

STATE OF CONNECTICUT
DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION
2018 INTEGRATED WATER QUALITY REPORT



July 2019

This document has been established pursuant
to the requirements of Sections 305(b) and 303(d)
of the Federal Clean Water Act

Brian Thompson, Acting Chief
Bureau of Water Protection and Land Reuse

Date

Katie S. Dykes, Commissioner

Bureau of Water Protection and Land Reuse
79 Elm Street
www.ct.gov/deep/iwqr
Hartford, CT 06106-5127
(860) 424-3704

Table of Contents

Table of Contents.....	ii
Table of Acronyms	iv
Introduction	1
Chapter 1 -Connecticut Consolidated Assessment and Listing Methodology (CT CALM)	5
Chapter 2 – 305(b) Assessment Results.....	33
Chapter 3 - Waterbodies Identified for Restoration and Protection Strategies Pursuant to Section 303 of the Clean Water Act.....	40
References	54
Figure 1-1. Connecticut Rivers and Lake Basins Index	11
Figure 1-2. Connecticut Estuary Basins Index.....	12
Figure 1-3. CT DEEP Monitoring BCG Value Results Map collected in 2016-2017 for the 2018 reporting cycle. For a closer look at the data that supports the BCG tier, go to https://ctdeepwatermonitoring.github.io/BCGMap	17
Figure 1-4. Macroinvertebrate Multimetric Index (MMI) model results showing the predicted stream health condition.	18
Figure 1-5. Map of Hypoxia interpolations overlain on sampling station locations and Connecticut assessment units to evaluate excursions below the dissolved oxygen criterion.....	25
Figure 1-6. Assessment units overlain on shellfish growing area classifications in Long Island Sound.....	29
Figure 2-1. Waterbody segments assessed for one or more designated uses	34
Figure 2-2. Waterbody segments assessed for Aquatic Life Use Support	36
Figure 2-3. Waterbody segments assessed for Recreational Use Support.....	37
Figure 2-4. Waterbody segments assessed for Shellfishing Use Support.....	38
Figure 3-1 Key Components of Water Quality	40
Figure 3-2: Water Quality Planning and Implementation Process	40
Figure 3-3. CT DEEP Water Quality Concerns	42
Figure 3-4. Total segments in US EPA Category 4 and 5.....	45
Figure 3-5. Total segments by Designated Use that require a TMDL or equivalent plan	46
Figure 3-6 Cumulative Number of Approved TMDLs in Connecticut.....	47
Figure 3-7. Sites impaired for aquatic life caused in part by Total Phosphorus (TP). Sites are shown in relation to wastewater discharges with TP permit limits and 305(b) segments impaired for aquatic life	50
Table 1-1. Designated uses for surface waters as described in CT WQS and the IWQR.....	6
Table 1-2. Timeline for submitting data to CT DEEP.....	8
Table 1-3. Aquatic Life Use Support (ALUS) categories and contributing decision criteria for wadeable streams.....	15
Table 1-4. Stream flow classes adopted under the Connecticut Stream Flow Standards and Regulations	19
Table 1-5. Aquatic Life Use Support (ALUS) categories and contributing decision criteria for lakes.	21
Table 1-6. Aquatic Life Use Support (ALUS) in estuaries as determined by dissolved oxygen levels.....	22
Table 1-7. Fish consumption use support and criteria.	26
Table 1-8. Shellfish harvesting use support as determined by shellfish growing area classifications.....	28
Table 1-9. Decision criteria for various categories of recreational use support.....	31
Table 2-1. Designated Use support summaries for rivers, lakes, and estuaries.....	35
Table 2-2. CT DEEP Probabilistic Monitoring Aquatic Life Use Support in Wadeable Streams 2011-2015 Summary	39
Table 3-1: Designated Uses for Surface Waters in Connecticut	41

