


DWR-WP-P-01-CALM-11142023

Tennessee's Consolidated Assessment and Listing Methodology (CALM)


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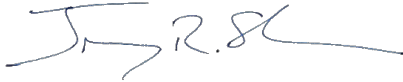
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Revision Number	Date	Brief Summary of Change
0	November 14, 2023	TDEC has been required by EPA to develop and periodically update a written CALM document for several years. This is the initial issuance of the CALM as a Policy Document.

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Revised November 2023

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I. Introduction to Water Quality Monitoring in Tennessee

The water quality program in Tennessee was established by the Water Quality Control Act of 1977 ("Act"), landmark state legislation that predates the federal Clean Water Act. The Act identifies the duties and authority of both the commissioner of the Department of Environment and Conservation (TDEC or "Department") and the Board of Water Quality, Oil, and Gas ("Board"). Additionally, the Act defines many of the important terms and concepts in water pollution control.

Important responsibilities of the TDEC commissioner under the Act include: investigating water quality statewide and developing water quality assessment reports, maintaining a permitting system for discharges and withdrawals, and having a process to ensure compliance with permit conditions. The duties of the Board include hearing appeals of permits and enforcement actions, and adopting rules, including Tennessee's water quality standards (designated uses, criteria, and the Antidegradation Statement).

The Division of Water Resources ("Division") within TDEC is composed of central office units and eight field offices in Memphis, Jackson, Nashville, Columbia, Cookeville, Chattanooga, Knoxville, and Johnson City. Water quality sampling is primarily done in the field offices. Water quality standards development and data management are performed in the central office. Water quality assessment is a shared responsibility between central and field offices.

So that water quality monitoring and assessment activities are accomplished consistently across the state, this Consolidated Assessment and Listing Methodology (CALM) policy document has been developed to help train new employees, maintain consistency within the agency, and provide transparency to the public. Many of these procedures are included in multiple SOP and QAPP documents, the annual monitoring workplan, and public reports such as the *List of Impaired and Threatened Waters in Tennessee* ("303(d) List") and *Tennessee's Clean Water Act Monitoring and Assessment Report* ("305(b) Report"). The CALM document consolidates some of these concepts into a single reference.

a. Important Concepts and Definitions

The Department has formally differentiated between documents that are either guidance or policy in nature. In general, guidance documents are designed to be used by the public or the regulated community to help them understand how to interact with the Department. An

example would be instructions on how to submit data required by permit conditions. Guidance documents are reviewed internally and also have an informal public review period.

Policy documents are designed to train, instruct and/or direct Departmental staff how to conduct and document activities related to statutory and other responsibilities. Examples of policy documents include internal SOPs. Policy documents are reviewed internally by staff, may be put out for public review and comment, and often reviewed by the Environmental Protection Agency (EPA).

The CALM is a policy document designed to be used by monitoring and assessment staff. While the document has an important place in providing public transparency regarding how water quality assessments are done, the writing is technical in nature as the target audience are staff.

Tennessee's definitions of important water quality assessment concepts, and acronyms used in this document are provided below. Those definitions that are direct quotes from either state laws or regulations are presented in italics, and a citation is provided.

"Pollutant" means sewage, industrial wastes, or other wastes; T.C.A. § 69-3-103(27)

"Pollution" means such alteration of the physical, chemical, biological, bacteriological, or radiological properties of the waters of this state, including, but not limited to, changes in temperature, taste, color, turbidity, or odor of the waters that will:

(A) Result or will likely result in harm, potential harm or detriment to the public health, safety, or welfare;

(B) Result or will likely result in harm, potential harm or detriment to the health of animals, birds, fish, or aquatic life;

(C) Render or will likely render the waters substantially less useful for domestic, municipal, industrial, agricultural, recreational, or other reasonable uses; or

(D) Leave or likely leave the waters in such condition as to violate any standards of water quality established by the board; T.C.A. § 69-3-103(28)

"Waters" means any and all water, public or private, on or beneath the surface of the ground, that are contained within, flow through, or border upon Tennessee or any portion thereof, except those bodies of water confined to and retained within the limits of private property in single ownership that do not combine or effect a junction with natural surface or underground waters; and T.C.A. § 69-3-103(44)

"Wet weather conveyance" means, notwithstanding any other law or rule to the contrary, man-

made or natural watercourses, including natural watercourses that have been modified by channelization:

(A) *That flow only in direct response to precipitation runoff in their immediate locality;*

(B) *Whose channels are at all times above the groundwater table;*

(C) *That are not suitable for drinking water supplies; and*

(D) *In which hydrological and biological analyses indicate that, under normal weather conditions, due to naturally occurring ephemeral or low flow there is not sufficient water to support fish, or multiple populations of obligate lotic aquatic organisms whose life cycle includes an aquatic phase of at least two (2) months.*

T.C.A. § 69-3-103(45)

Stream - A surface water that is not a wet weather conveyance. Rule 0400-40-03-.04(31)

Parameter – A biological, chemical, radiological, bacteriological, or physical property of water that can be directly measured. Some criteria are expressed in terms of a single parameter; others, such as habitat, nutrients, and biological integrity are not directly measured, but are derived from measurements of parameters. Rule 0400-40-03-.04(16)

Reference condition - A parameter-specific set of data from regional reference sites that establish the statistical range of values for that particular substance at least-impacted streams. Rule 0400-40-03-.04(19)

Reference Site - Least impacted waters within an ecoregion that have been monitored to establish a baseline to which alterations of other waters can be compared. Rule 0400-40-03-.04(20)

Response Variable – a characteristic of water quality that can be measured and changes as a result of an alteration of habitat, water withdrawal, or discharge of pollutants, as distinguished from agents that cause changes in aquatic systems. Rule 0400-40-03-.04(21)

Wadeable streams - Streams that can be sampled using a handheld, one meter square or smaller kick net without water and materials escaping over the top of the net. Rule 0400-40-03-.04(26)

Condition of Impairment – Excursions from water quality criteria of a magnitude, frequency, and/or duration such that a specific use classification is no longer supported by existing water quality. With the exception of pathogens, those excursions caused by natural conditions (not

anthropogenic in nature) will not be considered impairment. Examples of natural conditions include alterations caused by beaver dams, non-construction related rockslides of pyritic materials, groundwater with naturally elevated metals, and phosphate-bearing rock formations.
(Rule 0400-40-03-.05(7) in part)

List of Acronyms :

7Q10 – Lowest streamflow for 7 consecutive days that occurs on average once every 10 years
30Q5 -- Lowest streamflow for 30 consecutive days that occurs on average once every 5 years
ARAP – Aquatic Resource Alteration Permit
ATTAINS – Assessment, TMDL Tracking and Implementation System
BIP – Balanced Indigenous Population
BMP – Best Management Practice
CALM – Consolidated Assessment and Listing Methodology
CERCLA -- Comprehensive Environmental Response, Compensation, and Liability Act
DOR – Division of Remediation
DWR – Division of Water Resources
EPA – Environmental Protection Agency
EPT – Ephemeroptera, Plecoptera, and Trichoptera
ETW – Exceptional Tennessee Water
GIS – Geographic Information System
MS4 – Municipal Separate Storm Sewer Systems
NCBI – North Carolina Biotic Index
NELAC – National Environmental Laboratories Accreditation Conference
NHD – National Hydrography Dataset
NPDES – National Pollutant Discharge Elimination System
ONRW – Outstanding National Resource Waters
ORNL – Oak Ridge National Laboratory
%NuTol – Percent Nutrient Tolerant organisms
QAPP – Quality Assurance Project Plan
QSSOP – Quality System Standard Operating Procedure
SOP – Standard Operating Procedure
SQSH – Semi-Quantitative, Single-Habitat
TDEC – Tennessee Department of Environment and Conservation
TMI – Tennessee Macroinvertebrate Index
TVA – Tennessee Valley Authority
TWRA – Tennessee Wildlife Resources Agency
WPU – Watershed Planning Unit
WQI -- Water Quality Index

b. TDEC Watershed Approach

In the early 1970s, the USGS delineated 55 major hydrologic watershed boundaries (HUC8) within Tennessee. A watershed is the entire land area that drains into a particular watercourse or body of water. In 1996, the division adopted a watershed approach that reorganized existing programs and focused on integrated water quality management.

The watershed approach is an organizational monitoring framework. Ecoregions serve as a geographical framework for establishing water quality expectations.

The watershed approach is a decision-making process that reflects a common strategy for information collection and analysis as well as a common understanding of the roles, priorities, and responsibilities of all stakeholders within a watershed. Traditional activities like permitting, planning, and monitoring are coordinated. The watershed approach encourages integration of traditional regulatory (point source discharges and withdrawals) and non-regulatory (nonpoint source pollutant) programs. Stormwater runoff in some cities, counties, and other areas is regulated through Municipal Separate Storm Sewer Systems (MS4) permits.

When all pollutant sources are considered together, TDEC is better able to focus on those controls necessary to produce measurable improvements in water quality. This also results in a more efficient process. The watershed approach enables TDEC to focus its staff and financial resources on prioritized geographic location and makes it easier to coordinate between agencies and individuals with an interest in solving water quality problems.

Four main features are typical of the watershed approach:

- Identifying and prioritizing water quality problems in the watershed.
- Developing increased public involvement.
- Coordinating activities with other agencies.
- Measuring success through increased and more efficient monitoring and data gathering.



Figure 1

The 55 major watersheds in Tennessee have been

sorted into five groups based on the year of implementation in a five-year cycle (Figure 1).

Each group contains between 9 and 16 watersheds

(Table 1 and Figure 2). Over the years and most recently in 2023, adjustments were made in five watersheds to more evenly distribute monitoring resources.

Activities for each group are based on its position in the cycle. One of the following six key activities is occurring in each of the five watershed groups each year.

- 1. Existing Data Review and Planning.** Existing relevant and reliable data and reports from appropriate federal, state, and local agencies and citizen-based organizations are compiled and used to determine the current conditions and status of reservoirs, lakes, rivers, and streams where known. Data review and comparison of agency workplans guide the development of an effective monitoring strategy.
- 2. Monitoring.** Field data are collected from reservoirs, lakes, rivers and streams. Three standard operating procedures (SOPs) have been developed to guide sampling techniques and quality control for macroinvertebrate surveys (TDEC, 2021), chemical and bacteriological sampling (TDEC, 2022), and diatom sampling (TDEC, 2023 draft).

3. Assessment. Monitoring and all other relevant data are used to determine if the streams, rivers, lakes, reservoirs, and wetlands support their designated uses based on waterbody classifications and water quality criteria. The causes and most probable significant sources of impairment are identified for waterbodies that do not meet one or more of their designated uses.

4. Total Maximum Daily Load (TMDL) Development/Load Allocation. Section 303(d) of the Clean Water Act requires states to develop TMDLs for those waterbodies not attaining water quality standards. The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented, and water quality standards can be achieved.

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollutant sources and instream water quality conditions. A TMDL can be expressed as the sum of all point source loads (waste load allocations), nonpoint source loads (load allocations) and an appropriate margin of safety, and is represented by this relationship:

$$\text{TMDL} = \text{Sum of Point Sources} + \text{Sum of Nonpoint Sources} + \text{Margin of Safety}$$

5. Permits. Expiration and issuance of discharge and water withdrawal permits are synchronized to the five-year watershed cycle.

6. Watershed Management Plans. Previous watershed plans contained a general description, management strategies, and information relevant to water quality. The Division is currently transitioning to web-based watershed-specific mapping applications. Watershed specific information and resources may be found on the Department's watersheds page. <https://www.tn.gov/environment/program-areas/wr-water-resources/watershed-stewardship/tennessee-watersheds.html>

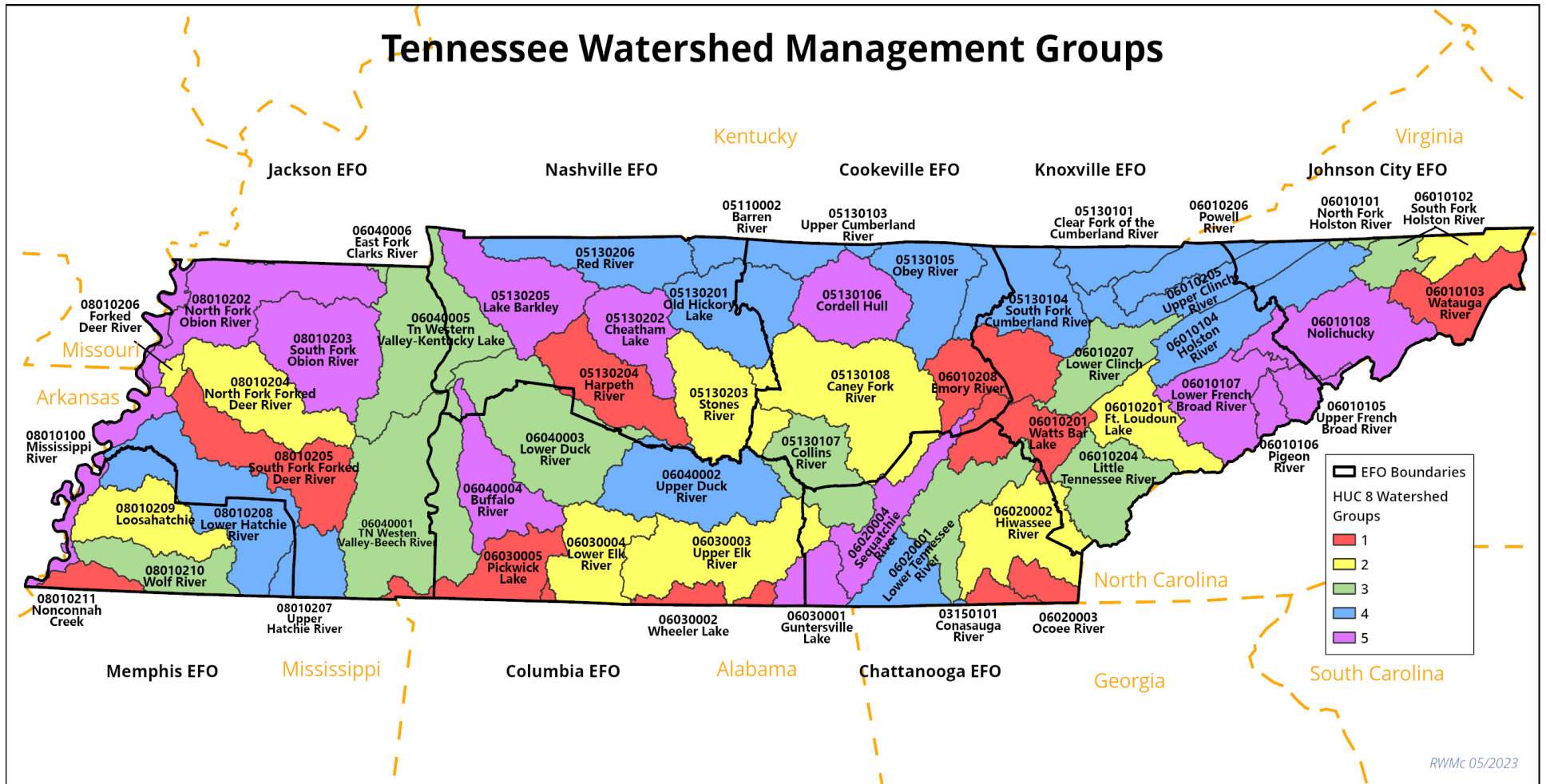
More details may be found on the Department's watershed management page.

