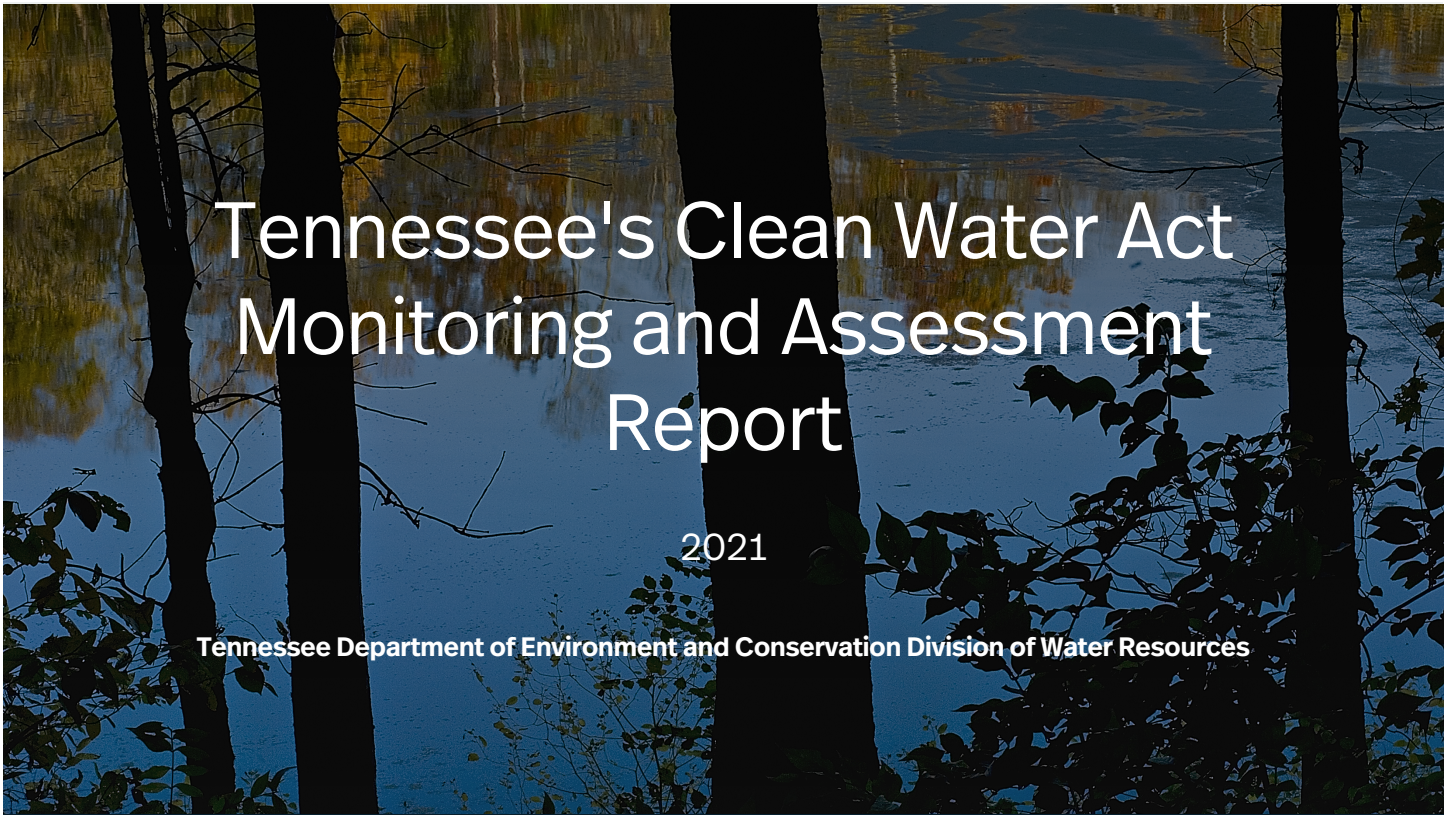

Tennessee's Clean Water Act Monitoring and Assessment Report

2021

Tennessee Department of Environment and Conservation Division of Water Resources

> *Recognizing that the waters of Tennessee are the property of the state and are held in public trust for the use of the people of the state, it is declared to be the public policy of Tennessee that the people of Tennessee, as beneficiaries of this trust, have a right to unpolluted waters. In the exercise of its public trust over the waters of the state, the government of Tennessee has an obligation to take all prudent steps to secure, protect, and preserve this right. (The Tennessee Water Quality Control Act, 1999)*

The Tennessee Department of Environment and Conservation is responsible for managing, protecting, and enhancing Tennessee's natural resources. Within the Department, the Division of Water Resources focuses on activities related to surface water, ground water and drinking water. Section 305(b) of the Federal Water Pollution Control Act, commonly called the Clean Water Act, requires a biennial analysis of water quality in the state. The Tennessee Water Quality Control Act also requires that the division report on the status of water quality. The Division will use this collection of story maps to help inform and clarify how waters are assessed in our state, how causes of pollution are determined, and what is being done to protect, improve and restore our valuable water resources.

Watershed Management Approach

Watershed Management Approach

Part of 1 of 5 - Tennessee's Clean Water Act Monitoring and Assessment Report

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Water Quality Assessment Process

Water Quality Assessment Process

Part 2 of 5 - Tennessee's Clean Water Act Monitoring and Assessment Report

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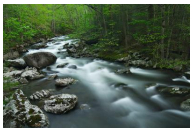

Water Quality Status

Water Quality Status

Part 3 of 5 - Tennessee's Clean Water Act Monitoring and Assessment Report

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Causes & Sources of Pollution

Causes & Sources of Pollution

Part 4 of 5 - Tennessee's Clean Water Act Monitoring and Assessment Report

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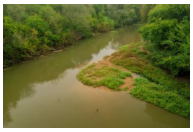

Successes, Projects & Outreach

Successes, Projects and Outreach

Part 5 of 5 - Tennessee's Clean Water Act Monitoring and Assessment Report

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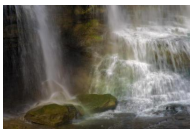


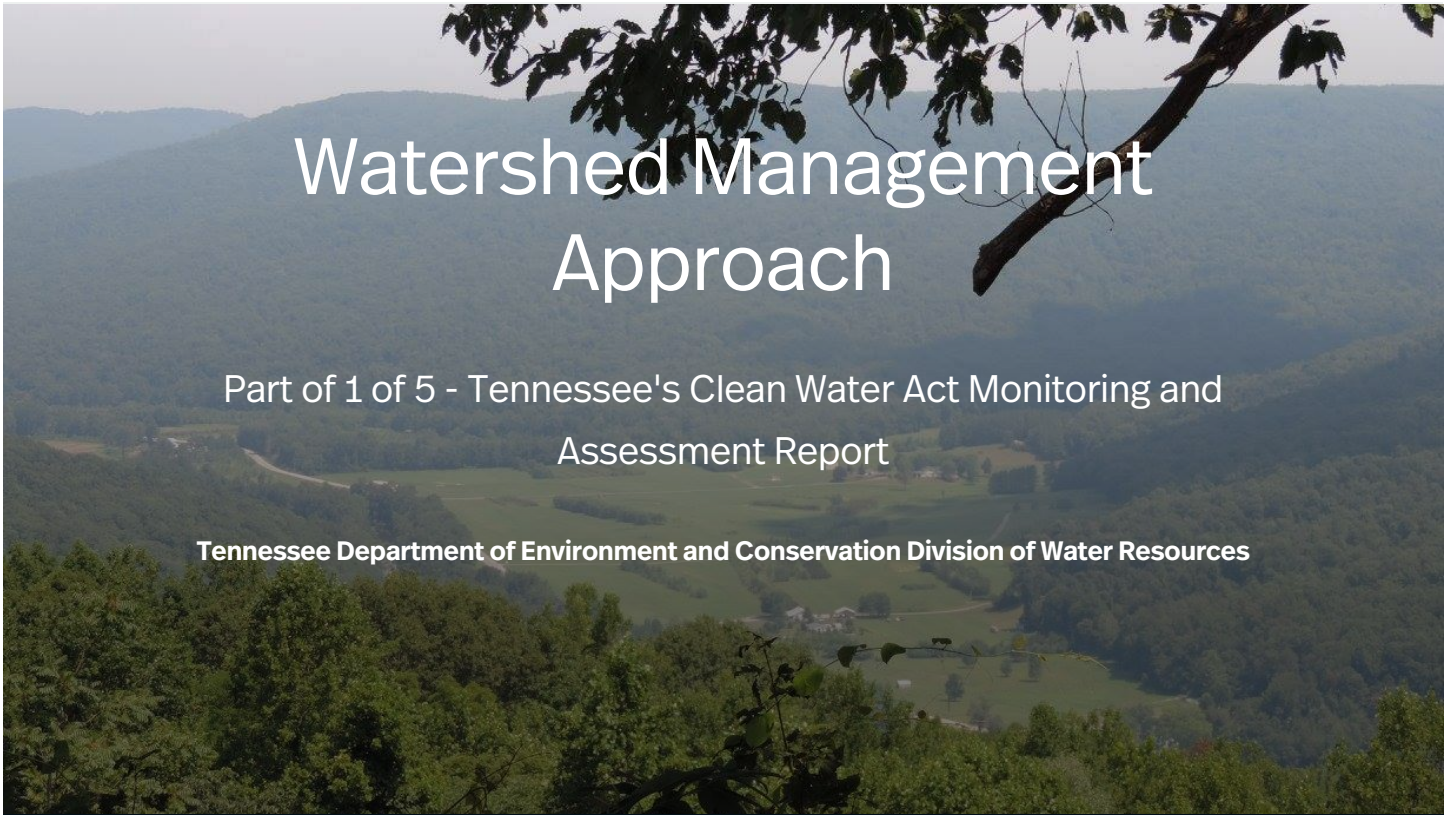
Prepared by: The Tennessee Department of Environment & Conservation

August 2021

Tennessee's Clean Water Act Assessment & Monitoring Report

Division of Water Resources

Questions/Comments?



A BIT ABOUT TENNESSEE

Tennessee is a rapidly growing state, with a population of nearly seven million people (US Census).

Tennessee also has a wealth of water resources with over 60,000 miles of rivers and streams and nearly 600,000 acres of lakes and reservoirs.

As an inland state that is over 400 miles wide, Tennessee shares its border with 8 other neighboring states.....more than any other state! Several large reservoirs are partially located in bordering states, including:

Reelfoot Lake (KY)

Pickwick Lake (AL and MS)

Kentucky Lake (KY)

Lake Barkley (KY)

Guntersville Lake (AL)

South Holston Lake (VA)

Dale Hollow Lake (KY)

Locations of reservoirs that Tennessee shares with adjacent states.

Being one of the most biodiverse states in the nation, Tennessee's landscape ranges from the Appalachian Mountains in the east to the Mississippi River floodplains in the west, with elevations from only 178 feet above sea level in west Tennessee all the way up to over 6,600 feet in the Great Smoky Mountains National Park.

The average statewide precipitation is over 50 inches annually, with most of that occurring between November and May. The average temperatures in Tennessee range from the low to mid 20s all the way up to the mid to upper 90s.

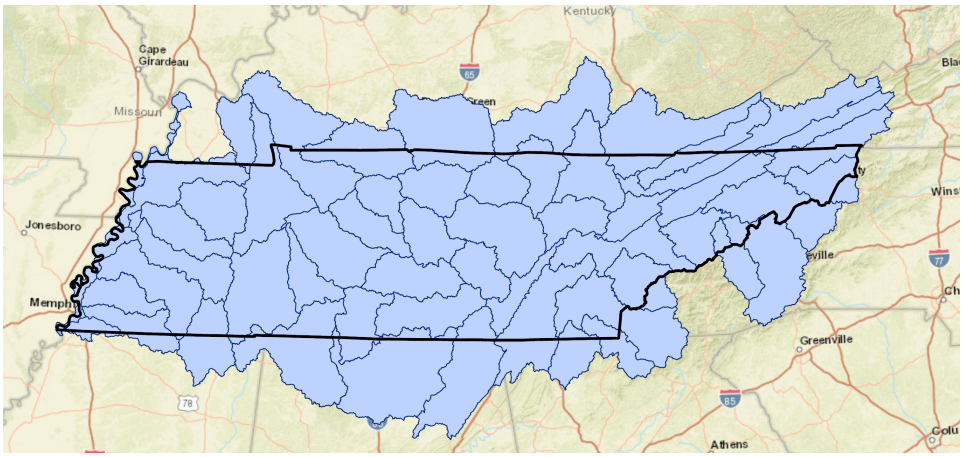
(Photo: The Nashville Crayfish (*Faxonius shoupi*) Learn more about this creature and conservation from the Nashville Zoo!)

WHAT IS A WATERSHED?

Everyone lives in a watershed. A watershed can be as small as your yard or neighborhood, or as large as a river basin that drains to the ocean. It's simply an area of land that drains to a common outlet.

In Tennessee, we have 55 distinct drainage areas known as HUC-8 watersheds as designated by the United States Geological Survey (USGS).

HUC stands for Hydrologic Unit Code and is the number that has been assigned to each drainage area.



Tennessee's watersheds

We use these watersheds as organizational units for many activities because they have readily identifiable boundaries that integrate terrestrial, aquatic, and geologic features. We can focus our efforts on a whole watershed in order to help reach the best balance in working to control point source pollution and polluted runoff as well as protect drinking water sources and sensitive natural resources.

This is what we refer to as the Watershed Approach.

A WATERSHED APPROACH

Over twenty years ago, Tennessee's Division of Water Resources began employing a watershed approach to conduct business. Existing programs were reorganized to focus on place-based water quality management using watershed boundaries.

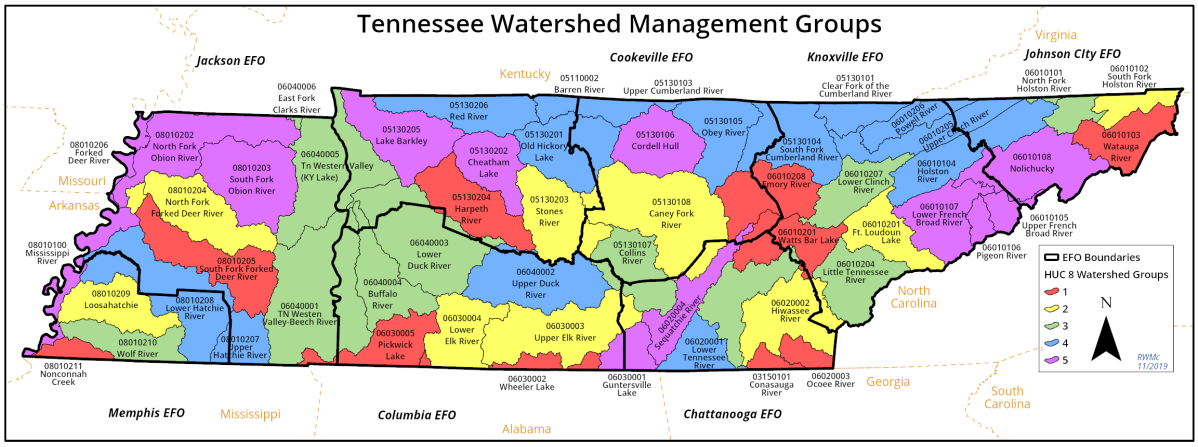
The watershed approach looks at all of the activities going on within a watershed and forms a decision-making process that reflects a common strategy for that specific watershed. It's an organizational framework that works on a five year-cycle.

Key activities that occur throughout the watershed cycle are:

- Planning and Data Review: Existing data and reports from appropriate agencies and organizations are compiled and used to assess the current conditions and status of rivers and streams. Review of all data and comparison of agency work plans guide the development of an effective monitoring strategy and help to determine where there is a need for more data.
- Water Quality Monitoring: Field, chemical, and biological data are collected for streams and lakes in the watershed. Follow-up collection may occur at a later date (approximately 1 year) if needed.
- Water Quality Assessment: Monitoring data are used to determine the designated use support status of streams, reservoirs, and lakes in the watershed by comparing data to the Water Quality Standards.

- TMDL / Alternative Restoration Plans: A TMDL is part of a plan to re-attain water quality standards for impaired waterbodies and/or to prevent impairments in healthy waters. When appropriate, alternative plans are developed where a set of actions or restoration efforts, pursued in the near term are designed to meet Water Quality Standards.
- Permit Issuance: The issuance and expiration dates of individual discharge permits are synchronized based on the watershed cycle. This allows for a better review of cumulative effects, coordinated permit limits, and assimilative capacity modeling. (Division Permit Data Viewer)

The watersheds in Tennessee are organized into five groups and arranged to place at least one watershed from each group within each of the Environmental Field Office (EFO) boundaries to be monitored every year. The Division of Water Resources bases activities for each group by its position in the cycle.



(EFO: Environmental Field Office, HUC: Hydrologic Unit Code)

Visit part two of Tennessee's Clean Water Act Monitoring and Assessment Report to learn about how we assess the waters in the state.

Part 2 of 5 - Water Quality Assessment Process

Prepared by: The Tennessee Department of Environment & Conservation

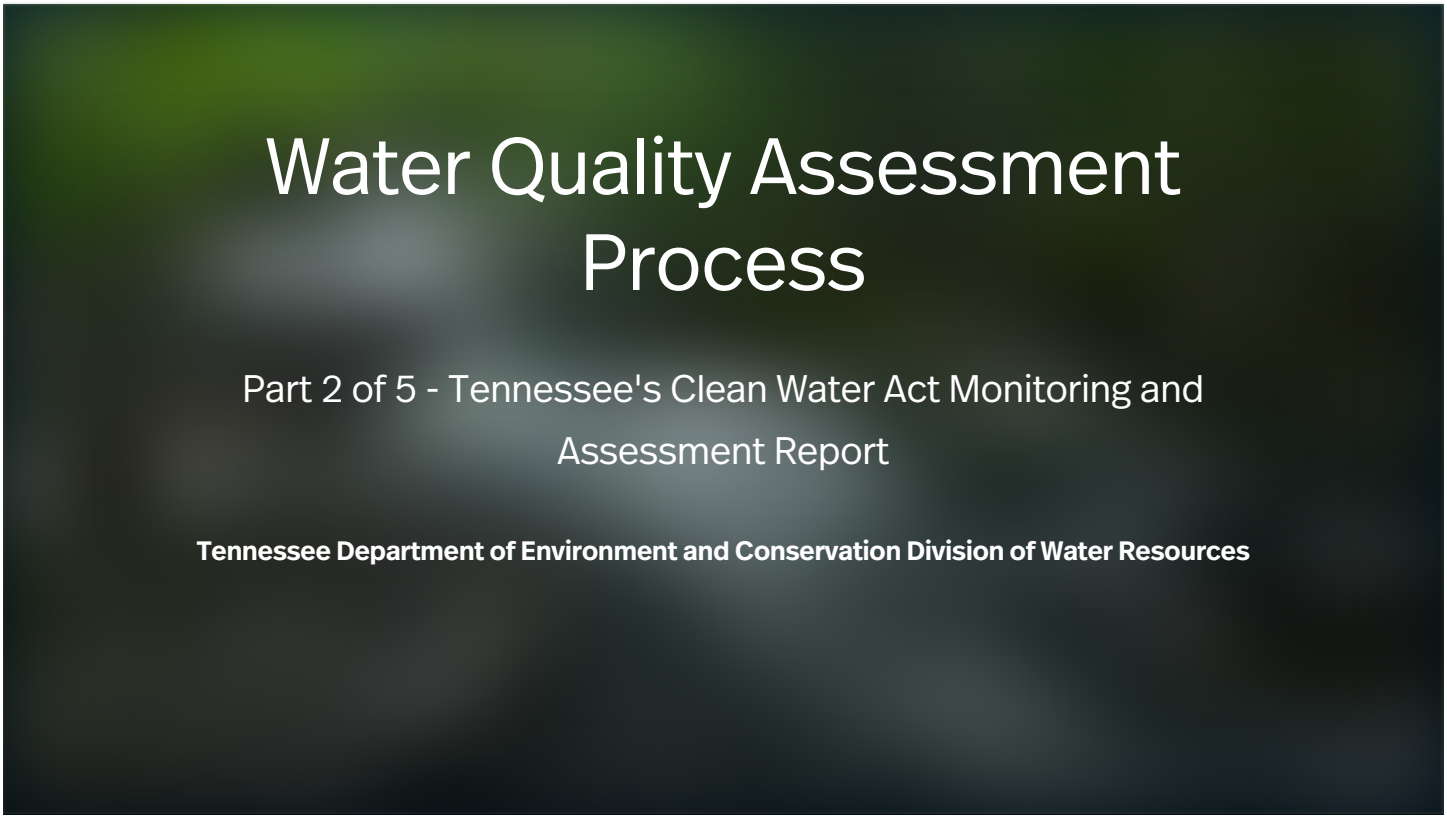
Tennessee's Clean Water Act Monitoring and Assessment Report

Tennessee's Clean Water Act Assessment & Monitoring Report

Division of Water Resources

August 2021

Questions/Comments?



THE ASSESSMENT PROCESS

Using a standardized assessment methodology, existing monitoring data from individual water resources are compared to Tennessee's Water Quality Standards in order to determine the health of the resource. Waters that show water quality criteria violations of a significant magnitude, frequency, and duration are identified through this process. These assessment decisions are tracked and compiled into various formats that can be accessed by the public.

EPA's How's My Waterway

As required by Section 303(d) of the Clean Water Act, the state compiles a list of impaired and threatened waters in Tennessee that fail to support appropriate designated uses due to one or more causes of pollution.