Table 3-2. Definitions of US EPA Categories 4 and 5 for Assessed Waterbodies in Connecticut	44
Table 3-3. Summary of Designated Uses with Common Stressors.....	52

Appendices

Appendix A-1. Connecticut 305b Assessment Results for Rivers and Streams

Appendix A-2. Connecticut 305b Assessment Results for Lakes

Appendix A-3. Connecticut 305b Assessment Results for Estuaries

Appendix A-4. Connecticut 305b Site Specific Fish Consumption Advisories

Appendix A-5. A Method to Identify Total Phosphorus as a Cause of Aquatic Life Impairment in Connecticut Freshwater High Gradient Non-Tidal Streams

Appendix B-1. List of Impaired Waters for Connecticut (EPA Category 5)

Appendix B-2. Waterbodies with Adopted TMDLs (EPA Category 4a)

Appendix B-3. Pollution Control Measures for Waterbody Segments (EPA Category 4b)

Appendix B-4. Nonpollutant Impairments (EPA Category 4c)

Appendix B-5. Reconciliation List of Impaired Waters (Delistings and Listings)

Appendix C-1. Priority List of Waters for Action Plan Development (including TMDL development)

Appendix C-2. List of Waters for Action Plan Development by 2022 Identified in Integrated Water Resource Management Reports

Appendix C-3. Alternative Approaches to Restoring and Protecting Water Quality

Table of Acronyms

303(d)	Section 303(d) of the Federal Clean Water Act, which requires States to employ corrective actions to address waters impaired by one or more pollutants (also referred to the 303(d) list)
305(b)	Section 305(b) of the Federal Clean Water Act, which requires States to assess and report on the status of their waters every two years
319(a)	Section 319(a) of the Federal Clean Water Act, which requires States to prepare a report that identifies waters impaired by nonpoint source pollution, its sources and programs to reduce such pollution
ADB	Assessment Database (Former database, replaced by ATTAINS in 2018)
ALUS	Aquatic Life Use Support
ATTAINS	Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System is the new online replacement for the obsolete ADB
AU	Assessment Unit; a section of a waterbody for which water quality is determined
CFU	Colony Forming Unit for bacteria enumeration
CSO	Combined Sewer Overflow
CT CALM	Connecticut Consolidated Assessment and Listing Methodology
CT DA/BA	Connecticut Department of Agriculture, Bureau of Aquaculture
CT DEP	Connecticut Department of Environmental Protection (previous name of Connecticut Department of Energy and Environmental Protection)
CT DPH	Connecticut Department of Public Health
CT WQS	Connecticut Water Quality Standards
CWA	(Federal) Clean Water Act
CWF	Connecticut Clean Water Fund
CT DEEP	Connecticut Department of Energy and Environmental Protection formally known as Connecticut Department of Environmental Protection
IWQR	Integrated Water Quality Report
MMI	Multimetric Index; used to assess the biological communities for Aquatic Life Use Support (ALUS)
NHD	National Hydrography Dataset
NSSP-MO	National Shellfish Sanitation Program Model Ordinance
QAPP	Quality Assurance Project Plan
RBP	Rapid Bioassessment Protocols
RBV	River Bioassessment for Volunteers
SDWA	(Federal) Safe Drinking Water Act
TMDL	Total Maximum Daily Load
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WQS	Water Quality Standards
WQX	EPA's National Data Water Quality Data Exchange

Introduction

This report was prepared to satisfy statutory reporting requirements pursuant to Sections 305(b) and 303(d) of the federal Clean Water Act (CWA). CWA Section 305(b) requires each State to monitor, assess and report on the quality of its waters relative to attainment of designated uses established by the State's [Water Quality Standards](#) (CT WQS). In Connecticut, the Department of Energy and Environmental Protection (CT DEEP) is the agency with primary responsibilities to report on these CWA activities. Section 303(d) of the CWA requires each State identify and prioritize water quality limited waterbodies and develop Total Maximum Daily Loads (TMDLs) or other management actions consistent with Water Quality Standards. These reports are brought together in the Integrated Water Quality Report (IWQR) which is submitted to the United States Environmental Protection Agency (US EPA) every two years for review and, in the case of waters identified pursuant to Section 303(d), US EPA approval.