TABLE 1 WATERSHED GROUPS IN TENNESSEE

Monit. Year	Watershed	HUC	EFO	Watershed	HUC	EFO
Grp 1 1997 2002 2007 2012 2017 2022 2027	Conasauga	03150101	CH	Ocoee	06020003	CH
	Harpeth	05130204	N	Pickwick Lake	06030005	CL, J
	Watauga	06010103	JC	Wheeler Lake	06030002	CL
	Upper TN (Watts Bar)	06010201	K, CH, CK	South Fork of the Forked Deer	08010205	J
	Emory	06010208	K, CK	Nonconnah	08010211	M
Grp 2 1998 2003 2008 2013 2018 2023 2028	Caney Fork	05130108	CK, CH, N	Upper Elk	06030003	CL
	Stones	05130203	N	Lower Elk	06030004	CL
	S. Fork Holston (u/s Boone Dam)	06010102	JC	North Fork Forked Deer	08010204	J
	Upper TN (Fort Loudoun)	06010201	K	Forked Deer	08010206	J
	Hiwassee	06020002	CH	Loosahatchie	08010209	M
Grp 3 1999 2004 2009 2014 2019 2024 2029	Collins	05130107	CK, CH, CL	TN Western Valley (Beech)	06040001	J
	N. Fork Holston	06010101	JC	Lower Duck	06040003	CL
	S. Fork Holston (d/s Boone Dam)	06010102	JC	TN Western Valley (KY Lake)	06040005	CL, N, J
	Little Tennessee (Tellico)	06010204	K	Wolf	08010210	N, J
	Lower Clinch	06010207	K	Clarks	06040006	J
	Tennessee (Chickamauga)	06020001	CH			

Monit. Year	Watershed	HUC	EFO	Watershed	HUC	EFO
Grp 4 2000 2005 2010 2015 2020 2025 2030	Barren	05110002	N	Holston	06010104	JC, K
	Clear Fork of the Cumberland	05130101	K, MS	Upper Clinch	06010205	JC, K
	Upper Cumberland	05130103	CK	Powell	06010206	JC, K
	South Fork Cumberland	05130104	K	Tennessee (Nickajack)	06020001	CH
	Obey	05130105	CK	Upper Duck	06040002	CL
	Cumberland (Old Hickory Lake)	05130201	N	Upper Hatchie	08010207	J, M
	Red	05130206		Lower Hatchie	08010208	J, M
	Lower Cumberland (Cheatham)	05130202	N	Nolichucky	06010108	JC, K
	Lower Cumberland (Lake Barkley)	05130205	N	Sequatchie	06020004	CH
Grp 5 2001 2006 2011 2016 2021 2026	Upper Cumberland (Cordell Hull)	05130106	CK, N	Guntersville	06030001	CH, CL
	Upper French Broad	06010105	K	Buffalo	06040004	CL, N
	Pigeon	06010106	K	Mississippi	08010100	M, J
	Lower French Broad	06010107	K	Obion	08010202	J
				Obion South Fork	08010203	J

FIGURE 2



c. Monitoring Objectives

Tennessee has a wealth of water resources with over 60,000 miles of rivers and streams (at the NHD 1:100,000 scale resolution) and more than 570,000 lake and reservoir acres. Monitoring data are used to not only assess streams, lakes, and reservoirs, but also to inform permit decisions and to assist in the development of water quality criteria. Recent physical, chemical, or biological survey results are not the only form of data available to inform the assessment process. While recent stream monitoring data are ideal, there are other valid information sources, such as GIS analysis of land use, recent aerial photographs, models, self-monitoring reports, compliance inspection results, and overflow reports. Stream assessment decisions are based on multiple sources of evidence and the Department's responsibility is to weigh all available information to arrive at a conclusion.

TDEC's watershed approach serves as an organizational framework for systematic assessment of the state's water quality. By viewing the entire drainage area or watershed as a whole, the Department is better able to schedule water quality monitoring, assessment, permitting activities, and stream restoration efforts. This unified approach affords a more in-depth study of each watershed and encourages coordination of public and governmental organizations. The watersheds are assessed on a five-year cycle that coincides with permit issuance.

A major purpose of the Division's water quality monitoring program is to provide a measure of Tennessee's progress towards meeting the goals established in the federal Clean Water Act and the Tennessee Water Quality Control Act. To accomplish this task, data are collected and interpreted to:

1. Assess the overall condition of the state's waters, both geographically and temporally.
2. Identify specific problem areas where parameter values violate Tennessee numerical or narrative water quality standards.
3. Identify causes and the most probable and significant sources of water quality problems.
4. Document areas with potential human health threats from fish tissue contamination or elevated bacteria levels. Identify those areas where the public may need to be warned to avoid water contact or fish consumption.
5. Establish trends in water quality.
6. Gauge water quality conditions downstream of point source dischargers or other permittees as an additional compliance check.

7. Document baseline conditions prior to a potential impact or as a reference stream for downstream or other sites within the same ecoregion and/or watershed.
8. Provide data for TMDL studies.
9. Assess water quality improvements based on site remediation, enforcement, Best Management Practices, TMDL implementation, and other restoration strategies.
10. Identify proper stream-use classification, plus assist in the application of the Antidegradation Statement.
11. Identify natural reference conditions on an ecoregion basis for refinement of water quality standards.
12. Identify and protect wetlands.

Guidance and Policy on how to conduct water quality monitoring appears in multiple documents. These include:

1. Quality Assurance Project Plan (QAPP) for 106 Surface Water Monitoring.
<https://www.tn.gov/content/dam/tn/environment/water/policy-and-guidance/dwr-pas-p-02-gapp-102017-update-2021-dec.pdf>
2. Fiscal Year 2022-2023 Surface Water Monitoring and Assessment Program Plan
https://www.tn.gov/content/dam/tn/environment/water/watershed-planning/wr_wq_monitoring-workplan-fy22-23.pdf
3. Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water
<https://www.tn.gov/content/dam/tn/environment/water/policy-and-guidance/dwr-wqp-p-01-qssop-chem-bac-082918-update-2022-jan.pdf>
4. Standard Operating Procedure for Macroinvertebrate Stream Surveys
https://www.tn.gov/content/dam/tn/environment/water/policy-and-guidance/DWR-PAS-P-01-Quality_System_SOP_for_Macroinvertebrate_Stream_Surveys-122821.pdf
5. Standard Operating Procedure for Diatom Stream Surveys 2023 Draft
6. Year 2022 303(d) List – Final Version
https://www.tn.gov/content/dam/tn/environment/water/watershed-planning/wr_wq_303d-2022-final.xlsx

7. Tennessee's Clean Water Act 2022 Monitoring and Assessment Report
<https://storymaps.arcgis.com/stories/dd05f7aa5fe24fd7b2bb17e52a968070>

d. Prioritization of Waterbodies for Monitoring

The Division maintains a statewide monitoring system consisting of over 8,200 established stations, an active subset of which are sampled on a rotating basis. In addition, new stations are created every year to increase the number of assessed streams, lakes, and reservoirs, refine existing assessments, or to support specific permitting or other regulatory purposes. Stations are sampled monthly, quarterly, semi-annually, or annually depending on the objectives of the project. Within each watershed cycle, the locations of monitoring stations and sampling plans are coordinated between the central office and staff in the eight Environmental Field Offices (EFOs) and the Tennessee Division of Mineral and Geologic Resources located across the state, based on the following priorities.

(Note: Emergency response is the highest priority monitoring activity, but these activities cannot be scheduled, thus are not identified in annual workplans. Historical examples of emergency responses include the 2016 Gatlinburg wildfire, the 2008 Kingston ash spill, the 2016 Memphis sewer line break, plus various industrial water spills.)

1. **Antidegradation Monitoring:** Before the Division can authorize new or increased degradation in Tennessee waterbodies (some exceptions exist), the appropriate categories under the Antidegradation Policy must be determined. These categories are (1) Available Parameters or (2) Unavailable Parameters, (3) Exceptional Tennessee Waters, and (4) Outstanding National Resource Waters (ONRWs). ONRWs are established by the Board through rulemaking. Categories 1 and 2 are on a “parameter-by-parameter” basis considering the existing water quality of the stream. Exceptional Tennessee Waters (ETWs) must be identified by Division staff based on 7 identifying characteristics established in Rule 0400-40-03-.06(4).

Waterbodies can be in more than one category at a time, due to the parameter-specific nature of categories 1 and 2 above. For example, the Ocoee River is an impaired stream due to multiple pollutants, but is also an Exceptional Tennessee Water due to its national significance as a white-water rafting resource. Thus, its antidegradation status is both unavailable for specific parameters and ETW.

Streams are evaluated as needed in response to requests for new or expanded National Pollutant Discharge Elimination System (NPDES) and Aquatic Resource Alteration Permit (ARAP) individual permits, including ARAP water withdrawal applications. When the waterbody requiring an antidegradation determination does not have recent water quality data from the last five years, surveys should be done by field office staff, unless the

applicant is willing to provide the needed information in a timely manner. In some circumstances, older data may be used if local experienced field staff believe they are still valid. Because the identification of antidegradation status must be determined prior to permit issuance, this work is done on the highest priority basis.

Streams are evaluated for antidegradation status based on a standardized ETW evaluation process, which includes information on specialized recreation uses, scenic values, ecological consideration, biological integrity, and attainment of water quality criteria. Because permit applications generally cannot be anticipated, these evaluations are generally not included in the workplan.

- 2. Posted Waters:** When the Department issues advisories due to elevated public health risks from excessive pathogen or contaminant levels in fish, it accepts the responsibility to continue to monitor those waters. Fish tissue monitoring is planned by a workgroup consisting of staff from DWR-TDEC, Tennessee Valley Authority (TVA), Oak Ridge National Laboratory (ORNL), and the Tennessee Wildlife Resources Agency (TWRA). The workgroup meets annually to coordinate a monitoring strategy. Fish tissue sampling for TDEC is contracted to the state laboratory. The strategy includes all posted waterbodies plus those frequently fished by the public. At a minimum, fish tissue samples in waters posted for consumption advisories are analyzed for the parameters included in the posting. In other frequently fished waters, mercury and PFAs are analyzed in fish tissue. During review of field office monitoring plans for the upcoming watershed year, central office staff may also discuss needed fish tissue sampling.

For pathogen contact advisories, in conjunction with the monitoring cycle, monthly E. coli samples, plus a minimum of one geomean sample (5 samples in 30 days) are a top priority to schedule and accomplish. If another entity (such as an MS4 program) has already planned to collect samples, that effort can substitute for Division sampling, if staff have confidence that the other entity will meet data quality objectives. However, field office staff need to confirm that this sampling is taking place, remembering that the ultimate responsibility remains with the Division.

Field office and central office staff review fish tissue and pathogen results and jointly decide whether an advisory could be proposed for lifting. Additionally, field office staff have the primary responsibility to ensure that existing signs on posted waterbodies are inspected periodically (annually is preferred) and replaced if damaged or removed.

- 3. Ecoregion Reference Streams, Ambient Monitoring Stations, and Southeastern Monitoring Network Trend Stations (SEMNTS):** Established ecoregion or headwater reference stations are monitored according to the watershed approach schedule. Each station is sampled quarterly for chemical quality, as well as in the spring and fall for macroinvertebrates and habitat. Diatoms are sampled once during the growing season (April – October). Both semi-quantitative and biorecon benthic samples are collected to provide data for continued refinement of both biocriteria and biorecon guidelines. If

watershed screening efforts indicate a potential new reference site, more intensive reference stream monitoring protocols are used to determine potential inclusion as a reference site.

Ambient Monitoring Sites are the Division's longest existing trend stations and any disruption in sampling over time reduces its ability to make comparisons. Regardless of monitoring cycle, all ambient stations will be sampled quarterly according to the set list of parameters established for this sampling effort.

Southeastern Monitoring Network Stations (SEMN): Like ambient stations, SEMN stations within each field office area will be sampled according to the project plan and grant for this project, regardless of watershed cycle.

- 4. Sampling downstream of Major Dischargers, Landfills, and CAFOs:** During each monitoring cycle, the major dischargers, landfills, and CAFOs are identified in targeted watersheds. Because these types of facilities are directly regulated by the Department, water quality monitoring can have a direct effect on future permitting or enforcement decisions. In addition, their effect on instream water quality can be profound, and can change rapidly, so they are a higher priority to monitor each and every cycle.

Stations are established at those waterbodies, preferably both upstream and downstream of the facility. Even if the facility does have in-stream monitoring requirements built into their permit, the Division should collect samples during the watershed monitoring cycle to provide additional QA/QC. The pollutants of concern and the effect these would have on the receiving stream may determine the location of the station(s). (Note: stations may not be required for dischargers into very large waterways such as the Mississippi River or large reservoirs.) Frequent collection (monthly recommended) of parameters should include those being discharged, plus a semi-quantitative single habitat (SQSH) survey. Stations downstream of STPs or industries that discharge nutrients should include a SQSH, collection of diatoms, and monthly nutrient monitoring. In streams, particular care should be taken to document with notes and photographs the extent and types of algal growth.

Stations should also be established downstream of CAFOs with individual permits or others in which water quality based public complaints have been received. The emphasis should be on monitoring biointegrity (SQKICK survey if the stream is wadeable or in a region in which SQBANK surveys can be done) and monthly nutrient and pathogen sampling.

Streams below Class I and Class II landfills, both active and inactive, are included in the annual monitoring workplan. Other types of landfills should also be reviewed for documentation of any known or potential water quality impacts. Sampling should be coordinated with the local Division of Solid Waste Management office. Parameters of concern at landfills include elevated dissolved solids, conductivity, inorganic salts, metals, chloride, and ammonia, and should be sampled monthly. Temperature and pH data are

required to interpret ammonia criteria. Hardness and Total Suspended Solids (TSS) is required to interpret metals data. A list of minimum required parameters is provided in the QAPP and Chemical/Bacteriological Monitoring SOPs

In addition, when developing workplans prior to the next monitoring cycle, field office staff should coordinate with the Division of Remediation (DoR) to confirm that any Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites affecting waters that are currently on the 303(d) List are being monitored by either DoR or the permittee. These water quality data are reviewed to determine whether the site continues to cause or contribute to violations of water quality standards. If data are not available, sampling should be designed to document water quality and provide a rationale for delisting if sufficient improvement is observed.

5. TMDL Development, Model Calibration, or other Special Project Monitoring:

While not common, occasionally the Division will need specific, targeted monitoring added to an annual workplan that would not otherwise be obtained through the more traditional Watershed Monitoring plan. This might involve the development of a new regionally- or parameter-specific TMDL.

