Alaska Department of Environmental Conservation

Alaska Consolidated Assessment and Listing Methodology (CALM) for 2020 Integrated Report on Water Quality

June 11, 2019

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Abbreviations, Acronyms, and Definitions

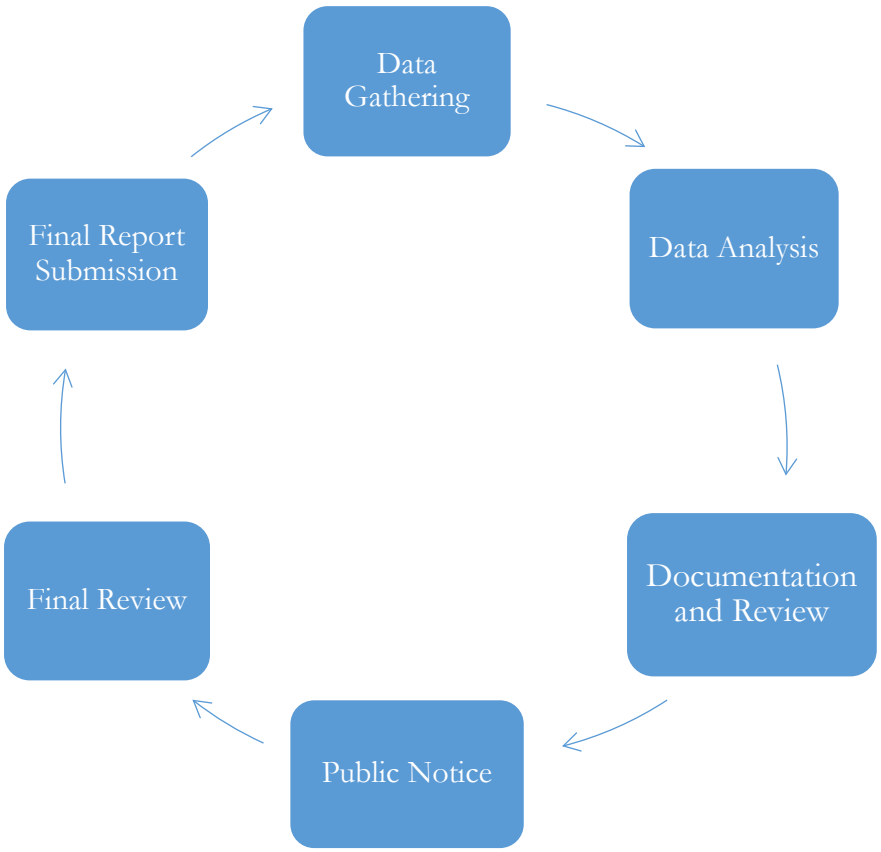
303(d)	Clean Water Act Section 303(d) requires that States provide a list of impaired waters that are not meeting water quality standards.
305(b)	Clean Water Act Section 305(b)
AAC	Alaska Administrative Code
Acute	An acute effect refers to a situation where the pollution is of such a nature that there is an immediate, obvious impact on the water environment.
ATTAINS	The Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System
AU	Assessment Unit. A waterbody segment or portion of a waterbody segment from which data are evaluated to determine compliance with water quality standards. Assessment units are typically delineated using the NHD reaches for fresh waters and grids for open waterbodies. AUs are the basis for identifying waterbody listings.
AWQMS	Ambient Water Quality Monitoring System
Call-for-data	A solicitation notice for parties to submit water quality data and information collected within ten years of the published end date that will be addressed in the forthcoming water quality assessment.
CALM	Consolidated Assessment and Listing Methodology
CFR	Code of Federal Regulations
Chronic	The chronic effect describes the situation where the pollution causes a gradual, ongoing accumulation of harmful effects in the water environment.
Continuous Monitoring	Sampling regime that records a series of parameter values at a defined frequency. Monitoring is automated through the use of an electronic sonde and downloaded periodically for assement purposes.
Criterion	A criterion is a set concentration or limit of a water quality parameter that, when not exceeded, will protect an organism, a population of organisms, a community of organisms, or a prescribed water use with a reasonable degree of safety; a criterion might be a narrative statement instead of a numerical concentration or limit
Critical Period	A reoccurring timeframe (e.g. a specific season or time of day) during which designated uses are more susceptible to impairment.
CWA	Clean Water Act or the Federal Water Pollution Control Act (33 U.S.C. 1251 - 1387), as amended through February 4, 1987
DEC	Alaska Department of Environmental Conservation
Designated Use	Designated uses are those uses specified in 18 AAC 70.020 as protected use classes for each waterbody or segment, regardless of whether those uses are being attained
EPA	U.S. Environmental Protection Agency
Exceedance	A water quality parameter result value that is greater than, or outside of the acceptable range of, an adopted numeric water quality standard criterion.
Impairment	Impairment describes the non-support of a designated use as defined at 18 AAC 70.020 in accordance with Alaska's CALM process.
Integrated Report	The Integrated Report is a state water quality status report used to satisfy the requirements of Clean Water Act (CWA) Section 303(d) and Section 305(b).