Water quality in Connecticut has improved over the last few decades as a result of protective laws, remediation efforts and a substantial investment in improved wastewater treatment. For example, the latest statewide assessment showed that 76% of the wadeable streams in Connecticut are healthy and meet aquatic life use support goals. Although difficult to compare with historic data because statistical surveys were not completed in the early years, it is appropriate to point out that the percentage of streams meeting aquatic life goals during the late 1970's and early 1980's was much lower.

In spite of tremendous progress in water quality, there are still gains to be made particularly in the area of nonpoint source (NPS) stormwater management, and infrastructure maintenance and improvements. Many of the remaining causes of impairment of Connecticut surface waters are difficult to identify (e.g., "cause unknown") and/or correct (e.g., Combined Sewer Overflows, urban stormwater runoff). Initiatives to maintain and improve water quality will require input and cooperation between from the numerous public and private interests that regulate, oversee and land use management and environmental policy, especially at the local level.

Water Pollution Control Programs

Maintenance and Improvements of Infrastructure

Public funding for improved sewage system infrastructure in Connecticut is substantial. The Connecticut [Clean Water Fund](#) (CWF) is the state's environmental infrastructure assistance program. The CWF program is defined by Sections 22a-475 through 22a-483 of the Connecticut General Statutes (CGS) and by regulations adopted February 19, 1992 pursuant to CGS 22a-482. The CWF is a nationally recognized program administered by the Office of the Treasurer and DEEP that provides grants and low interest loans to municipalities for wastewater infrastructure improvement projects.

Since its inception in 1986 through FY 2002, the CWF program was supported with an average annual authorization of \$48 million in General Obligation bonds, which support the grants. This investment has reaped great benefits to public health, water quality, economic development, and the beginning of restoring an oxygen depleted area in western Long Island Sound.

At no time in the history of the CWF has the demand for construction funding been higher. CT DEEP estimates wastewater infrastructure needs of nearly 5 billion dollars over the next twenty years. The projects include combined sewer overflow (CSO) correction projects to eliminate the discharge of nearly 2 billion gallons of combined sewage into Connecticut's waterways each year, denitrification projects necessary to restore the health of Long Island Sound, emerging water quality issues such as phosphorus removal, the need

for increased treatment capacity for the state's growth and economic development and the continued maintenance of existing wastewater infrastructure.

The priority list typically funds projects to support wastewater infrastructure projects whose implementation is considered significant to reduce serious negative impacts on water quality in our state. These projects include nitrogen removal projects in order to meet the TMDL for the Long Island Sound; phosphorus removal projects in order to comply with effluent limits that are being incorporated into NPDES permit renewals; and CSO improvement projects in our state's largest cities. Details of fundable project and program detail can be found in the [Clean Water Fund Priority List](#).

Prediction of the economic costs to meet the goals of the Clean Water Act is accomplished through the federally sponsored [Clean Watersheds Needs Survey](#). The survey, which is a joint venture among the individual states and the US EPA, results in a report to the United States Congress delineating the level of economic needs necessary to address water quality problems related to municipal wastewater conveyance and treatment, municipal stormwater management, combined sewer overflow correction, and non-point source pollution control.

Major gains in water quality have been achieved through these public investments, their analogs in the private sector, and protective legislation. Further maintenance and improvement of the quality of water resources will require continued public and private financial support. Essentially all aspects of Connecticut's clean water programs create long and short-term jobs. Upgrading of sewage treatment facilities, the extension of sewer lines, installation of industrial treatment facilities and ground water remediation all generate jobs in the design, engineering and construction industries. Operation and maintenance of these facilities creates long-term employment.