Effectiveness monitoring for completed TMDLs in the watershed group is more likely to be covered by data already being collected through the traditional Watershed Monitoring network and annual work plan, and not require additional, special monitoring. However, coordination between the Watershed Planning Unit (WPU) manager and the EFOs should still occur to ensure TMDL objectives are met. The frequency and parameters monitored for TMDL monitoring depends on the specific TMDL. Detailed information about TMDLs can be found in the Department's 106 Monitoring QAPP (TDEC, 2021), and in the document *Monitoring to Support TMDL Development* (TDEC, 2011).

Similarly, there may be specific situations where typical Watershed Monitoring will not generate all the specific data needed to assist in the development or calibration of water quality models utilized by the Division. Where such a need exists, these stations and parameters should be added to the monitoring plan, after coordination between the WPU manager and the EFOs.

Occasionally, the Division is given the opportunity to compete for special EPA grant resources for monitoring and other water quality research projects. If awarded, activities related to these grants become a high priority because the Division is under contract to achieve the milestones set out in the workplan.

Occasionally, monitoring activities related to these projects are contracted out to the state lab. However, if problems arise, field offices might be called upon if the lab or some other outside contractor is unable to fulfill the commitment. Examples of historical special studies include sediment oxygen demand surveys, nutrient studies, ecoregion delineation,

coalfield studies, air deposition surveys, reference stream monitoring, development of regional geomorphic reference curves, and various probabilistic monitoring designs.

- 6. Watershed Monitoring:** In addition to the previous priorities, each EFO should execute a more generalized Watershed Monitoring plan, designed to provide as much information about the overall health of streams within the cycle's watershed groups. This plan can encompass impaired, supporting, or unassessed waters. This category, although at the bottom of the priority list, actually constitutes the bulk of the Division's monitoring efforts and strategy, and in some ways represents the most important component overall.

The priorities within each Group's Watershed Monitoring plan may differ from cycle to cycle, due to considerations such as data from the previous cycle, long-term trends, new data from outside agencies, or known BMPs and restoration work. A Watershed Monitoring Plan will generally include stations to re-evaluate impaired waterbodies, stations to confirm continued support of designated uses, and stations to increase the number of assessed waterbodies. To achieve the maximum coverage and characterization of the health of the various Assessment Units within a given watershed, previously assessed streams should first be reviewed to see if they would qualify for assessment under the Evaluation Framework Protocols (see section IV.a. below) before committing to additional monitoring.

Water quality limited (impaired) streams are those that have one or more parameters that violate water quality standards and are included in the State's Impaired Waters List (303d). They are considered impaired by pollutants and not fully meeting designated uses. (Streams where ambient water quality is exactly at numeric criteria levels also have "unavailable parameters" and would be considered water quality limited, but would not be listed as impaired.)

While the majority of impaired waters are monitored at least every five years coinciding with the watershed cycle, there is no legal mandate to do so in all cases. For instance, a subset of impaired waters, such as those known to be impacted by severe and ongoing habitat alterations (e.g., channelization or upstream impoundments) or whose biological integrity scored very poorly the previous cycle, may be assessed using the Division's Evaluation Framework (see section IV.a.). Additionally, a stream that has been on the impaired waters list through many cycles with similar data obtained repeatedly may be a lower priority in a given cycle than a larger supporting stream that would revert to "not assessed" status without additional monitoring. The Division should not let impaired waters languish without additional data interminably, but in a given cycle the Division's limited monitoring efforts may be best spent on waters in another assessment category. This will always be a case-by-case prioritization decision each cycle.

When monitored, wadable waters that do not support fish and aquatic life are sampled at least once for macroinvertebrates (SQSH preferred), habitat parameters, and monthly for many of the listed pollutant(s), as well as other informative physicochemical parameters

during the monitoring year of the watershed cycle. (Benthic samples may also be collected in some non-wadable waters for ecoregions that have SQBANK criteria)

Large non-wadable waters that do not support fish and aquatic life and cannot be sampled for macroinvertebrates may be assessed for this use by monthly collection of the full suite of ambient chemical parameters, as well as any other listed pollutant(s), or additional informative physicochemical parameters during the monitoring year of the watershed cycle.

Streams with impacted recreational uses, such as those impaired due to pathogens are typically sampled monthly for *E. coli*. However, if the stream was listed in whole or part due to a previously failing geomean, a geomean sample should be collected during the current monitoring cycle. In any case, if an initial geometric mean is collected (5 samples within a 30-day period) in the first quarter of the monitoring year, and the geomean is well over the existing water quality criterion of 126 colony forming units (or MPN), the waterbody remains impaired with no additional *E. coli* sampling needed to confirm continued impairment. If the geomean results meet the water quality criterion, staff will continue with monthly samples during the remainder of the monitoring cycle. If the geomean is not substantially over the criterion and may have a rain-influenced sample, field staff may at their discretion continue monthly monitoring to evaluate if additional samples will indicate that the criterion is met and could lead to a potential delisting.

For parameters other than pathogens, data results may sometimes justify fewer sample collections. For example, there are cases where pollutants are at high enough levels that sampling frequency may be reduced while still providing a statistically sound basis for assessments. Field staff should consult Table 22 in the most recent QAPP for minimum sample frequency guidance for various parameters, and coordinate any reduced sampling frequency with central office assessment coordinators.

For streams previously assessed as fully supporting fish and aquatic life, or have not previously been assessed, macroinvertebrate surveys (SQSH or biorecons), habitat assessments, and field measurements of DO, specific conductance, pH and temperature are conducted at the majority of these sites. Monthly sampling of basic chemical parameters, including nutrients (nitrite+nitrate, total phosphorus, ammonia, and TKN), and pathogens (*E. coli*) should also be conducted on as many as these streams as possible to more fully evaluate all uses and better characterize existing water quality.

Once a Watershed Monitoring plan has been established and implemented, every effort should be made to collect the types and numbers of samples agreed to in the plan. In some unavoidable circumstances, such as dry or critically low-flow streams, monitoring may be appropriately bypassed during a monitoring cycle, if rescheduling is not possible. If possible, dry or low-flow streams should be revisited at a different season (winter/ spring) in regions where streams naturally go dry or flow sinks below the streambed in summer/fall, or in headwater streams. All observations of dry streams should be recorded

and reported so that it will be understood later during assessments that the stream was dry and therefore could not be sampled in a given month, and to help plan for future monitoring.

While each cycle's Watershed Monitoring plan may differ, in general higher priority for monitoring efforts would include:

- Currently impaired stream segments where the Department or other agency has developed control strategies and continued monitoring will be beneficial to track progress towards restoration.
- Currently impaired stream segments where previous data were close to, or indicate a trend towards supporting one or more designated uses, or the delisting of a specific parameter.
- Streams impaired for recreation, where other data are not available to evaluate ongoing conditions (e.g., overflow reports, DMRs, complaints)
- Streams impaired by, or suspected to be impaired by a water quality-related parameter, or a specific point source may be higher priorities than streams impaired by a habitat-related parameter, or a more generalized land-use source.
- Assessment of potential new reference stations in streams in relatively protected watersheds. Each year, existing reference streams are degraded by various impacts in their watersheds and have to be replaced.
- Previously assessed segments, particularly large ones, that would likely revert or have already reverted to Category 3 unassessed status. (Note that a single site per assessed segment is generally adequate if assessment was supporting and no changes are evident).
- Sites below ARAP activities or extensive nonpoint source impacts in wadeable streams where biological impairment is suspected. Examples might be unpermitted activities, violations of permit conditions, failure to install or maintain BMPs, large-scale development, clusters of stormwater permits or ARAPs, or a dramatic increase in impervious surfaces.
- Unassessed segments, especially with larger drainage areas or total number of stream miles, or in disturbed headwaters.
- Pre-restoration or BMP monitoring. This sampling would be to document improvements, but is also needed for antidegradation purposes and to confirm that the stream is a good candidate for such a project. This protects against the

possibility that a good stream could be harmed by unnecessary restoration, and evaluates the effectiveness of the restoration of BMP approach. In most compensatory mitigation scenarios this monitoring is performed by the permittee.

e. Data Quality Objectives

TDEC DWR has developed three Quality System Standard Operating Procedures (QSSOP) for instructing the collection of water pollution control data and appropriate quality control in the state. The QSSOP for Macroinvertebrate Stream Survey (TDEC, 2021) was first published in March of 2002 and has been periodically revised. The most recent revision reflected recent changes in taxonomic nomenclature and biometric recalibrations that were implemented in 2021. The QSSOP for Chemical and Bacteriological Sampling of Surface Waters was first published in March of 2004 and has also been periodically revised. The current version was published in January 2022 (TDEC, 2022). The QSSOP for Periphyton Stream Surveys was completed in 2010 (TDEC, 2010) and is currently under revision to reflect a diatom-based approach (TDEC, 2023 draft).

Each year, the Division submits a Quality Assurance Project Plan to EPA (TDEC, 2021). This document describes monitoring, analyses, quality control, and data management procedures used by the Division to have sufficient and quality data with which to develop TMDLs, 305(b) reporting, and 303(d) assessments. All documents are reviewed annually and revised as needed. A copy of any document revisions made during the year is sent to all appropriate stakeholders and posted on the website. A report is made to the Deputy Commissioner and Quality Assurance Manager of any changes that occur. Division staff are trained on field techniques outlined in the documents during the Division's annual meeting and during biological workshops.

Some Biological (SQSH, diatoms, and biorecons), bacteriological, and inorganic chemical samples are analyzed by the TDH Environmental Laboratories. Organic chemical samples, some SQSH samples, most diatoms, and most bacteriological samples are analyzed by contract labs. The biological laboratory and subcontractors follow the QSSOP for macroinvertebrate (TDEC, 2021) and for diatoms (TDEC, 2023 draft) sample analysis. The state and contract chemistry and bacteriological laboratories has standard operating procedures which follow approved EPA methodologies. All chemical laboratories are NELAC or equivalent certified. EPA audits the state laboratories on a regular schedule.

II. WATER QUALITY ASSESSMENT APPROACH

a. How TDEC Assesses Water Quality

The water quality assessment process in Tennessee consists of four parts:

1. Development of water quality standards either by promulgating national numeric criteria, statewide narrative criteria, or regional goals based on reference conditions and establishing appropriate classified uses for each waterbody
2. Implementation of a statewide water quality monitoring program, based on a watershed cycle.
3. Comparison of data to applicable water quality standards for each waterbody to assess water quality and categorize designated use support.
4. Geographic referencing of all water resources with the National Hydrography Dataset (NHD).

Monitoring data from individual waterbodies are compared to the water quality criteria that correspond to its classified uses. Violations of water quality standards are identified and the degree to which each individual waterbody meets its designated uses is determined. Assessment categories recommended by EPA are used to characterize water quality.

Assessment results are compiled and reported to the public. The principal means of disseminating this water quality information are [Tennessee's Clean Water Act Monitoring and Assessment Report](#) (305(b) Report) and [Tennessee's List of Impaired and Threatened Waters](#) (303(d) List), plus various databases and mapping features maintained on the Department's website at <http://www.tn.gov/environment/article/wr-water-resources-data-viewer> .

Additionally, because TDEC now utilizes the EPA ATAINS system as its primary database to store assessment data, this information can also easily be accessed using [EPA's How's My Waterway](#) public application.

Waters without data collected within the last five years are usually identified as not assessed unless previously identified as impaired, or qualifying for assessment using the Evaluated Framework (see section IV.a.).

Once it has been determined that a stream, river, lake or reservoir is not fully supporting of its designated uses, it is necessary to determine what are the parameters causing impairment (causes) and what are the most probable sources of those parameters.

b. Consideration of Magnitude, Frequency, and/or Duration in Assessment Decisions

According to the definition of the Condition of Impairment provided earlier, the magnitude, frequency, and duration of criteria violations are important factors in assessment decisions. It would be handy if there were a formula for this determination. Several decades ago, the Division experimented with just such a formula, a model called appropriately, the Water Quality Index (WQI). The WQI attempted to take into consideration how significant the violations were, how often they occurred and if known, how long they lasted. The WQI combined all those factors into a Severity Index for each station.

However, use of the WQI formula on ambient water quality data proved problematic. For example, the magnitude of each violation was established based on the current criterion for a parameter, the detection level, and the amount an ambient value exceeded both. Detection levels are seldom consistent, and in some parameters, the detection level could be much higher than the criterion. Additionally, the WQI had trouble dealing with “less than” or “greater than” data qualifiers. The model could not make these distinctions and as a result generated erroneous and misleading results.

The Division rarely has information about the true duration of an excursion from criteria unless there is continuous monitoring of a physical parameter like dissolved oxygen or temperature. Because the Division collects mostly grab samples, sometimes it must substitute the frequency of violations to arrive at some judgment about the duration.

Regarding magnitude: clearly the greater the excursion, the more concerning. When evaluating magnitude, the Division considers the relative potential harm to ecosystem function, toxicity, pathogenicity, or carcinogenicity of the pollutant in conjunction with the degree of exceedance above the criterion. For example, the Division would likely be more concerned if mercury were twice the criterion than if iron were ten times higher.

There are completely unavoidable data limitations on how the magnitude, frequency and/or duration provision is implemented. In the absence of standard equations that can be employed, a combination of statistical measures, scientific evidence, field observations and staff judgement is used to derive the most defensible assessment with the available data and supplemental information. The agency implements this provision consistently statewide, which is one of the responsibilities of the central office assessment staff.

Additionally, all assessments are subject to review by EPA, the public, the board and perhaps even the legal system. The Division must be mindful of the scientific and legal defensibility of assessments and must maintain the transparency of the decision process.

c. Resegmenting Streams

The original hydro-geographic indexing of Tennessee's streams took place in 1998 – 2000. EPA's Reach Indexing Tool was used to subdivide the waterbodies in EPA's GIS coverage into segments. At the time, there was no guidance on how best to do this, so the Division came up with its own approach.

In this approach, streams within each twelve-digit reach were given an additional four-digit segment number based on order. Mainstem streams were given a number in the thousands, tributaries to them were numbered in the hundreds, tributaries to them were numbered in the tens, and the smallest tributaries were numbered in the ones.

Within certain larger-order stream reaches, miscellaneous tributaries were segmented together and given the number -0999. Thus, they were segmented and accounted for, just not individually.

This system worked well, but at times, assessment units needed to be re-segmented, usually to assess each new segment with more precision.

At times, the Division collects or receives new data in a miscellaneous segment -0999 waterbody or in a small headwater tributary of a larger waterbody and must decide whether to individually segment the miscellaneous tributary or small headwater stream reach so that it can be independently assessed.

There are several ways the Division might receive new data in streams or reaches not previously individually indexed and assessed: complaint investigations, new antidegradation surveys, MS4 sampling in urban streams, NPDES-required surveys by industries or mines, pre or post mitigation surveys, or data associated with other restoration efforts. When these new data become available on a stream reach not previously individually indexed, staff must decide whether the data support individually indexing or segmenting the stream and should be used to determine use support of the new stream assessment unit.