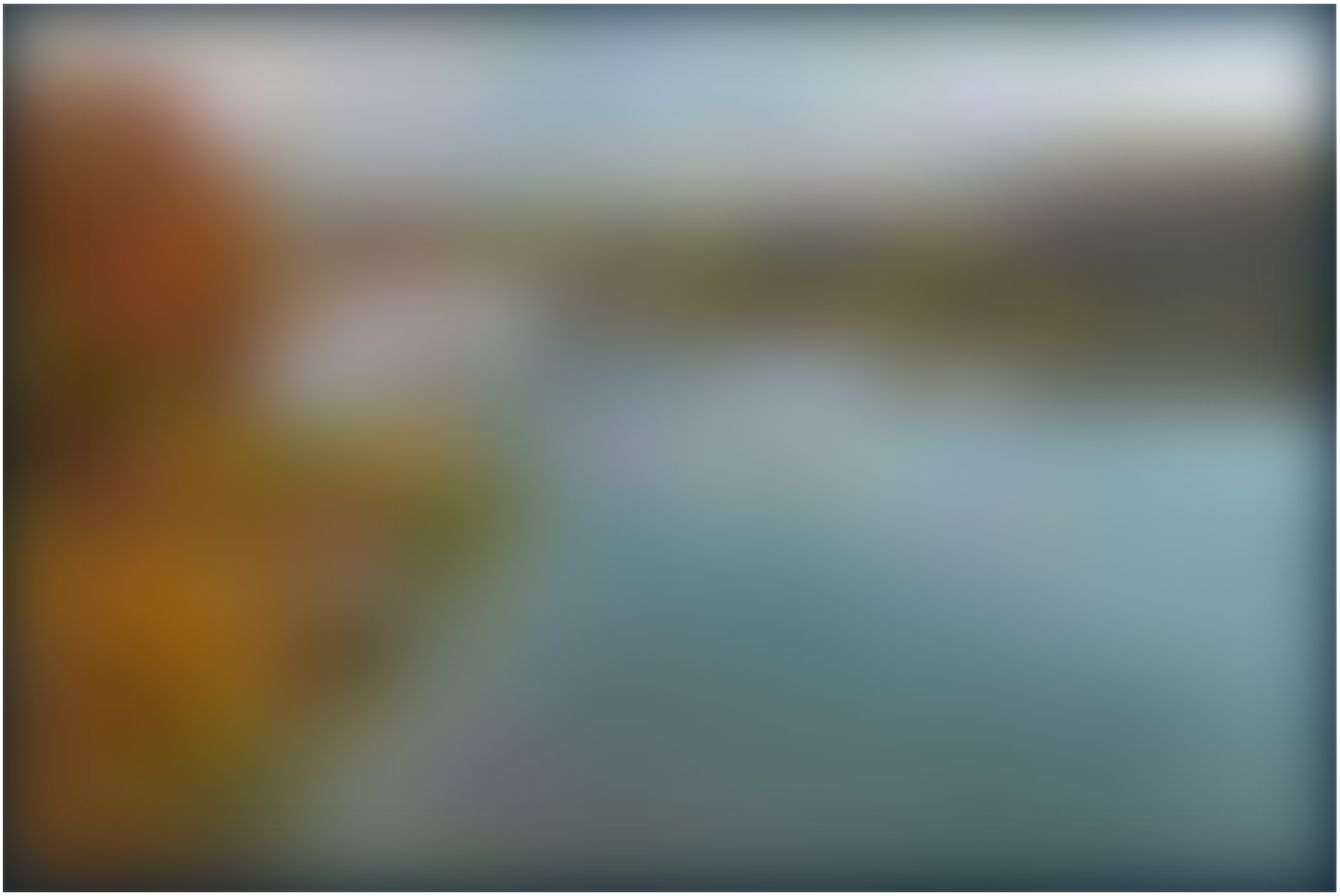
Tennessee's most recent EPA Approved Lists of Impaired and Threatened Waters can be found on the Division's website. It, along with previous documents can be found under "Water Quality Assessment Publications".

Waters that do not meet Tennessee's Standards.....

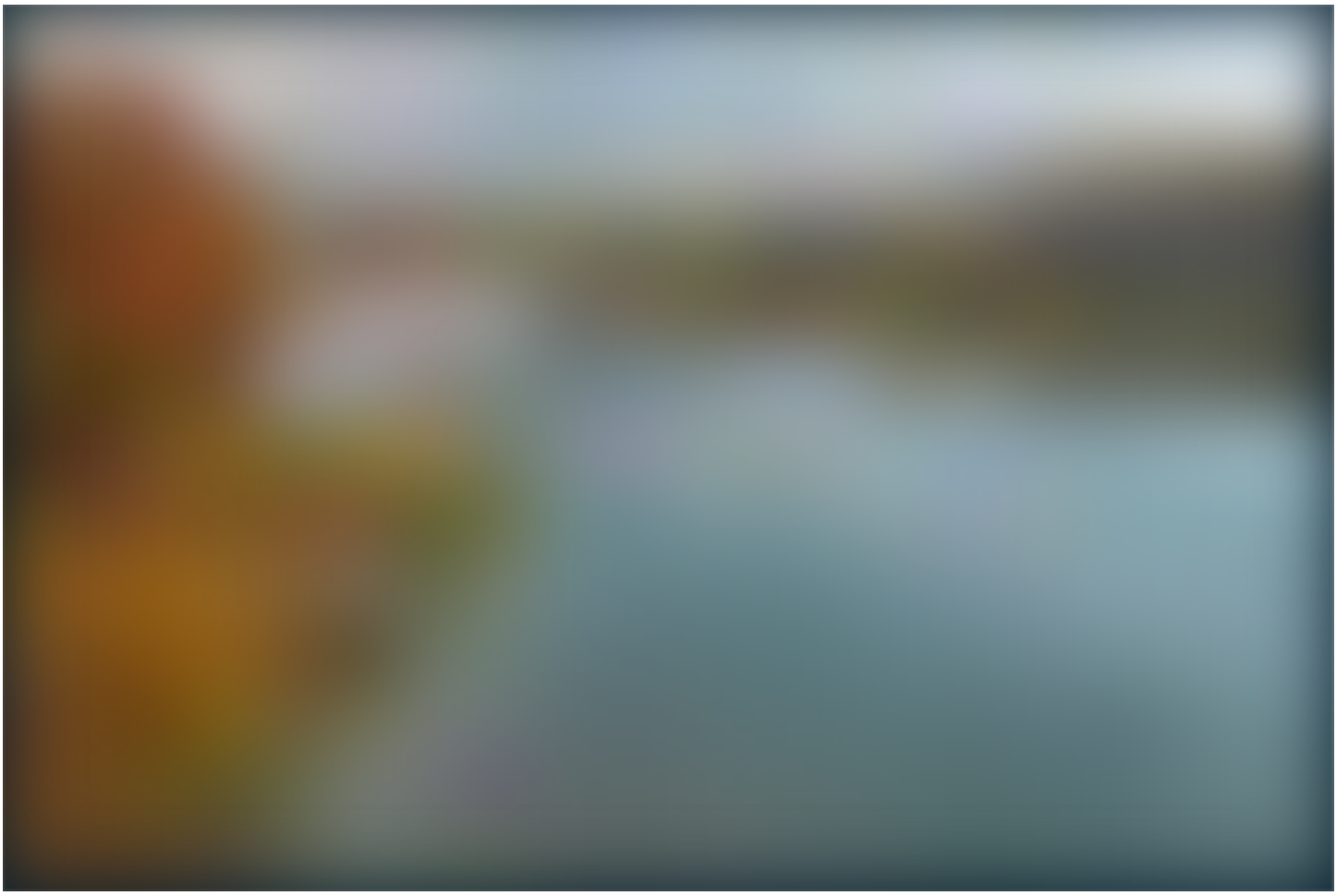
So, what are Water Quality Standards? They are a set of criteria for various parameters that describe the minimum condition waters must meet to safely protect human health and the environment and the measures to be taken to protect or achieve this desired condition.

Tennessee's Water Quality Standards are established in the *Rules of the Tennessee Department of Environment and Conservation* and are comprised of **three parts**.

Part 1: DESIGNATED USES

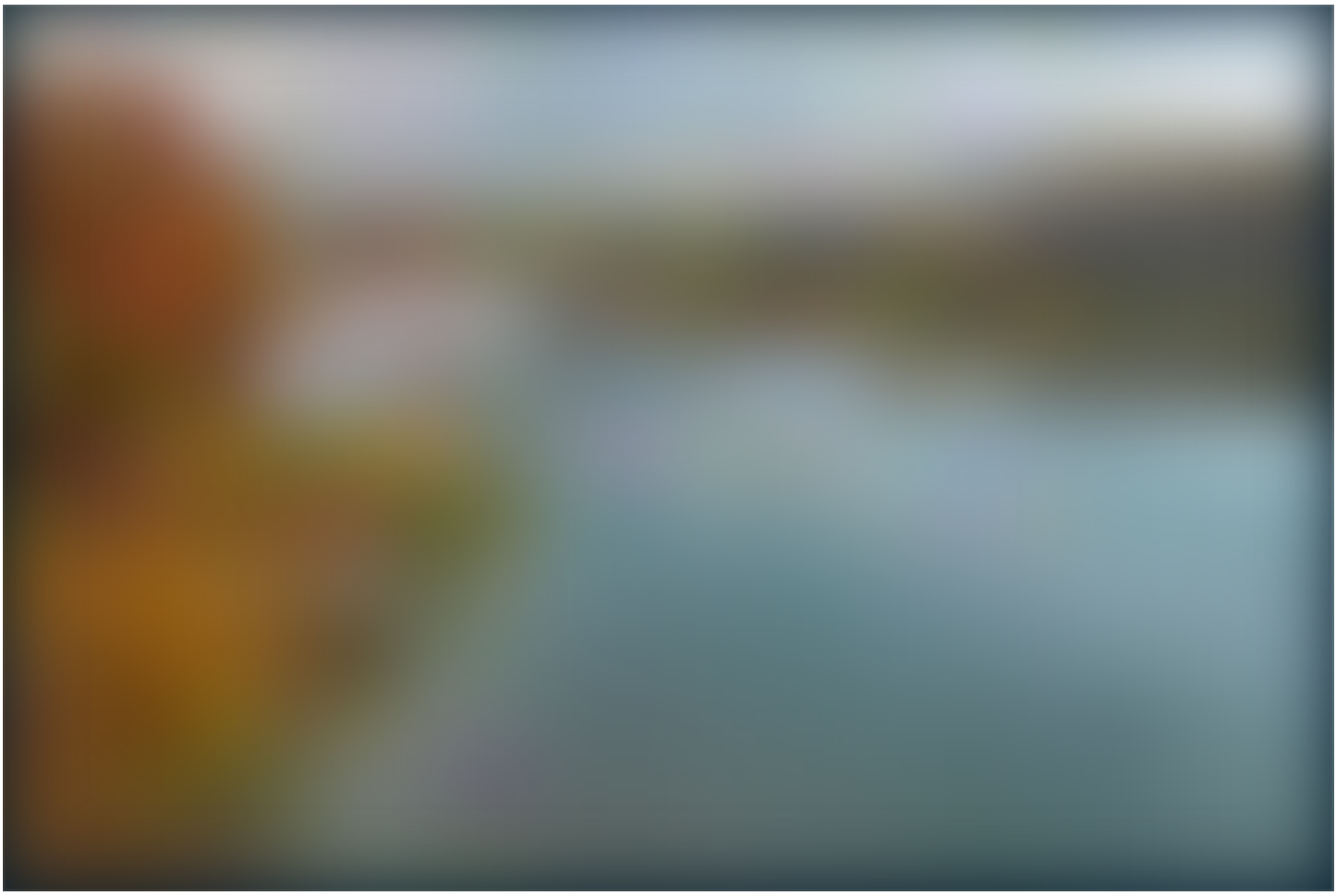


What are our waters used for? Each of Tennessee's waterways are classified for at least 2 of the following 7 designated uses:



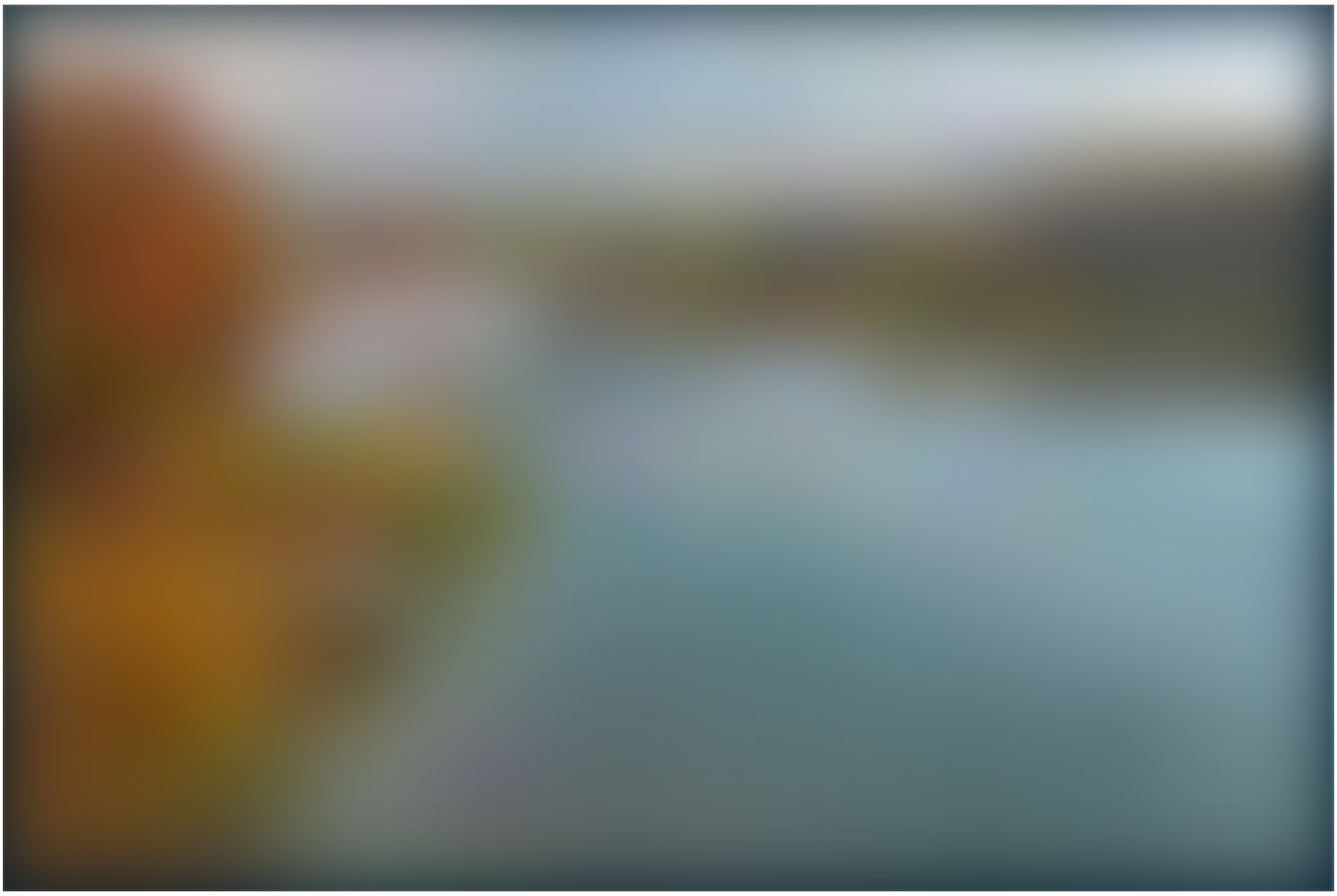
FISH AND AQUATIC LIFE

This use classification is assigned to all waterbodies for the protection of fish and other aquatic life such as aquatic insects, snails, mussels, and crayfish. Trout waters have more stringent criteria for dissolved oxygen and temperature. Additionally, the state has developed regional numeric interpretations of some narrative criteria such as nutrients and biological integrity.



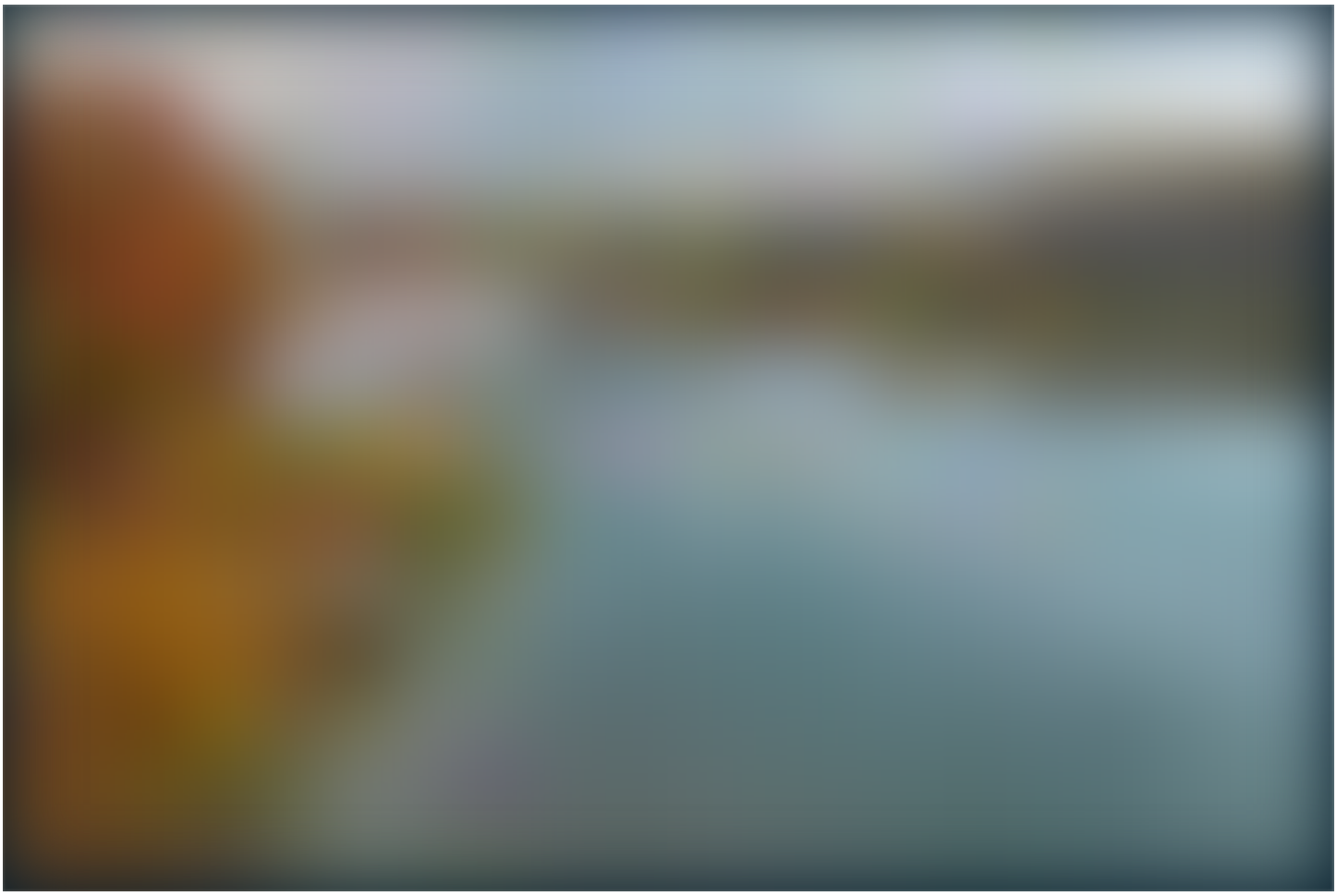
RECREATION

All waterbodies in Tennessee are classified for the protection of the public's ability to swim, wade, and fish. Threats to recreational uses of streams, rivers, lakes and reservoirs include the loss of aesthetic values due to algae or turbidity, elevated pathogen levels, and the accumulation of dangerous levels of metals or organic compounds in fish tissue.



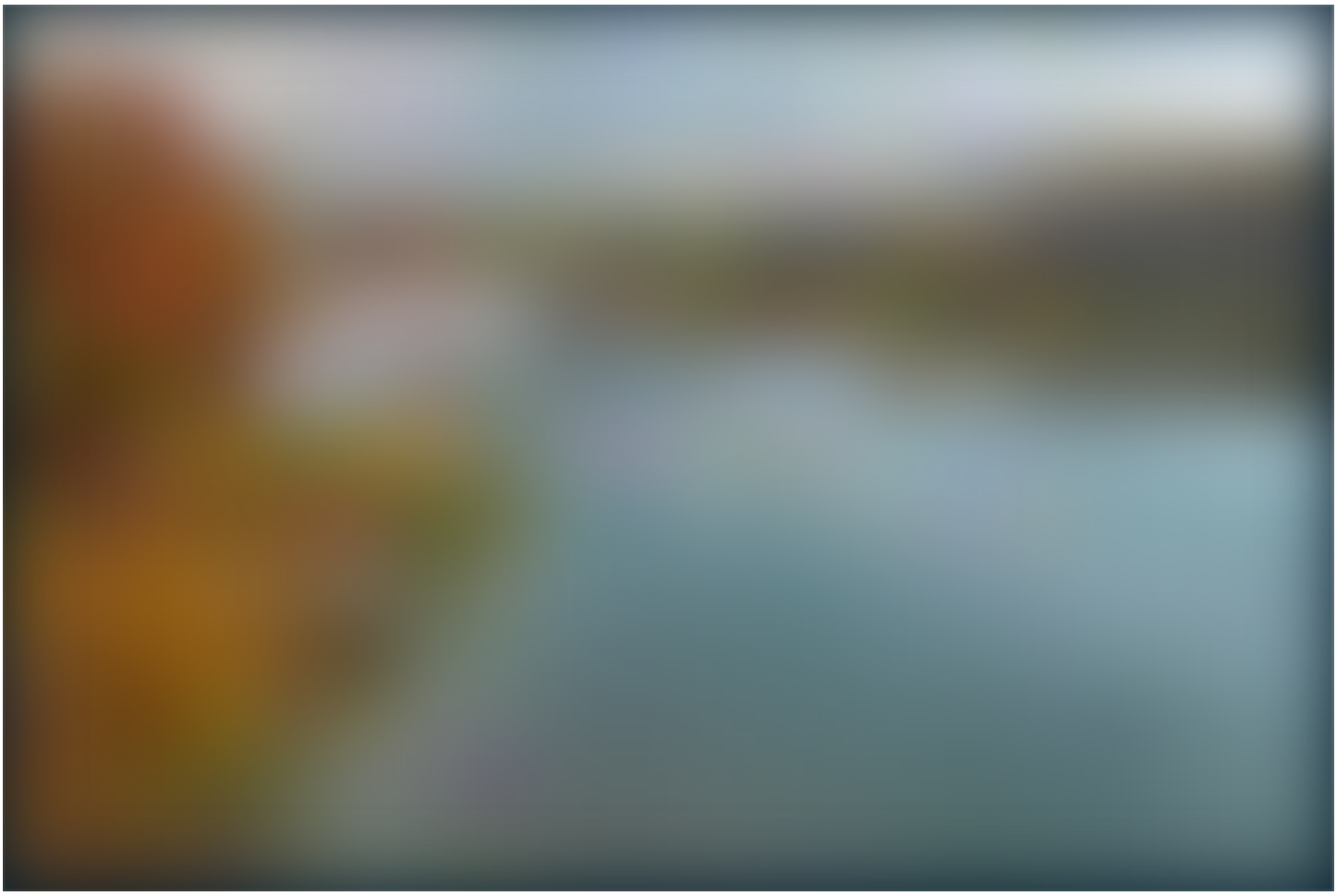
IRRIGATION

This use classification is assigned to waterways to protect the ability of farmers to use streams, rivers, lakes or reservoirs as a source of water to irrigate crops.