Nonpoint Source Pollution

Most nonpoint source pollution (NPS) is the result of human activities that generate diffuse pollutants over a wide geographic area. Precipitation washes these pollutants off of the landscape, creating polluted runoff that impacts the waterbodies into which it flows. However, NPS pollution may also be associated with non-precipitation events such as: malfunctioning septic systems, hydromodifications, atmospheric deposition, eroding streambanks and mine drainage. CT DEEP's NPS efforts work to abate known water quality impairments and prevent significant threats to water quality from nonpoint source pollution.

Connecticut's NPS efforts includes all the components required under the CWA Section 319(h) (Nonpoint Source Pollution Management Programs). CT DEEP has developed a watershed management strategy that establishes a framework to work through a networked approach with federal, state, and municipal governments and non-government agencies and organizations to conduct watershed management and strengthen the state's ability to control nonpoint source pollution. CT DEEP has organized and focused base program staff, establishing three "major basin" managers, and continues to target grant funds based on watershed priorities. Consistent with this approach, CT DEEP offers competitive annual Section 319 NPS grants to watershed initiatives for the priority watersheds, and to statewide nonpoint source initiatives.

CT DEEP NPS efforts are supported by both federal and state funds. CWA Section 319 funds support staff involved in NPS efforts as well as grants for planning and implementation of environmental programs and projects with the goal of improving water quality. CT DEEP State and federal funds support staff in other units that are involved in various aspects of NPS management. State bond and other special legislative acts provide funds for projects and grant programs targeting specific resources that address NPS pollution. Coastal Zone Management Act funds, awarded by the National Oceanic and Atmospheric Administration, support CT DEEP Office of Long Island Sound Programs NPS efforts in the coastal area. Numerous other funding sources, from other federal and state agencies, and private foundations, are utilized when available.

Unlike wastewater infrastructure initiatives, the costs and benefits accrued from NPS pollution management measures are not as easily measured. This is due to several factors: projects are often funded by contributions from a combination of state, federal and local agencies as well as from landowners, volunteer groups, foundations, businesses which may include monetary support as well as in-kind services; NPS controls take many shapes and forms and can be applied as structural or non-structural measures; projects can span several years; and many NPS efforts are focused on education, as a way to encourage adoption of recommended practices.

Educational components of NPS Programs often focus on preventative measures to keep high quality waters healthy. For example, maintenance of high quality potable water supplies is critical to the health and economic well-being of every resident. Likewise, clean water for swimming, fishing, and boating is extremely important to quality of life issues such as commercial fishing, marine industries and recreation all of which have associated economic benefits to citizens and generate tax revenues. CT DEEP has initiated research (https://www.ct.gov/deep/cwp/view.asp?a=2719&q=592132&deepNav_GID=1654) to collect information on high quality watersheds in Connecticut and these studies help to identify high quality water resources to the attention of Connecticut's citizens.

CT DEEP has focused on increasing awareness of Low Impact Development (LID) techniques for reducing stormwater and NPS runoff by working with our partners at the federal, state and local levels to provide information, educational materials and technical assistance in the application of LID techniques, building on existing programs such as the Governor's Responsible Growth Initiative, the University of Connecticut's Nonpoint Education for Municipal Officials (NEMO) program and US EPA's Smart Growth Program. The goal is to build better relationships and promote LID management practices with local land use agencies, academic institutions, nonprofit groups, the building industry and the public. Incorporating LID into land use plans can decrease impervious surfaces and limit runoff, leading to improved water quality and recharge of our rivers, streams and groundwater supplies.