As a general statement, staff should err on the side of using these data as part of the assessment process. The goals, methods, quantity, nature, and reliability of the data collected all factor into how the data will be used in this process. In some instances, there are legitimate reasons for not using these data to create a new segment or assessment, including:

1. The data are of questionable quality and do not meet the Division's QA/QC requirements.
2. The data are not of sufficient quantity to assess the stream. For example, a single pathogen result from a stream.
3. For biological data, the sample site is not representative of the remainder of the stream.
4. The new data are from a small headwater tributary stream that is already included within a larger stream assessment unit and the new data wouldn't change the existing assessment.
5. The data are old. (Generally, samples collected within the most current five years are considered recent data.)
6. The waterbody has not been confirmed as a jurisdictional stream.
7. The goal or purpose of the sampling was to document a transient or anomalous condition which would likely be short-lived and not reflective of the overall long-term support of classified uses in the waterbody.

An inappropriate reason to not create a new assessment unit is one based on perceived significance of the resource to the community or concerns about creating additional work for staff.

The Division assesses waterbodies, aggregates of many individual stream reaches and tributaries, not individual points. Although an individual short reach can have a sample that documents "pollution" (i.e., a criteria violation), the sample site results may not be representative of the assessment unit as a whole and may not reflect the overall Use Support of the Waterbody. For example, a Supporting Waterbody may have an individual localized point of impact.

d. Use of Data Submitted by Other Agencies and Citizens

The Division uses all reliable data that are readily available for the assessment of Tennessee's waterways. This includes data from TDEC, other local, state, and federal agencies, universities, NPDES permit holders, citizens, and the private sector.

The Division issues annual public notices requesting water quality data for use in the statewide water quality assessment. All submitted or otherwise readily available data are considered in

the assessment process. If data reliability cannot be established, data are used to screen waters for future studies.

Data collected by permittees as a requirement of NPDES or ARAP permits are reviewed for data quality and, once accepted, are stored in the appropriate database. If Division staff identify problems with permittee data, the permittee is informed about the issues, including the extent to which the data can be used in the assessment process.

In situations where data from the Division and another source do not agree, more weight is given to the Division's data unless the other data were significantly more recent or extensive, and have comparably stringent QA/QC protocols.

e. Assessment of Causes and Sources

Water quality assessments are conducted by comparing water quality and other relevant data to the appropriate criteria to determine if waters are supportive of designated uses, and to determine the causes and most probable and significant sources of impairment. To facilitate this process, several provisions have been made:

- Criteria have been refined to help evaluate data. Reference data generated through the ecoregion project has dramatically reduced the uncertainty associated with the application of statewide narrative and numerical criteria. Policy documents have been developed to assist in the interpretation of macroinvertebrate, nutrient, habitat, and diatom data. These documents are available on the Division's webpage at <https://www.tn.gov/environment/program-areas/wr-water-resources/water-quality/water-quality-reports---publications.html>
- Critical periods have been determined for various criteria. Certain collection seasons and types of data have proven more important for the protection of specific water uses. For instance, the critical period for parameters like toxic metals or organics is the low flow season of late summer and early fall. Likewise, most recreational water contact occurs in the summer, so pathogen results are considered most significant during that time.
- To ensure defensible assessments, data quality objectives have been set. For some parameters, a minimum number of observations are needed to assure confidence in the accuracy of the assessment. Other QA/QC requirements and staff qualifications are listed in Standard Operating Procedures in the publications link above.

- Provisions in the water quality criteria instruct staff to determine whether violations are caused by man-induced or natural conditions. Natural conditions are not considered the condition of impairment, except for pathogens. “Natural conditions” is not synonymous with terms like “Existing conditions,” “Historical conditions,” or “Upstream conditions.”
- The magnitude, frequency, and duration of criteria violations are considered in the assessment process.
- Streams and rivers in some ecoregions naturally go dry seasonally or historically have only subsurface flow during prolonged periods of low flow. Evaluations of biological integrity data include differentiating whether waters have been recently dry or are affected by human-induced conditions.
- Ecoregion reference sites have been established primarily in wadeable streams, a subset of which are targeted at small headwater streams. They are periodically reevaluated, and data are statistically analyzed. New sites are added when possible. Existing sites are dropped if data show the water quality has degraded, the site is not typical of the region, or the site does not reflect the best attainable conditions. Data from bordering states that share the same ecoregions are used to test suitability of reference sites and augment the dataset. Currently the state is reviewing river, lake, and reservoir data to identify reference conditions in these systems.

At watershed assessment meetings between central and field office staff, physical, chemical, habitat, and biological data are compared to water quality criteria. Where violations are of sufficient magnitude, frequency, and duration to be considered to constitute a condition of impairment, the specific pollutants are identified as the causes of impairment. Commonly, streams are impacted by more than one pollutant or in the case of removal of habitat, more than one kind of physical alteration.

In some cases, criteria are not parameters or a single number, but rather a combined group of metrics. Examples of these criteria include parameters combined into condition indexes such as habitat or biointegrity. In these cases, TDEC attempts to identify the actual parameter(s) causing the impact. For example, if the regional goal for the condition index habitat is not met, staff determine which components of habitat are the actual problem, such as lack of riparian vegetation. These aspects of habitat are then identified as the listed cause of impairment.

This “parameter-by-parameter” approach is also consistent with the Antidegradation Policy. The Division, when issuing permits that result in the degradation of a water quality parameter,

must identify whether or not the affected waterbody can receive additional loadings of that specific parameter

Once the causes of impairment have been identified, the next step is to list the most probable and significant sources of that parameter. This process is not intended to create an exhaustive list of all possible or even known sources, no matter how minor – again, its focus is on identifying for planning purposes the most likely and dominant source of a given pollutant in the watershed. Following are some general steps:

- If the parameter is associated with habitat loss, the activities causing the loss are identified, usually by a combination of data captured in Habitat Survey, biological submetrics, sampler observations, and a review of aerial photography. Commonly identified sources associated with habitat loss include channelization, crop production, pasture grazing, land development, and urban areas.
- If biological impairment is indicated, the distribution of genera can often provide an indication of the nature of the problem. For example, high numbers of worms and midges coupled with low numbers of clinger species can indicate excessive sediment affecting available habitat niches. A lack of sensitive EPT taxa in the absence of excessive habitat alteration, sedimentation, or nutrients can suggest the presence of a toxicant. A review of discharge data from permitted facilities might help identify the source of specific pollutants.
- If excessive sedimentation is indicated, construction general permits and aquatic resource alteration permits can be reviewed to resolve whether authorized activities are in compliance with permit conditions. In areas of intensive agricultural activities, aerial photographs can be used to identify areas of riparian loss, or direct cattle access that can cause channel destabilization and excessive erosion.
- If pathogen levels are elevated downstream of urban areas, compliance reports are reviewed for documentation of sewer line overflows or failing septic tanks. In some severe cases, evidence of overflows can be observed in the stream (manhole covers dislodged, presence of paper and latex products, etc.). In agricultural areas, aerial photographs are used to look for evidence of concentrated livestock either with access to, or in close proximity to, streams.
- At times, the sources of a pollutant are general urban stormwater runoff from within urbanized areas. This can include habitat degradation from the altered hydrological

regimes prevalent in highly impervious watersheds. The typical pollutant loadings and effects on hydrology from highly impervious urban watersheds is well-studied and documented. If a more specific source can be identified, such as an agricultural area or a collection system overflow point within the larger urbanized area, the more specific source is identified. Otherwise, if no specific point or other non-point source is identified, staff will identify urban runoff (coded as MUNICIPAL (URBANIZED HIGH DENSITY AREA) in ATTAINS) as the potential source.

f. Out of Cycle Assessment Requests

Water quality data will be used to assess/list/delist waterbodies wherever possible within the existing watershed cycle. Occasionally there may be a reason to assess outside of the normal cycle. Examples might include enforcement cases, emergency response/threats to public health, permit issues, TMDL studies, antidegradation surveys, and various follow-up monitoring or post-BMP monitoring.

If these requests are due to an internal agency need, the manager of the field office or central office unit will contact the WPU. In cases where compliance related factors are causing long-term impairment, the request will come to the central office as soon as possible so the reassessment can be reflected accurately in the ATTAINS database in conjunction with any enforcement actions. In this way, TDEC's position regarding impairment will be consistent.

On occasion, requests for out-of-cycle reassessments come from the public or the regulated community. Whenever possible, EFO/Unit Managers or Deputy Directors should deal directly with external customers, providing technical assistance, screening requests, and properly documenting data submittals. Requests will then be forward to WPU.

All external reassessment requests and data submittals will be in writing. The request should be thoroughly explained. Data should be accompanied by maps or other locational information. Data quality efforts should be detailed. Additionally, the request should explain why the data support the desired outcome.

These formal requests will receive a written response from WPU. An email acknowledgement is acceptable, unless the customer requests a letter. The response acknowledging receipt of the submittal will be accomplished within 10 working days and will offer the requester the option of a meeting with WPU. These reassessment meetings will be in the central office, unless a meeting at the local field office is more desirable and can be arranged.

WPU will provide a written response with a rationale for TDEC's decision within 90 days of receipt of request. WPU will coordinate with appropriate EFO/Unit Managers on the assessment decision and rationale. In some complex situations, this may necessitate the creation of an assessment team of EFO, WPU and other staff.

In the event of a large number of requests for assessment/re-assessment out of the normal cycle, processing of requests will be prioritized as follows:

- Emergency response/public health threat.
- Providing a timely response to an external customer.
- Providing timely response and coordination to a sister agency.
- Enforcement-driven assessment.
- Permit decision-driven assessment.

Occasionally, requests to reassess waterbodies come as part of a public comment regarding the Draft List of Impaired and Threatened Waters in Tennessee published in even-numbered years. Every public comment related to the List should get a response, but reassessment of complex waterbodies in the short period of time between the end of the comment period and the deadline for federal submission is not practicable.

Where the Division gets multiple reassessment requests, voluminous amounts of submitted data, references to data not yet submitted to TDEC, or simply that the waterbody in question will be reassessed shortly as part of the normal watershed cycle, there are obvious limitations to the Division's ability to do the assessment process justice. In these circumstances, the public should have no expectation that these requests will be honored.

III. Introduction to Water Quality Criteria

There are two types of criteria: numeric and narrative. Numeric criteria provide a specific level that should not be exceeded, while narrative criteria provide a description of the condition to be avoided. Water quality standards instruct staff to consider the frequency, magnitude, and duration of criteria violations and to determine whether the appearance of pollution might be due to natural conditions, such as groundwater influences, prolonged dryness, or recent flooding.

Numeric criteria are specific levels of parameters that should not be exceeded. Some may have acute or chronic criteria based on degrees of toxicity to aquatic life, plus “organisms only” or “water and organisms” values based on potential impacts to human health. Additionally, Maximum Contaminant Levels (MCLs) are applied to some waterbodies to protect public drinking water supplies.

Narrative criteria are written descriptions of water quality. These descriptions generally state that the waters should be “free from” particular types or effects of pollutants. The Division’s long-standing position is that narrative criteria should have a regional basis for interpretation. To help provide regional information for narrative criteria, criteria development documents based on reference stream data have been produced for biological integrity (Arnwine and Denton, 2001), habitat (Arnwine and Denton, 2001), and nutrients (Denton *et al.*, 2001). Guidelines for biological criteria and habitat are re-calibrated periodically and are now published in the Department’s QSSOP for Macroinvertebrate Stream Surveys (TDEC, 2021).

All streams in Tennessee are always classified for fish and aquatic life protection and recreation, so the more stringent of these criteria always apply to any stream. Waters are only classified for domestic water supply if they are large suitable waterbodies such as reservoirs, or other waterbodies currently or potentially used as a raw water source by public water suppliers. However, assessment staff should be aware that many small streams are used by private homeowners without access to public water, often with little treatment. Where these unofficial uses are noted by monitoring staff, assessments should be protective of human health.

It is important to note that water quality criteria are reviewed and may be revised each Triennial Review. While the Division will attempt to update this document to keep pace with revisions, the currently promulgated Rule 0400-40-03-.03 should be considered the most accurate resource for information regarding criteria and their interpretation.

a. Flow Basis for Criteria

The general water quality criteria apply at all flows for waterbodies that are not wet weather conveyances. (Some criteria apply to wet weather conveyances, however they are not classified. This is explained further in the next section.)

The flow basis for application of criteria is found in Rule 0400-40-03-.05(4):

Water quality criteria for fish and aquatic life and livestock watering and wildlife set forth shall generally be applied in permits on the basis of the following stream flows: unregulated streams - stream flows equal to or exceeding the 7-day minimum, 10-year recurrence interval; regulated streams - all flows in excess of the minimum critical flow occurring once in ten years as

determined by the Division. All other criteria shall be applied on the basis of stream flows equal to or exceeding the 30-day minimum 5 year recurrence interval.

Previously, the awkward wording of the first sentence led many outside the Department to believe that fish and aquatic life or recreational criteria do not apply at flows below the 7Q10 or 30Q5 levels. The idea that there are flow scenarios where “anything goes” for water quality simply cannot be the case, because it would present possibly acutely toxic conditions and direct threats to human health. In the 2019 Triennial Review, the words “in permits” were added to the first sentence in order to make it clear that flow basis is only used to derive permit limits.

If a stream falls below the 7Q10 level and criteria are violated due to an NPDES discharge at permitted levels, that could represent the condition of impairment in the stream. However, it would only be a permit violation if the conditions established in the permit were exceeded.

Some assessment methodologies may not be applicable at very high or low flows. For example, the SOP for performing macroinvertebrate surveys requires that sufficient flow be present during and prior to sampling. Should such a survey be done where sufficient flows are not, or have not previously been present, the results would not be considered valid. In another example, dissolved oxygen criteria should not be applied to stagnant, non-flowing waters.

A discussion of application of the flow criteria under the fish and aquatic life and recreational criteria follows later in this Chapter.

b. Wet Weather Conveyances (WWCs)

On rare occasions, such as spills or unpermitted discharges, staff may be required to determine whether impacts to a wet weather conveyance comply with the Act.. Wet weather conveyances do not have designated uses. However Rule 0400-40-03-.02(6) provides:

Waters identified as wet weather conveyances according to the definition found in Rule 0400-40-03-.04, shall be protective of humans and wildlife that may come in contact with them and shall not adversely affect the quality of downstream waters. Applicable water quality standards will be maintained downstream of wet weather conveyances.

In determining whether impacts to wet weather conveyances comply with the Act, staff should consider the following:

- Wet weather conveyances usually connect with streams some distance downstream. If the distance is short, and the receiving stream small, any criteria violations in the WWC should be assumed to negatively impact downstream water quality. In other situations, staff may treat the WWC similarly to a discharge outfall, and sample the WWC, and the stream both upstream and downstream of the confluence to determine the impact on

water quality.

- The Act directly authorizes physical alterations of wet weather conveyances under specific conditions. T.C.A. § 69-3-108(q)(1). If physical alterations were not done in a way that was “protective of humans and wildlife” or would impair the uses of downstream receiving waters, then the alterations would be unlawful.
- For toxic pollutants, acute criteria should not be exceeded in the WWC. If a WWC flows more than 4 consecutive days, chronic criteria should not be exceeded. Any detectable level of mercury, pesticides, PCBs, or other carcinogens should be a matter of concern. Whether criteria are violated would be determined by sampling in the receiving stream.
- Pathogen levels in a WWC should not exceed the criteria for recreational use.
- Wet weather conveyances should be generally free of bioaccumulative or radioactive substances, acidity, heavy metals, inorganic salts, oil and grease, color, or any other substance or condition that creates an environmental hazard or public nuisance.

