2024 Guidance for Assessing and Reporting Surface Water Quality in Texas

In Compliance with Sections 305(b) and 303(d) of the Federal Clean Water Act

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TCEQ SFR-127
Nov. 13, 2024

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Texas Integrated Reports published since 1998 are available on the TCEQ website at:
www.tceq.texas.gov/waterquality/assessment/305_303.html

The preparation of this report was financed in part through grants from the United States Environmental Protection Agency.

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List of Abbreviations Used

AD	adequate data
ALU	aquatic life use
AU	assessment unit
AVS	acid volatile sulfide
BEACH	Beaches Environmental Assessment and Coastal Health
BMP	best management practice
BPJ	best professional judgment
C	concern assessment
°C	degrees Celsius
CASRN or CAS#	Chemical Abstract Service Registry Number
CFR	Code of Federal Regulation
CFS or ft3/s	cubic feet per second
CI	confidence interval
CN	concern
CRP	Clean Rivers Program
CS	concern – screening levels
CV	coefficient of variation
CWA	Clean Water Act
DO	dissolved oxygen
DSHS	Texas Department of State Health Services
DWS	domestic water supply
E	enterococci
EC	*E. coli*
EPA	United States Environmental Protection Agency
ERM	effects range—median
ESG	equilibrium sediment-partitioning guideline
°F	degrees Fahrenheit
FS	fully supporting
FW	freshwater
GLO	Texas General Land Office
HH	human health
HQI	habitat quality index
ID	inadequate data
IBI	index of biotic integrity
I-Plan	Total Maximum Daily Load Implementation Plan
IPs	Procedures to Implement the Texas Surface Water Quality Standards
IR	Integrated Report
JQ	based on judgment of the assessor
LCRA	Lower Colorado River Authority
LD	limited data
LOQ	limit of quantitation
m	meter
MCL	maximum contaminant level

µg/L	micrograms per liter
µS/cm	microSiemens per centimeter
mg/L	milligrams per liter
ml	milliliter
NA	not assessed
NDMC	National Drought Mitigation Center
NC	no concern
NCR	noncontact recreation
NHD	National Hydrography Dataset
NS	not supporting
OE	other information evaluated
OS	outside state boundaries
PEC	probable effects concentration
PEL	probable effects level
PCR	primary contact recreation
PCR2	primary contact recreation 2
PWS	public water supply
QA	quality assurance
QC	quality control
7Q2	seven-day, two-year low-flow
RBA	rapid bioassessment
RUAA	recreational use attainment analysis
RWA	receiving water assessment
SCR1	secondary contact recreation 1
SCR2	secondary contact recreation 2
SM	superseded method
SR	not spatially representative
SW	saltwater
SWQM	surface water quality monitoring
SWQMIS	Surface Water Quality Monitoring Information System
TAC	Texas Administrative Code
TBWP	Texas Beach Watch Program
TCEQ	Texas Commission on Environmental Quality
TDS	total dissolved solids
TMDL	total maximum daily load
TOC	total organic carbon
TOXNET	Toxicology Data Network
TPWD	Texas Parks and Wildlife Department
TSSWCB	Texas State Soil and Water Conservation Board
TR	not temporally representative
TSWQS	Texas Surface Water Quality Standards
USGS	United States Geological Survey
U	use attainment
UAA	use attainability analysis
WPP	watershed protection plan

Chemical Acronyms and Abbreviations

2,4 – D	2,4-Dichlorophenoxyacetic acid
2,4,5-TP	2-2,4,5-trichlorophenoxy propionic acid
BHC	Hexachlorocyclohexane
$CaCO_3$	Calcium carbonate
Chl *a*	Chlorophyll *a*
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
HCB	Hexachlorobenzene
MEK	Methyl ethyl ketone
MTBE	Methyl tert-butyl ether
NH_3-N	Ammonia-nitrogen
NO_3-N	Nitrate-nitrogen
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
TBT	Tributyltin
TDS	Total dissolved solids
TN	Total nitrogen
TP	Total phosphorus
TTHM	Total trihalomethanes

Dioxins and Furans

TCDD	Tetrachlorodibenzo-p-dioxin
HpCDD	Heptachlorodibenzo-p-dioxin
HpCDFs	Heptachlorodibenzofurans
HxCDDs	Hexachlorodibenzo-p-dioxins
HxCDFs	Hexachlorodibenzofurans
OCDD	Octachlorodibenzo-p-dioxin
OCDF	Octachlorodibenzofuran
PeCDD	Pentachlorodibenzo-p-dioxin
PeCDF	Pentachlorodibenzofuran
TCDF	Tetrachlorodibenzofuran

Chapter 1
Summary of the Reporting Approach

Introduction

In compliance with Sections 305(b) and 303(d) of the Federal Clean Water Act (CWA), the Texas Commission on Environmental Quality (TCEQ) evaluates water bodies in the state and identifies those that do not meet uses and criteria defined in the Texas Surface Water Quality Standards (TSWQS). Guidance developed by the United States Environmental Protection Agency (EPA) directs each state to document and submit the results of its evaluation to the EPA biennially, in even-numbered years (CWA Section 305(b)(1)). TCEQ publishes the results on its website as the Texas Integrated Report of Surface Water Quality (IR) prepared by TCEQ and submitted biennially to the EPA.

The IR describes the status of water quality in those surface water bodies of the state evaluated for a given assessment period. TCEQ uses data collected during a recent seven to ten-year period. The data are gathered by many different organizations all of which operate according to approved quality control (QC) guidelines and sample collection procedures. The quality of waters described in the IR represents a snapshot of conditions during the specific time period considered in the assessment.

Assessment Guidance Overview

Water quality is evaluated according to this assessment guidance developed by staff of TCEQ with input through an advisory stakeholder process. Individuals representing diverse organizations and interests are invited to participate in the revision of current guidance and to develop, review, and comment on new draft guidance prior to each IR as needed due to the proposal of new or revised methods. The advisory group includes but is not limited to, state agencies, environmental consultants, river authorities, environmental groups, industry, agricultural interests, and municipalities.

After the evaluation is complete, all water bodies are placed into one of five categories. The categories indicate the status of water quality. Category 5 constitutes the 303(d) List of Impaired Waters for which total maximum daily loads (TMDLs) or other management measures may be required. TCEQ holds a public comment period to solicit input from the public and stakeholders on the IR and prepares a schedule identifying TMDLs TCEQ expects to develop and submit to the EPA within the next two years. The TMDL schedule is submitted to the EPA as part of the IR.

Development of the Integrated Report and 303(d) List

Development of the IR includes the following basic steps:

- Active solicitation and selection of acceptable data and information to develop the IR.
- Solicit stakeholder input on assessment guidance and revise existing methods as necessary.
- Assessing the data and information to determine which water bodies are not meeting TSWQS (See Chapters 2 and 3).
- Preparing and categorizing the draft IR.
- Data provider review of assessment data and summary information.
- Receiving public comment on the draft IR.
- Revising and finalizing the assessment and List based on new information and comments from the EPA and the public.
- Developing a schedule for TMDLs for Category 5 water bodies.
- Present draft IR at a TCEQ Agenda for Commission approval.
- Submit draft IR to EPA for review and approval.

Data and Information Used

As required by CWA Section 303(d) and 40 Code of Federal Regulations (CFR) Section 130.7(b)(5), TCEQ considers all existing and readily available water quality-related data and information during the development of the IR. TCEQ solicits data and information primarily through established public outreach mechanisms of the Texas Clean Rivers Program (CRP), including steering committee meetings, public meetings, publications, and by posting drafts of the IR on TCEQ's website.

TCEQ and the EPA recognize that there are some boundaries that must be established for the data and information ultimately used for listing. These include:

- **Time limitations** – In most circumstances, data collected prior to the most recent seven-to-ten-year assessment period do not adequately reflect current conditions.

- **Data quality** – Given the regulatory implications associated with the use of water quality data, the TCEQ uses scientifically rigorous and consistent water quality sampling methods to help ensure valid outcomes.

- **Data format –** All data must be in a form that does not require extensive data format manipulation to be useable for assessment. TCEQ provides guidance and support to monitoring entities that allow them to submit data in an appropriate and consistent format.

Data must therefore meet minimum quality assurance (QA) and QC requirements established by TCEQ. This includes collection of data according to applicable procedures in the *Surface Water Quality Monitoring Procedures, Volume 1: Physical and Chemical Monitoring Methods, RG 415, and Volume 2: Methods for Collecting and Analyzing Biological Assemblage and Habitat Data, RG 416*, hereafter referred to as the SWQM Procedures Volume 1 and SWQM Procedures Volume 2, as well as applicable Texas laboratory accreditation requirements (Title 30 Texas Administrative Code [TAC], Chapter 25).

Data that are not collected under a TCEQ-approved quality assurance project plan (QAPP), if submitted, must be accompanied by documentation of QA for evaluation by TCEQ water quality staff. Data without appropriate QA documentation will be considered as anecdotal evidence to support or refute assessment results but will not be used in statistical evaluations.

Readily Available Data and Information

Readily available data considered for inclusion in the IR include the following:

- **Routine surface water quality data stored in TCEQ's Surface Water Quality Monitoring Information System (SWQMIS) database**
  - These data are used to conduct the assessment and to compile the draft IR. This database consists of water quality data collected by TCEQ, the United States Geological Survey (USGS), the Texas Department of State Health Services (DSHS), the Texas Parks and Wildlife Department (TPWD), Texas State Soil and Water Conservation Board (TSSWCB), and CRP planning agencies and their associated partners.
- **Routine data and information obtained from other sources**.
  - Fish consumption advisories, aquatic life closures, and oyster waters closures issued by the DSHS.
  - Recreational beach advisory information provided by the Texas General Land Office (GLO).
  - Drought information from the National Drought Mitigation Center (NDMC).

Other Data and Information

To refine the draft IR, TCEQ relies on an initial data provider review and a formal public comment period to solicit additional data and information that support the listing process. These additional data and information can be used to support or refute results of the initial data assessment and to revise the category of water bodies. These data and information may also be used to direct future water quality monitoring activities. In all cases, the appropriateness of these data for use in the IR are determined by TCEQ water quality staff.

Water Quality Data Collected for Watershed Protection Plans and TMDL Implementation Plans

By definition, a watershed represents an area, peripherally bounded by a divide which causes water to drain to a watercourse or body of water. Water quality in the lower reaches of a watershed is directly influenced by the physical characteristics and anthropogenic activities in the upstream portions. Hence, water quality impairments in downstream assessment units (AUs) are influenced by conditions and activities that occur in the upper subwatershed and contributing tributaries. TCEQ and the TSSWCB recognize the importance of this connectivity and support the development of restoration plans (Watershed Protection Plans [WPPs] and TMDLs/TMDL Implementation Plans [I-Plan]) as a means to address water quality impairments identified in the IR. WPPs and TMDLs include detailed objectives, strategies, and measurable benchmarks designed to improve water quality in impaired assessment units. Typically, water quality monitoring in contributing tributaries or targeted areas is a critical component of a WPP or a TMDL and samples are collected to address several objectives, including:

- Quantifying concentrations of pollutants which can be used to support modeling activities.
- Identifying contributing sources of pollutants.
- Tracking the effectiveness of best management practices (BMPs).

These data are an important component of effective implementation and are used to direct efforts designed to contribute to the overall restoration of water quality within watersheds (impaired AUs as well as contributing tributaries). Considering these objectives, the assessment of data collected in the contributing tributaries located in subwatersheds, or targeted environmental conditions would be of limited utility for determining use attainment in the impaired AU(s). Identification of additional impairments in these contributing tributaries, or targeted areas based on these data is not likely to lead to increased effectiveness of the overall restoration plan. Thus, water quality data collected from contributing tributaries, or targeted areas as part of WPP and TMDL activities for source identification, model development, or BMP effectiveness will typically be excluded from the assessment.

Categorizing Water Bodies

During the assessment, water quality parameters are evaluated against criteria designated in the TWQS. As a result, one of five categories is assigned to each parameter by segment to assist with the development of management strategies. When a segment falls into more than one category because of different impairments (Categories 4 and 5), its overall category is the highest numbered category assigned to any one use. Details about categories, assigning categories, and associated management strategies are discussed in Chapter 5.

Removing a Water Body from the 303(d) List

Water bodies are removed from the 303(d) List (Category 5) for any one of the following reasons:

- **Standards are met** – Additional monitoring data demonstrate that a water body meets applicable water quality standards.

- **Errors in listing** – Errors in the data or procedures used to list the water body invalidate the original basis for listing.
- **New procedures used** – Procedures used by the state to assess water quality monitoring data are routinely improved and revised. In the absence of recent data, the original data set for a listed water body may be reassessed with more accurate procedures and be found to attain the standard or criteria. The strength and quality of the data set, and quality of the water, must also meet the requirement for delisting using revised methods.
- **Revised standards** – Water quality standards and criteria have been revised, and a listed water body attains the new standards or criteria.
- **TMDL approval** – The EPA approves a TMDL designed to attain water quality standards for a water body—Category 4a.
- **Water body expected to meet** – Based on water quality controls in place (other than a TMDL), attainment of the water quality standards is expected in a reasonable period of time—Category 4b.
- **Impairment not caused by a pollutant** – New information demonstrates that the impairment is not caused by a pollutant, and that water quality conditions cannot be changed by the allocation and control of pollutants through the TMDL process—Category 4c.

Note that for Category 4 impairments, because there are water quality controls in place, or the nonsupport is not amenable to TMDL processes, impairments are removed from Category 4 when water quality standards are attained.

Public Participation

The draft IR, including the 303(d) List, is posted on TCEQ’s website. Stakeholders and the public are alerted of opportunities to comment through a notice of publication in the Texas Register. Through the CRP, TCEQ has contracted with river authorities or other local water quality management entities in each major river basin to engage a diverse stakeholder group. TCEQ distributes notification of opportunities to comment through the stakeholder process.

Comments, data, and information must be submitted during the formal public comment period in written form, via email, post, or special delivery to ensure an accurate record of the comments of the person or group submitting them. Comments received during the comment period are considered in the development of the draft IR. Those who comment will not be notified that their comments were received.

A summary of all comments received during the formal public comment period, along with TCEQ’s response to those comments, are published with the draft IR on TCEQ’s website.

Preparation of the Schedule for TMDL Development

In compliance with 40 CFR 130.7(b)(4), TCEQ prepares a schedule for the TMDLs that TCEQ expects to develop and submit to the EPA within the next two years. The TMDL schedule is submitted to the EPA as part of the draft IR. Additional factors, not known at the time of the schedule development, may alter the time required to complete the TMDL and hence the date of submission to EPA. The two most significant factors are a change in funding availability, and a change in the degree of complexity of a TMDL.

Preparation of the Final 303(d) List

During the data provider review and public comment periods, TCEQ staff evaluate the data and information received and responds to requests for information. TCEQ staff modify the IR, including the 303(d) List as appropriate, considering applicable guidance and legal requirements. This may result in:

- Removal of a water body or a parameter from the 303(d) List.
- Addition to the 303(d) List of water bodies or parameters not on the draft list.
- Changes in category.
- Upon Commission approval at a TCEQ agenda, the draft 303(d) List, the TMDL Schedule, and supporting materials and summary documents are submitted to the EPA. The supporting materials include, but are not limited to:
    - The most recent Guidance for Assessing and Reporting Surface Water Quality in Texas.
    - A list of water bodies or pollutants removed from the previous list, along with reasons for delisting.
    - A list of water bodies or pollutants added to the 303(d) List.
    - A summary of public comments on the draft 303(d) List, and TCEQ's response to the comments.
    - A summary for each water body describing the status of use support and assessment information.
    - A list of water bodies with Concerns for Use Attainment or Screening Levels.

The final submission is also available for public review on TCEQ's website, Texas Integrated Report of Surface Water Quality[1] and upon request by telephone, mail, or email.

[1] www.tceq.texas.gov/waterquality/assessment/305_303.html

Chapter 2
General Assessment Methodology

Introduction

TCEQ administers water quality management programs with the goal of protecting, maintaining, and restoring Texas water resources including the support of aquatic life, recreation, fishing, and drinking water supplies. The TSWQS reflect the regional and geologic diversity of the state by dividing major river basins, bays, and estuaries into defined segments (referred to as classified segments). Appropriate water uses (e.g., such as aquatic life, recreation, or oyster waters) are designated for each of the classified segments. Site-specific criteria are developed for classified segments to evaluate general uses (e.g., water temperature, pH, chloride, sulfate, and total dissolved solids (TDS). For general uses, site specific criteria apply to classified segments but not to unclassified water bodies.

Numerical criteria (water quality parameter concentrations) established in the TSWQS provide a quantitative basis for evaluating use support and for managing point and nonpoint loadings in Texas surface waters. These criteria are used as maximum or minimum instream concentrations that may result from permitted discharges and nonpoint sources. Procedures for assessing instream water quality against numerical criteria are specified in the TSWQS in addition to this guidance. The implementation of this guidance and each assessment decision may at times involve best professional judgment (BPJ) in the application of the water quality standards. Best professional judgment includes expert opinion and decisions based on available data and site-specific conditions.

The TSWQS also contain narrative criteria (verbal descriptions) that apply to all waters of the state and are used to evaluate support of applicable uses. Narrative criteria include general descriptions, such as the existence of excessive aquatic plant growth, foaming of surface waters, taste- and odor-producing substances, sediment build-up, and toxic materials. Narrative criteria are evaluated with screening levels, if they are available, as well as other information, including water quality studies, existence of fish kills or contaminant spills, photographic evidence, and local knowledge. Narrative criteria, a form of general criteria, are applied to all classified and unclassified waters. The assessment methods for determining compliance with the narrative criteria are not based on adopted numeric criteria but rather an assessment practice prescribed in this guidance. All available lines of evidence must be considered when making listing decisions, including professional judgment.

Instream concentrations of some parameters such as nutrients and chlorophyll a (Chl *a*), toxic substances in sediment, and toxic substances in fish tissue are useful in identifying water quality concerns and in evaluating the causes of nonsupport of the narrative standards. The screening levels (instream concentrations) for these parameters establish targets that can be directly compared to monitoring data. The screening levels are statistically derived from long-term monitoring data or published levels of concern. Recent monitoring data are compared to the screening levels to identify areas where elevated concentrations are causes of concern.

Summary of Method Changes for 2024

Impairments for which a WPP is under development or accepted by EPA will be assigned to Subcategory 5r.

Spatially Representative Data

Geographic Areas for Assessment

The term “water body” is used in a nonspecific way to refer to a stream, reservoir, or estuary. A water body is generally divided into one or more segments. Classified segments are “water bodies” defined in Appendix A of the TSWQS. These segments have designated uses and water quality criteria to support those uses. Each segment is given a number which identifies the river basin and segment. For example, the Brazos River Below Navasota River segment number is 1202.

Water bodies not defined in Appendix A of the TSWQS are considered unclassified waters. For the purpose of the assessment, unclassified waters not in the TSWQS will be referenced to the classified segments described in the Appendix A. Each unclassified water body is given a number which associates it to the classified segment with a letter designation. For example, Beason Creek 1202A, is a small stream which flows into Segment 1202 of the Brazos River. This also applies to certain unclassified water bodies given site specific descriptions, designated uses for aquatic life and criteria listed in Appendix D of the TSWQS. These water bodies follow the same naming convention of other unclassified water bodies. The site-specific descriptions often make up only a portion of a water body. Further delineation of these Appendix D water bodies for the assessment is defined in the section Assessment Units.

Considering the Representativeness of Stations

Water quality standards and criteria are set to protect the attainable uses for each water body. Sample sites used for ambient water quality monitoring are located in areas determined to be reasonably characteristic of major hydrologic portions of the water body and where the criteria should be attainable. Representative sites for stream sample collection should be placed in areas of good flow or circulation. For reservoirs, sites should be located downstream of headwaters and away from shorelines and isolated coves. Reservoir arm sites should be located nearer the main body of the reservoir, rather than the riverine tributary areas. For biological sampling, all habitat types are sampled for characteristics of the fish community, while optimal available habitat, for example cobble substrate riffles, are sampled for benthic macroinvertebrates. The assessor can use BPJ in determining if sites are representative of an assessment area and if it is appropriate to apply criteria to the data. Note that the TSWQS Section 307.9(b) states, “Representative samples to determine standards attainment will be collected at locations approved by the Agency. Samples collected at nonapproved locations may be accepted at the discretion of the Agency.”

Assessment Units

For the purpose of the assessment, use support is reported at both the segment and subarea levels. Each assessment subarea is known as an assessment unit (AU) which is defined as the smallest geographic area of use support reported in the assessment. Support of criteria and uses are evaluated for each AU. To address water quality regulatory activity such as permitting, standards development, and remediation, use support information applies to the AU level. The 303(d) List is reported at the level of the AU for each water body.

An AU often consists of a single representative station used to characterize standards attainment. The data from multiple stations in a single AU can be used in the assessment based on assessor judgment.

Each AU within a water body segment is given a number such as AU_01. A segment may consist of one or more AUs.

There are two general types of AUs:

- **Primary segment AUs** – AUs which are hydrologically defined: They can be the entire segment or parts of the segment, but the cumulative size of the entire primary segment AUs must add up to the total size of the segment. The numbering convention consists of the segment number followed by the AU number (0101_01, 0101_02).

- **Special purpose AUs** – AUs which are defined by available information such as oyster water maps, fish advisories, or special assessments (such as sediment or fish surveys) may cover all or part of the segment. Numbering convention for special purpose AUs include:
  - Oyster waters – 2439OW_01, 2439OW_02
  - Fish advisory – 2451FA_01
  - Special assessments (sediment, fish survey) – 2422SA_01, 2422SA_02

The special purpose AUs assigned to swimming beaches designated by the Texas Beach Watch Program (TBWP) do not follow the convention of the other special purpose AUs. Recreational beach AUs are assigned by segment number and beach name within the segment. For example, 2501BC is the segment identifier for Brazoria County beaches located in Segment 2501. Each beach is also assigned an AU number. For example, 2501BC_01 is Follets Island, 2501BC_02 is Quintana, and 2501BC_03 is Surfside. Since these AUs are linear, they do not add up to the entire segment size.

All assessment methods and use attainment status are reported for each of the primary segment AUs. In some instances, the use and assessment method summary statistics will be calculated across the entire segment, for example, as applied to some general uses (chloride, sulfate, TDS). This same information will be reported for each of the primary AUs (the results will be the same for each AU).

More than one AU type can describe the same parts of a segment. For example, the entire segment can be made up of four smaller AUs—AU_01, AU_02, AU_03, and AU_04. Or, 1403SA_01 can be a sediment survey that applies to the lower part of the segment and includes primary AU 1403_03 and 1403_04. The results of the sediment survey will be repeated for each of these primary AUs (_03 and _04).

AUs do not have to be contiguous; for example, the various marshy fringe areas of a lake can make up one of the primary AUs.

For fish consumption and oyster water assessments, the stream length or area defined as the AU are determined by the information made available by the responsible regulatory entity rather than hydrology. Such information may include oyster water maps, beach advisory days, or fish consumption advisories.

Defining Assessment Units

An AU may have one station, several stations, or no stations if it is in an unmonitored part of the segment. Stations are typically assigned to only one AU within the primary AU type, and do not have to be grouped the same way for special AU types.

An AU can be assessed using only one station that is selected as most representative, or using data combined from several stations.

AUs may be redefined to better represent hydrologically distinct areas of streams, reservoirs, and estuaries. To provide consistency from year to year, the numbering of AUs will be unchanged if boundaries are shifted a little, even if a station is reassigned to an adjacent AU. However, when AUs are combined (because they are not hydrologically distinct areas) or when AUs are split, the description and AU numbering will be changed to better represent the updated assessment area. The National Hydrography Dataset (NHD) is used to georeference the assessment results. In many cases stream paths extend into the upper portions of the watershed beyond the description of the AU. Because TCEQ assesses “surface water in the state,” as defined in the TSWQS, TCEQ’s water programs will identify a regulatory need to define an AU within the context of “surface water in the state.”

Stream AUs

The upstream boundary of the most upstream primary AU is based on yield of the upstream watershed or the flow, which may be calculated from watershed size. For classified water bodies, the upper and lower boundaries are defined in the TSWQS. For unclassified water bodies, the upper and lower boundaries are generally based on the NHD. Certain water bodies, or portions of water bodies, are defined in Appendix D of the TSWQS. For streams described in Appendix D, the entire length typically constitutes one AU (see Figure 2.1).

However, if it is evident that hydrology and water quality conditions are different within the area described in Appendix D, based on water quality sampling and flow information, the segment can be split into more than one AU, with the same criteria applied to all AUs (See Figure 2.2).

Generally, the boundary of one AU and start of another AU is the point where the flow increases due to a confluence with a tributary or wastewater outfall since that can impact water quality. Tributary inflows that have the potential to influence water quality in the parent segment are typically used to define an AU boundary (see Figure 2.3).

Note: The examples used in Figures 2.1 to 2.3 are based on actual water bodies included in the assessment but may have been modified to illustrate various AU selection scenarios.

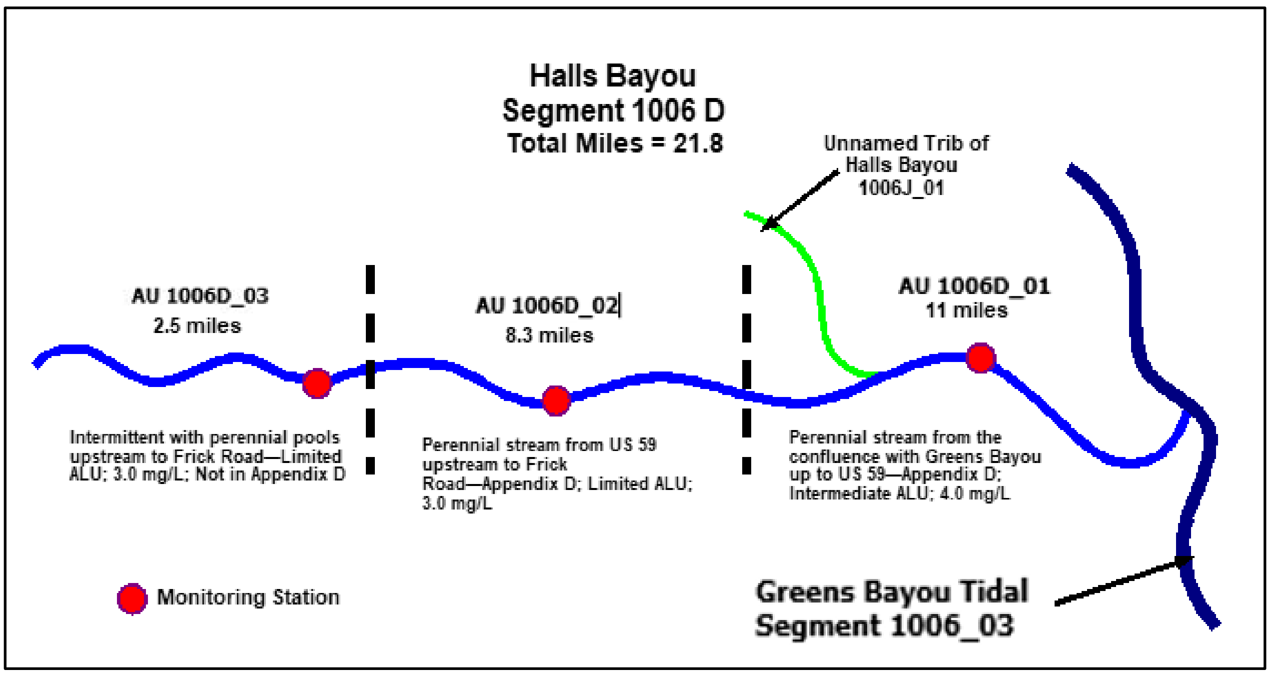

Figure 2.1. Water body with AUs defined in Appendix D

In this example a water body is divided into three AUs, two of which are defined in Appendix D and one with a presumed Aquatic Life Use (ALU).

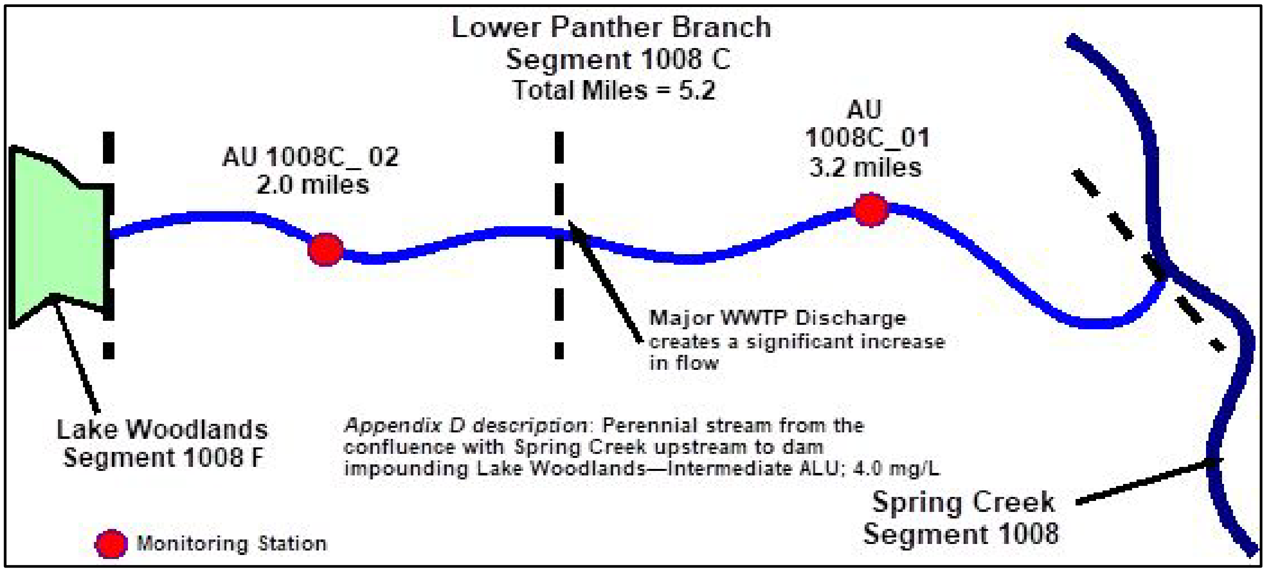

Figure 2.2. Appendix D defined water body divided into two AUs to reflect a significant change in flow.

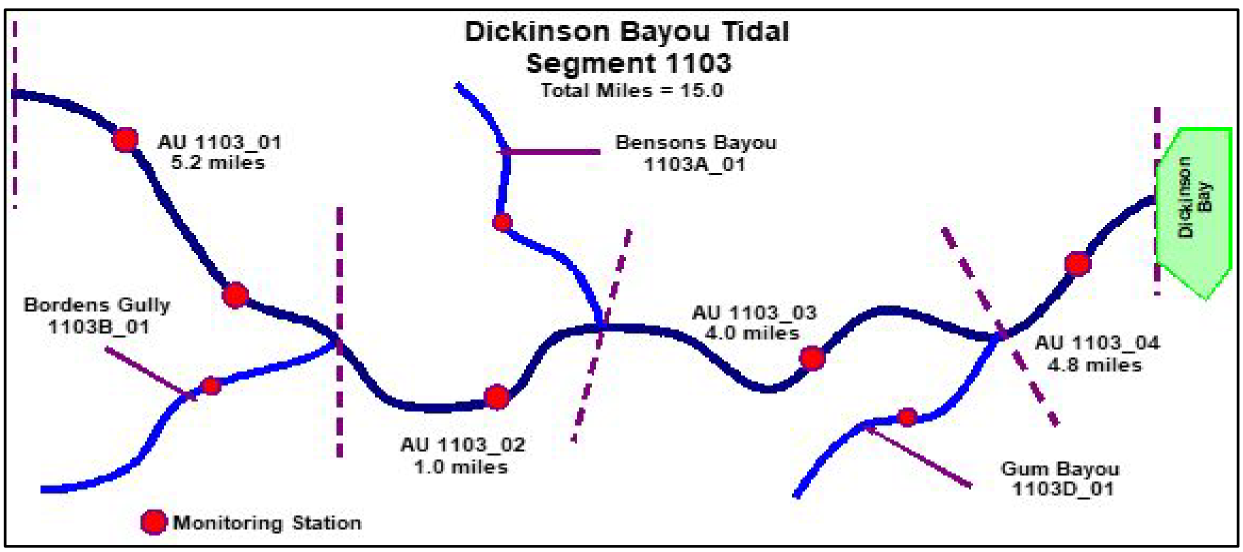

Figure 2.3. Water body divided into four AUs to reflect inflow from water bodies with the potential to influence water quality in the parent segment.

Generally, stream AUs are no more than 25 miles in length. Because an AU represents an area of similar hydrology, a station located anywhere in the AU represents water quality conditions in the entire AU. Stream stations generally characterize a length of stream both upstream and downstream of the station. This length is about 12.5 miles or half the 25 miles typically represented by an AU. A station can also be located at the lower end of an AU characterizing 25 miles upstream of that point. An AU that includes a station located near the upper end of the boundary is typically avoided. Based on assessor judgment an AU can be longer than 25 miles. This is generally limited to areas where there are no wastewater discharges or tributary inflow and water quality is similar throughout the AU.

Reservoir and Estuary AUs

Primary AUs are defined as hydrologically distinct arms or areas of a reservoir. For most reservoirs distinct AUs will represent the main body near the dam, and in each major arm or the upper part of the reservoir.

To meet the goals of the monitoring program, a reservoir or estuary with more than one AU has at least one AU representing the central area of the water body and one AU for each major tributary arm. The reservoir or estuary can also be divided into AUs at hydrologic constrictions that form distinct coves or subbays.

Generally, each station is at the center of a concentric AU. Tables 2.1 and 2.2 describe the AU delineations for reservoirs and estuaries derived from historical practices. Linear distances described for stations may be more or less if there are other stations representing hydrologically distinct areas.

Table 2.1. Number of Assessment Units Based on Reservoir Size

Size (acres)[1]	Number of AUs	Typical Linear distance described by station (miles)[2]
3000 or less	1 or more	1
3000 - 6000	2 or more	2
6000 - 10000	3 or more	3
10000 or greater	4 or more	3

[1] 3000 acres/640 equals 4.7 square miles

[2] Radius of the assessment area

Table 2.2. Number of Assessment Units Based on Estuary Size

Size (acres)	Number of AUs	Typical Linear distance described by station (miles)[1]
< 3	1 or more	1
3 - 10	2 or more	2
10 - 50	4 or more	3
> 50	5 or more	3

[1] Radius of the assessment area

Depth of Water Quality Measurements

Surface measurements—typically collected at a depth of 0.3 meters (m) from the water surface—are considered the most appropriate for consistency with water quality standards and are generally used for assessing the following: water temperature, chloride, sulfate, TDS (or specific conductance), dissolved oxygen (DO), nutrients, Chl *a*, *E. coli*, and enterococci. Samples collected by the USGS that are composited over depth (using equal-discharge-increment or equal-width-increment methods) may also be utilized in an assessment. In deep streams, reservoirs, estuaries, and the Gulf of Mexico, DO and pH measurements made in profile over the entire mixed surface layer may also be used with the exception of bacteria and temperature. For toxic substances in water, individual surface grab samples are evaluated. If samples are available for the same day at multiple depths, criteria expressed as averages are evaluated as surface-to-bottom composite samples.

Determination of the Surface Sample, Profiles, and Mixed Surface Layer

The surface sample is typically collected at 0.3 m, or is the shallowest sample, not deeper than 1.5 m. Water column profiles are required in water bodies with depths greater than 1.5 meters and are taken at consistent depth intervals (depth intervals determined by the total water depth). The profile measurements should be made within one hour of the collection time of the water sample. Procedures for measuring depth or vertical profiles in reservoirs, deep rivers, bays, and barge and ship channels greater than 1.5 m in depth are outlined in the most recent version of Chapter 3 of the SWQM Procedures Volume 1.

If the mixed surface layer is used, the following guidelines exist for each water body type: For reservoirs, the mixed surface layer in a water column profile is defined as the portion of the water column from the surface to the depth at which water temperature decreases more than 0.5 °C. When a profile of measurements is reported, DO (mean of measurements) and pH (median of measurements) criteria apply to the entire mixed water column when the water column is not stratified, or only to measurements made in the mixed surface layer if the water column is stratified. In rare instances, large declines in DO or pH may occur with depth within the mixed surface layer defined by water temperature, or a superheated layer at the surface may constrict the mixed surface layer by this definition. Best professional judgment may then be used to determine which DO and/or pH measurements are assessed from the mixed surface layer. The information considered for this decision will be recorded and made available in the assessment files.

The mixed surface layer for tidally influenced water bodies is defined as the portion of the water column from the surface to the depth at which the specific conductance is 6,000 microSiemens per centimeter (µS/cm) greater than the conductance at the surface. DO and pH criteria apply to the entire mixed water column when the water column is not stratified, or only to measurements made in the mixed surface layer if the water column is stratified. On occasion, tidal areas may temporarily have fresh water, and the mixed surface layer is determined by considering temperature.

Monitoring personnel often make vertical field measurement profiles in deep freshwater and tidal streams. In these cases, the surface sample and profile are determined using the same method described above for reservoirs and estuaries.

Determining the Extent of Tidal Influence

In most cases, the extent of tidal influence in freshwater streams that drain to tidal streams, estuaries, or the Gulf of Mexico, is determined by making field measurements (specific conductance and salinity), collecting water samples (TDS and chloride), and observing level recorders sequentially upstream from the stream's mouth over several complete tidal cycles. A water body is considered tidally influenced when there is observed tidal activity, TDS is greater than or equal to 2,000 milligrams per liter (mg/L), salinity is greater than or equal to 2 parts per thousand, or specific conductance is greater than or equal to approximately 3,000 µS/cm. In the absence of monitoring data, the tidal limit in a freshwater stream is approximated as the point where the 5-foot contour line (5 feet above average sea level) on a USGS topographic map crosses the stream. Marine criteria developed in the TSWQS apply to all tidally influenced streams (classified and unclassified), estuaries, and the Gulf of Mexico.

Temporally Representative Data

Frequency and Duration of Sampling

The assessment must use a sample set that is temporally representative of conditions within the period of record. Optimally, sampling should be routinely scheduled over several years and at a minimum of two years, with approximately the same intervals of time between sampling events. This routine sampling plan results in monthly or quarterly sample data sets which are considered temporally representative of long-term conditions.

In some instances where water quality data indicates dramatic improvements or declines and there is good cause to believe the change will be persistent, the assessor may determine it is appropriate to use only the more recent and representative dataset. These changes in water quality could be due to identified permanent changes in pollutant loadings, such as a new treatment facility, implementation of best management practices, or hydrologic changes.

Sediment and fish tissue samples generally do not vary greatly over time and are considered useful integrators of water quality over time and space. Fish and sediment samples collected as part of a one-time special monitoring event may be used in the assessment. For example, ten fish samples or ten sediment samples collected on the same day from an AU would meet the minimum sample requirement.

The most recent advisory or closure issued by the Texas DSHS which is still in effect is used to determine support of the fish consumption use. Sometimes these advisories may have been issued in years prior to the period of record for the assessment.

Considering the Representativeness of Sample Events

To provide a temporally balanced dataset, water sampling events should be collected on a routine frequency, for example each week, month, or quarter. Such a sampling regime will assess a range of flow and temperature conditions. An exception is sediment and tissue samples which have no such temporal requirements.

Monitoring projects that collected data which are determined to bias the dataset will be excluded. These may include data collected as part of a complaint investigation, equipment test, or a focused short-term special study targeting specific conditions. Sampling projects targeted to high or low flow conditions may generate biased datasets. Such data can be used to add to a narrative for the water body assessment and may be useful for planning follow-up monitoring, but, in general, are not used in the calculation for determining use support, listing, or delisting. Special study data that is determined to be routine by design, e.g., monthly TMDL monitoring, may be used in the assessment.

Other sources of data and information, for example volunteer monitoring, compliance monitoring, and complaint investigations can be used to plan future monitoring and to document sources of pollutants.

Samples from the same day or month will be used from different stations, or from different routine programs at the same station, if they comprise a routine data set or were collected at a consistent frequency that independently meets temporal requirements for number of years and seasonality.

When samples that temporally bias the data set must be removed, samples in the remaining temporally representative data set will be those collected earliest, provided that they are collected after 8 a.m. The samples that are not used, however, may be considered by the assessor to determine if they, in fact, identify a water quality concern.

On a case-by-case basis, when impairments are identified for parameters expressed as averages, the data set is subsequently evaluated to ensure the criterion is also exceeded more than one time. If the average exceeds, and this is the result of only one or two high values, the assessor will use judgment in the evaluation of the data set.

For criteria expressed as a 24-hour average, an arithmetic average or a time-weighted average will be calculated (see SWQM Procedures Volume 1 for the method). This calculated value will be available as a parameter value.

As an alternative to using more than one station, only the single, most representative site in an AU could be used to characterize standards attainment. The assessment at the other stations can be reported in the IR, but based on assessor judgment, not used to determine use support or concerns for the AU.

Seasonal Requirements

Sample data must be collected over a minimum of two years (though not necessarily consecutive).

- No more than two-thirds of the samples can be collected in any one year (defined as approximately 12 consecutive months).
- No more than one-third of the sample data are from any one of the four seasons.
- If most of the samples are collected twice yearly, samples must represent the warm half of the year (approximately March 15 thru Oct. 15) and cool half of the year (approximately Oct. 16 thru March 14) of both years. No more than two-thirds of the samples should be from one of these two distinct parts of the year.
- If more samples are collected than needed for any particular time period, sample data from the routine monitoring program or those with the earliest collection date (for each week, month, or half year, dependent on routine sampling frequency) will be used as a systematic and unbiased method to select a representative data set for assessment. The samples that are not used, however, may be considered by the assessor to determine if they, in fact, identify a water quality concern.
- There are specific seasonal requirements for biological (see "Determining Overall Aquatic Life Use" in Chapter 3) and 24-hour DO measurements (see "Dissolved Oxygen" in Chapter 3). Note: DO criteria may vary seasonally or with flow (see Appendix A of Chapter 307 footnotes of the TSWQS).
- Sample events should be separated by approximately equal time intervals.
- Samples using more accurate methods or indicators may be used preferentially over older data.
- More recent data that meet the requirements for a representative data set may be used, and older data excluded, if the water quality is known to have changed, and there is evidence that these changes will persist.

Period of Record

The 2024 assessment period of record for the last seven years is Dec. 1, 2015 through Nov. 30, 2022. Samples from these seven years are evaluated when available, and if necessary, the most recent samples collected in the preceding three years (Dec. 1, 2012 through Nov. 30, 2015) can also be included to meet the requirements for minimum sample number.