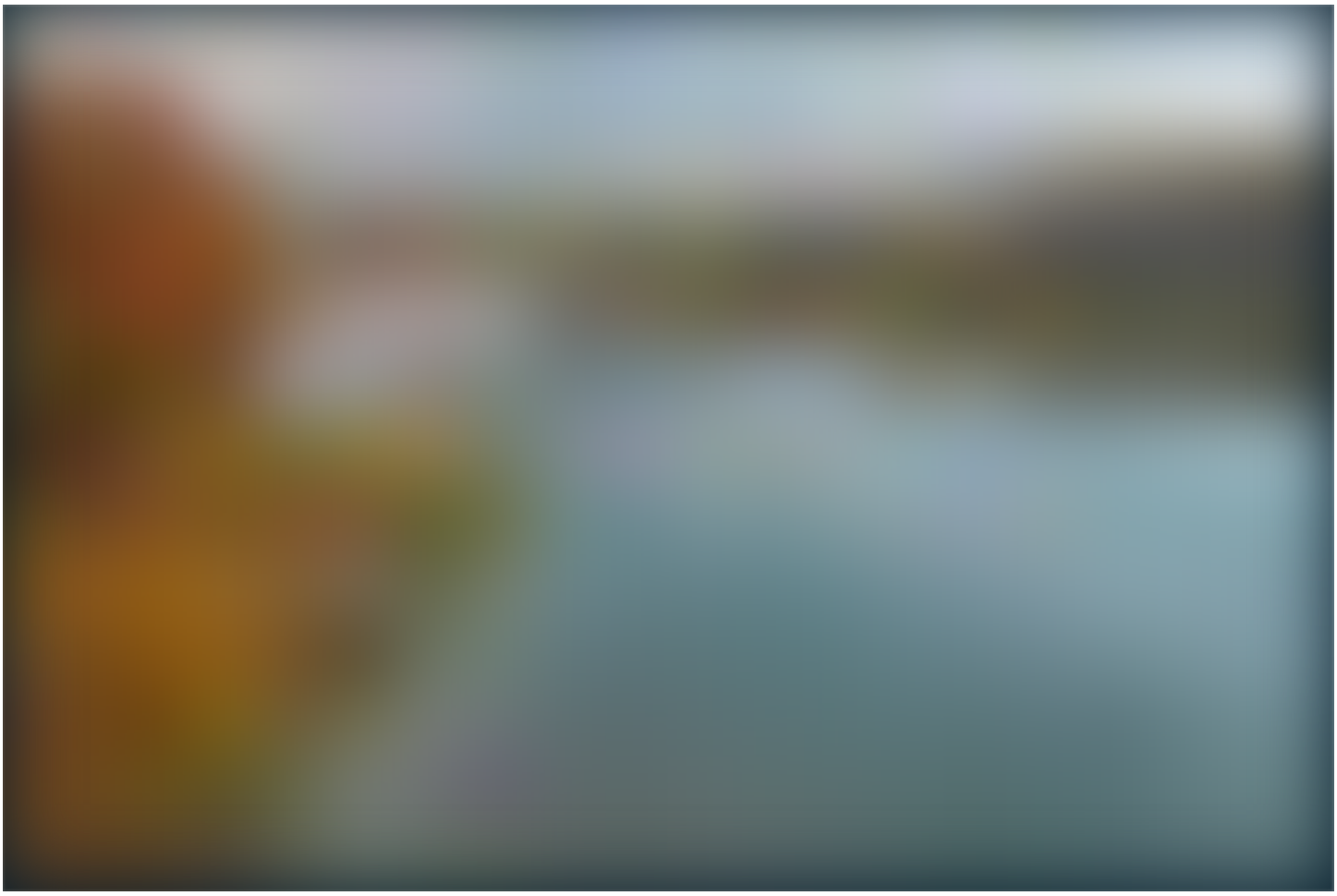
LIVESTOCK WATERING AND WILDLIFE

This use classification protects waters for their use as an untreated drinking water source for livestock and wildlife.



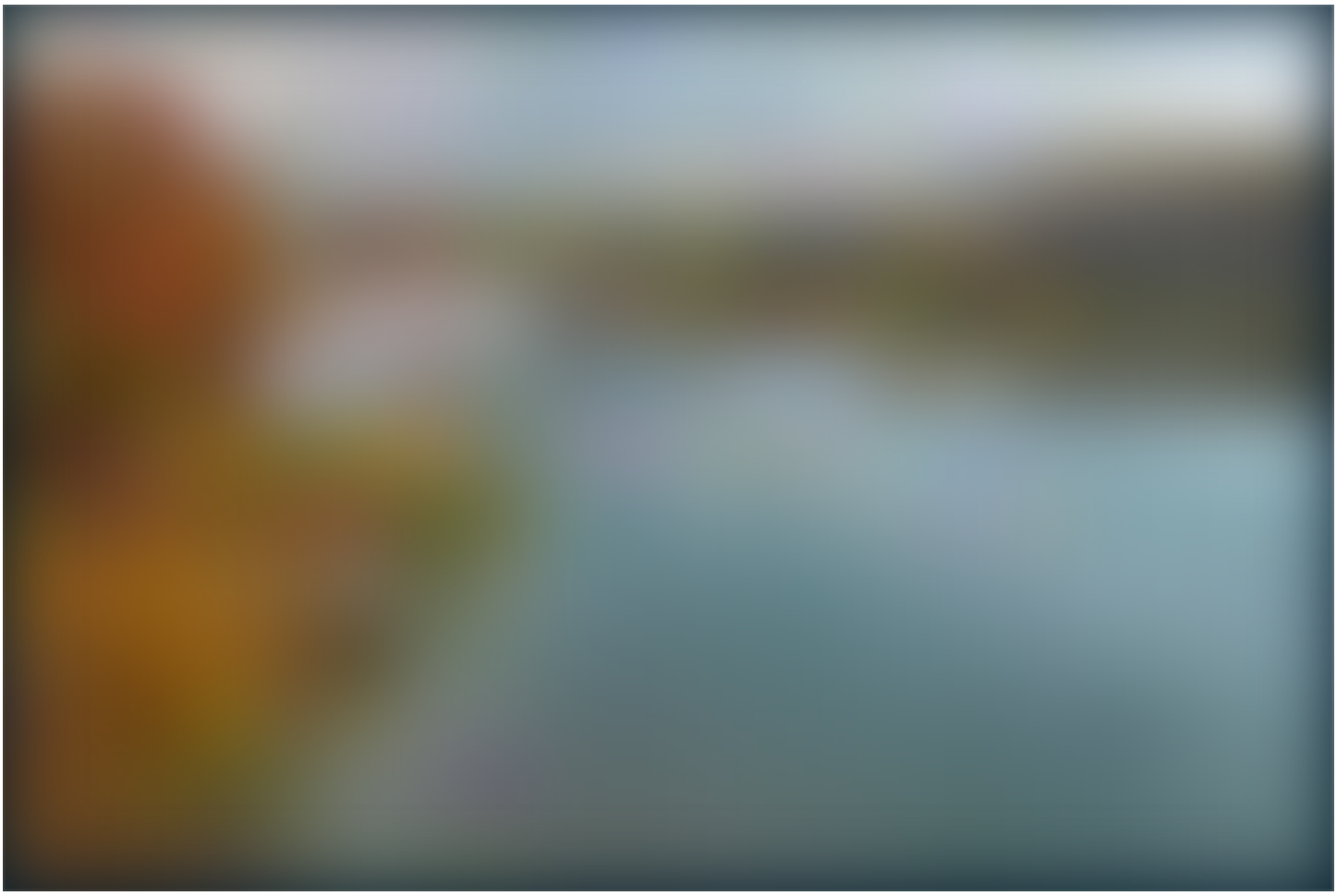
DRINKING WATER SUPPLY

This use classification is assigned to waterbodies that are currently or are likely to be used for domestic water supply.



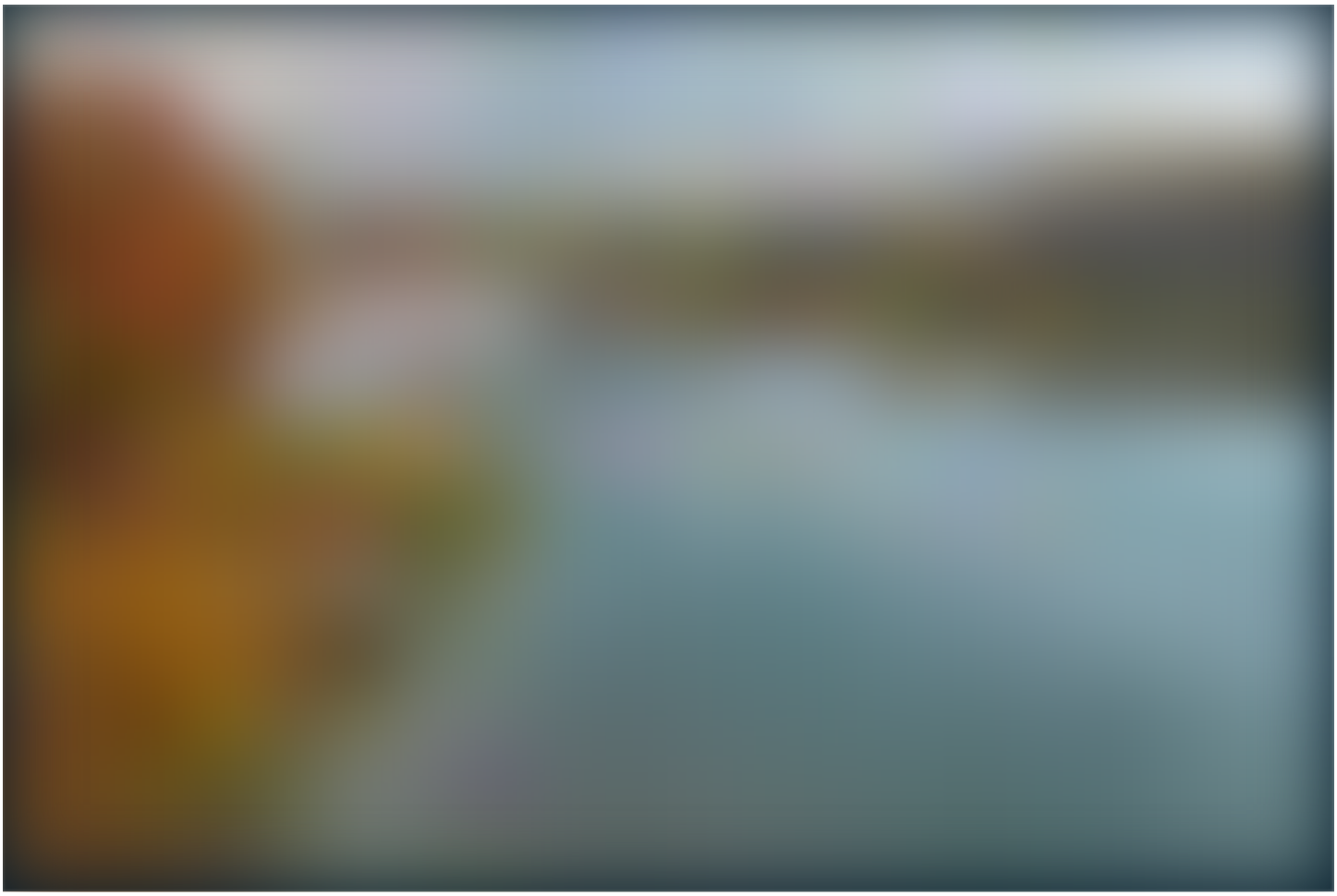
NAVIGATION

This classification is designated to protect navigational rivers and reservoirs from any physical alterations that would adversely affect commercial transport of goods by barges or other large boats.



INDUSTRIAL WATER SUPPLY

This classification is assigned to waters currently used for industrial purposes. If needed, additional waters may be designated as industrial water supplies.



0400-40-04 - Use Classifications for Surface Waters

Designated uses are goals, not necessarily a documentation of the current use of that waterbody. Even if a stream, river, lake or reservoir is not currently used for a given activity, if classified, it should be protected for that use in the future. All waterbodies not specifically listed in General Water Quality Criteria, 0400-40-03 are classified for fish and aquatic life, recreation, irrigation, and livestock watering and wildlife.

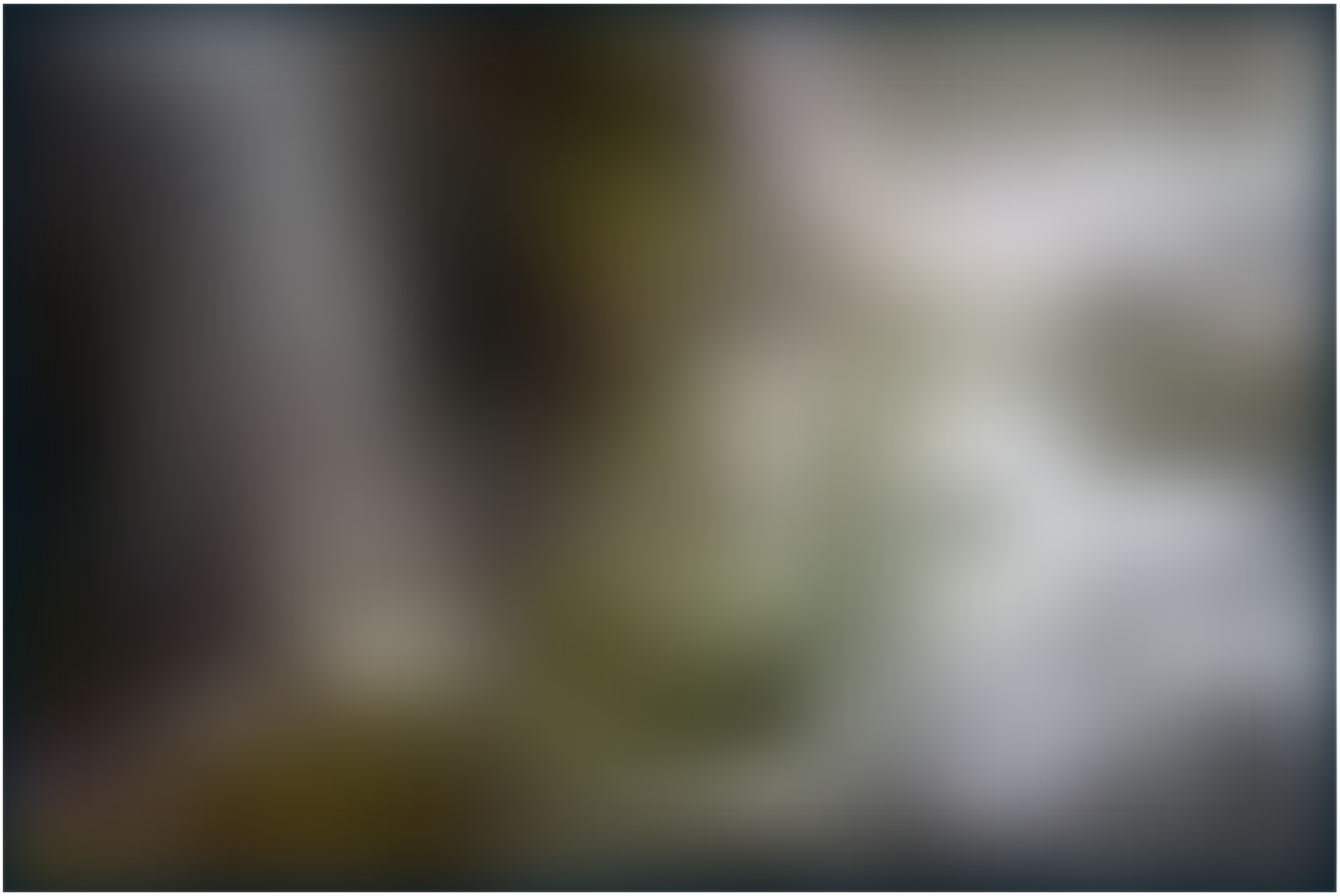
Part 2: CRITERIA

The second part of Water Quality Standards identifies criteria to protect each of the designated uses. Criteria may be numeric or narrative. Numeric criteria are specific levels of parameters that should not be exceeded. Narrative criteria are written descriptions of water quality. These descriptions generally state that waters should be “free from” particular types or effects of pollutants. Some narrative criteria, such as nutrients, biological integrity and habitat can be interpreted using numeric translators that are developed from ecoregion reference monitoring.

Each designated use has been assigned specific water quality criteria by the Tennessee Water Quality, Oil & Gas Board.

0400-40-03 General Water Quality Criteria

Part 3: ANTIDEGRADATION



Antidegradation Statement

The third component of Tennessee's Water Quality Standards is the establishment of provisions to protect existing conditions and prevent future degradation to water quality. These provisions are also known as the state's Antidegradation Statement.

The antidegradation policy fully protects the existing uses of all surface waters in Tennessee. In those waters that are designated as high quality, degradation can only be allowed if it is in the public interest and there are no practicable alternatives available. For waters that have been deemed impaired, discharges causing measurable degradation of the parameters that caused the original

impairment are not allowed. In such waters, habitat alterations must not result in significant degradation. High quality waters include those with available parameters and those designated as Exceptional Tennessee Waters. Under the Antidegradation Statement, Outstanding Natural Resources Waters are subject to even greater protections.

0400-40-03-.06 Antidegradation Statement

Exceptional Tennessee Waters

Tennessee Water Quality Standards require the incorporation of the antidegradation policy into regulatory decisions. Part of the responsibility that the policy places on the Division of Water Resources, is the identification of Exceptional Tennessee Waters (ETW) and Outstanding National Resource Waters (ONRW).

In general, these are waterbodies with good water quality, important ecological significance, valuable recreational uses, or outstanding scenery.

In ETW, degradation cannot be authorized unless (1) there is no reasonable alternative to the proposed activity that would render it non-degrading and (2) the activity is in the economic or social interest of the public.

In ONRW, no new discharges, expansions of existing discharges, or mixing zones will be permitted unless such activity will not result in measurable degradation of the water quality.

A current list of known high quality waters, which includes both ETW and ONRW is available on the state's website.

List of ETW/ONRW

MONITORING

With designated uses established, streams classified and criteria identified.....water resources can then be **monitored** and **assessed**.

Almost half of the stream miles and nearly all the large reservoirs in Tennessee have been monitored and assessed. Waters without data collected within the last five years are usually identified as not assessed unless previously identified as impaired.

About 45 percent of assessed streams and rivers and 63 percent of assessed reservoir acres are fully supporting of assigned designated uses. The remainder of assessed waterbodies are impaired to some degree and therefore, not supporting of all designated uses.

The Division of Water Resources has developed a monitoring strategy based on the need to collect data for various program responsibilities. Biological, chemical, bacteriological, and physical data are collected to supply information for the activities listed below. Additional information concerning the monitoring strategy can be found in the in the Division of Water Resources Monitoring and Assessment Program Plan posted on the TDEC webpage.

- Watershed Monitoring
- 303(d) Monitoring
- Long-Term Trend Monitoring
- Antidegradation Monitoring
- Ecoregional Reference Stream Monitoring
- Permit Compliance Monitoring
- Complaint Investigation Monitoring
- Probabilistic Monitoring

- Fish Tissue Monitoring

Details on the different types of monitoring can be found HERE.

Annual Surface Water Monitoring and Assessment Program Plan (July 2020)

The Consolidated Assessment and Listing Methodology (CALM) is a document explaining to agency water quality assessment staff how the criteria in Rule 0400-40-.03 are applied to ambient data. As stated in the rule, the condition of impairment is created with when criteria violations are of a magnitude, frequency and duration to cause loss of classified use. The CALM provides parameter-specific advice on how staff should make this determination of loss of use and what additional factors should be considered. While this is designed for Division assessment staff, the public and regulated community can gain insight into how this process works by reviewing this document.

The Environmental Protection Agency provides guidance and participates in the review process.

CALM Document

Visit part three of Tennessee's Clean Water Act Monitoring and Assessment Report to learn about the status of water quality in the state.