Even if a WWC exceeds protection levels found in the Water Quality Criteria, they are not suitable for inclusion in Tennessee’s 303(d) List. Of course, if WWC alterations cause or threaten downstream impacts to a classified water, such as altering hydrology in a downstream wetland, that condition should be listed.

c. Interpretation of Numeric Water Quality Criteria

Toxic Substances (Numeric)

- For fish and aquatic life criteria, metals data are “translated” according to the water quality standards before comparison to criteria. For example, toxicity of certain metals can be influenced by the waterbody’s hardness and the amount of total suspended solids in the water. Widely accepted methodologies are used to translate toxicity data.

This additional explanation appears in Rule 0400-40-03-.02 (8):

All fish and aquatic life metals criteria are expressed as total recoverable, except cadmium, copper, lead, nickel, silver, and zinc which are expressed as dissolved. Translators will be used to convert the dissolved fraction into a total recoverable permit limit. One of three approaches to

metals translation will be used: (1) translator is the same as the conversion factor, (2) translator is based on relationships derived from STORET data, (3) a site-specific translator is developed. Where available, a site-specific translator is preferred. For assessing whether criteria for cadmium, copper, lead, nickel, silver, and zinc are exceeded by ambient water quality conditions, the dissolved criteria will also be translated in order to allow direct comparison to the ambient data, if total recoverable.

Assessment staff use a formula to calculate the allowable instream concentration of a hardness-based metal. Sample hardness and TSS levels are needed to accurately run the formula. In the absence of sample specific hardness and TSS values, carefully selected assumptions based on ecoregion historical ranges or similar nearby streams could be used.

Some areas of the state have naturally low hardness levels. These areas include but are not limited to the delta (Subcoregion 73a) along the Mississippi River and the Blue Ridge Mountains of east Tennessee. Additionally, the mountains tend to be low in suspended solids levels. In these areas, assessment staff should be particularly aware of possible metals toxicity.

Assessment staff should also be mindful that unlike other hardness-dependent metals, the toxicity of cadmium increases as suspended solids levels increase.

- According to EPA guidance, numeric chronic fish and aquatic life protection criteria should not be exceeded more than once in a three-year period. This time interval presents an implementation challenge to staff, as chemical sampling normally is on a five-year cycle. Where TDEC has multiple years of chemical data at a site - such as ambient and reference stations, or sites where dischargers collect and submit instream data - TDEC will follow the one chronic exceedance every three years guidance for establishing use impairment. In the more common occurrence where there is a year's worth of data for every five-year cycle, TDEC would not generally initially list a waterbody if only one chronic exceedance was noted, but would usually consider the segment impaired if a chronic criterion is violated twice during the monitoring year. However, a single chronic exceedance may be sufficient to maintain a previous listing for that pollutant.
- A single violation of acute criteria for a toxic substance can provide the basis for an assessment of fish and aquatic life impairment.

- For protection of the Recreational use, monitoring data are compared to either (1) Water and Organisms or (2) Organisms Only numeric criteria. The Water and Organism criteria should only be applied to waters classified for both Recreation and Domestic Water Supply designated uses. The Domestic Water Supply use also has additional applicable numeric toxin criteria. Because criteria for human health impacts are based on long-term exposure to a pollutant, either by drinking treated water or ingesting fish or other aquatic life, ambient levels over time are compared to criteria, unless the magnitude requires a more immediate response.

Pathogen Criteria (Numeric)

- Tennessee utilizes *E. coli* as the pathogen indicator because this group is generally considered more reflective of true human health risk than are fecal coliform data.
- A minimum of ten monthly samples, or a failing geomean, are required to assess waterbodies as impaired due to high bacteria levels, unless the levels in a fewer number of monthly samples geomean are very elevated (see QAPP Table 22 for sampling frequencies at various concentrations), or the stream is already listed as impaired for pathogens and insufficient recent data exists to change the assessment. Unless the stream is documented to have been dry for an extended portion of the year, streams cannot be assessed as fully supporting for Recreation without a minimum of ten monthly samples except as allowed under the Evaluation or Extrapolation Frameworks in this policy (see Section IV.a.).
- Although it is preferable to document a passing monthly geomean (5 samples in 30 days) to delist waters currently impaired for *E. coli* based in whole or in part on a previously failing geomean, EPA will allow the use of an annual geomean of monthly *E. coli* values when monitoring restrictions prevent the collection of a 5 in 30 geomean. EPA will accept the delisting of the *E. coli* parameter for waters that have an annual geomean of monthly *E. coli* values less than the geomean criteria of 126 col/100mL. EPA has concluded that use of a 12-monthly sample geomean as a surrogate for the standard geomean values is an appropriate interpretation of the applicable water quality standard.
- The natural conditions provision does not apply to pathogens, per Rule 0400-40-03-.05(7). Any stream that violates the criterion, regardless of source, should be evaluated for the condition of impairment. If impairment is confirmed, the waterbody should be listed.

- The seasonality of pathogens samples is critical, depending on the sources. Where cattle have access to streams and use them as lounging areas as a refuge from heat, or areas with failing septic tanks, low-flow, dry-season data are more meaningful than higher-flow, wet-season data. Conversely, urban or agricultural runoff sources may be elevated and overflows and bypasses from collection systems and sewage treatment plants more likely in wet season samples. Assessment staff should consider the most likely sources of pathogens and be mindful of the appropriate season and proper timing of sample collection to accurately gauge impacts.
- In the absence of flow data, samples collected in late summer and fall are considered lower-flow or dry-season samples. It is important to note that pathogen samples collected during the “wet season” are not assumed to qualify for the “Rain Event Provision (see Section f. below), are not disregarded, and data indicating point source contributions are never given less consideration due to elevated flows.

Dissolved Oxygen (Numeric)

- Meters must be properly calibrated to ensure accuracy. While it does not happen often, meters can malfunction, and assessment staff should watch for signs of faulty results, such as multiple streams indicating low or elevated oxygen on the same day, or values that seem out of place in the historical range of data at a site. The *Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water* (TDEC 2022) requires post calibration checks, which are especially critical when unexpected readings are obtained. Questionable data should be purged and not uploaded to databases.
- Dissolved oxygen levels in streams and rivers are measured within the thalweg in flowing water. In lakes and reservoirs, dissolved oxygen is measured at mid-depth or five feet if the water is deeper than ten feet. Data collected at extreme low flows should be interpreted with caution as any violations may be due to natural stagnation rather than pollution.
- There are subcategories under the criteria for dissolved oxygen for streams in the Mississippi delta [subcoregion 73(a)], identified trout streams, streams with naturally reproducing trout, and streams within the Blue Ridge Mountain ecoregion (66). Criteria are higher in trout streams and the Blue Ridge, and lower in the Delta. Promulgated criteria should be consulted prior to assessment of these waters.

- If the source of the low dissolved oxygen is a non-anthropogenic source such as groundwater, spring, or wetland, then the low dissolved oxygen is considered natural and not the condition of impairment.
- If the available data are insufficient to make a reasonable judgment of the frequency, magnitude, and duration of dissolved oxygen criterion violations (such as a single low monthly sample), the stream may not be considered impaired. However, in these cases staff should make every effort to obtain continuous monitoring data during the next critical temperature and flow season to assess the diurnal dissolved oxygen conditions more comprehensively.

pH (Numeric)

- The pH criterion range for wadeable streams and rivers is 6.0 - 9.0 standard units. For non-wadeable rivers, streams, reservoirs, lakes, and wetlands, the pH range is 6.5 – 9.0 standard units.
- In order to be accurate, pH meters must be properly calibrated. While it does not happen often, meters can malfunction, and assessment staff should watch for signs of faulty results, such as multiple streams indicating low or elevated pH on the same day, or values that seem out of place in the historical range of data at a site. The *Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water* (TDEC 2022) requires post calibration checks, which are especially critical when unexpected readings are obtained. Questionable data should be purged and never uploaded to databases.
- In low conductivity streams (<100 umhos/cm³) readings from field pH meters may be inaccurate. In low conductivity streams where field measurements appear to violate criteria, a low ionic strength pH sample should be sent to the state lab for confirmation.
- Elevated pH is an importation factor elevating the toxicity of ammonia, so in these conditions, care should be taken to also collect and review ammonia data.
- Increased acidity causes some metals to become more available and therefore more toxic. In many waterbodies assessed as impaired by acidity, it is difficult to discern whether the harm was caused by the reduced pH or the resulting metal toxicity, especially in areas with historical or active mining present.

- Staff should be mindful that each unit of the pH scale going either up or down is an order of magnitude (tenfold) change in hydrogen ions rather than a simple linear change. That means that a pH level of 3 is ten times more acidic than a level of 4. Assessment decisions for pH need to consider this magnitude difference. In reviewing pH data, results cannot be averaged due to logarithmic scale.

Temperature (Numeric)

- The temperature criteria can be violated in three different ways. A (1) temperature difference from downstream to upstream, (2) a rapid rate of change, and (3) exceedance of a maximum temperature. Temperature criteria are more stringent in trout streams.
- Where the maximum temperature criterion has been exceeded, assessment staff should determine whether heat has been increased in the waterbody because of a discharge or withdrawal. If that is not the case, increased temperature may be due to increased sun exposure from impoundments or loss of riparian cover. If temperature is identified as a cause of impairment the contributing cause of the excessive heat and its impact should also be identified as a cause of non-support.
- In lakes, the cause of elevated temperatures might be strong stratification due to the inability of light to penetrate as deeply into the water column because of excessive algae. In that case, nutrients should be considered as a possible additional cause.
- Elevated temperatures also cause ammonia to be more toxic, especially if combined with high pH levels. In eutrophic lakes, this combination of effects is common. Assessors should be mindful of this connection.
- Large dischargers into normally cool mountain streams can cause an undesirable elevation in temperature. Where this is a strong possibility, assessors should ask that the discharger be required to monitor upstream and downstream of their outfall. Staff can use those data to assess the stream.
- Turbines and generation schedules at dams or other power facilities can cause temperature pulsing in tailwaters, dramatically impacting aquatic life. Where these conditions violate water quality criteria, the stream should be identified as impaired by

temperature alteration, with upstream impoundment as source.

- Section 316(a) of the CWA applies to point sources with thermal discharges. It authorizes the NPDES permitting authority to impose alternative effluent limitations for the control of the thermal component of a discharge in lieu of the effluent limits that would otherwise be required under sections 301 or 306 of the CWA. Therefore, discharges from power plants or other facilities that are covered under this provision are not required to meet state temperature criteria. The alternative effluent limitation is that they must maintain a Balanced and Indigenous Population (BIP) of aquatic and other wildlife in the receiving waters. There is very little guidance to states on how to interpret this provision. Generally, it has been Tennessee's interpretation that populations should be similar in makeup and community structure both upstream and downstream of the outfall. These determinations are made through the NPDES permitting process.

It is always important to note that an NPDES permit with a 316(a) provision does not shield the discharger from effects that might be related to heat, such as low dissolved oxygen, fish kills, increased ammonia toxicity, impacts to recreational uses, or propagation of species whose presence or abundance is attributable to alternative effluent limitations. If these impacts occur, then the waterbody should be assessed as impaired.

- In the absence of an NPDES permit with a 316(a) provision, state temperature criteria apply, even if biointegrity measures are met.

Human Health (Numeric)

- There are two types of human health criteria: Water and Organisms, and Organisms Only. Water and Organism criteria apply only where waterbodies are classified for domestic water supply. The Organisms Only criteria apply everywhere else.
- Normally, the criteria for metals are most stringent under the fish and aquatic life protection use because aquatic life tend to be more sensitive to these toxicants than people. However, there are exceptions. The criterion for mercury is lower under the human health (recreational) use. Mercury ambient water quality data should always be compared to the recreational criterion and attention should be given to detection levels to ensure that they are near or below criteria levels.

At present, the lowest criterion for arsenic is the recreational criterion. Particularly in West Tennessee, arsenic can be elevated and should always be sampled and assessed. For antimony and thallium, there are numeric recreational criteria, but no equivalent fish and aquatic life criterion.

The criterion for lead under the fish and aquatic life criterion is hardness dependent and the allowable instream concentration derived from the formula can be over 5 µg/L, the current domestic water supply criterion, which is not hardness dependent. Assessment staff should be mindful that where lead levels are above 5 µg/L, the waterbody should be checked to determine whether it is classified for domestic water supply.

- Because criteria for human health impacts are based on long-term exposure to a pollutant, either by drinking treated water or consuming fish or other aquatic life for a lifetime, ambient levels over time are compared to criteria, unless the magnitude of excursions requires a more immediate response.

MCLs and Other Domestic Water Supply Criteria (Numeric)

- Domestic Water Supply criteria apply only to waterbodies classified for domestic water supply. These criteria are designed to prevent a public water supplier from undue effort and costs to remove pollutants from surface waters. .
- In East and Middle Tennessee, lakes or rivers are commonly used as raw water sources, along with some springs or groundwater. In West Tennessee, sources are almost exclusively groundwater, so few surface streams are classified for domestic water supply west of the Tennessee River.
- In Tennessee, the most common reason for rivers or lakes to be assessed as failing to support the domestic water supply use is nutrients. There is a numeric criterion for nitrate, 10 mg/L. If that level is exceeded, the stream is impaired for this use. (It is unusual for lakes to have nitrate levels that high.) Phosphorus can also create treatment problems.
- Lake eutrophication and the resulting stratification caused by excessive nutrients can impact water treatment in multiple ways. Excessive algae can elevate pH levels, interfering with treatment, and cause taste and odor problems. Additionally, increased

concentration of organics can create disinfection byproducts that are carcinogenic.

- If a public water supplier has reported a significant issue related to the removal of pollutants without numeric criteria, the waterbody is assessed as impaired by that substance. It is critical during the assessment process that staff familiar with public water suppliers within a watershed be consulted regarding treatment issues caused by pollutants.
- Some secondary MCLs are designed to prevent scaling in pipes or system corrosion. Assessment staff should exercise caution in assessing streams or lakes as impaired for those parameters. While dischargers should not be allowed to cause in-stream violations, exceedances caused by natural sources of dissolved solids, like groundwater, should not be assessed as impaired.
- There is a numeric criterion for beryllium for domestic water supply, but not for fish and aquatic life or recreation. As noted in the previous segment, the domestic water supply criteria for certain metals are not hardness dependent like they are under fish and aquatic life protection. For metals such as cadmium, nickel, or lead, staff should be mindful the most stringent criterion might be under the domestic water supply use in situations of higher hardness values.

Nutrient Criteria (Numeric)

- Under the criteria for recreation [0400-40-03-.03(4)(i)], a numeric nutrient response criterion based on chlorophyll *a* has been adopted for Pickwick Lake. The criterion of 18 µg/L is based on an average level during the growing season (April – September). Compliance is measured within the photic zone over the lake's deepest point, the forebay. Primarily, data generated by TVA are used to gauge compliance with this criterion.
- Under the domestic water supply protection criteria [0400-40-03-.03(1)(j)], there are existing nitrate and nitrite criteria of 10 mg/L and 1 mg/L, respectively. These criteria only apply to streams or lakes classified for domestic water supply and should be considered chronic rather than acute criteria. It is uncommon for these criteria to be violated.