Listing	Listing describes the water quality assessment process and resulting categorization of a waterbody in accordance to the DEC CALM process
Natural Condition	Natural condition means any physical, chemical, biological, or radiological condition existing in a waterbody before any human-caused influence on, discharge to, or addition of material to, the waterbody.
QA/QC	Quality Assurance / Quality Control
QAPP	Quality Assurance Project Plan. A formal scientific plan for the collection, identification, and evaluation of data.
QMP	Quality Management Plan
SOP	Standard Operating Procedure
STORET	'STORage and RETrieval', an electronic database maintained by U.S. EPA for water quality monitoring data. STORET has been incorporated into a central federal database for environmental data; the Water Quality Portal (WQP)
Sufficient and Credible	Sufficient and credible means scientifically valid chemical, physical, or biological data that (A) is of adequate quantity and quality; and (B) is collected under a sampling and analysis plan, including quality assurance and quality control procedures, and addressing spatial and temporal coverage, as applicable.
TMDL	Total Maximum Daily Load
Toxic	Toxic means of, relating to, or resulting from a substance or substance combination that causes in affected organisms or their offspring (A) death, disease, malignancy, or genetic mutations; (B) abnormalities or malfunctions in growth, development, behavior, or reproduction; or (C) other physical or physiological abnormalities or malfunctions
WQ	Water Quality
WQA	Water Quality Assessment. Used to satisfy CWA sections 303(b) and 305(a) reporting requirements.
WQP	Water Quality Portal. The Water Quality Portal (WQP) is the product of a long-term collaboration between the National Water Quality Monitoring Council, the USGS, and the EPA. By combining data from three federal data databases- USGS NWIS, EPA STORET, and USDA STEWARDS
WQS	Water Quality Standards. Rules that consist of a water quality criterion, protected class (i.e., designated use), and antidegradation policy. The water quality standards represent the chemical, physical, and biological conditions necessary to support the state designated uses of a waterbody.

Introduction and Background

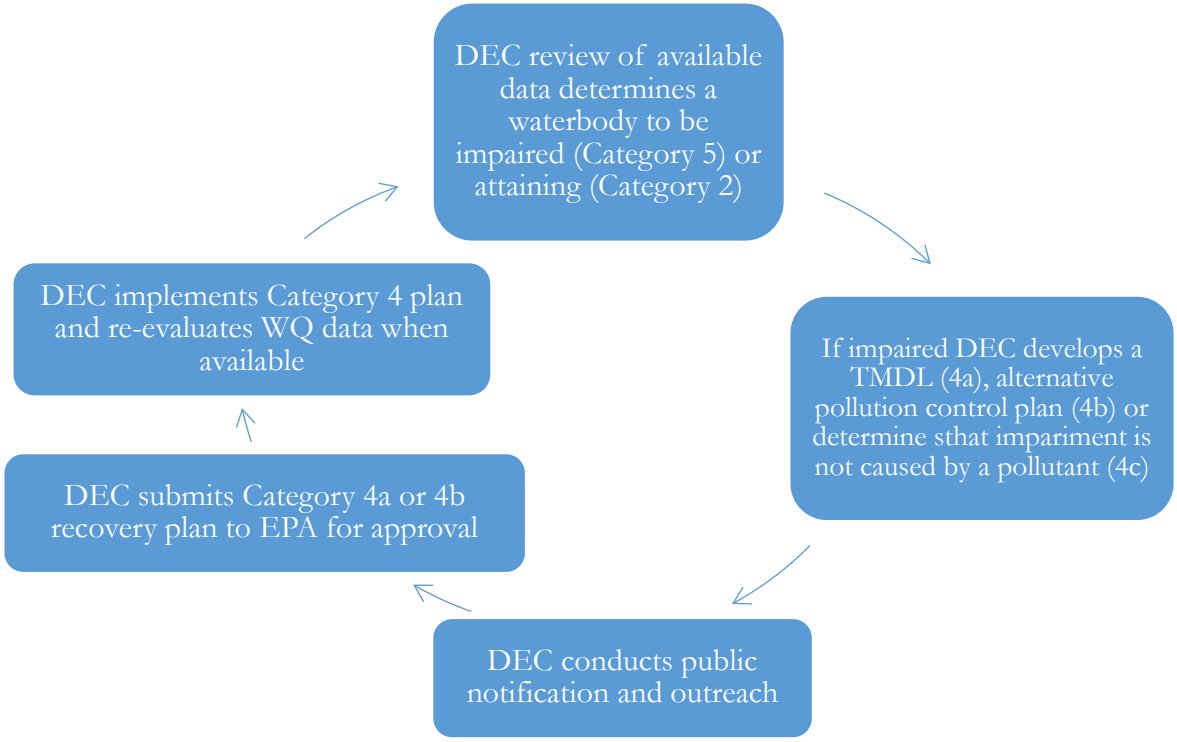
The Consolidated Assessment and Listing Methodology (CALM) describes the Department of Environmental Conversation's (DEC) policies and procedures for conducting water quality data analysis for the Alaska Integrated Water Quality Monitoring and Assessment Report (Integrated Report) under Clean Water Act sections 303(d) and 305(b). DEC uses the term '303(d) process' in this document to describe water quality (WQ) assessment-related actions that result in a Category 4 or Category 5 determination. The general process for developing the annual Integrated Report can be described in Figure 1. More detailed information on the Integrated Report is available at http://dec.alaska.gov/water/water-quality/integrated-report.

Figure 1. Water Quality Assessment and Integrated Report Cycle



Following an impairment decision, DEC will schedule a restoration planning process following an impairment decision (Figure 2) Additional details on the restoration process is beyond the scope of this document.

Figure 2: Waterbody Impairment and Restoration Process



The CALM defines the minimum data requirements and analysis used during the Integrated Report development process. The CALM employs a two-step process:

1. DEC evaluates data to determine if sufficient and credible data exists to make a listing or a delisting decision; followed by
2. An assessment of the data in accordance to the policies noted in this and other relevant DEC documentation.

Water quality assessments should yield transparent and reproducible recommendations based on clear numeric or narrative thresholds allowing decisions to be largely data driven. DEC's CALM is considered to be in alignment with EPA's Consolidated Assessment and Listing Methodology (2002) and similar EPA recommendations. DEC may need to make WQS decisions on matters not referenced in this methodology or in a manner not in accordance with this methodology to address unusual or unforeseen situations. Any listing decisions made by DEC that deviate from the CALM will be clearly explained in the waterbody assessment record. The CALM will be periodically revisited and revised to incorporate advances in scientific procedures.