Minimum Number of Samples

At least 10 (20 for bacteria) samples over the seven-year period of record are required for assessment of use attainment (listing and delisting). However, fewer than the required number of samples can be used to identify nonsupport for use attainment parameters if the threshold number of exceedances for these parameters is met when using the binomial method (See "Small datasets indicating nonsupport" below). Use attainment and concern assessment parameters are identified in Table 2.3. Concerns can be identified with as few as four samples. This count of samples does not include those measurements or samples that are excluded for use in calculations, for example events when flow is below the seven-day, two-year low-flow (7Q2) on perennial streams. Samples collected from multiple monitoring stations in an assessment area may be aggregated to meet the minimum sample requirement. All assessment methods based on the average will require 10 samples (20 for bacteria) for listing and delisting, although in rare instances the assessor will make the use attainment decision with fewer samples and indicate this by reporting a data set qualifier of JQ (based on judgment of the assessor).

Each assessment method (parameter) is evaluated independently for minimum sample number. These minimum sample numbers were chosen to allow confidence in the assessment, while making the best use of limited monitoring resources. All stations with four or more temporally representative samples are assessed, although it may not be possible to establish use support with so few samples.

In order to calculate a TSI, a minimum of four Chl *a* measurements, two total phosphorus (TP), and two Secchi disk measurements are required for a reservoir.

Extending the period of record and minimum number of samples to increase confidence in listing and delisting

In order to ensure that minimum sample size requirements can be met for determining use support, the period of record will be extended back in time, up to a period of record of ten years, until the minimum sample number is identified. At least half of the samples (five samples) must come from the most recent seven-year sample period. This will establish use support for more water bodies and parameters and will report more recent water quality conditions than the previous practice of carrying forward the assessment information from only the last period that had a complete dataset.

A minimum of 10 samples (20 for bacteria) from the last seven years or the most recently collected 10 samples (20 for bacteria) for up to ten years are used to determine use support. Concerns will be identified with as few as four samples if they are within the last seven years. The sample set must be temporally representative, and it may be useful to include recent samples from the previous seven-year period to establish concern status.

Table 2.3. Sample Size Requirements for Assessment Methods

Columns 4 through 6 show the minimum sample sizes and levels of parameter support for data qualifier.

(See Table 2.4 for definitions of levels of support and data qualifier.)

Use	Assessment Method	Use Attainment or Concern Assessment	ID Inadequate Data	LD Limited Data	AD Adequate Data
Aquatic Life Use	DO 24-hr average	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	DO 24-hr minimum	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	DO grab minimum	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	DO grab screening level	C	<4 NA	4-9 CS, NC	10 CS, NC
	Acute toxic substances in water	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	Chronic toxic substances in water	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	Acute ambient toxicity tests in water	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	Chronic ambient toxicity tests in water	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	TOXNET ambient toxicity tests in water – lethality	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	TOXNET ambient toxicity tests in water - sub-lethality	C	<4 NA	4-9 CS, NC	10 CS, NC
	Acute toxicity tests in whole sediment	N/A	<4 NA	4-9 Report tests only	10 Report tests only
	Chronic toxicity tests in whole sediment	N/A	<4 NA	4-9 Report tests only	10 Report tests only

Use	Assessment Method	Use Attainment or Concern Assessment	ID Inadequate Data	LD Limited Data	AD Adequate Data
Aquatic Life Use, continued	Elutriate toxicity tests in sediment	N/A	<4 NA	4-9 Report tests only	10 Report tests only
	Toxic substances in sediment	C	<4 NA	4-9 CS, NC	10 CS, NC
	Line of evidence (LOE) toxic sediment condition	U	<4 (LOE is not reported if less than four samples are available)	4-9 CN, NC, NS (data set qualifier must be JQ rather than LD)	10 NS, CN, FS (data set qualifier must be JQ rather than AD)
	Habitat	C	0 NA	1 CS, NC	2 CS, NC
	Macrobenthic community	U	0 NA	1 CN, NC	2 NS, CN, FS
	Fish community	U	0 NA	1 CN, NC	2 NS, CN, FS
Recreation Use	*E. coli* and Enterococci geomean	U	<7 NA	7-19 CN, NC	20 NS, CN, FS
	Enterococci single sample	U	<7 NA	7-19 CN, NC, NS	20 NS, CN, FS
Recreational Beaches	TBWP advisories	U	[1]	[1]	[1]
General Use	Water temperature	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	High pH	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	Low pH	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	Dissolved solids	U	<4 NA	4-9 CN, NC	10 NS, FS
	Enterococci (1006, 1007) geometric mean	U	<7 NA	7-19 CN, NC	20 NS, CN, FS

Use	Assessment Method	Use Attainment or Concern Assessment	ID Inadequate Data	LD Limited Data	AD Adequate Data
General Use, continued	Reservoir nutrient criteria	U	<4 NA	4-9 NA	10 NS, FS
	Reservoir nutrient criteria	C	<4 NA	4-9 NA	10 CS, NC, FS
	Nutrient screening levels	C	<4 NA	4-9 CS, NC	10 CS, NC
	Nutrient enrichment	U	2	2	2
	Altered color	U	2	2	2
	Fish kill reports	U	2	2	2
Fish Consumption Use	DSHS advisories, closures, and risk assessments	U	3	3	3
	HH bioaccumulative toxics in water or tissue average	U	<4 NA	4-9 CN, NC, NS	10 NS, CN, FS
	Bioaccumulative toxics in fish tissue	C	<4 NA	4-9 CS, NC	10 CS, NC
Oyster Waters Use	DSHS shellfish harvesting maps	U	4	4	4

[1] See text, NA, CN, NS, FS (data qualifier OE)
[2] See text, NA, CN, NC, NS (data set qualifier OE)
[3] See text, NA, NC, NS, FS (data set qualifier OE)
[4] See text, NA, NS, FS (data set qualifier OE)

Small datasets indicating nonsupport

Water bodies with small data sets will be identified as not supporting designated uses for methods using a percent exceedance without regard for sample size, provided they meet the threshold number of exceedances that would be required for the minimum sample size and are otherwise representative-routine data collected over at least a two-year period. For these water bodies there is certainty that small datasets with a threshold number of exceedances will demonstrate nonsupport of uses should more samples be collected to reach a total sample size of 10. All assessment methods based on averages will require 10 samples (20 for bacteria) for listing unless there is considerable evidence indicating nonsupport. Best professional judgment will be used in these instances. Delisting with an assessment method based on an average requires a minimum of 10 samples (20 for bacteria).

Flow Conditions

Water quality criteria and screening levels generally apply to perennially flowing streams when flow is greater than critical or severe low-flow conditions. Removing measurements made below critical low flows is a way to avoid inappropriately listing a water body based on data that do not support the TSWQS when strictly applied. Many small, unclassified streams in Texas develop intermittent stream flow in summer months and eventually become completely dry, while others maintain perennial pools when flow is interrupted. The decision matrices illustrated in Chapter 3—Tables 3.2, 3.4, 3.8, 3.9, 3.10, 3.13, and 3.15—were developed for this guidance to explain which DO, toxic substances in water, bacteria, general use, human health, and surface water criteria respectively, apply under different flow conditions. These tables summarize when site-specific and general criteria are applicable, consistent with the TSWQS.

Eliminating Critical Low-Flow Events on Perennial Streams

Provisions in Section 307.8(a) of the TSWQS specify applicability of standards under critical low-flow conditions. Critical low-flow is defined as the low-flow condition that consists of the 7Q2 or alternative low-flows for spring-fed streams. The 7Q2 is the lowest stream flow for seven consecutive days with a recurrence interval of two years, as statistically determined from historical data. Critical low-flows in springflow-dominated streams or rivers that contain federally listed endangered or threatened aquatic or aquatic dependent species are determined from the 0.1 percentile derived from a lognormal distribution of historical data. Critical low-flows in springflow-dominated streams that do not contain federally listed endangered or threatened species are determined from the 5th percentile of historical data. In the Procedures to Implement the Texas Surface Water Quality Standards (IPs) (RG-194, most current revision), if the calculated critical low-flow was equal to or less than 0.1 cfs, it was rounded to 0.1 cfs. The IPs also indicate that if base flow information is not available to estimate the 7Q2, then a value of 0.1 cfs is usually assumed for perennial streams. Critical low flows for classified segments are included in Appendix C of the IPs. Site-specific critical low-flow values for DO for the eastern and southeastern Texas ecoregions are specified in Section 307.7(b)(3)(A)(ii), Table 4 of the TSWQS. Site-specific critical low flows for a subset of these streams is 0.0 cfs.

Data for the following parameters are removed if the measured flow is below the critical low flow:

Classified stream segments

- DO
- pH
- temperature
- chronic toxic criteria

- chronic ambient toxicity tests

Unclassified stream segments

- DO
- chronic toxic criteria
- chronic ambient toxicity tests

Note: If there is no 7Q2 value, 0.1 cfs will be used for assessment on perennial streams. If there is only flow severity information available, data with a flow severity equal to 1means no flow (on perennial streams) will be excluded. If there is no available flow information for a particular classified perennial stream, flow will be presumed to be above the critical low flow. Note that perennial streams are only rarely below the critical low flow, so it is unlikely that samples were collected during this condition.

For unclassified intermittent streams and intermittent streams with perennial pools, do not evaluate the flow (cfs or flow severity) or eliminate data below the critical low flow, since this value is zero.

Toxicity

The following apply at all flows above a quarter of the critical low flow (see Section 307.8 (a)(3) in the TSWQS) on perennial classified and unclassified streams:

- Acute toxic criteria.
- Acute ambient water toxicity test (the river authorities and EPA Houston Lab have been running only acute tests).

The chronic toxic criteria and chronic ambient water toxicity tests also apply to intermittent streams that support significant aquatic life, including streams identified as intermittent with pools. This includes:

- Pools large enough to support significant aquatic life (greater than 20% stream bed, greater than 1 meter deep).
- Perennial streams and small pools downstream of wastewater discharges on streams that would otherwise be intermittent, but outside the area where the criteria may not apply as established in TCEQ’s permitting process.

Note: Chronic toxic criteria do not apply to intermittent streams with no pools, only acute toxic criteria apply to streams with these conditions.

Determining Attainability due to Severe Low-Flow in Perennial Streams

In addition to applicability of standards below critical low flows, provisions addressing the attainability of standards in severe low-flow conditions are included in Section 307.9(e)(8) of the TSWQS. These provisions address attainability of criteria applied as long-term averages during severe low-flow conditions, such as negligible streamflow or when residual pools in intermittent streams shrink during very dry periods. Below these severe low-flows, water quality tends to become degraded even under natural conditions.

Data for the parameters listed below are removed when the two following conditions are met:

1. Perennial stream flow is below 0.1 cfs.
2. Intermittent streams when < 20% of the stream bed of a 500-meter sampling reach is covered by pools; or when extremely dry conditions are indicated by comparable observations in flow severity

Classified Stream Segments

- TDS
- chloride
- sulfate
- bacteria
- human health criteria

Unclassified Water Bodies

- bacteria
- human health criteria

Eliminating Data Collected During Flood and other Extreme High-Flow Events

Provisions included in Section 307.9(b) of the TSWQS states that samples collected during extreme hydrologic conditions such as high-flows and flooding immediately after heavy rain should not be used to assess attainment. Sample results for all parameters associated with events that have flow severity reported as 4 (flood flow) will be excluded from the assessment. In rare cases, sample results associated with a reported flow severity value of 4 may be retained if other information indicates the reported flow severity was not truly reflective of extreme hydrologic conditions.

Additionally, in coordination with stakeholders such as data providers, results associated with a discretely measured flow discharge that is indicative of extreme hydrologic conditions will be removed from the dataset and a reassessment will be performed on a case-by-case basis. The 90th percentile flow as determined from an established hydrograph will be used to define extreme hydrologic conditions unless an evaluation of the hydrograph clearly warrants the use of a different percentile. Specifically, this includes consideration when there is a dramatic increase on the hydrograph. Additionally, information developed by another water quality management program (e.g., TMDL Program) may be considered.

The 90th percentile flow must be determined using one of the following methods:

- Using historical records from the nearest representative USGS or International Boundary and Water Commission (IBWC) flow gauge. Chapter 3 of the SWQM Procedures Volume 1 describes how to determine when a gauge is representative of flow conditions at a nearby station.
- Calculating percentile flow for small freshwater streams without gauges using statistical corrections to account for relative watershed size.

When this method is implemented, it will be implemented for all parameters. At times, high flow events may be the result of unusual circumstances and warrant additional consideration (i.e. extended dam releases or unusual spring flows). In these cases, additional information from data providers and stakeholders may be considered when deciding to remove specific data from assessment.

Methodology for Determining Standards Attainment

Levels of Support

A range of water quality conditions and assessment status is expressed by a level of support established in each assessment unit (in some instances each station) for each use and parameter combination. Support status reflects (1) that data are not sufficient to allow assessment, (2) when only a concern can be established from limited data, and (3) when the assessment can confidently establish the level of support.

Assessment methods for use attainment (based on numeric and narrative TSWQS) apply to the parameters, the use, the AU, and the segment. Assessment methods are discussed in Chapter 3 (also see Table 3.1). When current support status cannot be assessed because the dataset is not adequate, the support status from the previous assessment is reported if it was a concern or impairment. Impairments identified in previous years may be removed (delisted) when the data indicates that the use is fully supported.

Support status is expressed with a letter or several letters with the definitions in Table 2.4. A support code and data set qualifier from the columns in Table 2.4 are reported for each assessment use, method, and parameter.

Table 2.4. Support Codes and Data Set Qualifiers

Resulting Support Code for Use	Support Code Assigned to Parameter	Level of Use Support	Use Standard or Screening Level Concern
FS	FS	standard for use fully supported—however may not meet delisting requirements; Note: Fish consumption rolls up to NA when advisories/risk assessment method is not available	Use

Resulting Support Code for Use	Support Code Assigned to Parameter	Level of Use Support	Use Standard or Screening Level Concern
NS	NS	standard not supported	Use
FS	CN	concern—near nonattainment for parameter with adequate data	Use
NA	CN	concern—near nonattainment for parameter with limited data	Use
NA	NC	no concern for parameter with limited data	Use
NA	NA	not assessed	Use
NA	CS	concern—screening levels indicate marginal water quality for parameter by concern assessment methods	Concern
NA	NC	no concern—for screening level parameters	Concern
NA	NA	not assessed	Concern

Table 2.4

Data Set Qualifier Codes	Data Set Qualifier for Parameters
AD	adequate data—meets minimum sample number and other requirements
LD	limited data (less than minimum sample size of 10)
TR	not temporally representative, used with NA
SR	not spatially representative, used with NA
JQ	based on judgment of the assessor
SM	this assessment method is superseded by another method
ID	inadequate data (<4 samples), used with NA
OS	assessment area outside state boundaries
OE	other information than ambient samples evaluated

Notes:

A support code is assigned to the segment, AU, use, and parameters. Both the support code and dataset qualifier are required to describe attainment for parameters. The assessment method is not assigned a support code or a data set qualifier.

Assessment methods based on averages (including median and geometric mean) are reported as FS when criteria are attained.

Values Below Reporting Levels

Many individual values in the SWQMIS water quality database are reported as less than the limit of quantitation (LOQ), otherwise known as the reporting limit. There is no generalized way to determine the true value for an individual result in the range between zero and the LOQ. In order to include as many individual data points in the analysis as possible and to indicate the level of monitoring effort, for values reported as less than the LOQ, whichever of the following measurements is smaller, half of the

LOQ (when the LOQ is less than the criterion/screening level) or half of the criterion/screening level (when the LOQ is greater than the criterion/screening level), is used in the assessment. Thus, no value reported as less than the LOQ will be counted as an exceedance when assessing individual values against a criterion/screening level. For values expressed as greater than the LOQ, the whole value is used.

When most of the reported values for a parameter are less than the LOQ, and the LOQ is significantly greater than the criterion (note that a margin of safety of about two for aquatic life and five to ten is incorporated into criteria), the samples are not used for calculation of averages or percent exceedances. A status of “Not Assessed” may be identified, rather than fully supporting or no concern. The assessor will use judgment when identifying parameters as fully supporting or delisting when the dataset includes values below the LOQ.

Rounding Values

For managing measurement values, the EPA Standard Methods Rule of Rounding is used. Digits that are not significant are dropped. If the digit 6, 7, 8, or 9 is dropped, the preceding digit is increased by one unit. For example, 2.89 becomes 2.9. If the digit 0, 1, 2, 3, or 4 is dropped, do not alter the preceding digit. For example, 2.53 becomes 2.5. If the digit 5 is dropped, round off the preceding digit to the nearest even number. For example, 2.25 becomes 2.2 and 2.35 becomes 2.4.

Trend Analysis

TCEQ has identified trend analysis as a tool to determine if a water body is not expected to meet applicable water quality standards. In general, trend analysis provides information which contributes to a quantitative, objective assessment of whether or not the values for a random variable such as chloride concentration, or biological integrity (the dependent variable) are increasing or decreasing over time, as a function of an independent variable such as time. Trend analysis also provides an estimate of the rate of change. In most cases the explanatory (independent) variable will be time. TCEQ may also look at trend analyses to evaluate improvement in impaired water bodies as well as where there are no trends. However, trend analyses will most likely be prioritized to evaluate water bodies which appear to be threatened. For purposes of generating a statistical trend, 20 to 60 samples collected over a period of five to 20 years are required. TCEQ has some long-term stations as part of the routine monitoring network. One of the purposes of these monitoring stations is to assess long-term water quality trends.

Trend Analysis Method

For details relating to the trend analysis method refer to the CRP Guidance, Task 5 Data Analysis and Reporting, Exhibit 5E—Data Analysis Steps.[2] Methods described in

[2] www.tceq.texas.gov/waterquality/clean-rivers/guidance/index.html

Task 5 can be used by any data provider to TCEQ and reviewed by the assessors for listing considerations.

Use of the Binomial Method for Establishing Required Number of Exceedances for Nonsupport of Designated Uses

Water quality assessments are based on a group of measurements for a particular water quality parameter of interest. Performing analyses on a set of samples results in uncertainty and the potential for error in this process. For the 303(d)-listing process, there are essentially two categories of such errors:

- **Type 1 Error**. Identifying a water body as not supporting when that water body is actually fully supporting.
- **Type 2 Error**. Identifying a water body as fully supporting when that water body is actually not supporting.

The *binomial method* provides a means to estimate the probability of committing Type 1 and/or Type 2 errors for situations when the analysis is based on a variable that represents one of two conditions. Water quality variables that are either less than or equal to a criterion, or greater than the criterion, is an example of a binomial variable.

Note: This method does not apply to criteria expressed as averages, such as TDS, geometric mean for bacteria indicators, and chronic toxic criteria.

When the binomial method is used, the proportion of the population that exceeds the criterion is denoted as p. Whereas, the proportion of the population that meets the criterion is denoted as q (denoted as 1-p). In the case of a fully supporting water body, p is equal to or less than 10% (0.1 is the probability of collecting a sample that exceeds the criterion), and q is greater than or equal to 89.9% (0.899 is the probability of collecting a sample that meets the criterion).

Since water quality assessment relies on multiple samples the cumulative probabilities are determined to estimate the probability of committing Type 1 and Type 2 errors.

The binomial method can be used to calculate the probability of erroneously classifying a water body as not supporting for each combination of number of samples (*n*) and number of exceedances (*e*). This cumulative probability represents the Type 1 error. By calculating these cumulative probabilities for each combination of *n* and *e*, it becomes possible to select the combination which provides an acceptable probability of committing a Type 1 error and to identify the probability of a Type 2 error.

Error rates for delisting decisions can be described in a similar, but reversed, manner for each combination of number of *(n)* and *(e)*. A Type 1 error would occur if a water body was delisted when that water body is actually not supporting. A Type 2 error would be made if it was not delisted and it was actually fully supporting.

For each sample size, a minimum threshold number of exceedances must be identified for listing, considering Type 1 and 2 error rates (see Table 2.5). Appendices A and B provide examples of the number of samples and exceedances that result in various levels of use and concern attainment.

Table 2.5. Compliance with Water Quality Criteria and Acceptable Error for Listing, Delisting, and Concerns with at Least Ten Samples (20 for Recreational Use)

Use and Concerns Attainment	Error Type	LIST Maximum Acceptable Sample Error Rate (%)	LIST Exceedance Rate for Parameter (%)	CONCERN Maximum Acceptable Sample Error Rate (%)	CONCERN Exceedance Rate for Parameter (%)	DELIST Resulting Sample Error Rate* (%) †	DELIST Exceedance Rate for Parameter (%)
Conventional Use Attainment	Type 1	20	10	20	8	37-70	11
	Type 2	68	20	82	20	8-25	5
		38	30				
Dissolved Oxygen Concerns	Type 1	n/a	n/a	20	8	n/a	n/a
	Type 2	n/a	n/a	82	20		
Toxic Use Attainment	Type 1	40	10	40	8	31-67	9
	Type 2	45	20	41	20	14-46	5
		16	30				
Recreational Use Attainment (Coastal, single sample)	Type 1	20	20	20	16	41-59	21
Recreational Use Attainment, continued	Type 2	20	40	60	32	3-9	10
Screening Level Concerns	Type 1	n/a	n/a	20	20	n/a	n/a

Use and Concerns Attainment	Error Type	LIST Maximum Acceptable Sample Error Rate (%)	LIST Exceedance Rate for Parameter (%)	CONCERN Maximum Acceptable Sample Error Rate (%)	CONCERN Exceedance Rate for Parameter (%)	DELIST Resulting Sample Error Rate* (%) †	DELIST Exceedance Rate for Parameter (%)
	Type 2	n/a	n/a	68	40		

* The methodology for delisting is not based in target error rates. See discussion on delisting below.

[1] Range for 10 to 20 samples (20 to 30 for Bacteria)

The specified maximum acceptable Type 1 error rate for identifying impairments and concerns for conventional parameters is less than 20% near the threshold frequency of exceedances (10% actual exceedances for conventionals). For toxics, in order to be more protective, a larger Type 1 error probability, 40%, is accepted. Increasing the maximum acceptable Type 1 error rate decreases the chances of a Type 2 error occurring.

The resulting Type 2 error rate at the threshold exceedance of 20% for conventional parameters is 68% and for toxics it is 45%. Because criteria are conservative and set to protect for the best water quality conditions when developing permits, exceedance rates of two to three times the threshold frequency can occur without the need for listing and additional water quality controls through the TMDL process. At these higher exceedance rates, the resulting Type 2 error rate is 38% for conventional parameters, and about 16% for toxics. Note that at a sample size less than 10, the Type 2 error rate cannot be controlled in a useful way.

Delisting parameters on the 303(d) List

Water bodies will be delisted from Category 5 when the rate of exceedances is 10% for conventional parameters (and/or the mean is not exceeded for criteria evaluated as a mean), 8% for toxic substances, and 20% for enterococci in coastal recreation waters. This delisting methodology is based on a simple percentage. The use of a simple percentage increases confidence that previously impaired waters are attaining their use before they are delisted. Exceedance rates and associated Type 1 and Type 2 errors associated with delisting for these parameters are summarized in Table 2.5.

Removing impairments (Category 4 or Category 5) to aquatic life due to depressed DO must be based on evaluations of 24-hour datasets even if the original listing was identified based on instantaneous grab samples. Temporal and seasonal guidelines for 24-hour datasets are included in Chapter 3.

Removing Impairments from Category 4

For Category 4 impairments, where there are water quality controls in place, or the nonsupport is not caused by a pollutant, the additional level of assurance (requirement that the criteria are not exceeded more than 10% of the time) is not required. In these cases, use attainment is determined by applying the statistical method. Similarly, the binomial method is also applied when new standards and criteria have been adopted.

Chapter 3
Assessment of Beneficial Uses

Introduction

Assessment of each beneficial use is accomplished by applying several assessment methods. These methods often have several criteria or screening levels that are used to evaluate assessment parameters (see Table 3.1). Use attainment (U) assessment methods are used to determine use support and concerns for near nonattainment for uses; concern (C) assessment methods are used to identify concerns with screening levels.

Table 3.1. Use Assessment Methods, Parameters, and Impairments

Use	Assessment Method	Use Attainment or Concern Assessment	Assessment Parameter*	Impairment/ Concern*
Aquatic Life Use	DO 24-hr average	U	DO 24-hr average	Depressed DO
	DO 24-hr minimum	U	DO 24-hr minimum	Depressed DO
	DO grab minimum	U	DO grab	Depressed DO
	DO grab screening level	C	DO grab	Depressed DO
	Acute toxic substances in water	U	Metals, organics	Lead in water, etc.
	Chronic toxic substances in water	U	Metals, organics	Lead in water, etc.
	Acute ambient toxicity tests in water	U	Water acute toxicity	Water toxicity
	Chronic ambient toxicity tests in water	U	Water chronic toxicity	Water toxicity
	TOXNET ambient toxicity tests in water - lethality	U	Water acute toxicity	Water toxicity
	TOXNET ambient toxicity tests in water – sub-lethality	C	Water chronic toxicity	Water toxicity
	Acute toxicity tests in whole sediment	U**	Sediment acute toxicity	Report test results only
	Chronic toxicity tests in whole sediment	U**	Sediment chronic toxicity	Report test results only
	Elutriate toxicity tests in sediment	U**	Sediment elutriate toxicity	Report test results only

Use	Assessment Method	Use Attainment or Concern Assessment	Assessment Parameter*	Impairment/ Concern*
Aquatic Life Use, continued	Toxic substances in sediment	C	Lead, etc.	Lead in sediment, etc.
	LOE toxic sediment condition	U	Sediment Toxicity (LOE)	Toxic Sediment (LOE)
	Habitat	C	Habitat	Habitat
	Macrobenthic community	U	Macrobenthic community	Impaired macrobenthic community
	Fish community	U	Fish community	Impaired fish community
Recreation Use	Bacteria geomean	U	*E. coli* or Enterococci	Bacteria
	Bacteria single sample (coastal recreation waters)	U	Enterococci	Bacteria
Recreational Beaches	Number of Beach Advisories	U	Beach Watch Advisories	Beach Watch Advisories
General Uses	Water temperature	U	Temperature	Temperature
	High pH	U	pH	pH
	Low pH	U	pH	pH
	Dissolved solids	U	TDS, chloride, or sulfate	TDS, chloride, or sulfate
	Enterococci (1006, 1007) geometric mean	U	Enterococci	Bacteria
	Nutrients (Reservoirs) Appendix F	U	Secchi depth, DO, TN, TP, Chl *a*	Excessive algal growth
	Nutrients (Reservoirs) Appendix F	C	Secchi depth, DO, TN, TP, Chl *a*	Excessive algal growth
	Nutrient screening levels	C	ammonia, TP, nitrate, Chl *a*	ammonia, TP, nitrate, Chl *a*
	Nutrient enrichment	C	Algae, macrophytes, or DO grab, DO 24-hr	Excessive algal growth, excessive macrophyte growth, or DO swings
	Altered color	U	Color	Color
	Fish kill reports	U	Golden alga	Harmful algal blooms/golden alga

Use	Assessment Method	Use Attainment or Concern Assessment	Assessment Parameter*	Impairment/ Concern*
General Use, continued	Fish kill reports	C	Golden alga	Harmful algal blooms/golden alga
Fish Consumption Use	DSHS advisories, closures, and Risk Assessments	U	PCBs, etc.	PCBs in large-mouth bass (as specified in advisory)
	Human Health (HH) bioaccumulative toxics in water and tissue	U	Acrylonitrile, etc.	Acrylonitrile in water, etc.
	Bioaccumulative toxics in fish tissue	C	Arsenic, etc.	Arsenic in fish tissue, etc.
Domestic Water Supply Use	Surface water HH criteria for DWS average	U	Arsenic, nitrate, etc.	Arsenic in water, etc.
	Surface water toxic substances average concern	C	Alachlor, atrazine, MTBE, and perchlorate	Alachlor, atrazine, MTBE, and perchlorate in water
Oyster Waters Use	DSHS shellfish harvesting maps	U	Bacteria, zinc, etc.	Bacteria (oyster waters)

* See Chemical Abbreviations and Acronyms

** Represents a component of the sediment LOE approach

Aquatic Life Use

Each classified segment in the TSWQS (Appendix A) is assigned an ALU, based on physical, chemical, and biological characteristics of the water body. The five ALU categories are exceptional, high, intermediate, limited, or minimal (no significant) aquatic life use.

Support of the ALU is based on assessment of dissolved oxygen criteria, toxic substances in water criteria, ambient water and sediment toxicity test results, and indices for habitat, benthic macroinvertebrate, and fish community, provided that the minimum number of samples are available. Each set of criteria is generally evaluated independently; attainment of the ALU is described in Table 3.6, Decision Matrix for Integrated Assessments of Aquatic Life Use Support.

For freshwater streams not classified in the TSWQS, the ALU and criteria are presumed based on the stream flow type. Stream flow type (perennial, intermittent with pools, or intermittent) is established from flow data associated with samples, information provided by local monitoring staff, previous assessments, or recent Receiving Water

Assessments (RWAs). Flow types, assigned ALUs, and criteria, when established in Appendix D of the TSWQS or in support of TCEQ permit decisions will be used when available.

Dissolved Oxygen

Aquatic life uses are evaluated using 24-hour average and minimum criteria. The criteria are not supported when they are exceeded more than 10 percent of the time using the binomial method.

24-hour average criteria. DO criteria (24-hour averages) to protect aquatic life uses described in Table 3.2 range from 2.0 to 6.0 mg/L

DO average criteria are compared to the measurement taken at the surface or to the average of measurements in the mixed surface layer when a profile of measurements is reported.

Minimum criteria. DO criteria (24-hour minimum) to protect aquatic life uses described in Table 3.2 range from 1.5 to 4.0 mg/L. DO minimum criteria are compared to the instantaneous measurement taken at the surface or to the average of measurements in the mixed surface layer when a profile of measurements is reported.

DO grab screening level. Grab DO measurements are made at the majority of sampling events. These measurements are compared to the average DO criterion value and a concern is identified when this screening level is exceeded. The DO grab screening level is compared to the instantaneous measurement taken at the surface or to the average of measurements in the mixed surface layer when a profile of measurements is reported.

Seasonal and flow dependent criteria. For some classified and unclassified water bodies, DO criteria may vary dependent on seasonal or flow conditions. In these cases, the DO average and minimum criteria are lower during the warmer months, during low flow, or during a combination of season and flow.

Seasonal Requirements for 24-hour DO Data Sets. Twenty-four-hour DO monitoring events should include unbiased, seasonally representative data with samples allocated to various times of the year for at least two years. Approximately 50-66% of the 24-hour DO monitoring events must be spaced over an index period representing warm-weather seasons, March 15-Oct. 15. Twenty percent of the measurements must be made during the critical period, July 1-Sept. 30. Approximately one month must separate each 24-hour sampling event. Although samples over the entire year are not required at this time, current monitoring guidance encourages year-round sampling. Additional temporal guidelines and details for collecting 24-hour data sets are included in SWQM Procedures Volume 1.

Hierarchy of assessment methods for determining use support for DO. When the number of both 24-hour measurements (average and minima) and grab DO measurements (evaluated against the DO minimum criterion and DO screening level) are adequate for assessment, the assessment results for 24-hour DO data sets are used to determine both use support and concerns. When this is the case, the data set qualifier for the assessment methods using grab samples is reported as SM (superseded by another method). The assessor must consider grab exceedances of the DO minimum criterion and use judgment to determine if these exceedances indicate nonsupport of the criterion and use. When this is the case, the data set qualifier for the 24-hour minimum is reported as JQ (based on judgment of the assessor).

Unclassified Streams

Establishing ALU based on stream flow-type. In contrast to other criteria, DO criteria are derived from ALU categories. The ALU is assigned to unclassified segments for assessment, based on the flow-type for the segment.

Unclassified perennial streams are presumed to have a high ALU and corresponding average DO criterion of 5.0 mg/L (3.0 mg/L minimum). Unclassified intermittent streams with significant ALU created by perennial pools are presumed to have limited ALUs protected by a 3.0 mg/L criterion for average DO (2.0 mg/L minimum). Intermittent streams without perennial pools are presumed to have a minimal ALU protected by a 2.0 mg/L average criterion (1.5 mg/L minimum).

Site-specific standards. Site-specific ALU and associated DO criteria have been assigned to some unclassified water bodies through RWAs (see Appendix D of the TSWQS). For other unclassified water bodies, the ALU and associated DO criteria are presumed based on the flow-type or other information developed by TCEQ's water programs. The ALU and criteria for unclassified water bodies most recently used for assessment will be provided with assessment results. Another consideration is perennial streams located in the Eastern and Southern areas of the state-as described in the TSWQS, 307.7(b) (3)(a)(ii)-where a strong dependent relationship has been demonstrated to exist among summertime DO concentration, stream flow, and channel bed slope. Streams with significant ALU in these areas of the state are evaluated for 24-hour DO concentrations using criteria dependent on flow and stream channel bed slope. If a water body or AU does not support the DO criteria, the impairment must be verified according to the steps outlined in the following section.

Eastern and Southern Texas Dissolved Oxygen

The Regression equation for DO/streamflow/bed slope. A regression equation was used to develop a table that relates DO/streamflow/bed slope in Section 307.7 of the TSWQS. The table is applicable to classified and unclassified perennial streams in defined areas of East and South Texas.

The steps below for confirming DO impairments in Eastern and Southern Texas demonstrate how to define an adjusted critical low flow value. This superseding site-specific critical low flow value is applied when the initial assessment was nonsupport.

To develop the original regression equation, stream flows and average DO concentrations were measured during steady-state conditions, and bed slopes were estimated from 1:24,000 scale USGS topographic maps. Approximately 72% of the variation in observed average DO concentrations in these minimally impacted streams is explained by the regression equation.

To reproduce the results of the table in the WQ Standards and solve for flow, the regression is applied as follows:

$$Q = e^{(DO - 7.088 - 0.686\ln(Bd) + k + j)/0.551} - 0.01$$

Where:

DO = DO criterion from regression (mg/L; 24-hour average)

Q = adjusted critical low flow (cfs)

Bd = Bed slope (m/km)

k = 1.61 (constant for 50th percentile of tree canopy cover)

j = 0.5 (to set the DO criterion an increment below the predicted ambient DO)

Calculating bed slope. Calculations for deriving bed slope can be found in the “Modeling Dissolved Oxygen” section in the IPs (RG-194).

Confirming apparent DO impairments in the Eastern or Southern portions of the state. If a perennial water body in the Eastern or Southern portions of the state (as defined in Section 307.7(b)(3)(A)(ii) of the TSWQS) does not support the DO criteria (new impairments only), then each individual sample not attaining the assigned criterion (24-hour average, 24-hour minimum, or grab minimum) is evaluated to further assess validity of the sample. Using Table 4 in the TSWQS, the procedure described below is used to determine an adjusted critical low flow under which a DO measurement should be excluded. When the measured flow is below this adjusted critical low flow value the DO measurement is excluded and not used for use attainment determinations. This procedure applies to both classified and unclassified perennial streams for which new DO impairments have been identified.

1. Calculate the bed slope for the subject stream reach or use the monitoring station bed slope found in SWQMIS.

2. Find the adjusted critical low flow using bed slope and flow for the stream 24-hour average DO criteria using Table 4 of the WQS. For bed slopes below the minimum listed in Table 4, use 0.1 m/km. For bed slopes above the maximum listed in Table 4, use 2.4 m/km.

Example for a stream with a bed slope of 0.4 m/km,

- If the DO criterion is 6.0 mg/L, the appropriate critical low flow is 20.0 cfs
- If the DO criterion is 5.0 mg/L, the appropriate critical low flow is 3.3 cfs
- If the DO criterion is 4.0 mg/L, the appropriate critical low flow is 0.5 cfs
- If the DO criterion is 3.0 mg/L, the appropriate critical low flow is 0.1 cfs

Note: Use the DO column corresponding to the DO criterion for the segment to evaluate all exceedances, including the minimum. For example, Segment 0404 has a DO criterion of 5.0 mg/L listed in Appendix A of the TSWQS. In this case, the 3.3 cfs listed in the above example would be the adjusted critical low flow for determination of validity of all samples (24-hour average, 24-hour minimum, and grab minimum) not meeting their respective criterion.

1. If the flow at the time of DO measurement is at or above the adjusted critical low from the table, then the exceedance indicated in the initial screening for this sample is valid.

2. If the flow at the time of DO measurement is below the adjusted critical low flow from the table, then the sample event is not considered in the assessment.

3. Reassess the DO for the water body or AU using the appropriate data.

Note: As with other perennial streams, if a flow severity of 1 (no flow), or flow value of 0 is recorded, then data are considered below the critical low-flow and automatically excluded. If neither flow nor flow severity was recorded the data is presumed to be above the critical low flow and the DO data is assessed against the criterion.

Delisting Dissolved Oxygen Impairments

Removing impairments (Category 4 or Category 5) to aquatic life due to depressed DO must be based on evaluations of 24-hour datasets even if the original listing was identified based on instantaneous grab samples. Temporal and seasonal guidelines for 24-hour datasets are included in this chapter.

Table 3.2. Aquatic Life Use—Dissolved Oxygen Criteria

Criteria for Classified water bodies listed in Appendix A of the TSWQS are in columns 3 through 6 (header cells shaded yellow).

Criteria for Unclassified water bodies and those listed in Appendix D of the TSWQS are in columns 7 through 10 (header cells shaded green).

Water Body/ Segment Type	Flow-Type*	Most Typically Designated Aquatic Life Use	Typically Designated Criteria [1] 24-hour average/ minimum (mg/L) [2]	Eliminate samples collected below the critical low flow [3]	Presumed 7Q2—if not published or no information to contrary [1]	Presumed Aquatic Life Use [4]	Presumed Criteria 24-hour average/ minimum (mg/L)	Eliminate samples below critical low flow [5]	Presumed 7Q2 if not published or no information to contrary [1]
Freshwater Stream	Perennial Stream [5]	Exceptional	6.0/4.0	Yes	0.1 cfs	High	5.0/3.0	Yes	0.1 cfs
		High	5.0/3.0						
		Intermediate	4.0/3.0						
		Limited	3.0/2.0						
	Intermittent Stream with perennial pools adequate to support significant aquatic life [6]	Limited	3.0/2.0	n/a	0.0 cfs	Limited	3.0/2.0	No 7Q2 is 0.0 cfs	0.0 cfs
	Intermittent Stream [7] and intermittent stream with perennial pools not adequate to support significant aquatic life (with or without wastewater flow)	Minimal	2.0/1.5	n/a	0.0 cfs	Minimal	2.0/1.5	No 7Q2 is 0.0 cfs	0.0 cfs
Reservoir	Reservoir	Exceptional	6.0/4.0	n/a	n/a	High	5.0/3.0	n/a	n/a
		High	5.0/3.0						
		Intermediate	4.0/3.0						
		Limited	3.0/2.0						

Water Body/ Segment Type	Flow-Type*	Most Typically Designated Aquatic Life Use	Typically Designated Criteria [1] 24-hour average/ minimum (mg/L) [2]	Eliminate samples collected below the critical low flow [3]	Presumed 7Q2—if not published or no information to contrary [1]	Presumed Aquatic Life Use [4]	Presumed Criteria 24-hour average/ minimum (mg/L)	Eliminate samples below critical low flow [5]	Presumed 7Q2 if not published or no information to contrary [1]
Tidal Stream	Tidal Stream	Exceptional	5.0/4.0	n/a	n/a	High	4.0/3.0	n/a	n/a
		High	4.0/3.0						
		Intermediate	3.0/2.0						
Estuary	Estuary	Exceptional	5.0/4.0	n/a	n/a	High	4.0/3.0	n/a	n/a
		High	4.0/3.0						
		Intermediate	3.0/2.0						
Ocean	Ocean	Exceptional	5.0/4.0	n/a	n/a	n/a	n/a	n/a	n/a
Freshwater Wetland	Freshwater Wetland	**	**	n/a	n/a	**	**	n/a	n/a
Saltwater Wetland	Saltwater Wetland	**	**	n/a	n/a	**	**	n/a	n/a

* Use published flow type or other reliable source such as the SWQM flow-type questionnaire.

1 For East Texas—see TSWQS Table 4 for site-specific critical low flows. The critical low-flow is published however if a more recent TCEQ permit action alters the critical low-flow at the site, a more accurate critical low-flow may be calculated and used.

2 Springtime criteria, up to 1.5 mg/L higher than shown, to protect fish spawning periods are applied during that portion of the first half of the year when water temperatures are 63.0 to 73.0 ° F (see Table 3 in the TSWQS).

3 Presume event was above the critical low flow for classified perennial stream segments when no flow information is available (either severity code or measurement) for the event. Flow severity of 1 is no flow, and thus the event is below critical low flow. Flow severity of 2 through 5 is above the critical low flow.

4 Presumed ALU and criteria are used for unclassified water bodies except for perennial streams listed in Appendix D of the TSWQS.

5 Definition of perennial stream: A stream that does not have a period of zero flow at any time during most years.

6 Definition of intermittent with perennial pools for purposes of determining criteria support: A stream that has a period of zero flow for at least one week during most years but has adequate and persistent pools that provide habitat to support significant aquatic life. Generally, an “adequate pool” to support aquatic life is deeper than one meter and >100 meters long; or where large pools cover >20% of the stream bed in a 500-meter reach.

7 Definition of intermittent stream: A stream that has a period of zero flow for at least one week during most years. If flow records are available, a stream with a 7Q2 of less than 0.10 cfs is considered intermittent.

** Aquatic life use is derived from contiguous/adjoining segments. Criteria are not specified.

Toxic Substances in Water

Support of the ALU, based on toxic chemicals in water, includes an evaluation of those metals and organic substances for which criteria have been developed. TCEQ has developed water quality criteria in the TSWQS for metals and organic substances (see Table 3.3). Acute criteria apply to all waters of the state and at all flows above one-fourth the critical low-flow except in small zones of initial dilution near wastewater discharge points. Chronic criteria apply outside of mixing zones in water bodies with ALUs designated in Appendices A and D of the TSWQS, in unclassified perennial streams when the stream flow is greater than the critical low-flow, and in intermittent streams that support significant aquatic life.

For evaluating acute toxicity, individual measurements of metals and organic substances are compared against acute criteria established in the TSWQS (Table 1 in the TSWQS). Selection of which set of criteria (freshwater or saltwater) to use in the comparison is based on the location of the station; for example, for a station located in tidally influenced water, the saltwater criteria are applicable (see Table 3.4).

Support of the ALU is also based on *toxic substance chronic criteria* for either freshwater or saltwater. Saltwater criteria are used at stations in segments classified as tidal, where tidal activity is indicated by specific conductance measurements that routinely exceed 3,000 µS/cm, or where the stream is below five feet in elevation and tidal activity is presumed. For each parameter at each site, the average of all values is compared against the chronic criterion to determine ALU support. If the average exceeds the criterion, the use is not supported.

Should the average be exceeded over the period of record, the data set is subsequently evaluated to ensure the criterion is also exceeded more than one time. If the average exceeds, and this is the result of only an occasional high value, then the assessor will use judgment in the evaluation of the data set and consider a concern rather than an impairment. Additional monitoring is a priority when a concern for toxic contaminants is identified.