Total Dissolved Solids (Numeric)

Assessment staff should be mindful that there is a total dissolved solids numeric criterion of 500 mg/L under both the domestic and industrial water supply classified uses. However, as this criterion is likely designed to prevent scaling of pipes, care should be taken in assessing streams as impaired for this parameter, unless caused by a discharger or landfill.

d. Interpretation of Narrative Criteria

Nutrient Criteria (Narrative)

- The primary designated uses that have narrative nutrient criteria are fish and aquatic life and recreation. As noted in a previous section, a numeric nutrient response criterion based on chlorophyll *a* has been adopted for Pickwick Lake. Otherwise, waters are not generally assessed as impaired by nutrients unless coinciding evidence of negative biological responses are also documented.
- Division staff utilize a weight-of-evidence approach to interpreting the narrative nutrient criterion for fish and aquatic life protection. Factors considered in this approach include concentrations of nutrient parameters such as total phosphorus or nitrate+nitrite, ecosystem dominance by taxa tolerant of excessive nutrients, reductions in available habitat, excessive algal growth, biomass concentrations, harmful algae blooms, or other response variables such as significant diel oxygen swings, elevated temperatures, or pH levels. Streams causing or contributing to downstream nutrient-related biological responses can also be considered impaired.

Not every stream with excessive nutrients will demonstrate equivalent responses of all of these indicators, and some effects may be more obvious than others, but these additional lines of evidence contribute to a stronger and more defensible listing or delisting rationale:

- a. In wadable streams, regional numeric nutrient goals (Denton *et al.*, 2001) for the protection of fish and aquatic life are used as guidance regarding acceptable concentrations. Assessment staff should note that regional nutrient goals should not be applied as if they are acute or chronic numeric criteria based on toxicity.

For concentrations to be considered excessive, they should on average be higher than regional goals, or demonstrate significantly high seasonal spikes.

- b. In streams where continuous dissolved oxygen monitoring has occurred, wide swings in diurnal oxygen levels can be an indication of nutrient enrichment. This type of monitoring is most meaningful under low-flow, elevated-stress scenarios that typically occur in higher temperature summer months (June-October).
- c. The %NuTol metric, a component of the Tennessee Macroinvertebrate Index, is designed for sensitivity to excessive nutrients. In most bioregions, scores between 30% and 50% demonstrate some stressors affecting the macroinvertebrate community while those higher than 50% may indicate and support a listing for nutrient impairment. However, the metric does not include all nutrient-tolerant macroinvertebrates found in Tennessee so low scores do not necessarily mean other negative biological responses do not exist. Taxa lists should be reviewed when the %NuTol is low and nutrient levels are above regional goals to determine if there is a dominance of other nutrient tolerant taxa.
- d. Algae are another important biological indicator when abundant growth is observed. A process for on-site ratings of visible algae concentrations by trained field staff is documented in the SOP for benthic macroinvertebrate sampling. This qualitative scale is slight, moderate, high, or choking. These ratings should be considered supporting evidence when assessing nutrient impairment. Note that algae growth can be limited due to heavy canopy cover, unstable substrate, or herbivore activities even under high nutrient conditions. Dominance of scrapers should be considered if it is suspected that herbivore activity has affected the algal population.
- e. The Division has developed the Tennessee Diatom Index to augment the existing lines of evidence for biological responses in nutrient impaired streams. This index was developed regionally with sister states (AL, KY, GA) and EPA, combining databases, and developing and calibrating index metrics sensitive to nutrient loadings. This scientifically defensible index was specifically designed to evaluate the biological integrity and nutrient-related stressor responses of the diatom community, and is specifically calibrated across the various ecoregions in Tennessee. It is currently being included in evaluations of the narrative nutrient

criteria and assessment of designated use impairment, in conjunction with the various other response variables described above.

- Historically, when evidence of nutrient impairment has been documented, assessment staff focused on identifying and listing the specific nutrient species (e.g., “Total Phosphorous”, “Nitrate+Nitrite”) exhibiting the highest exceedances from ecoregional goals based on ambient monitoring data. Nutrient assessments are complex and often there is a lack of segment-specific studies documenting which nutrient may be limiting and responsible for the biological responses observed. Therefore, staff will transition to a more generic impairment listing of “Nutrients.” As assessments are conducted, staff will consider existing nutrient species listings and will clarify to this new “Nutrients” cause where appropriate. These clarifications will not be considered as delistings for the purposes of ATTAINS documentation, and 303(d) reporting.
- In lakes and reservoirs, strong oxygen and temperature stratification is an indication of nutrient enrichment. Where lake profile information is available, staff should watch for decreased light transmission, elevated temperatures in the upper portions (sometimes above the maximum temperature of 30.5 degrees), a strong thermocline (a rapid decrease in temperature at the depth light can no longer penetrate), and elevated pH due to algae as signs of excessive nutrients. Chlorophyll *a* samples can be used to document biomass.

EPA and Division staff have traditionally used the Trophic State Index developed by Robert Carlson in 1977 as a way of gauging the eutrophication of lakes. Eutrophication is a natural process that can be accelerated by human activities in which lakes move from being nutrient poor (oligotrophic) to having excessive nutrients (eutrophic and hypereutrophic).

Interpretation of Carlson’s Index can be based on Chlorophyll *a* or total phosphorus levels, or the Secchi depth, as seen in the Table 2 below. A Secchi disk is a black and white metal disk that is lowered into a lake until it can no longer be seen by the observer. It is a simple, inexpensive way to measure light penetration.

Chlorophyll *a* and phosphorus levels increase with eutrophication, Secchi depth decreases. Carlson Index scores over 50 are considered eutrophic. Scores over 70 are considered hypereutrophic (see Table 2 below).

Table 2
Carlson's Trophic State Index for Lakes

Trophic Index	Chl (µg/L)	P (µg/L)	SD (meters)	Trophic Class
<30—40	0—2.6	0—12	>8—4	Oligotrophic
40—50	2.6—20	12—24	4—2	Mesotrophic
50—70	20—56	24—96	2—0.5	Eutrophic
70—100+	56—155+	96—384+	0.5—<0.25	Hypereutrophic

There are some natural lakes in Tennessee, but most are actually reservoirs. Where lakes or reservoirs are determined by staff to be eutrophic or hypereutrophic, they should be watched for signs that use support has been impacted. Such signs include strong stratification, excessive algae or harmful algae blooms, elevated surface temperatures, elevated pH levels, fish kills, public complaints about water contact issues, treatment problems for public water suppliers, taste and odor problems in finished water, and low dissolved and elevated metals in reservoir tailwaters.

Where loss of use support is documented, staff should determine whether the entire reservoir or just a portion is impacted. It is not uncommon for large reservoirs to display different water quality characteristics in the various parts of the waterbody. In some cases, problems might be restricted to an embayment. These smaller segments can be assessed differently than the main reservoir for 303(d) Listing purposes as appropriate. As noted previously, streams causing or contributing to nutrient-related biological responses and impairment in a downstream reservoir can also be considered impaired.

Suspended Solids and Excessive Siltation Criteria (Narrative)

- Historically, excessive sediment or siltation has been one of the primary pollutants in Tennessee waterways. The Division has utilized multiple ways to determine if a stream, river, lake, or reservoir is impaired due to silt. These methods include physical measurements, visual observations, chemical analysis (total suspended solids), macroinvertebrate and diatom metrics, and habitat surveys.
- Fish & Aquatic Life Use impairment from excessive sediment or siltation is most often based upon the Habitat narrative criteria. Excessive sediment prevents the quality of

stream habitat from providing “for the development of a diverse aquatic community that meets regionally-based biological integrity goals” (Rule 0400-40-03-.03(3)(n)), and is cited as a parameter associated with this criterion.

- There are two additional narrative criteria for suspended solids and siltation. Excessive amounts of solids and deposits are prohibited in Rule 0400-40-03-.03(3)(c): “There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits, or sludge banks of such size or character that may be detrimental to fish and aquatic life.”

Excessive amounts of suspended solids are prohibited in Rule 0400-40-03-.03(3)(d): “There shall be no turbidity, total suspended solids, or color in such amounts or of such character that will materially affect fish and aquatic life.”

In non-wadable streams suspended solids concentrations at chemical stations can be used to assess sediment-related criteria when other types of data are not available, by comparison with reference stream values.

- The most effective methodology for identification of impairment due to silt in wadable streams is a biological survey that includes a habitat assessment. Benthic macroinvertebrate community metrics such as high % Oligochaetes and Chironomids coupled with low % Clingers can be a good signal of excessive sedimentation affecting the Habitat criteria. Elevated % of *Navicula* diatoms (motile taxa tolerant of sediment) can also be indicative of sedimentation. Regional guidelines for habitat-based parameters associated with siltation (embeddedness and sediment deposition) have been established for each subcoregion (TDEC Macroinvertebrate QSSOP Appendix A, 2021).
- Ecoregions vary in the amount of silt that can be tolerated before aquatic life is impacted. Through work at reference streams, staff found that the appearance of excessive sediment/silt is often, but not always, associated with loss of biological integrity. Thus, for water quality assessment purposes, it is important not only to establish whether aquatic life is being impaired, but also to ensure that the methods used were sensitive to siltation. For those waterbodies where loss of biological integrity can be documented, the habitat assessment, biological submetrics, and stream survey observations can determine if this loss is due to excessive silt deposits.
- Identifying the sources of excessive silt in waterways can be problematic because there may be many potential candidates. Additionally, sources do not necessarily have to be

widespread throughout the watershed to have a major impact, especially because released sediment can have a persistent effect as it moves through the system. Construction-related sources can be spotted through aerial photographs, GIS data layers, staff observations, complaints, and compliance and enforcement activities. In urban areas with high percentages of impervious surfaces, increased stormwater flows can destabilize channel stability and increase in-channel erosion rates. In agricultural areas, aerial photographs can be used to spot high-erosion areas. Across the state, channelization and riparian vegetation loss speeds and worsens sediment transport and bank erosion rates.

Biological Integrity Criteria (Narrative)

- Biological integrity criteria are designed to protect fish and aquatic life. As stated in Rule 0400-40-03-.03(3)(m): *“The waters shall not be modified through the addition of pollutants or through physical alteration to the extent that the diversity and/or productivity of aquatic biota within the receiving waters are substantially decreased or, in the case of wadeable streams, substantially different from conditions in reference streams in the same ecoregion.”*
- Biological surveys using macroinvertebrates as the indicator organisms are the primary method for assessing fish and aquatic life use support. Two standardized biological methods, biorecons and semi-quantitative single habitat (SQSH) samples, are used to produce a biological index score. These methods are described in *Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys* (TDEC, 2021) and are specifically referenced in the water quality criteria.
- Another utilized biological survey method is the biorecon. Multiple habitats can be sampled, and biological scores are compared to the metric values obtained in ecoregion reference streams. Three metrics are examined: taxa richness, number of families or genera of caddisflies, mayflies, and stoneflies (EPT), and number of intolerant families or genera. This method only uses qualitative data and relies heavily on the expertise of the biologist.
- If a more quantitative assessment is needed, a SQSH is collected. Organisms are identified to genus and an index based on seven biological metrics is used for comparison to reference streams. These metrics are EPT taxa richness, total taxa richness, percent EPT-*Cheumatopsyche*, percent oligochaetes and chironomids, percent

clingers-*Cheumatopsyche*, modified North Carolina Biotic Index (NCBI), and percent nutrient tolerant. Percent Crustacea and Mollusca are substituted for %Clingers and ETO (Ephemeroptera, Trichoptera, Odonata) Richness is substituted for EPT Richness in ecoregion 73. Waterbodies are generally considered impaired if the biological integrity falls below 32. This method provides quantified data that can be used to calculate metrics based on relative abundance as well as richness.

- While waterbodies whose TMI scores meet or exceed 32 are generally considered to have good biological integrity, exceedances of stand-alone numeric fish and aquatic life use criteria such as dissolved oxygen, pH, temperature, or toxic substances (described in the previous sections) must be considered and can individually be a cause of impairment of this designated use.
- If both biorecon and SQSH data are available and the results do not agree, generally more weight is given to the SQSH. However, SQSH results may be suspect if the amount of targeted habitat was not adequate or not representative in that stream. In those scenarios more weight may be given to the biorecon, if the surveyed habitats are different than the SQSH.
- The Division has had decades of experience with the TMI from over 10,000 individual stream surveys. Although the recently completed Tennessee Diatom Index is considered a “scientifically defensible method” for evaluating biological community health at this trophic level, at this time the Division will place more weight on the benthic macroinvertebrate data until more experience has been gained with corresponding diatom data.
- If biological data from the Division and another agency do not agree, more weight is given to the state’s data unless the other agency’s data are considerably more recent and the sample methods/data quality are consistent with TDEC SOPs.
- To be comparable to ecoregion guidance and to use the TMI calibrated metrics, streams must be similar size and drainage as the reference streams in the bioregion and must have at least 80 percent of the upstream drainage within that bioregion.
- In large non-wadable waters where SQBANK sampling is not appropriate, biological integrity may be extrapolated from monthly collection of the full suite of ambient

chemical parameters, as well as any other listed pollutant(s), or additional informative physicochemical parameters during the monitoring year of the watershed cycle

Habitat Data (Narrative)

- Habitat alteration of one or more parameters is one of the major causes in waterbody impairment in Tennessee. The criterion for habitat is an example of a condition index. That means that the Habitat criteria is based upon measurement of the parameters associated with habitat. *“The quality of stream habitat shall provide for the development of a diverse aquatic community that meets regionally-based biological integrity goals”* (Rule 0400-40-03-.03(3)(n)).
- One tool Division staff use is a modified version of a standardized scoring system developed by EPA to rate the habitat in a stream (Barbour, *et al.*, 1999). The *QSSOP for Macroinvertebrate Stream Surveys* (TDEC, 2021) provides the modified State guidance for completing a habitat assessment and evaluating the results.
- Total and individual habitat metric scores as assessed by Division biologists are compared to regional goals derived from the ecoregion reference stream database. These regional goals are based on 75 percent of the median reference condition scores for the ecoregion.
- In addition to the standardized Habitat Survey metric scores, this criterion is also evaluated based upon sampler observations, notes, and photographs, as well as information obtained from aerial imagery.
- According to the narrative criterion, habitat should not be assessed as impaired unless biological harm can be established. In some obvious scenarios, this harm can be assumed, for example in systems drastically altered by historic channelization, encapsulation, impoundment, or concrete lining of streams. See Evaluated Framework Protocol section below.

Color (Narrative)

- The criterion for color is based on the creation of objectionable conditions. Color is measured as true (dissolved) color or apparent (particulate and dissolved) color. The type of measurement that is most relevant is site-specific, and based on whether the color is dissolved or particulate.
- Color associated with sediment or algae can be objectionable, but should be generally assessed as excessive sediment or algae (if appropriate) rather than as a violation of the

color criterion.