IWQR Report Overview

Chapter 1, Consolidated Assessment and Listing Methodology (CT CALM) describes the procedure used by the CT DEEP to assess the quality of the State's waters relative to attainment of Connecticut Water Quality Standards (CT WQS). The CT CALM serves to document the protocols used by CT DEEP to assess water quality data as well as establishing minimum standards for data acceptability to insure that only credible data are used to perform the assessments. Although CT DEEP relies primarily on data collected as part of our Ambient Monitoring and Assessment Program, data from other state and federal agencies, local governments, drinking water utilities, volunteer organizations, and academic sources are also solicited and considered when making assessments.

Chapter 2, Clean Water Act Section 305(b) Assessment Results provides summary tables and figures presenting the results of CT DEEP's assessment of all readily available data relating to designated use attainment in Connecticut waters. Designated uses include "habitat for fish and aquatic life", also referred to as Aquatic Life Use Support (ALUS), "recreation", and "fish consumption", reflecting the principal designated uses assigned to all waters. Assessment results are provided in more detailed tables by waterbody type in Appendix A. Waterbody assessment results are presented in ascending order by waterbody ID number. Inland water (rivers, streams, and lakes) are presented first in Appendix A-1 and A-2, followed by estuarine waterbody segments in Appendix A-3.

Chapter 3, Waterbodies Identified for Restoration and Protection Strategies Pursuant to Section 303 of the Clean Water Act, provides additional information concerning water quality limited waterbodies, such as those assessed waters that do not currently meet water quality standards, commonly referred to as "impaired waters". This Chapter also provides information on the identification of stressors which impact water quality and the development of TMDLs or other appropriate management actions to restore or protect surface waters in Connecticut.

US EPA Reporting Structure

For the 2018 report cycle, US EPA has changed the reporting structure for States to provide water quality information on assessed waterbodies. Some of the changes included revised terms and data outputs which have in turn changed some of the structure CT DEEP had established in previous cycle IWQR reports. In the following chapters, CT DEEP has highlighted and provided details for any significant changes from previous reports due to the new reporting structure.

Chapter 1 -Connecticut Consolidated Assessment and Listing Methodology (CT CALM)

Introduction

CT DEEP submits an IWQR to the US EPA to fulfill the reporting requirements of CWA Sections 305(b) and 303(d). The CT CALM documents the decision-making process for assessing and reporting in the IWQR on the quality of surface waters of the state. The assessments conducted during this report cycle are based on the [CT WQS](#) established on October 10, 2013 and approved by EPA on December 11, 2013. CT WQS are adopted as regulations and are contained in Sections 22a-426-1 through 22a-426-9 of the Regulations of Connecticut State Agencies.

The assessment and listing process outlined here should be viewed in context of the CWA and CT WQS. The CWA is the primary federal law that protects our nation's surface waters, including lakes, rivers, wetlands, estuaries and ocean waters. In authorizing the Act, Congress declared as a national goal the attainment, wherever possible, of "water quality, which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water". This goal is popularly referred to as the "fishable / swimmable" requirement of the CWA. In 1967, predating the CWA, the State of Connecticut adopted Water Quality Standards as required under Section 22a-426 of the Connecticut General Statutes to accomplish this and other water quality goals.

The CT WQS contains policy statements addressing the protection of water quality and a classification of state waters. Described for each class are: 1) water quality classifications; 2) numeric or narrative criteria for various parameters or conditions to maintain water quality; and 3) designated uses that should be supported. For example, the designated uses for Class A waters are: habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreational use; and water supply for industry and agriculture. CT DEEP assesses whether the state waters meet the designated uses by categorizing them into levels of support. Table 1-1 identifies the designated uses for which waterbodies are assessed and associates these uses with the appropriate water quality classification.

Level of Support of Designated Uses

In making water quality assessments, each designated use of a waterbody is assigned a level of support (i.e., either fully supporting, not supporting, insufficient information, not assessed), which characterizes whether or not the water is suitable for that use. The level of use support attainment is based upon available data and other reliable information. The following use support categories are currently used for reporting in the IWQR. These are general definitions. Refer to the section in this report entitled [Assessment Methodology](#) for specific information regarding the criteria for determining levels of support for each designated use.