The CALM is structured in the following manner:

- Section 1 Call for Data provides information regarding how DEC aquires and evaluates the applicability of water quality data

- Section 2 Data Qualification Process provides direction on when sufficient and credible data exists to determine how a water should be categorized during the 303(d) or 305(b) assessment process.
- Section 3 Exclusions provides the list of criteria that should not be evaluated using this guidance.
- Section 4 Waterbody Categorization describes the general process used to determine which category a waterbody would be assigned to following CALM protocols.
- Section 5 Impairment Thresholds provides the minimum data requirements and exceedance thresholds for conventional and toxic pollutants to determine if a water should be categorized as impaired (Category 4 or 5), attaining (Category 1 or 2) or if there is insufficient information (Category 3).
- Section 6 Overwhelming Evidence Policy indicates the final analysis that should be considered to determine if overwhelming evidence exists which could result in an impairment finding even with limited data.
- Appendix A provides additional data clarifications when applying the CALM thresholds.
- Appendix B: Binomial Methodology

Section 1. Call for Data

DEC staff collaborate on WQ monitoring with a diverse group of sources including governmental agencies across local, state, and federal boundaries, as well as Alaskan tribes, municipalities, and watershed-based nongovermental organizations. DEC issues a public notice every two years (biannual) asking for WQ data for Alaska's waters and accepts WQ data and information on a continuous basis. DEC maintains the DEC Ambient Water Quality Management System (AWQMS) database to store water quality data locally and as the mechanism to submit data to EPA's National database, the Water Quality Portal (WQP), through the Water Quality Exchange data network.

The following is a sample of information requested by DEC to help facilitate the data submission process.

- Waterbody name, identification and location,
- Sampling location identifiers including latitude/longitude (if available),
- Date and time each sample was collected,
- Type of sample,
- Parameters analyzed and analytical methods,
- QA/QC data and any data qualifiers

In order for WQ data to be considered as the primary evidence for a 305(b) waterbody determination for attainment/impairments decisions, a quality assurance project plan (QAPP) and the appropriate metadata must be available.

Section 2. Data Qualification Process

To ensure a high quality system of data collection, appropriately qualified[1] and trained personnel must perform all WQ sampling and monitoring activities. The DEC Water Programs Quality Management Plan serves as the guiding document for the data qualification process.[2] DEC may facilitate the development of generic QAPPs and quality management plans for citizen environmental groups and grantees. DEC's intent is to ensure that appropriate QAPP and QMP controls are in place and in practice. Additional QAPP guidance, checklists, and samples are available at http://dec.alaska.gov/water/water-quality/quality-assurance/,

QAPPs, laboratory data transmittals, chain of custody forms, calibration records and laboratory qualifications should be available upon request. Water flow data should be provided if readily available. Non-direct measurements such as photos, weather conditions and waterbody conditions may be requested as supporting documentation.

Older data (> 5 years) may be considered as ancillary evidence when determining if a waterbody meets or exceeds WQ criteria if pollutant sources causing the impairment have not substantially changed or more recent confirmatory data is collected. Data older than 10 years may not be used to determine impairment, but may be used in trend analysis or other modelling for protection or restoration purposes.

As a means of explicitly defining how Alaska will evaluate available data and/or information from other sources for its reliability and significance in the assessment process, DEC has developed the Water Quality Data Qualification process (Table 1) presented on the following pages. Application of the highest level of data feasible is essential to ensuring DEC's listing determinations, including Category 5 decisions, are technically and legally defensible. Data levels 2-4 are most desireable as Category 5 decisions may result in significant expenditures of public and private resources to alleviate the source(s) of the impairment and bring the waterbody back into compliance with state WQS.

[1] "Qualified" mean a person who has been trained or possesses the education, experience and expertise to collect environmental samples

[2] Document is available at http://dec.alaska.gov/water/water-quality/quality-assurance/

Table 1. Water Quality Data Qualification Process

Data Use (Integrated Report Eligible Category)	Data Level	Technical Component	Spatial and Temporal Coverage	Data Quality
Screening Purposes (Category 3 only)	**1**	Monitoring via grab sampling	Low spatial and temporal coverage: • Limited number of sampling locations • Quarterly or less frequent sampling with limited period of record (e.g.,. 1 day • Limited data representing critical conditions • Sampling personnel not trained • Data older than 5 years	• Low precision and sensitivity • QAPP not adequate or not followed • QA/QC results are inadequate • Methods not documented • Inadequate metadata
Screening or Overwhelming Evidence (Category 3 or 5)	**2**	Use of one of the following: • Grab sampling • Rotating basin surveys based on single visit • Verified volunteer data	Moderate spatial and temporal coverage: • Adequate assessment unit coverage, several sites within assessment unit • Data that are likely to reflect current conditions, but may be older than five (5) years	• Low precision and sensitivity • QAPP including approved SOPs available • QA/QC results adequate • Approved SOPs used in field and lab • Adequate metadata

Table 1. Cont.

Data Use	Data Level	Technical Component	Spatial and Temporal Coverage	Data Quality
Assessment Purposes (Category 2, 4 or 5)	**3**	One (1) of the following: • Water quality monitoring using grab samples • Rotating basin surveys involving multiple visits or automatic sampling • Calibrated models (calibration data greater than 5 years old) • Limited use of continuous monitoring instrumentation	Broad spatial and temporal coverage of sites with sufficient frequency and coverage to capture acute events: • Representative site(s) within an assessment unit • Sampling during key periods (e.g., critical hydrological regimes), multiple samples at high and low flows • Minimum of 10 representative data points total (all years, all sites, after averaging) from multiple sampling events representing a minimum three-week seasonal period of concern • Samples collected during at least 2 years, not necessarily consecutive years, within a 5 year period • Period of sampling adequate to monitor for chronic conditions for the specific parameter of concern • Data that are likely to reflect current conditions, but may be older than five (5) years	• Moderate precision and sensitivity • QAPP adequate • QA/QC protocols followed, QA/QC results adequate • Approved SOPs used for field and lab. • Adequate metadata
Assessment Purposes (Category 1, 2, 4 or 5)	**4**	Water quality monitoring using composite samples, a series of grab samples, and/or continuous monitoring devices	Broad spatial and temporal (at least 2 years) coverage of fixed sites with sufficient frequency and coverage to capture acute events, chronic conditions, and other potential chemical/ physical impacts: • Representative site(s) within an assessment unit • Sampling during key periods of water quality concern (e.g., critical hydrological regimes), including multiple samples at high and low flows • Minimum of 20 representative data points total (all years, all sites, after averaging) from multiple sampling events representing a minimum three-week seasonal period of concern • Samples collected during at least 2 years, not necessarily consecutive years, within the most recent five (5) years	High precision and sensitivity • Approved QAPP • QA/QC protocols followed, QA/QC results adequate • Approved SOPs used for field and lab; qualified samplers[1]; adequate metadata