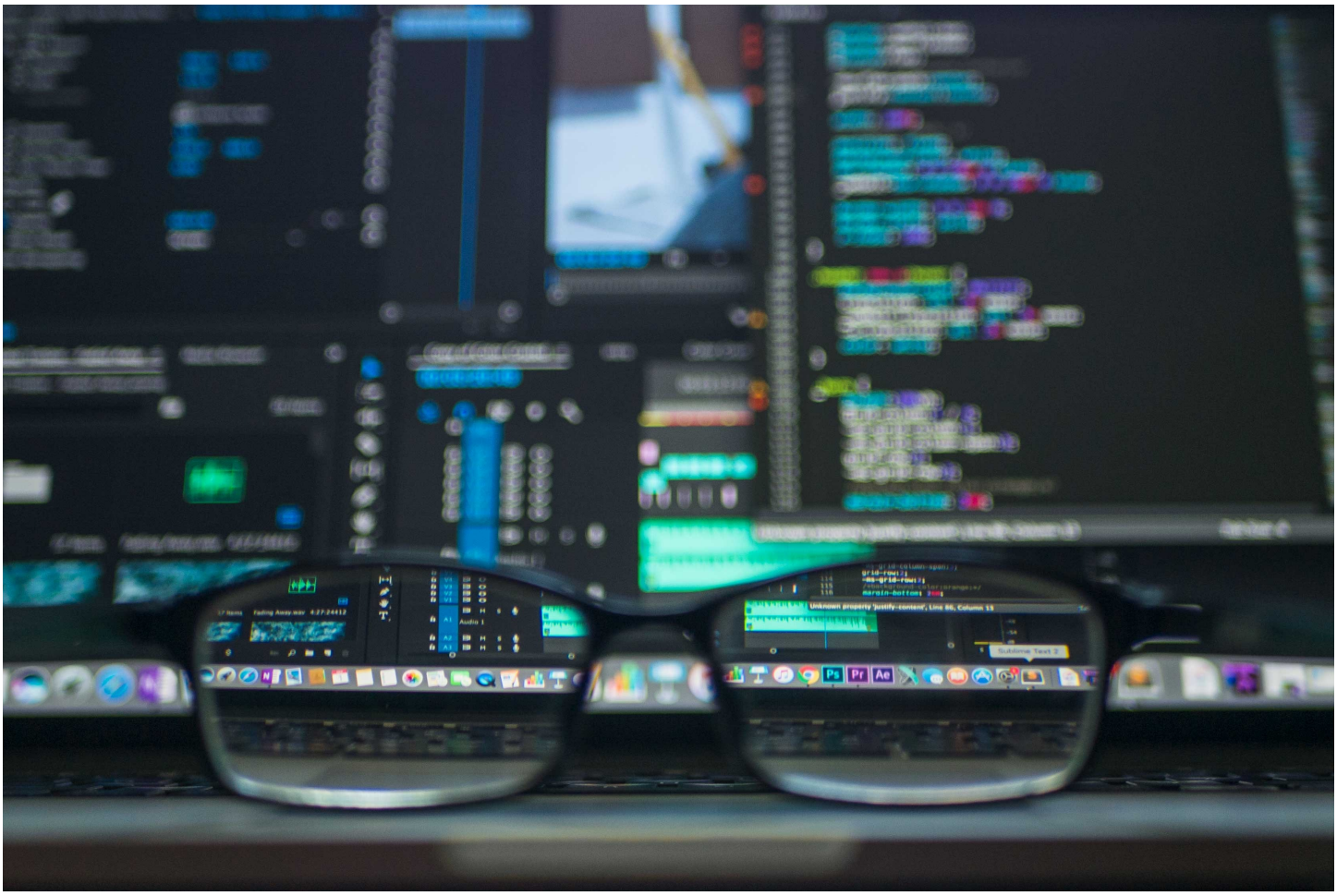
Part 3 of 5 - Water Quality Status

Prepared by: The Tennessee Department of Environment & Conservation

Tennessee's Clean Water Act Monitoring and Assessment Report

Tennessee's Clean Water Act Assessment & Monitoring Report	Division of Water Resources
August 2021	Questions/Comments?

WATER QUALITY DATA



Data Sources & Objectives

The Division uses all reliable data that is readily available in order to assess the status of the waters in Tennessee. TDEC frequently utilizes data from the following partners:

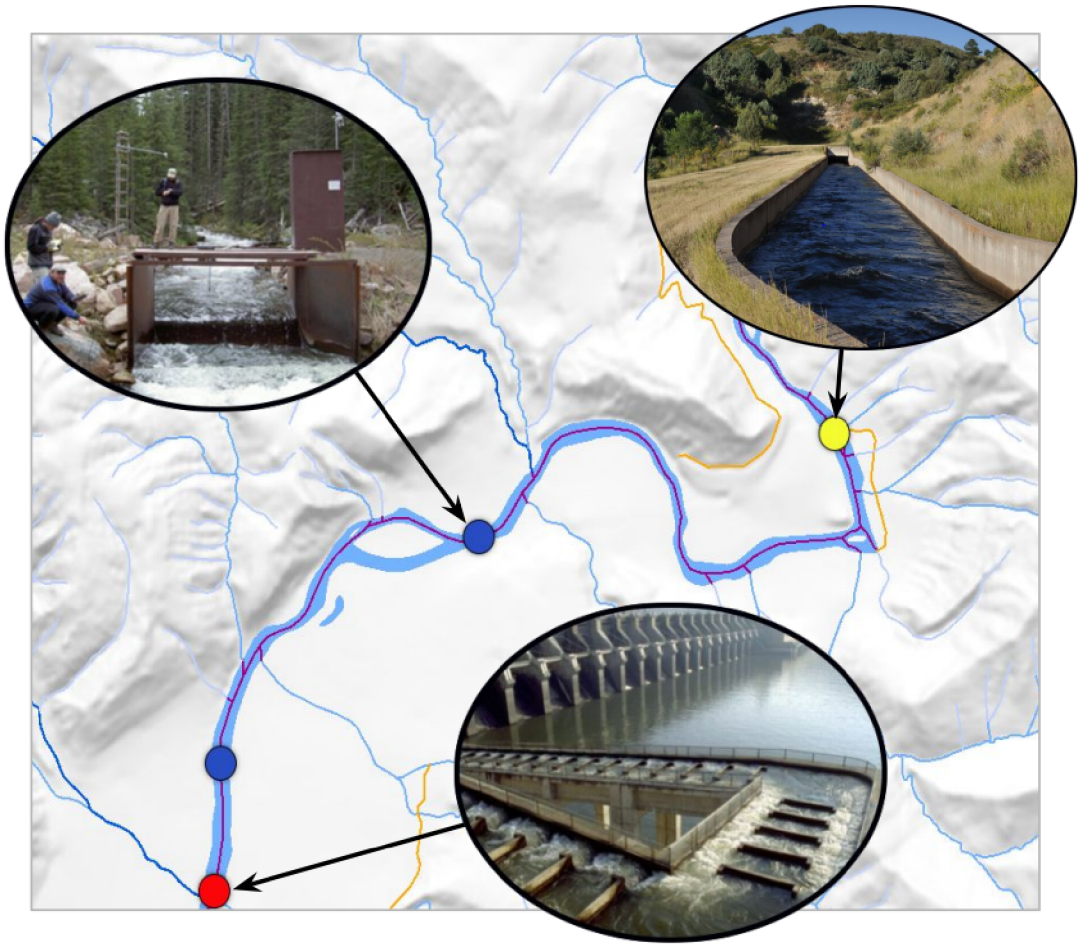
- US Army Corps of Engineers
- Tennessee Valley Authority
- US Geological Survey
- Tennessee Wildlife Resources Agency
- Permittees
- US Forest Service
- Universities

To assure the highest confidence in the assessment results, all data must be of reliable quality. As part of this goal, an annual *Quality*

Assurance Project Plan for 106 Monitoring (TDEC) is compiled by the Division and approved by EPA. This document defines monitoring, analyses, quality control, and assessment procedures.

In order to specify collection techniques within the state, standard procedures have been developed for collection of water quality, biological samples. The procedures also identify appropriate quality control measures.

- *QSSOP for Macroinvertebrate Stream Surveys*
- *QSSOP for Chemical and Bacteriological Sampling of Surface Waters*
- The *QSSOP for Periphyton Stream Surveys*
- Quality Assurance Project Plan For 106 Monitoring



Data Management

Water quality assessments are completed using the best tools that are available at that time. The aim is to always increase the efficiency, accuracy, and accessibility of waterbody assessments while allowing for organization of large amounts of data and ease of sharing the information out to the public. Some such tools are:

- DWR Ambient Water Quality Data
- DWR Water Quality MapViewer
- STORET & Water Quality Exchange (WQX)
- National Hydrography Products
- EPA's How's My Waterway

ASSESSMENT CATEGORIES

Waterbodies are assessed by comparing monitored water conditions to Water Quality Standards for the waterbody's designated uses. Data that meet state quality control standards and are comparable with Division collection techniques are used to assess water quality. After use support is determined data are updated in the EPA ATTAINS system to reflect the assessment. The ATTAINS database system assigns an integrated report category based on this data entry and places waterbodies into one of five categories.

Category 1

The waters are fully supporting of all designated uses. These streams, rivers, and reservoirs have been monitored and meet the most stringent water quality criteria for all designated uses for which they are classified.

Category 2

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

Category 3

The waters are not assessed for any use due to insufficient or outdated data. However, waterbodies previously identified as impaired are not changed to this category simply because data are old.

Category 4

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

Category 4a are impaired waters that have already had all necessary TMDLs approved by EPA.

Category 4b are impaired waters do not require TMDL development since “use impairment caused by a pollutant is being addressed by the state through other pollution control requirements” (EPA,2005). An example of a 4b waterbody might be where a discharge point has been moved to another waterbody with more assimilative capacity.

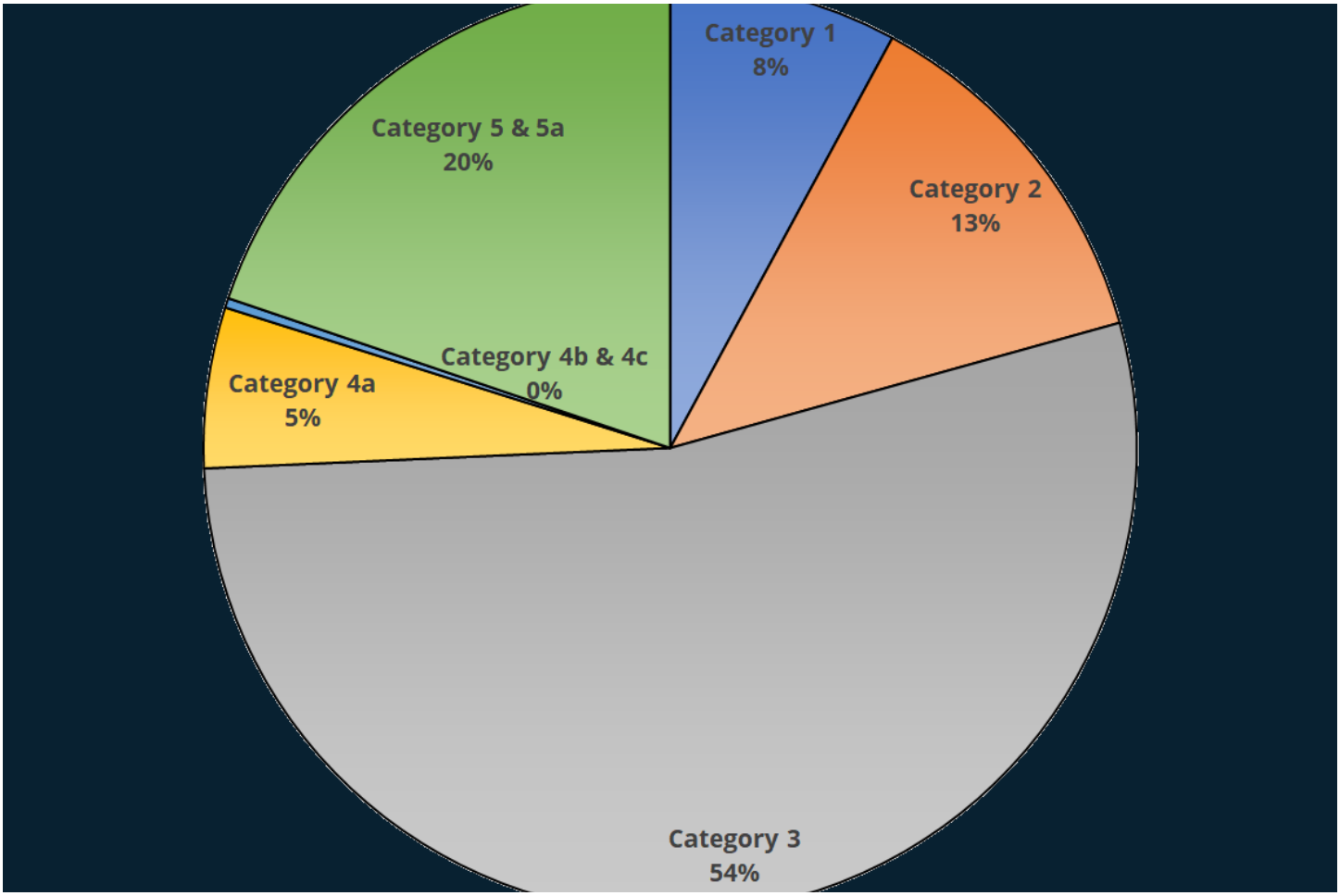
Category 4c are impaired waters in which the impacts are not caused by a pollutant (e.g., flow alterations).

Category 5

Category 5 waters have been monitored 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 pollution and need to have TMDLs developed. Category 4 and 5 waters are included in the state's list of impaired waters.

Category 5-Alt is reserved for those Category 5 waters for which an alternative plan in advance of a TMDL has been accepted by EPA.

ASSESSMENT STATUS



Tennessee STREAMS & RIVERS

Categories and Designated Uses:

TOTAL MILES = 60,392

ASSESSED = 28,003

The stream miles are broken down into the following categories:

Category 1 - 4,771 miles (fully supporting all uses)

Category 2 - 7,713 miles (fully supporting, but not all uses supported)

Category 3 - 32,389 miles (insufficient data/not assessed)

Category 4a - 3,364 miles (impaired/has a TMDL)

Category 4b - 9 miles (impaired/does not require TMDL)

Category 4c - 193 miles (impaired/impact by alteration not pollutant)

(categories 4b + 4c = >1%)

Category 5 - 11,951 miles (impaired/needs a TMDL)

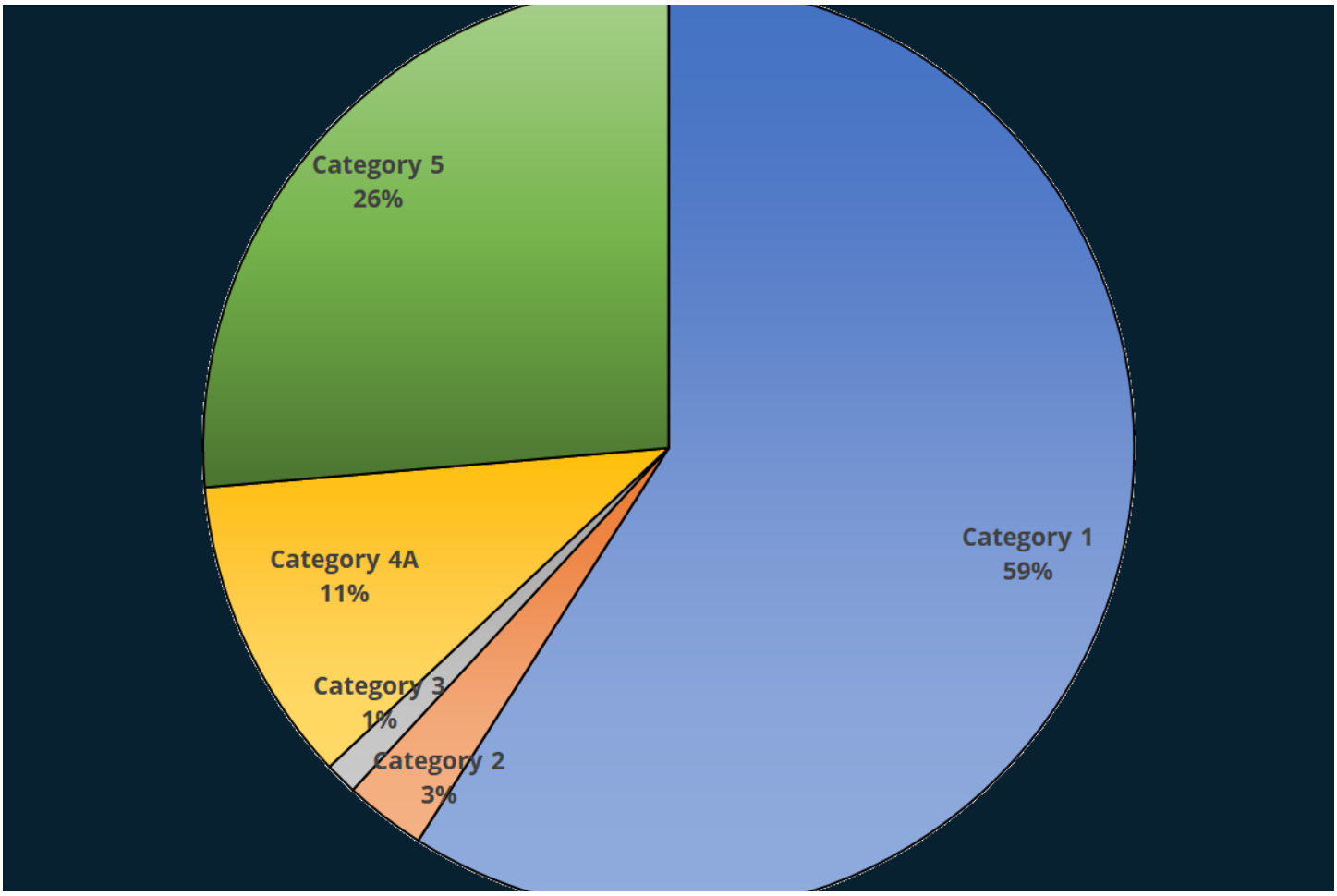
Category 5a - 4.5 miles (approved alternative plan)

Individual Classified Designated Use Support for Rivers and Streams

Designated Use	Miles of Streams Classified	Classified Miles Assessed	Miles Meeting Use	% of Assessed Miles Meeting Use
Fish & Aquatic Life Protection	60,389	26,640	14,807	56%
Recreation	60,389	16,141	7,136	44%
Irrigation	60,389	27,840	27,839	100%
Livestock Watering and Wildlife	60,393	27,763	27,762	100%
Domestic Water Supply	3,996	3,490	3,424	98%
Industrial Water Supply	3,403	2,997	2,994	100%

(click on table to enlarge)

Note: All waters are classified for more than one use, but may or may not have all uses fully supporting. Thus, this table cannot be used to derive percentages for overall use support in Tennessee. In addition, assessment rates for individual uses may not match overall use assessment rates.



Tennessee LAKES & RESERVOIRS

Categories and Designated Uses:

TOTAL ACRES = 586,774

ASSESSED = 580,165

The reservoir acres are broken down into the following categories:

Category 1 - 346,411 acres (fully supporting all uses)

Category 2 - 16,614 acres (fully supporting, but not all uses supported)

Category 3 - 6,609 acres (insufficient data/not assessed)

Category 4A - 62,522 acres (impaired/has a TMDL)

Category 5 - 154,618 acres (impaired/needs a TMDL)

Individual Classified Designated Use Support for Reservoirs and Lakes

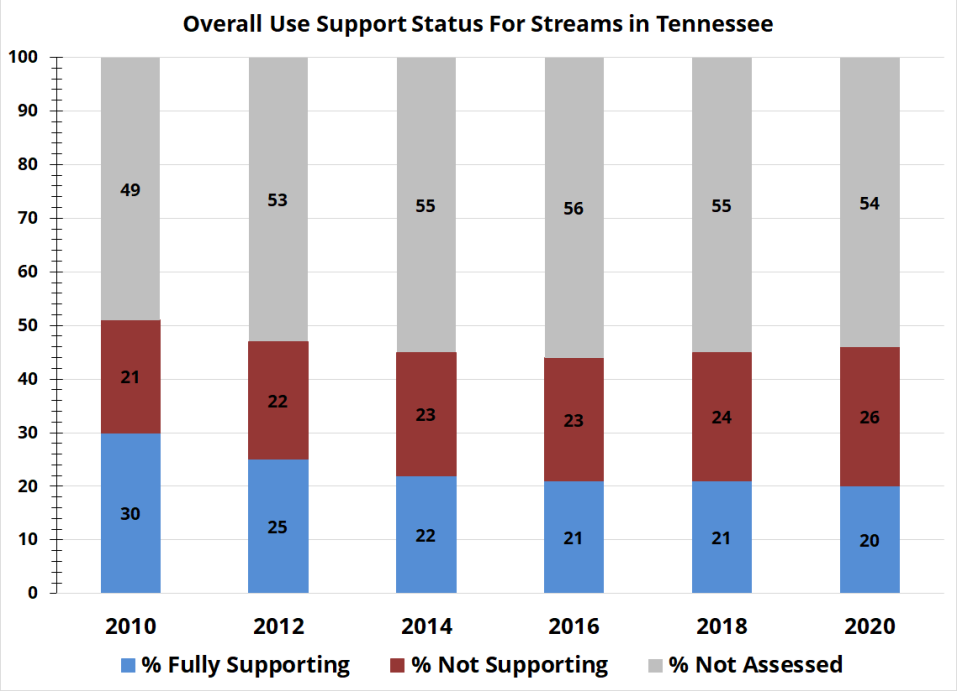
Designated Use	Acres of Lake Classified	Classified Acres Assessed	Acres Meeting Use	% of Assessed Acres Meeting Use
Fish & Aquatic Life Protection	586,774	574,962	551,413	96%
Recreation	586,774	563,098	362,122	64%
Irrigation	586,774	579,085	579,085	100%
Livestock Watering and Wildlife	586,774	579,085	579,085	100%
Domestic Water Supply	531,254	528,463	522,663	99%
Industrial Water Supply	448,709	447,537	447,537	100%

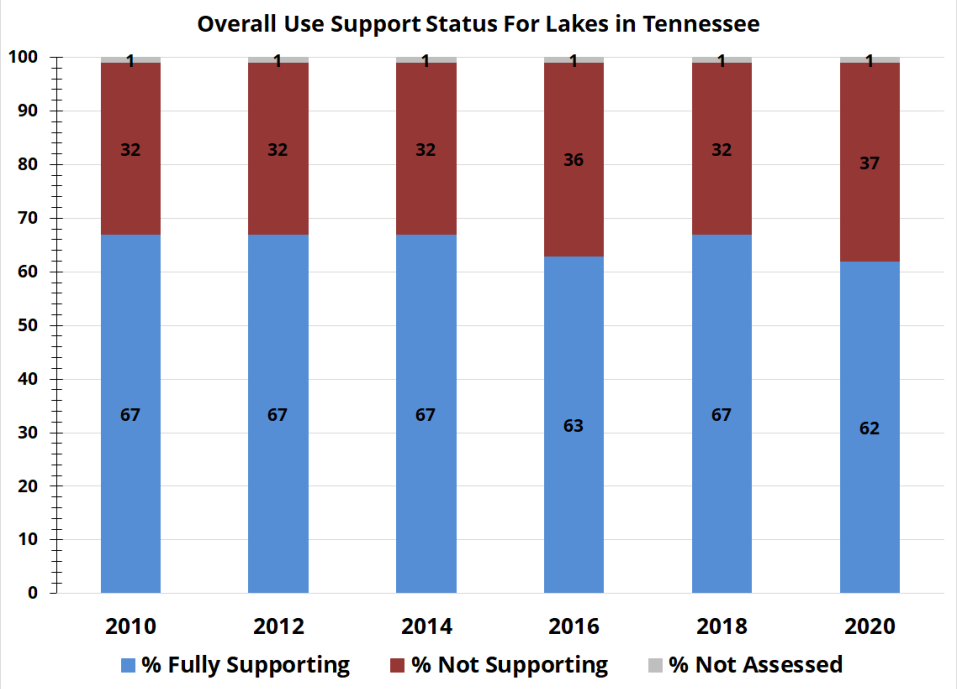
(click on table to enlarge)

Note: Reservoirs are classified for more than one use, but may or may not have all uses fully supporting. Thus, this table cannot be used to derive percentages for overall use support in Tennessee. Also, assessment rates for individual uses may not match overall use assessment rates.