- Naturally-occurring color, such as tannins in wetlands, falls under the “natural conditions” clause in water quality standards and should not be assessed as impairment.
- True or apparent color data can be compared to levels found in reference streams for that ecoregion.
- Other relevant information sources include discharge monitoring reports from upstream industries, contacts from other agencies, and public complaints.

Flow (Narrative)

- The criterion for flow under both recreation and fish and aquatic life is simply that flows should support the intended use.
- Like other criteria, the natural conditions provision applies. That means that assessors must ensure that alteration or removal of flow is caused by human activities such as dams, diversions, or withdrawals rather than natural conditions such as beaver dams, drought, or karst features.
- Although it is well established that the anthropogenic alteration of natural hydrologic regimes can result in excessive peak flows which destabilize channel morphologies, accelerate bank erosion, and/or scour benthic habitat, currently these impacts are more commonly listed for sediment, substrate alteration, or another habitat-related parameter, and not a flow-related cause.

e. Interpretation of Natural Conditions Provision

Tennessee’s water quality standards provide, *“With the exception of pathogens, those excursions caused by natural conditions (not anthropogenic in nature) will not be considered impairment.”* Rule 0400-40-03-.05(7).

In addition, Rule 0400-40-03-.05(7) sets out that while any excursion from water quality criteria is a violation, violations caused by natural conditions should be treated differently.

For purposes of water quality assessment, with the exception of pathogens, excursions of water quality standards caused by natural conditions will not be considered the condition of impairment. Examples of natural conditions include alterations caused by beaver activity, non-construction related rockslides of pyritic materials, and groundwater with naturally elevated metals or low dissolved oxygen levels.

Documentation that similar criteria violations are occurring in other stream segments in a given region or area, even “reference” streams, is not in itself an adequate argument that a criteria violation being seen in a specific waterbody therefore must represent a “natural condition.” Anthropogenic impacts and effects are nearly ubiquitous in many regions of the state, and very careful study planning and data analysis would be necessary to support such an argument.

When the magnitude, frequency, and duration of water quality violations causes the loss of a use, that waterbody is considered to be impaired, unless the parameters are elevated entirely due to natural rather than anthropogenic sources. Table 3 provides examples of water quality criteria violations that might be viewed as natural in origin as opposed to those assessed as anthropogenic in origin.

Table 3
Examples of Natural Conditions vs Anthropogenic Causes

Parameter(s)	Nature of Issue	Example of Natural Conditions	Example of Anthropogenic Causes
Low DO and elevated metals	Groundwater with naturally suppressed DO levels or elevated metals.	Springs and natural groundwater connections. (Gaining reaches of streams.)	Oil, water, or gas well drilling mishaps.
Flow issues	Prolonged dryness	Drought. Losing reaches of streams. Karst features.	Excessive water withdrawals or diversions. Streams in karst areas being “sunk” by construction activities. Failing or improper placement of pipes.
Flow issues	Stagnant or reduced flows due to impoundments.	Beaver dams.	Concrete, rock, or earthen impoundments. Sand plugs caused by channelization.

Elevated biomass	Plant or algae response to nutrients	Wetlands or lakes in delta region of state without other nutrient sources in watershed.	Reservoirs with excessive inflows of nutrients from surrounding watershed.
Low pH	Elevated acidity	Landslide areas in acid-bearing rock formations.	Disturbance of acid-bearing rock formations by construction or mining.

Natural Conditions Parameter Specific Information

Metals

There are natural sources of most metals and they are often found to be elevated in groundwater, rocks, and soil. Metals found in groundwater include but are not limited to iron and manganese. Other metals commonly found in native rock include iron, manganese, and aluminum. Lead and copper are components of soil that can cause water quality criteria violations in areas of erosion and low hardness water (hardness affects toxicity of some metals).

For metals with low toxicities, such as manganese and iron, background is considered to be the levels found in reference streams. These metals are often more likely to cause a habitat problem if they get to high enough levels to precipitate out on substrate surfaces and interstitial spaces.

For aluminum, the Division uses EPA's acute criterion for exceedances due to man-made sources such as mining or reclamation. The Division has not adopted a chronic criterion for aluminum. In 1988, EPA suggested a chronic criterion of 87 ug/l, but this suggested level is frequently exceeded at Division reference streams in several areas of the state, with no apparent impact to sensitive taxa, making this number difficult to defend legally. As with iron and manganese, aluminum levels found at reference streams are used to determine background (natural) levels.

It is unusual for copper and lead to exceed formula-based numeric criteria, but when they do, those events are considered violations, even if due to background soil concentrations, if those are due to man induced erosion. While there are background levels of mercury from rocks, those are generally insignificant in Tennessee compared to mercury from legacy sites, industrial dischargers, and the burning of coal. Thus, criteria violations for mercury in Tennessee are always considered anthropogenic in origin.

Organic Contaminants

Pesticides, Herbicides, Other Man-Made Organic Contaminants – There are no natural sources of these contaminants.

Sediment

There are natural and ecologically stable rates and amounts of sediment transport in streams. TDEC's guidance for habitat assessments is an ecoregion-based approach that incorporates the natural variability in sediment loading statewide. When ambient sediment levels significantly exceed reference conditions due to anthropogenic sources or hydromodifications, this will be reflected in lowering of Habitat Survey scores, and reflected in sampler observations and notes. When these elevated levels cause impacts to biointegrity or habitat conditions, or if the narrative "free from" criterion is being violated, then Sedimentation/ Siltation will be considered a cause of impairment.

Habitat and Nutrients

Similar to sediment, compared to reference condition data, and determined to be causing impacts to biointegrity.

Pathogens

There are natural sources of pathogens, however, because the human-health-based criterion does not differentiate between natural or background sources, whenever that criterion is exceeded, the stream will be considered impaired. The source will be identified as natural in origin, if TDEC has determined this to be true. E. coli from native wild populations of animals would be considered "natural." Domesticated animals such as livestock or pets, or non-native populations (such as a captive deer hunting reserve) are not considered natural sources.

Relationship of Water Quality Criteria Violations Caused by Natural Conditions to the Antidegradation Statement

According to the Antidegradation Statement, when water quality for a specific parameter is at or not meeting appropriate water quality criteria, that waterbody is unavailable for additional measurable degradation of that parameter. (Or in the case of physical alterations, degradation above a *de minimis* level.) Although a stream that violates water quality standards due to

natural sources is not considered to be polluted, it is still unavailable for additional measurable degradation.

The comment field on the ATTAINS Database will be used to communicate that the waterbody violates water quality standards. Permitting staff have access to this information and apply it to their antidegradation review.

f. Interpretation of the Rain Event Provision

Tennessee's water quality standards contain a provision (Rule 0400-40-03-.05(5)) specific to pathogen data that allows rain event samples to be counted as data outliers: *"When interpreting pathogen data, samples collected during or immediately after significant rain events may be treated as outliers unless caused by point source dischargers. Such outlier data may be given less weight in assessment decisions than non-rain event sampling results."*

Determining antecedent rainfall and instream flow conditions at the time a sample was taken can rely on multiple information sources – nearby flow gauges, real-time flow measurements, sampler observations or photographs, data from nearby on-line rain gauges, or NOAA models.

This provision is a more specific example of the general concept that the Division should consider the nature, magnitude, frequency, and duration of all water quality standards violations when assessing the support of designated uses. The pathogen criterion is intended to protect human health from exposure through bodily contact, and as a practical matter high flow storm events represent a hydrologic condition in which people are less likely to be recreating in state waters.

Rain events samples may be given less weight, but that does not mean they are completely ignored or cannot be used as part of the assessment process. The Division typically collects 12 monthly E. coli samples during a monitoring year. If up to two of these observations exceeded criteria but were documented to be associated with significant rain events and all the other data met criteria, the Division may assess these streams as fully supporting for Recreation use. If more than two samples were elevated, even if proximate to storm events, or the other non-storm event data was consistently elevated, the stream would be considered impaired. Additionally, the Division would generally not use this provision as a basis for delisting a stream currently assessed as impacted by pathogens – these streams should clearly meet criteria under all conditions before delisting would be proposed.

TDEC's Chemical and Bacteriological SOP suggests that monitoring staff should generally avoid sampling when streams are over "bank full" volume. However, this provision should not be interpreted as meaning that the Division is prohibited from sampling under any conditions or

that rain event samples are not violations if they exceed criteria, especially for criteria designed to be protective of fish and aquatic life.

Additionally, as noted the rain event provision does not apply if the source of pathogens is point source in origin, such as collection system overflows or animal waste lagoon failures.

IV. Listing and Prioritization

a. Framework for Establishing “Evaluated” and “Extrapolated” Water Quality Assessments Protocols

A committee within the Division was created in 2015 to explore ways to slow or reverse the trend in water quality assessments towards the “two color map.” The two color map is a projection of a possible outcome in which, due to limited monitoring resources and a previous emphasis on sampling impaired waters every cycle, most waterbodies in Tennessee are assessed as either “impaired” or “not assessed,” thus producing a map with only two colors, gray and red.

In the initial meeting of the committee, it was the consensus of the group that in order to reverse the two-color map trend, a combination of techniques would have to be employed, including but not limited to: new technology, maximizing partnerships, and increasing sampling efficiency.

The group decided to adopt a consistent and defensible methodology for “extrapolating” recently collected biological or chemical data to assess smaller adjacent segments with similar land uses but without direct monitoring stations or data. Extrapolation involves extending the geographical reach for which recent monitoring data can be applied during assessments.

In addition, the group determined to enhance the use of “evaluated” assessments. Evaluated assessments are based on professional judgment, historical data, and information sources other than recently collected benthic or chemical data. Evaluation involves extending the temporal period for which previous monitoring data can be applied during assessments, along with review of other information of the current status of the watershed and stream condition.

This policy is designed to not only assist the assessment process, but to also aid in the development of the annual monitoring workplan.

Introduction

- As a science agency, TDEC’s credibility and professional ethics must be maintained at a high level and its decision processes must be above reproach. This policy of extrapolating data and using evaluated assessments is neither intended, nor should it be used, to bias Tennessee’s water quality assessments in the direction of “fully supporting” waters. As with other assessment techniques, extrapolation and evaluation should also be applied to impaired waters that meet the conditions of these protocols.
- Recent physical, chemical, or biological survey results are not the only forms of data available to inform the assessment process. While recent stream sample data are the ideal, there are other valid information sources, such as GIS analysis of land use, recent aerial photographs, models, self-monitoring reports, compliance inspection results, and overflow reports. Stream assessment decisions are based on multiple sources of evidence and the agency weighs all available information to arrive at a conclusion.
- An important part of TDEC’s scientific credibility as an agency is consistency. Once statewide guidance has been developed, it should be followed at every step of the assessment process. All methodologies evolve, but changes to this process should be preceded by a change in the policy.
- Both field office and central office staff have critical roles and water quality assessments in Tennessee are created in partnership. Field Office staff have undisputed expertise in local conditions that form the basis of assessments. Central Office staff have the equally important task of ensuring that the assessment decision process is comprehensive, defensible, consistent throughout the state, and compliant with existing laws and regulations.
- Evaluated or extrapolated information can only be used in a limited set of circumstances (and for a limited amount of time in many cases) for fish and aquatic life assessments and an even more limited set of circumstances for recreational use assessments. The Domestic Water Supply use can only be assessed by using recent data. As the Division has done historically, assessment of the uses of irrigation and livestock and wildlife watering can be done with evaluated or extrapolated information, but only if either fish and aquatic use and/or recreation are also being similarly assessed.
- Monitoring resources are not unlimited. The policy will help the Division to maximize the possibility of assessing waterbodies with nearby extrapolated data or with data other than recent chemical or benthic surveys. It is generally intended for use in situations where experience, current data, and prior data have shown there is very little

question about the support or non-support of the given assessment unit. Situations where this relative certainty of continued or inferred support status is questionable for any reason should not be considered candidates for the Evaluated or Extrapolated protocols.

Data Extrapolation for Assessment Purposes

Potential candidates for Extrapolation of recent monitoring data generally fall into two categories:

- 1) *Small Assessment Units that are tributaries to larger downstream Assessment Units with data collected during the most recent watershed cycle.* Upstream segments with a relatively small number of stream miles and drainage areas can be assessed for the fish and aquatic life use provided:
 - It is the consensus judgment of assessment staff that the conditions in these tributary Assessment Units mirror those in the downstream monitored waterbody;
 - Both Assessment Units are within the same ecoregion and general land use type;
 - The extrapolated waterbody has its confluence with the assessed waterbody upstream of the latter's active monitoring station;
 - The distance between the monitoring station and the extrapolated waterbody is close enough to represent the water quality contribution of the extrapolated segment and no major tributary confluences occur between the extrapolated tributary and the active monitoring station;
 - The recent data being extrapolated is conclusive and clearly indicates an unambiguous use support status;
 - The extrapolated waterbody is proportionally a small contributor in drainage area and hydrology to the assessed receiving waterbody; and
 - There are no significant permits within the extrapolated waterbody.

- 2) *Larger order, mainstem segments of streams or rivers in which the immediate upstream and downstream mainstem Assessment Units have data collected during the most recent watershed cycle.* Bracketed segments can be assessed for the fish and aquatic life or recreation uses provided:
 - It is the consensus judgment of assessment staff that the conditions in the mainstem Assessment Units over which data is to be extrapolated mirror those in the upstream and downstream monitored segment reaches;
 - Both the monitored and extrapolated Assessment Units are within the same general land use type;

- The distances between the monitoring stations and the bracketed extrapolated mainstem segment are in close enough proximity to be representative of the water quality within the extrapolated segment, and no major additional tributary confluences occur between the extrapolated reach and the active monitoring stations;
- The recent data being extrapolated is relatively conclusive and clearly indicates an unambiguous use support status; and
- There are no significant active permits within extrapolated waterbody segment.

When developing the draft monitoring workplan, waterbodies whose previous assessment was based on extrapolated data should not be proposed as candidates for evaluation, because their previous assessment was not based on recent benthic or chemical data from the waterbody itself. Similarly, data or other information from a currently evaluated waterbody cannot be used for further extrapolation. The assessed waterbody should have recent monitoring data available – an assessment unit cannot be evaluated, then further extrapolated.

Data Evaluations for Assessment Purposes

Evaluated Assessments Eligible to Be Considered “Fully Supporting Based on Factors Other Than Recent Chemical or Benthic Data.”

Waterbodies fully contained within the Great Smoky Mountains National Park:

- Can be assessed as “fully supporting” for fish and aquatic life provided they have not been recently altered and are at elevations below 5,000 feet. (At elevations above 5,000 feet, acidification due to atmospheric deposition may occur.)
- Can be assessed as “fully supporting” for recreation provided they do not contain herds of mammals (such as horse stables or gangs of elk), campgrounds, or permitted discharges.
- When developing the draft monitoring workplan, waterbodies that are proposed as candidates to be evaluated rather than monitored because they fall under this category should be specifically identified but may be compiled into a group for convenience. A

brief rationale for not monitoring these waterbodies should be provided (e.g., no stables, less than 5000 feet in elevation, no private inholdings or campgrounds, etc.)

