iowa DNR conducting and compiling more research related to the toxicity of TDS, chloride, and sulfate in order to better protect river, stream, and lake aquatic life uses and reevaluate the current interim approach for TDS. Research has shown that integrative parameters such as TDS are not robust predictors of toxicity. Iowa DNR research into existing ion concentrations in Iowa waters found that of the common substances comprising the major portion of TDS, toxicity is always associated with either sulfate or chloride. Sodium, calcium, magnesium and carbonates make up the other ions in the majority, but these are not sufficiently toxic to create the need for individual water quality standards. Simply put, if sulfate and chloride, alone or in combination, meet the proposed standards, toxicity from the other major ions comprising "total dissolved solids" is insignificant. Therefore, the TDS concentration provides no additional useful information. The old site-specific TDS standard was cumbersome and results in restrictions where none should exist. The specific ion criteria for chloride and sulfate are based on the most up-to-date toxicity data and were approved by the EPA.

## B. Tools/Approaches to Achieve Compliance

For facilities discharging into a waterbody with zero flow, the end of pipe default chloride limits are shown in the following Table:

**Table 1. End of Pipe Chloride Limits**

| Chemical | Monthly Average (mg/L) | Daily Maximum (mg/L) |
|---|---|---|
| Chloride | 389 | 629 |

Based on the research of this issue in other states, it is clear there is no easy treatment solution for the removal of chloride. The treatment options are few and the ones that are available are typically cost prohibitive when considered for publicly owned treatment works. The following includes a list of options that facilities can consider if chloride compliance issues arise.

### 1. Source Reduction

Chloride source reduction can be accomplished in several ways, including, but not limited to:

- Modified operation of home water softeners by optimizing salt usage
- Removal of home water softeners
- Exchange tank home water softeners
- Soften water where needed; a.k.a. "feed softened water"
- Removal or replacement of centralized ion exchange
- Best management practices where solid salt is used to prevent it from being washed down the drain (e.g. kosher slaughter house and IDOT truck washing operations)
- Removal of chlorine contributions to the waste stream or effluent (e.g. chlorine bleach, disinfection via chlorination)

Options such as minimizing home water softener use, removal of water softeners, and using softened water at points where necessary can save money immediately or in the long run, depending on how the options are implemented. Exchange tank softening is more expensive than traditional home water softening. Removal or replacement of centralized ion exchange water softening for municipalities can be costly and may be considered as a last resort if it is identified as the main source of the chloride or sulfate in the effluent entering Iowa's surface waters and the drinking water system is not treating for compliance with a drinking water Maximum Contaminant Level (MCL). Maintaining compliance with the safe drinking water standards is also a primary factor that must be considered when analyzing possible central ion exchange removal.

The sources of chloride may vary dramatically from town to town or industry to industry depending on several factors, including, but not limited to:

Municipalities:
- The use of home water softening
- Drinking water treatment plant backwash
- Industrial contributors
- Centralized ion-exchange softening
- Source water

Industries:
- Industry type
- Processes that utilize salt
- Source water
- Use of softened water
- Closed or open loop cooling water
- Brine recovery

**2. Effluent Recycle or Reuse**

The effluent could be potentially used for other purposes including cooling water and livestock watering. This is a win-win solution and result in no discharge.

**3. Site-specific Water Chemistry Data Collection**

A unique aspect to the proposed chloride criteria is that its toxicity is dependent on hardness and sulfate (and conversely, sulfate toxicity is dependent on hardness and chloride). In general, the harder the water, the less toxic chloride and sulfate is to aquatic life. Conservative statewide default values will be used in the initial calculation of chloride and sulfate permit limits.

If a facility cannot comply or struggles to comply with chloride numeric permit limits, then it may explore the option of establishing revised chloride limitations based on site-specific hardness and sulfate concentrations of the effluent and receiving stream. Site-specific effluent limits will ensure the appropriate benchmarks are in place for determining compliance. This is anticipated to be a course of action widely used as a first step towards compliance.