Overall Use Support

The following charts show a breakdown of how Tennessee's streams and lakes have been supporting the designated uses for which they have been assessed from 2002 through 2020.





ASSESSMENT MAP

ArcGIS Web Application

Visit part four of Tennessee's Clean Water Act Monitoring and Assessment Report to learn about causes and sources of the water pollution in the state.

Part 4 of 5 - Causes and Sources of Pollution

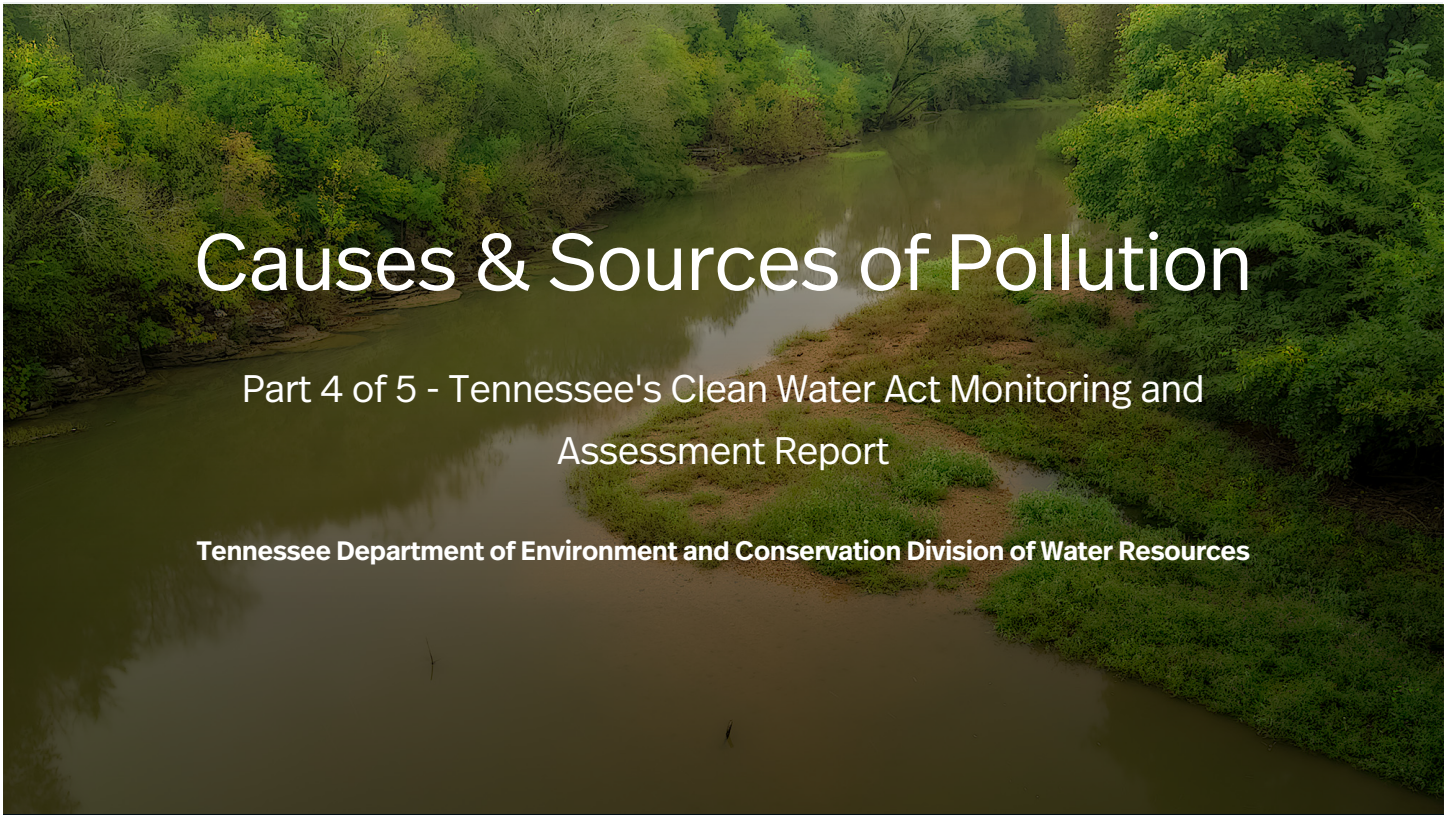
Prepared by: The Tennessee Department of Environment & Conservation

Tennessee's Clean Water Act Monitoring and Assessment Report

Tennessee's Clean Water Act Assessment & Monitoring Report

Division of Watershed Management

Questions/Comments?



Causes & Sources of Pollution

Part 4 of 5 - Tennessee's Clean Water Act Monitoring and Assessment Report

Tennessee Department of Environment and Conservation Division of Water Resources

POLLUTION

Pollution is an alteration of the physical, chemical, biological, bacteriological, or radiological properties of water that would cause a waterbody to not fully support the uses that it has been designated for.

The Division of Water Resources follows the processes outlined in the Consolidated Assessment and Listing Methodology (CALM) document to assess the causes of pollution in streams, rivers, lakes, and reservoirs.

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 the pollutant is (cause) and where it is coming from (source).

POLLUTION IN STREAMS & RIVERS

HABITAT ALTERATION AND SILTATION in streams:

HABITAT AND RIPARIAN ALTERATION refers to the physical modification of a stream or river which often results in a loss of habitat, and affects the biological communities within the stream. This could be something as simple as cutting down trees along the river bank, mowing in the riparian area or allowing livestock to graze in that area, causing the banks to break down or erode. Other types

of habitat alteration could be channelization, channel relocations, gravel dredging, culverts or even dams.

The stream banks (riparian habitat) are so important to the overall health of the stream.

Riparian vegetation is important because it:

- Provides a buffer zone that prevents sediment in runoff from entering the water.
- Provides roots to hold banks in place, preventing erosion.
- Provides habitat for fish and other aquatic life.
- Provides canopy that shades the stream or river. (This shading keeps water temperatures down and prevents excessive algal growth, which in turn prevents large fluctuations in dissolved oxygen levels.)
- Provides a food source for aquatic invertebrates that eat fallen leaves and for fish that eat insects that fall from trees.

SILTATION is often closely related to habitat alteration and together they are cited for more than any other impairment in Tennessee streams.

While some erosion is a natural process, tons of soil are lost every year due to human activities. Siltation is generally attributed to land disturbing activities such as agriculture and construction.

Some of the significant economic impacts caused by silt are increased water treatment costs, filling in of reservoirs and lakes, loss of navigation channels and increased likelihood of flooding.

Siltation affects biological properties of waters by:

- Smothering eggs and nests of fish.

- Transporting other pollutants, in possibly toxic amounts, or providing a reservoir of toxic substances that may become concentrated in the food chain.
- Clogging the gills of fish and other forms of aquatic life.
- Covering substrate that provides habitat for aquatic insects, a main food source of fish.
- Reducing biological diversity by altering habitats to favor burrowing species.
- Accelerating growth of submerged aquatic plants and algae by providing more favorable substrate.

Siltation affects chemical properties of waters by:

- Interfering with photosynthesis.
- Decreasing available oxygen due to decomposition of organic matter.
- Increasing nutrient levels that accelerate eutrophication in reservoirs and lakes.
- Transporting organic chemicals and metals into the water column (especially if the original disturbed site was contaminated).

Siltation affects physical properties of waters by:

- Reducing or preventing light penetration.
- Changing temperature patterns.
- Decreasing the depth of pools or lakes.
- Changing flow patterns.

Preventive planning in land development projects can protect streams and rivers from silt and protect valuable topsoil. Best Management Practices (BMPs) such as the installation of silt fences and maintenance of trees and undergrowth as buffer zones along creek banks can prevent soil from entering the creek. Farming practices that minimize land disturbance, such as fencing livestock

out of creeks and no-till practices not only protect water quality but also prevent the loss of topsoil.

PATHOGENS in streams:

Pathogens are disease-causing organisms such as bacteria or viruses that can pose an immediate and serious health threat if ingested. Many bacteria and viruses that can be transferred through water are capable of causing serious or even fatal diseases. The main sources for pathogens are untreated or inadequately treated human or animal fecal matter.

Indicator organisms are used as water quality criteria to test for the presence of pathogens. The *E. coli* group is considered by EPA to be an indicator of true human risk.

Currently, Tennessee has over 8,000 stream miles assessed as impaired by *E. coli*.

Problem concentrations of pathogens happen at different times in various waterbodies across the state. High levels during heavy rainfall can be associated with wastewater collection system problems or with large concentrations of livestock and inadequate buffer zones adjacent to streams or rivers. *E. coli* can be elevated under low flow conditions also, especially in areas with failing or inadequate septic systems or places where livestock have direct access to streams or rivers.

NUTRIENTS in streams:

> Nutrient pollution is one of America's most widespread, costly and challenging environmental problems, and is caused by excess nitrogen and phosphorus in the air and water. (US-EPA)

EPA-Nutrient Pollution

Tennessee shares in the problem of having waterways with elevated nutrient concentrations caused predominantly by livestock, municipal wastewater systems, urban runoff, failing septic systems and improper application of fertilizers.

Nutrients cause algae growth which produces oxygen during daylight hours, but uses oxygen at night. This leads to significant diurnal fluctuations in oxygen levels. You might notice floating algal mats or filamentous algae in waters with high nutrient concentrations.

Elevated nutrients cause aquatic life to shift towards groups that eat algae and can tolerate dramatic dissolved oxygen fluctuations, and can reduce or eliminate more intolerant (sensitive) or specialized organisms.

Nutrient pollution sources are challenging to identify and controlling this type of pollution can be very complex.

LOW DISSOLVED OXYGEN in streams:

Dissolved oxygen is a measure of how much oxygen is available in the water therefore available to support the organisms that live in it.

Depleted dissolved oxygen can restrict or even eliminate aquatic life. While some species of fish and aquatic insects can tolerate lower levels of oxygen for short periods, prolonged exposure will affect biological diversity and in extreme cases, cause massive fish kills.

Nearly 2,000 miles of streams in Tennessee are currently impaired by low dissolved oxygen levels.

Low dissolved oxygen levels are often caused by the decay of organic material. This condition can be improved by reducing the

amount of organic matter entering a waterbody.

Streams and rivers that receive substantial amounts of ground water inflow, or have very sluggish flow rates, can have naturally low dissolved oxygen levels.

METALS in streams:

The major concern regarding metal contamination is toxicity to fish and aquatic life, plus the danger mercury poses to people who come in contact with the water or eat fish from the contaminated waterbody. The precipitation of metals such as iron and manganese can affect habitat.

Metals that may impact waters in Tennessee include mercury, iron, manganese, arsenic, lead, zinc, copper, aluminum, and chromium.

Sections of 21 rivers and streams have been posted for elevated levels of mercury in fish tissue. (ADVISORIES)

ORGANIC CONTAMINANTS in streams:

Organic contaminants are man-made chemicals which contain carbon. Some chemicals of concern might be:

- Polychlorinated Biphenyls (PCBs)
- Dichloro-diphenyl-trichloroethane (DDT)
- Chlordane
- Dioxins

These chemicals are all listed by EPA as priority pollutants and classified as probable human carcinogens (cancer causing agents).

In some waterbodies, these substances have accumulated in sediment and are concentrated through the food chain into the fish and therefore pose a health threat to those that consume fish or shellfish.

Over three-hundred river miles in Tennessee are listed as impaired by organic contaminates.

Some organic pollutants in very low concentrations can pose a threat to human health. Many of these compounds have been banned from use for several decades. However, organic pollution that occurred decades ago still poses a serious threat. These substances tend to remain in the environment for an extremely long time.

Dioxins are man-made by-products of herbicide manufacturing, certain historical paper mill manufacturing processes, and the incineration of chlorine-based chemicals. Dioxins are considered among the most toxic substances released into the environment. EPA has not found a safe exposure level. In fact, EPA has determined that dioxins, in addition to being probable human carcinogens, can cause reproductive and developmental problems.

One problem in identifying organic pollution is that water quality criteria are often below current detection levels. Detection of these substances is generally made either by analyzing fish tissue levels and/or by use of sediment screening values provided by EPA. Since organic contaminants can bioaccumulate in fish, it is important to make sure catfish, bass and other species consumed by people are safe to eat. Children and pregnant or nursing women are the most sensitive sub-population.

pH in streams:

The pH is a measure of how acidic or basic the water is and is an important measurement when looking at water quality. (USGS)

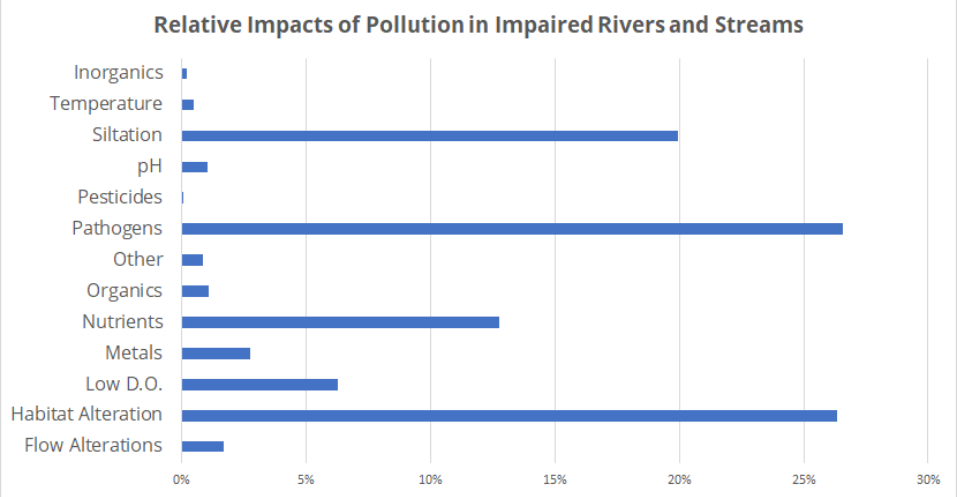
Low pH, elevated alkalinity, or a significant change in the pH or acidity of the water over a relatively short period of time, can greatly impact aquatic life. Currently, 330 stream miles are listed as impaired by low pH, most are found in areas with historical mining activities.

Disturbance of certain rock formations during road construction or mining activities may release acidity to streams or rivers. Excessive amounts of algae can cause streams and rivers to violate Standards on the alkaline side, but this phenomenon more commonly occurs in lakes.

The pH level also plays an important role in the toxicity of metals, with pH levels below 5.5 generally increasing toxic effects. On the other hand, ammonia toxicity is increased in the presence of high pH.

FLOW ALTERATION in streams:

Over 500 stream miles are currently assessed as impaired by flow alteration. Flow alteration is a change to the flow that leads to a loss of instream habitat. Impoundments and channelization are common sources of flow alteration. In extreme cases, flow alterations cause stream or river channels to be dry.



Over time, the most common causes of pollution in rivers and streams have been found to be habitat alteration, siltation, pathogens and nutrients coming primarily from agriculture, hydrologic modification and municipal dischargers. Note that waters can have pollution from more than one source and totals are not additive.

POLLUTION IN RESERVOIRS & LAKES

Some of the same types of pollutants that occur in rivers and streams also impact reservoirs and lakes, although in different magnitudes. The effects of most of these pollutants are the same as in flowing water, however, persistent substances are more likely to accumulate and remain in reservoirs and lakes for a very long time.

METALS in lakes:

As in rivers and streams, the major concern regarding metal contamination is toxicity to fish and aquatic life, plus the danger mercury poses to people who come in contact with the water or eat fish from the contaminated waterbody.

The reservoirs in Tennessee assessed as impaired by metals have been impacted by legacy activities, atmospheric deposition, or industrial discharges. The copper, iron, and zinc found in three Ocoee River reservoirs are from historical mining operations.

Mercury in the Clinch River section of Watts Bar Reservoir is from legacy activities at the Department of Energy (DOE) Reservation. Additional reservoirs or embayments impacted by mercury include upper Fort Loudoun, upper Cherokee, Beech, Watauga, South

Holston, Tellico, Norris, Big Sandy, Normandy and the Hiwassee embayment of Chickamauga Reservoir.

ORGANIC CONTAMINANTS in lakes:

Priority organic substances such as PCBs and dioxins are the cause of pollution in over a third of the impaired lake acres. Reservoirs and lakes serve as sediment traps and once a pollutant gets into the sediment it is very difficult to remove. These materials move through the food chain and can become concentrated in fish tissue. People eating fish from the waterbody may also concentrate these toxic substances in their bodies, which can lead to health problems.

Currently, over 95,000 lake acres, are posted for organic contamination.

Elevated levels of PCBs have been found in fish tissue collected from the following reservoirs:

- Fort Loudoun Reservoir
- Boone Reservoir
- Tellico Reservoir
- Watts Bar Reservoir
- Nickajack Reservoir
- Melton Hill Reservoir
- Woods Reservoir
- Parksville Reservoir (Ocoee)

PCBs were extensively used in the U.S. for industrial and commercial uses until they were banned in 1976. Unfortunately, over 1.5 billion pounds of PCBs were produced before the ban. It is not known how many tons ended up in waterways in Tennessee.

NUTRIENTS in lakes:

Almost 23,000 lake acres have been assessed as impaired due to nutrients.

As with rivers and streams, when reservoirs and lakes have elevated levels of nutrients, large amounts of algae and other aquatic plants can grow. Plants and algae produce oxygen during daylight hours. As aquatic vegetation dies and decays, oxygen can be depleted and dissolved oxygen may drop below the levels needed for fish and other aquatic life.

As reservoirs and lakes age, they go through a process called eutrophication. When this occurs naturally, it is caused by a gradual accumulation of the effects of nutrients over many years. Ultimately, eutrophication results in the filling of the lake from soil,

silt, and organic matter from the watershed. Pollution from human activities can greatly accelerate this process. Eutrophication that would naturally occur over centuries can be accelerated to a few decades.

Tennessee's water quality criterion for nutrients in lakes and reservoirs is currently narrative. The exception is Pickwick Reservoir where a numeric chlorophyll a criterion has been adopted. The assessment basis to consider lakes impaired is the level of eutrophication that interferes with the intended uses of the lake.

This process is complicated by the complex nature of the public's uses for lakes and reservoirs. For example, algae production can help some species of fish thrive, benefiting sport fishermen. However, swimmers and boaters prefer clear water. In addition, man-made reservoirs are highly managed systems making it difficult to establish a reference condition.

SILTATION in lakes:

Sediment and silt cause significant problems in reservoirs and lakes as well as flowing water.

In Tennessee nearly 20,000 lake acres have been assessed as impaired by sediment and silt. Since reservoirs and lakes serve as sediment traps, once sediment enters a lake it tends to settle out, initially in embayment and inflow areas, but ultimately throughout the reservoir or lake.

It is both difficult and expensive to remove sediment from reservoirs and lakes. Three reservoirs, Ocoee #3, Ocoee #2, and Davy Crockett, have almost filled in with sediment caused by historic mining activities. Parksville Lake has significant delta

formation in its upper reaches. Reelfoot Lake in West Tennessee is also impacted by sediment.

LOW DISSOLVED OXYGEN in lakes:

Just like in rivers, a depletion of dissolved oxygen can restrict or even eliminate aquatic life. The dissolved oxygen (DO) minimum water quality standard for reservoirs and lakes is 5 mg/L measured at a depth of five feet or mid-depth lake is less than ten feet deep. In eutrophic reservoirs or lakes, the DO can be much lower than 5 mg/L. Even in reservoirs and lakes that have a DO of 5 mg/L at the prescribed depth, the dissolved oxygen levels can be near zero at greater depths.

The most common reason lakes and reservoirs have fish kills due to low DO is eutrophication. Overproduction of algae raises oxygen

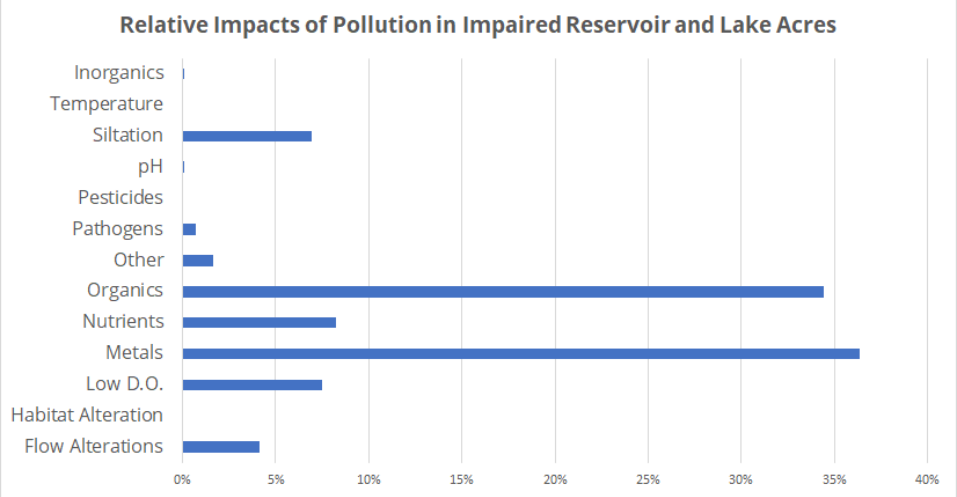
levels on sunny days, but on cloudy days and at night the algae die-off can cause DO levels to plummet. Additionally, high levels of biomass will restrict light penetration to a few feet or even inches. Below the depth where light can penetrate, DO levels will be very low.