Fully Supporting: The designated use is fully achieved in the waterbody.

Not Supporting: The designated use is not supported in the waterbody

Insufficient Information: Insufficient data/information available to support an evaluation of attainment of designated uses in the waterbody.

Not Assessed: No current readily available information is available to assess use support.

Table 1-1. Designated uses for surface waters as described in CT WQS and the IWQR.

Designated Use	Applicable Class of Water or Class Goal	Functional Definition
Recreation	AA, A, B, SA, SB	Swimming, water skiing, surfing or other full body contact activities (primary contact), as well as boating, canoeing, kayaking, fishing, aesthetic appreciation or other activities that do not require full body contact (secondary contact).
Habitat for fish and other aquatic life and wildlife.	AA, A, B, SA, SB	Waters suitable for the protection, maintenance and propagation of a viable community of aquatic life and associated wildlife.
Fish Consumption is not specified independently as a use in the CT WQS, but implicit in "Habitat for fish and other..." ^a However, CT will continue to report on Fish Consumption as a separate use for 305(b)/303(d)	AA, A, B, SA, SB	Waters supporting fish populations that are free of contaminants at concentrations that would limit human consumption.
Shellfish harvesting for direct human consumption where authorized.	SA	Waters from which shellfish can be harvested both recreationally and commercially and consumed directly without depuration or relay. Waters may be conditionally approved.
Commercial shellfish harvesting where authorized.	SB	Waters supporting commercial shellfish harvesting for transfer to a depuration plant or relay (transplant) to approved areas for purification prior to human consumption (may be conditionally approved); also support seed oyster harvesting
Existing or proposed ^b drinking water supplies.	AA	Waters presently used for public drinking water supply or officially proposed for future public water supply.
Potential drinking water supplies.	A	Waters that have not been identified, officially, but may be considered for public drinking water supply in the future.
Navigation	AA, A, B, SA, SB	Waters capable of being used for shipping, travel or other transportation by private, military or commercial vessels.
Water Supply for Industry	AA, A, B, SA, SB	Waters suitable for industrial supply.
Agriculture	AA, A, B	Waters suitable for general agricultural purposes.

^a Also addressed in CT WQS policy statement #14: "Surface waters... shall be free of chemical constituents in concentrations or combinations which will... bioconcentrate or bioaccumulate in tissues of fish, shellfish and other aquatic organisms at levels which will impair the health of aquatic organisms or wildlife or result in unacceptable tastes, odors or health risks to human consumers..."

^b Surface waters identified as potential drinking water supplies as specified in Section 22a-426-4(b) of the Regulations of Connecticut State Agencies.

Information Used to Assess Use Support

Depending on the waterbody and data availability, any one or combination of several types of data may be used to assess water quality and use support: ambient physical and chemical; benthic macroinvertebrate and fish community; indicator bacteria; indicators of productivity and enrichment/eutrophication; aquatic toxicity; tissue contaminant; sediment chemistry/toxicity; and effluent analysis. Following guidance from US EPA (2005), the following sources of data and information are considered in conducting assessments:

- ◆ Results from recent ambient monitoring;
- ◆ Recent Section 305(b) reports, 303(d) lists, and 319(a) nonpoint assessments;
- ◆ Reports of water quality problems provided by local, state, territorial or federal agencies, volunteer monitoring networks, members of the public or academic institutions;
- ◆ Fish and shellfish advisories, restrictions on water sports or recreational contact;
- ◆ Reports of fish kills;
- ◆ Safe Drinking Water Act source water assessments;
- ◆ Superfund and Resource Conservation and Recovery Act reports;
- ◆ Results from predictive modeling, dilution calculations or landscape analysis; and
- ◆ Results from analysis of water quantity impacting aquatic life and other designated uses.