Section 3. Waterbody Delineation

The DEC WQA process applies to waters of the state as described at 18 AAC 70.990(66). DEC's methodology for identifying assessment units (AU) follows a hydrologic approach starting from the mouth of a waterbody and moving upstream. DEC applies the National Hydrography Dataset (NHD) reach codes as the initial basis for deterning the length of an AU. Changes in hydrology and significant landuse influences identified during the assessment process are considered when determining whether to assign a new AU segment. Due to the limited availability of geographical information across Alaska and the dynamic nature of waterbodies in general, some AUs may be more precise than others and updated as more information becomes available.

Section 4. Exclusions

The 2020 CALM will not be used for the following pollutants for determining attainment as specific methodologies have been or scheduled to be developed (see: http://dec.alaska.gov/water/water-quality/integrated-report):

- Pathogens (2019)
- Petroleum Hydrocarbons, Oils, and Grease (2015)
- Residues (2003)
- Turbidity (2016)
- Toxic Pollutants in Sediment (in development)
- Temperature (in development)
- Nutrients, i.e., nitrates, total nitrogen, ammonia, phosphates/phosphorus (future development)
    - Nutrients are non-conservative parameters that can be taken up or released by biological processes.
    - Nitrate/nitrites may be evaluated for the drinking water use only based on the drinking water criterion without averaging (i.e. exceedance is determined using individual measurements) due to acute toxic effects.

Section 5. Waterbody Category Assignment

5.1 Waterbody Categories

DEC categorizes waterbodies as follows:

Category 1. WQS Attained for All Designated Uses

Water quality data indicates that all criteria for all designated uses are being met.

Category 2. WQS Attained for Select Designated Uses

Category 2 is assigned to those waterbodies where data indicates that WQS for some certain designated uses are attained, but there is insufficient data and information to determine if the WQS for the remaining designated are attained.

Category 3. Water of Concern (Insufficient Data).

Category 3 is assigned to those waterbodies where data or information is insufficient to determine if the WQS for designated uses are persistently being attained or impaired. This may be due to a lack of conclusive numeric or narrative information to make a definitive determination about the waterbody in question. Examples of situations where this may occur include:

- Incomplete dataset (e.g. too few samples, not representative)
- Differing quality in applicable datasets (e.g., Level 1 v. Level 2)
- Age of the data (i.e., historic (>10 years), >5 years, but conditions have substantially changed)
- Water chemistry-based criteria (e.g., ammonia, hardness-based metals); when multiple samples fail to include critical information to calculate a criterion accurately.
- Binomial test fails for both attainment and impairment determinations due to statistical confidence level.

Category 4. Impaired or Threatened

Category 4 describes those waterbodies in which available data indicates that at least one designated use is not being supported or threatended but a total maximum daily load (TMDL definition below) is not required at this time. Those waters that do require a TMDL or other form of pollution prevention control are described below.

Category 4a. Impaired with a Total Maximum Daily Load

Category 4a describes those impaired waterbodies for which an EPA-approved total maximum daily load (TMDL) has been established. A TMDL is the calculation of the maximum amount of a pollutant allowed to enter a waterbody so that the waterbody will meet and continue to meet water quality standards for that particular pollutant. A TMDL determines a pollutant reduction target and allocates load reductions necessary to the source(s) of the pollutant.[3]

Category 4b. Impaired with Other Pollution Controls

Category 4b describes those impaired waterbodies where WQS can be attained through other pollution control measures and a formal plan has been approved of by EPA.[4] A TMDL is not needed because other pollution control requirements are expected to result in the attainment of an applicable WQS in a reasonable period of time.

Category 4c. Impaired, Not Caused by a Pollutant.

Category 4c describes those waterbodies whose failure to meet WQS is not caused by a pollutant (as defined by the Clean Water Act); instead, the waterbody is subject to impairment due to a non-pollutant such as:

- Physical barrier to fish migration
- Invasive species

[3] Text retrieved from https://www.epa.gov/tmdl/overview-total-maximum-daily-loads-tmdls. on 1-14-2019.
[4] Eric Monschein and Shera Reems. 2009. Catgory 4b: Current Status and National Trends. *US Environmental Protection Agency, Office of Water

- Flow alterations, including dewatering as the result of anthropogenic activity (e.g., urbanization)

Category 5. Impaired (the 303(d) List)

Impaired waterbodies where WQS for one or more criteria are not attained requiring TMDL or recovery plan development. Category 5 waterbodies are those identified on the CWA Section 303(d) list of impaired waters.

5.2 Assessment Process

In Alaska, the process for identifying waterbodies that do not meet WQS, as required in the CWA Section 303(d), begins with an internal review of existing and new information to determine (1) the presence of pollutants, (2) the occurrence of persistent exceedances of WQS, (3) whether or not impacts on the designated uses are occurring, and (4) the degree to which WQS and the other criteria are attained.

In 2018, EPA created a national database and website that integrates the data from the 303(d) report and the 305(b) report, allowing states to provide waterbody-specific assessment results and summary reports in a streamlined manner. The new database is named the Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System (ATTAINS). The concept of ATTAINS is to move the 303(d) and 305(b) reporting process (i.e., Integrated Report) to a paperless process using Exchange Network technology. In the ATTAINS database, states assess and track the water quality assessments for their surface waters in AUs that may cover an entire waterbody, or be limited to an individual waterbody section. DEC assigns all applicable (e.g., freshwater or marine) use classes to an AU unless a use has been modified per 18 AAC 70.230 or 18 AAC 70.235. ATTAINS tracks the attainment status for designated uses in the applicable AU. The goals of ATTAINS are to more effectively support water quality decision makers and to provide an interactive portal to the public on the water quality status of waterbodies anywhere in the United States. Additional information is on ATTAINS is available at https://www.epa.gov/waterdata/attains.