Lakes that are eutrophic often strongly stratify, which means that there is a layer of warm, well-oxygenated water on top of a cold, poorly oxygenated layer. Stratification limits the dissolved oxygen available to fish and other aquatic life. Currently, over 20,000 lake acres are listed as impaired by oxygen depletion.

DO levels in lakes and reservoirs can also be affected by discharges from upstream dams. Water released from the bottom of the reservoir may have very low dissolved oxygen levels.

PESTICIDES in lakes:

Pesticides, if used improperly, can cause harm to humans, animals, and the environment. Many pesticides have been banned in the U.S. but pollution that occurred decades ago still poses a serious threat, since they remain in the environment for an extremely long time. In some waterbodies, these substances have accumulated in sediment and pose a health threat to those that consume fish or shellfish. Pesticides are more likely to bioaccumulate in these fish species since they tend to accumulate more in fattier fish.



The most common causes of pollution in lakes and reservoirs has have been found to be metals and toxic organics such as PCBs and dioxins. Note that waters can have pollution from more than one source and totals are not additive.

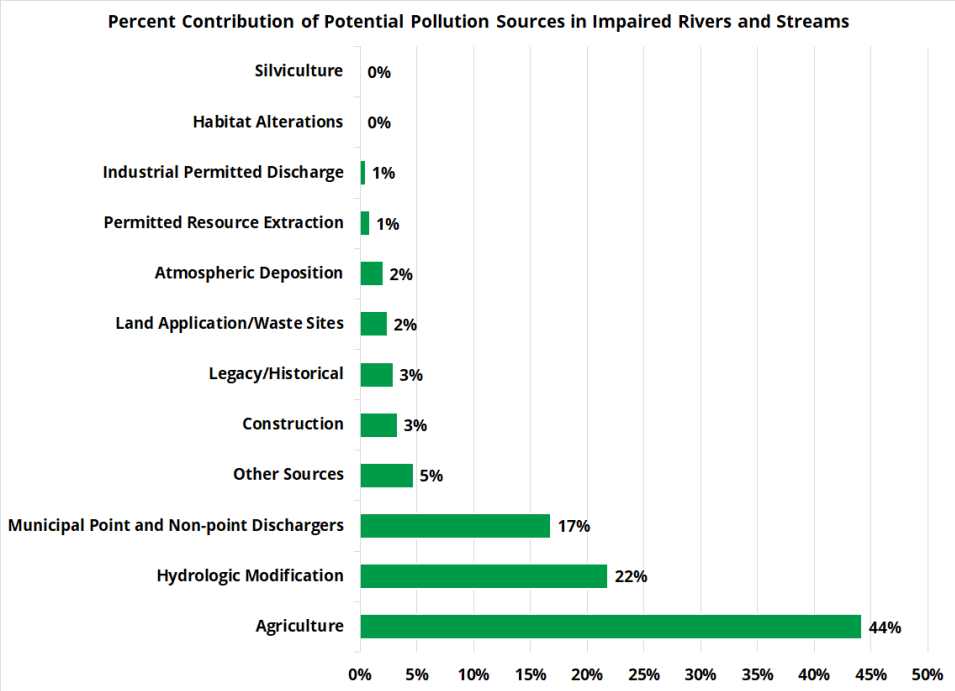
POTENTIAL SOURCES OF POLLUTION

Although the identification of sources of pollution is not required by EPA, Tennessee feels that identification of potential sources contributes more information to the assessment process that can be used by both internal and external customers to further investigate solutions to restore water quality. The identification of sources during the assessment process is by no means exhaustive and complete for all available sources of a pollutant. The Division uses source categories that are defined by the EPA ATTAINS system and focuses on the most common or more obvious potential sources in the watershed.

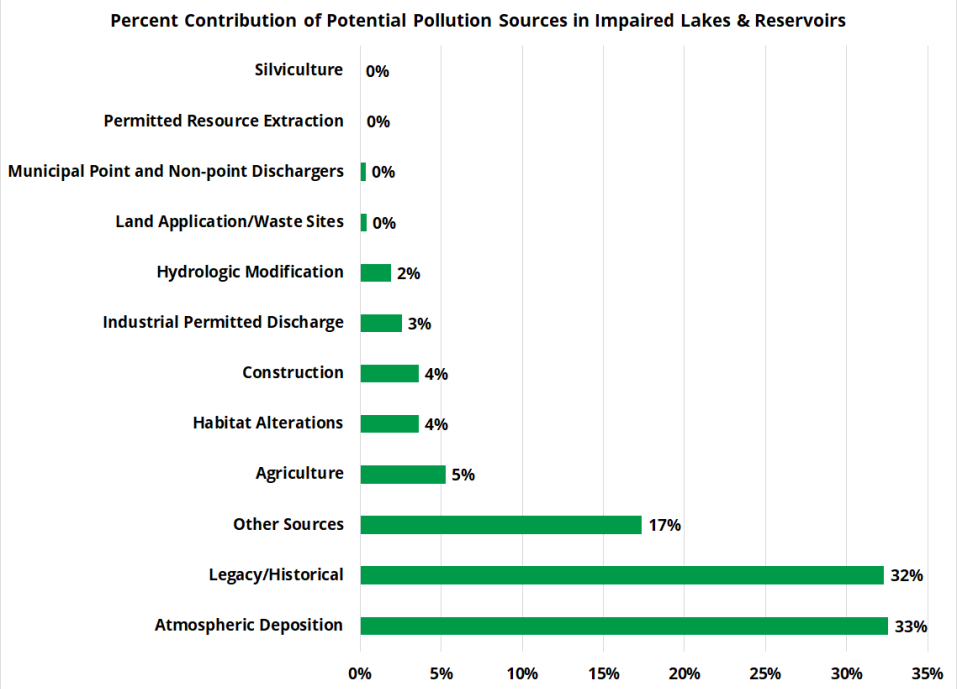
Major potential sources of pollutants in streams and rivers include agricultural activities, hydrologic modification (channelization, dams, and navigation dredging), and municipal discharges and runoff.

Some sources are more evenly distributed across the state, while others are concentrated in particular areas. Channelization and crop production is most widespread in west Tennessee, dairy farming and other intensive livestock operations are concentrated in the Ridge and Valley region of east Tennessee and in southern middle Tennessee. Rapid commercial and residential development in urban areas is always a concern.

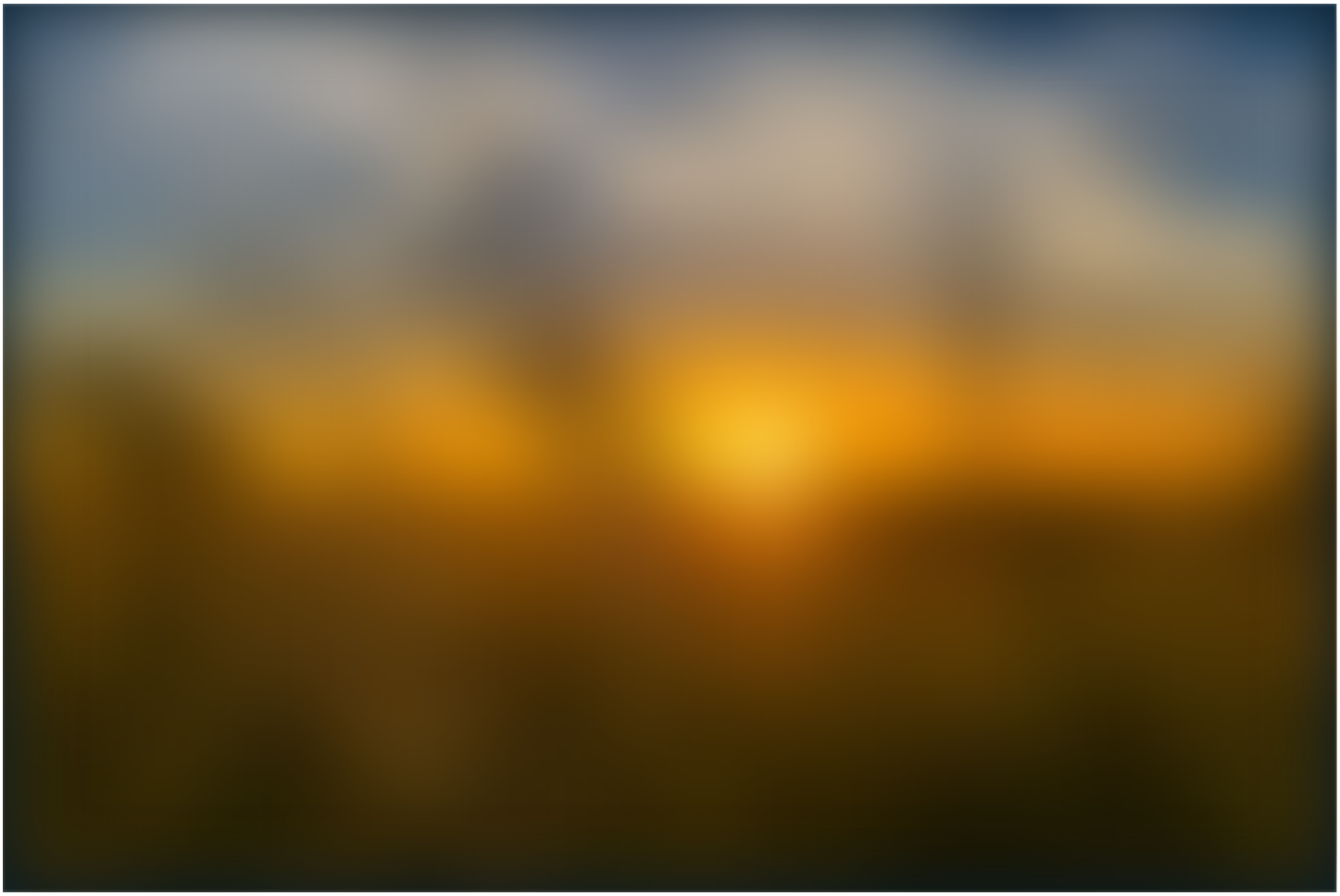
For reservoirs, the major source of impairment is contaminated sediment from legacy pollutants. Over half of the sources of impact to reservoirs and lakes are legacy toxic substances and atmospheric deposition of mercury.



Relative Sources of Impacts to Streams and Rivers (totals are not additive)



Relative Sources of Impacts to Lakes and Reservoirs (totals are not additive)



Agricultural Impairment in Streams

Tennessee is fortunate to have over 90,000 farms, averaging 130 acres in size comprising almost half the land use in the state. Farms supply food, earn the state 20 billion dollars annually and provide over 200,000 jobs (Tennessee Department of Agriculture, 2014). Agricultural activities contribute to approximately 44% of the impaired stream miles in the state. The largest single source of impacts is grazing of livestock, followed by crop production. Crop cultivation can lose 20 tons of soil per acre annually (TDEC, 2012). In west Tennessee, due to erosion from crop production (mostly cotton and soybean) substantial quantities of soil are lost annually. In middle Tennessee, cattle grazing and hog farms are the major agricultural activity and can result in bank erosion, plus elevated bacteria and nutrient levels. In east Tennessee, runoff from feedlots and dairy farms have significantly impacted some waterbodies.

The Tennessee Water Quality Control Act (TWQCA) does not give the Division authority to regulate water runoff originating from normal agricultural activities such as crop production and livestock grazing. However, agricultural activities that may result in a point source pollution, such as animal waste system discharges from concentrated livestock operations, are regulated.

Sources of Agricultural Impairment	Stream Miles Impaired	Relative Contribution
Specialty Crop Production	114	1.0%
CAFOs	49	0.4%
Unrestricted Cattle Access	296	2.5%
Dairies (Outside Milk Parlor Areas)	40	0.3%
Irrigated Crop Production	133	1.1%
Grazing in Riparian or Shoreline Zones	7437	63.3%
Animal Feeding Operations (NPS)	163	1.4%
Livestock (grazing or feeding)	7	0.1%
Aquaculture (permitted)	2	0.0%
Non-irrigated Crop Production	3517	29.9%

Note: Pollutants in streams can come from more than one source. These totals are not additive. (CAFO=Concentrated Animal Feeding Operation)

Tennessee has made great strides in recent years to prevent agricultural and forestry impacts to water quality. Educational and cost-sharing projects promoted by the Department of Agriculture, Natural Resource Conservation Service (NRCS) and University of Tennessee Agricultural Extension Service have helped farmers implement Best Management Practices (BMP's) all over the state. Farmers are voluntarily helping to decrease erosion rates and protect streams and rivers by increasing riparian habitat zones and setting aside conservation reserves.

The Division has a memorandum of understanding with the Tennessee Department of Agriculture (TDA). Under this agreement, the Division and TDA jointly resolve complaints about water pollution from agricultural activities. When a problem is found or a complaint has been filed, TDA has the lead responsibility to contact the farmer or logger. Technical assistance is offered to correct the problem.

Hydrologic Modification Impairment in Streams

Altering the physical and hydrological properties of streams and rivers is the source of impairment in about 22 percent of the impaired streams and rivers in Tennessee. Modifications include channelization (straightening streams), impoundments (construction of a reservoir), dredging for navigation, and flow regulation or modification.

It is likely that the extent of streams impacted by the effects of channelization has been under-reported, as many unassessed streams have also been channelized, especially in West Tennessee. It is unlikely that channelized streams can meet Water Quality Standards, but the Department does not assess these streams as impacted without biological data.

Hydrologic Modification	Stream Miles Impaired	Relative Contribution
Channelization	4276	82.6%
Dredging (Navigation Channel)	207	4.0%
Upstream Impoundment	640	12.4%
Flow Regulation/Modification	39	0.8%
Channel Erosion/Incision from Upstream Modification	12	0.2%

Note: Pollutants in streams can come from more than one source. These totals are not additive.

Physical alteration of waterbodies can only be done as authorized by the state. Permits to alter streams or rivers called Aquatic Resource Alteration Permits (ARAPs) are issued by TDEC's Natural Resources Section. This section administers Section 401 of Federal Clean Water Act, which provides Water Quality Certification to ensure that a discharge will not violate Tennessee's Water Quality Standards. The U.S. Army Corps of Engineers oversees Section 404 of the Federal Clean Water Act, which regulates the discharge of dredge or fill material into waterways. Failure to obtain a permit before modifying a stream or river can lead to enforcement actions.

Channelization: A source of impairment for over 82% of the streams and rivers assessed as impacted by hydrologic modification. Originally, channelization was implemented to control flooding and protect croplands along rivers. In West Tennessee, channelization was used extensively to drain wetlands to create cropland. Throughout Tennessee, streams and rivers continue to be impaired by channelization and bank destabilization from vegetation removal.

Costs associated with channelization include:

- Increased erosion rates and soil loss.
- Elimination of valuable fish and wildlife habitat by draining wetlands and clearing riparian areas.
- Destruction of bottomland hardwood forests.
- Magnification of flooding problems downstream.
- "Down-cutting" of streambeds as the channel tries to regain stability.

Stream and River Impoundment: Problems associated with the impoundment of free flowing water are increasing as more streams and rivers are dammed. Impoundments are constructed for a variety of reasons including flood control, power generation, fishing, livestock, irrigation, industrial use, water supply, and aesthetics. Dams not only affect the impounded stream segment but also have the potential to alter the physical, chemical and biological components of downstream reaches.

It has been the experience of the Division that very few of these impoundments can be managed in such a way as to avoid water quality problems. In 2006 a random survey of 75 streams below small impoundments across the state showed 95% did not support fish and aquatic life (Arnwine et al 2006).

Problems often associated with stream and river impoundment include:

- Downstream habitat alteration including increased sediments, bank instability and embeddedness.
- Geomorphic changes including loss of channel sinuosity downstream.
- Loss of stream or river for certain kinds of recreational use.
- Detrimental changes in flow rates downstream of the dam.
- Elevated metals and nutrients downstream of the dam.
- Barriers to fish migration.
- Altered biological communities in the impounded section and downstream.

Dredging: Dredging or removing substrate from a stream or river is done to deepen river channels for navigation or to mine sand or gravel for construction. Dredging can cause habitat disruption, substrate alteration, sedimentation, and erosion. Dredging cannot be done without authorization from the state.

Municipal Discharge Impairment in Streams

Point and non-point discharges within cities is the source of impairment in about 17% of the impaired streams and rivers in Tennessee.

Municipal Point and Non-point Dischargers	Stream Miles Impaired	Relative Contribution
Separate Storm Sewer (MS4)	15	0.3%
Package Plants	21	0.4%
Combined Sewer Overflows	10	0.2%
Sanitary Sewer Overflows	954	18.7%
Urbanized (High Density Area)	3118	61.1%
Municipal Point Source	984	19.3%

Note: Pollutants in streams can come from more than one source. These totals are not additive.

Municipal Stormwater Discharges: As stormwater drains through urban areas, it picks up pollutants from yards, streets, and parking lots and carries them to nearby waterways. The runoff can be laden with silt, bacteria, metals, and nutrients. Following heavy rains,

streams and rivers can contain various pollutants at elevated levels for several days. Water Quality Standards violations have been documented in Tennessee's four largest cities: Memphis, Nashville, Chattanooga, and Knoxville, plus many other smaller towns.

The federal National Pollutant Discharge Elimination System (NPDES) program regulates stormwater runoff. Industries and large commercial operations must operate under the state's general NPDES permit for industrial stormwater discharges. This permit requires site-specific stormwater pollution prevention plans and mandatory installation of pollution control measures.

Under Tennessee Municipal Separate Storm Sewer Systems (MS4) permits, cities must develop stormwater programs and regulate sources at a local level. In addition to Tennessee's four MS4 Phase I cities (Memphis, Nashville, Chattanooga, and Knoxville) that are covered under individual NPDES permits, 92 other cities and counties are now covered by the MS4 Phase II general permits.

There are six Phase II MS4 program elements designed to further reduce pollutants from stormwater. The elements include public education and outreach, along with public participation and involvement. Further, a plan must be implemented to detect and eliminate illicit discharges to the storm sewer system.

Construction sites must obtain coverage under the state's general NPDES permit for construction stormwater runoff if clearing, grading or excavating is planned on any site larger than one acre or any disturbance of less than one acre if it is part of a larger common plan of development or sale. Sites receiving coverage under the permit are required to control erosion as well as address post-construction stormwater runoff.

Combined Sewer Overflows: In Tennessee, only three cities (Nashville, Chattanooga, and Clarksville) have combined sewers

(sanitary waste and storm water carried in the same sewer). Permits require that when these sewers overflow during large storm events, monitoring must be conducted. Six creeks and a five mile portion of the Cumberland River in Nashville have water contact advisories due to combined sewer overflows.

Municipal Point Source Discharges: Municipal sewage treatment plants have permits designed to prevent impacts to the receiving waterbody. On rare occasions, sewage treatment systems fail to meet permit requirements. Sometimes, a waterbody downstream of a facility is found to not meet biological criteria even if permit limits are being met. In those cases, permit requirements must be adjusted along with other watershed improvements to address water quality concerns.

Sanitary Sewer Overflows: Collection systems convey raw sewage to treatment plants through a series of pipes and pump stations. Unfortunately, these systems occasionally malfunction or become overloaded, which can result in the discharge of high volumes of untreated sewage to a stream or river. A serious concern near urban areas is children exposed to elevated bacteria levels while playing in streams and rivers after heavy rains. Municipalities monitor sanitary sewer collection systems to ensure that they are not leaking. NPDES permits contain provisions that prohibit overflows and require that they be reported to TDEC. Enforcement can be taken against cities that fail to report and correct sewage system problems.

Other Impairment in Streams

A small grouping of sources, along with unknown sources account for approximately 5% of the impaired streams and rivers in Tennessee.

Other Sources	Stream Miles Impaired	Relative Contribution
Sources Outside State Jurisdiction or Borders	214	19.4%
Military Base (NPS)	13	1.2%
Sources Unknown	829	75.0%
Off-Road Vehicles	27	2.4%
Golf Courses	20	1.8%
Water Fowl	2	0.2%

Note: Pollutants in streams can come from more than one source. These totals are not additive.

Construction Impairment in Streams

Construction related sources account for 3% of the impaired streams and rivers in Tennessee.

As Tennessee continues to grow and the populations of communities are expanding, the construction of subdivisions, shopping malls, and highways can harm water quality if the sites are not properly stabilized. The impacts most frequently associated with land development are silt and habitat alteration. Construction sites must obtain coverage under the state's general NPDES permit for construction stormwater runoff if clearing, grading or excavating is planned on any site larger than one acre or any disturbance of less than one acre if it is part of a larger common plan of development or sale.

In addition, local stormwater control programs and regulations have been helpful in controlling water quality impacts from land development. MS4 Phase I cities (Memphis, Nashville, Chattanooga, and Knoxville) already have construction stormwater control programs in effect. The 92 cities and counties covered under the Phase II MS4 general permit have developed construction stormwater control programs. In these cities, local staff helps identify sources of stormwater runoff and develop control strategies.

Construction	Stream Miles Impaired	Relative Contribution
Site Clearance	735	93.2%
Hwys. /Roads/Bridges, Infrastructure (new)	30	3.8%
Construction Stormwater Discharge (Permitted)	24	3.0%

Note: Pollutants in streams can come from more than one source. These totals are not additive.

Legacy/Historical Impairment in Streams

Historical activities account for nearly 3% of the impaired streams and rivers in Tennessee.

Impacts from Abandoned Mining: In the 1970's, coal mining was one of the largest pollution sources in the state. "Wildcat" operators strip-mined land without permits or regard for environmental consequences to provide low-priced coal to the growing electric industry. When the miners had removed all the readily available coal, they would abandon the site. In 1983, the price for coal fell so low it was no longer profitable to run "wildcat" mining operations, so most illegal mining operations stopped.