Assessing Compliance with an Acute Toxic Criterion as a Percent of Samples Exceeding the Criterion Up to 10 Percent

Since acute criteria have additional statistical safeguards and safety factors incorporated into them, even moderate rates of exceedance may not constitute an ecological disruption. To assess compliance from limited data sets, even the use of a 10 percent exceedance rate could cause a water body to be inappropriately considered impaired. This is an important consideration with a very small number of measured exceedances when the possibility of statistical and measurement error is only marginally acceptable. Consideration of a smaller frequency of exceedance would be impractical.

The relevant narrative provisions in the EPA-approved TSWQS Section 307.4(d), Section 307.6(b), Section 307.6(c) do not suggest that a single measured exceedance of an acute (or chronic) toxic criterion should be considered a violation of the standards. TCEQ added the following clarification in Section 307.9(a) of the 2010 TSWQS: "Unless otherwise stated in this chapter, additional details concerning how sampling data are evaluated to assess standards compliance are provided in TCEQ's Guidance for Assessing and Reporting Surface Water Quality in Texas as amended."

Using the Sample Average to Compare to a Chronic Toxic Criterion Instead of Assessing Compliance as a Percentage of Samples Exceeding the Criterion

The definition of chronic toxicity in Section 307.3(a)(12) of the 2018 TSWQS is as follows: "Toxicity which continues for a long-term period after exposure to toxic substances. Chronic exposure produces sublethal effects, such as growth impairment and reduced reproductive success, but it may also produce lethality. The duration of exposure applicable to the most common chronic toxicity test is seven days or more."

The standards also indicate that "specific numerical chronic aquatic life criteria are applied as seven-day averages." The purposes of the seven-day average are (1) to establish a low-flow "cut-off" for applicability of the criterion as defined by 7Q2 stream flows, (2) to tie the criteria to a typical seven-day duration of chronic lab tests, and (3) to indicate that assessment of instream compliance is based on an average condition not on a single "grab" sample.

For purposes of monitoring instream compliance with standards, it is not appropriate to compare single samples against the chronic criteria because that approach does not allow for any averaging of instream measurement. EPA guidance suggests that exceedances of chronic criteria should only occur every three years. This is based on the observation that three years might be needed between substantial ecological disruptions to allow time for aquatic biota to recover. The criteria, which are in fact an attempt to develop an acceptable concentration for average exposure (albeit over somewhat limited time periods in testing), have a variety of safety factors and statistical safeguards incorporated into them.

Hardness and pH-based Criteria

The existence of toxicity is determined at the time of the sampling event to get the most accurate determination of instream conditions for acute toxicity. This is done by computing the threshold concentration of toxicant needed to cause toxicity at the time of collection, and then comparing this threshold concentration to the sample event toxicant concentration. It is necessary to use the event hardness or pH and the TSWQS equation to calculate a unique acute criterion for each event.

Using event specific hardness. When event specific hardness data are available, these results are used for determining acute toxicity. Then, each calculated criterion is compared to the corresponding measured concentration of toxicant in order to determine support of the criterion for that sample.

Note: Calcium and magnesium are often reported instead of hardness. Hardness can be computed from calcium and magnesium for a sample event using this equation:

$$Hardness\ (mg/L\ CaCO_3) = 2.497\ (calcium,\ mg/L) + 4.118\ (magnesium,\ mg/L)$$

Using default values. When event specific hardness is available or calculated, this value is used for determining acute toxicity. When event specific data are not available, default values for segment specific hardness or pH are used in the screening program to calculate an allowable instream concentration of toxicants. Hardness or pH values, published in the IPs, were developed as a conservative threshold concentration for permitting, above which the instream conditions would exceed the criterion. When a permitted discharge is modeled using the computed criteria, instream concentrations are expected to exceed the criterion about 15 percent of the time if the facility is discharging at the permitted limit and when a stream is near critical low flow conditions. The published segment specific hardness or pH values are used in the calculation of both acute and chronic criteria for a classified segment and its unclassified tributaries. See Table 5 of the IPs for segment specific hardness and pH values.

Hierarchy for using pH and hardness values. When data are available, the hierarchy of preferred hardness or pH values for calculation criteria is as follows:

- Classified segments. Assessors will use event hardness values. When no event values exist, 15th percentile values published in the IPs for the segment (or basin when segment values do not exist) are used.

- Unclassified segments. Assessors will use event hardness values. When no event values exist, 15th percentile values published in the IPs for the basin are used.

Use of the 15th percentile of hardness is conservative when applied to all samples in a data set and, on occasion, may incorrectly identify nonsupport of acute criteria for the segment. The assessor can develop a rationale (e.g. a data set of a minimum of 30 values) for using an alternate percentile, for example the 50th percentile, when it is more appropriate for the AU or station.

Free Ionic Form of Silver

The TSWQS express the freshwater criterion for silver in the free ionic form. Silver data in the SWQMIS database are reported as the dissolved fraction. The percentage of dissolved silver that is present in the free ionic form is calculated and compared to the criterion.

TCEQ developed a regression equation (R2 = 0.87) that calculates the percentage of dissolved silver that is in the free ionic form. The following equation is used to determine what percentage of dissolved silver is in the free ionic form:

$$Y = \exp\ [\exp\ (1/(0.6559 + 0.0044 \times Cl))]$$

Where:

Y = percent of dissolved silver in the free ionic form

Cl = dissolved chloride (mg/L)

The percentage obtained from the above equation is converted to a proportion and then multiplied by the dissolved fraction to obtain the free ionic silver concentration. For this equation, chloride values are obtained from the IPs, Tables D1-D25. When the 50th percentile chloride value of the range of chloride values exceeds 140 mg/L, the percentage of silver in the free ionic form will be 8.98 percent. The event-specific chloride or the 50th percentile value of the dissolved chloride concentration for each AU or station can be used, provided that 30 or more chloride measurements from ambient samples are available. For unclassified water bodies, the 50th percentile for the classified segment that receives the water can be used, or when the unclassified water body is freshwater and the segment is saltwater, the basin values can be used.

Table 3.3. Criteria for Specific Metals and Organic Substances in Water for Protection of Aquatic Life

(All values are listed or calculated in micrograms per liter (µg/L))

(Hardness concentrations are input as milligrams per liter (mg/L))

Parameter*	Parameter Code	Freshwater Acute Criteria	Freshwater Chronic Criteria	Saltwater Acute Criteria	Saltwater Chronic Criteria
Aldrin	39330	3.0	---	1.3	---
Aluminum (d)	01106	991w	---	---	---
Arsenic (d)	01000	340w	150w	149w	78w
Cadmium (d)	01025	(1.136672-(ln(hardness)(0.041838))) $^{(we(1.0166\ (\ln(hardness))-2.4743))}$	(1.101672-(ln(hardness)(0.041838))) $^{(we\ (0.7409\ (\ln(hardness))-4.719))}$	40.0w	8.75w
Carbaryl	39750	2.0	---	613	---
Chlordane	39350	2.4	0.004	0.09	0.004
Chlorpyrifos	81403	0.083	0.041	0.011	0.006
Chromium (Tri) (d)	01030	$0.316w e^{(0.8190(\ln(hardness))+3.7256)}$	$0.860w e^{(0.8190(\ln(hardness))+0.6848)}$	---	---
Chromium (Hex) (d)	01220	15.7w	10.6w	1,090w	49.6w
Copper (d)	01040	$0.960m e^{(0.9422(\ln(hardness))-1.6448)}$	$0.960m e^{(0.8545(\ln(hardness))-1.6463)}$	13.5w	3.6w
Cyanide[1] (free)	00722	45.8	10.7	5.6	5.6
4,4' - DDT	39370	1.1	0.001	0.13	0.001
Demeton	39560	---	0.1	---	0.1
Diazinon	39570	0.17	0.17	0.819	0.819
Dicofol	39780	59.3	19.8	---	---
Dieldrin	39380	0.24	0.002	0.71	0.002
Diuron	39650	210	70	---	---
Endosulfan I (*alpha*)	34361	0.22	0.056	0.034	0.009
Endosulfan II (*beta*)	34356	0.22	0.056	0.034	0.009

Parameter*	Parameter Code	Freshwater Acute Criteria	Freshwater Chronic Criteria	Saltwater Acute Criteria	Saltwater Chronic Criteria
Endosulfan sulfate	34351	0.22	0.056	0.034	0.009
Endrin	39390	0.086	0.002	0.037	0.002
Guthion	39580	---	0.01	---	0.01
Heptachlor	39410	0.52	0.004	0.053	0.004
Hexachloro-cyclohexane (*gamma*) (Lindane)	39782	1.126	0.08	0.16	---
Lead (d)	01049	(1.46203-(ln(hardness)(0.145712))) $(we^{(1.273(\ln(hardness))-1.460)})$	(1.46203-(ln(hardness)(0.145712))) $(we^{(1.273(\ln(hardness))-4.705)})$	133w	5.3w
Malathion	39530	---	0.01	---	0.01
Mercury	71900	2.4	1.3	2.1	1.1
Methoxychlor	39480	---	0.03	---	0.03
Mirex	39755	---	0.001	---	0.001
Nickel (d)	01065	$0.998we^{(0.8460(\ln(hardness))+2.255)}$	$0.997we^{(0.8460(\ln(hardness))+0.0584)}$	118w	13.1w
Nonylphenol	37745	28	6.6	7	1.7
Parathion (ethyl)	39540	0.065	0.013	---	---
Pentachlorophenol	39032	*e*(1.005(pH)-4.869)	*e*(1.005(pH)-5.134)	15.1	9.6
Phenanthrene	34461	30	30	7.7	4.6
PCBs [2]	39516	2.0	0.014	10	0.03
Selenium	01147	20	5	564	136
Silver, as free ion	01523	0.8w	---	2w	---
Toxaphene	39400	0.78	0.0002	0.21	0.0002
TBT	30340	0.13	0.024	0.24	0.0074

Parameter*	Parameter Code	Freshwater Acute Criteria	Freshwater Chronic Criteria	Saltwater Acute Criteria	Saltwater Chronic Criteria
2,4,5 Trichlorophenol	77687	136	64	259	12
Zinc (d)	01090	$0.978we^{(0.8473(\ln(hardness))+0.884)}$	$0.986we^{(0.8473(\ln(hardness))+0.884)}$	92.7w	84.2w

* See Chemical Acronyms and Abbreviations

1 Compliance will be determined using the analytical method for available cyanide.

2 These criteria apply to the sum of all congener or all isomer or homolog or Aroclor analysis.

(d) Indicates that the criteria for a specific parameter are for the dissolved portion in water. All other criteria are for total recoverable concentrations, except where noted.

e The mathematical constant that is the basis of the natural logarithm. When rounded to four decimal points, e is equal to 2.7183.

w Indicates that a criterion is multiplied by a water-effect ratio (WER) in order to incorporate the effects of local water chemistry on toxicity. The WER is equal to 1 except where sufficient data is available to establish a site-specific WER. WERs for individual water bodies are listed in Appendix E when standards are revised. The number preceding the w in the freshwater criterion equation is an EPA conversion factor.

m Indicates that a criterion may be multiplied by a WER or a biotic ligand model result in order to incorporate the effects of local water chemistry on toxicity. The multiplier is equal to 1 except where sufficient data is available to establish a site-specific multiplier. Multipliers for individual water bodies are listed in Appendix E when standards are revised. The number preceding the m in the freshwater equation is an EPA conversion factor.

Table 3.4. Aquatic Life Use—Toxic Criteria

Criteria for Classified water bodies listed in Appendix A of the TSWQS are in columns 3 through 6 (header cells shaded yellow).

Criteria for Unclassified water bodies and those listed in Appendix D of the TSWQS[1] are in columns 7 through 10 (header cells shaded green).

FW = Freshwater SW = Saltwater

Water Body/ Segment Type	Flow-Type*	Aquatic Life Criteria	Eliminate samples collected below the Critical low-flow [2]	Presumed 7Q2 if not published or no information to contrary	Aquatic Life Criteria	Eliminate samples below Critical low-flow [2]	Presumed 7Q2 if not published or no information to contrary
Freshwater Stream	Perennial Stream [3]	FW Acute	Yes [4]	0.1 cfs	FW Acute	Yes [4]	0.1cfs
		FW Chronic	Yes	0.1 cfs	FW Chronic	Yes	0.1 cfs
Freshwater Stream	Intermittent Stream with perennial pools adequate to support significant aquatic life [5]	FW Acute	n/a	0.0 cfs	FW Acute	No 7Q2 is 0.0 cfs	0.0 cfs
		FW Chronic	n/a	0.0 cfs	FW Chronic	No 7Q2 is 0.0 cfs	0.0 cfs
Freshwater Stream	Intermittent Stream [6] and intermittent stream with perennial pools not adequate to support significant aquatic life (with or without wastewater flow)	FW Acute	n/a	0.0 cfs	FW Acute	No 7Q2 is 0.0 cfs	0.0 cfs
Reservoir	Reservoir	FW Acute	n/a	n/a	FW Acute	n/a	n/a
		FW Chronic	n/a	n/a	FW Chronic	n/a	n/a
Tidal Stream	Tidal Stream	SW Acute	n/a	n/a	SW Acute	n/a	n/a
		SW Chronic	n/a	n/a	SW Chronic	n/a	n/a

Water Body/ Segment Type	Flow-Type*	Aquatic Life Criteria	Eliminate samples collected below the Critical low-flow [2]	Presumed 7Q2 if not published or no information to contrary	Aquatic Life Criteria	Eliminate samples below Critical low-flow [2]	Presumed 7Q2 if not published or no information to contrary
Estuary	Estuary	SW Acute	n/a	n/a	SW Acute	n/a	n/a
		SW Chronic	n/a	n/a	SW Chronic	n/a	n/a
Ocean	Ocean	SW Acute	n/a	n/a	n/a	n/a	n/a
		SW Chronic	n/a	n/a	n/a	n/a	n/a
Freshwater Wetland	Freshwater Wetland	FW Chronic	n/a	n/a	FW Acute	n/a	n/a
		FW Acute	n/a	n/a	FW Chronic	n/a	n/a
Saltwater Wetland	Saltwater Wetland	SW Acute	n/a	n/a	SW Acute	n/a	n/a
		SW Chronic	n/a	n/a	SW Chronic	n/a	n/a

* Use published flow type or other reliable source such as the SWQM flow-type questionnaire.

1 Presumed ALU and criteria are used for unclassified water bodies except for the site-specific criteria listed in Appendix E, and perennial streams listed in Appendix D of the TSWQS.

2 Presume event was above the critical low flow for classified perennial stream segments when no flow information is available (either severity code or measurement) for the event. Flow severity of 1 is no flow, and thus the event is below critical low flow. Flow severity of 2 through 5 is above the critical low flow.

3 Definition of perennial stream: A stream that does not have a period of zero flow at any time during most years

4 Samples are eliminated below ¼ of the critical low flow.

6 Definition of intermittent stream: A stream that has a period of zero flow for at least one week during most years. If flow records are available, a stream with a 7Q2 of less than 0.10 cfs is considered intermittent.

5 Definition of intermittent with perennial pools: A stream that has a period of zero flow for at least one week during most years but has adequate and persistent pools that provide habitat to support significant aquatic life (not just a refuge). Generally, an “adequate pool” to support aquatic life is deeper than one meter and >100 meters long; or where large pools cover >20% of the stream bed in a 500-meter reach.

6 Definition of intermittent stream: A stream that has a period of zero flow for at least one week during most years. If flow records are available, a stream with a 7Q2 of less than 0.10 cfs is considered intermittent.

Narrative Criteria Protecting Aquatic Life

Ambient Water Toxicity

Aquatic life is protected from toxic conditions in water by narrative criteria. ALU support is evaluated based on ambient water toxicity tests using sensitive test organisms. Sample toxicity can be established with tests using a minimum of two species of test organisms. If any of these tests exhibit toxicity, the sample is considered toxic. Support of the ALU is determined with ambient acute and chronic toxicity tests in water. The narrative criteria protecting aquatic life is not supported when samples are toxic more than ten percent of the time using the binomial method. An exception is when there are fewer than 10 samples. In these cases, a minimum of two exceedances are required, corresponding to a greater than 10% exceedance rate.

Samples generated by EPA Region 6 (Toxicology Data Network) TOXNET Program will be evaluated as concerns when persistent (> 50% and based on the judgment of the assessor) sublethal effects are identified. Where such concerns for sublethal effects are identified with TOXNET samples, subsequent testing using conventional water toxicity testing methods will be a priority for confirming sublethal effects. The water body may be listed based on lethal effects demonstrated with TOXNET samples, and with conventional water toxicity testing methods exhibiting lethal or sublethal effects. Persistent sublethal effects based on conventional water toxicity testing will be used to list the water body, with some judgment allowed to the assessor in cases where toxicity testing is highly episodic and occurrences of sublethal toxicity are observed at varying points in time and under various water quality conditions (e.g. sublethal toxicity is observed under a condition of flow or temperature that confounds the attribution of toxicity to a given condition and all other indicators demonstrate support of a use).

Determination of ambient toxicity is subject to some judgment by the assessor. All available information must be evaluated, including the reliability of the toxicity tests, presence of toxic contaminants, health of the biological community and condition of fish sampled, and the proximity and route to known and potential sources of toxic contaminants.

Ambient Sediment Toxicity

Aquatic organisms are also protected against toxic conditions in sediment. Sediment toxicity in conjunction with other water quality information may be used to make determinations of water quality standards attainment. Sediment toxicity sample collection is to be conducted to examine specific water bodies where sediment screening level concerns have been identified. Ambient sediment toxicity assessments will examine the spatial and temporal relationship between contaminants, observed toxicity, and resident biological communities. All information will be integrated into a multiple lines of evidence approach to best judge the condition of the area of investigation and to identify toxic sediment. The lines of evidence (LOE) process described in this guidance document is appropriate for defining use support and listing or delisting on the 303(d) List. Planning water quality restoration and decisions about implementation, will require additional sampling and information gathering.

The method for evaluating sediment toxicity is outlined in Appendix C. Ambient sediment toxicity status is reported only with the LOE assessment method and only when there are at least two of the following LOE available for consideration—toxicity tests (ambient whole sediment or elutriate tests), sediment contaminant levels, or biological community data. However, use support for aquatic life using the LOE ambient sediment toxicity method is routinely reported only when ambient whole sediment or elutriate tests are available. Acute and chronic whole sediment and elutriate test outcomes are reported as results for these assessment methods (number of samples and number of exceedances), but use attainment or concern status is not reported for these methods.

When concerns for sediment toxicity are identified using elutriate samples, additional monitoring and evaluation of use attainment will be initiated within two years using whole sediment toxicity tests.

Metal and Organic Substances Sediment Contaminant Levels

Sediments are screened for metal and organic substances that have demonstrated adverse ecological effects. Sample contaminant concentrations are compared to screening levels developed by TCEQ's Ecological Risk Assessment Program as second-effects levels and outlined in Table 3.5. A concern for aquatic life is identified if more than 20 percent of the contaminant samples exceed the screening levels using the binomial method.

Table 3.5. Screening Levels for Sediment

CAS #	Constituent*	Freshwater	Marine
Inorganics (mg/kg dry weight)			
7440-36-0	Antimony	12 [p]	25 [c]
7440-38-2	Arsenic	33 [a]	70 [b]
7440-43-9	Cadmium	4.98 [a]	9.6 [b]
7440-47-3	Chromium	111 [a]	370 [b]
7440-50-8	Copper	149 [a]	270 [b]
7439-89-6	Iron	40,000 [d]	--
7439-92-1	Lead	128 [a]	218 [b]
7439-96-5	Manganese	1,100 [d]	--
7439-97-6	Mercury	1.06 [a]	0.71 [b]
7440-02-0	Nickel	48.6 [a]	51.6 [b]

CAS #	Constituent*	Freshwater	Marine
7440-22-4	Silver	1.7 [n]	3.7 [b]
7440-66-6	Zinc	459 [a]	410 [b]
PAHs (µg/kg dry wt.)[i]			
83-32-9	Acenaphthene	88.9 [e]	500 [b]
208-96-8	Acenaphthylene	128 [e]	640 [b]
120-12-7	Anthracene	845 [a]	1,100 [b]
56-55-3	Benz[*a*]anthracene	1,050 [a]	1,600 [b]
50-32-8	Benzo[*a*]pyrene	1,450 [a]	1,600 [b]
218-01-9	Chrysene	1,290 [a]	2,800 [b]
53-70-3	1,2,5,6-Dibenz[*a*, *h*]anthracene	135 e	260 [b]
206-44-0	Fluoranthene	2,230 [a]	5,100 [b]
86-73-7	Fluorene	536 [a]	540 [b]
91-57-6	2- Methyl naphthalene	201 [e]	670 [b]
91-20-3	Naphthalene	561 [a]	2,100 [b]
85-01-8	Phenanthrene	1,170 [a]	1,500 [b]
129-00-0	Pyrene	1,520 [a]	2,600 [b]
n/a	Low Molecular Weight PAHs [g, h]	--	3,160 [b]
n/a	High Molecular Weight PAHs [g, i]	--	9,600 [b]
n/a	Total PAHs [g, j]	22,800 [a]	44,792 [b]
Chlorinated Pesticides/PCBs/Benzenes (µg/kg dry wt.)			
309-00-2	Aldrin	80 [d]	--
11097-69-1	Aroclor 1254	340 [d, m]	709 [e]
12674-11-2	Aroclor 1016	530 [d, m]	--
11096-82-5	Aroclor 1260	240 [d, m]	--
12672-29-6	Aroclor 1248	1,500 [d, m]	--
65-85-0	Benzoic acid	3,800 [n]	650 [n]
100-51-6	Benzyl alcohol	--	73 [n]
319-84-6	*alpha*-BHC	100 d, [m]	--
319-85-7	*beta*-BHC	210 [d, m]	--
319-86-8	*delta*-BHC	2300 [l]	--
58-89-9	*gamma*-BHC (Lindane)	4.99 [a]	0.99 [e]
608-73-1	BHC [g]	120 [d, m]	-
57-74-9	Chlordane (Total)	17.6 [a]	4.79 [e]

CAS #	Constituent*	Freshwater	Marine
331-41-5	Diazinon/Spectracide	7.3 [l]	--
132-64-9	Dibenzofuran	680 [n]	580 [n, m]
60-57-1	Dieldrin	61.8 [a]	4.3 [e]
105-67-9	2,4-dimethylphenol	--	29 [n]
959-98-8	*alpha*-endosulfan	7.4 [l]	--
33213-65-9	*beta*-endosulfan	35 [l]	--
72-20-8	Endrin	207 [a]	62.4 [e]
118-74-1	HCB (Hexachlorobenzene)	240 [d, m]	-
76-44-8	Heptachlor	2.74 [e]	2.74 [e]
1024-57-3	Heptachlor epoxide	16 [a]	--
77-47-4	Hexachlorocyclopentadiene	202 [o]	1,060 [o]
121-75-5	Malathion	6.2 [l]	--
72-43-5	Methoxychlor	95 [l]	--
2385-85-5	Mirex	1,300 [d, m]	--
95-48-7	2-methylphenol (*o*-cresol)	--	63 [n]
106-44-5	4-methylphenol (*p*-cresol)	2000 [n]	670 [n]
59-50-7	3-methyl-4-chlorophenol	5,620 [o]	--
56-38-2	Parathion (ethyl)	3.7 [o]	300 [o]
608-93-5	Pentachlorobenzene	2,660 [o]	44,350 [o]
87-86-5	Pentachlorophenol	1,200 [n]	690 [n]
108-95-2	Phenol	210 [n]	1,200 [n]
95-94-3	1,2,4,5-tetrachlorobenzene	1,590 [o]	1,640 [o]
72-55-9	Sum DDE [g]	31.3 [a]	374 [e]
72-54-8	Sum DDD [g]	28 [a]	7.81 [e]
50-29-3	Sum DDT [g]	62.9 [a]	4.77 [e]
1336-36-3	Total PCBs [g]	676 [a]	180 [b]
	Other Pesticides (µg/kg dry wt.)		
8001-35-2	Toxaphene	32 [k, m]	--
	Phthalates (µg/kg dry wt.)		
117-81-7	Bis(2-ethyl-hexyl)phthalate	22,000 [n]	2,647 [f]
85-68-7	Butyl benzyl phthalate	150,000 [l]	640 [n, m]
84-74-2	Di-*n*-butyl phthalate	80,000 [l]	17,000 [n, m]
117-84-0	Di-*n*-octyl-phthalate	1,100 [n]	45,000 [n, m]
84-66-2	Diethyl phthalate	11,000 [l]	1,100 [n, m]

CAS #	Constituent*	Freshwater	Marine
131-11-3	Dimethyl phthalate	8,900 [o]	530 [n, m]
Volatiles (µg/kg dry wt.) [m]			
67-64-1	Acetone	360,180 [o]	1,003,360 [o]
107-13-1	Acrylonitrile	1,650 [o]	3,240 [o]
71-43-2	Benzene [n]	2,870 [o]	4,080 [o]
104-51-8	*n*-butylbenzene	6,570 [o]	--
103-65-1	*n*-propylbenzene	4,350 [o]	--
135-98-8	*sec*-butylbenzene	5,280 [o]	--
98-06-6	*tert*-butylbenzene	7,260 [o]	--
75-27-4	Bromodichloromethane	14,740 [o]	--
78-93-3	2-butanone (MEK)	154,260 [o]	--
75-15-0	Carbon disulfide	780 [o]	--
56-23-5	Carbon tetrachloride	21,000 [l]	36,740 [o]
108-90-7	Chlorobenzene	3,000 [o]	8,180 [o]
124-48-1	Chlorodibromomethane	940 [o]	--
67-66-3	Chloroform (trichloromethane)	5,670 [o]	8,860 [o]
74-87-3	Chloromethane	106,800 [o]	52,430 [o]
98-82-8	Cumene (isopropylbenzene)	53,950 [o]	--
99-87-6	*p*-Cymene (4-isopropyltoluene)	5,980 [o]	--
95-50-1	1,2-dichlorobenzene	4,950 [o]	4,440 [o]
541-73-1	1,3-dichlorobenzene	350 [o]	1,950 [o]
106-46-7	1,4-dichlorobenzene	4,650 [o]	4,210 [o]
75-71-8	Dichlorodifluoromethane	22,090 [o]	--
75-34-3	1,1-dichloroethane	13,890 [o]	--
107-06-2	1,2-dichloroethane	28,680 [o]	26,260 [o]
75-35-4	1,1-dichloroethene	11,200 [o]	92,470 [o]
156-60-5	1,2-dichloroethene (*trans*)	71,840 [o]	--
540-59-0	1,2-dichloroethene (mixed *cis* and *trans*)	36,850 [o]	2,950 [o]
78-87-5	1,2-dichloropropane	21,120 [o]	21,520 [o]
542-75-6	1,3-dichloropropene	1,370 [o]	260 [o]
121-14-2	2,4-dinitrotoluene	8,020 [o]	14,960 [o]
100-41-4	Ethylbenzene	7,880 [o]	4,100 [o]
87-68-3	Hexachlorobutadiene	550 [k, m]	670 [o]
67-72-1	Hexachloroethane	3,945 [o]	5,640 [o]

CAS #	Constituent*	Freshwater	Marine
110-54-3	*n*-Hexane	50 [o]	--
591-78-6	2-hexanone	28,200 [o]	--
108-10-1	4-methyl-2-pentanone (MIBK)	116,590 [o]	272,060 [o]
74-83-9	Methyl bromide	460 [o]	2,490 [o]
80-62-6	Methyl methacrylate	56,980 [o]	-
75-09-2	Methylene chloride	46,520 [o]	22,940 [o]
98-95-3	Nitrobenzene [n]	6,290 [o]	8,000 [o]
71-41-0	1-pentanol	1,630 [o]	--
67-63-0	2-propanol [n]	80 [o]	--
100-42-5	Styrene	61,420 [o]	22,310 [o]
79-34-5	1,1,2,2-tetrachloroethane	3,800 [o]	3,690 [o]
127-18-4	Tetrachloroethene	8,210 [o]	3,210 [o]
108-88-3	Toluene	20,290 [o]	7,750 [o]
75-25-2	Bromoform	1,310 [o]	10,670 [o]
120-82-1	1,2,4-trichlorobenzene	5,310 [o]	2,320 [o]
71-55-6	1,1,1-trichloroethane	24,790 [o]	35,860 [o]
79-00-5	1,1,2-trichloroethane	5,880 [o]	1,800 [o]
79-01-6	Trichloroethene	13,690 [o]	7,300 [o]
75-69-4	Trichlorofluoromethane	10,120 [o]	--
75-01-4	Vinyl chloride	4,180 [o]	--
1330-20-7	Xylenes	12,010 [o]	7,620 [o]

* See Chemical Acronyms and Abbreviations

a MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Environ. Contam. Toxicol.* 39: 20–31. Freshwater benchmarks are threshold-effect concentrations and second effects levels are probable effects concentrations.

b Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environmental Management.* 19(1): 81–97. Marine benchmarks are effects range—low, and second-effects levels are effects range—median.

c Long, E.R. and L.G. Morgan. 1991. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. Technical memo. Seattle: National Oceanic and Atmospheric Administration. NOS OMA 52.

d Persaud, D., R. Jaagumagi, and A. Hayton. 1993. Guidelines for the protection and management of aquatic sediment quality in Ontario. Toronto: Ontario Ministry of the Environment, Water Resources Branch. Lowest effect level used as benchmark, and severe-effect level used as second effects level.

e Canadian Sediment Quality Guidelines for the Protection of Aquatic Life. Interim sediment quality guidelines used as benchmark, probable effects level (PEL) used as second-effects level. <ceqg-rcqe.ccme.ca/en/index.html> Last accessed July 15, 2016.

f Smith, S.L., D.D. MacDonald, K.A. Keenleyside and C.L. Gaudet. 1996. The Development and Implementation of Canadian Sediment Quality Guidelines. Development and Progress in Sediment Quality Assessment: Rationale, Challenges, Techniques & Strategies. pp. 233-49. Threshold effect levels (TEL) used as benchmark and probable effect level (PEL) used as second effects level.

g When benchmarks represent the sum of individual compounds, isomers, or groups of congeners, and the chemical analysis indicates an undetected value, the proxy value specified at 30 TAC 350.51(n) shall be used for calculating the sum of the respective compounds, isomers, or congeners. This assumes that the particular chemical of concern has not been eliminated in accordance with the criteria at 350.71(k).

h The low molecular weight PAH benchmark is to be compared to the sum of the concentrations of the following compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, and 2-methyl naphthalene. The PAH benchmark is not the sum of the corresponding benchmarks listed for the individual compounds.

i The high molecular weight PAH benchmark is to be compared to the sum of the concentrations of the following compounds: fluoranthene, pyrene, benz(a)anthracene, chrysene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, and dibenzo(a,h)anthracene. The PAH benchmark is not the sum of the corresponding benchmarks listed for the individual compounds.

j Total PAH refers to the sum of the concentrations of each of low and high molecular weight PAHs listed above and any other PAH compounds that are not eliminated in accordance with 30 TAC 350.71(k). The benchmarks for total PAHs are the most relevant in evaluating risk in an ERA, as PAHs almost always occur as mixtures. Values for individual, low molecular weight, and high molecular weight PAHs are included as guidelines to aid in the determination of disproportionate concentrations within the mixture that may be masked by the total.

k New York State Department of Environmental Conservation. 1999. *Technical guidance for screening contaminated sediments.* Albany: Division of Fish, Wildlife, and Marine Resources. These values corrected to bulk sediment values by assuming 1 percent total organic carbon (TOC) (value × 0.01).

l U.S. EPA. 2004. *The incidence and severity of sediment contamination in surface waters of the United States. National sediment quality survey*. Washington: Office of Science and Technology. Second Edition. EPA 823-R-04-007. These values corrected to bulk sediment values by assuming 1 percent TOC (value × 0.01). Tier 2 equilibrium sediment-partitioning guideline (ESG) used for benchmark, and Tier 1 ESG used for second-effects level.

m Values in the original reference were based on percentage TOC. These values were converted to bulk sediment values by assuming 1 percent TOC (value × 0.01).

n Washington State Sediment Management Standards. Chapter 173-204, Washington Administrative Code[3]; Feb. 25, 2013.

o Benchmarks derived using formula in P.C. Fuchsman. 2003. Modification of the equilibrium partitioning approach for volatile organic compounds in sediment. *Environ. Toxicol. Chem*. 22: 1532–34. TCEQ Surface water benchmark values were used as inputs. K_{oc} values taken from the Chemical and Physical Properties PCL table. TRRP-24 default values of 1 percent fraction organic carbon and 0.37 porosity were used. The person can adjust these values with site-specific data.

p Washington State Department of Ecology. 2011. *Development of benthic Sediment Quality Values for freshwater sediments in Washington, Oregon, and Idaho.* Publication No. 11-09-054.

Fish and Benthic Community Assessment

In the TSWQS, an exceptional, high, intermediate, or limited ALU is assigned to each classified water body, and to some unclassified water bodies, based on physical, chemical, and biological characteristics (see Appendices A and D of the TSWQS).

[3] app.leg.wa.gov/WAC/default.aspx?cite=173-204

Biological characteristics that describe each ALU category are assessed, based on fish and/or benthic macroinvertebrate data.

For water bodies where ALU categories have been designated or presumed, use attainment can be assessed using biological data. ALU category assignments are based on the use of multi-metric indices of biotic integrity (IBI) which integrate structural and functional attributes of biotic assemblages. This provides a firm basis for establishing use support limiting the uncertainty in the final determinations.

Fish and benthic community data are collected according to field methods specified in TCEQ's SWQM Procedures Volume 2 and used to evaluate the biological condition based on the IBI. The IBI is exclusive to freshwater streams and cannot be used to assess samples collected from reservoirs or tidal streams. Regional fish and benthic IBIs must be used where available.

If benthic macroinvertebrates are collected according to *quantitative protocols* using a Surber sampler, the integrity of the benthic macroinvertebrate community should be evaluated based on the benthic IBI for quantitative samples. If benthic macroinvertebrates are collected according to *rapid bioassessment (RBA) protocols* (5-minute kicknet, RBA snags), then the integrity of the benthic macroinvertebrate community should be evaluated based on the benthic IBIs for Rapid Bioassessment samples.

Aquatic Habitat

Habitat quality is assessed by evaluating physical habitat parameters collected according to TCEQ's SWQM Procedures Volume 2. The habitat evaluation procedures involve rating nine parameters across four categories using a multi-metric habitat quality index (HQI). The total HQI score obtained from the stream reach is compared to categorical HQI score ranges associated with exceptional, high, intermediate, and limited ALUs. When the HQI score falls below the categorical score range of the ALU category assigned to the water body, the habitat attainment status is reported as a concern.

Temporal Considerations for Biological Dataset Used in Assessment

Two bioassessment events. If only two bioassessment events are considered, both should be conducted during the index period March 15 to Oct. 15, with only one of the two events occurring between July 1 and Sept. 30. Ideally, results for both events come from the same index period. This reduces the probability of missing effects of perturbation(s) that occurred in the latter portion of the index period.

More than two bioassessment events. If more than two bioassessment events are considered, then the study should be two or more years, with two events or more per year. More than two samples collected during the same year may be considered if sample dates are consistent with temporal guidelines below.

All events should be between March 15 and Oct. 15 with one-half to two-thirds of the events occurring between July 1 and Sept. 30. Additionally, there should be at least one month between each event, and results should come from periods of moderate to low flow but above the 7Q2.

Determining Overall Aquatic Life Use

The determination of fish and/or benthic macroinvertebrate integrity should be used in conjunction with physical and chemical data to provide an integrated assessment of support of the aquatic life use for water bodies identified in the TSWQS (Appendices A and D). Support of the aquatic life use is assessed according to the decision matrix in Table 3.6. Determination of attainment using bioassessment data and calculations used for scoring are included in TCEQ's SWQM Procedures Volume 2.

The average score is compared to the aquatic life use point score ranges for fish, and for benthic macroinvertebrates, depending on what field protocols were followed. If sample results from multiple events exhibit an unusually high amount of variability as indicated by the calculated coefficient of variation (CV) exceeding 2X the ecoregion aquatic life use category specific CV for fish and/or benthics as shown in Tables D.1-D.3, the reasons for excessive variability will be evaluated, and the validity of the samples will be assessed. An aquatic life concern is identified when only one sample event is available for assessment and nonsupport of the use is indicated.

When assessing the results of IBI scores against criteria, it is important to consider the variability associated with both fish and benthic datasets. A discussion of variability and the implementation of a CV in biological assessments are discussed in Appendix D.

Threatened and Endangered Species

When water quality conditions do not support a healthy aquatic community or individual populations, including threatened and endangered species, that ALU is not attained. Up-to-date information for threatened and endangered species can be found on the TPWD website. This information can be used to identify the presence of these species for use in assigning categories for TMDL development and planning the basin cooperative monitoring schedule.

Table 3.6. Decision Matrix for Integrated Assessments of ALU Support

Overall ALU Support based on Bioassessment, DO, Toxics in Water, and Ambient Toxicity in Water. For three or more lines of evidence, unless otherwise illustrated here, nonattainment of any line of evidence discussed here results in nonsupport of the ALU.

Bioassessment Data	Dissolved Oxygen Data		Toxics in Water Testing		Habitat Assessment	
	Meets Criteria**	DO Not Meet Criteria	All Meet Criteria	Do Not Meet Criteria	Meets Screening Criteria	Does Not Meet Screening Criteria (reported as a concern)
Benthic macroinvertebrate and fish bioassessments done and both attain designated ALU	Fully Supported	Not Supported*	Fully Supported	Not Supported	Fully Supported	Fully Supported *
Benthic macroinvertebrate and fish bioassessments done and one of the two does not attain designated ALU	Fully Supporting with a Concern for fish or benthics	Not Supported	Fully Supporting with a Concern for fish or benthics	Not Supported	Fully Supporting with a Concern for fish or benthics	Fully Supporting with a Concern for fish or benthics
Both benthic macroinvertebrate and fish bioassessment done and both indicate nonattainment of designated ALU	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported
Only fish bioassessment done and indicates nonattainment of designated ALU	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported
Only benthic macroinvertebrate bioassessment done and indicates nonattainment of designated ALU	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported	Not Supported

Bioassessment Data	**Dissolved Oxygen Data**		**Toxics in Water Testing**		**Habitat Assessment**	
Only fish bioassessment collected. Fish indicates attainment of designated ALU***	Fully Supported	Not Supported*	Fully Supported	Not Supported	Fully Supported	Fully Supported *
Only benthic macroinvertebrate bioassessment done and indicates attainment of designated ALU***	Fully Supported	Not Supported*	Fully Supported	Not Supported	Fully Supported	Fully Supported *
Bioassessment data not available	Fully Supported	Not Supported	Fully Supported	Not Supported	Fully Supported	Not Supported**

Both fish and macroinvertebrate samples are required to make an ALU attainment determination for 305(b)/303(d) assessment purposes. In certain cases where it is only possible to collect one or the other, the ALU determination may be made based on only fish or benthic macroinvertebrates according to the framework presented in this table. Proper justification is required for why only one type of community was sampled.

* Long-term bioassessment monitoring will be conducted to determine if adverse effects to the fish and/or benthic macroinvertebrates are detected.

** When the habitat index indicates nonsupport, the habitat attainment status is reported as a concern.

*** When it is only possible, or appropriate (e.g. due to habitat limitations), to sample either the fish or benthic macroinvertebrate assemblage then the results will be evaluated for support. If samples are collected for only one assemblage but it would be possible or appropriate to sample both the fish and benthic macroinvertebrate assemblage, then results will be evaluated as a concern.

Recreation Use

Indicator Bacteria

Recreation Use categories and criteria (Table 3.7) are assigned to all water bodies. Two organisms are routinely analyzed in water samples collected to determine support of the recreation use: Escherichia coli (*E. coli*) in freshwater, and enterococci in tidal water bodies and certain inland water bodies (see Table 3.8). Fecal coliform will continue to be used to assess the oyster waters (14 colonies/100mL median).

Table 3.7. Contact Recreation Use Categories

FW = Freshwater SW = Saltwater

Uses	E. coli (FW) (colonies/100mL)	Enterococci (Salty inland FW) * (colonies/100mL)	Enterococci (SW) (colonies/100mL)
Primary contact recreation 1 (PCR 1)	126	33	35/130***
Primary contact recreation 2 (PCR 2)	206	--	--
Secondary contact recreation 1 (SCR 1)	630	165	175**
Secondary contact recreation 2 (SCR 2)	1,030	270	--
Noncontact recreation (NCR)	2,060	540	350

* Salty (high saline) inland FW = High saline inland water bodies (conductivity ≥ 10,000 µS/cm)
** Secondary contact 1 for SW would only be applicable when not in conflict with the federal Beach Act
*** Single sample criterion used to assess PCR in coastal recreation waters

Recreation use categories and criteria for classified segments are specified in Appendix A of the TSWQS. Site-specific recreation use categories and criteria for selected unclassified water bodies are specified in Appendix G. For water bodies not specifically listed in Appendix A or Appendix G, primary contact recreation is the presumed use, except that secondary contact recreation 1 can be assigned to individual streams if (1) the stream is less than 0.5 meters deep, (2) an analysis demonstrates that primary contact recreation does not occur, and (3) the use of the stream is reviewed during a prescribed public participation process. Establishment of another recreation use category requires a recreational use attainment analysis (RUAA) or other standards revision process to determine the appropriate recreation use category.

The recreation uses in the TSWQS are as follows:

- **PCR 1 –** Water recreation activities, such as wading by children, swimming, water skiing, diving, tubing, surfing, and whitewater kayaking, canoeing, and rafting, involving a significant risk of ingestion of water.
- **PCR 2 –** Water recreation activities that involve a significant risk of ingestion of water occur, but less frequently than for primary contact recreation 1. Will be designated where recreation occurs less frequently due to physical characteristics of the water body or limited public access.
- **SCR 1 –** Water recreation activities, such as fishing, commercial and recreational boating, and limited body contact incidental to shoreline activity, not involving a significant risk of water ingestion and that commonly occur.
- **SCR 2 –** Water recreation activities, such as fishing, commercial and recreational boating, and limited body contact incidental to shoreline activity, not involving a significant risk of water ingestion but that occur less frequently than for secondary contact recreation 1 due to (1) physical characteristics of the water body and/or (2) limited public access.
- **NCR –** Activities, such as ship and barge traffic, birding, and using hike and bike trails near a water body, not involving a significant risk of water ingestion, and where primary and secondary contact recreation should not occur because of unsafe conditions. The recreation use for these water bodies is protected by the same criteria and indicators assigned to contact recreation waters— *E. coli*, and enterococci.

A noncontact recreation use and an *E. coli* geometric average of 605 colonies/100mL is assigned to Segment 2308 of the Rio Grande near El Paso. A noncontact recreation use and an *E. coli* geometric average of 126 colonies/100mL is assigned to Segment 0105, Rita Blanca Lake. A noncontact recreation use and an enterococci geometric average of 35 colonies/100mL is assigned to Segments 1005, 1701, 2436, 2437, 2438, 2484, and 2494. Some water bodies (for example, Segments 1006 and 1007 of the Houston Ship Channel) are not assigned a recreation use in the TSWQS.