Section 303(d) of the CWA requires that waterbodies not expected to meet WQS without additional controls be listed as Category 5 (impaired). Section 303(d) of the CWA goes on to require that a pollution prevention plan (i.e. Total Maximum Daily Load (4a)) must be developed and implemented for Category 5 waterbodies. Alternatively, a waterbody recovery plan can be developed and the waterbody would then be placed in Category 4b. Category 4c is reserved for waterbodies with impairment not caused by a pollutant. DEC does not place waterbodies into Category 5 based on inconclusive or circumstantial data or solely on the basis of observation. EPA retains final authority over approval over the listing and delisting of Category 5 waters and reclassification of Category 4 or 5 waters determined to be attaining WQS.

In most cases, data should meet the qualifications for data level 3 or 4 in Table 1 to be evaluated for a decision on waterbody impairment. Data meeting qualifications for data level 2 may be considered for "threatened" impairment status if the data demonstrates overwhelming evidence (see Section 4) or there are multiple lines of evidence (e.g. biological studies, other less qualified data confirming exceedances) that indicate impairment. A sample exceeding a pollutant's magnitude does not necessarily equate to a persistent exceedance of the WQS and sufficient and credible data should be available to make a defensible determination as to attainment or impairment.

Waterbody attainment decisions for data evaluations falling below impairment thresholds will require:

- Data level 4 quality for initial assessments (Category 3 to 2).
- Data level 3 (or the level of data originally used to designate an impairment) will be necessary for reassessments following a period with no pollution control actions (Category 5 to 2).
- Data level 3 quality for reassessment following recovery actions (e.g. BMPs installed, new restrictions in effect) under a TMDL or other pollution controls.

Targeted sampling efforts do not necessarily need to be consecutive but should occur within five years of WQA periods to be considered representative of current water quality.

Waters lacking sufficient and/or credible data in accordance with Section 2 of this document; including overwhelming evidence, to conclude whether a designated use is 'attaining' or 'impaired' will be classified as Category 3.

5.3 Conventional Pollutants

Magnitude

The magnitude of a WQS is the numeric concentration of a pollutant determined to be protective of the designated use. 18 AAC 70(b) specifies the magnitude values used by DEC for conducting water quality assessments.

Duration Periods

Duration describes the length of time a pollutant may be present and potentially impacting a designated use before the criterion is considered exceeded. DEC will accept and analyze data for conventional pollutants that describe discrete (a.k.a. instantaneous or "grab" samples) measurements or samples or time series monitoring datasets (a.k.a. continuous) collected using probes. Duration periods vary by pollutant may be based on hourly, daily, of multiple day assessment periods. All datasets are subject to requirements outlined in Section 1 of this document.

Discrete Data: All pollutants may be subject to discrete data assessment (e.g data from grab samples); however, discrete measurement may have a tendency to underestimate daily extreme values and should be evaluated accordingly during the assessment process. Discrete samples may be considered to be representative of averaging periods if limited data (e.g., multiple samples over a 4 day period) is available for assessment purposes. In cases where multiple discrete samples are available for assessment in a representative time period (e.g., multiple samples in a single day) the applicable value will be dependent on the characteristics of the pollutant of concern.

Continuous Data: Continuous monitoring (a.k.a time-series monitoring) typically applies to pollutants like dissolved gas, dissolved oxygen, pH, and turbidity. Continuous montiring is generally considered to be a more reliable means of assessing water quality data as it is able to capture the presence of diurnal cycles and other naturally occurring fluctuations. Continuous datasets must be reviewed in their entirity (e.g., not censored) for consideration in the assessment process.

Frequency Thresholds

Frequency describes the allowable number of times a water quality criterion can be exceeded without resulting in non-attainment of the designated use. Frequency thresholds vary depending on the nature of the pollutant and assessment methodology. The frequency component is intended to allow inconsequential excursions above the magnitude and to account for uncertainty in the accuracy and representativeness of random samples collected from the waterbody.[5] For the purposes of conducting assessments for conventional pollutants DEC will be applying the binomial statistical method (Appendix B) unless otherwise specified in other DEC guidance and/or regulation.

Other considerations:

- Spatial considerations of the water being characterized should consider the effect of an intervening tributary, outfall, or pollution source
- Per 18 AAC 70.010(d) If it is suspected that the impairment is the result of naturally occurring pollutant, the department will follow the procedures set out in the department's Natural Conditions Guidance and Tools at http://dec.alaska.gov/water/water-quality/standards/natural-conditions.[6]
- The timing of a monitoring schedule should be such that sampling identifies the range of conditions in the assessment unit, including those periods critical to the attainment of the designated use.

5.4 Toxic Pollutants

Magnitude

The numeric criteria for toxic pollutants are identified in the *Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances* (2008).

Duration Periods

Duration periods for toxic pollutants for the protection of aquatic life and human health vary depending on short term (acute) or longer-term (chronic) exposure. All datasets are subject to requirements outlined in Section 1 of this document. DEC requires the arithmetic averaging of multiple samples (≥2) collected within a 4-day period in the assessment unit to calculate chronic criteria for aquatic life. Discrete data may be considered representative of duration averages for acute and chronic criteria for aquatic life provided it meets data criteria identified in Section 1 of this document.