Although many streams and rivers are still impaired by runoff from abandoned mines, which contain pollutants such as silt, pH, manganese, and iron, significant progress has been made in site reclamation. Some abandoned strip mines are being reclaimed under the Abandoned Mine Reclamation program and others are naturally re-vegetating. New mining sites are required to provide treatment for runoff.

Contaminated Sediments: The main problem with toxic contaminants in sediment is that it can become concentrated in the food chain. As toxic substances become re-suspended in the water column, they are absorbed in by algae, which in turn are eaten by insects and small fish. Small fish eat insects and big fish eat little fish. This continues up the food chain getting more concentrated in each larger animal.

In most places in Tennessee, it is safe to eat the fish. However, in some waterbodies, organic pollutants (primarily PCBs, dioxins, chlordane and other pesticides in the sediment) and mercury are bioconcentrated through the food chain in the fish.

Fish tissue samples are collected and analyzed from waterbodies across the state. Results are compared to criteria developed by the Food and Drug Administration (FDA) and EPA. If fish tissue is contaminated and the public's ability to safely consume fish is impaired, the waterbody is posted with signs and assessed as not supporting recreational uses.

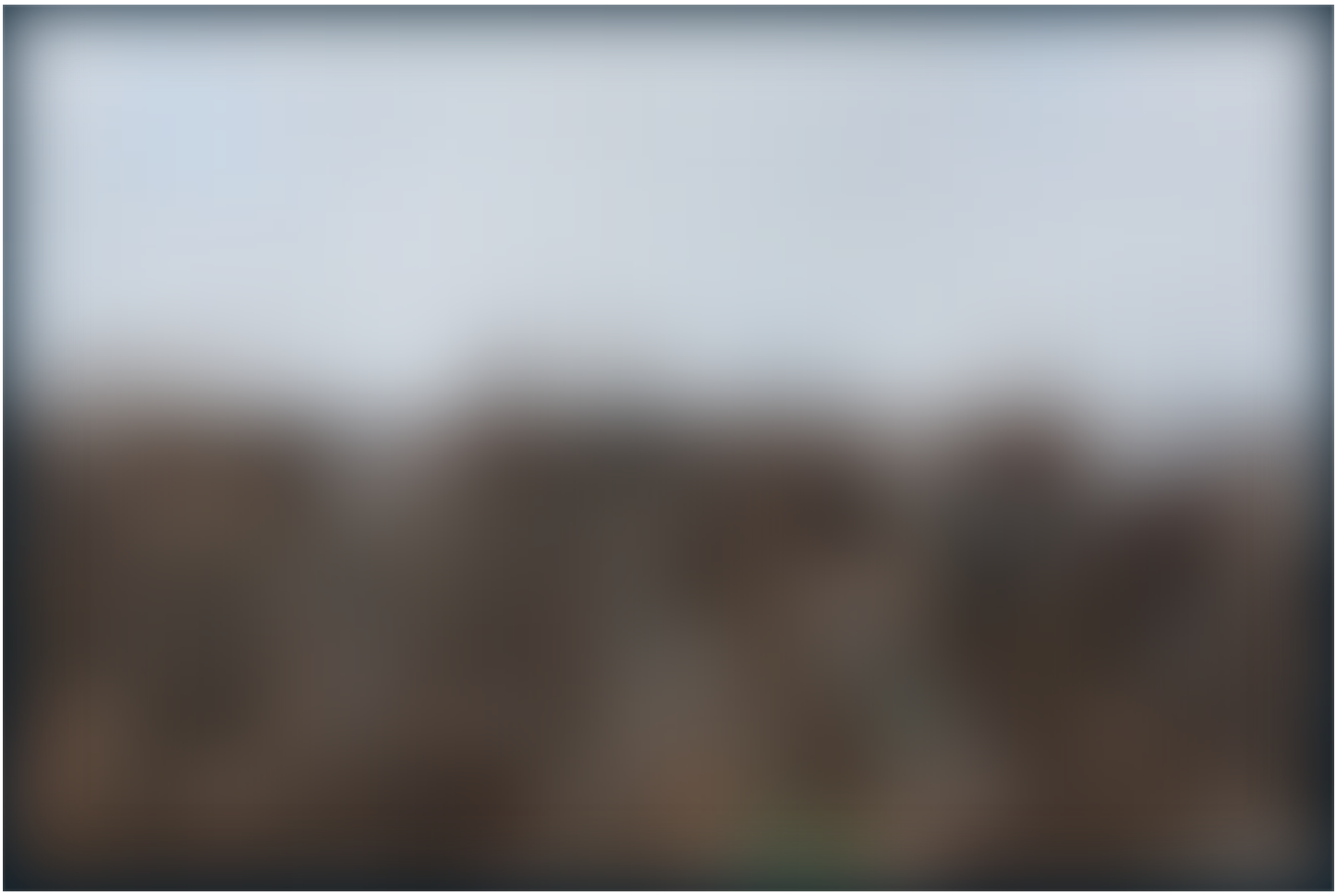
The advisories are listed on the TDEC website and included in sport fishing regulations. The Tennessee Valley Authority (TVA) and the Tennessee Wildlife Resources Agency (TWRA) share resources and expertise in this process.

Many substances found in fish tissue today, like DDT, PCBs, and chlordane, were widely distributed in the environment before they were banned. The levels of these substances will slowly decrease over time. Currently companies with permits to discharge organic substances have very restrictive limits.

Legacy/Historical	Stream Miles Impaired	Relative Contribution
Contaminated Sediment	351	47.1%
CERCLA NPL (Superfund)	30	4.1%
Abandoned Mine Lands (Inactive)	339	45.4%
Mill Tailings	19	2.5%
Mine Tailings	7	1.0%

Note: Pollutants in streams can come from more than one source. These totals are not additive.

(CERCLA NPL=Superfund National Priorities List)



Land Application / Waste Site Impairment in Streams

Solid waste and septic systems contribute to water quality problems in various ways and account for about 2% of the impaired streams and rivers in Tennessee. Solid waste in landfills can leach into groundwater and surface water if not prevented. Wastewater in failing septic tanks can leak into the ground causing water contamination. Treated wastewater and sludge are applied to land as fertilizers and can be washed into waterbodies causing nutrient loading if applied incorrectly. Another concern is the use and maintenance of underground storage tanks that can contain substances like petroleum products, solvents, and other hazardous chemicals and wastes. These can leak into the groundwater and may reach the surface water.

Land Application/Waste Sites	Stream Miles Impaired	Relative Contribution
On-site treatment systems (septic systems and similar)	488	86.0%
Land Application of Wastewater Biosolids (Non-agricultural)	21	3.7%
Landfills	52	9.2%
Industrial Land Treatment	3	0.6%
Land Application of Waste	3	0.5%

Note: Pollutants in streams can come from more than one source. These totals are not additive.

The remaining 4% of impairment in Tennessee streams can be attributed to atmospheric deposition (<2%), permitted resource extraction (1%), industrial permitted discharges (<1%), habitat alterations (<1%) and silviculture (<1%).

Atmospheric Deposition in Lakes

Atmospheric deposition as a source of pollution is attributed to nearly 33% of the impaired reservoir acres. Atmospheric deposition occurs when air pollutants are deposited to land or water. Primary anthropogenic sources of pollutants include burning fossil fuels, agricultural activities, and emissions from industrial operations. Tennessee currently has over 98,400 lake acres impaired by atmospheric deposition of mercury, mostly found in east Tennessee.

In 2009, the Division began a probabilistic study of fish tissue to test a model that may predict mercury air deposition. The mercury levels found in fish tissue did not correlate with the air deposition model that was used. Several fish taken from areas with predicted high levels of mercury air deposition contained relatively low levels

of contamination. Other fish that had higher concentrations of mercury came from areas with low predicted depositional mercury.

Legacy Impairment in Lakes

Legacy/Historical	Lake Acres Impaired	Relative Contribution
Contaminated Sediment	97,705	94%
Abandoned Mine Lands (Inactive)	2,254	2%
Mill Tailings	2,254	2%
Mine Tailings	2,254	2%

Note: Pollutants in reservoirs can come from more than one source. These totals are not additive.

Like rivers and streams, lakes are impaired by many different sources of pollution. Legacy, or historical pollutants are the number one source of contamination in Tennessee Reservoirs. Nearly 32% of the use impairments to reservoirs are due to pollutants that were

introduced prior to the enactment of water quality regulations or before EPA banned their use. These legacy pollutant sources include contaminated sediments, mill & mine tailings, and abandoned mine lands.

Contaminated Sediments: The largest source of legacy pollutants is contaminated sediments. Along with mercury, two organic substances banned in the 1970's, chlordane and PCBs, are responsible for most of the continuing problem of sediment contamination today. These substances bind with the sediment and are very slow to break down, remaining in the environment for a long time. Once in the sediment, they become part of the aquatic food chain. Bioaccumulation in fish tissue has resulted in consumption advisories in several reservoirs. The levels of these substances will slowly decrease over time.

Abandoned Mines/Mine Tailings/Mill Tailings: The Copper Basin in the tri-state area of Tennessee, Georgia, and North Carolina was extensively mined beginning in 1843. Before 1900, this was the largest metal mining area in the southeast. The last mine closed in 1987. Runoff from disturbed areas has contaminated three downstream reservoirs on the Ocoee River. Much of the area has now been reforested and along with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) activities, commonly known as Superfund, water quality in the Ocoee River watershed has improved. Although much work remains to be done before water quality goals are met, the transport of pollutants to the Ocoee River appears to have diminished.

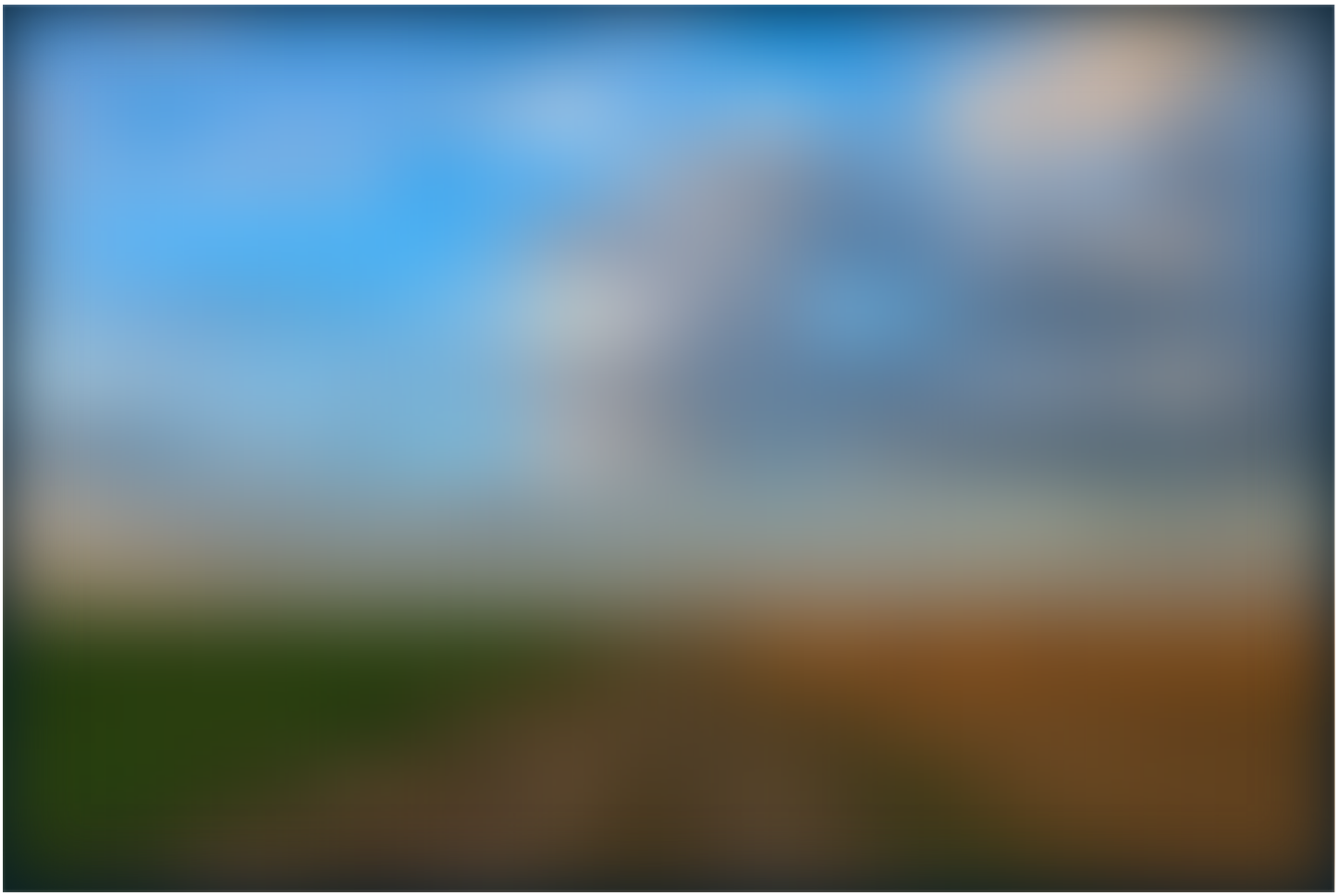
Other Impairment in Lakes

Other Sources	Lake Acres Impaired	Relative Contribution
Sources Outside State Jurisdiction or Borders	35,987	68%
Sources Unknown	1,050	2%
Internal Nutrient Recycling	15,500	30%

Note: Pollutants in reservoirs can come from more than one source. These totals are not additive.

Nearly 17% of impairment in Tennessee reservoirs can be attributed to sources outside of the state and to internal nutrient cycling. Internal nutrient cycling is the release and recapture of nutrients from the sediment of a lake or reservoir, which functions to accelerate eutrophication. Reelfoot Lake in west Tennessee accounts for all the lake acres assessed as impaired by nutrient cycling. This lake is in an advanced state of eutrophication due to sediment and nutrients.

Eutrophication is a natural process that will occur in any lake. It becomes pollution when it is accelerated by human activities, interferes with the desired uses of the lake or reservoir, or causes Water Quality Standards to be violated in the reservoir or receiving stream or river.



Agricultural Impairment in Lakes

Similar to streams and rivers, reservoirs and lakes can be greatly impacted by agricultural activities. Plowing and fertilizing croplands can result in the runoff of tons of soil and nutrients annually. Over 16,000 lake acres in Tennessee are listed as impaired due to farming activities. Most of these acres are in Reelfoot Lake, which is listed as impaired due to erosion from agricultural activities.

Agriculture	Lake Acres Impaired	Relative Contribution
Grazing in Riparian or Shoreline Zones	481	3%
Animal Feeding Operations (NPS)	34	0%
Non-irrigated Crop Production	15,587	97%

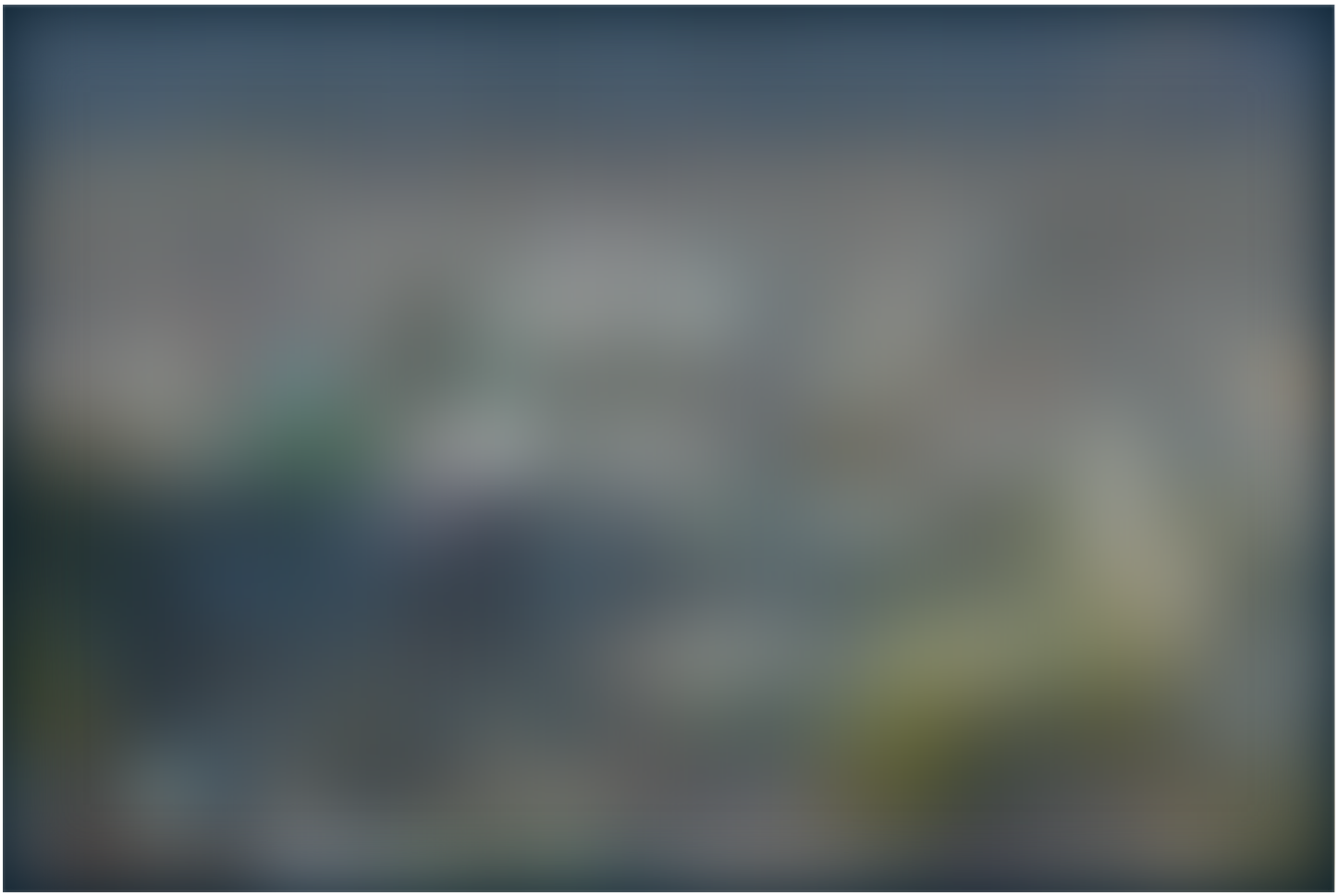
Note: Pollutants in reservoirs can come from more than one source. These totals are not additive.

The remaining impairment in Tennessee lakes can be attributed to:

- Habitat Alteration - Loss of wetlands in Reelfoot Lake accounts for the majority of lake acres impaired due to habitat modification. (3.5%)
  - Construction - Almost all of the lake acres assessed as impaired by construction are due to the land development around Reelfoot Lake. Clearing land for development results in increased sedimentation, nutrient runoff, drainage, filling, and loss of wetlands. (3.5%)
  - Industrial Point Source Discharges (2.5%)

- Hydrologic modifications - Upstream impoundments (<2%)
- Municipal sources - discharges from separate storm sewer systems, collection system failures, and combined sewer overflows. (<1%)
- Permitted Resource extraction (<1%)
- Silviculture (<1%)

ADVISORIES



When the waters in Tennessee are found to have high bacteria levels or when fish are contaminated and pose a potential risk to people, we want to make sure that the citizens of Tennessee are

aware of those threats to public health. The department notifies citizens when the waters are not safe to swim in and/or when fish consumption should be limited. We do that through news releases, posting of warning signs and updating our advisories list.

TN ADVISORIES

> *The Commissioner shall have the power, duty, and responsibility to...post or cause to be posted such signs as required to give notice to the public of the potential or actual dangers of specific uses of such waters. (Tennessee Water Quality Control Act)*

Visit the fifth and final part of Tennessee's Clean Water Act Monitoring and Assessment Report to learn about projects that are going on across the state and how you can be involved in helping to protect and improve the water resources that we all enjoy.

Part 5 of 5 - Successes, Projects and Outreach

Prepared by: The Tennessee Department of Environment & Conservation

Tennessee's Clean Water Act Monitoring and Assessment Report

Tennessee's Clean Water Act Assessment & Monitoring Report

Division of Water Resources

August 2021

Questions/Comments?

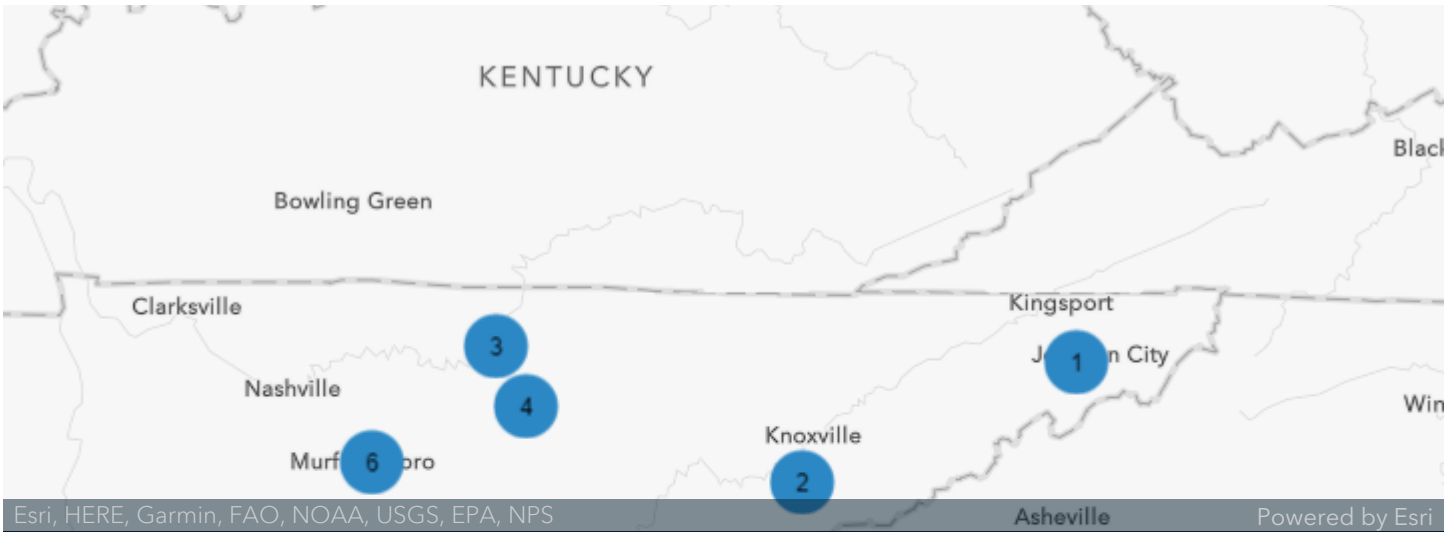
Successes, Projects and Outreach

Part 5 of 5 - Tennessee's Clean Water Act Monitoring and Assessment Report

Tennessee Department of Environment and Conservation Division of Water Resources

Watershed Projects & Improvements

At any given time, there are great projects going on all across the state of Tennessee that are working towards protecting and improving our water resources. Here, we would like to highlight just a few that we are involved with.