Recreational uses in coastal recreation waters will be evaluated using both geometric mean and single sample methods. An enterococci geometric mean (35 colonies/100mL) and single sample (130 colonies/100mL) must both be met to identify a waterbody as fully supporting. The single sample will apply the binomial method based on a 20% exceedance rate with 20% Type 1 error rate (Appendix B). This will apply to bays and estuaries designated or presumed to have primary contact recreation (PCR 1 or 2), based on a 7-year assessment period and a minimum sample size of 20 data points.

Beginning with the 2012 IR, the variability of bacteria data was considered by initiating a two-tiered approach for assessing new impairments in streams to (1) initially screen all AUs having 10 or more samples to determine exceedance of the geomean, and then to (2) identify impairments where sample size is greater than 20 and statistical confidence is sufficient to make this determination. The purpose of the secondary screening is to establish a greater level of confidence that a new listing is based on an exceedance of a criterion rather than random variation. This approach was developed to increase confidence in bacteria impairment listings while assuring concurrent implementation of management measures are directed to address the most severe impairments.

The tiered approach will be implemented in two steps. First, for those AUs with more than 10 samples, the geomean will be calculated and compared to the criterion. If the geomean is greater than the criterion and there are fewer than 20 samples in the dataset, a concern will be identified and monitoring in the AU will be prioritized during the coordinated monitoring process. This will ensure that in future listing cycles, there will be adequate samples to determine if an impairment exists. The second tier will require 20 samples to determine the use support status. For AUs with more than 20 samples, a confidence interval (CI) will be calculated (at the 80% confidence level) to determine the use attainment status. If the lower boundary of the CI is below the 126 (*E. coli*) or 33 (enterococci) criterion, then the AU will not be placed on the 303(d) List but will also be identified as a concern and targeted for additional monitoring. Water bodies will be listed if the lower boundary of the CI is above 126 or 33 respectively.

The use of the CI allows recreational attainment to be effectively assessed without requiring an extraordinarily high minimum number of samples. The procedures for applying the CI also provide several measures to reduce the risk of missing a significant impairment:

The required confidence level is lower than typical statistical confidence levels (usually 0.95).

- Confidence interval screening will only apply to potential new listings. A waterbody may be delisted when it has at least 20 samples and attains a geomean below the criteria.

Table 3.8. Recreation Use—Bacterial Indicator Criteria

EC = *E. coli* E = Enterococci

Water Body Type	Flow-Type*	Recreation Use Categories	Criteria Geomean (colonies/100mL)	Eliminate samples collected when:
Freshwater Stream	Perennial Stream [1]	PCR 1 PCR 2 SCR 1 SCR 2 NCR	126 EC 206 EC 630 EC 1,030 EC 2,060 EC	Flow < 0.1 cfs
Freshwater Stream	Intermittent Stream with Perennial Pools adequate to support significant aquatic life [2]	PCR 1 PCR 2 SCR 1 SCR 2 NCR	126 EC 206 EC 630 EC 1,030 EC 2,060 EC	([4])
Freshwater Stream	Intermittent Stream [3] and intermittent stream with perennial pools not adequate to support significant aquatic life	PCR 1 PCR 2 SCR 1 SCR 2 NCR	126 EC 206 EC 630 EC 1,030 EC 2,060 EC	([4])
Salty Inland Freshwater Stream[5]	Perennial Stream [1]	PCR 1 SCR 1 SCR 2 NCR	33 E 165 E 270 E 540 E	Flow < 0.1 cfs
Salty Inland Freshwater Stream[5]	Intermittent Stream with Perennial Pools adequate to support significant aquatic life [2]	PCR 1 SCR 1 SCR 2 NCR	33 E 165 E 270 E 540 E	([4])

Water Body Type	Flow-Type*	Recreation Use Categories	Criteria Geomean (colonies/100mL)	Eliminate samples collected when:
Salty Inland Freshwater Stream[5]	Intermittent Stream [3] and intermittent stream with perennial pools not adequate to support significant aquatic life	PCR 1 SCR 1 SCR 2 NCR	33 E 165 E 270 E 540 E	([4])
Reservoir	Reservoir	PCR 1 NCR	126 EC 2,060 EC	n/a
Tidal Stream	Tidal Stream	PCR 1 SCR 1 NCR	35 E 175 E 350 E	n/a
Estuary	Estuary	PCR 1 NCR	35 E/130 (E single sample) ** 350 E	n/a
Ocean	Ocean	PCR 1	35 E/130 (E single sample) **	n/a
Freshwater Wetland	Freshwater Wetland	PCR 1	126 EC	n/a
Saltwater Wetland	Saltwater Wetland	PCR 1	35 E	n/a
Freshwater Perennial Stream	Freshwater Perennial Stream Segment 2308 only	NCR	605 E	Flow < 0.1 cfs
Reservoir	Reservoir Segment 0105 only	NCR	126 EC	n/a
Tidal Stream	Tidal Stream Segments 1005, 1701, 2436, 2437, 2438, 2484, and 2494 only	NCR	35 E	n/a
Coastal Beaches	Estuary (Basin 24)/Ocean (Basin 25)	PCR 1	104 (E single sample evaluation of BAV)	n/a

* Use published flow type or other reliable source such as the SWQM flow-type questionnaire.

[1] Definition of perennial stream: A stream that does not have a period of zero flow at any time during most years.

[2] Definition of intermittent with perennial pools for purposes of determining criteria support: A stream that has a period of zero flow for at least one week during most years but has adequate and persistent pools that provide habitat to support significant aquatic life. Generally, an "adequate pool" to support aquatic life is deeper than one meter and >100 meters long; or where large pools cover >20% of the stream bed in a 500-meter reach.

[3] Definition of intermittent stream: A stream that has a period of zero flow for at least one week during most years. If flow records are available, a stream with a 7Q2 of less than 0.10 cfs is considered intermittent.

[4] Less than 20% of the stream bed of a 500-meter sampling reach is covered by pools.

[5] Fecal coliform has been phased out as criteria for salty inland waters however, fecal coliform would continue to be used for oyster waters criterion (14 colonies/100mL median).

** Site-specific criterion used to assess PCR in coastal recreation waters.

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Delisting bacteria impairments on perennial streams. If nonpoint sources are the primary contributors of bacteria to a water body, then bacteria concentrations may be lower if low-flow samples are overrepresented in the data set. When removing perennial streams from the 303(d) List due to improved conditions for bacterial indicators, consideration should be given to overrepresentation of low flow conditions in the dataset as the criteria are not applicable below 0.1 cfs in perennial streams.

Recreational Beaches

The Beaches Environmental Assessment and Coastal Health (BEACH) Act requires that states, in cooperation with EPA, develop and implement a program to monitor for pathogens and pathogen indicators in coastal recreation waters adjacent to public bathing beaches. The Act also requires public notification when water quality standards for pathogens or pathogen indicators are exceeded.

The GLO TBWP collects water samples from 164 stations at 62 recreational beaches along the Texas coast in Aransas, Brazoria, Cameron, Galveston, Jefferson, Matagorda, Nueces, and San Patricio Counties. The GLO contracts with universities, local governments, and laboratories to collect samples and test them for the presence of enterococci. Samples are collected weekly during the peak beach season from May through September and every other week from October through April. The GLO maintains an interactive mapping tool[4] locating each beach by county. Maps and other information are available on the TBWP website.

Advisories are recommended when the samples of enterococci bacteria exceed the GLO's Beach Action Value of 104 colonies/100mL. When samples indicate bacteria levels are high enough to warrant an advisory, the water at that beach must be sampled every 24-hours until bacteria levels fall within a safe range. An advisory lasts at least 24-hours but can be extended if bacteria levels continue to exceed recommended levels. Samples are collected under a QAPP consistent with TCEQ bacteria collection and analysis protocols. Samples are analyzed for enterococci bacteria using EPA's Method 1600 or the IDEXX Enterolert system.

Reporting Beach Assessment Information

The GLO compiles the beach data and provides TCEQ with summary information for each beach monitored. The information includes the total number of samples from all stations and the number of days each station is under an advisory. TCEQ assesses each beach for the assessment period of record. If a beach is under an advisory > 25% of the sampled days, the beach is "Not Supporting" the recreation beaches use. All impairments identified using this method are categorized as 5a due to human health considerations.

- Beach advisories < 20% of the time—Fully Supporting

[4] cgis.glo.texas.gov/Beachwatch/index.html

- Beach advisories 20-25% of the time—Concern
- Beach advisories < 20% of the time—Delisted and Fully Supporting
- Beach advisories > 25% of the time—Not Supporting

Table 3.9. General Use—Criteria for Assessment

Criteria for Classified water bodies listed in Appendix A of the TSWQS are in columns 3 through 5 (header cells shaded yellow).

Criteria for Unclassified water bodies and those listed in Appendix D of the TSWQS are in columns 6 through 8 (header cells shaded green).[1]

Water Body/ Segment Type	Flow Type*	Assigned Criteria and Screening Levels [2] Also see Table 3.10	Eliminate samples collected below the critical low-flow [3]	Presumed 7Q2 if not published or with no information to contrary	Criteria and Screening Levels	Eliminate samples below critical low flow	Presumed 7Q2 if not published with or no information to contrary
Freshwater Stream	Perennial Stream [4]	-Water temperature -Dissolved solids -High pH -Low pH -Nutrients screening levels	Yes Water Temp High pH Low pH only	0.1 cfs	Nutrients screening levels	n/a	0.1 cfs
Freshwater Stream	Intermittent Stream with perennial pools adequate to support significant aquatic life [5]	-Water temperature -Dissolved solids -High pH -Low pH -Nutrients screening levels	n/a	0.0 cfs	Nutrients screening levels	n/a	0.0 cfs
Freshwater Stream	Intermittent Stream [6] and intermittent stream with perennial pools not adequate to support significant aquatic life (with or without wastewater flow)	n/a	n/a	0.0 cfs	Nutrients screening levels	n/a	0.0 cfs

Water Body/ Segment Type	Flow Type*	Assigned Criteria and Screening Levels [2] Also see Table 3.10	Eliminate samples collected below the critical low-flow [3]	Presumed 7Q2 if not published or with no information to contrary	Criteria and Screening Levels	Eliminate samples below critical low flow	Presumed 7Q2 if not published with or no information to contrary
Reservoir	Reservoir	-Water temperature -Dissolved solids -High pH -Low pH -Nutrients (Reservoirs) Appendix F	n/a	n/a	Nutrient screening levels	n/a	n/a
Tidal Stream	Tidal Stream	-Water temperature -High pH -Low pH -Nutrients screening levels	n/a	n/a	Nutrients screening levels	n/a	n/a
Estuary	Estuary	-Water temperature -High pH -Low pH -Nutrients screening levels	n/a	n/a	Nutrients screening levels	n/a	n/a
Ocean	Ocean	-Water temperature -High pH -Low pH -Nutrient screening levels	n/a	n/a	Screening levels for nutrients not available	n/a	n/a
Freshwater Wetland	Freshwater Wetland	n/a	n/a	n/a	Screening levels for nutrients not available	n/a	n/a

Water Body/ Segment Type	Flow Type*	Assigned Criteria and Screening Levels [2] Also see Table 3.10	Eliminate samples collected below the critical low-flow [3]	Presumed 7Q2 if not published or with no information to contrary	Criteria and Screening Levels	Eliminate samples below critical low flow	Presumed 7Q2 if not published with or no information to contrary
Saltwater Wetland	Saltwater Wetland	n/a	n/a	n/a	Screening levels for nutrients not available	n/a	n/a
Tidal Stream	Tidal Stream Segments 1006 and 1007 only	Enterococci [7]	n/a	n/a	n/a	n/a	n/a

* Use published flow type or other reliable source such as the SWQM flow-type questionnaire.

1 General Use site-specific criteria are not assigned in the TSWQS to unclassified water bodies.

2 General Use site-specific criteria are listed in Appendix A and/or Appendix F of the TSWQS. Nutrient screening levels are listed in Table 3.11.

3 Presume event was above the critical low flow for classified perennial stream segments when no flow information is available for the event. Otherwise, samples collected from classified perennial streams are excluded from the assessment when: stream flows are below the site-specific 7Q2 value or the presumed 7Q2 of 0.1 cfs, or when flow severity = 1 and there is no reported streamflow.

4 Definition of perennial stream: A stream that does not have a period of zero flow at any time during most years.

5 Definition of intermittent with perennial pools for purposes of determining criteria support: A stream that has a period of zero flow for at least one week during most years but has adequate and persistent pools that provide habitat to support significant aquatic life. An “adequate pool” to support aquatic life is deeper than one meter and >100 meters long; or where large pools cover >20% of the stream bed in a 500-meter reach.

6 Definition of intermittent stream: A stream that has a period of zero flow for at least one week during most years. If flow records are available, a stream with a 7Q2 of less than 0.1 cfs is considered intermittent.

7 Enterococci 30-day geometric mean – 168 colonies/100mL.

Table 3.10. General Use—Chloride, Sulfate, and TDS* Criteria

Classified Water Bodies in Appendix A of the TSWQS [1]

Water Body/Segment Type	Flow Type [2]	Assigned Criteria [3]	Eliminate samples collected when:
Freshwater Stream	Perennial Stream [4]	-Chloride -Sulfate -TDS	Flow < 0.1 cfs [5]
Freshwater Stream	Intermittent Stream with perennial pools adequate to support significant aquatic life [6]	-Chloride -Sulfate -TDS	Yes [7]
Freshwater Stream	Intermittent Stream [8] and intermittent stream with perennial pools not adequate to support significant aquatic life (with or without wastewater flow)	n/a	n/a
Reservoir	Reservoir	-Chloride -Sulfate -TDS	n/a
Tidal Stream	Tidal Stream	n/a	n/a
Estuary	Estuary	n/a	n/a
Ocean	Ocean	n/a	n/a
Freshwater Wetland	Freshwater Wetland	n/a	n/a
Saltwater Wetland	Saltwater Wetland	n/a	n/a

* See Chemical Acronyms and Abbreviations

1 General Use site-specific criteria are not assigned in the TSWQS to unclassified water bodies.

2 Use published flow type or other reliable source such as the SWQM flow-type questionnaire.

3 General Use (chloride, sulfate, and TDS) site-specific criteria are listed in Appendix A of the TSWQS.

4 Definition of perennial stream: A stream that does not have a period of zero flow at any time during most years.

5 Presume event was above 0.1 cfs for classified perennial stream segments when no flow information is available for the event.

6 Definition of intermittent with perennial pools for purposes of determining criteria support: A stream that has a period of zero flow for at least one week during most years but has adequate and persistent pools that provide habitat to support significant aquatic life. An "adequate pool" to support aquatic life is deeper than one meter and >100 meters long; or where large pools cover >20% of the stream bed in a 500-meter reach.

[7] Less than 20% of the stream bed of a 500-meter sampling reach is covered by pools.

[8] Definition of intermittent stream: A stream that has a period of zero flow for at least one week during most years. If flow records are available, a stream with a 7Q2 of less than 0.1 cfs is considered intermittent.

General Use

Water quality criteria for several constituents are established in the TSWQS to safeguard general water quality, rather than for protection of one specific use (see Tables 3.9 and 3.10). Water temperature, pH, chloride, sulfate, TDS, and Chl *a* are the parameters protecting aquatic life, recreation, domestic water supply (DWS), and other beneficial uses of water resources. For the purpose of assessment, the criteria protecting these multiple uses are evaluated for attainment of a construct that we entitled, “general use.”

Specific criteria for each of the other parameters are assigned to every classified segment in the TSWQS based on physical, chemical, and biological characteristics. Water temperature, pH, chloride, sulfate, TDS, and Chl *a* criteria developed for classified segments do not apply to unclassified water bodies. Enterococci criteria are also assigned to two Houston Ship Channel segments to protect general uses.

Concerns for general uses are identified with screening levels for nutrients and Chl *a* (see Table 3.11) for both classified and unclassified water bodies with the exception of some classified reservoirs identified in the TSWQS for which Chl *a* site-specific criteria were developed. Although other concerns are reported for general use, attainment of the general use for unclassified water bodies is not assessed and therefore not reported.

Water Temperature

Compliance with the temperature criterion is determined by evaluating only the surface samples. The use is supported when it is demonstrated that the temperature criterion is not attained due to permitted thermal discharges and it can be demonstrated that there is a healthy and balanced indigenous aquatic community.

High and Low pH

Values of pH are evaluated over the mixed surface layer when data are available. The median of the value in the mixed surface layer for each sample event is determined and these median values are evaluated against the high and low criteria using the binomial method. Use of the median measurement avoids comparing the criteria to extreme values observed at times in the summer near the surface and caused by natural conditions.

Chloride, Sulfate, and TDS

Chloride, sulfate, and TDS criteria in the TSWQS were developed to represent annual averages of all values that were collected when stream flow equaled or exceeded the 7Q2 value established for each segment. Due to infrequent monitoring and absence of stream flow information at many sites, all chloride, sulfate, and TDS values are averaged for all sites within the segment and compared to the criterion for each parameter. The assessment of general uses based on the average concentration applies to the entire length or area of the segment. Samples collected at the surface or within the mixed surface layer are used when they are available. For TDS, a value is calculated by multiplying specific conductance measured at the surface by a factor of 0.65. The chloride, sulfate, and TDS criteria are not supported if the average value exceeds the criteria.

Enterococci—Segments 1006 and 1007

An enterococci bacterial criterion is established for two Houston Ship Channel Segments (1006 and 1007) to provide indication of contamination, rather than protection of a recreational use. Attainment of the enterococci criterion is based on the geometric mean.

Reservoir Nutrient Criteria

Site specific Chl *a* criteria have been established in Appendix F of the TSWQS for selected reservoirs throughout the state. Nutrients are also assessed for reservoirs not included in the TSWQS. Assessment of the general use is based on a weight of evidence framework that considers multiple conditions and parameters. Specific information on the assessment method for evaluating nutrient criteria are included in Appendix F of this Guidance.

Narrative Criteria for Nutrient Enrichment

Excessive Vegetation Growth—Algae

The growth of microscopic algae can be stimulated by nutrient enrichment. Excessive growth of algae can result in unhealthy levels of DO for aquatic life as well as interfere with recreational uses of the water body and imparts unpleasant taste to drinking water. General use concerns or impairments due to excessive algae may be addressed through the implementation of TMDLs or WPPs.

Screening Levels for Nutrients and Chlorophyll *a*

Water bodies are protected from excessive nutrient levels in order to support the general uses through the use of screening levels. The screening levels listed for nutrients and Chl *a* in Table 3.11 were statistically derived from SWQM monitoring data. They are based on the 85th percentile values for each parameter in freshwater streams, tidal streams, reservoirs without numeric criteria and thresholds for narrative criteria, and estuaries. A concern for water quality is identified if the screening level is exceeded greater than 20 percent of the time using the binomial method, based on the number of exceedances for a given sample size (see Appendices A and B).

Dissolved Oxygen

Changes in DO including low DO and DO swings can result from eutrophic conditions. Such conditions can limit the development of healthy aquatic communities or cause fish kills. Exceedances due to low DO are documented by comparing diel concentrations against the 24-hour minimum criteria. When the minima are exceeded, an impairment of the DO criteria is identified. If a TMDL or Watershed Protection Plan identifies excessive algae growth as a cause, then these plans may include a target for nutrients.

Table 3.11. Screening Levels for Nutrient Parameters

Water Body Type	Nutrients*	Screening Level
Freshwater Stream	NH_3-N NO_3-N TP Chl *a*	0.33 mg/L 1.95 mg/L 0.69 mg/L 14.1 µg/L
Reservoir	NH_3-N NO_3-N TP Chl *a*	0.11 mg/L 0.37 mg/L 0.20 mg/L 26.7 µg/L
Tidal Stream	NH_3-N NO_3-N TP Chl *a*	0.46 mg/L 1.10 mg/L 0.66 mg/L 21.0 µg/L
Estuary	NH_3-N NO_3-N TP Chl *a*	0.10 mg/L 0.17 mg/L 0.21 mg/L 11.6 µg/L

* See Chemical Acronyms and Abbreviations

Narrative Criteria for Color

To ensure support of the general uses, Section 307.4(b)(5) of the TSWQS specifies that waste discharges shall not cause substantial and persistent changes from ambient conditions of turbidity or color.

Support of the color standard will be a judgment made by the assessor and based on an evaluation of a number of factors. Visible changes in the water downstream of a colored wastewater discharge must be reported by field observers for an assessment to be made. Some of the factors that may be used include:

Quantitative data. The platinum-cobalt method (Standard Method 2120B) for water samples collected from both upstream and downstream of discharges. The magnitude and areal extent of color changes will be quantified.

Qualitative information. Photographic evidence. Local information (public or professional).

Additional information may be considered, such as color sample results for other water bodies in the same ecoregion.

Support of this narrative criterion under 307.4(b)(5) applies only to surface waters directly influenced by waste discharges. Determination of support of 307.4(b)(5) will be based on a combination of the methods described above and should include quantitative measures using the platinum-cobalt method or other applicable methods approved by TCEQ's executive director.

Fish Kill Reports and Support of Other Narrative Criteria

Additional information is solicited from CRP partners, TCEQ central and regional office staffs, and other basin stakeholders to document conditions that may contribute to narrative criteria concerns or nonsupport. Such information may consist of water quality studies, occurrence of fish kills or contaminant spills, photographic evidence, local knowledge, and BPJ.

In some cases, fish kills occur when physicochemical conditions stimulate a bloom of golden algae (*Prymnesium parvum*) and the subsequent formation of toxins. In these cases, the excessive growth of golden algae is identified as a concern or impairment for general use attainment.

Trophic Status of Lakes

As reservoirs and lakes age, eutrophication increases producing conditions less suitable to support general uses. Eutrophication of reservoirs and lakes in Southern states is enhanced due to warm, fertile climates. Human activities can accelerate the process by increasing the rate at which nutrients and organic substances enter the impoundments by way of the surrounding watershed. Sewage discharges, agricultural and urban runoff, leaking septic tanks, and erosion of stream banks can increase the flow of nutrients and organic substances into reservoirs and lakes. These substances may overstimulate the growth of algae and aquatic plants, creating conditions that interfere with contact recreation (swimming), boating (noncontact recreation), and the health and diversity of native fish, plant, and animal populations. Overproduction of bacteria, fungi, and algae may also impart foul odors and tastes to the water.

Section 314 of the CWA of 1987 requires all states to classify lakes and reservoirs according to trophic state. The trophic state of a reservoir refers to its nutritional status. Various classification schemes or indices have been developed that group reservoirs into discrete quality (trophic) states along a continuum from oligotrophic (poorly nourished) to hypereutrophic (over nourished). The basis for the trophic state index concept is that, in many reservoirs, the degree of eutrophication may be related to increased nutrient concentrations. Typically, phosphorus is the nutrient of concern, and an increase in its concentration may trigger a responding increase in the amount of algae (estimated by Chl *a*) in the reservoir. Due to increased algal biomass, water transparency, as measured by a Secchi disk or submarine photometer, decreases.

Major Texas reservoirs are evaluated and ranked by TCEQ using Carlson's Trophic State Index (TSI). Carlson's Index was developed to compare Secchi disk depths, Chl *a* concentrations, and TP concentrations obtained by in-reservoir sampling (Carlson, 1977). These three variables are highly correlated and are considered estimators of algal biomass. By using multiple regression analysis, the index relates Secchi disk depth to TP concentration and to Chl *a* concentration. The final result of the analysis is a ranking of reservoirs from the least to most eutrophic.

Fish Consumption Use

Fish consumption use attainment and concerns are evaluated with three assessment methods described below. For a full assessment of use attainment for fish consumption and a determination of fully supporting, a DSHS risk assessment or advisory is required. Risk assessments are costly and conducted only on water bodies where the assessment has indicated a risk from consumption.

Advisories, Closures, and Risk Assessments

TCEQ assesses the fish consumption use by reviewing DSHS human risk assessment information, consumption advisories, and aquatic life closures. TCEQ and DSHS routinely coordinate on activities related to fish consumption use by exchanging information, discussing candidate water bodies for risk assessments, and funding projects. TCEQ consults with the DSHS concerning recent data and information on existing and imminent fish consumption advisories and aquatic life closures. The fish consumption use is supported in water bodies where the DSHS has collected tissue data and a subsequent risk assessment for parameters of local concern indicates no significant risk due to consumption over a person's lifetime. Where risk assessments have been performed for only a limited number of pollutants or the risk assessment is not up to date, yet no risk is identified, a support status of NC (no concern) is reported. The use is not supported when a consumption advisory has been issued for the general population, or a subpopulation that could be at greater risk (children or women of child-bearing age), or when an aquatic life closure has been issued that prohibits the taking of aquatic life from the affected water body. Parameters causing nonsupport of the criteria are identified by a review of the DSHS risk assessment that forms the basis for an advisory. TCEQ will list water body impairments for fish-tissue on the 303(d) list where DSHS has issued public consumption advisories.

Human Health Criteria for Bioaccumulation and Fish Consumption Use

Support of the fish consumption use is also determined by review of human health criteria for toxics in water designated in the TSWQS (see Table 3.12). For each toxicant parameter, across the segment, the average of all values for water samples collected during a 7-10-year period is computed. The averages are evaluated for human health criteria as indicated in Table 3.12 of the Guidance. The assessment of fish consumption use with human health water column criteria applies to all of the AUs with a sustainable or incidental fishery.

Table 3.12. Criteria in Water for Specific Toxic Materials – Human Health Protection

(All values are listed or calculated in micrograms per liter unless otherwise noted)

Parameter*	CASRN	Column A Water and Fish (µg/L)	Column B Fish Only (µg/L)
Acrylonitrile	107-13-1	1.0	115
Aldrin	309-00-2	1.146E-05	1.147E-05
Anthracene	120-12-7	1,109	1,317
Antimony	7440-36-0	6[1]	1,071
Arsenic (d)	7440-38-2	10[1]	---
Barium (d)	7440-39-3	2,000[1]	---
Benzene	71-43-2	5[1]	581
Benzidine	92-87-5	0.0015	0.107
Benzo(*a*)anthracene	56-55-3	0.024	0.025
Benzo(*a*)pyrene	50-32-8	0.0025	0.0025
Bis(chloromethyl)ether	542-88-1	0.0024	0.2745
Bis(2-chloroethyl)ether	111-44-4	0.60	42.83
Bis(2-ethylhexyl)phthalate	117-81-7	6[1]	7.55
Bromodichloromethane	75-27-4	10.2	275
Bromoform	75-25-2	66.9	1,060
Cadmium (d)	7440-43-9	5[1]	---
Carbon Tetrachloride	56-23-5	4.5	46
Chlordane	12789-03-6	0.0025	0.0025
Chlorobenzene	108-90-7	100[1]	2,737
Chlorodibromomethane	124-48-1	7.5	183
Chloroform	67-66-3	70[1]	7,697
Chromium (Hex) (d)	18540-29-9	62	502
Chrysene	218-01-9	2.45	2.52
Cresols [2]	---	1,041	9,301
Cyanide (free) [3]	57-12-5	200[1]	---

Parameter*	CASRN	Column A Water and Fish (µg/L)	Column B Fish Only (µg/L)
4,4'-DDD	72-54-8	0.002	0.002
4,4'-DDE	72-55-9	0.00013	0.00013
4,4'-DDT	50-29-3	0.0004	0.0004
2,4-D	94-75-7	70[1]	---
Danitol	39515-41-8	262	473
1,2-Dibromoethane	106-93-4	0.17	4.24
m-Dichlorobenzene	541-73-1	322	595
o-Dichlorobenzene	95-50-1	600[1]	3,299
p-Dichlorobenzene	106-46-7	75[1]	---
3,3'-Dichlorobenzidine	91-94-1	0.79	2.24
1,2-Dichloroethane	107-06-2	5[1]	364
1,1-Dichloroethylene	75-35-4	7[1]	55,114
Dichloromethane	75-09-2	5[1]	13,333
1,2-Dichloropropane	78-87-5	5[1]	259
1,3-Dichloropropene	542-75-6	2.8	119
Dicofol	115-32-2	0.30	0.30
Dieldrin	60-57-1	2.0E-5	2.0E-5
2,4-Dimethylphenol	105-67-9	444	8,436
Di-n-Butyl Phthalate	84-74-2	88.9	92.4
Dioxins/Furans (TCDD Equivalents)	1746-01-6	7.80E-8	7.97E-8
Congener/Isomer		Toxic Equivalency Factor	
2,3,7,8 TCDD		1	
1,2,3,7,8 PeCDD		1	
2,3,7,8 HxCDDs		0.1	
1,2,3,4,6,7,8 HpCDD		0.01	

Parameter*	CASRN	Column A Water and Fish (µg/L)	Column B Fish Only (µg/L)
2,3,7,8 TCDF		0.1	
1,2,3,7,8 PeCDF		0.03	
2,3,4,7,8 PeCDF		0.3	
2,3,7,8 HxCDFs		0.1	
2,3,4,7,8 HpCDFs		0.01	
OCDD		0.0003	
OCDF		0.0003	
PCB 77		0.0001	
PCB 81		0.0003	
PCB126		0.1	
PCB 169		0.03	
Endrin	72-20-8	0.02	0.02
Epichlorohydrin	106-89-8	53.5	2,013
Ethylbenzene	100-41-4	700[1]	1,867
Ethylene Glycol	107-21-1	46,744	1.68E7
Fluoride	16984-48-8	4,000[1]	---
Heptachlor	76-44-8	8.0E-5	0.0001
Heptachlor Epoxide	1024-57-3	0.00029	0.00029
Hexachlorobenzene	118-74-1	0.00068	0.00068
Hexachlorobutadiene	87-68-3	0.21	0.22
Hexachlorocyclohexane (*alpha*)	319-84-6	0.0078	0.0084
Hexachlorocyclohexane (*beta*)	319-85-7	0.15	0.26
Hexachlorocyclohexane *(gamma)* (Lindane)	58-89-9	0.2[1]	0.341
Hexachlorocyclopentadiene	77-47-4	10.7	11.6
Hexachloroethane	67-72-1	1.84	2.33
Hexachlorophene	70-30-4	2.05	2.90

Parameter*	**CASRN**	**Column A Water and Fish (µg/L)**	**Column B Fish Only (µg/L)**
4,4'-Isopropylidenediphenol (bisphenol A)	80-05-7	1,092	15,982
Lead (d)	7439-92-1	1.15	3.83
Mercury in freshwater [4]	7439-97-6	0.0122	0.0122
Mercury in saltwater [5]	7439-97-6	---	0.0250
Methoxychlor	72-43-5	2.92	3.0
Methyl Ethyl Ketone	78-93-3	13,865	9.92E+5
MTBE	1634-04-4	15[7]	10,482
Nickel (d)	7440-02-0	332	1140
Nitrate-Nitrogen as total Nitrogen	14797-55-8	10,000[1]	---
Nitrobenzene	98-95-3	45.7	1,873
N-Nitrosodiethylamine	55-18-5	0.0037	2.1
N-Nitroso-di-n-Butylamine	924-16-3	0.119	4.2
Pentachlorobenzene	608-93-5	0.348	0.355
Pentachlorophenol	87-86-5	0.22	0.29
PCBs [6]	1336-36-3	6.4E-4	6.4E-4
Pyridine	110-86-1	23	947
Selenium	7782-49-2	50[1]	---
1,2,4,5-Tetrachlorobenzene	95-94-3	0.23	0.24
1,1,2,2-Tetrachloroethane	79-34-5	1.64	26.35
Tetrachloroethylene	127-18-4	5[1]	280
Thallium	7440-28-0	0.12	0.23
Toluene	108-88-3	1,000[1]	---
Toxaphene	8001-35-2	0.011	0.011
2,4,5-TP (Silvex)	93-72-1	50[1]	369
1,1,1-Trichloroethane	71-55-6	200[1]	784,354
1,1,2-Trichloroethane	79-00-5	5[1]	166

Parameter*	**CASRN**	**Column A Water and Fish (µg/L)**	**Column B Fish Only (µg/L)**
Trichloroethylene	79-01-6	5[1]	71.9
2,4,5 Trichlorophenol	95-95-4	1,039	1,867
TTHM (Sum of total trihalomethanes)		80[1]	--
bromodichloromethane	75-27-4		
dibromochloromethane	124-48-1		
tribromomethane (bromoform)	75-25-2		
trichloromethane (chloroform)	67-66-3		
Vinyl Chloride	75-01-4	0.23	16.5

* See Chemical Acronyms and Abbreviations

1 Based on Maximum Contaminant Levels (MCLs) specified in 30 TAC Chapter 290 (relating to Public Drinking Water).

2 Consists of *m*, *o*, and *p* Cresols. The criteria are the same for all three, and the criteria are applied independently to each form of cresol. CASRNs for cresols are 95-48-7 for *o*-Cresol, 108-39-4 for *m*-Cresol, and 106-44-5 for *p*-Cresol.

3 Compliance is determined using the analytical method for available cyanide.

4 Consumption rate for fish and shellfish was estimated as 10 grams per person per day.

5 Consumption rate for fish and shellfish was estimated as 15 grams per person per day.

6 Until Method 1668 or equivalent method to measure PCB congeners is approved in 40 Code of Federal Regulations Part 136, compliance with PCB criteria is determined using Aroclor data or any alternate method listed in a TCEQ-approved Quality Assurance Plan.

7 Based on aesthetics criteria in the 1998 Oxygenated Fuels Association study Taste and Odor Properties of Methyl Tertiary-Butyl Ether and Implications for Setting a Secondary MCL.

(d) Indicates that the criteria for a specific parameter are for the dissolved fraction in water. All other criteria are for total recoverable concentrations, except where noted.

Should the average be exceeded over the period of record, the data set is subsequently evaluated to ensure the criterion is also exceeded more than one time. If the average exceeds, and this is the result of only an occasional high value, the assessor will use judgment in the evaluation of the data set and a concern, rather than impairment, may be identified. Additional monitoring is initiated when a concern for toxic contaminants is identified.

Column A criteria are used for freshwater bodies which are designated for DWS. These levels of contaminants pose a risk to humans when they are exposed through both drinking water and eating fish from the water body. Column B criteria are used for fresh and tidal waters that are capable of supporting sustainable fisheries and that are not designated for DWS. Ten times the levels in Column B are used for unclassified perennial water bodies that are less than third order streams, reservoirs less than 50 acres in size, or other water bodies with only an incidental fishery. The average of data from all sites in the segment is used with the exception of very long stream segments where water may be taken from hydrologically isolated assessment units.

Table 3.13. Fish Consumption Use—Human Health Criteria

Criteria for Classified water bodies listed in Appendix A of the TSWQS are in columns 3 through 6 (header cells shaded yellow).

Criteria for Unclassified water bodies and those listed in Appendix D of the TSWQS are in columns 7 through 11 (header cells shaded green).

* Refer to Table 3.12—Human Health Criteria (Col. A and Col. B)

Water Body/ Segment Type	Flow Type*	Criteria for water bodies designated for DWS use Screening levels for bioaccumulative substances in tissue[1]	Criteria for freshwater bodies capable of supporting sustainable fishery, not designated for DWS use[2] Screening levels for bioaccumulative substances in tissue[1]	Eliminate samples collected when:	Criteria for tidally influenced water bodies Screening levels for bioaccumulative substances in tissue[1]	Criteria for water bodies designated for DWS use, or used for public drinking water supplies. Screening levels for bioaccumulative substances in tissue[1]	Criteria for freshwater bodies capable of supporting sustainable fishery, not designated for DWS use, or used for public drinking water supplies[2] Screening levels for bioaccumulative substances in tissue[1]	Eliminate samples collected when:	Criteria for freshwater bodies with incidental fishery[3] Screening levels for bioaccumulative substances in tissue[1]	Criteria for tidally influenced water bodies Screening levels for bioaccumulative substances in tissue[1]
Freshwater Stream	Perennial Stream[4]	Human Health Criteria—Col. A	Human Health Criteria—Col. B	Flow < 0.1 cfs[5]	n/a	Human Health Criteria—Col. A	Human Health Criteria—Col. B	Flow < 0.1 cfs[5]	Ten times Human Health Criteria—Col. B[6]	n/a
Freshwater Stream	Intermittent Stream with perennial pools[7] adequate to support significant aquatic life	Human Health Criteria—Col. A	Human Health Criteria—Col. B	Yes[8]	n/a	Human Health Criteria—Col. A	n/a	Yes [8]	Ten times Human Health Criteria—Col. B[6]	n/a

Water Body/ Segment Type	Flow Type*	Criteria for water bodies designated for DWS use Screening levels for bioaccumulative substances in tissue[1]	Criteria for freshwater bodies capable of supporting sustainable fishery, not designated for DWS use[2] Screening levels for bioaccumulative substances in tissue[1]	Eliminate samples collected when:	Criteria for tidally influenced water bodies Screening levels for bioaccumulative substances in tissue[1]	Criteria for water bodies designated for DWS use, or used for public drinking water supplies. Screening levels for bioaccumulative substances in tissue[1]	Criteria for freshwater bodies capable of supporting sustainable fishery, not designated for DWS use, or used for public drinking water supplies[2] Screening levels for bioaccumulative substances in tissue[1]	Eliminate samples collected when:	Criteria for freshwater bodies with incidental fishery[3] Screening levels for bioaccumulative substances in tissue[1]	Criteria for tidally influenced water bodies Screening levels for bioaccumulative substances in tissue[1]
Freshwater Stream	Intermittent Stream [9] and intermittent stream with perennial pools not adequate to support significant aquatic life (with or without wastewater flow)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Reservoir	Reservoir	Human Health Criteria—Col. A	Human Health Criteria—Col. B	n/a	n/a	Human Health Criteria—Col. A	Human Health Criteria—Col. B	n/a	Ten times Human Health Criteria—Col. B[10]	n/a
Tidal Stream	Tidal Stream	n/a	n/a	n/a	Human Health Criteria—Col. A Col. B	n/a	n/a	n/a	n/a	Human Health Criteria—Col. A Col. B

Water Body/ Segment Type	Flow Type*	Criteria for water bodies designated for DWS use Screening levels for bioaccumulative substances in tissue[1]	Criteria for freshwater bodies capable of supporting sustainable fishery, not designated for DWS use[2] Screening levels for bioaccumulative substances in tissue[1]	Eliminate samples collected when:	Criteria for tidally influenced water bodies Screening levels for bioaccumulative substances in tissue[1]	Criteria for water bodies designated for DWS use, or used for public drinking water supplies. Screening levels for bioaccumulative substances in tissue[1]	Criteria for freshwater bodies capable of supporting sustainable fishery, not designated for DWS use, or used for public drinking water supplies[2] Screening levels for bioaccumulative substances in tissue[1]	Eliminate samples collected when:	Criteria for freshwater bodies with incidental fishery[3] Screening levels for bioaccumulative substances in tissue[1]	Criteria for tidally influenced water bodies Screening levels for bioaccumulative substances in tissue[1]
Estuary	Estuary	n/a	n/a	n/a	Human Health Criteria— Col. A Col. B	n/a	n/a	n/a	n/a	Human Health Criteria— Col. A Col. B
Ocean	Ocean	n/a	n/a	n/a	Human Health Criteria— Col. A Col. B	n/a	n/a	n/a	n/a	Human Health Criteria— Col. A Col. B
Freshwater Wetland	Freshwater Wetland	Human Health Criteria—Col. A	Human Health Criteria—Col. B	n/a	n/a	Human Health Criteria— Col. A	Human Health Criteria— Col. B	n/a	Ten times Human Health Criteria— Col. B	n/a
Saltwater Wetland	Saltwater Wetland	n/a	n/a	n/a	Human Health Criteria— Col. A Col. B	n/a	n/a	n/a	n/a	Human Health Criteria— Col. B

* Use published flow type or other reliable source such as the SWQM flow-type questionnaire.

1 Screening levels for bioaccumulative substances in tissue samples are not subject to elimination based on flow.

2 Sustainable fisheries—Descriptive of water bodies which potentially have sufficient fish production or fishing activity to create significant long-term human consumption of fish. Sustainable fisheries include perennial streams and rivers with a stream order of three or greater; lakes and reservoirs

greater than or equal to 150 acre-feet and/or 50 surface acres; all bays, estuaries, and tidal rivers. Water bodies which are presumed to have sustainable fisheries include all designated segments listed in Appendix A unless specifically exempted.

[3] Incidental fishery—A level of fishery that applies to water bodies that are not considered to have a sustainable fishery, but do have an ALU of limited, intermediate, high, or exceptional. Water bodies with minimal ALU, such as intermittent streams, are not assigned either a sustainable or incidental fishery (noted as “no fishery” in the assessment and not assessed for fish consumption use).

[4] Definition of perennial stream: A stream that does not have a period of zero flow at any time during most years.

[5] Presume event was above 0.1 cfs for classified perennial stream segments when no flow information is available for the event.

[6] Less than third order.

[7] Definition of Intermittent with perennial pools for purposes of determining criteria support: A stream that has a period of zero flow for at least one week during most years but has adequate and persistent pools that provide habitat to support significant aquatic life. An “adequate pool” to support aquatic life is deeper than one meter and >100 meters long; or where large pools cover >20% of the stream bed in a 500-meter reach.

[8] Less than 20% of the stream bed of a 500-meter sampling reach is covered by pools.

[9] Definition of intermittent stream: A stream that has a period of zero flow for at least one week during most years. If flow records are available, a stream with a 7Q2 of less than 0.10 cfs is considered intermittent.

[10] Less than 50 acres.

Bioaccumulative Substances in Fish Tissue

Screening levels for bioaccumulative substances in fish tissue (Table 3.14) are determined by the DSHS. Previously, screening levels for organic substances in fish tissue were derived from water-based human health criteria designated in the TSWQS. TDSHS uses tissue-based Health-Based Assessment Comparison (HAC) values, for certain contaminants, to assess health risks of humans from the consumption of fish tissue. Deriving less-conservative screening levels from HAC values provides a more analogous linkage between tissue screening levels and available fish tissue data.

The screening levels for bioaccumulative substances in fish tissue are used to determine concerns for the fish consumption use (see Table 3.14). Seven years of data are screened using these levels. Water quality concerns are identified when the screening levels are exceeded greater than 20 percent of the time based on the binomial method. The assessment of fish consumption use with tissue screening levels applies to all of the AUs with a sustainable or incidental fishery. Data from all sites in the segment are used with the exception of very long stream segments where water may be taken from hydrologically isolated assessment units.

Table 3.14. Screening Levels for Metals and Organic Substances in Tissue

All values listed as mg/kg or µg/g wet weight.