- Waterbodies Evaluated under this category may be reviewed each monitoring and assessment cycle to determine if they remain qualified candidates, regardless of how many previous cycles the Evaluated status has been used, or when the last biological or chemical data were collected.

Waterbodies fully contained within Designated Wilderness Areas within the Cherokee National Forest:

- Can be assessed as “fully supporting” for fish and aquatic life provided they are at elevations below 5,000 feet.
- Can be assessed as “fully supporting” for recreation provided they do not contain herds of mammals (such as horse stables or gangs of elk), campgrounds, or permitted discharges.
- When developing the draft monitoring workplan, waterbodies that are proposed as candidates to be evaluated rather than monitored because they fall under this category should be specifically identified but may be compiled into a group for convenience. A brief rationale for not monitoring these waterbodies should be provided.
- Waterbodies Evaluated under this category may be reviewed each monitoring and assessment cycle to determine if they remain qualified candidates, regardless of how many previous cycles the Evaluated status has been used, or when the last biological or chemical data were collected

Other Waterbodies fully contained within the Cherokee National Forest:

- Can be assessed as “fully supporting” for fish and aquatic life provided they have not been recently altered (including logging, large prescribed burns, extensive off-road recreation, or mining), do not have significant private inholdings, and are at elevations below 5,000 feet.

- Can be assessed as “fully supporting” for recreation provided they do not contain potential sources of pathogens such as private inholdings of land, herds of mammals, permitted discharges, or developed campgrounds.
- When developing the draft monitoring workplan, waterbodies that are proposed as candidates to be evaluated rather than monitored because they fall under this category should be specifically identified but may be compiled into a group for convenience. Aerial imagery and any USFS records of recent logging or proscribed burns should be reviewed. A brief rationale for not monitoring these waterbodies should be provided.
- Waterbodies Evaluated under this category may be reviewed each monitoring and assessment cycle to determine if they remain qualified candidates, regardless of how many previous cycles the Evaluated status has been used, or when the last biological or chemical data were collected.

Waterbodies within the Big South Fork National River and Recreational Area:

- Can be assessed as “fully supporting” for fish and aquatic life provided they are fully contained within the park, have not been altered, have no private inholdings of land, and no history of mining.
- Can be assessed as “fully supporting” for recreation provided they are fully contained within the park, have no herds of mammals or campgrounds, and have no private inholdings of land.
- When developing the draft monitoring workplan, waterbodies that are proposed as candidates to be evaluated rather than monitored because they fall under this category should be specifically identified, but may be compiled into a group for convenience. A brief rationale for not monitoring these waterbodies should be provided.
- Waterbodies Evaluated under this category may be reviewed each monitoring and assessment cycle to determine if they remain qualified candidates, regardless of how many previous cycles the Evaluated status has been used, or when the last biological or chemical data were collected

Waterbodies with High Biological Integrity in Stable or Undeveloped Watersheds

- Wadeable streams that scored either 36 or greater on a SQSH or a 15 on a Biorecon in the previous assessment cycle may be assessed as “Fully Supporting” for Fish & Aquatic Life provided that it is the consensus judgment of assessment staff based on site visits, or other knowledge/data sources that the conditions in these streams and watersheds have not materially changed.
- Streams in this Evaluated category are not eligible for similarly assessing the Recreation classified use without sufficient recent pathogen data.
- When developing the draft monitoring workplan, streams that are proposed as candidates to be Evaluated rather than monitored because they fall under this category should be specifically identified. A brief rationale for not monitoring these streams should be provided which explains the basis for the belief that conditions have not changed (e.g., site visits). However, conditions should be presumed to have potentially changed if the stream’s watershed is being rapidly developed, is in an urbanized area, or an area with intensive agriculture.
- Stream assessed under this category may skip biological sampling for one assessment cycle, but not for two. Staff should be careful to avoid having too many sites postponed to the second cycle to avoid creating an overly heavy workload the following cycle.

Limitations Placed on the Evaluated Category “Fully Supporting Based on Factors Other Than Recent Chemical or Benthic Data.”

- Waterbodies evaluated under this category will be differentiated from other “fully supporting” assessments based on recent monitoring data by noting them as “evaluated” in ATTAINS, and will be given a different color on assessment maps.
- Evaluated waterbodies cannot be expanded to incorporate more miles than the original assessment that was based on recent chemical or benthic data.

Evaluated Assessments Eligible to Be Considered “Not Supporting Based on Factors Other Than Recent Chemical, Bacteriological, or Benthic Survey Data”

Waterbodies with Extensive Physical Alterations or Very Poor Biological Integrity

- Consistent with existing policy, streams previously assessed as impacted due to flow or habitat alteration from relatively permanent impacts such as upstream impoundments, channelization where site constraints (e.g. in urban settings) are preventing natural channel evolution and recovery, culverting, or hard armoring do not require new data be collected each cycle if the condition is still present.
- Unassessed streams that are extensively concrete lined, or encapsulated can be presumed to be habitat impaired, especially if they are tributaries to habitat-impaired streams with recent data (see Extrapolation Protocol section above).
- Streams that scored either 20 or less on a SQSH, or a 5 or less on a biorecon in the previous assessment cycle can be assessed as “Not Supporting” the fish and aquatic life classified use provided that it is the consensus judgment of assessment staff that :
 - 1) the conditions in these streams have not improved,
 - 2) the previous low scores were not due to natural conditions such as prolonged dryness, or beaver activity,
 - 3) the previous low scores were not due to a shorter-term activity such as road construction or land development, and,
 - 4) no known BMPs or remediation efforts have taken place.

Stream assessed under this Evaluated subcategory can miss having data collected for one assessment cycle, but not for two. Staff should be careful to avoid having too many sites postponed to the second cycle to adequately sample during that monitoring year.

- Waterbodies evaluated under this category will be differentiated from other “not supporting” assessments based on recent monitoring data by noting them as “evaluated” in ATTAINS, and will be given a different color on assessment maps.
- When developing the draft monitoring workplan, waterbodies that are proposed as candidates to be evaluated rather than monitored because they fall under this category should be specifically identified. A brief rationale for not monitoring these waterbodies should be provided (e.g., hard armoring, upstream impoundment) that includes an explanation of why staff feel that conditions have not changed.

Waterbodies with other documented pollutant sources

- Waterbodies may be assessed as impacted by parameters in the absence of stream data if effluent data from dischargers indicate that at that volume and concentration of parameters, the discharge would cause the stream to violate water quality standards. An example of this might be chronic ammonia permit violations from a sewage treatment plant.
- Waterbodies may be assessed as impacted by pathogens based on factors other than in-stream data if in the professional judgment of the assessment staff, there is a high likelihood that the water quality standard is being violated. This type of evidence might include the presence of sludge banks, failing animal waste lagoons, chronically inadequate treatment at domestic wastewater plants, bypass of treatment, and data from collection system overflow reports.
- Waterbodies evaluated as impacted by chemical parameters or pathogens one cycle will be considered a high priority in future sampling plans.
- Streams or lakes with legacy chemicals should be assessed as impacted for the recreational use if a fishing advisory is present, even if recent tissue data are not available. Parameters identified as impaired should be the ones upon which the advisory is based.

b. De-listing of Streams Previously Assessed as Impaired

Because the mission of the Division is to protect water quality and maintain support of all designated uses, the type, amount, and confidence in the data used during the assessment process may differ when determining when a previously listed stream is now consistently meeting the relevant water quality criteria and should be a candidate for delisting. In general, the Division will be more conservative in terms of the conclusiveness of the available data prior to delisting, as compared to an initial assessment or maintaining an existing support condition.

This conservative approach can also manifest in certain situations with the division maintaining a listing for an additional monitoring cycle when most recent data may indicate a chemical parameter level is still consistently elevated, but just below criteria

threshold, or indicate very marginal biological support. A sudden and significant change in results from historical trends may also need to be confirmed before delisting.

This more conservative assessment of data in potential delisting scenarios is especially important with pathogens and other impairments of the Recreation use, because these are directly tied to human health. More information on pathogen delisting can be found in **Interpretation of Numeric Water Quality Criteria** and **Interpretation of the Rain Event Provision** sections.

Generally, in the absence of data documenting use support, waterbodies previously assessed as impaired should remain assessed as impaired. However, possible exceptions might be the moving of a discharge or bypass point from a stream or the closing of a dairy that was the primary pathogen source within a watershed. These situations will be considered on a case-by-case basis, and collection of new, confirming data is still recommended when possible.

Previous impairment listings based on extrapolation, evaluated data, or best professional judgment without instream data may be delisted based on the same weight of contrary data. For example, if a stream was previously listed for pathogens based on overflow reports rather than instream data, a significant reduction in overflows could be a sufficient basis for delisting.

Delisting of individual parameters related to the narrative nutrient and habitat criteria when the biological integrity and fish and aquatic life use are still impaired can present difficulties. This can include parameters such as sediment, riparian loss, or nutrients. Because these criteria are narrative, and the initial listing of a related parameter is generally based on a suite of converging lines of evidence, it is difficult to empirically document the absence of continued impact from that specific parameter when biology is still not meeting goals. Similar converging lines of evidence will be used to support delisting such parameters.

For example, a stream was listed based on previous data documenting low biological integrity and indicating channelization impacts and elevated nutrients levels were the contributing cause of this impairment. Current monitoring data confirm low biological integrity remains, however these data also documented lower levels of nutrients in monthly sampling, a new diatom sample showing a very healthy community, the % NuTol for benthic invertebrates was quite low, and no significant algae growths noted (as had been previously). The narrative nutrient criterion requires indications of a

negative biological response to be considered compromised, and all current data do not indicate such a response, and in fact indicate nutrients are no longer a factor in the continuing impairment of the Fish & Aquatic Life use. Therefore, nutrients would no longer be considered to be a contributing cause and the parameter should be delisted.

c. Identification of Threatened Waterbodies

When multiple years of water quality data can be used to establish a trend that indicates that a water quality criterion is likely to be exceeded in the near future, that stream will be identified as threatened by the specific pollutants (but without attendant Sources), included in the 303(d) List, and assigned a TMDL priority.

d. Identification of Assessment Category

Tennessee uses the assessment process and categories recommended by EPA and determined in ATTAINS. Waterbodies impaired or threatened by one or more pollutants are placed in one of the following categories. Note that impaired streams can contain pollutants in more than one category (under Category 4 or 5), especially if a TMDL has been developed for some pollutants, but not others.

Category 1 waters are **fully supporting** of all designated uses. These streams, rivers, and reservoirs have been recently monitored, or were assessed using the Evaluated or Extrapolated Framework protocols, and meet the most stringent water quality criteria for all designated uses for which they are classified. The biological integrity of Category 1 waters favorably compares to reference streams in the same subcoregion and pathogen concentrations are at acceptable levels.

Category 2 waters are **fully supporting** of some designated uses, but have not been assessed for all uses. In many cases, these waterbodies have been monitored or evaluated and are fully supporting of fish and aquatic life, but have not been assessed for recreational use.

Category 3 waters are **not assessed** for any use due to insufficient or outdated data. However, streams previously identified as impaired are not moved to this category simply because data are old.

Category 4 waters are **impaired**, but a TMDL has been completed or is not required. Category 4 has been further subdivided into three subcategories.

Category 4a pollutant-impaired waters have all necessary TMDLs developed and approved by EPA. (Note: if not all TMDLs have been completed for the impaired segment, the segment remains in Category 5.)

Category 4b specific pollutants in impaired waters do not require TMDL development because “other pollution control requirements required by local, State or Federal authority are expected to address all water-quality pollutants” (EPA, 2003). An example of a 4b stream might be where a discharge point will be moved in the near future to another waterbody with more assimilative capacity.

Category 4c impaired waters in which the impacts are not caused by a pollutant (e.g., flow alterations).

Category 5 waters have been recently monitored, or assessed using the Evaluated or Extrapolation Framework protocols, and found to not meet one or more water quality standards. These waters have been identified as **not supporting** one or more designated uses. Category 5 waterbodies are moderately to highly impaired by pollutants and need to have TMDLs developed. Category 5A is reserved for those Category 5 waters for which an alternative, advanced restoration plan (ARP) has been accepted by EPA. All Category 5 waters are included in the 303(d) List. The current 303(d) list may be viewed at <http://www.tn.gov/environment/article/wr-wq-water-quality-reports-publications>

e. TMDL Prioritization

TMDL priorities are parameter-specific, and methodologies have not yet been developed for all pollutants or conditions. Thus, a stream that has multiple causes of impairment may be high priority for one cause, but low priority for another.

HIGH (H) Tools are available to produce the TMDL and the stream is in one of the watersheds being studied in the next two years. The TMDL will be produced in the next two years.

MEDIUM (M) Tools are available to produce the TMDL, but the stream is not in a watershed being studied in the next two years. The TMDL will be produced in the next five to eight years.

LOW (L) Tools are not currently available to produce the TMDL or the stream is not in the watershed being studied in the next two years. The TMDL will be produced in the next 8-13 years. Alternatively, a Low Priority may indicate that the segment is a TMDL Vision priority, or an alternative restoration strategy will be produced in advance of a TMDL.

NOT APPLICABLE (NA)

- 4a - A TMDL has already been completed, submitted to EPA, and approved by EPA.
- 4b - A TMDL is not needed because a different type of control strategy is in place which will bring about compliance with the criterion in a reasonable amount of time.
- 4c – The impact to the stream is not being caused by a pollutant.

f. Public Participation

Each year, prior to the start of the assessment process for that state fiscal year, the Division issues a public notice requesting that citizens, municipalities, the regulated community,

academia, and other entities submit data they would like to have considered in the assessment process. The watersheds targeted for reassessment are identified, but data from other watersheds are also accepted.

Potential submitters are reminded that the agency has data quality control objectives. Submissions that do not meet these objectives may be used as a screening tool rather than to assess streams. Data are requested in electronic format and to provide location information so the Division can tell where they were collected.

In the same time period, individual letters are sent to long-term cooperating agencies requesting data for the targeted watersheds. These agencies include the Tennessee Valley Authority and U.S. Army Corps of Engineers.

Odd-numbered year water quality reassessments are uploaded into ATTAINs but are not sent to EPA or published in a 303(d) list until the following even-numbered year. In even-numbered years, a draft List of Impaired Waters is published and a public notice is issued. Individual 303(d) listings, the identification of assessment category, and TMDL prioritization are all issues upon which the public is invited to comment. Following the completion of the review period, comments are considered and addressed and the 303(d) List, assessment categories, and TMDL priorities are revised as appropriate.

g. Resolution of Disputed Assessments

At times, entities submitting data will also provide comment about what the assessment decision should be. The Division appreciates the sharing of these comments, but cannot be bound by them, since its responsibility is to assess streams based on its independent analysis of all available data and understanding of SOPs, policies, rules, and regulations.

When entities and the Division have data in the same segment during the same time period, in many cases the data will correlate. In cases in which they do not, more weight will be given to the Division's data in assessment decisions. Additionally, the Division reserves the right to wait for additional data or assessment cycles to make a change of a stream's existing assessment when data are borderline, may represent a short-term condition, or appear to be an outlier.

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