The Iowa DNR's site-specific data collection guidance requires two years of data at a frequency of once per month for each parameter, or one year of data at a frequency of twice per month. For chloride, both hardness and sulfate wastewater effluent and ambient upstream samples need to be collected. Site=specific data collection must follow the procedures described in the Wasteload Allocation Procedure Document, available on the Iowa DNR's Wasteload Allocations webpage at: https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Wasteload-Allocations

**4. Mixing Zone Study**

Chloride effluent limits are calculated using the default mixing zone percentages. However, a facility can collect site-specific mixing zone data which can be used to calculate the chloride limits in lieu of the default mixing zone percentages. The mixing zone study must follow the procedures described in the Wasteload Allocation Procedure Document, available on the Iowa DNR's Wasteload Allocations webpage at: https://www.iowadnr.gov/Environmental-Protection/Water-Quality/Wasteload-Allocations

**5. Piping to a Larger Waterbody**

For facilities that discharge into an effluent dominated stream, the end of pipe chloride limits apply. The discharge could be piped to a waterbody that has higher critical low flows. Higher dilution could potentially increase the chloride limits.

**6. Outfall Consolidation**

Consolidating effluent streams may be a feasible option for industries with multiple outfalls that contain different process wastewater streams. It is possible that combining these treated wastewater streams together may make practical sense in order to achieve compliance with the chloride criteria.

**7. Diffuser Installation (if discharging to a perennial stream)**

An in-stream diffuser to disperse effluent across a more significant portion of the stream is an optional artificial means to achieve rapid mixing. A diffuser must be properly designed to achieve rapid mixing with the stream flow at the diffuser to minimize the potential adverse impact from the discharge in order to prevent acutely toxic conditions and allow safe fish passage. Diffuser wasteload allocation calculations will be based on the percentage of stream critical low flow that passes across the operational portion of the diffuser as demonstrated by a dye study or accurate diffuser modeling. The discharge flow from diffuser ports must achieve homogeneous mixing within 100 feet downstream of the diffuser. Thus, for a dye study or modeling of a diffuser, a rapid and uniform mixing dilution factor must be achieved within 100 feet downstream of the diffuser. Several permits are required for the diffuser structure, including a construction permit.

**8. Stepwise Limits (only discharge if stream is above a specified stream flow)**

A stepwise flow approach can be used if a facility chooses to not discharge below a specified stream flow and only discharges when stream flow is high enough to assimilate the discharge. Stepwise water quality based effluent limits will be derived using the specified stream flow in lieu of the critical low flows. This approach can be used if the facility clearly demonstrates that there is sufficient storage available to operate in this manner and has an accurate means of determining stream flow at the point of discharge.

**9. Flow Variable Limits (if there is a gage nearby and can measure stream flow accurately)**

Flow variable effluent limits can provide point source discharge facilities the option to have water quality based effluent limits that vary with stream flow. However, flow variable limits are not a replacement for treatment. The flow variable limit approach provides a mechanism that is both protective of water quality standards and provides flexibility for facilities to achieve compliance under elevated stream flow conditions.

In order to be eligible for flow variable limits, a facility is required to:

(1) Demonstrate its ability to meet its effluent limits at critical low flow conditions;
(2) Be able to obtain daily stream flow measurements that accurately represent the stream flow at the outfall location;
(3) Pass an antidegradation review if the facility does not currently have flow variable limits.

Flow variable limits are expressed as pounds per day per unit stream flow in cubic feet per second (lbs/day/cfs) and are based on the applicable chronic and acute water quality criteria and the assimilative capacity of the receiving stream under different flow conditions.

**10. Compliance Schedules and Disadvantaged Communities**

A compliance schedule may be included in a NPDES permit to provide a facility with time to achieve compliance with permit limits. A longer compliance schedule may be included in an NPDES permit if the facility is qualified as a disadvantaged community. Contact an NPDES permit writer to obtain more information on compliance schedules and disadvantaged communities.

**11. Water Quality Standard Variance**

A water quality standard (WQS) variance is a time-limited designated use and criteria: (1) for a specific pollutant; (2) from a specific source or for a specific water body; and (3) that reflects the highest attainable condition for a specific time period. This type of variance is a regulatory mechanism that allows progress toward attaining a designated use and criterion that is not currently attainable. It can be used as a tool to provide time and flexibility for facilities toward compliance. Several states have used the tool for multiple discharge variances. However, based on 40 CFR 131.14, a WQS variance is a water quality standard subject to EPA review and approval. The time and effort that takes to adopt a WQS variance can be a concern.