Parameter Code	Parameter	Freshwater and Saltwater
Metals		
01004	Arsenic	0.036
71940	Cadmium	0.175
71939	Chromium	5.25
71937	Copper	250.5
71936	Lead	0.6
71930	Mercury	0.525
01069	Nickel	35.0
01149	Selenium	4.375
71938	Zinc	525
Organic Substances		
34680	Aldrin	0.003
39075, 39785	Hexachlorocyclohexane *(gamma)* (Lindane)	0.525
34682	Chlordane	0.156

Parameter Code	Parameter	Freshwater and Saltwater
81897	DDD total	0.227
81896	DDE total	0.16
39376	DDT total	0.16
39406	Dieldrin	0.003
20463	Dioxins	0.349
34365	Endosulfan I (alpha)	3.5
34360	Endosulfan II (beta)	3.5
34355	Endosulfan sulfate	3.5
34685	Endrin	0.525
34687	Heptachlor	0.012
34686	Heptachlor epoxide	0.006
34688, 39703	Hexachlorobenzene	0.034
81644	Methoxychlor	8.75
81645	Mirex	0.35
39515	PCBs	0.027
34691	Toxaphene	0.049

Domestic Water Supply Use

Surface Water

Human Health Criteria for Domestic Water Supply Use

The DWS use is evaluated for surface water bodies by comparing the average sample data from a water body to criteria values for constituents in Column A of the human health criteria from the TSWQS (see Table 3.12). The human health criteria are in part based on the primary MCL adopted in 30 TAC Section 290. These assessments are restricted to water bodies designated in Appendix A of the TSWQS for DWS use (public water supply (PWS) or aquifer protection), water bodies designated as sole-source surface drinking water supplies in Appendix B of the TSWQS, or surface waters used for public drinking water supplies (see Table 3.15). The average of data from all sites in the segment is used with the exception of very long stream segments where water for DWS may be taken from hydrologically isolated assessment units. In these cases, data may be evaluated at the level of an assessment unit. For aquifer protection use, only data from locations in the recharge zone, transition zone, or contributing zone for the Edwards Aquifer as designated in the TSWQS, are evaluated.

Should the average be exceeded over the period of record, the data set is subsequently evaluated to ensure the criterion is also exceeded more than one time. If the average exceeds, and this is the result of only one or two high values, the assessor will use judgment in the evaluation of the data set and a concern rather than impairment may be identified. Additional monitoring is initiated when a concern for toxic contaminants is identified.

Toxic Substances Long-Term Average Concerns

Some organic compounds (at this time only alachlor, atrazine, MTBE, and perchlorate) that have potential human health impacts are evaluated. When data are available for surface waters designated or currently used for DWS, concerns for water quality will be identified if the average concentrations of all sites in the segment exceed human health screening guidelines established by TCEQ for drinking water. Human health screening levels are 2 µg/L for alachlor, 3 µg/L for atrazine, 240 µg/L for MTBE, and 22 µg/L for perchlorate. The average of data from all sites in the segment is used with the exception of very long stream segments where water for DWS may be taken from hydrologically isolated assessment units. In these cases, data may be evaluated at the level of an assessment unit.

Oyster Waters Use

Oyster water use is assigned to most coastal bays to protect existing and potential harvest of edible species of clams, oysters, and mussels. The oyster water use is not assessed within a 1,000-foot buffer zone—an area measured from the shoreline to ordinary high tide. This zone is established for all bay and gulf waters with the exception of those associated with river and coastal basins. Concentrations of bacteria in water must not exceed criteria established to maintain seafood safe for human consumption. The median fecal coliform concentration criterion in bay and gulf waters is 14 colonies per 100 mL. The DSHS has authority to administer the National Shellfish Sanitation Program for Texas. This authority allows the DSHS to classify shellfish growing areas and to issue certificates for the interstate shipment of shellfish. The TPWD has the responsibility for enforcement of laws concerning harvesting of shellfish.

Table 3.15. Domestic Water Supply Use— Criteria and Screening Levels for Assessment of Surface Water

Criteria and screening levels apply to classified water bodies in Appendix A of TSWQS with DWS Use assigned, water bodies in Appendix B of TSWQS that are sole-source surface drinking water supplies, and surface waters used for public drinking water supplies.

Water Body/Segment Type	Flow -Type*	Criteria and Screening Levels ‣ Human Health Criteria—Col A (see Table 3.12) ‣ alachlor, atrazine, MTBE, and perchlorate (see Concerns for DWS Surface Water section) [1]	Eliminate samples collected when flow < 0.1 cfs. [2]
Freshwater Stream	Perennial Stream [3]	Human Health Criteria alachlor, atrazine, MTBE, and perchlorate	Yes
Freshwater Stream	Intermittent Stream with perennial pools adequate to support significant aquatic life [4]	Human Health Criteria alachlor, atrazine, MTBE, and perchlorate	n/a
Reservoir	Reservoir	Human Health Criteria alachlor, atrazine, MTBE, and perchlorate	n/a

* Use published flow type or other reliable source such as the SWQM flow-type questionnaire.

[1] Screening levels for Alachlor, atrazine, MTBE, and perchlorate are not subject to elimination based on flow.

[2] Presume event was above 0.1 cfs for classified perennial stream segments when no flow information is available for the event, unless a flow severity of 1, indicating no flow, is reported.

[3] Definition of perennial stream: A stream that does not have a period of zero flow at any time during most years.

[4] Definition of intermittent with perennial pools: A stream that has a period of zero flow for at least one week during most years but has adequate and persistent pools that provide habitat to support significant aquatic life (not just a refuge). Generally, an “adequate pool” to support aquatic life is deeper than one meter and >100 meters long; or where large pools cover >20% of the stream bed in a 500-meter reach.

Oyster Water Classification Categories

The DSHS produces and provides annual updates to maps that delineate the classification of shellfish harvesting areas along the Texas coast. The status (open or closed) of shellfish growing areas is subject to change by the DSHS at any time. These changes may be the result of high rainfall and runoff, flooding, hurricanes and other extreme weather conditions, major spills, red tides, or the failure or inefficient operation of wastewater treatment facilities.

Assessment of the oyster waters use is made using the most recent DSHS Shellfish Classification Harvesting Area Maps[5].

The DSHS classifies shellfish growing areas into one of four categories.

Approved Area

An area approved for growing and harvesting shellfish for direct marketing. Approved areas are not contaminated by pathogenic organisms, toxic substances, or marine biotoxins in concentrations that present actual or potential hazards to public health. The classification of approved areas is determined by sanitary surveys conducted by the DSHS.

Approved areas meet the standard except under extreme conditions and are assessed as Fully Supporting.

Conditionally Approved Area

A conditionally approved area is a classification used to identify harvest areas which meet the criteria for an approved area except under certain conditions. Conditions causing degraded water quality must be predictable and definable-river stage, wastewater treatment plant effluents, run-off conditions. A conditionally approved area is closed when the approved criteria are not supported.

Conditionally approved areas are assessed as Fully Supporting.

Restricted Area

Restricted areas are shellfish growing areas classified as threatened or contaminated by poor water quality. Shellfish harvested from these areas must be cleaned by depuration (moved to processing plants for cleansing in clean water) or by relaying (moved to estuarine waters in an approved area).

Areas classified as restricted due to poor water quality are assessed as Not Supporting.

Some restricted areas have recent water quality surveys indicating acceptable fecal coliform densities, yet the area is restricted based on high risk of microbial

[5] www.dshs.state.tx.us/seafood/shellfish-harvest-maps.aspx

contamination-proximity to marinas and wastewater treatment plants, stormwater runoff, and drainage from areas frequented by livestock or waterfowl.

Areas classified as restricted for reasons other than water quality impairment are reported as Not Assessed.

Prohibited Area

A prohibited area is where recent DSHS sanitary surveys or other monitoring program data indicate that fecal material, pathogenic microorganisms, poisonous or deleterious substances, marine toxins, or radionuclides may reach the area in excessive concentrations. The taking of shellfish for any human food purposes from such areas is prohibited. Shellfish from a prohibited area may not be taken for cleansing by depuration or relaying.

Prohibited areas with sanitary surveys indicating poor water quality, or where the DSHS has determined that water quality is likely to be poor based on historical surveys, are assessed as Not Supporting.

Areas classified as prohibited for reasons other than water quality impairment or are prohibited solely because DSHS does not have the resources to conduct sanitary surveys are reported as Not Assessed.

Reporting Oyster Water Use Attainment

The assessment describes the general attainment condition for large areas of the bay and reflects both water quality conditions and administrative decisions made by the DSHS Seafood and Aquatic Life Group. Due to the complexity of shellfish classification areas, assessment units will include the open bay area only. Restricted areas that include river channels, the Intracoastal Waterway, shoreline, harbors, ship channels, tidal wetlands, subdivision channels and other structures identified by DSHS Classification of Shellfish Harvesting Area maps will not be included in the defined oyster water assessment units. When the attainment status is assigned to entire assessment units for the IR, decisions on area-specific detail may be made in the planning stages of a TMDL.

Chapter 4
Methodology for Assigning Pollutant Causes and Sources

Cause and Source Codes for Pollutants

For each water body or portion of a water body where a nonsupport of a designated use or a use concern is identified, the cause(s) and source(s) are evaluated from available information (SWQM data, field observations, land use, CRP assessments, nonpoint source assessment reports, special studies, and intensive surveys).

The *sources of impairment and concerns* defined in this document reflect potential source information. Possible sources include activities, facilities, or conditions occurring in the watershed that might keep the water from meeting the criteria to prevent the attainment of designated uses. These lists of possible sources are not exhaustive, and do not constitute defined targets for water quality management actions. As water quality strategies and management actions are developed and implemented (e.g., TMDLs and watershed protection plans), pollution sources will be identified and quantified through additional monitoring, land use evaluations, and modeling efforts. New information from these studies overrides the preliminary source lists in this document. Interested parties should refer to the source identifications as developed by specific water quality management projects for definitive information.

Whenever possible, analysts link pollution causes and stressors with their sources for the analysis. *Causes* are those pollutants such as pesticides, metals, or low DO that contribute to actual nonsupport or partial support of designated uses (see Table 4.1). *Stressors* are factors or conditions (for example, stream flow, siltation, or habitat alterations) other than specific pollutants that cause nonsupport of uses. Activities, facilities, or conditions that contribute pollutants or stressors are sources that contribute to the nonsupport of designated uses in a water body (see Table 4.2).

Sources of pollution are classified into two primary groups by their origin. Each of these types result from different natural conditions or anthropogenic activities and may be controlled by specific voluntary or regulatory water quality management measures.

- ***Nonpoint source pollution*** generally results from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification. NPS pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and ground waters.

- ***Point source pollution*** has as its source any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants or wastes are or may be discharged into or adjacent to any water in the state. Point sources are regulated by Texas Pollutant Discharge Elimination System (TPDES) permits, which may include effluent limitations, monitoring, and reporting requirements. Consistent with the TPDES Program, stormwater discharges from separate storm sewer systems from cities and stormwater discharges associated with industry and construction are considered point sources of pollution.

Table 4.1. List of Causes and Stressors

Name	Name
Aluminum in water	Hexachloroethane in water
Arsenic in water	Pyridine in water
Cadmium in water	Trichloroethene in water
Chromium in water	Benzene in water
Copper in water	Carbon tetrachloride in water
Cyanide in water	Chlorobenzene in water
Lead in water	1,1-Dichloroethylene in water
Mercury in water	1,2-Dichloroethane in water
Nickel in water	1,3-Dichloropropene in water
Selenium in water	Nitrobenzene in water
Silver in water	Tetrachloroethene in water
Zinc in water	1,1,1-Trichloroethane in water
Aldrin in water	Vinyl chloride in water
Carbaryl (Sevin) in water	DDE in water
Chlordane in water	Chloroform in water
Chloropyrifos (Dursban) in water	1,2,4,5-Tetrachlorobenzene in water
Dieldrin in water	1,2-Dibromoethane in water
Endrin in water	Bis (Chloromethyl)ether in water
Heptachlor in water	Cresols in water
PCBs in water	Danitol in water
Parathion in water	Hexachlorophene in water
Phenanthrene in water	Methyl ethyl ketone in water
Tributyltin (TBT) in water	N-Nitrosodiethylamine in water

Name	Name
gamma-BHC (Lindane) in water	N-Nitroso-di-n-butylamine in water
Toxaphene in water	Pentachlorobenzene in water
DDT in water	Silvex in water
Dicofol (Kelthane) in water	Total dissolved solids in water
Diuron (Karmex) in water	Chloride in water
Endosulfan I (alpha) in water	Sulfate in water
Endosulfan II (beta) in water	Bacteria in water
Endosulfan sulfate in water	High pH in water
Pentachlorophenol (PCP) in water	Low pH in water
2,4,5-Trichlorophenol in water	Nitrate in water
Demeton in water	Orthophosphorus in water
Guthion in water	Ammonia in water
Malathion in water	Total Phosphorus in water
Methoxychlor in water	Chlorophyll-*a* in water
Mirex in water	Temperature in water
Depressed DO in water	Barium in water
Arsenic in sediment	Fluoride in water
Cadmium in sediment	2,4-D in water
Chromium in sediment	1,4-Dichlorobenzene in water
Copper in sediment	Trihalomethane in water
Lead in sediment	Alachlor in water
Manganese in sediment	Atrazine in water
Mercury in sediment	MTBE in water
Nickel in sediment	Perchlorate in water
Silver in sediment	Toxaphene in edible tissue
Zinc in sediment	Bromodichloromethane in sediment
Antimony in sediment	1,2,3,7,8 PeCDD in edible tissue
Iron in sediment	Diazinon in water
1,4-Dichlorobenzene in sediment	2,3,7,8 TCDF in edible tissue
Acenaphthene in sediment	Antimony in water
Acenaphthylene in sediment	Di-n-butyl phthalate in water
Acrylonitrile in sediment	Bromodichloromethane in water

Name	Name
Aldrin in sediment	1,2-Dichloropropane in water
Anthracene in sediment	Ethylbenzene in water
Benzo(a)pyrene in sediment	1,1,2,2-Tetrachloroethane in water
Chlordane in sediment	Bromoform in water
Chloromethane in sediment	1,1,2-Trichloroethane in water
Chrysene in sediment	Bis(2-chloroethyl)ether in water
DDD in sediment	1,3-Dichlorobenzene in water
DDE in sediment	1,2-Dichlorobenzene in water
DDT in sediment	Dichloromethane in water
Dibenz(a,h)anthracene in sediment	2,4-Dimethylphenol in water
Dieldrin in sediment	2,3,7,8 TCDD in edible tissue
Endrin in sediment	1,2,3,7,8 PeCDF in edible tissue
Fluoranthene in sediment	2,3,4,7,8 PeCDF in edible tissue
Fluorene in sediment	2,3,7,8 HxCDDs in edible tissue
Heptachlor epoxide in sediment	2,3,7,8 HxCDFs in edible tissue
Hexachlorobenzene (HCB) in sediment	1,2,3,4,6,7,8 HpCDD in edible tissue
Hexachlorobutadiene (HCBD) in sediment	OCDD in edible tissue
Hexachloroethane in sediment	Thallium in water
Mirex in sediment	Anthracene in water
Naphthalene in sediment	Toluene in water
PCBs in sediment	OCDF in edible tissue
Phenanthrene in sediment	2,3,4,7,8 HpCDFs in edible tissue
Pyrene in sediment	PCB 77 in edible tissue
Trichloroethene in sediment	PCB 81 in edible tissue
Bis(2-ethyl-hexyl)phthalate in sediment	PCB 126 in edible tissue
1,3-Dichlorobenzene in sediment	PCB 169 in edible tissue
Benzo(a)anthracene in sediment	Hexachlorocyclopentadiene in water
alpha-BHC in sediment	Bis(2-ethylhexyl)phthalate in water
beta-BHC in sediment	Dibromochloromethane in water
gamma-BHC (Lindane) in sediment	3,3-Dichlorobenzidine in water
Toxaphene in sediment	alpha-BHC in water

Name	**Name**
Di-n-butyl phthalate in sediment	Aroclor 1254 in sediment
Acetone in sediment	Aroclor 1016 in sediment
Benzene in sediment	Aroclor 1260 in sediment
Carbon disulfide in sediment	Aroclor 1248 in sediment
Carbon tetrachloride in sediment	BHC in sediment
Chlorobenzene in sediment	2-Butanone in sediment
Dichlorodifluoromethane in sediment	1,2-Dichlorobenzene in sediment
1,1-Dichloroethane in sediment	2-Hexanone in sediment
1,2-Dichloroethene in sediment	2-Propanol in sediment
1,2-Dichloroethane in sediment	beta-BHC in water
1,2-Dichloropropane in sediment	Bis(2-ethylhexyl)phthalate in sediment
Ethylbenzene in sediment	Benz(a)anthracene in water
4-Methyl-2-Pentanone (MIBK) in sediment	p-Dichlorobenzene in water
Methyl bromide in sediment	p-Dichlorobenzene in sediment
Methylene chloride in sediment	m-Dichlorobenzene in sediment
Nitrobenzene in sediment	Endrin in edible tissue
Styrene in sediment	Low molecular weight PAHs in sediment
1,1,2,2-Tetrachloroethane in sediment	High molecular weight PAHs in sediment
Tetrachloroethene in sediment	Total PAHs in sediment
Toluene in sediment	N-Butylbenzene in sediment
Bromoform in sediment	Cumene in sediment
1,2,4-Trichlorobenzene in sediment	p-Cymene in sediment
1,1,1-Trichloroethane in sediment	Hexane in sediment
1,1,2-Trichloroethane in sediment	Methyl methacrylate in sediment
Trichlorofluoromethane in sediment	Toxicity in water
Vinyl chloride in sediment	Toxicity in sediment
Xylene in sediment	Heptachlor in sediment
Chloroform in sediment	Malathion in sediment
2-Methylnaphthalene in sediment	Methoxychlor in sediment
Arsenic in edible tissue	Parathion in sediment

Name	Name
Cadmium in edible tissue	Endosulfan I (alpha) in sediment
Chromium in edible tissue	Endosulfan II (beta) in sediment
Copper in edible tissue	Pentachlorophenol (PCP) in sediment
Lead in edible tissue	n-Propylbenzene in sediment
Mercury in edible tissue	sec-Butylbenzene in sediment
Nickel in edible tissue	tert-Butylbenzene in sediment
Selenium in edible tissue	Chlorodibromomethane in sediment
Zinc in edible tissue	1,1-Dichloroethylene in sediment
Aldrin in edible tissue	1,3-Dichloropropene in sediment
Benzidine in edible tissue	1-Pentanol in sediment
Benzo(a)pyrene in edible tissue	1,2,4,5-Tetrachlorobenzene in sediment
Chlordane in edible tissue	Pentachlorobenzene in sediment
Chrysene in edible tissue	2,4-Dimethylphenol in sediment
DDD in edible tissue	Hexachlorocyclopentadiene in sediment
DDE in edible tissue	Diazinon in sediment
DDT in edible tissue	2,4-Dinitrotoluene in sediment
Dieldrin in edible tissue	Benzoic acid in sediment
Heptachlor in edible tissue	Benzyl alcohol in sediment
Heptachlor epoxide in edible tissue	Di-n-octyl phthalate in sediment
Hexachlorobenzene (HCB) in edible tissue	N-Butyl benzyl phthalate in sediment
Hexachlorobutadiene (HCBD) in edible tissue	Diethyl phthalate in sediment
Hexachloroethane in edible tissue	Dimethyl phthalate in sediment
Mirex in edible tissue	Dibenzofuran in sediment
PCBs in edible tissue	2-Methylphenol (o-cresol) in sediment
Pyridine in edible tissue	4-Methyphenol (p-cresol) in sediment
Benzo(a)anthracene in edible tissue	Phenol in sediment
beta-BHC in edible tissue	3-Methyl-4-chlorophenol in sediment
Dicofol (Kelthane) in edible tissue	delta-BHC in sediment
Pentachlorophenol (PCP) in edible tissue	Impaired habitat in water

Name	Name
Nitrobenzene in edible tissue	Impaired macrobenthic community in water
1,2,4,5-Tetrachlorobenzene in edible tissue	Impaired fish community in water
alpha-BHC in edible tissue	Ambient toxicity in water
gamma-BHC (Lindane) in edible tissue	Nutrients in water
Cresols in edible tissue	Excessive algal growth in water
Hexachlorophene in edible tissue	Macrophytes in water
N-Nitrosodiethylamine in edible tissue	Fish kill in water
N-Nitroso-di-n-butylamine in edible tissue	Altered color in water
Pentachlorobenzene in edible tissue	No oyster waters closure
Acrylonitrile in water	Dioxin in edible tissue
Benzidine in water	Zinc in oyster tissue
Benzo(a)anthracene in water	Bacteria in oyster waters
Benzo(a)pyrene in water	Nonylphenol in water
Chrysene in water	Endosulfan I (alpha) in edible tissue
DDD in water	Endosulfan II (beta) in edible tissue
Heptachlor epoxide in water	Endosulfan sulfate in edible tissue
Hexachlorobenzene (HCB) in water	Methoxychlor in edible tissue
Hexachlorobutadiene (HCBD) in water	

Table 4.2. List of Source Names

Name	Name
Above ground storage tank leaks (tank farms)	Marina boat maintenance
Accidental release/spill	Marina dredging operations
Acid mine drainage	Marina fueling operations
Agricultural return flows	Marina related shoreline habitat degradation
Agricultural water diversion	Marina/boating pump-out releases
Agriculture	Marina/boating sanitary on-vessel discharges
Airports	Marinas and recreational boating
Animal feeding operations (NPS)	Mill tailings
Animal holding/management areas	Mine tailings
Animal shows and racetracks	Mining
Anthropogenic land use changes	Motorized watercraft
Aquaculture (not permitted)	Mountaintop mining
Aquaculture (permitted)	Municipal (urbanized high-density area)
Atmospheric deposition	Municipal point source discharges
Atmospheric deposition - acidity	Municipal point source impacts from inadequate industrial/commercial pretreatment
Atmospheric deposition - nitrogen	Natural conditions - water quality standards use attainability analyses needed
Atmospheric deposition - toxics	Natural sources
Auction barns	Natural-beaver dams/log jams
Ballast water releases	Natural-drought
Barge canal impacts	Natural-flood
Baseflow depletion from groundwater withdrawals	Naturally occurring organic acids
Brownfield (non-NPLl) sites	Natural-snowmelt
Cargo loading/unloading	Nonmetals mining discharges (permitted)
CERCLA NPL (Superfund) sites	NPS

Name	Name
Changes in ordinary stratification and bottom water hypoxia/anoxia	NPS pollution from military base facilities (other than port facilities)
Changes in tidal circulation/flushing	NPS pollution from military port facilities
Channel erosion/incision from upstream hydromodifications	Off-road vehicles
Channelization	On-site treatment systems (septic systems and similar decentralized systems)
Chemical leak/spill	Open pit mining
Coal mining	Other marina/boating on-vessel discharges
Coal mining (subsurface)	Other recreational pollution sources
Coal mining discharges (permitted)	Other shipping releases (wastes and detritus)
Combined sewer overflows	Other spill related impacts
Commercial districts (industrial parks)	Other turf management
Commercial districts (shopping/office complexes)	Package plant or other permitted small flows discharges
Commercial harbor and port activities	Pesticide application
Confined animal feeding operations - CAFOs (point source)	Petroleum/natural gas activities
Confined animal feeding operations (NPS)	Petroleum/natural gas production activities (permitted)
Construction	Pipeline breaks
Construction stormwater discharge (permitted)	Placer mining
Contaminated groundwater	Point source(s) – unspecified
Contaminated sediments	Pollutants from public bathing areas
Contribution from downstream waters due to tidal action	Post-development erosion and sedimentation
Cooling water intake structures (impingement or entrainment)	Potash mining
Cranberry production	Rangeland grazing
Crop production (crop land or dry land)	RCRA hazardous waste sites

Name	**Name**
Crop production (irrigated)	Recreation and tourism (nonboating)
Crop production (nonirrigated)	Reduced freshwater flows
Crop production with subsurface drainage	Reduction in baseflow
Dairies	Releases from waste sites or dumps
Dam construction (other than upstream flood control projects)	Removal of riparian vegetation
Dam or impoundment	Residential districts
Deicing (storage/application)	Runoff from forest/grassland/parkland
Discharges from biosolids (sludge) storage, application, or disposal	Rural (residential areas)
Discharges from municipal separate storm sewer systems (ms4)	Salt storage sites
Discharges from offshore oil and gas exploration (permitted)	Saltwater intrusion
Dredge mining	Sand/gravel/rock mining or quarries
Dredging (e.g., for navigation channels)	Sanitary sewer overflows (collection system failures)
Drought-related impacts	Seafood processing operations
Dry weather flows with NPS pollutants	Sediment resuspension (clean sediment)
Erosion and sedimentation	Sediment resuspension (contaminated sediment)
Erosion from derelict land (barren land)	Septage disposal
Forced drainage pumping	Sewage discharges in unsewered areas
Forest roads (road construction and use)	Shallow lake/reservoir
Freshets or major flooding	Shipbuilding, repairs, drydocking
Golf courses	Silviculture activities
Grazing in riparian or shoreline zones	Silviculture harvesting
Groundwater loadings	Silviculture, fire suppression
Habitat modification - other than hydromodification	Site clearance (land development or redevelopment)
Hardrock mining discharges (permitted)	Source unknown

Name	Name
Harvesting/restoration/residue management	Sources outside state jurisdiction or borders
Heap-leach extraction mining	Specialty crop production
Highway/road/bridge runoff (nonconstruction related)	Spills from trucks or trains
Highways, roads, bridges, infrastructure (new construction)	Streambank erosion
Historic bottom deposits (not sediment)	Streambank modifications/destabilization
Historical source, no longer present	Subsurface (hardrock) mining
Hydrostructure impacts on fish passage	Surface mining
Illegal dumps or other inappropriate waste disposal	Surface water diversions
Illicit connections/hook-ups to storm sewers	Surface water withdrawals
Impacts from abandoned mine lands (inactive)	Total retention domestic sewage lagoons
Impacts from geothermal development	Transfer of water from an outside watershed
Impacts from hydrostructure flow regulation/modification	UIC wells (underground injection control wells)
Impacts from land application of wastes	Unknown point source
Impacts from resort areas	Unpermitted discharge (domestic wastes)
Impervious surface/parking lot runoff	Unpermitted discharge (industrial/commercial wastes)
Inadequate instream habitat	Unrestricted cattle access
Industrial land treatment	Unspecified domestic waste
Industrial point source discharge	Unspecified land disturbance
Industrial thermal discharges	Unspecified unpaved road or trail
Industrial/commercial site stormwater discharge (permitted)	Unspecified urban stormwater
Internal nutrient recycling	Upstream source
Introduction of non-native organisms (accidental or intentional)	Upstream/downstream source
Lake fertilization	Urban development in riparian buffer

Name	Name
Landfills	Urban runoff/storm sewers
Leaking underground storage tanks	Wastes from pets
Legacy/historical pollutants	Water diversions
Littoral/shore area modifications (nonriverine)	Waterfowl
Livestock (grazing or feeding operations)	Watershed runoff following forest fire
Loss of riparian habitat	Wet weather discharges (nonpoint source)
Loss of wetlands	Wet weather discharges (point source and combination of stormwater, SSO, or CSO)
Low head dams	Wetland drainage
Low water crossing	Wildlife other than waterfowl
Managed pasture grazing	Woodlot site clearance
Manure lagoons	Woodlot site management
Manure runoff	Yard maintenance
Marina boat construction	

Chapter 5
Categorizing Water Quality Conditions for Management Activities

Introduction

The goal of the CWA is the restoration and maintenance of the chemical, physical, and biological integrity of the nation’s waters; to attain water quality which provides for protection and propagation of fish and wildlife; and provide recreation. This translates into TCEQ’s goal that all water quality standards are attained for all surface waters in Texas.

This chapter describes the categorization of waters and associated water quality management activities. Assigning categories is part of TCEQ’s strategy for overall management of water quality and supports administration of the various programs that implement protection and improvement strategies.

Assigning categories to indicate how specific water quality issues are being addressed is part of the State’s watershed action planning (WAP) process. The primary objectives of the WAP process are to improve access to the State’s water quality management decisions and to improve transparency and coordination in water quality improvement efforts. The WAP process facilitates input from stakeholders and cooperators for determining the appropriate categories and steps towards restoring water quality.

Describing Water Bodies and Standards Attainment

TCEQ and its cooperators monitor the State’s surface waters. TCEQ, in turn, analyzes the data and information, and assesses the water quality by comparing the data to the water quality standards and criteria. Water quality standards are composed of designated uses and their associated criteria for instream conditions necessary to support those uses. The uses represent the purposes designated for a water body. For example, the aquatic life use provides for a suitable environment for fish and other aquatic life. Contact recreation use provides for water that is safe for swimming or other contact with the water. The criteria may be expressed in terms of narrative descriptions of desirable conditions, or as numeric limits on certain pollutants. Pollutants are collectively referred to as parameters. For example, a high aquatic life use is generally associated with an average criterion of 5 mg/L of DO. The parameter in this case is DO. In other words, each criterion consists of a measurable value and a parameter.

Uses and criteria are usually assigned to an entire segment. A segment is a water body or part of a water body with a specific location, defined dimensions, and designated or presumed uses. Segments are the basic geographic unit used in defining and measuring water quality.

To increase the spatial accuracy of the assessment, many segments may be further divided into AUs in order to evaluate conditions in areas that are more homogeneous in chemical, physical, and hydrological characteristics than are whole segments. An AU may be evaluated using data from one or more monitoring sites. See Chapter 2 for a more complete definition of AUs.

If a criterion is not attained, the associated use is identified as impaired. The combination of one parameter (where the measurable value exceeds the criterion) with one use is called an impairment. In some cases, there are insufficient data to determine if the standard is attained, but the available data may point to a concern that water quality may be declining. Since more than one use is usually applied to any segment, the water quality data may indicate support of one use, but not another. For instance, the contact recreation use may be impaired, while the aquatic life use is still supported.

Water Quality Categories

Defining water quality conditions within a specific waterbody allows TCEQ to communicate information on the status of the State's water resources. This information can be used by the public, municipalities as well as by state and federal agencies to make decisions regarding water quality. Classifying the overall condition of a specific water body can provide information about the status of water resources and the effectiveness of programs responsible for the protection of water quality.

As part of the development of the IR, one of five categories is assigned to each of the segments. The categories indicate the status of water quality in the segment and describe water quality condition. Strategies for water bodies in Categories 1, 2, and 3 include additional data collection and assessment, and implementation through wastewater permits and other protective measures. Strategies for water bodies in Categories 4 and 5 are summarized in the subcategories and targeted for the specific AUs and uses that are impaired. Strategies for AUs in 4 and 5 include review of water quality standards; projects to characterize the sources, extent, and severity of impairments; and projects to improve water quality or restore support of an impaired use.

The five categories for segments are:

1. All designated uses are supported, no use is threatened.

2. Available data and/or information indicate that some, but not all of the designated uses are supported.

3. There is insufficient or unreliable available data and/or information to make a use support determination.

4. Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed.

a. A state developed TMDL has been approved by EPA or a TMDL has been established by EPA for any water-pollutant combination.

b. Other required control measures are expected to result in the attainment of an applicable water quality standard in a reasonable period of time.

c. The impairment or threat is not caused by a pollutant.

5. Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

a. A TMDL is underway, scheduled, or will be scheduled.

b. A review of the water quality standards for the water body will be conducted before a management strategy is selected.

c. Additional data and information will be collected or evaluated before a management strategy is selected.

n. Water body does not meet its applicable Chl *a* criterion, but additional study is needed to verify whether exceedance is associated with causal nutrient parameters or impacts to response variables.

Assigning Categories

A category is assigned to each impairment by the SWQM program. When there are existing impairments, the program starts with the category carried over from the previous cycle and considers other information, including recommendations from the WAP process. In the WAP process, TCEQ, TSSWCB, and the CRP Partners determine and document specific strategies for each impairment, which may include a recommendation for a category change in the next IR update.

For new impairments, SWQM assessors assign a category based on program recommendations, data provider information or stakeholder input. For both existing and new impairments, recommendations for categories may be made outside the IR cycle within WAP proceedings. These will be considered by SWQM during the next IR update.

Hierarchical Category Assignments

The category assigned to a segment is dependent on the categories of all the AUs in that segment. Categories are assigned based on the evaluation of the criterion of each individual parameter within an AU. Because multiple parameters are used to evaluate most uses, each parameter must first be evaluated against the associated criteria before the overall use support for the AU can be determined. Similarly, the use support of each AU within a segment must be determined to evaluate the use support of that segment.

For example, Segment 0101 is composed of two AUs. Two uses are designated for the segment-support of aquatic life and contact recreation. In AU_01 both uses are supported, so the AU is assigned to Category 1. In AU_02, the aquatic life use is supported but there is insufficient available data to determine whether the contact recreation use is supported, so that AU is assigned to Category 1 for the aquatic life use and Category 3 for the contact recreation use. Overall, the segment would be assigned to Category 2 because one or more uses are supported but there is insufficient or unreliable data and/or information available to determine use support for others.

Similarly, in another segment, if some of the uses are supported, but others are not, then the segment would be assigned to Category 4 or 5, depending on whether the state is already taking action to improve water quality (Category 4), or plans to take such action in the future (Category 5).

Table 5.1 shows the progression from categorizing each parameter in one AU, to categorizing each use in each AU within a segment, and then determining the final segment category. It also summarizes the strategies associated with the subcategories of Categories 4 and 5.

Table 5.1. Assigning Categories to Parameters, Uses, AUs, and Segments

Category Number	Category for Each Parameter within AU (parameter AU)	Category for Each Overall Use within AU (Use/AU)	Overall Category for AU (all Uses/AU)	Overall Category for Segment (all uses/ all AUs)
1		Overall Use is supported for this AU.	All uses are assessed and supported.	All uses are supported; no evidence that nonattainment of any standard will occur in the near future.
2			Some uses are assessed and supported; others are not assessed	Some uses are supported; no evidence that nonattainment of any standard will occur in the near future; and insufficient or no data and information are available to determine if the remaining uses are supported.
3	There is insufficient or unreliable available data and/or information to make a use support determination.	Overall Use not assessed for this AU	No uses are assessed	There is insufficient or unreliable available data and/or information to make a use support determination.
4		Overall Use not supported but a TMDL is not required	Some uses are not supported in the AU, but a TMDL is not required	Use is not supported, or nonattainment of water quality standards is predicted in the near future for one or more parameters, but no TMDLs are required
4a	TMDL completed and approved by EPA for this parameter			
4b	Other control requirements are reasonably expected to result in attainment of the water quality standard in the near future for this parameter			

Category Number	Category for Each Parameter within AU (parameter AU)	Category for Each Overall Use within AU (Use/AU)	Overall Category for AU (all Uses/AU)	Overall Category for Segment (all uses/ all AUs)
4c	Nonattainment of the water quality standard is shown to be caused by pollution, not by a pollutant for this parameter			
5		Overall Use not supported and a TMDL may be required for a parameter	Some uses are not supported and a TMDL may be required	One or more uses are not supported, or nonattainment of water quality standards is predicted in the near future for one or more parameters, and a TMDL may be required.
5a	A TMDL is underway, scheduled, or may be scheduled for this parameter			
5b	A review of the water quality standard will be conducted before a management strategy is scheduled for this parameter			
5c	Additional data or information will be collected and/or evaluated before a management strategy is selected for this parameter			

Category Number	Category for Each Parameter within AU (parameter AU)	Category for Each Overall Use within AU (Use/AU)	Overall Category for AU (all Uses/AU)	Overall Category for Segment (all uses/ all AUs)
5n	The water body does not meet applicable Chl *a* criterion, but additional study is needed to verify exceedance is associated with causal nutrient parameters or impacts to response variables.			
5r	A WPP is under development or accepted by EPA for this parameter.			

Categories 1, 2, and 3

The management actions and the most common ways that segments move from one category to another during subsequent biennial assessments are detailed for segments assigned to Categories 1 through 3 in Table 5.2.

For some uses in both Category 1 and 3, the available data may indicate what is termed a “concern” (see Chapter 2). A concern is identified in Category 1 segments if the standard is attained but one or more data points do exceed the criteria. A concern may be identified in Category 3 segments, even though there are fewer than the minimum numbers of samples required for full assessment, and one or more of these samples exceeds the criteria. Parameters which were initially determined to be impaired but affected by excessive drought will be assigned to Category 3. For more information concerning the approach for addressing impairments and data influenced by drought please see Appendix E.

Table 5.2. Categories 1,2, and 3—Management Strategies

Category Number	Description	Action
1	All designated uses are supported, no use is threatened.	TCEQ and/or other agencies: · Set priorities for data collection based on concerns, the importance of the resource, and local interest. Information about pollution risk, intensity of use (for example, how often is a water body used for swimming), and water quality concerns is considered during annual planning meetings at the river basin scale involving agency staff and local monitoring entities. The cooperative multi-agency routine monitoring schedule[6] and more details on the monitoring strategy are available on the Lower Colorado River Authority (LCRA) Web. · Conduct routine monitoring to document ongoing conditions. · Reassess uses based on new data.
2	Available data and/or information indicate that some, but not all of the designated uses are supported.	TCEQ and/or other agencies: · Set priorities for data collection based on concerns, the importance of the resource, and local interest. Information about pollution risk, intensity of use (for example, how often is a water body used for swimming), and water quality concerns is considered during annual planning meetings at the river basin scale involving agency staff and local monitoring entities. The cooperative multi-agency routine monitoring schedule and more details on the monitoring strategy are available on the LCRA Web. · Conduct routine monitoring to document ongoing conditions. · Reassess uses based on new data.
3	There is insufficient or unreliable available data and/or information to make a use support determination.	TCEQ and/or other agencies: · Set priorities for data collection based on concerns, the importance of the resource, and local interest. · Conduct routine monitoring to document ongoing conditions. · Reassess uses based on new data.

[6] cms.lcra.org/

Category 4

Category 4 is for those impairments that do not require a TMDL. The uses and parameters in this category are not included on the 303(d) List. Category 4 is divided into four subcategories. These subcategories convey the status and plans for different kinds of impairments (see Table 5.3).

Note that for Category 4 impairments, because there are water quality controls in place, or the nonsupport is not amenable to TMDL processes, impairments are removed from this category when water quality standards are attained without the additional level of assurance required for delisting from Category 5 (for example, that no more than 10% of the samples exceed for conventional parameters).

With each subsequent assessment, the AU may be moved to a different category. The ultimate goal is to support all uses so it can be removed from Subcategory 4a.

Table 5.3. Category 4-Management Strategies

Available data and/or information indicate that at least one designated use is not being supported or is threatened, but a TMDL is not needed.

Subcategory	Action	Most Common Category Reassignment
4a A state developed TMDL has been approved by EPA or a TMDL has been established by EPA for any water-pollutant combination.	· TCEQ develops an I-Plan to reduce pollutant load, based on TMDL(s). · TCEQ issues or renews TPDES permits according to the TMDL, adjusting effluent limitations as needed. · Local, state, or federal authorities, or private entities, implement other actions according to the I-Plan. · TMDL program tracks implementation of all planned activities and progress toward standards attainment. · If control measures do not lead to attainment of the standard in the time frame set out in the I-Plan, TCEQ may revise the TMDL and/or the I-Plan. · TCEQ or other agencies continue routine monitoring and conduct additional monitoring as described in the I-Plan.	If standard is attained, and all other uses are met, the AU and segment are removed from Subcategory 4a.

Subcategory	Action	Most Common Category Reassignment
4b Other required control measures are expected to result in the attainment of an applicable water quality standard in a reasonable period of time.	· Local, state, or federal authorities, or private entities, implement actions that are expected to result in standards attainment. · SWQM tracks progress towards standards attainment through monitoring program. · TCEQ or other agencies continue routine monitoring.	If standard is attained, and all other uses are met, the AU and segment are removed from Subcategory 4b.
4c The impairment or threat is not caused by a pollutant.	No action required.	

Subcategory 4a

A parameter is moved into Subcategory 4a during the assessment that immediately follows EPA approval of a TMDL for that parameter. Depending on when the EPA approves the TMDL, the actual move to Subcategory 4a may take place as long as two years after approval. Generally, TCEQ works with stakeholders to develop a TMDL and I-Plan. Depending on the types of actions needed to restore the use of the water body, other agencies play a leadership or partnership role in the development and execution of the I-Plan. Attainment of the standard is expected upon full implementation of the plan, although that may take many years or decades. In some cases, an adaptive management approach is used that allows for periodic revisions of the TMDL or the I-Plan.

Subcategory 4b

This subcategory represents a situation where controls other than a TMDL are expected to result in attainment of the standard within a reasonable time frame. These other controls must be in progress or planned, and TCEQ must provide credible evidence that these measures will result in standards attainment. The exact definition of a “reasonable time frame” will vary depending on the impaired use but will be defined in the justification TCEQ presents to move the AU into Subcategory 4b.

From EPA’s *Guidance for 2006 Assessment, Listing, and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the CWA* (July 29, 2005):

> “EPA will evaluate on a case-by-case basis a state’s decisions to exclude certain segment/pollution combinations from Category 5 (the Section 303(d) List) based on the 4b alternative. States should provide in their submission the rationale which supports their conclusion that there are “other pollutant control requirements”

sufficiently stringent to achieve applicable water quality standards within a reasonable period of time."

Some Subcategory 4b examples are:

- Impairments due to legacy pollutants where remediation under a superfund project or natural attenuation (in the absence of a current source) is projected to result in standards attainment.
- AUs where a specific discharger is known to be the source of the impairment and enforcement actions are underway to correct the problem.
- A WPP has been prepared with nine required elements, and the plan is approved by the Commission as part of the Water Quality Management Plan and a commitment to implement water quality controls that will restore water quality.

TCEQ will provide a description of pollution controls and how they will achieve water quality standards, and the measures that will track the progress in restoring water quality so the plan can be revised as needed.

If these other controls result in attainment of the standard, the AU is removed from Subcategory 4b. If the measures have not been successful in the expected time frame, the AU will be moved to one of the subcategories of Category 5.

Subcategory 4c

This subcategory is reserved for those water bodies where the impairment is caused by stressors other than specific pollutants that can be allocated under a TMDL. This may also include situations where water quality degradation is not due to a specific pollutant (for example, impairment of biological community due to habitat loss).

There are conceivably many types of nonpollutant impairments which could be considered for this subcategory. Prior to the release of a draft 303(d) List, candidates for Subcategory 4c are identified. This step includes consideration of the appropriateness of the standard, and thus whether the impairment more appropriately belongs in Subcategory 5b.

A primary consideration for Category 4c relies on the differentiation between "pollution" and "pollutant." The CWA and Texas Water Code (TWC) include specific information which clearly define each:

CWA Section 502(6) – The term "pollutant" means dredged spoil, solid waste, incinerator residue, sewage, sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. This term does not mean (A) "sewage from vessels or a discharge incidental to the normal operation of a vessel of the Armed Forces" within the meaning of section 3122 of this Act; or (B) water, gas, or the material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil or gas production and disposed of in a well, if the well-used either to facilitate production or for disposal purpose is approved by authority of the State in which the well is located, and if such State determines that such injection or disposal will not result in the degradation of ground or surface water resources.