- Acute aquatic life criteria – instantaneous; or one-hour exposure
- Chronic aquatic life criteria – 4-day arithmetic average[7] depending on sampling frequency
- Human Health and Drinking Water criteria - DEC will apply the arithmetic mean of the most recent three years of data to determine compliance with WQS unless DEC determines that a skewed dataset exists and application of a geometric mean is more appropriate for

[5] Oregon Department of Environmental Quality. 2018. *Integrated Reporting Improvements: Statistical Methods for Listing and Assessment of Large and Long Term Data Sets*. Portland, Oregon
[6] Note that the DEC 2006 Guidance was not approved of by EPA for use in Clean Water Act approved programs and additional consultation with EPA may be required before a reference site will be considered applicable.
[7] EPA 2002 CALM. p. 4-6

assessment purposes.[8] All flow data associated with human health or drinking water will be calculated as the harmonic mean.[9]

Duration values for other designated uses (e.g., water supply; recreation) vary depending on the pollutant in question. For additional information, please contact DEC WQS staff.

Frequency Thresholds

Most recommended national water quality criteria for toxic substances protecting aquatic life specify that a WQS is not to be exceeded more than once every three years *on average.*[10] This frequency was selected by EPA because it is statistically impossible to project that an excursion will never occur, and to acknowledge that aquatic communities often exhibit resilience to infrequent excursions above the assigned magnitude.[11] The EPA frequency threshold policy was generally based on small sample sets. For larger sample sets (≥18 samples), EPA has accepted a five percent exceedance threshold within a three year period.[12] In general, DEC applies the following frequency thresholds:

- Acute aquatic life – not more than once in the most recent three year period
- Chronic aquatic life – at least two exceedances and >5% exceedance frequency (See Appendix B) in the most recent 3 year period[13,14]
- For the purposes of conducting aquatic life assessments for larger datasets DEC will be applying the binomial statistical method (Appendix B) unless otherwise specified in other DEC guidance and/or regulation
- Human Health – The harmonic mean concentration of the most recent three years of data *on average*[15] may not exceed criterion

Other Considerations

- Spatial considerations of the water being characterized should consider the effect of an intervening tributary, outfall, or pollution source.

[8] Per EPA 2002 CALM p. 4-7
[9] EPA Water Quality Standards Handbook Ch. 5. p.13
[10] DEC emphasizes this term as larger datasets may indicate that one exceedance is not indicative of water quality over a three year period and that the exceedance rate may be significantly lower. The term *average* is not intended to have a statistical meaning in this context.
[11] Oregon 2018 Integrated Reporting Improvements: Statistical Methods for Listing and Assessment of Large and Long Term Data Sets.. Water Quality Standards and Assessments. Oregon Department of Environmental Quality.
[12] Clarification of EPA Comments on the Draft Methodology for Oregon's 2018 Water Quality Report and List of Water Quality Limited Waters. U.S. Environmental Protection Agency Region 10. Received July 2, 2019
[13] Oregon 2018 Integrated Reporting Improvements: Statistical Methods for Listing and Assessment of Large and Long Term Data Sets. Pg 20. Water Quality Standards and Assessments. Oregon Department of Environmental Quality.
[14] Oregon. 2018 Summary of Binomial Listing Methodology Peer Review: Pg 5. Water Quality Standards and Assessments. Oregon Department of Environmental Quality.
[15] DEC generally limits assessment periods to the most recent credible period. Data beyond three years may be considered on a case-by-case basis if it can be demonstrated that such data is credible and applicable to the assessment process.

- WQS with narrative criteria will be addressed on a case-by-case basis as exceedances of narrative standards are more difficult to ascertain, as there are typically no quantifiable expressions of parameter concentration or loading that result in nonattainment. It is often the impact of pollution or of a pollutant, and not the pollutant itself, which is observed.
- If it is apparent that naturally occurring pollutant is present, an undisturbed reference site is required for demonstrative purposes. Data minimums do not apply to reference sites, but the chosen site must meet criteria for a reference site outlined the department's Natural Conditions Guidance and Tools at http://dec.alaska.gov/water/water-quality/standards/natural-conditions.[16]

Section 6. Overwhelming Evidence

In cases where data is limited due to small or incomplete datasets, DEC may apply the concept of *Overwhelming Evidence* in which information besides the total number of samples is used in the decision making process. EPA's 2002 CALM states:

> "An assessment methodology should take into account the balance between desired data requirements and the practical realities affecting the availability of information and the strength of the available evidence… Generally, decisions should be based on very small sample sizes only when there is overwhelming evidence for impairment."[17]

Overwhelming evidence uses multiple lines of evidence to determine whether a particular narrative threshold is exceeded. DEC will consider overwhelming evidence in cases where sample sizes do not meet minimum criteria or sampling data is inconclusive and yet there is other overwhelming evidence of an impairment. DEC will also consider the anthropogenic factors (e.g., current and historic regulatory practices, monitoring efforts) that may have a relationship between water quality and it's management in a particular waterbody. DEC does not consider the factors noted as overwhelming evidence to alone be sufficient for placement of a AU in Category 5. Data used for overwhelming evidence must meet at least data level 2 qualification in Table 1.

6.1 Conventional Pollutants

- Best professional judgement – the dataset must provide clearly valid, reliable, and relevant exceedances of a numeric criterion of sufficient magnitude, frequency and/or duration to ensure that a "real" impairment exists based on limited data.
- Weight of evidence – quality and quantity of all readily available data and ancillary information (e.g. biological evaluations, older data, pollutant source information)
- Timing of exceedances – consideration of factors that may be contributing to the presence of pollutant concentrations including weather and flow (e.g. storm events)
- Data are not associated with wastewater treatment system upset or other short-term event

[16] Note that the 2006 Guidance was not approved of by EPA for use in Clean Water Act approved programs and additional consultation with DEC and EPA may be required before a reference site will be considered applicable.
[17] EPA 2002 CALM

6.2 Toxic Pollutants

- > one sample that exceed acute criterion for aquatic life by two times (2x)
- 'Weight of evidence'; quality and quantity of all readily available data and ancillary information (e.g. biological evaluations, older data, pollutant source information)
- Case by case for drinking water and human health criteria
- Data are not associated with wastewater treatment system upset or other short-term event

Additional factors applicable to the assessment process for both conventional and toxic pollutants may also include the use of biologic indicators (as available), habitat data, or public health advisories. DEC reserves the right to utilize additional lines of evidence during the CALM process.