The primary sources of assessment information for rivers are ambient monitoring data collected by CT DEEP monitoring staff, and physical, chemical and bacteria data collected at fixed sites by the United States Geological Survey (USGS). Lake assessments and trophic status are generally determined from studies conducted by CT DEEP, the Connecticut Agricultural Experiment Station, USGS and Connecticut College since 1979 (Frink and Norvell, 1984; Canavan and Siver, 1995; Healy and Kulp, 1995; CT DEP, 1998) as well as recent studies by professional contractors. For estuaries, use assessments are based primarily on physical, chemical and biological monitoring by the CT DEEP Long Island Sound Study and National Coastal Assessment (Strobel, 2000), bacterial monitoring for shellfish sanitation by the Connecticut Department of Agriculture, Bureau of Aquaculture (CT DA/BA), and bathing beach monitoring by state and local authorities.

Reasonable efforts are also made to incorporate data from other state and federal agencies, municipalities, utilities, consultants, academia, and volunteer monitoring groups. CT DEEP directs a monitoring program for volunteers from which monitoring information is obtained. The details of this program, [A Tiered Approach to Citizen – Based Monitoring of Wadeable Streams and Rivers](#), can be obtained from the CT DEEP website.

Other types of information that may be used for assessments include water quality surveys conducted by municipalities and discharge monitoring data from municipal sewage treatment plants, industries and remediation projects. CT DEEP staff may conduct effluent or ambient toxicity tests as a follow-up to investigate suspected problems. Knowledge of a condition known to cause water quality impairment is also considered valid information for determining use support. For example, the presence of a CSO in a stream segment may automatically preclude recreational use support.

Schedule and Degree of Confidence in Assessment Information

CT DEEP will consider information for assessments up to November 1 prior to the year when the IWQR is due to US EPA. Data and information submitted after November 1 will be considered for the next IWQR reporting cycle and data quality will be evaluated for use in assessments using a three-tiered system (Table1-2).

Table 1-2. Timeline for submitting data to CT DEEP.

IWQR Reporting Year	Deadline for Data Submission
2018	11/1/2017
2020	11/1/2019
2022	11/1/2021
2024	11/1/2023
2026	11/1/2025
2028	11/1/2027
2030	11/1/2029

Tiered data quality considerations for assessments of the State's waters

Tier 1- Data typically are in the form of digital photos or written descriptions of observations. These data can be helpful as a record of an episodic event. Tier 1 data are not likely to provide sufficient information to formalize an assessment, but can provide supporting information when other data exists for a waterbody.

Tier 2- Data collected may not have been collected under a formal Quality Assurance Project Plan (QAPP). Tier 2 data are not likely to be enough information to formalize an assessment, but can provide supporting information when other data exists for waterbody.

Tier 3- Data are collected under a formal monitoring plan which follows a QAPP approved by CT DEEP or US EPA. QAPPs shall include laboratory tests to be used and data quality objectives. Standard Operating Procedures for field procedures and lab techniques should be explained as well as a plan for data management. Chemistry results should be provided from a state-certified laboratory. Taxonomic identifications should be from a taxonomist with sufficient experience to provide reliable taxonomic identifications, preferably with certifications by the Society for Freshwater Science and American Fisheries Society. Project objectives should be consistent with CT DEEP's use of data for waterbody assessment purposes. Tier 3 data may be used to support use assessments.

Geographic and Temporal Extent of Assessment Coverage

Assessment Units

Waterbodies, such as streams, lakes or estuaries are divided into water quality assessment units (AUs). Each unit is considered to have homogenous water quality (*i.e.*, use support is uniform throughout the unit). Generally, streams units are delimited by features that may cause a change in water quality or habitat, such as a confluence with a tributary, a point source discharge, an impoundment or a significant change in land use. Lakes are generally assessed as one segment. Long Island Sound, including its embayments and river-mouth estuaries, was divided into 211 AUs based primarily on designated uses such as shellfishing and recreation and physical features such as depth and distance from shore.