CWA Section 502(19) – The term "pollution" means the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water.

TWC Section 26.001(14), and the TSWQS, Section 307.3(a)(47) – The term "pollution" is defined as the alteration of the physical, thermal, chemical, or biological quality of, or the contamination of, any water in the state that renders the water harmful, detrimental, or injurious to humans, animal life, vegetation, or property or to the public health, safety, or welfare, or impairs the usefulness or the public enjoyment of the water for any lawful or reasonable purpose.

1. When information confirms that nonattainment of the standard is caused by pollution, the impairment is put in Category 4c. The available data and information are researched to rule out a pollutant as the cause of the impairment. It is possible that some small level of a pollutant loading might be identified, but TCEQ must demonstrate that the pollutant loading is inconsequential. In some cases, TCEQ may not have the staff resources to carry out this step at the time of the assessment; and in that case the parameter is placed in Category 5c, and this additional assessment work is carried out at a later date.

2. When available information confirms that nonattainment of the standard is caused by natural conditions or sources of pollutants that cannot be allocated and controlled through TMDL, the impairment is put into Category 4c. For example:

   - Natural low flow conditions of water which prevent the attainment of the use.

   - Physical conditions related to the natural features of the water body which preclude attainment of the use.

   - A naturally occurring pollutant concentrations not attributed to waste discharges or the activity of man which prevents attainment of water quality standards not related to human health, e.g., aquatic life use criteria.

Justification for the placement of the impairment in Category 4c is drafted and this information is provided with the draft IR. The justification includes information as to the probable sources and causes, however, there is no commitment by TCEQ or any other agency to carry out restoration activities.

Once a parameter is in Category 4c, TCEQ will not permit additional loading that causes or contributes to the impairment. However, TCEQ may consider trading opportunities.

Category 5

Category 5 includes impairments which may require a TMDL or other water quality management strategy. This category is divided into five subcategories indicating specific actions necessary to address impairments. These subcategories are a useful management tool for TCEQ and inform stakeholders of the status and plans for different kinds of impairments (see Table 5.4).

Table 5.4. Category 5 – Management Strategies

Available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed.

Subcategory	Action	Most Common Category Reassignment
5a A TMDL is underway, scheduled, or will be scheduled.	· TCEQ schedules a TMDL dependent upon available funding and develops a TMDL for each pollutant or condition. · TCEQ will not permit additional loading that will cause or contribute to the impairment. · In some cases, new data and information gathered for the TMDL may lead to a different restoration approach prior to completion of the TMDL. · TCEQ or other agencies continue routine monitoring.	If TMDL is approved by EPA, parameter moves to Subcategory 4a. If water quality standards for the parameter are not attained, it remains in Subcategory 5a until the TMDL is approved, or in 4a if the I-Plan is completed.
5b A review of the standards for the water body will be conducted before a management strategy is selected.	· TCEQ will not permit additional loading that will cause or contribute to the impairment. · TCEQ sets priorities for these impairments then initiates a UAA or other special study for each affected AU. If appropriate, a new standard (designated use and/or site-specific criterion) will be proposed to EPA. · TCEQ or other agencies continue routine monitoring.	If TCEQ adopts a standards revision that EPA approves, the water body is reassessed with the revised standard to determine attainment. If TCEQ does not propose standards revision, or if TCEQ proposes a change that EPA disapproves, the parameter moves to Subcategory 5a or 5c if impairment continues and pollutant is identified. If controls are in progress or impairment is not caused by a pollutant, the parameter is moved to Subcategory 4b or 4c.

Subcategory	Action	Most Common Category Reassignment
5c Additional data and information will be collected or evaluated before a management strategy is selected.	· TCEQ will not permit additional loading that will cause or contribute to the impairment. · TCEQ or other agencies: o Carry out parameter or area-specific study. o Continue routine monitoring. o Develop watershed characterizations.	If pollutant is identified, parameter moves to Subcategory 5a. If impairment is not caused by a pollutant, the parameter is moved to Subcategory 4c. In rare instances, additional data may show the affected use is being met, and the parameter is moved to Category 1.
5n Water body does not meet its applicable Chl *a* criterion, but additional study is needed to verify whether exceedance is associated with causal nutrient parameters or impacts to response variables.	· TCEQ will not permit additional loading that will cause or contribute to the impairment. · TCEQ or other agencies: o Conduct site-specific nutrient evaluation studies, including potential sources of nutrients in the watershed and/or, o Develop watershed characterizations. · TCEQ program coordination and prioritization of 5n waters.	If standard is attained, the AU and segment are removed from Subcategory 5n. Information gathered from enhanced monitoring, nutrient evaluation studies, and/or watershed characterization may provide the basis for selecting a restoration strategy (watershed protection plan, TMDL, or other more appropriate plan to address internal cycling of nutrients) to attain water quality standards. AU and segment are moved to Subcategory 5a, 5c, or 5r. Information gathered from enhanced monitoring, nutrient evaluation studies and/or watershed characterizations may provide the basis to demonstrate that exceedances of Chl *a* are not caused by a pollutant, and a TMDL is not required. The AU and segment are moved to Subcategory 4c.

Subcategory	Action	Most Common Category Reassignment
5r A WPP is under development or accepted by EPA.	· TCEQ will not permit additional loading that will cause or contribute to the impairment. · TCEQ, other agencies, or stakeholders: o Carry out parameter or area-specific study. o Continue routine monitoring. o Develop watershed characterizations. o Implement voluntary management measures included in established WPPs. o Perform effectiveness monitoring to evaluate the success of implementation.	If standard is attained, the AU is removed from Subcategory 5r. Management measures will remain in place to protect water quality. Long term routine monitoring will be conducted to provide data for assessment.

Subcategory 5a

Impairments are placed in Subcategory 5a only after TCEQ determines that the impairment does not more appropriately belong in Subcategories 5b, 5c, 5n, 5r, 4b, or 4c, and a TMDL is determined to be appropriate.

In each of these cases, TCEQ would identify the pollutant prior to placement of the impairment in Subcategory 5a. If it is unclear that the impairment is caused by a pollutant, it is placed in Subcategory 5c. If the impairment is clearly not caused by a pollutant, the AU is placed in Subcategory 4c.

After the 303(d) List is finalized, but prior to submission to EPA, TCEQ develops a schedule for TMDLs for parameters in Subcategory 5a. The schedule includes the anticipated date of submittal of the TMDLs to EPA for those TMDLs that will be completed in the next two years.

Upon approval of the TMDL by EPA, the parameter is moved to Subcategory 4a during the subsequent assessment, unless the standard is attained, in which case the AU and segment are moved to Category 1. In some cases, new data and information gathered for the TMDL may lead to a different strategy prior to completion of the TMDL, and the parameter is moved to Subcategory 4b, 4c, 5b, or 5r, as appropriate.

Subcategory 5b

Parameters are placed in this subcategory if there is a need to review the designated use or water quality criteria. Water bodies listed on the 303(d) list may be considered candidates for a UAA or RUAA. UAAs and RUAAs are conducted on classified or on unclassified water bodies for which uses and criteria have been established. Aquatic Life Assessments (ALA) are conducted on unclassified water bodies where the presumed aquatic life use and/or the associated DO criteria are not attained. The purpose of the UAA or ALA is to determine if existing uses and criteria are appropriate and, if not, to develop uses, assign presumed uses, and propose criteria changes.

TCEQ has developed a process for prioritizing these water bodies for the development of a UAA or site-specific criterion. The factors used by TCEQ and WAP partners to prioritize water bodies for standards review are:

- Adequacy of the data set describing the extent and severity of the nonsupport, including direct measurements of use support such as biological data.
- Comparison of conditions and measurements at similar sites in the ecoregion.
- History of recent UAAs or other standard-related work.
- Changes in water quality since a previous review of the standards.
- The extent to which natural causes and sources are believed to contribute to nonsupport of the existing standards.

Common examples of Subcategory 5b parameters are:

- TDS, chloride, and sulfate where the current or historical data set indicates criteria should be reviewed.
- The physical suitability of a waterbody to support primary contact recreation. Conditions related to flow status or hydrology may limit activities associated with primary contact recreation.
- DO, where (1) the criteria are not supported but the biological community is healthy; or (2) modeling shows that the DO criteria cannot be met under natural conditions; or (3) data collected for a pending permit prompts a review of the standard.
- Biological community is impaired based on a presumed or designated use, where information indicates that to be an inappropriate use designation.

If a standard revision is proposed, the parameter remains in Subcategory 5b until EPA takes action on the proposed standard. A reassessment against the new standard will then determine the new category for the parameter. If the impairment still exists, the parameter is moved to Subcategory 4b, 4c, 5a, or 5c, as appropriate. If revision of the standard is not proposed by TCEQ, or if TCEQ proposes a change that EPA disapproves, the parameter moves to Subcategory 4b, 4c, 5a, or 5c as appropriate.

Subcategory 5c

Impairments are commonly placed in Subcategory 5c if there is insufficient information to determine the best course of action to address the impairment. Impairments are also placed in Subcategory 5c if there is existing information that has not yet been thoroughly evaluated to determine the best management strategy. The information needed, and therefore the action required, for each Subcategory 5c impairment is parameter and water-body specific. An impairment may be the result of poor water quality conditions observed for only a few years. It may be prudent to continue sampling for several more years and reassess to confirm that the impairment is persistent and characteristic of the water body before initiating a TMDL, WPP, or standards review. Information on the various attributes of the watershed could be compiled as part of a watershed characterization to gain a better understanding of the problem.

Subcategory 5n

This subcategory is established to focus management actions that address nutrients in reservoirs with numeric Chl *a* criteria. Subcategory 5n will be assigned when the water body does not meet its applicable Chl *a* criterion, and additional information from causal nutrient parameters or impacts to response variables corroborates the exceedance of Chl *a*. However, additional nutrient-specific data and information is needed before a management strategy, such as a TMDL or watershed protection plan, is initiated. Reservoirs in 5n will be prioritized for additional studies and management efforts, including enhanced monitoring, nutrient-evaluation studies, and/or characterization of the contributing watershed.

Information developed while assigned to subcategory 5n can be used to provide the basis for traditional restoration efforts such as TMDLs and WPPs. Due to the complexity of nutrient dynamics in reservoirs, addressing internal cycling of nutrients, as well as other site-specific factors, may also need to be considered to appropriately manage nutrients and excessive algae. Information developed may also demonstrate that exceedances of Chl *a* are not caused by a pollutant, and a TMDL is not required.

Subcategory 5r

Impairments identified as Subcategory 5r have a WPP under development or EPA-accepted, nine-element WPPs that address multiple impairments and water quality concerns with a goal to restore and protect water quality. WPPs are community-developed approaches that identify potential nonpoint sources of waterbody impairments throughout a watershed and provide a framework for implementation strategies to reduce pollution and improve overall water quality. Development of a WPP generally takes about three years, depending on the nature of the work required. Attainment of the standard is expected upon full implementation of the plan, although that may take many years or decades. An adaptive management approach is used that allows for periodic revisions of the WPP and assessment of progress towards meeting the goals.

Water Quality Concerns

Water quality concerns include those waters not considered impaired; however, data indicate that pollutant levels are elevated or exceed specific screening thresholds. These water bodies are prioritized through routine monitoring and directed toward the following:

- Completing data sets where limited information indicates that a water quality criterion shows a standard is not attained, but with a limited data set.
- Concerns for water bodies that are near nonattainment.
- Waters with known water quality concerns.
- No specific priority for bodies that have no known water quality problems or without current water quality data.

These priorities for routine monitoring are outlined in Table 5.5. A more detailed description of TCEQ’s monitoring process for waters with concerns and impairments can be found in the most current version of the Texas Surface Water Quality Monitoring and Assessment Strategy. The TCEQ SWQM Program and the Texas CRP provide for an integrated evaluation of physical, chemical, and biological characteristics of aquatic systems in relation to human health concerns, ecological condition, and designated uses. The monitoring strategy outlines the basis for the establishment of effective TCEQ management policies that promote the protection, restoration, and responsible use of Texas surface-water resources.

Table 5.5. Monitoring Objectives to Address Concerns

Level of Support for Parameter	General Monitoring Objective	Priority
Concern for standard support (CN) or not supporting (NS) with a limited data set (LD) (small data set; <10 samples) or even insufficient data (ID) (<10 samples or <20 for bacteria)) Reservoirs in Subcategory 5n	The few samples collected in these AUs show problems. Sample until an adequate data set is available for reassessment. Enhanced monitoring for nutrients and other nutrient evaluations.	1st
Concern for near nonattainment of standard support (CN) with adequate data (AD) for water quality criteria. Or concerns (CS) for DO grab samples	Continue routine monitoring to establish that near nonattainment is ongoing. When DO grab samples identify a concern, schedule 24-hour sampling to determine if the 24-hour mean and/or 24-hour minimum criteria for DO are attained.	2nd
Concern for support (CS) with adequate data (AD) for narrative screening criteria, i.e., nutrients and sediment	Continue monitoring to establish that concern is ongoing. Monitor other water quality causes and sources related to the parameter of concern.	3rd
For water bodies where uses are fully supported (FS) with adequate data (AD), or no concern (NC) with limited data (LD)	Continue monitoring to establish that the designated uses continue to be supported. Include conventional parameters on high use water bodies and water bodies of local interest. Monitor at least one station in each classified segment and important water body Monitor toxics and biological monitoring in areas where this monitoring has not been conducted.	4th

Appendix A
Number of Samples and Exceedances to Identify Concern, Impairment, or to Delist a Parameter by the Binomial Method—Tables

Table A.1. Minimum Threshold Number of Exceedances to List or to Identify a Concern for Use-Attainment of Conventional Parameters.

Listing – To identify a water body as impaired with an intended Type-1 error rate of no more than 20% at an exceedance rate of 10% and a Type-2 error rate of no more than about 38% at an exceedance rate of 30%. A minimum number of three exceedances are required for 303(d) listing. (Actual Type-2 at 20% exceedance rate is for information only).

Concern – To identify a water body as a concern for near nonattainment with an intended Type-1 error rate of no more than 20% at an exceedance rate of 8% and a Type-2 error rate of no more than 82% at an exceedance rate of 20%.

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1 at 10% Exceedance	Listing Actual Type-2 at 20 % Exceedance	Listing Actual Type-2 at 30% Exceedance	Listing Number of exceedances for listing in 2004	Concern Number of Exceedances	Concern Actual Type-1 at 8% Exceedance	Concern Actual Type-2 at 20% Exceedance
4	1				3	1	28	41
	2					2	3	82
	3					3	0	97
5	1				3	1	34	33
	2					2	5	74
	3					3	0	94
6	1				3	1	39	26
	2					2	8	66
	3					3	1	90
7	1				3	1	44	21
	2					2	10	58
	3					3	1	85
8	1				3	1	49	17
	2					2	13	50
	3					3	2	80
9	1				3	1	53	13
	2					2	16	44
	3					3	3	74

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1 at 10% Exceedance	Listing Actual Type-2 at 20 % Exceedance	Listing Actual Type-2 at 30% Exceedance	Listing Number of exceedances for listing in 2004	Concern Number of Exceedances	Concern Actual Type-1 at 8% Exceedance	Concern Actual Type-2 at 20% Exceedance
10	1	65	11	3	3	1	57	11
	2	26	38	15		2	19	38
	3	7	68	38		3	4	68
11	1	69	9	2	3	1	60	9
	2	30	32	11		2	22	32
	3	9	62	31		3	5	62
12	1	72	7	1	3	1	63	7
	2	34	27	9		2	25	27
	3	11	56	25		3	7	56
13	1	75	5	1	3	1	66	5
	2	38	23	6		2	28	23
	3	13	50	20		3	8	50
	4	3	75	42		4	2	75
14	1	77	4	1	3	1	69	4
	2	42	20	5		2	31	20
	3	16	45	16		3	10	45
	4	4	70	36		4	2	70
15	1	79	4	0	3	1	71	4
	2	45	17	4		2	34	17
	3	18	40	13		3	11	40
	4	6	65	30		4	3	65
16	1	81	3	0	4	1	74	3
	2	49	14	3		2	37	14
	3	21	35	10		3	13	35

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1 at 10% Exceedance	Listing Actual Type-2 at 20 % Exceedance	Listing Actual Type-2 at 30% Exceedance	Listing Number of exceedances for listing in 2004	Concern Number of Exceedances	Concern Actual Type-1 at 8% Exceedance	Concern Actual Type-2 at 20% Exceedance
	4	7	60	25		4	3	60
17	1	83	2	0	4	1	76	2
	2	52	12	2		2	40	12
	3	24	31	8		3	15	31
	4	8	55	20		4	4	55
18	1	85	2	0	4	1	78	2
	2	55	10	1		2	43	10
	3	27	27	6		3	17	27
	4	10	50	16		4	5	50
19	1	86	1	0	4	1	79	1
	2	58	8	1		2	46	8
	3	29	24	5		3	19	24
	4	11	46	13		4	6	46
20	1	88	1	0	4	1	81	1
	2	61	7	1		2	48	7
	3	32	21	4		3	21	21
	4	13	41	11		4	7	41

Table A.2. Maximum Threshold Number of Exceedances to Delist a Water Body for Conventional Parameters.

Delisting – To identify a water body as attaining its use, and delisted with an exceedances rate of no more than 10%, resulting in a Type-1 error rate of no more than 70% at an exceedance rate of 11% and no more than 38% at an exceedance rate of 20%; and a Type-2 error rate of 8 to 25% at an exceedance rate of 5%.

Number of Samples	Number of Exceedances	Actual Type-1 at 11% Exceedance	Actual Type-1at 20 % Exceedance	Actual Type-2 at 5% Exceedance	Actual % Exceedance When Delisting
10	0	31	11	40	10
	1	69	37	9	
	2	91	68	1	
11	0	28	9	43	9
	1	65	32	10	
	2	89	62	2	
12	0	25	7	46	8
	1	61	27	12	
	2	86	56	2	
13	0	22	5	49	8
	1	57	23	14	
	2	83	50	2	
14	0	20	4	51	7
	1	53	20	15	
	2	81	45	3	
15	0	17	4	54	7
	1	50	17	17	
	2	78	40	4	
16	0	15	3	56	6
	1	46	14	19	
	2	75	35	4	
17	0	14	2	58	6
	1	43	12	21	
	2	71	31	5	

Number of Samples	Number of Exceedances	Actual Type-1 at 11% Exceedance	Actual Type-1at 20 % Exceedance	Actual Type-2 at 5% Exceedance	Actual % Exceedance When Delisting
18	0	12	2	60	6
	1	40	10	23	
	2	68	27	6	
19	0	11	1	62	5
	1	37	8	25	
	2	65	24	7	
20	0	10	1	64	10
	1	34	7	26	
	2	62	21	8	

Table A.3. Minimum Threshold Number of Exceedances to Identify a Concern for Dissolved Oxygen

Concern – To identify a water body as a concern (using an average of DO grabs) with an intended Type-1 error rate of no more than 20% at an exceedance rate of 8% and a Type-2 error rate of no more than 82% at an exceedance rate of 20%.

Number of Samples	Number of Exceedances	Actual Type-1at 8% Exceedance	Actual Type-2 at 20 % Exceedance
4	1	28	41
	2	3	82
	3	0	97
5	1	34	33
	2	5	74
	3	0	94
6	1	39	26
	2	8	66
	3	1	90
7	1	44	21
	2	10	58
	3	1	85
8	1	49	17
	2	13	50
	3	2	80
9	1	53	13
	2	16	44
	3	3	74
10	1	57	11
	2	19	38
	3	4	68
11	1	60	9
	2	22	32
	3	5	62

Number of Samples	Number of Exceedances	Actual Type-1at 8% Exceedance	Actual Type-2 at 20 % Exceedance
12	1	63	7
	2	25	27
	3	7	56
13	1	66	5
	2	28	23
	3	8	50
	4	2	75
14	1	69	4
	2	31	20
	3	10	45
	4	2	70
15	1	71	4
	2	34	17
	3	11	40
	4	3	65
16	1	74	3
	2	37	14
	3	13	35
	4	3	60
17	1	76	2
	2	40	12
	3	15	31
	4	4	55
18	1	78	2
	2	43	10
	3	17	27
	4	5	50

Number of Samples	Number of Exceedances	Actual Type-1at 8% Exceedance	Actual Type-2 at 20 % Exceedance
19	1	79	1
	2	46	8
	3	19	24
	4	6	46
20	1	81	1
	2	48	7
	3	21	21
	4	7	41

Table A.4. Minimum Threshold Number of Exceedances to List or to Identify a Concern for Use-Attainment of Bacteria (Coastal Recreation Waters, single sample) Parameters.

Listing – To identify a water body as impaired with an intended Type-1 error rate of no more than 20% at an exceedance rate of 20% and a Type-2 error rate of no more than 20% at an exceedance rate of 40%. A minimum number of seven exceedances are required for 303(d) listing.

Concern – To identify a water body as a concern for near nonattainment with an intended Type-1 error rate of no more than 20% at an exceedance rate of 16% and a Type-2 error rate of no more than 60% at an exceedance rate of 32%.

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1at 20% Exceedance	Listing Actual Type-2 at 40% Exceedance	Concern Number of Exceedances	Concern Actual Type-1at 16% Exceedance	Concern Actual Type-2 at 32% Exceedance
7	5			2	31	29
	6			3	9	60
	7			4	2	85
8	5			2	37	22
	6			3	12	50
	7			4	3	77
9	5			2	43	16
	6			3	16	41
	7			4	4	68
10	5			3	21	33
	6			4	6	60
	7			5	1	81
	8			6	0	94
11	5			3	25	26
	6			4	8	51
	7			5	2	74
	8			6	0	90
	9			7	0	97
12	5			2	59	6

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1at 20% Exceedance	Listing Actual Type-2 at 40% Exceedance	Concern Number of Exceedances	Concern Actual Type-1at 16% Exceedance	Concern Actual Type-2 at 32% Exceedance
12, continued	6			3	30	21
	7			4	11	43
	8			5	3	67
	9			6	1	85
13	4			2	64	5
	5			3	35	16
	6			4	14	36
	7			5	4	59
	8			6	1	79
14	5			4	17	30
	6			5	6	52
	7			6	2	73
15	5			4	21	24
	6			5	8	45
	7			6	2	66
16	5			4	25	20
	6			5	10	38
	7			6	3	59
17	5			3	53	6
	6			4	28	16
	7			5	12	32
	8			6	4	53
18	5			3	57	4
	6			4	32	12

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1at 20% Exceedance	Listing Actual Type-2 at 40% Exceedance	Concern Number of Exceedances	Concern Actual Type-1at 16% Exceedance	Concern Actual Type-2 at 32% Exceedance
18, continued	7			5	15	27
	8			6	6	46
	9			7	2	66
19	5			2	83	1
	6			3	61	3
	7			4	36	10
	8			5	18	22
	9			6	7	40
20	4	59	2	2	85	0
	5	37	5	3	64	2
	6	20	13	4	40	8
	7	9	25	5	21	18
	8	3	42	6	9	34
21	4	63	1	3	68	2
	5	41	4	4	44	6
	6	23	10	5	24	15
	7	11	20	6	11	29
	8	4	35	7	4	47
22	3	85	0	3	71	1
	4	67	1	4	48	5
	5	46	3	5	27	12
	6	27	7	6	13	25
	7	13	16	7	5	41
23	3	87	0	2	90	0

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1at 20% Exceedance	Listing Actual Type-2 at 40% Exceedance	Concern Number of Exceedances	Concern Actual Type-1at 16% Exceedance	Concern Actual Type-2 at 32% Exceedance
23, continued	4	70	1	3	74	1
	5	50	2	4	51	4
	6	31	5	5	30	10
	7	16	12	6	15	21
	8	7	24	7	6	36
24	3	89	0	2	92	0
	4	74	0	3	76	1
	5	54	1	4	55	3
	6	34	4	5	34	8
	7	19	10	6	17	17
	8	9	19	7	8	31
25	3	90	0	4	58	2
	4	77	0	5	37	6
	5	58	1	6	20	14
	6	38	3	7	9	27
	7	22	7	8	4	43
	8	11	15	9	1	59
26	3	92	0	4	62	2
	4	79	0	5	40	5
	5	62	1	6	23	12
	6	42	2	7	11	23
	7	25	6	8	5	37
	8	13	12	9	2	54

Table A.5. Maximum Threshold Number of Exceedances to Delist a Water Body for Bacteria (Coastal Recreation Waters, single sample) Parameters

Delisting – To identify a water body as attaining its use, and delisted with an exceedance rate of no more than 20%, resulting in a Type-1 error rate of no more than 59% at an exceedance rate of 21%, and no more than 6% at an exceedance rate of 40%; and a Type-2 error rate of no more than 3 to 9% at an exceedance rate of 10%. To delist a bacteria impairment, the geometric mean criterion must also be attained.

Number of Samples	Number of Exceedances	Actual Type-1 at 21% Exceedance	Actual Type-1 at 40% Exceedance	Actual Type-2 at 10% Exceedance	Actual % Exceedance When Delisting
20	2	18	0	32	20
	3	37	2	13	
	4	59	5	4	
	5	77	13	1	
21	2	15	0	35	19
	3	33	1	15	
	4	54	4	5	
	5	73	10	1	
22	2	13	0	38	18
	3	29	1	17	
	4	50	3	6	
	5	69	7	2	
23	2	11	0	41	17
	3	26	1	19	
	4	45	2	7	
	5	65	5	2	
	6	81	12	1	
24	2	9	0	44	17
	3	23	0	21	
	4	41	1	9	

Number of Samples	Number of Exceedances	Actual Type-1 at 21% Exceedance	Actual Type-1 at 40% Exceedance	Actual Type-2 at 10% Exceedance	Actual % Exceedance When Delisting
24, continued	5	61	4	3	
	6	77	10	1	
25	2	8	0	46	20
	3	20	0	24	
	4	37	1	10	
	5	57	3	3	
	6	74	7	1	
26	1	2	0	75	19
	2	7	0	49	
	3	17	0	26	
	4	34	1	11	
	5	53	2	4	
27	1	1	0	77	19
	2	6	0	52	
	3	15	0	28	
	4	30	0	13	
	5	48	2	5	
	6	66	4	1	
28	1	1	0	78	18
	2	5	0	54	
	3	13	0	31	
	4	27	0	14	
	5	45	1	6	
	6	63	3	2	

Number of Samples	Number of Exceedances	Actual Type-1 at 21% Exceedance	Actual Type-1 at 40% Exceedance	Actual Type-2 at 10% Exceedance	Actual % Exceedance When Delisting
29	1	1	0	80	18
	2	4	0	57	
	3	11	0	33	
	4	24	0	16	
	5	41	1	6	
	6	59	2	2	
30	1	1	0	82	20
	2	3	0	59	
	3	10	0	35	
	4	21	0	18	
	5	37	1	7	
	6	55	2	3	
	7	72	4	1	

Table A.6. Minimum Threshold Number of Exceedances to Identify a Concern for Screening Level Parameters

Concern – To identify a water body as a screening level concern with an intended Type-1 error rate of no more than 20% at an exceedance rate of 20% and a Type-2 error rate of no more than 68% at an exceedance rate of 40%.

Number of Samples	Number of Exceedances	Actual Type-1 at 20% Exceedance	Actual Type-2 at 40 % Exceedance
4	1	59	13
	2	18	48
	3	3	82
5	1	67	8
	2	26	34
	3	6	68
6	1	74	5
	2	34	23
	3	10	54
7	1	79	3
	2	42	16
	3	15	42
	4	3	71
8	1	83	2
	2	50	11
	3	20	32
	4	6	59
9	1	87	1
	2	56	7
	3	26	23
	4	9	48

Number of Samples	Number of Exceedances	Actual Type-1 at 20% Exceedance	Actual Type-2 at 40 % Exceedance
10	1	89	1
	2	62	5
	3	32	17
	4	12	38
	5	3	63
11	1	91	0
	2	68	3
	3	38	12
	4	16	30
	5	5	53
12	1	93	0
	2	73	2
	3	44	8
	4	21	23
	5	7	44
13	1	95	0
	2	77	1
	3	50	6
	4	25	17
	5	10	35
	6	3	57
14	1	96	0
	2	80	1

Number of Samples	Number of Exceedances	Actual Type-1 at 20% Exceedance	Actual Type-2 at 40 % Exceedance
14, continued	3	55	4
	4	30	12
	5	13	28
	6	4	49
15	1	96	0
	2	83	1
	3	60	3
	4	35	9
	5	16	22
	6	6	40
16	1	97	0
	2	86	0
	3	65	2
	4	40	7
	5	20	17
	6	8	33
17	1	98	0
	2	88	0
	3	69	1
	4	45	5
	5	24	13
	6	11	26
	7	4	45

Number of Samples	Number of Exceedances	Actual Type-1 at 20% Exceedance	Actual Type-2 at 40 % Exceedance
18	1	98	0
	2	90	0
	3	73	1
	4	50	3
	5	28	9
	6	13	21
	7	5	37
19	1	99	0
	2	92	0
	3	76	1
	4	54	2
	5	33	7
	6	16	16
	7	7	31
20	1	99	0
	2	93	0
	3	79	0
	4	59	2
	5	37	5
	6	20	13
	7	9	25
	8	3	42

Table A.7. Minimum Threshold Number of Exceedances to List or to Identify a Concern for Use-Attainment of Toxic Parameters

Listing – To identify a water body as impaired with an intended Type-1 error rate of no more than 40% at an exceedance rate of 10% and a Type-2 error rate of no more than 16% at an exceedance rate of 30%. A minimum number of two exceedances are required for 303(d) listing. (Actual Type-2 at 20% exceedance rate is for information only).

Concern – To identify a water body as a concern for near nonattainment with an intended Type-1 error rate of no more than 40% at an exceedance rate of 8% and a Type-2 error rate of no more than about 20% at an exceedance rate of 20%.

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1 at 10% Exceedance	Listing Actual Type-2 at 20 % Exceedance	Listing Actual Type-2 at 30% Exceedance	Listing Number of exceedances for listing in 2004	Concern Number of Exceedances	Concern Actual Type-1at 8% Exceedance	Concern Actual Type-2 at 20% Exceedance
4	1				2	1	28	41
	2					2	3	82
	3					3	0	97
5	1				2	1	34	33
	2					2	5	74
	3					3	0	94
6	1				2	1	39	26
	2					2	8	66
	3					3	1	90
7	1				2	1	44	21
	2					2	10	58
	3					3	1	85
8	1				2	1	49	17
	2					2	13	50
	3					3	2	80
9	1				2	1	53	13
	2					2	16	44
	3					3	3	74

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1 at 10% Exceedance	Listing Actual Type-2 at 20 % Exceedance	Listing Actual Type-2 at 30% Exceedance	Listing Number of exceedances for listing in 2004	Concern Number of Exceedances	Concern Actual Type-1at 8% Exceedance	Concern Actual Type-2 at 20% Exceedance
10	1	65	11	3	2	1	57	11
	2	26	38	15		2	19	38
	3	7	68	38		3	4	68
11	1	69	9	2	2	1	60	9
	2	30	32	11		2	22	32
	3	9	62	31		3	5	62
12	1	72	7	1	2	1	63	7
	2	34	27	9		2	25	27
	3	11	56	25		3	7	56
13	1	75	5	1	2	1	66	5
	2	38	23	6		2	28	23
	3	13	50	20		3	8	50
	4	3	75	42		4	2	75
14	1	77	4	1	2	1	69	4
	2	42	20	5		2	31	19
	3	16	45	16		3	10	45
	4	4	70	36		4	2	70
15	1	79	4	0	2	1	71	4
	2	45	17	4		2	34	17
	3	18	40	13		3	11	40
	4	6	65	30		4	3	65
16	1	81	3	0	2	1	74	3

Number of Samples	Listing Number of Exceedances	Listing Actual Type-1 at 10% Exceedance	Listing Actual Type-2 at 20 % Exceedance	Listing Actual Type-2 at 30% Exceedance	Listing Number of exceedances for listing in 2004	Concern Number of Exceedances	Concern Actual Type-1at 8% Exceedance	Concern Actual Type-2 at 20% Exceedance
16, continued	2	49	14	3		2	37	14
	3	21	35	10		3	13	35
	4	7	60	25		4	3	60
17	1	83	2	0	3	1	76	2
	2	52	12	2		2	40	12
	3	24	31	8		3	15	31
	4	8	55	20		4	4	55
18	1	85	2	0	3	1	78	2
	2	55	10	1		2	43	10
	3	27	27	6		3	17	27
	4	10	50	16		4	5	50
19	1	86	1	0	3	1	79	1
	2	58	8	1		2	46	8
	3	29	24	5		3	19	24
	4	12	46	13		4	6	46
20	1	88	1	0	3	1	81	1
	2	61	7	1		2	48	7
	3	32	21	4		3	21	21
	4	13	41	11		4	7	41

Table A.8. Maximum Threshold Number of Exceedances to Delist a Water Body for Toxic Parameters.

Delisting – To identify a water body as attaining its use, and delisted with an exceedance rate of no more than 8%, resulting in a Type-1 error rate of no more than 67% at an exceedance rate of 9%, and no more than 23% at an exceedance rate of 20%; and a Type-2 error rate of 14 to 46% at an exceedance rate of 5%.

Number of Samples	Number of Exceedances	Actual Type-1 at 9% Exceedance	Actual Type-1 at 20% Exceedance	Actual Type-2 at 5% Exceedance	Actual % Exceedance When Delisting
10	0	39	11	40	0
	1	77	38	9	
	2	95	68	1	
11	0	35	9	43	0
	1	74	32	10	
	2	93	62	2	
12	0	32	7	46	0
	1	71	27	12	
	2	91	56	2	
13	0	29	5	49	8
	1	67	23	14	
	2	89	50	2	
14	0	27	4	51	7
	1	64	20	15	
	2	87	45	3	
15	0	24	4	54	7
	1	60	17	17	
	2	85	40	4	
16	0	22	3	56	6
	1	57	14	19	
	2	83	35	4	

Number of Samples	Number of Exceedances	Actual Type-1 at 9% Exceedance	Actual Type-1 at 20% Exceedance	Actual Type-2 at 5% Exceedance	Actual % Exceedance When Delisting
17	0	20	2	58	6
	1	54	12	21	
	2	81	31	5	
18	0	18	2	60	6
	1	51	10	23	
	2	78	27	6	
19	0	17	1	62	5
	1	31	8	25	
	2	59	24	7	
20	0	15	1	64	5
	1	45	7	26	
	2	73	21	8	

Appendix B
Number of Samples and Exceedances to Identify Concern, Impairment, or to Delist a Parameter by the Binomial Method—Graphic Tables

Figure B.1. Binomial Method for Listing and Delisting Conventional Parameter Use-Attainment and Concerns

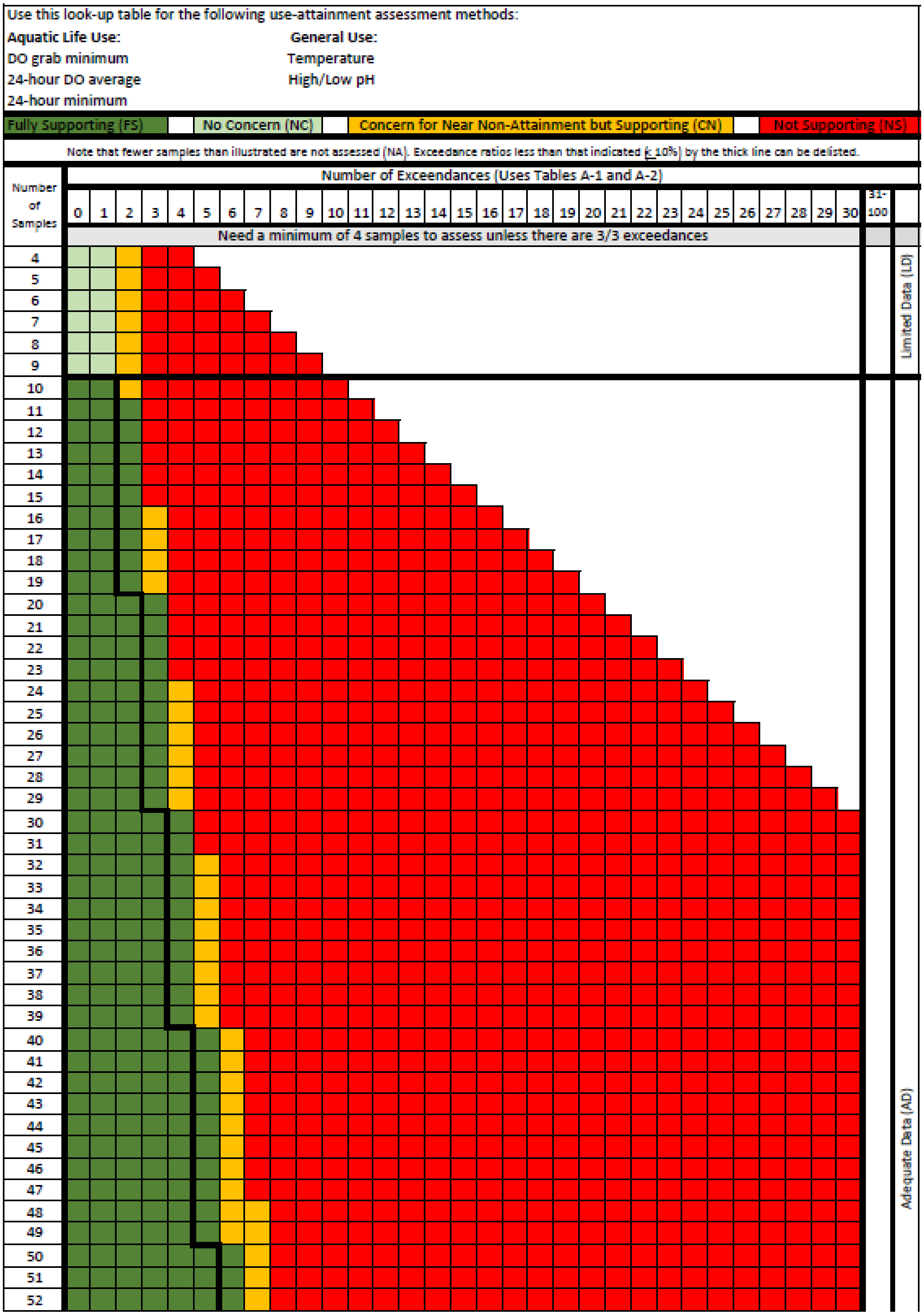

Figure B.1. Binomial Method for Listing and Delisting Conventional Parameter Use-Attainment and Concerns, cont.

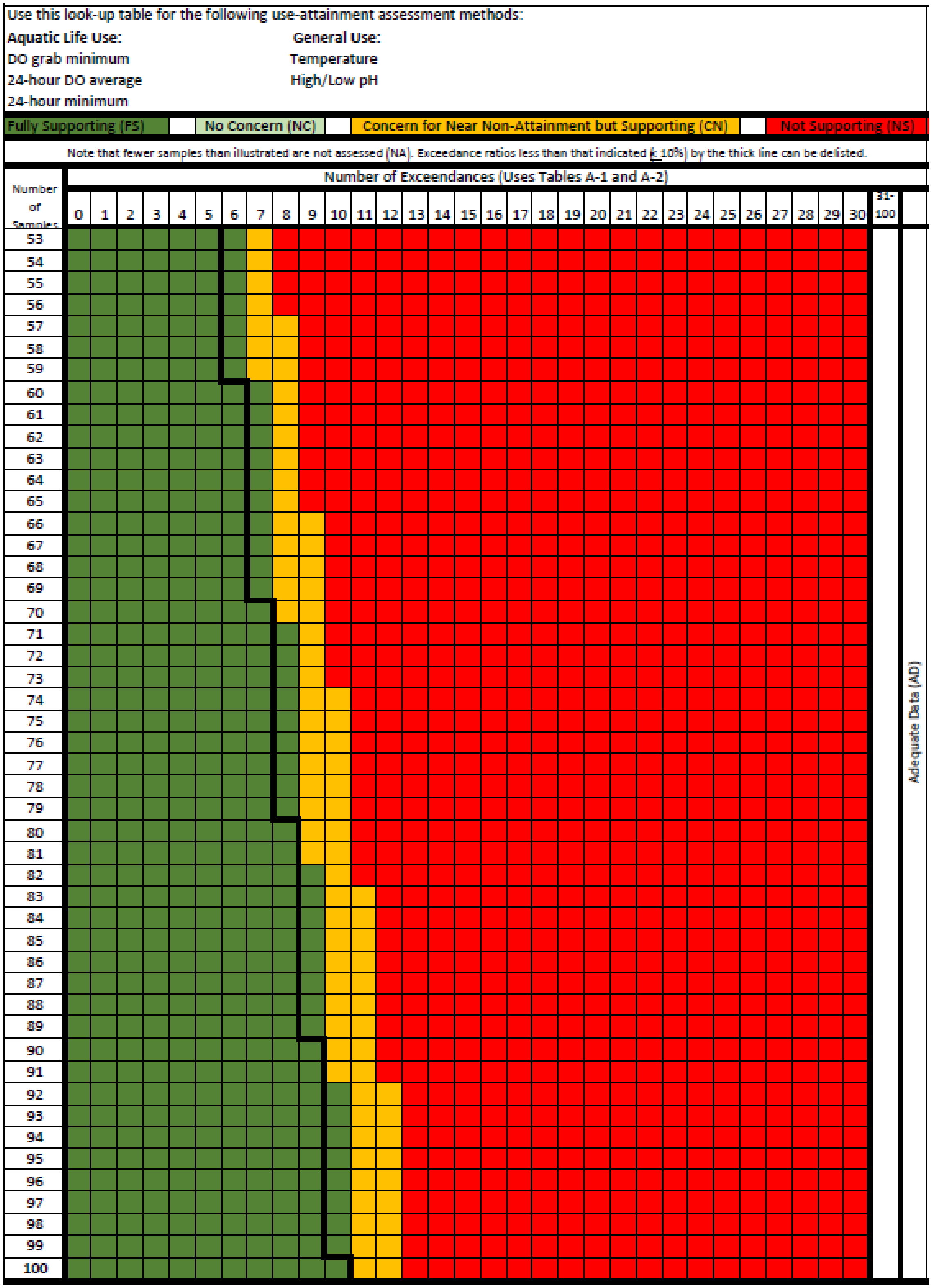

Figure B.2. Binomial Method for Determining Dissolved Oxygen Concerns

Use this look-up table for the following concern assessment method:
Aquatic Life Use:
DO grab screening level (against criteria for the 24-hr average)

No Concern (NC) | Concern (CS) | Note that fewer samples than illustrated are not assessed (NA)

Number of Samples	Number of Exceedances (Uses Table A-3) 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31-100	
4	NC	NC	CS	CS	CS																												Limited Data (LD)
5	NC	NC	CS	CS	CS	CS																											Limited Data (LD)
6	NC	NC	CS	CS	CS	CS	CS																										Limited Data (LD)
7	NC	NC	CS	CS	CS	CS	CS	CS																									Limited Data (LD)
8	NC	NC	CS	CS	CS	CS	CS	CS	CS																								Limited Data (LD)
9	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS																							Limited Data (LD)
10	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS																						Adequate Data (AD)
11	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS																					Adequate Data (AD)
12	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS																				Adequate Data (AD)
13	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS																			Adequate Data (AD)
14	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS																		Adequate Data (AD)
15	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS																	Adequate Data (AD)
16	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS																Adequate Data (AD)
17	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS															Adequate Data (AD)
18	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS														Adequate Data (AD)
19	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS													Adequate Data (AD)
20	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS												Adequate Data (AD)
21	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS											Adequate Data (AD)
22	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS										Adequate Data (AD)
23	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS									Adequate Data (AD)
24	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS								Adequate Data (AD)
25	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS							Adequate Data (AD)
26	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS						Adequate Data (AD)
27	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS					Adequate Data (AD)
28	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS				Adequate Data (AD)
29	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS			Adequate Data (AD)
30	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
31	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
32	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
33	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
34	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
35	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
36	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
37	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
38	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
39	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
40	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
41	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
42	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
43	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
44	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
45	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
46	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
47	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
48	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
49	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
50	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)

Figure B.2. Binomial Method for Determining Dissolved Oxygen Concerns, cont.