Appendix A. Data Considerations

Topic	Action
Non-detect results	0.5 x detection limit (MDL or method detection limit) will be used if a binomial test is being conducted. If 90% (conventionals) of the results are ND, and/or the three highest results (Toxics) do not exceed acute, chronic or human health/drinking water criteria, then no binomial test needs to be conducted.
Quality assurance samples	The highest of the regular sample or QA sample will be used, not both.
Hardness	If hardness as $CaCO_3$ was not calculated by the laboratory and a hardness value is needed for metals evaluation against WQC, it will be calculated (when data is available) by multiplying the calcium result in mg/L by 2.48 and the magnesium result in mg/L by 4.11 and then adding these results to yield total hardness as $CaCO_3$. DEC may also consider one of the following approaches: • Application of the 15th percentile of hardness value as a default value if regional hardness data is not generally available; • application of the 85th percentile of regional hardness data as a default value if such data is available and considered sufficient and credible; or • The geometric mean of all measured data for a similar waterbody in the region of concern that is statistically similar in geochemistry.

Appendix B. Binomial Listing and Delisting Determination Process for Conventional and Toxic Pollutants

Background

The bionomial statistical test is applied during the WQA process to avoid making a premature or erroneous decision when changing the status of a water. It is intentionally difficult to list a waterbody as impaired so that this is not done in error.[18] However, once listed, it is more difficult to demonstrate attainment status to again avoid error and ensure water resources are being accurately characterized and protected. This approach is considered to be conservative since it minimizes potential errors and keeps waters from moving rapidly in and out of impairment status from report to report, particularly when the evidence is close to the threshold for change.

The binomial test is an important step in reducing potential errors as a sample size effects a state's ability to characterize water quality for both attainment or impairment.[19]

> Larger data sets have a greater probability of detecting less frequent exceedances. If a small data set detects an exceedance, the waterbody is likely experiencing a higher frequency of exceedances. However, if a small data set does not detect an exceedance, it is difficult to say with statistical confidence that the water is attaining WQS (EPA 2002 p.52).

For relevant data sets, DEC is proposing to use a binomial hypothesis test that accounts for sample size, errors in sample accuracy and precision, and explicitly defines the acceptable levels of certainty in making a determination. Using this method, the risk of making errors in determining both impairment and attainment is defined and can be weighed.

> EPA does not recommend making decisions based on small data sets of water column chemistry for attainment. Therefore, in the overwhelming majority of WQS scenarios, an approach based on probability sampling, in which states define an acceptable probability of decision error, will be preferred. Statistical inference based on sequential sampling designs may offer an alternative that allows states use defined data quality objectives to identify impaired waters with small data sets. When a state describes its acceptable levels of decision error, it is able to identify the corresponding number of exceedances within a particular sample size that meet the level of decision error (EPA 2002 p. 58).

Absent complete information characterizing the water quality of a particular waterbody, application of binomial statistics informs the decision making process by considering uncertainty, potential for error, and confidence in the listing/delisting decision. This creates a balance between the availability of data and the strength of that data. Overestimation of the number of "true" exceedances of a criterion has the potential to result in an erroneous 303(d) listing or delisting. Listing has the potential to significantly increase regulatory burdens on dischargers and/or communities or

[18] Errors are typically defined as being either Type I errors (incorrectly listing a waterbody that is attaining uses) or Type II errors (not listing a waterbody when that water is not attaining uses).
[19] EPA, 2002. Consolidated Assessment and Listing Methodology. Toward a Compendium of Best Practices, First Edition. First Edition. Office of Wetlands, Oceans, and Watersheds. Washington D.C. p.49

disincentivize the collection and submission of long-term datasets to DEC (Section 1). Incorrectly delisting a water could result in continuing environmental degradation.

DEC will consider the quality of the data (Section 2), the criteria for determining attainment as described in Section 5, and other relevant evidence as discussed in Section 6 when determing whether to list a waterbody.

A listing determination is based on water quality data that demonstrates a pollutant is present, at a magnitude and duration, beyond the allowable frequency value. For conventional pollutants, this means that a pollutant exceeds the numeric criterion in more than 10 percent of the time in a given dataset. For toxic pollutant, this means that a pollutant exceeds the numeric criterion more than once in three years or in approximately five percent of the total dataset.[20,21]

Delisting describes the removal of a waterbody previously placed on the 303(d) list as it is now attaining water quality standards or conditions have changed. The following describes DEC's delisting terms or conditions.

1. Waterbody is attaining WQS. Waters may be removed from Category 5 and reassigned to Category 2 if there is sufficient information to determine that a waterbody persistently meets water quality criteria for the pollutant(s) of concern.[22] Water quality data must be determined to be meeting Data Category 3 or Data Category 4 requirements.
2. Current information demonstrates an error in the Category 5 listing. A waterbody may be removed from Category 5 if there is information that the original listing was erroneous due to sampling or data interpretation. DEC may determine whether Category 2 or 3 is most appropriate based on the quality of the information available.
3. WQS have been modified. In cases where DEC adopts a revised criterion (e.g., site specific criteria); reclassifies a waterbody per 18 AAC 70.235, or adopts an EPA-recommended value that is less stringent than previously adopted, a waterbody may be removed from Category 5 and reassigned to Category 2.
4. A TMDL or other pollution control requirements (e.g., 4b) have been approved.
5. It has been determined that the source of impairment is not a pollutant as defined in state and federal regulation.

The process for listing and delisting a waterbody subject to conventional pollutants, except at noted in Section 4, is documented in Tables 1 and 2.

The process of delisting a waterbody previously identified as Category 5 (impaired) for toxic pollutants for the designated use of aquatic life is described at Tables 5 and 6.