1 Little Limestone Creek Water Pollution Investigation and Water Quality Management Plan

Also funded through an EPA grant through TDEC to the First Tennessee Development District. This project is aiming to create a water quality management plan for a watershed within the Town of Jonesborough.

2 Watershed Improvement Plan for the City of Maryville

This project, to provide an integrated watershed planning process for the stakeholders in the City of Maryville, TN, was funded by an EPA grant through TDEC to the East Tennessee Development District. (project was completed through LDA Engineering)

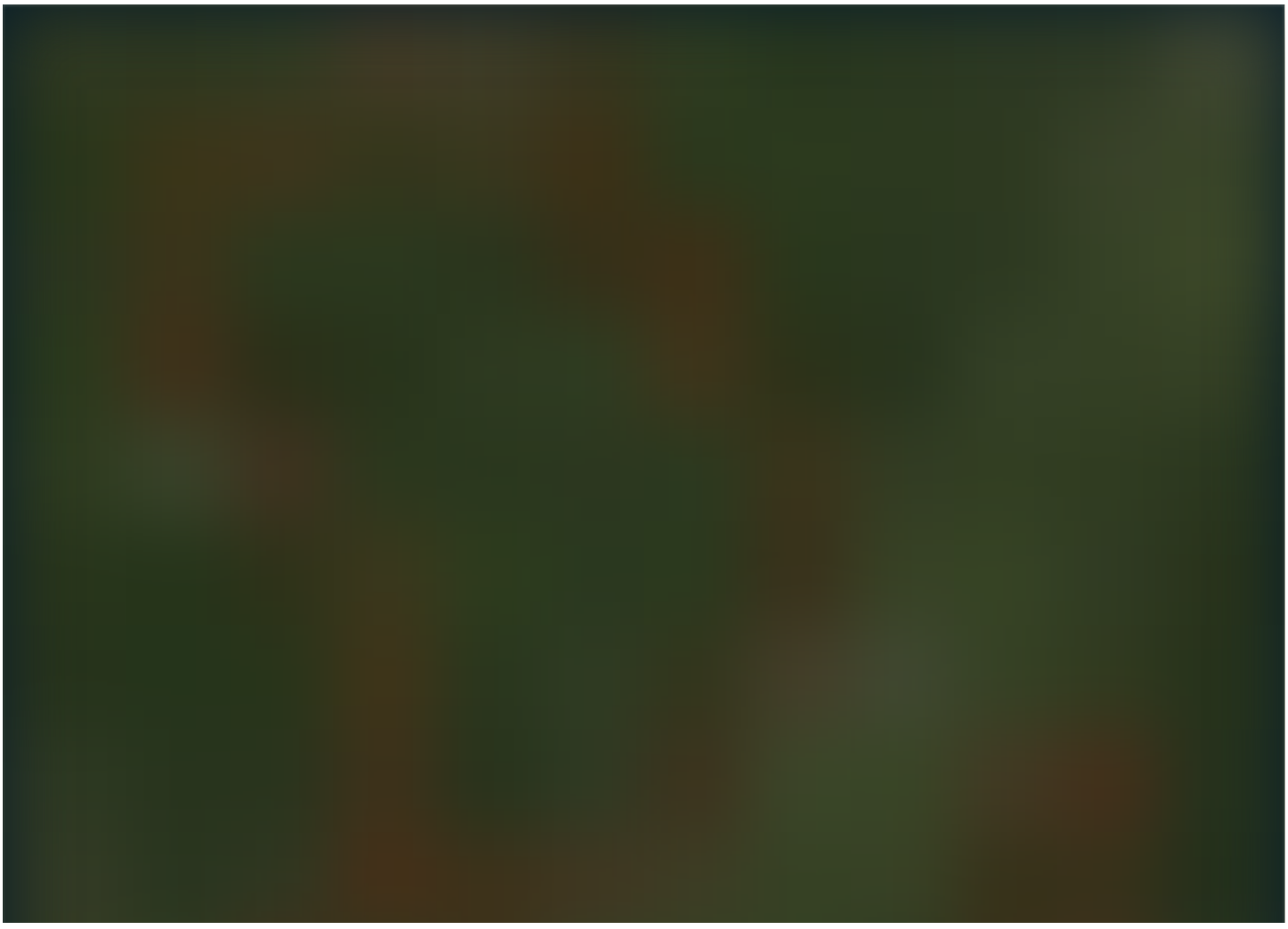
3 Planning for Watershed-Wide Stormwater Management

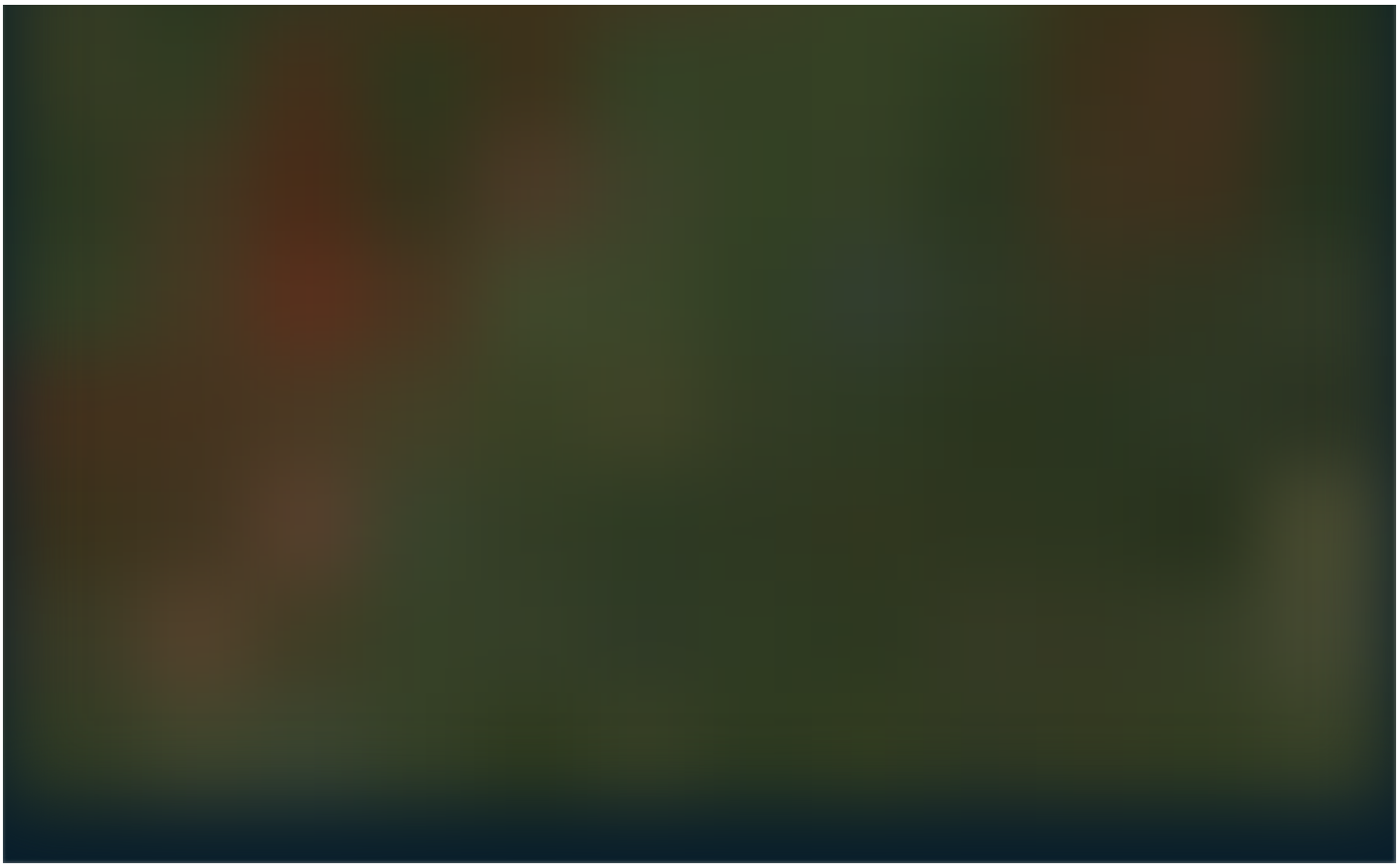
This project, to provide watershed management in the Town of Gainesboro, was funded by an EPA grant through TDEC to the Upper Cumberland Development District. (Project is being completed by Tennessee Tech University)

4 Falling Water River Watershed

Another project that was funded by an EPA grant through TDEC to the Upper Cumberland Development District focused on developing a watershed plan for the Falling Water River Watershed in Middle Tennessee. The goal of this project is to holistically identify and address water quality impairments in collaboration with state and local stakeholders in order to conserve and restore watershed health.

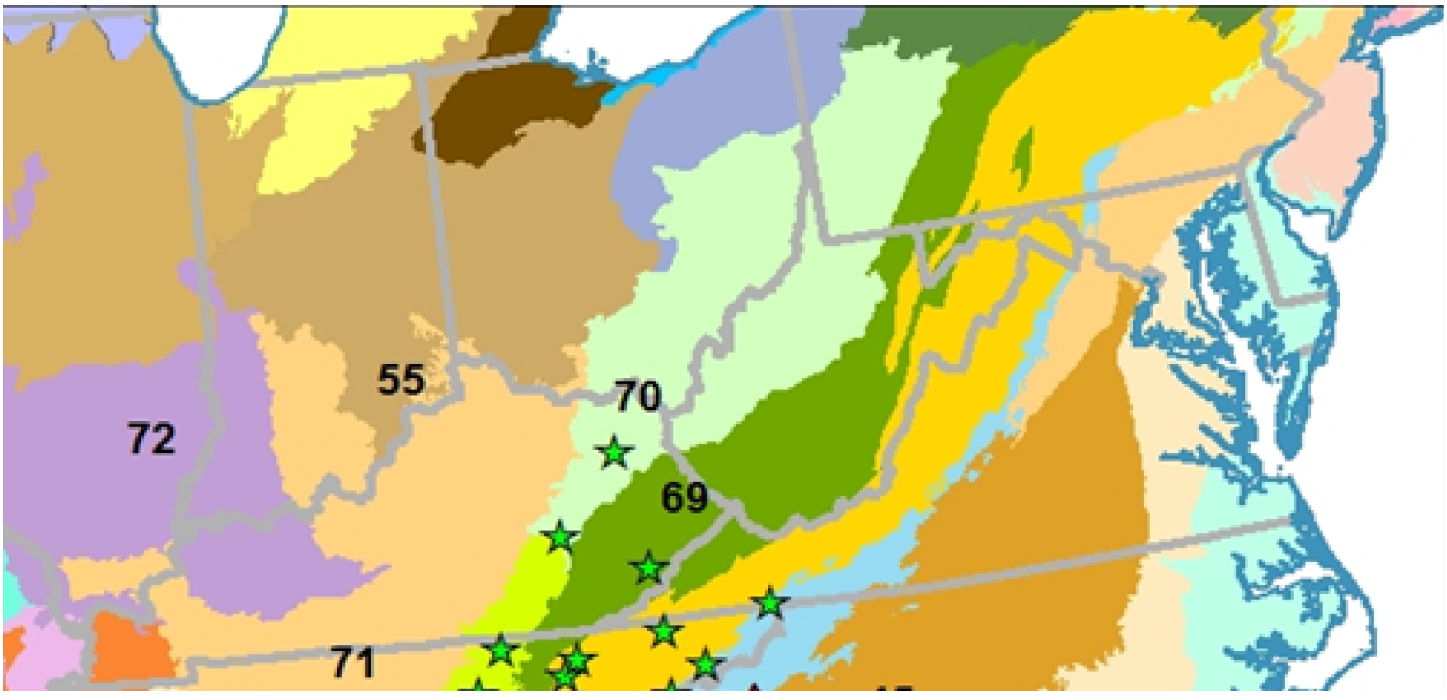
5 Remote Sensing Review of the Impacts of Clearcutting and Rock Harvesting on Flooding in Marion County

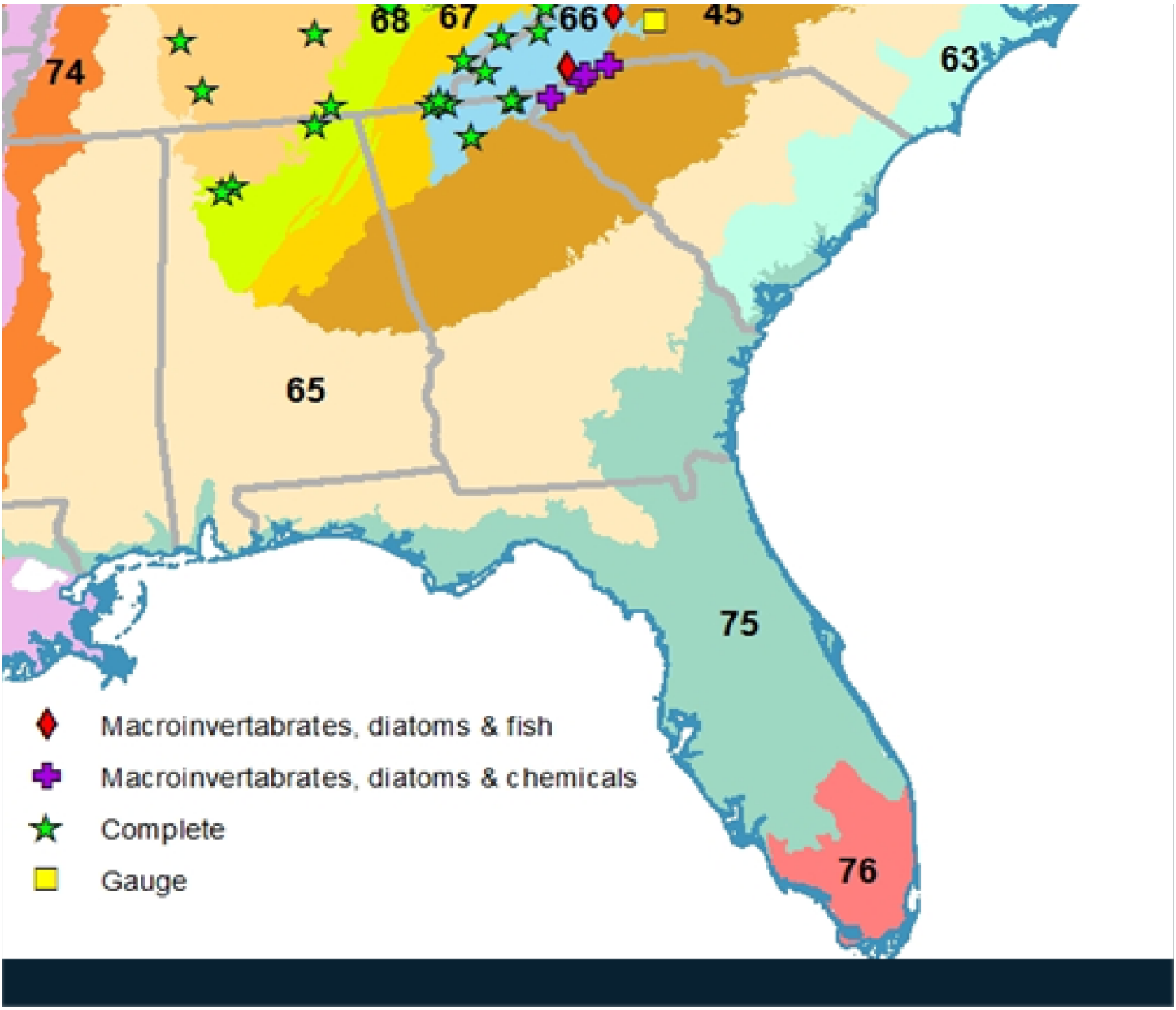




This project, led by the Southeast Tennessee Development District will be working to identify land use disturbances that could be increasing flooding in the areas.

6 Southeast Monitoring Network





For the last ten years, biologists from Tennessee, Kentucky, Alabama, Georgia, North Carolina, and South Carolina in partnership with TVA, and EPA created a joint reference stream monitoring network to study the potential for fluctuations in stream biological populations in response to variations in hydrology and temperature from changing climate conditions. Fifteen of the selected sites are in Tennessee.

Falling Water River Project

This is a map showing the real-time water level monitoring stations managed by Tennessee Tech...

https://gisportal.tntech.edu/arcgis/home/item.html?id=9e6e404a8cc54c708acbc227346541bd

Gainesboro Project

This is a map showing the real-time water level monitoring stations managed by Tennessee Tech...

https://gisportal.tntech.edu/arcgis/apps/webappviewer/index.html?id=7d9ef35cca2142539c8d4401e203e945

Watershed improvement plan project for Maryville, Tennessee. Project led by LDA Engineering on behalf of the East Tennessee Development District with funding from TDEC through the 604(b) planning grant from EPA.

Public Participation

Do you pollute??

Unfortunately.....it is true that most everyone contributes to pollution in some way or another. Sometimes, a small careless or thoughtless act results in far reaching damage. By understanding how pollution impacts our planet and what each of us can do to reduce our contributions, collectively we CAN make a difference in Tennessee's resources.

What can you do?

Learn. Get Involved. Be a part of the solution! There are so many ways that you can help.

Reduce, Reuse and Recycle!

Use and dispose of chemicals properly.

Prevent erosion and runoff

Obtain appropriate permits for activities

What else can you do?

Dispose of pharmaceuticals properly.

Did you know that your unused medications can find their way into our waterways?!?! Don't flush them or throw them away.....take them to a prescription drug take-back box!

Also.....

Report pollution.....

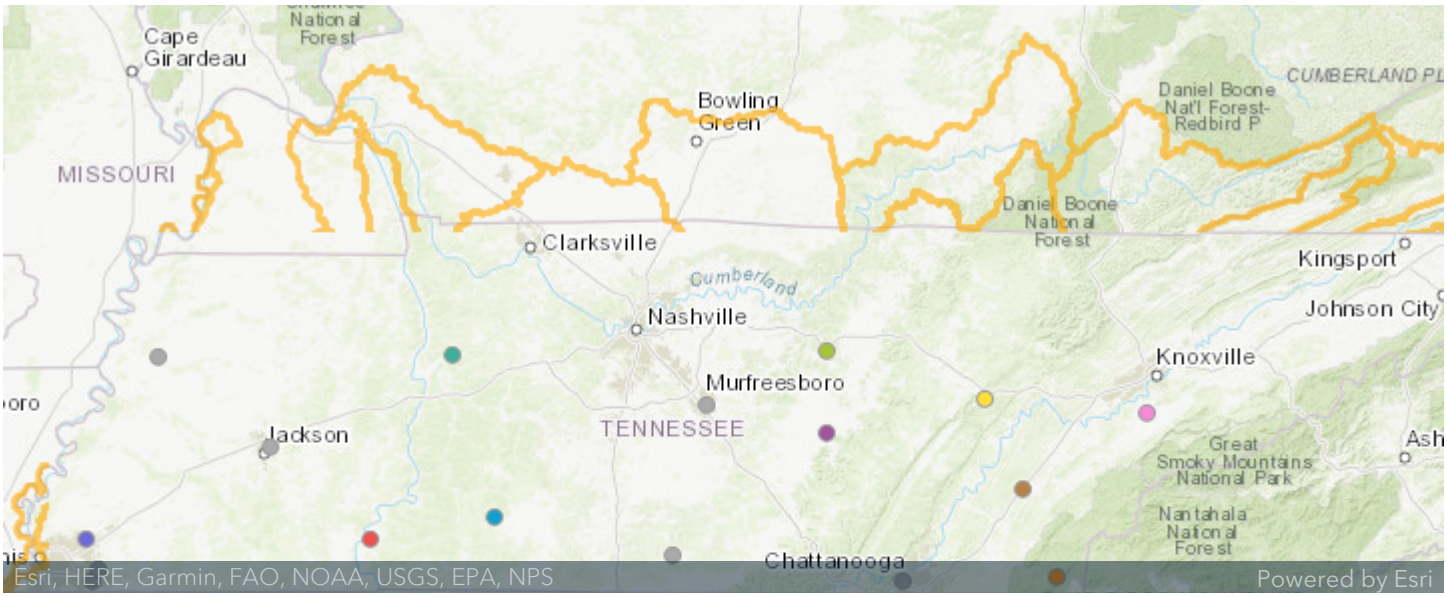
The public is a very important source of information on pollution. Please be sure to report pollution and always provide as much detailed information as possible. (description, location, photos etc.) This can be done in several different ways.

Contact your local environmental field office. (see map)

You can also report issues to the department via AskTDEC or by calling 888-891-8332.

Environmental issues should be a part of planning in communities and environmental laws encourage public participation. The Division of Water Resources invites public participation and offers opportunities throughout our processes. These can always be viewed on our website.

Participation Opportunities



Division personnel often attend and sometimes host events across the state in order to reach out to the public and teach them a little bit about our water resources and what they can do to help protect them.

Resources

There are so many resources out there that it is hard to keep up. TDEC has developed interactive maps and databases that supply a wealth of information. Below are just a few links to help you get started.

- Water Resources Data & Map Viewers
- Water Quality Reports and Publication
- TDEC Rules and Regulations (0400 Rules of the TN Dept of Environment & Conservation)
- Tennessee Code (Title 69 Waters, Waterways, Drains And Levees)
- Electronic Code of Federal Regulations (Title 40 Protection of the Environment)

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