Use this look-up table for the following concern assessment method:
Aquatic Life Use:
DO grab screening level (against criteria for the 24-hr average)

No Concern (NC) | Concern (CS) | Note that fewer samples than illustrated are not assessed (NA).

Number of Samples	Number of Exceedances (Uses Table A-3)																															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31-100	Adequate Data (AD)
	Need a minimum of 4 samples to assess unless there are 3/3 exceedances																																
51	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
52	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
53	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
54	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
55	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
56	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
57	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
58	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
59	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
60	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
61	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
62	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
63	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
64	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
65	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
66	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
67	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
68	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
69	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
70	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
71	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
72	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
73	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
74	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
75	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
76	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
77	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
78	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
79	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
80	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
81	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
82	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
83	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
84	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
85	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
86	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
87	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
88	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
89	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
90	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
91	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
92	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
93	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
94	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
95	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
96	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
97	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
98	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
99	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
100	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		

Figure B.3. Binomial Method for Listing and Delisting Recreational Use-Attainment and Concerns

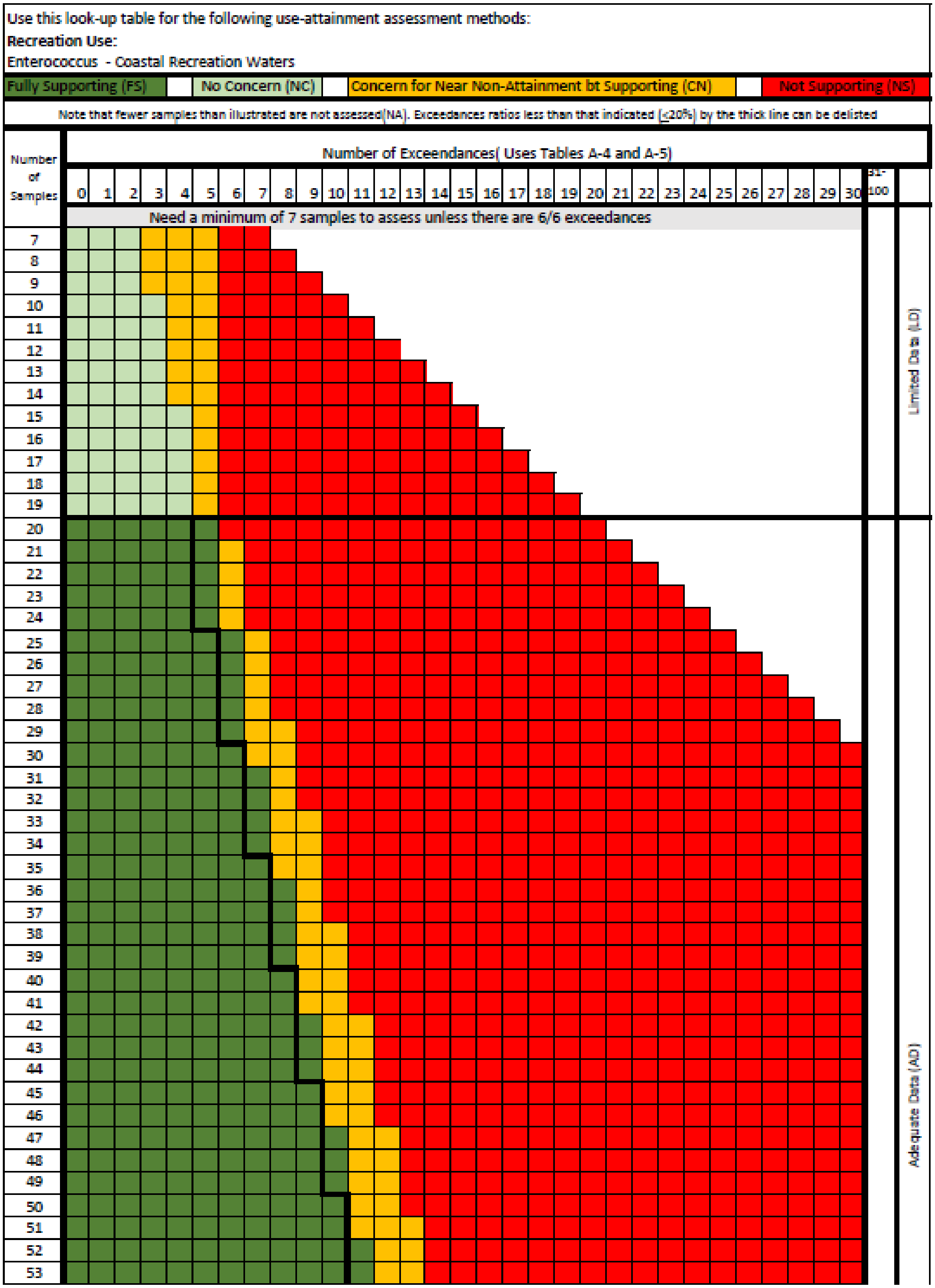

Figure B.3. Binomial Method for Listing and Delisting Recreational Use-Attainment and Concerns, cont.

Use this look-up table for the following use-attainment assessment methods:

Recreation Use:

Enterococcus - Coastal Recreation Waters

Fully Supporting (FS) | No Concern (NC) | Concern for Near Non-Attainment bt Supporting (CN) | Not Supporting (NS)

Note that fewer samples than illustrated are not assessed(NA). Exceedances ratios less than that indicated (≤20%) by the thick line can be delisted

Number of Samples	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31-100	Adequate Data (AD)
54	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
55	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
56	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
57	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
58	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
59	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
60	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
61	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
62	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
63	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
64	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
65	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
66	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
67	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
68	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
69	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
70	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
71	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
72	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
73	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
74	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
75	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
76	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
77	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
78	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
79	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
80	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
81	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
82	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
83	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
84	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
85	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
86	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS		
87	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS		
88	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS		
89	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS		
90	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS		
91	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS	NS		
92	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS		
93	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS		
94	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS		
95	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS		
96	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS	NS		
97	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS		
98	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS		
99	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS		
100	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	FS	CN	CN	CN	CN	NS	NS	NS	NS	NS	NS	NS		

Figure B.4. Binomial Method for Determining Screening Level Concerns

Use this look-up table for the following use-attainment assessment methods:

Aquatic Life Use: Toxic Substances in Sediment

General Use: Nutrient Screening Levels; Chlorophyll-a Screening Levels

Fish Consumption Use: Bioaccumlative Toxics in Tissue

No Concern (NC) | Screening Levels Concern (CS) | Note that fewer samples than illustrated are not assessed (NA)

Number of Samples	Number of Exceedances (Uses Table A-6)																															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31-100	
4	NC	NC	CS	CS	CS																												Limited Data (LD)
5	NC	NC	NC	CS	CS	CS																											
6	NC	NC	NC	CS	CS	CS	CS																										
7	NC	NC	NC	CS	CS	CS	CS	CS																									
8	NC	NC	NC	NC	CS	CS	CS	CS	CS																								
9	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS																							
10	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS																						Adequate Data (AD)
11	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS																					
12	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS																				
13	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS																			
14	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS																		
15	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS																	
16	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS																
17	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS															
18	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS														
19	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS													
20	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS												
21	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS											
22	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS										
23	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS									
24	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS								
25	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS							
26	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS						
27	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS					
28	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS				
29	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS			
30	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
31	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
32	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
33	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
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37	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
38	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
39	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
40	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
41	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
42	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
43	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
44	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
45	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
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47	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
48	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
49	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
50	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
51	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
52	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		

Figure B.4. Binomial Method for Determining Screening Level Concerns, cont.

Use this look-up table for the following use-attainment assessment methods:

Aquatic Life Use: Toxic Substances in Sediment

General Use: Nutrient Screening Levels; Chlorophyll-a Screening Levels

Fish Consumption Use: Bioaccumlative Toxics in Tissue

No Concern (NC) | Screening Levels Concern (CS) | Note that fewer samples than illustrated are not assessed (NA)

Number of Samples	Number of Exceedances (Uses Table A-6)																																
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31-100	
53	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		Adequate Data (AD)
54	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
55	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
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57	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
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59	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
60	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
61	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
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63	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
64	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
65	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
66	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
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73	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
74	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
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77	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
78	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
79	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
80	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
81	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
82	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
83	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
84	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
85	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
86	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS	CS		
87	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS		
88	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS		
89	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS		
90	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS		
91	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS	CS		
92	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS		
93	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS		
94	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS		
95	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS		
96	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS	CS		
97	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS		
98	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS		
99	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS		
100	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	CS	CS	CS	CS	CS	CS	CS		

Figure B.5. Binomial Method for Listing and Delisting Toxic Parameter Use-Attainment and Concerns

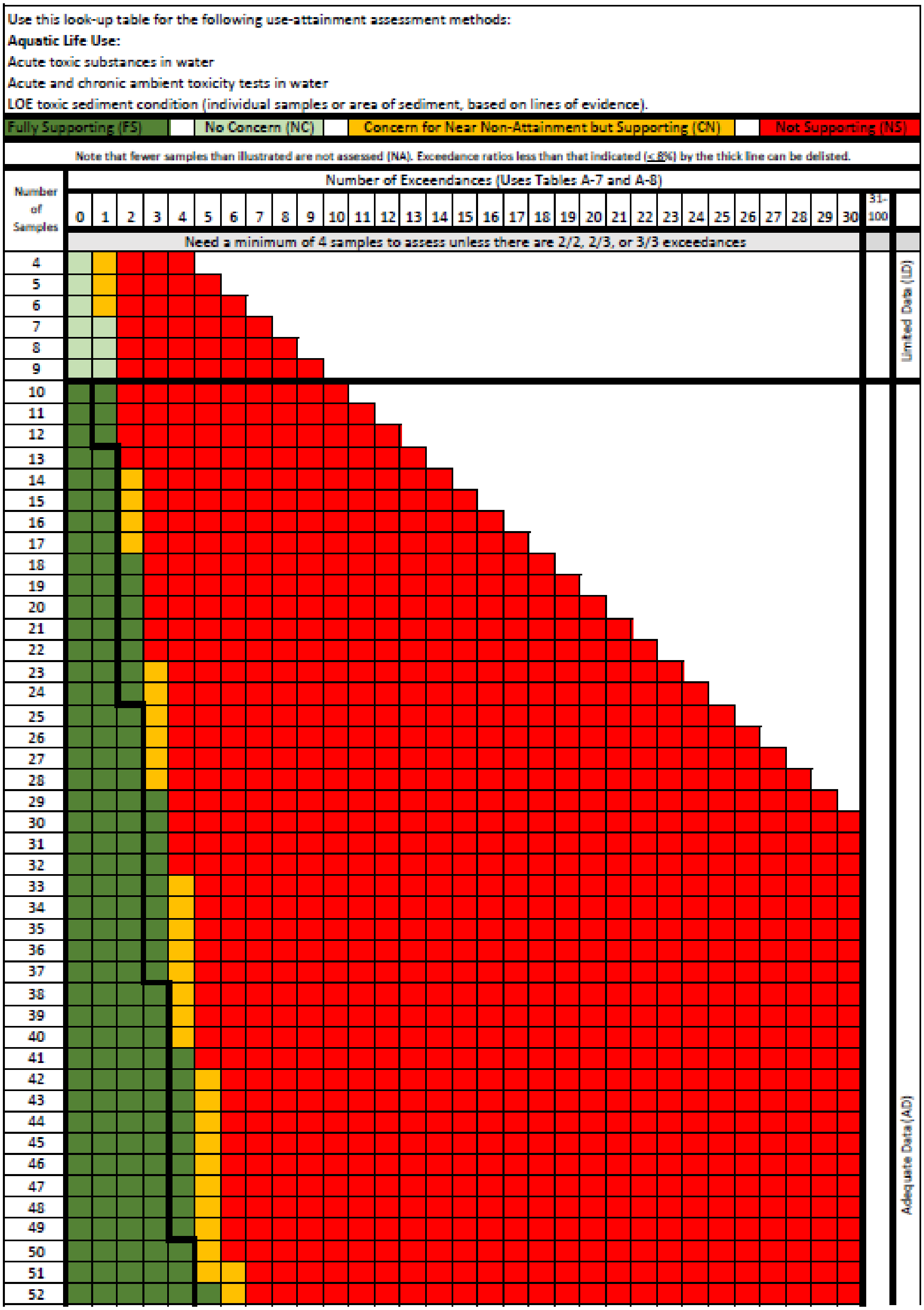
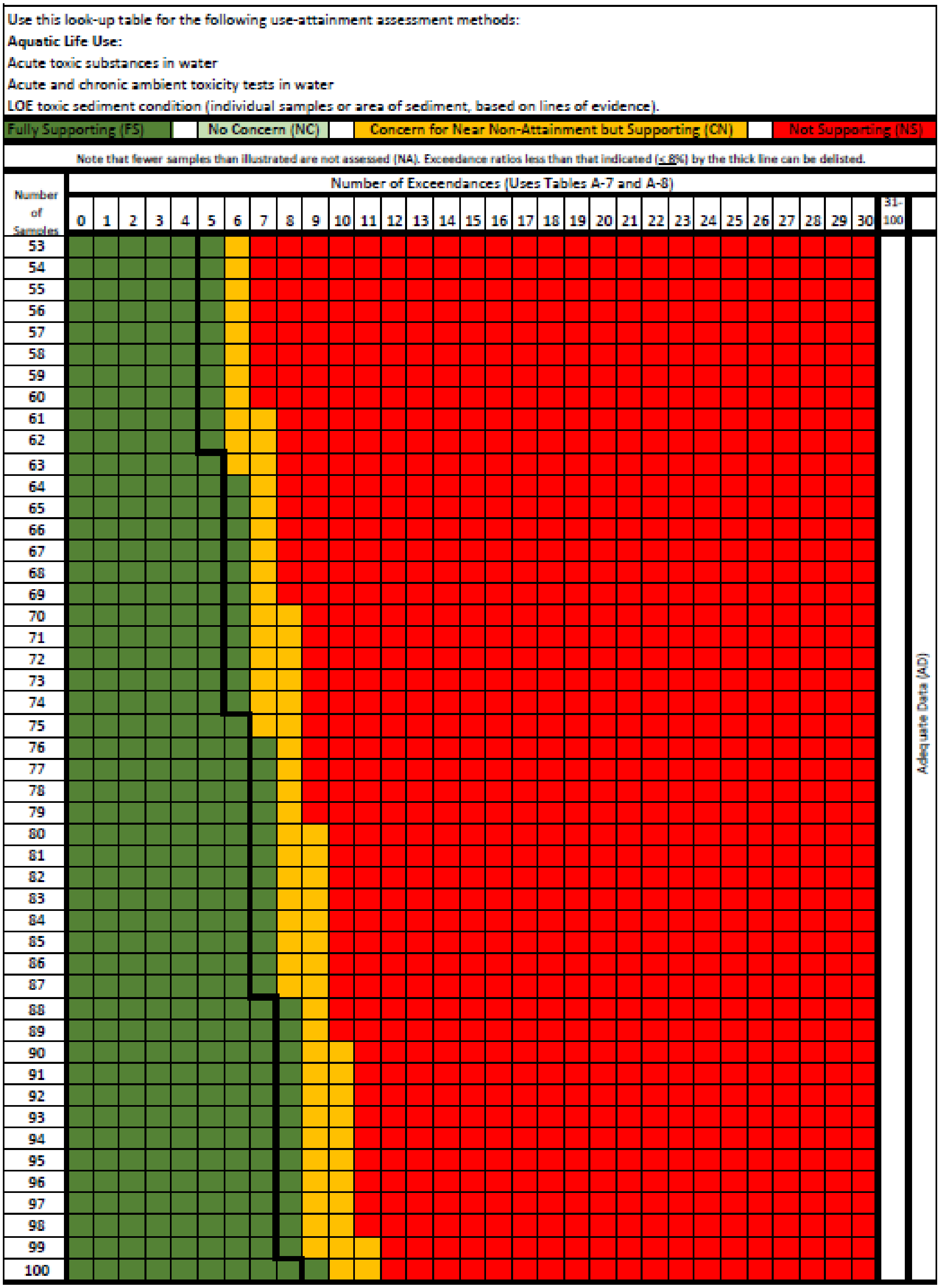


Figure B.5. Binomial Method for Listing and Delisting Toxic Parameter Use-Attainment and Concerns, cont.



Appendix C
Evaluating Sediment Toxicity

Ambient sediment toxicity assessment is formulated upon multiple lines of evidence to reach a decision on risk characterization leading to risk management. The LOE process described in this guidance document is appropriate for defining use support and listing or delisting on the 303(d) List. Planning water quality restoration and decisions about implementation will require additional sampling and information gathering.

The framework by which ambient sediments are to be assessed is considered a weight of evidence approach. This is commonly defined as a determination related to possible ecological impacts based upon multiple lines of evidence. This determination incorporates judgments concerning the quality, extent, and congruence of the data contained in the different lines of evidence.

Whole Sediment Toxicity Tests

Sediment Toxicity. Sediment toxicity tests provide direct information on the effects of sediment toxins upon a representative benthic community at that site. In these tests, sediment collected from ambient sites is populated with benthic organisms (typically midges and/or amphipods) in a laboratory setting.

The sediment may exhibit toxicity from chemicals present, physical textural conditions, invasive predatory organisms, ammonia, chlorides, high sediment oxygen demand, pathogens, etc. It is the objective of the test assessment in the laboratory to eliminate superfluous information such as unexpected predation from transient organisms in the sediment or adverse test environmental conditions.

The laboratory sediment tests typically use whole sediment and are placed into test containers and covered with laboratory water. Whenever possible, comparison to a reference sediment is used to evaluate toxicity. Reference sediments that are collected at an uncontaminated site in the same or similar water body have similar textural, organic, and inorganic characteristics.

For purposes of assessment in the SWQM program, the test duration is usually not longer than 10 days and measures survival and growth. Longer tests can be conducted that include measurements of survival, growth (length/weight) and reproduction whereby the resulting evidence will be considered. However, longer tests do not necessarily add more information to the assessment since at the ten-day exposure most chemicals have reached equilibrium in biological tissue and have had effects on survival of these short-lived organisms if concentrations and subsequent dosing are at toxic thresholds. Sediment tests should be supplemented with all available data on site conditions and water/sediment quality to enable judgment in interpretation of the results. Sediment characteristics such as texture, organic carbon, pH, and acid volatile sulfide (AVS) are important in understanding the absence or presence of sediment toxicity. AVS may bind some metals making them biologically unavailable and could account for the absence of toxicity expected at some contaminated sites.

Whole sediment toxicity tests provide a strong line of evidence for assessing ambient toxicity for the following reasons:

Test organisms used are endemic to benthic habitats

- Test conditions attempt to reproduce the ambient conditions

Approved Methods. The following methods are approved for whole sediment toxicity tests:

Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates (EPA/600/R-99/064)

- Standard Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates (ASTM, 2005, E1706-05)

Considerations. The following considerations should be taken into account when assessing sediment toxicity data:

Adverse conditions during the test (e.g., presence of predatory organisms, high ammonia levels).

- Procedures employed, including modifications to standard protocols. Modifications to existing methods must be well documented within the published method and well described. Applications for alternate testing procedures will be made to the executive director.
- Temporal and spatial distribution of the samples which are representative of the assessment area.
- Porewater samples—Do porewater samples indicate elevated levels of contaminants?
- Potentially confounding effects of other constituents--AVS, TOC, grain size.
- Although tests may be performed, confounding effects may necessitate that the assessor rely on other supporting data, information and BPJ.

Evidence of Toxicity. The evidence of toxicity will depend exclusively on the toxicological endpoint of the tests employed. To determine the presence of toxicity, ambient samples will be compared whenever possible to a reference sediment. In the absence of suitable reference sediment, a "clean" laboratory sediment is used. The magnitude of the difference in either mortality (lethality) between the ambient samples and clean samples (control) will determine toxicity. Statistical tests used in the assessment of lethal toxicological endpoints for the typical 7- or 10-day test will employ an alpha level of 0.05.

The statistical tests used in the determination of toxicity will vary based upon the distribution of the data. The survival proportions will be transformed using arcsine transformation (arcsine(√p)), where p = proportion surviving in replicates. The data will then be examined for homogeneity of variance and departure from normality using Bartlett's and Shapiro-Wilks tests, respectively. If the Bartletts and Shapiro tests indicate the transformed data are normally distributed, then the data will be analyzed using a one-way ANOVA. If the ANOVA is significant at the specified alpha level, then Dunnett's Multiple Comparison Test will be used to identify specific significant differences between ambient and control sediments. Non-normal data sets and\or data sets with nonhomogeneous variances will be analyzed using Steel's Many-one Rank Test to determine significant toxicity.

Elutriate Toxicity Tests

In these tests, sediments are vigorously mixed with laboratory test water for a specified period of time, thereby transferring contaminants associated with the sediments to the water. The laboratory test water is then siphoned off and water column test organisms (typically minnows and/or water fleas) are introduced to the test water (the elutriate) in the absence of sediments, thus exposing the aquatic organisms to any contaminants present. These tests are useful for representing the exposure to chemicals that can occur after sediments have been resuspended into the water column or after they have passed through the water column as part of dredged material disposal operations. In terms of assessing ambient sediment toxicity, elutriate tests have been the subject of considerable debate as to their utility and will be used as evidence of potential toxicity which must be supported by other lines of evidence. In effect, they can identify a concern if assessed without other evidence of toxicity.

Results of these tests should be considered a weaker line of evidence when evaluating ambient sediment toxicity, indicating the potential for in situ sediment toxicity. The following aspects should be considered when using elutriate tests to evaluate ambient toxicity:

- These tests were developed to evaluate the effects of dredge disposal on aquatic organisms. Sediment used in this method is prepared in a way which is not representative of ambient conditions (samples are often shaken for 24 hours). However, these tests may represent conditions experienced under high flow events where substantial amounts of sediment resuspension may occur.
- These tests are conducted on water column organisms which may be affected differently than the benthic organisms.
- Elutriate tests have shown correlation with whole sediment tests and serve well as a screening tool to indicate a need for additional lines of evidence.

Draft results from a comparative study of elutriate and whole sediment toxicity tests, conducted by EPA ORD and Region 6, demonstrated that acute elutriate tests are more likely to produce false negatives than false positives as compared to whole sediment tests. This suggests that the elutriate tests are less sensitive than whole sediment tests and, as such, would be indicative of toxic conditions at more acutely toxic sites. It would be reasonable to conclude that elutriate testing may provide meaningful results in the terms of identifying sites that need immediate attention. Elutriate tests have a place in the routine assessment of sites suspected of toxicity and the prioritization of acutely toxic sites for further testing or management action.

Approved Methods. The following methods were adapted by the EPA Region 6 Ambient Toxicity Monitoring Program.

Sediment elutriates are prepared by combining a subsample from the homogenized sediment sample with appropriate culture water. The sediment and water are combined in a sediment-to-water ratio of 1:4 by volumetric displacement. After combining, the mixture is tumbled end-over-end for approximately 24 hours, after which the mixture is allowed to settle for an additional 24 hours at 3-4 °C. After settling, the elutriate is siphoned off and filtered through a 1.5-micron glass fiber filter. Standard laboratory tests and statistical data analyses are conducted according to:

- Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms (U.S. EPA 2002)[7].
- Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms (U.S. EPA 2002). [8]
- Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (U.S. EPA 2002).[9]

Considerations. The following considerations should be taken into account when assessing sediment elutriate data:

- Test organisms used in the tests.
- Procedures employed, including modifications to standard protocols. Modifications to existing methods must be well documented within the published method and well described. Applications for alternate testing procedures will be made to the executive director.
- Temporal and spatial distributions of the samples which are representative of the assessment area.
- Potentially confounding effects of other constituents—AVS, TOC, grain size.
- Sublethal toxicity should not be assessed.
- Some contaminants are released under elutriate test conditions but may not be bioavailable under ambient conditions.

[7] www.epa.gov/sites/production/files/2015-08/documents/short-term-chronic-freshwater-wet-manual_2002.pdf

[8] www.epa.gov/sites/production/files/2015-08/documents/short-term-chronic-marine-and-estuarine-wet-manual_2002.pdf

[9] www.epa.gov/sites/production/files/2015-08/documents/acute-freshwater-and-marine-wet-manual_2002.pdf

Evidence of Toxicity. The evidence of toxicity will depend exclusively on the toxicological endpoint of the tests employed. To determine the presence of toxicity, ambient samples will be compared to "clean" laboratory sediment samples. The magnitude of the difference in mortality (lethality) between the ambient samples and clean samples (control) will determine toxicity. Statistical tests used in the assessment of lethal toxicological endpoints for the typical 7- or 10-day test will employ an alpha level of 0.05.

The statistical tests used in the determination of toxicity will vary based upon the distribution of the data. The survival proportions will be transformed using arcsine transformation (arcsine($\sqrt{p}$)), where p = proportion surviving in replicates. The data will then be examined for homogeneity of variance and departure from normality using Bartlett's and Shapiro-Wilks tests, respectively. If the Bartlett's and Shapiro-Wilks tests indicate the transformed data are normally distributed, then the data will be analyzed using a one-way ANOVA. If the ANOVA is significant at the specified alpha level, then Dunnett's Multiple Comparison Test will be used to identify specific significant differences between ambient and control sediments. Non-normal data sets and\or data sets with nonhomogeneous variances will be analyzed using Steel's Many-one Rank Test to determine significant toxicity.

Biological Communities

Benthic Community. In the presence of well-defined indices of biotic integrity, direct measurement of the health of the biological community can be made at the site of interest. This important line of evidence can be a direct measure of toxic effects in the population to be protected. Prevailing conditions, however, such as ambient water temperature and salinity can affect the community more than chemical stressors. The reservoir and estuarine environments are more challenging to biological communities than freshwater streams or offshore environments.

The benthic community analysis is indicative of ambient conditions and should be compared to reference conditions that have been firmly established. Indices that are indicative of the condition of environmental health are preferred such as those used for wadeable Texas streams. For many ecosystems, a defensible index with adequate reference conditions and site comparisons that can be used to determine biological condition is lacking. When such metrics are available and agreed upon, benthic analysis deserves considerable weight of evidence in any site assessment. Comparison to a site-specific reference location or water body can also be employed. Other factors for evaluating biological data can be based on the relationship between levels of contamination and fundamental measures of community structure such as species richness, abundance, and occurrence of tolerant and intolerant species.

Considerations. The following considerations should be taken into account when assessing biological community data:

- Communities assessed—nekton or benthos.

- Biological integrity assessment methods—Are there accepted indices by which to assess biological communities? Although TCEQ does not have established methods for assessment of estuarine and reservoir benthic biological integrity, scientifically valid methods to evaluate the health of biological communities should be considered, for example those using least-impacted reference conditions. Where the Agency determines methods proposed for a sediment toxicity evaluation project are acceptable, the methods may be used for evaluating the health of biological communities as a Line of Evidence.

- TCEQ's IBI, used to evaluate aquatic life use support in wadeable streams, may not be sensitive enough to demonstrate toxicity to all sensitive species or life stages.

Sediment Contaminants

The level of contaminants in the sediment can be used to imply a cause for observed ambient toxicity. A toxicity identification evaluation (TIE) may be necessary to identify a specific pollutant for load reduction (regulatory activity). These tests, however, are expensive and may not be successful for some groups of pollutants.

Sediment Chemistry. Sediment chemistry may be indicative of toxic sediments if the chemicals present are responsible for toxicity. Ideally, elevated levels of chemicals should coincide spatially and temporally with observed toxicity. The chemical analyses should be structured to identify toxicants such as ammonia, which may be naturally occurring or the result of test conditions, and substrate texture that is physically harmful to test organisms. Chemistry can be compared to screening benchmarks for indications of relative sediment quality. Other approaches may consider equilibrium partitioning and presence of AVS (for metals) to account for expected toxicity or lack thereof.

Considerations. The following considerations should be taken into account when assessing sediment contaminant concentrations:

- Screening levels used—including PECs, PELs, ERMs, effects range limits.

  Current screening levels (second-effects levels for sediment) were developed for TCEQ's Ecological Risk Assessment Program and can be found in the most recent revision of the *TCEQ Ecological Screening Benchmarks* tables on the Ecological Risk Assessment[10] webpage. Sediment screening levels are outlined in Table 3.5 in the assessment guidance.

- Temporal and spatial distribution of the samples.

- Potentially confounding effects of other constituents--AVS, TOC, and grain size.

[10] www.tceq.texas.gov/remediation/eco

Best Professional Judgment

BPJ comprises the use of expert opinion and judgment based on available data and site-specific conditions to determine, for example, environmental status or risk. For the assessment of ambient toxicity in sediment, BPJ will support other lines of evidence to provide final determinations of use support. In many cases, BPJ will provide insight to site-specific conditions, biological assessment methodologies, toxicological test conditions and contaminant analyses.

Because the LOE approach relies on judgment of the assessor, the data set qualifier is reported as JQ (see Table 2.4 in the assessment guidance).

Applicability of Ambient Sediment Toxicity to Reservoirs and Intermittent Streams

In order for ambient sediment toxicity to be relevant, the aquatic community must be exposed and affected. Areas that are evaluated for toxicity should have overlying water and conditions which create the potential for an established benthic community.

Weight of Evidence for Determining Use Attainment

Evidence considered for determining ecological risk of areas assessed for ambient sediment toxicity will include whole sediment toxicity test results, elutriate toxicity test results, biological community data, and contaminant concentrations and related parameters such as AVS and TOC. The decisions will be supported by the interpretation of the data which will include the use of BPJ, as discussed below and illustrated in Tables C.1 to C.4.

Each line of evidence used in the ecological risk assessment leading to decisions on impairment of the water body has strengths and limitations in data collection and interpretation. These factors for each parameter must be considered and weighted accordingly in the assessment for sediment in an area where data for lines of evidence are available.

As with any assessment determination for a water body or assessment area, the support status is ultimately made with professional judgment of the assessor.

Table C.1. Relative Weights of Lines of Evidence for Sediment Toxicity

Whole Sediment Tests (Indicate Toxicity)	Elutriate Tests (Indicate Toxicity)	Biological Community (Indicates Effects of Toxicity)		Level of Contaminants (Indicates Potential for Toxicity)	BPJ
		Established IBI or method	Observations but no accepted methods		
50	10	25	10	10	10, 0, or -10

If both whole sediment and elutriate tests are available, use only the whole sediment tests results

If BPJ indicates toxicity, then value = 10

If BPJ indicates a lack of toxicity, then value = -10

If BPJ does not indicate either toxic or not toxic condition, then BPJ value = 0

Toxic if > 50

Concern if >15 – 50

No Concern or Unassessed if ≤ 15

No concern requires two of the following:

- Whole sediment or elutriate tests
- Sediment contaminants
- Biological community data

Otherwise, not assessed.

Table C.2. Line of Evidence – Example 1

Identifies a Concern for Ambient Toxicity in Sediment

Line of Evidence	Result	Points
Whole Sediment Tests indicate toxicity	No	0
Elutriate Tests indicate toxicity	No data	0
Biological community indicates effects of toxicity (established IBI)	Yes	25
Level of Contaminants Indicates Potential for Toxicity	Yes	10
BPJ (no toxicity in whole sediment tests)		-10
	Total	**25**

Table C.3. Line of Evidence – Example 2

Identifies a Concern for Ambient Toxicity in Sediment

Line of Evidence	Result	Points
Whole Sediment Tests indicate toxicity	No data	0
Elutriate Tests indicate toxicity	Yes	10
Biological community indicates effects of toxicity (established IBI)	Yes	10
Level of Contaminants Indicates Potential for Toxicity	Yes	10
BPJ (no toxicity in whole sediment tests)		10
	Total	**40**

Table C.4. Line of Evidence – Example 3

Identifies Aquatic Life Use Impairment for Ambient Toxicity in Sediment

Line of Evidence	**Result**	**Points**
Whole Sediment Tests indicate toxicity	Yes	50
Elutriate Tests indicate toxicity	No data	0
Biological community indicates effects of toxicity (established IBI)	No	0
Level of Contaminants Indicates Potential for Toxicity	Yes	10
BPJ (no toxicity in whole sediment tests)		10
	Total	**70**

Appendix D
Determining Aquatic Life Use Attainment

Introduction

The biological integrity of aquatic systems is determined by evaluation of the status of a variety of assemblages within a habitat (including fishes, benthic macroinvertebrates, algae, fungi, etc.). Each of these assemblages tends to require a unique set of ecological conditions, at the micro- and macroscale. Changes in the characteristics of the biotic assemblages may be reflected in the IBI results indicating improving or deteriorating conditions. Thus, it is important to monitor more than one assemblage, since human-induced changes, natural variation in instream ecological conditions, and biotic interactions can result in differences in IBI results.

TCEQ currently uses fish and benthic macroinvertebrate assemblages as the primary biotic indicators of water quality. Both assemblages, along with physical habitat data, are used to establish or revise the ALU Category for water bodies, and both assemblages are used to assess support of designated aquatic life use for the 305(b) assessment. Historically, when establishing the appropriate ALU for a previously unclassified water body, fish have been the primary indicator, with benthic macroinvertebrate and physical habitat evaluations used as complementary information.

Biological Assessments: Water Bodies with Benthic Macroinvertebrate and Fish Assemblages in Different ALU Categories

When assessing a water body for which the ALU Category was established without bioassessments, the highest ALU category indicated by either the fish or benthic macroinvertebrates will be compared to the designated or presumed use, to determine support (Chapter 3, Table 3.6). In this scenario, if results from ALM for both assemblages indicate support of the designated or presumed use, the water body will be considered fully supporting. If results from ALM for either assemblage indicate nonsupport of the designated or presumed use, the water body will be identified as fully supporting, but with a concern, and an effort will be undertaken to properly define the ALU category for both assemblages for future assessments. If results from ALM indicate that neither assemblage supports the designated, or presumed use, the aquatic life use will be considered impaired.

When the ALU category was established based on a UAA including biological data, and the methods used in the UAA are current, the assessment should be consistent with the findings of the UAA for each assemblage. For example, if a high ALU category was established based primarily on fish, and the benthic macroinvertebrate IBI results were in the intermediate ALU category, then the fish will be assessed against the criterion for high ALU, and the benthics will be assessed against the criterion for intermediate ALU. This will reduce the likelihood of missing a source of impairment that more significantly affects one assemblage.

Assessing Attainment of Aquatic Life Use Category

To assess attainment of the designated or presumed ALU category for an AU, the mean IBI score of a minimum of two samples collected from each of one or more representative sites within the AU will be used in conjunction with the assemblage/ecoregion/method specific CV (Tables D.1-D.3). The appropriate CV is assigned based on the ALU indicated by the sample mean and not the presumed/designated ALU for that AU. If there is no CV listed in the table for the applicable sample ALU category and ecoregion, use the CV from the next available ALU category in the table. If the applicable sample ALU category and ecoregion is blank and falls between two different ALU categories, use an average of the CVs from the higher and lower ALU category. For example, if the average regional fish IBI score from Ecoregions 25-26 falls in the high ALU category, the applicable CV will be an average of the exceptional (9.58%) and intermediate (8.43%) CVs. Statewide benthic CVs must be used for samples collected in ecoregions where regionalized benthic IBIs are not available. All samples from all stations within the AU will be used to calculate the mean IBI score for that AU. If it is determined that a site is not representative of aquatic habitat in an AU, then results for bioassessments conducted at that site will not be included in the assessment of that AU.

Table D.1. Fish regionalized ecoregion/Aquatic Life Use category CV

Aquatic Life Use	Ecoregion 24	Ecoregion 25, 26	Ecoregion 27, 29, 32	Ecoregion 30	Ecoregion 31	Ecoregion 33, 35	Ecoregion 34
Exceptional	6.63% (23)	9.58% (8)	7.21% (40)	2.96% (471)	4.32% (11)	6.94% (310)	7.16% (10)
High	5.96% (96)	-	5.94% (238)	3.94% (561)	2.88% (11)	4.77% (1589)	3.65% (30)
Intermediate	7.02% (22)	8.43% (15)	6.93% (237)	6.35% (142)	6.02% (6)	6.49% (604)	4.26% (10)
Limited	8.42% (91)	14.29% (1)	11.89% (145)	-	-	9.27% (272)	5.15% (4)

Samples are collected according to sampling protocols described in Chapter 3 of TCEQ's SWQM Procedures, Volume 2 and evaluated using the Regionalized IBI as described in the same document. Each CV represents the average of all ecoregion/aquatic life use category pairwise comparisons used to derive the CV's. The number of pairwise comparisons used to calculate the average is given in parentheses.

Table D.2. Benthic Macroinvertebrates statewide ecoregion/Aquatic Life Use category CV

Aquatic Life Use	Ecoregion 27, 29, 32	Ecoregion 30	Ecoregion 31	Ecoregion 33, 35	Ecoregion 34
Exceptional	--	6.47% (6)	--	4.45% (6)	--
High	5.22% (24)	5.95% (40)	6.90% (1)	6.28% (56)	5.09% (9)
Intermediate	6.06% (23)	6.43% (13)	8.76% (2)	8.98% (76)	6.31% (7)
Limited	9.78% (5)	--	--	7.42% (12)	--

Samples are collected according to sampling protocols described in Chapter 5 of TCEQ's SWQM Procedures, Volume 2 and evaluated using the statewide benthic macroinvertebrate IBI as described in the same document. Each CV represents the average of all ecoregion/Aquatic Life Use Category pairwise comparisons used to derive the CV's. The number of pairwise comparisons used to calculate the average is given in parentheses.

Table D.3. Benthic Macroinvertebrates regionalized ecoregion/Aquatic Life Use Category CV

Aquatic Life Use	Ecoregion 27, 29, 32	Ecoregion 30	Ecoregion 33, 35	Ecoregion 34
Exceptional	4.01% (36)	8.16% (21)	4.28% (160)	4.18% (46)
High	6.05% (10)	7.64% (73)	3.45% (367)	2.04% (154)
Intermediate	5.99% (10)	5.82% (240)	6.56% (101)	4.78% (20)
Limited	-	9.50% (138)	10.96% (18)	-

Samples are collected according to sampling protocols described in Chapter 5 of TCEQ's SWQM Procedures, Volume 2 and evaluated using the regionalized benthic macroinvertebrate IBI as described in the same document. Each CV represents the average of all ecoregion/Aquatic Life Use Category pairwise comparisons used to derive the CVs. The number of pairwise comparisons used to calculate the average is given in parentheses.

To establish the interval about the mean, the appropriate CV will be multiplied by the mean IBI score. The resultant product will be added to the mean to delineate the upper limit of the interval. The highest ALU category included in the interval described about the mean using the CV will be used to determine attainment. The water body will be determined to be attaining the designated or presumed use if the CV interval includes the designated or presumed use, or if the interval is entirely contained in a higher ALU category. See example scenarios below in table/figure pairs Table D.4/Figure D.1, Table D.5/Figure D.2, and Table D.6/Figure D.3. The water body will be determined as not attaining the existing use if the CV interval is entirely in a lower ALU category or categories (Table D.7/Figure D.4).

Physical habitat data is also considered when evaluating aquatic life use attainment. Concerns may be identified based on habitat parameters measured during biological surveys. Parameters and methods used to measure physical habitat characteristics are found in the SWQM Procedures Volume 2. As with fish and benthic macroinvertebrate data, data must be collected from two separate events to be evaluated as part of the IR.

Table D.4. Application of CV on biological samples Example 1 – Juniper Creek

Scenario: Two samples for fish and macroinvertebrates are collected from Juniper Creek with a designated high ALU in ecoregion 30 (Texas Plateau Ecoregion). The resultant IBI for both samples fall within high ALU interval.

Sample Date	Statewide Benthic IBI Score	Regional Fish IBI Score
5/15/2006	34	46
8/15/2006	32	44
Mean	33 (H)	45 (H)
Sample CV	4.28%	3.14%
ER/ALU Category specific CV	5.95%	3.94%
ER/ALU CV * Mean IBI Score	1.9635	1.773
CV adjusted mean	34.9635 (H)	46.773 (H)

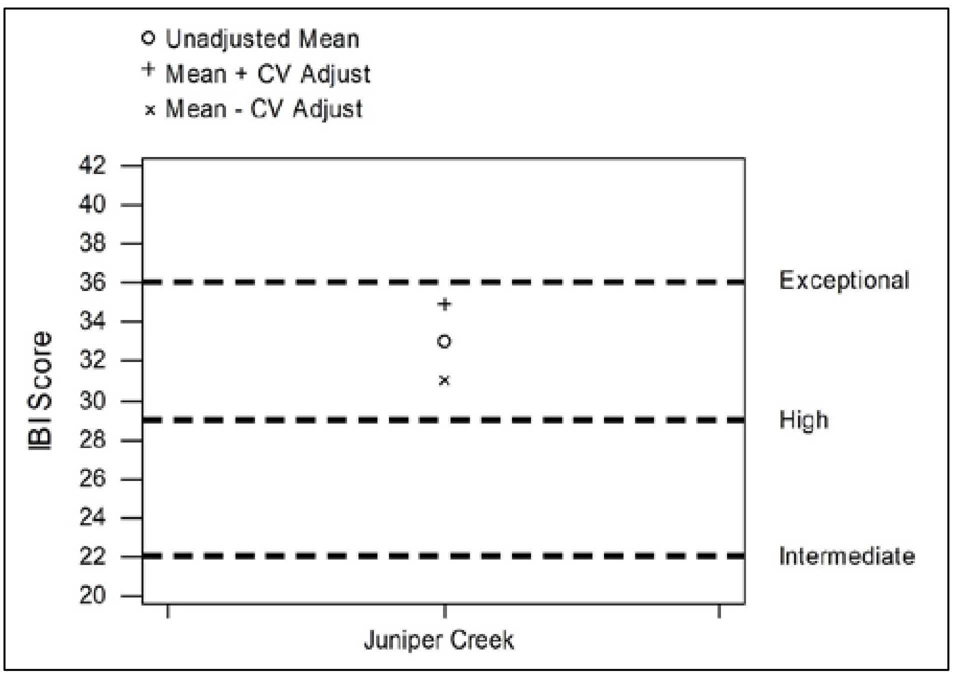


Figure D.1. Graph of data from Example 1 – Juniper Creek

The unadjusted Mean IBI Score is in the high ALU interval. The unadjusted Mean + CV adjustment falls in high ALU interval. This indicates a high ALU is appropriate for benthic macroinvertebrates in Juniper Creek and the designated high ALU is supported.