The process of delisting a waterbody from Category 4a or Category 4b determined to be impaired for aquatic life requires;

[20] IBID. p.45
[21] EPA, 2003. Guidance for 2004 assessment, listing, and reporting requirements pursuant to sections 303(d) and 305(b) of the Clean Water Act.
[22] DEC does not have a policy for placement of a water in Category 1 as such a policy would require water quality characterization of a much larger subset of state waters than is currently available.

- ≥ 10 discrete samples demonstrating attainment of aquatic life criteria within a three-year period. Multiple samples collected within a four-day period for determining compliance with chronic criteria will be averaged in accordance to Section 5 of this document. 4-day assessment periods should be no less than four days apart and adequately spaced to demonstrate that they are representative of the assessment unit and critical condition(s) identified in the original listing determination.
- The conditions of the TMDL (4a) or alternative pollution plan (4b) are documented to have been or actively are being implemented.

DEC will seek to maintain balance between Type I errors (incorrectly listing a waterbody that is attaining uses) or Type II errors (not listing a waterbody when that water is not attaining uses) by adoption of a 90 percent confidence level (10 percent exceedance) when using binomial methodology for determining attainment. With small sample sizes, uncertainty and the probably of making Type I errors is high and decreases with larger sample sizes.

Critical Values for Listing a Waterbody for Conventional Pollutants

Null Hypothesis: Actual exceedance proportion is ≤10 percent (e.g., the water is attaining WQS)
Alternate hypothesis: Actual exceedance proportion is >10 percent
Minimum confidence level is 90 percent
Minimum sample size of ten

Table 1: Binominal sample requirements for Listing (Conventionals)[23]

Sample Size	Number of exceedances required for listing
10-11	2
12-18	4
19-25	5
26-32	6
33-40	7
41-47	8
48-55	9
56-63	10
64-71	11
72-79	12
80-88	13
89-96	14
97-104	15
105-113	16
114-121	17
122-130	18
131-138	19
139-147	20
148-156	21
157-164	22
165-173	23
174-182	24
183-191	25
192-199	26
200+	Consult with DEC

Critical Values for Delisting a Waterbody for Conventional Pollutants

Delisting a waterbody typically requires application of the alternate hypothesis in which it is assumed that the water is impaired. In an effort to avoid delisting a water when it is in fact impaired (e.g., Type II error) the number of samples is increased to 15 as a means of increasing balance between Type I and II errors. Increasing the minimium sample size increases the statistical power and confidence in the delisting decision, avoids committing a Type II error, and prevents waters from

[23] Adapted from Oregon Department of Environmental Quality. 2018. Draft Methodology for Oregon's 2018 Water Quality Report and List of Water Quality Limited Waters. Water Quality Division. Portland, Oregon

moving back and forth between different categories with each assessment cycle. In general, DEC anticipates that more water quality data will be available for delisting than what was collected and assessed during the listing determination process.

Null Hypothesis: Actual exceedance proportion is >10 percent (e.g., the water is not attaining WQS)
Alternate hypothesis: Acutal exceedance proportion is ≤10 percent
Minimum confidence level is 90 percent
Minimum sample size of 15

Table 2: Binomial Sample Requirement for Delisting (Conventionals)[24]

Sample Size	Number of allowable exceedances required for Delisting
15	1
16-18	2
19-25	3
26-32	4
33-40	5
41-47	6
48-55	7
56-63	8
64-71	9
72-79	10
80-88	11
89-96	12
97-104	13
105-113	14
114-121	15
122-130	16
131-138	17
139-147	18
148-156	19
157-164	20
165-173	21
174-182	22
183-191	23
192-199	24
200+	Consult with DEC

[24] Adapted from Oregon Department of Environmental Quality. 2018. Draft Methodology for Oregon's 2018 Water Quality Report and List of Water Quality Limited Waters. Water Quality Division. Portland, Oregon

Critical Values for Listing Toxic Pollutants in Category 5

Null Hypothesis: Actual exceedance proportion is ≤5 percent (e.g., the water is attaining WQS)
Alternate hypothesis: Acutal exceedance proportion is >5 percent
Minimum confidence level is 90 percent
Minimum sample size of 2

Table 3: Binominal Sample Requirements for Listing (Toxics-Cat 5)[25]

Sample Size	Number of exceedances required for listing
2-18	2
19-22	3
23-35	4
36-49	5
50-63	6
64-78	7
79-92	8
93-109	9
110-125	10
126-141	11
142-158	12
159-174	13
175-191	14
192-200	15
>200	Consult with DEC

Critical Values for Delisting Toxic Pollutants in Category 5

Delisting a waterbody typically requires application of the alternate hypothesis in which it is assumed that the water is impaired. In an effort to avoid delisting a water when it is in fact impaired (e.g., Type II error) the number of allowable exceedances is decreased as a means of increasing balance between Type I and II errors. Increasing the minimium sample size increases the statistical power and confidence in the decision in an effort to prevent waters from moving back and forth between different categories with each assessment cycle. In general, DEC anticipates that more water quality data will be available for delisting than what was collected and assessed during the listing determination process.

Null Hypothesis: Actual exceedance proportion is >5 percent (e.g., the water is not attaining WQS)
Alternate hypothesis: Acutal exceedance proportion is ≤5 percent
Minimum confidence level is 90 percent
Minimum sample size of 18

[25] Adapted from Oregon Department of Environmental Quality. 2018. Draft Methodology for Oregon's 2018 Water Quality Report and List of Water Quality Limited Waters. Water Quality Division. Portland, Oregon

Table 4: Binomial Sample Requirements for Delisting (Toxics-Cat 5)[26]

Sample Size	Number of allowable exceedances required for Delisting
18-22	1
23-35	2
36-49	3
50-63	4
64-78	5
79-94	6
95-109	7
110-125	8
126-141	9
142-158	10
159-174	11
175-191	12
192-200	13
>200	Consult with DEC

[26] Adapted from Oregon Department of Environmental Quality. 2018. Draft Methodology for Oregon's 2018 Water Quality Report and List of Water Quality Limited Waters. Water Quality Division. Portland, Oregon