Table D.5. Application of CV on biological samples Example 2 – Agarita Creek

Scenario: Two samples for fish and macroinvertebrates are collected from Agarita Creek with a designated high ALU in ecoregion 30 (Texas Plateau Ecoregion). The resultant IBI for both samples fall within the high ALU interval, and the unadjusted mean falls in intermediate ALU interval.

Sample Date	Statewide Benthic IBI Score	Regional Fish IBI Score
5/15/2006	29	42
8/15/2006	26	40
Mean	27.5 (I)	41 (I)
Sample CV	7.71%	3.45%
ER/ALU Category specific CV	6.43%	6.35%
ER/ALU CV * Mean IBI Score	1.76825	2.6035
CV adjusted mean	29.26825 (H)	43.6035 (H)

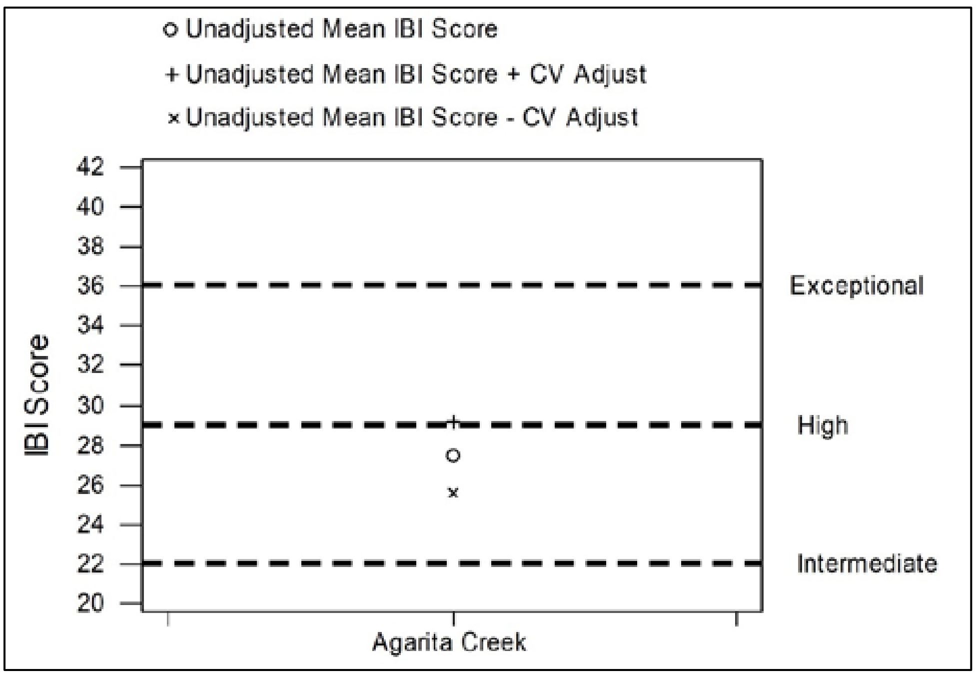


Figure D.2. Graph of data from Example 2 – Agarita Creek

The unadjusted Mean IBI Score is in the intermediate ALU interval. The unadjusted Mean + CV adjustment falls in high ALU interval. This indicates a high ALU is appropriate for benthic macroinvertebrates in Agarita Creek, and the designated high ALU supported.

Table D.6. Application of CV on biological samples Example 3 – Yucca Creek

Scenario: Two samples collected for fish and macroinvertebrates from Yucca Creek with a designated high ALU in ecoregion 30 (Texas Plateau Ecoregion). The resultant IBI for both samples fall in the high ALU interval, and the unadjusted mean falls in high ALU. The sample CV is greater than 2x ecoregion/ALU specific CV.

Sample Date	Statewide Benthic IBI Score	Regional Fish IBI Score
5/15/2006	36	51
8/15/2006	24	35
Mean	30 (H)	43 (H)
Sample CV	28.28%	26.31%
ER/ALU Category specific CV	5.95%	3.94%
ER/ALU CV * Mean IBI Score	1.785	1.6942
CV adjusted mean	31.785 (H)	44.6942 (H)

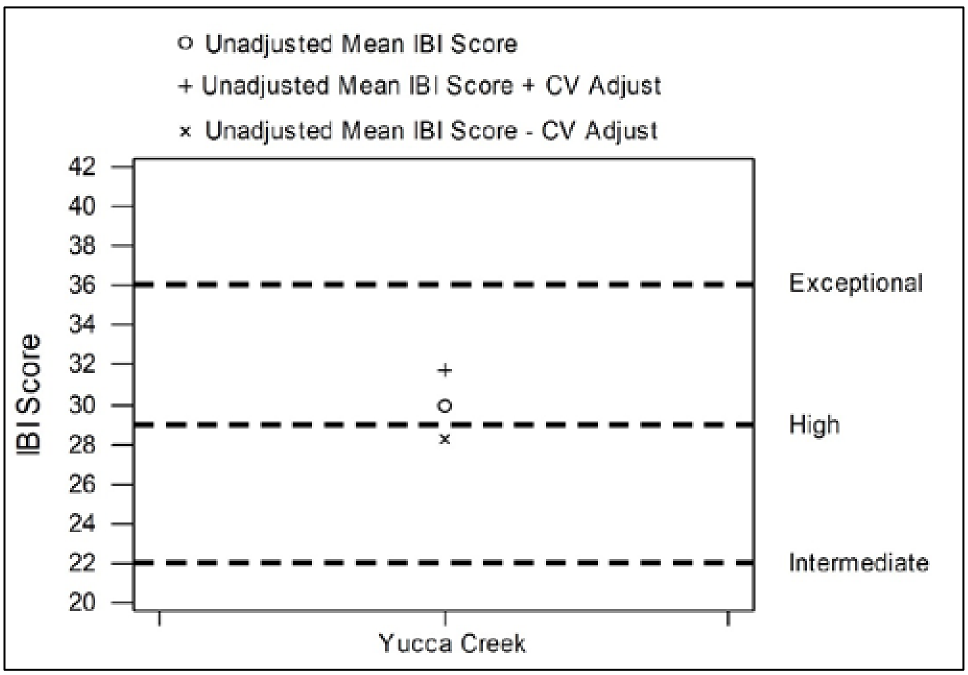


Figure D.3. Graph of data from Example 3 – Yucca Creek

The unadjusted Mean IBI Score is in the high ALU interval. The unadjusted Mean + CV adjustment falls in the high ALU interval. This indicates a high ALU is appropriate for benthic macroinvertebrates in Yucca Creek, and the designated high ALU is supported.

Table D.7. Application of CV on biological samples Example 4 – Yaupon Creek

Scenario: Two samples collected for fish and macroinvertebrates from Yaupon Creek with a designated high ALU in ecoregion 30 (Texas Plateau Ecoregion). The resultant IBI for both samples fall in the intermediate ALU interval, and the unadjusted mean falls in intermediate ALU interval.

Sample Date	Statewide Benthic IBI Score	Regional Fish IBI Score
5/15/2006	23	32
8/15/2006	22	30
Mean	22.5 (I)	31 (I)
Sample CV	3.14%	4.56%
ER/ALU Category specific CV	6.43%	6.35%
ER/ALU CV * Mean IBI Score	1.44675	1.9685
CV adjusted mean	23.94675 (I)	32.9685 (I)

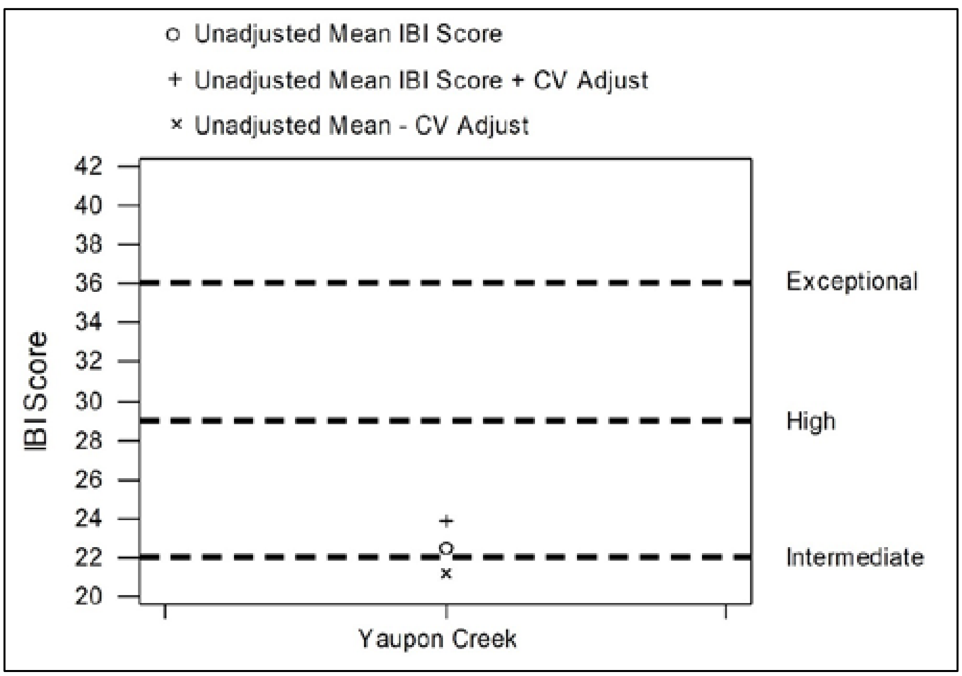


Figure D.4. Graph of data from Example 4 – Yaupon Creek

The unadjusted Mean IBI Score is in the intermediate ALU interval. The unadjusted Mean + CV adjustment falls in the intermediate ALU interval. This indicates an intermediate ALU is appropriate for benthic macroinvertebrates in Yaupon Creek, and the designated high ALU is not supported.

Appendix E
Use of the National Drought Mitigation Center Drought Index in the Texas Integrated Report for Clean Water Act Sections 305(b) and 303(d)

In accordance with Section 307.9(b) of the TSWQS, sample results identified to be collected under extreme hydrologic conditions will be excluded from attainment determinations. Past efforts to identify such conditions in streams were based on the effects of persistent drought on water quality and relied primarily on the availability of instream flow measurement data and local precipitation records. These previous efforts were revised to include the drought severity classification system, particularly the Drought Severity Index (DSI), developed by the NDMC. The goal is to identify when use impairments are the result of changes in water quality due to persistent and extreme drought conditions. Within the context of use attainment determinations, the DSI is considered primarily as an indicator of surrounding drought conditions. When used in conjunction with other information, the DSI can be used to evaluate the potential impacts of drought on water quality as part of the IR. TCEQ will continue to engage stakeholders to further refine the approach to incorporate drought information as part of use attainment determinations.

Evaluation of Drought Impacts in Reservoirs

Drought evaluations for the 2022 IR will focus exclusively on new impairments in reservoirs. Evaluations will rely both on the DSI system as well as historical reservoir capacity (percent full) reported by the Texas Water Development Board (TWDB). Due to site-specific conditions and regional watershed management, each reservoir will be evaluated individually, especially information about historical reservoir capacity.

In the current method, the weekly drought index score (from the United States Drought Monitor map) for each monitoring station during a given period of suspected drought will be reviewed to evaluate the potential for drought effects. Data from weekly United States Drought Monitor maps and water quality monitoring stations are associated to develop an Excel spreadsheet with all the water quality monitoring stations and the weekly drought scores during the period of interest. This process consists of adding all the Drought Monitor data for the period of interest to a map document, along with the SWQM monitoring stations, and then adding the drought score for the region to the table of SWQM monitoring stations.

The current method follows these general steps to use the DSI in the IR:

- Review Excel spreadsheets with monitoring stations and weekly DSI values for the waterbody during the period of interest.

- Weekly drought maps will be overlain on TCEQ GIS layers for newly impaired waterbodies. Since multiple DSI categories may overlap a waterbody, the weekly DSI value for each is weighted and all are averaged to determine a monthly weighted DSI value for the waterbody.

  Below is the scale for weighted DSI scores (DSI+1), adapted from the NDMC Classification Scheme, which includes the addition of a score for No Drought, for statistical purposes:

  - D0: No Drought
  - D1: Abnormally Dry
  - D2: Moderate Drought
  - D3: Severe Drought
  - D4: Extreme Drought
  - D5: Exceptional Drought

This information will be used together with historical reservoir capacity data to evaluate extreme drought as a possible cause of unrepresentative conditions within the reservoir. The onset of the extreme hydrologic conditions caused by persistent drought will be identified as the period when the weighted DSI reached the “Exceptional Drought” (DSI = 5) category, and the reservoir percent full indicated a significant decline towards a historic low. According to the U.S. Drought Monitor, such events have a < 2% chance of occurring in any given year out of 100 years (Svoboda et al., 2002). The end of the extreme hydrologic condition caused by drought will be demarked by a period in which the reservoir percent full began to recover and increase towards or above the historic average and the DSI fell below the “Moderate Drought” category (DSI = 2). In some cases, due to the inherent variability in the data it will be necessary to implement some degree of judgment when establishing these boundaries. Additionally, information concerning conditions on specific reservoirs may need to be addressed on a case-by-case basis as it is supplied by local or regional data providers. This may include information related to reservoir hydrology, flow, knowledge of the local watershed, and other available resources.

All data for the impaired parameter, including data used for screening and thresholds in the nutrient assessment (Appendix F of the Guidance), during extreme hydrologic conditions is removed and the dataset is reassessed. Removal of this data may result in a data set with a lower number of samples that required for the IR as specified in the Guidance. In these cases, it may be necessary to go into the 10-year period of record in order to have an adequate number of samples to conduct an assessment. If the parameter is found to be meeting the use or not assessed, it will be placed in Category 3. If the impairment remains after removing the data, then it will be placed in Subcategory 5c.

References

Svoboda, M., D. Lecomte, M. Hayes, R. Heim, K. Gleason, J. Angel, B. Rippey, R. Tinker, M. Palecki, D. Stooksbury, D. Miskus, and S. Stephens, 2002. The Drought Monitor. Bull. Amer. Meteor. Soc., 83, 1181–1190, DOI: https://doi.org/10.1175/1520-0477-83.8.1181.

Appendix F
Assessing Chlorophyll *a* in Reservoirs

Goal

In 2013, the EPA approved 39 of 75 Chl *a* criteria for reservoirs adopted by TCEQ in the 2010 revisions to the Texas Surface Water Quality Standards (TSWQS). The EPA requested TCEQ "incorporate its plans and timeline for revising the disapproved Chl *a* criteria" for the remaining 36 reservoirs (Table F.1). The following procedures were developed to achieve this goal and establish a consistent framework to evaluate reservoirs with or without EPA-approved Chl *a* criteria. Reservoirs which did not have Chl *a* criteria adopted as part of the 2010 TSWQS may be evaluated using the framework developed for reservoirs without approved Chl *a* criteria.

To accomplish this, TCEQ established a protocol to assess numeric nutrient criteria for Chl *a* and developed an alternative protocol to identify concerns for nutrients as part of the Texas IR of Surface Water Quality. Potential impacts to existing, designated, presumed or attainable uses from excessive nutrients are evaluated in accordance with the narrative and numeric criteria for nutrients in the TSWQS. These criteria are protective of multiple uses such as contact recreation, aquatic life, and public water supplies.

Line of Evidence Framework

While assessing Chl *a* concentrations provides a more meaningful status of the health of a waterbody than simply examining TN and TP the evaluation of Chl *a* concentration alone does not allow for a holistic analysis of nutrient enrichment in a reservoir. To better assess whether a reservoir is meeting existing, designated, presumed or attainable uses in relation to nutrients, more parameters must be considered. A line of evidence approach using a mix of numeric criteria and numeric translators of narrative criteria allows for the evaluation of impacts from excessive algae caused by nutrients on protected uses. In accordance with Section 307.7(b)(4)(E) of the TSWQS, numeric and narrative nutrient criteria are intended to protect multiple uses such as recreation, aquatic life and PWS.

TCEQ staff developed a line of evidence approach for nutrient assessment in lakes and reservoirs which involves the use of numeric translators of narrative criteria as "thresholds," in addition to numeric Chl *a* criteria approved by EPA (Table F.2). Multiple lines of evidence corroborate adverse nutrient conditions to prioritize management efforts in reservoirs identified as impaired, with Chl *a* serving as the primary indicator. This methodology provides a more robust assessment of reservoir conditions and increases certainty that excessive algae caused by nutrients are impacting factors like water clarity, increased algae biomass and DO attainment.

Causative parameters evaluated as potential stressors include TN and TP. Indicators of biological response include Secchi depth, DO, and the primary response variable Chl *a*. In addition to water quality data, TCEQ will consider information provided by stakeholders that documents localized effects of excessive algae caused by nutrients. This information will be considered on a case-by-case basis, using best professional judgment.

Table F.1. Reservoirs Included as Part of Nutrient Assessments

Segment ID	Segments with Numeric Criteria (EPA Approved Chl *a* Criteria) Segment Name	Segment ID	Other Segments, Including Those with Numeric Chl *a* Criteria Disapproved by EPA Segment Name
0208	Lake Crook	0199A	Palo Duro Reservoir
0209	Pat Mayse Lake	0212	Lake Arrowhead
0213	Lake Kickapoo	0229A	Lake Tanglewood
0217	Lake Kemp	0302	Wright Patman Lake
0223	Greenbelt Lake	0507	Lake Tawakoni
0405	Lake Cypress Springs	0509	Murvaul Lake
0510	Lake Cherokee	0512	Lake Fork Reservoir
0603	B.A. Steinhagen Lake	0605	Lake Palestine
0610	Sam Rayburn Reservoir	0803	Lake Livingston
0613	Lake Tyler	0807	Lake Worth
0613	Lake Tyler East	0809	Eagle Mountain Reservoir
0614	Lake Jacksonville	0815	Bardwell Reservoir
0811	Bridgeport Reservoir	0818	Cedar Creek Reservoir
0813	Houston County Lake	0823	Lewisville Lake
0816	Lake Waxahachie	0826	Grapevine Lake
0817	Navarro Mills Lake	0827	White Rock Lake
1207	Possum Kingdom Lake	0830	Benbrook Lake
1216	Stillhouse Hollow Lake	0836	Richland-Chambers Reservoir
1220	Belton Lake	1012	Lake Conroe
1228	Lake Pat Cleburne	1203	Whitney Lake
1231	Lake Graham	1205	Lake Granbury
1233	Hubbard Creek Reservoir	1208A	Millers Creek Reservoir
1234	Lake Cisco	1212	Somerville Lake
1235	Lake Stamford	1222	Proctor Lake
1240	White River Lake	1225	Waco Lake
1249	Lake Georgetown	1237	Lake Sweetwater
1403	Lake Austin	1247	Granger Lake

Segment ID	Segments with Numeric Criteria (EPA Approved Chl *a* Criteria) Segment Name	Segment ID	Other Segments, Including Those with Numeric Chl *a* Criteria Disapproved by EPA Segment Name
1404	Lake Travis	1252	Lake Limestone
1405	Marble Falls Lake	1254	Aquilla Reservoir
1406	Lake Lyndon B. Johnson	1412A	Lake Colorado City
1408	Lake Buchanan	1416B	Brady Creek Reservoir
1419	Lake Coleman	1423	Twin Buttes Reservoir
1422	Lake Nasworthy	1425	O.C. Fisher Lake
1426A	Oak Creek Reservoir	2103	Lake Corpus Christi
1429	Lady Bird Lake	2312	Red Bluff Reservoir
1433	O.H. Ivie Reservoir	2454A	Cox Lake
1805	Canyon Lake		
1904	Medina Lake		
2116	Choke Canyon Reservoir		

Assessment Protocol

Results of water quality data are compared to numeric thresholds and criteria in stepwise flow charts. Multiple lines of evidence are evaluated in the flow charts to identify (1) attainment of numeric criteria for Chl *a* in reservoirs with Chl *a* criteria approved by EPA; and (2) assessment of other reservoirs for identification of concerns. Separate flow charts were established and are depicted in Figures F.1. and F.2. respectively. Exceedances of thresholds for biological response variables and nutrient stressors are assessed to identify nutrient enrichment. This assessment protocol uses medians of Chl *a*, Secchi depth, TN, and TP data collected from monitoring sites indicated in Appendix F of the TSWQS for those reservoirs with approved Chl *a* criteria (or comparable station); or from sites closest to the dam or main body for reservoirs without approved criteria. Comparable stations in the main pool of the reservoir may be evaluated in accordance with Section 307.9(e)(7) of the TSWQS. Sources of information evaluated to determine comparability may include stations used as part of previous water quality evaluations (such as the Trophic Classification of Texas Reservoirs), geospatial information, and input from data providers. When multiple stations for a single reservoir are evaluated, data will be pooled (combined) to provide a single median for purposes of comparing to the criteria or threshold to determine attainment

In reservoirs without Chl *a* criteria approved by EPA, 10-year trends of the Chl *a* Trophic Status Index (TSI) will also be used, when available. If a 10-year trend for a reservoir is not available, the median of Chl *a* should be evaluated using an upper threshold of > 40 ug/L, to determine if the reservoir is approaching hypereutrophic status and as an indication of potential nuisance conditions. Concerns or impairments for DO are considered from any portion (assessment unit) reported for the reservoir. The assessment will only be conducted for lakes or reservoirs where the full suite of parameters was monitored and reported. If a full suite of parameters is not available, the outcome will be “Not Assessed.”

Compare water quality results to the associated threshold or criteria in Table F.3. and Table F.4. to determine which variables indicate potential nutrient enrichment. Indicators of nutrient concentrations (TP and TN) are considered causal variables. Chl *a*, Secchi depth, and DO are considered response variables. Possible attainment outcomes are listed below:

- Attainment of Numeric Criteria for Chl *a* (Figure F.1.)
  - Not Assessed (NA), limited data
  - Fully Supporting (FS)
  - Not Supporting (NS)
- Other Reservoirs Assessed for the Concerns List (Figure F.2.)
  - Not Assessed (NA), limited data
  - No Concern (NC)
  - Concern-screening level (CS)

In order to accurately characterize reservoir condition, the line of evidence approach uses thresholds based on site specific and statewide data. For the 2022 IR, the line of evidence approach will only be applied to reservoirs included in Table F.1. and nutrient impairments identified accordingly.

Previous nutrient assessment methods in reservoirs used statewide screening values representing the 85th percentile of individual nutrient constituents (Chl *a*, ammonia, nitrite + nitrate, OP and TP). Water quality concerns were identified for those areas where elevated levels of nutrients were based on exceedances of individual samples with the screening levels. These screening levels will only continue to be evaluated in reservoirs without numeric criteria and thresholds for narrative criteria, to provide a broad screening of available data. A final assessment outcome will not be determined for these reservoirs. See Chapter 3, Assessment of Beneficial Uses for additional information regarding screening levels for nutrient parameters.

Table F.2. Threshold (T) and Criteria (C) Value Determination

Parameter	Standard Source	Notes
	Reservoirs with Chl *a* criteria APPROVED by EPA	
Secchi Depth (T)	Rule Project no. 2007-002-307-PR (2010 proposed revisions to the TSWQS)	Calculated from historical sampling data, set at the upper parametric prediction interval, 90% confidence level (site-specific).
DO (C)	TSWQS, Appendices A and D	Site-specific or presumed.
TN (T)	Database Analysis to Support Nutrient Criteria Development, University of Arkansas 2013 Report	Concentration of TN at which statistically significant changes in magnitude and variability of Secchi depth occur (statewide).
TP (T)	Rule Project no. 2007-002-307-PR (2010 proposed revisions to the TSWQS)	Calculated from historical sampling data, set at the upper parametric prediction interval, 90% confidence level (site-specific).
Chl *a* (C)	TSWQS, Appendix F	Calculated from historical sampling data, set at the upper parametric prediction interval, 99% confidence level, (site-Specific).
	Reservoirs with Chl *a* criteria DISAPPROVED by EPA or numeric criteria not adopted	
Secchi Depth (T)	Rule Project No. 2007-002-307-PR (2010 proposed revisions to the TSWQS)	Calculated from historical sampling data, set at the upper parametric prediction interval, 90% confidence level (site-specific).
DO (C)	TSWQS, Appendices A and D	Site-specific or presumed.
TN (T)	Database Analysis to Support Nutrient Criteria Development, University of Arkansas 2013 Report	Concentration of TN at which statistically significant changes in magnitude and variability of Secchi depth occur.
TP (T)	Rule Project No. 2007-002-307-PR (2010 proposed revisions to the TSWQS)	Calculated from historical sampling data, set at the upper parametric prediction interval, 90% confidence level (site-specific).
Chl *a* (T)	Rule Project No. 2007-002-307-PR (2010 proposed revisions to the TSWQS). If >30 ug/L, 30 ug/L is used.	Calculated from historical sampling data, set at the upper parametric prediction interval, 95% confidence level.
Chl *a* Trend	Trophic Classification of Texas Reservoirs, 10-year trend of Chl *a* Trophic Status Index (TSI) points.	Change in calculated Chl *a* TSI over a 10-year period, as reported in the Trophic Classification of Texas Reservoirs during each IR Cycle.

Table F.3. Criteria and Threshold Values for Reservoirs with Numeric Criteria (EPA Chl *a* - Approved Chl *a* Criteria).

Numerical thresholds for TN and TP as indicated in Table F.3 are to be used for assessment purposes only and are not to be used as water-quality based effluent limits in wastewater discharge permits for wastewater permitting.

Segment	Segment Name	Station	Chl *a* (ug/L) Criteria (>)	TN (mg/L) Threshold (>)	TP (mg/L) Threshold (>)	Secchi (m) Threshold (<)
0208	Lake Crook	10137	7.38	0.8	0.2	0.19
0209	Pat Mayse Lake	10138 16343	12.4	0.8	0.04	1.12
0213	Lake Kickapoo	10143	6.13	0.8	0.09	0.28
0217	Lake Kemp	10159	8.83	0.8	0.03	1.08
0223	Greenbelt Lake	10173	5	0.8	0.03	1.73
0405	Lake Cypress Springs	10312	17.54	0.8	0.03	1.19
0510	Lake Cherokee	10445 15514	8.25	0.8	0.02	1.21
0603	B.A. Steinhagen Lake	10582	11.67	0.8	0.08	0.37
0610	Sam Rayburn Reservoir	14906	6.22	0.8	0.03	1.82
0613	Lake Tyler	10637	13.38	0.8	0.03	1.06
0613	Lake Tyler East	10638	10.88	0.8	0.03	1.06
0614	Lake Jacksonville	10639	5.6	0.8	0.03	1.34
0811	Bridgeport Reservoir	10970	5.32	0.8	0.06	1.01
0813	Houston County Lake	10973	11.1	0.8	0.03	1.27
0816	Lake Waxahachie	10980	19.77	0.8	0.03	0.63
0817	Navarro Mills Lake	10981	15.07	0.8	0.08	0.37
1207	Possum Kingdom Lake	11865	10.74	0.8	0.05	2.22
1216	Stillhouse Hollow Lake	11894	5	0.8	0.03	2.84
1220	Belton Lake	11921	6.38	0.8	0.03	1.81
1228	Lake Pat Cleburne	11974	19.04	0.8	0.08	0.45
1231	Lake Graham	11979	6.07	0.8	0.05	0.61
1233	Hubbard Creek Reservoir	12002	5.61	0.8	0.04	1.16
1234	Lake Cisco	12005	5	0.8	0.02	1.33
1235	Lake Stamford	12006	16.85	0.8	0.07	0.42
1240	White River Lake	12027	13.85	0.8	0.06	0.42
1249	Lake Georgetown	12111	5	0.8	0.04	1.86

Segment	Segment Name	Station	Chl *a* (ug/L) Criteria (>)	TN (mg/L) Threshold (>)	TP (mg/L) Threshold (>)	Secchi (m) Threshold (<)
1403	Lake Austin	12294	5	0.8	0.03	1.82
1404	Lake Travis	12302	5	0.8	0.03	3.13
1405	Marble Falls Lake	12319	10.48	0.8	0.03	1.24
1406	Lake Lyndon B. Johnson	12324	10.29	0.8	0.03	1.23
1408	Lake Buchanan	12344	9.82	0.8	0.03	1.64
1419	Lake Coleman	12398	6.07	0.8	0.02	1.08
1422	Lake Nasworthy	12418	16.91	0.8	0.05	0.46
1426A	Oak Creek Reservoir	12180	6.93	0.8	0.03	0.59
1429	Lady Bird Lake	12476	7.56	0.8	0.04	1.69
1433	O.H. Ivie Reservoir	12511	5.77	0.8	0.03	1.74
1805	Canyon Lake	12597	5	0.8	0.03	2.17
1904	Medina Lake	12826 12825	5	0.8	0.01	2.49
2116	Choke Canyon Reservoir	13019 13020	12.05	0.8	0.05	0.99

Table F.4. Threshold Values for Reservoirs with Chl *a* Criteria Disapproved by EPA or Numeric Criteria not Adopted.

Numerical thresholds for TN and TP as indicated in Table 4 are to be used for assessment purposes only, and are not to be used as water-quality based effluent limits in wastewater discharge permits for wastewater permitting.

Segment	Segment Name	Station	Chl *a* (ug/L) Threshold (>)	TN (mg/L) Threshold (>)	TP (mg/L) Threshold (>)	Secchi (m) Threshold (<)
0199A	Palo Duro Reservoir	10005	19.02	0.8	0.24	0.3
0212	Lake Arrowhead	10142	9.93	0.8	0.16	0.55
0229A	Lake Tanglewood	10192	30	0.8	1.23	0.57
0302	Wright Patman Lake	10213 14907	18.74	0.8	0.11	0.52
0507	Lake Tawakoni	10434	30	0.8	0.05	0.89
0509	Murvaul Lake	10444	30	0.8	0.07	0.55
0512	Lake Fork Reservoir	10458	13.1	0.8	0.04	1.46
0605	Lake Palestine	16159	24.29	0.8	0.03	0.82
0803	Lake Livingston	10899	20.64	0.8	0.16	0.67
0807	Lake Worth	10942	30	0.8	0.09	0.65
0809	Eagle Mountain Reservoir	10944 10945	22.94	0.8	0.07	0.8
0815	Bardwell Reservoir	10979	20.44	0.8	0.05	0.56
0818	Cedar Creek Reservoir	10982 16748 16749	27.81	0.8	0.07	0.8
0823	Lewisville Lake	11027 17830	16.39	0.8	0.06	0.6
0826	Grapevine Lake	11035 16113 17827	10.48	0.8	0.1	0.84
0827	White Rock Lake	11038	29.73	0.8	0.1	0.4
0830	Benbrook Lake	15151 11046	24.42	0.8	0.07	0.75
0836	Richland-Chambers Reservoir	15168	13.88	0.8	0.04	1.13
1012	Lake Conroe	11342	21.72	0.8	0.05	0.82
1203	Whitney Lake	11851	16.18	0.8	0.03	1.32
1205	Lake Granbury	11860	20.15	0.8	0.07	0.99

Segment	Segment Name	Station	Chl *a* (ug/L) Threshold (>)	TN (mg/L) Threshold (>)	TP (mg/L) Threshold (>)	Secchi (m) Threshold (<)
1208A	Millers Creek Reservoir	11679	14.02	0.8	0.08	0.24
1212	Somerville Lake	11881	30	0.8	0.09	0.63
1222	Proctor Lake	11935	25.22	0.8	0.1	0.52
1225	Waco Lake	11942	21.07	0.8	0.09	0.76
1237	Lake Sweetwater	12021	11.81	0.8	0.74	0.74
1247	Granger Lake	12095	10.43	0.8	0.06	0.41
1252	Lake Limestone	12123	17.4	0.8	0.08	0.7
1254	Aquilla Reservoir	12127	12.48	0.8	0.04	0.58
1412A	Lake Colorado City	12167	13.94	0.8	0.05	0.67
1416B	Brady Creek Reservoir	12179	21.97	0.8	0.03	0.59
1423	Twin Buttes Reservoir	12422	12.7	0.8	0.09	0.55
1425	O.C. Fisher Lake	12429	30	0.8	0.14	0.28
2103	Lake Corpus Christi	12967	15.01	0.8	0.18	0.41
2312	Red Bluff Reservoir	13267	21.96	0.8	0.04	0.78
2454A	Cox Lake	12514	11.9	0.8	0.29	0.12

Additional notes for Chl *a*:

- Numerical thresholds for TN and TP as indicated in Tables F.3 and F.4 are to be used for assessment purposes only and are not to be used as water-quality based effluent limits in wastewater discharge permits for wastewater permitting. Information regarding the establishment of effluent limits for nutrients in wastewater permitting is located in the IPs.

- The thresholds used in place of criteria disapproved by EPA are more stringent than criteria adopted by TCEQ in the 2010 TSWQS. Statistical calculations of prediction intervals for Chl *a* thresholds were based on a 0.05 (95th) confidence level; prediction intervals for Chl *a* criteria approved by EPA were based on a 0.01 (99th) confidence level. For more information, see Notes provided in Table F.2.

- For reservoirs with criteria disapproved by EPA: If a reservoir whose TCEQ-adopted Chl *a* criterion was greater than 30ug/L, then the criterion was capped at 30 ug/L. This decision was based on published literature of Chl *a* trends, and EPA's Technical Support Document EPA Review of Reservoir-specific Chl *a* Criteria for 75 Texas Reservoirs. Current literature suggests that Chl *a* concentrations greater than 30 ug/L can result in nuisance algal blooms, toxic cyanobacteria and toxin production, taste and odor compound production and generation of disinfection byproducts in finished drinking water. Therefore, no reservoirs have thresholds above 30ug/L.

- In reservoirs without numeric nutrient criteria, the 10-year change in Chl *a* TSI as reported in this Integrated Reporting Cycle's Trophic Classification of Texas Reservoirs will be evaluated for increasing Chl *a* trends and identify reservoirs experiencing a high rate of enrichment. The Chl *a* TSI may increase gradually due to natural conditions, particularly from reservoir aging. However, a change of 10 Chl *a* TSI points within a 10-year period may indicate cultural eutrophication, and rapid transition toward undesirable trophic conditions.

Table F.5. Data Sources for Parameters Used in Reservoir Nutrient Assessments

Reservoirs with Chl *a* criteria APPROVED and DISAPPROVED by EPA

Parameter	Data Source	Notes
Secchi depth	SWQMIS - Median	Station in Appendix F of the TSWQS, or comparable station
DO	IR	Level of Support (LOS) from assessed grab and diurnal DO methods in all assessment units of reservoir
TN	SWQMIS - Median	Calculated by parameter availability: 00625 + 00630, 00625 + 00593; or 00625 + 00615+00620. Reported at station in Appendix F of the TSWQS, or comparable station.
TP	SWQMIS - Median	Reported at station in Appendix F of the TSWQS, or comparable station.
Chl *a*	SWQMIS - Median	Reported at station in Appendix F of the TSWQS, or comparable station.

Table F.6. Parameter Codes Used for Reservoir Nutrient Assessments

Parameter Code	Parameter	Parameter Code	Parameter
00078	Secchi Depth	00630	Nitrate + Nitrite
00300	DO	00625	TKN
00593	Total Nitrate + Nitrite	00665	TP
00615	Nitrite	32211	Chl *a* spec
00620	Nitrate	70953	Chl *a* fluoro

Notes about the data:

- When values are reported below the analytical reporting level, ½ of the reported value is substituted in the analysis.

- o SWQM typically substitutes ½ the reported value during assessments, and the criteria were developed with ½ the reported value substituted.

- Standards for the attainment of DO and Chl *a* criteria are applicable to the mixed surface layer. Additional procedures regarding depth of water quality measurements are described in the *Guidance for Assessing and Reporting Surface Water Quality in Texas.*

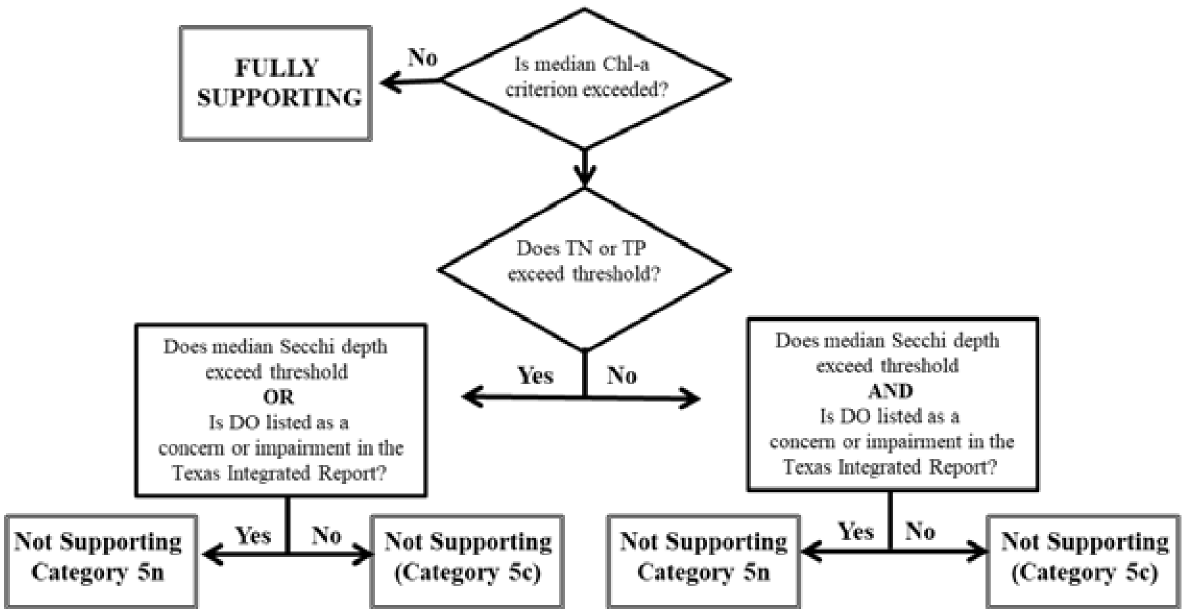


Figure F.1. Flow chart for assessing reservoirs with EPA approved Chl *a* criteria

Not Assessed: < 10 samples for any variable

Support: ≥10 samples for all variables (adequate data)

Subcategory 5C: Additional data and information will be collected or evaluated before a management strategy is selected.

Subcategory 5n: The applicable Chl *a* criterion is not attained, and additional information from causal nutrient parameters or impacts to response variables corroborates the exceedance of Chl *a*. However, additional nutrient-specific data and information are needed before a management strategy, such as a TMDL or watershed protection plan, is initiated.

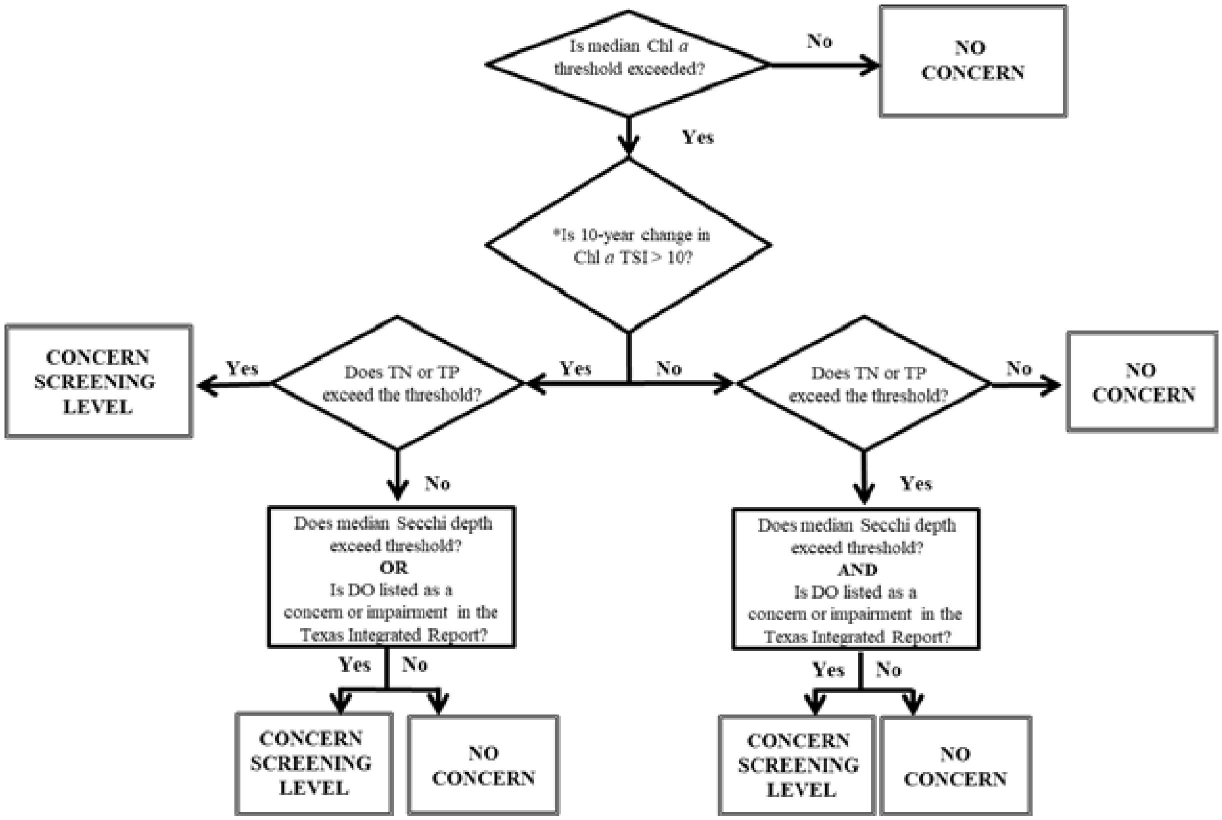


Figure F.2. Flow chart for assessing all other reservoirs for Concerns

*If a 10-year trend for a reservoir is not available, the median of Chl *a* should be evaluated using an upper threshold of > 40 ug/L, to determine if the reservoir is approaching hypereutrophic status and as an indication of potential nuisance conditions.

Not Assessed: < 10 samples for any variable

Adequate Data: ≥ 10 samples for all variables

Narrative criteria Section 307.4(f): Nutrients from permitted discharges or other controllable sources must not cause excessive growth of aquatic vegetation that impairs an existing, designated, presumed, or attainable use.