All AUs are organized by a unique identification number (ID305b), which tracks assessment information stored in the online EPA Assessment, Total Maximum Daily Load Tracking and Implementation System (ATTAINS) database through each assessment cycle. Both river and lake AUs are derived from CT basin numbers (Figure 1-1) explained and cataloged in the [Gazetteer of Drainage Areas of Connecticut](#) (Nosal, 1997). Stream and river segments are indexed to the [National Hydrography Dataset](#) (NHD) at a scale of 1:24,000, and lakes are geographically indexed to the CT DEEP lakes data layer. Estuary segments were completely reorganized following the 2006 reporting cycle (Figure 1-2) to better consider bathymetry, water quality, shellfish classification maps, and geographic extent detailed in *Summary Report & Users Guide Connecticut Coastal Assessment And Segmentation Project Final – May 11, 2006 Amended – October 3, 2007* (Streich, 2007). All AUs are created and geographically indexed using USGS extension tools and ArcGIS software.

Management of Assessment Information

Beginning with the 2018 assessment cycle, all assessment data (*e.g.*, AU descriptions, assessment methods, use support, causes and sources of impairment) must be stored electronically in the new online EPA ATTAINS database. In early 2016, EPA began plans to replace the existing assessment storage system which relied on individual access databases in each state, with a new online interface portal integrated into the existing EPA ATTAINS system. At this time, EPA announced the mandatory policy that all future assessment data submittals would need to be through the ATTAINS portal, making 2018 the first submittal for the state of CT, and all states, in ATTAINS. Due to delays in design and technical issues between EPA and contractors hired to create the new data system and migrate state data into it, CT DEEP could not approve existing assessments and enter 2018 updated assessment information until February 2019. This change of assessment process controlled by EPA is the major factor which delayed the submittal of the 2018 Connecticut IWQR.

Raw monitoring data are stored and managed in an electronic database that contains sampling results and meta-data collected by CT DEEP staff since 1997. While CT DEEP uses this in-house database for monitoring and assessment purposes, US EPA's National Data Warehouse (WQX) will be the ultimate repository for all monitoring results. CT DEEP is in the final stages of a long-term project that will provide seamless transfer of all water related data to the EPA's WQX.

Data used for Rivers and Stream Assessments

There are 5,830 river miles in the State of Connecticut. CT DEEP has developed an [Ambient Water Quality Monitoring Program Strategy](#) (CT DEEP, 2015) that incorporates a combination of targeted and probabilistic sampling designs for an ALUS assessment of rivers and streams. This strategy is intended to provide sufficient targeted data to answer questions about the effectiveness of specific water pollution control activities and also support a statewide probabilistic ALUS assessment at the end of a five-year rotation. Sampling includes annual evaluations of benthic and fish community reference sites, focused monitoring (physical, chemical and/or biological) for TMDL development or other management actions, and follow-up to reported problems.

Physical, chemical and bacteria data from the cooperative CT DEEP/USGS long-term fixed-network were also reviewed for this report. This network of approximately thirty sites provides data for up to eight sampling events at each site per year on several major rivers and streams throughout the State.

Rivers and streams with new physical, chemical, and biological data collected during 2015-2016 were evaluated and assessed for this reporting cycle using the most recent available information from the CT DEEP water monitoring and fisheries, USGS, municipalities, watershed groups and other quality assured volunteer groups. Updated assessment information can be found in Appendix A-1 of this report.

For this reporting cycle, a Generalized Random Tessellation Stratified (GRTS) survey design (Stevens and Olsen 2004) was provided to CT DEEP from EPA and implemented with a target population of streams based on the National Hydrography Dataset at the 1:24,000 scale. No stratification was included in the survey design. A total of 100 wadeable stream sites were sampled from 2011-2015 to obtain a statewide estimate of aquatic life use attainment.

Data Used for Lake Assessments

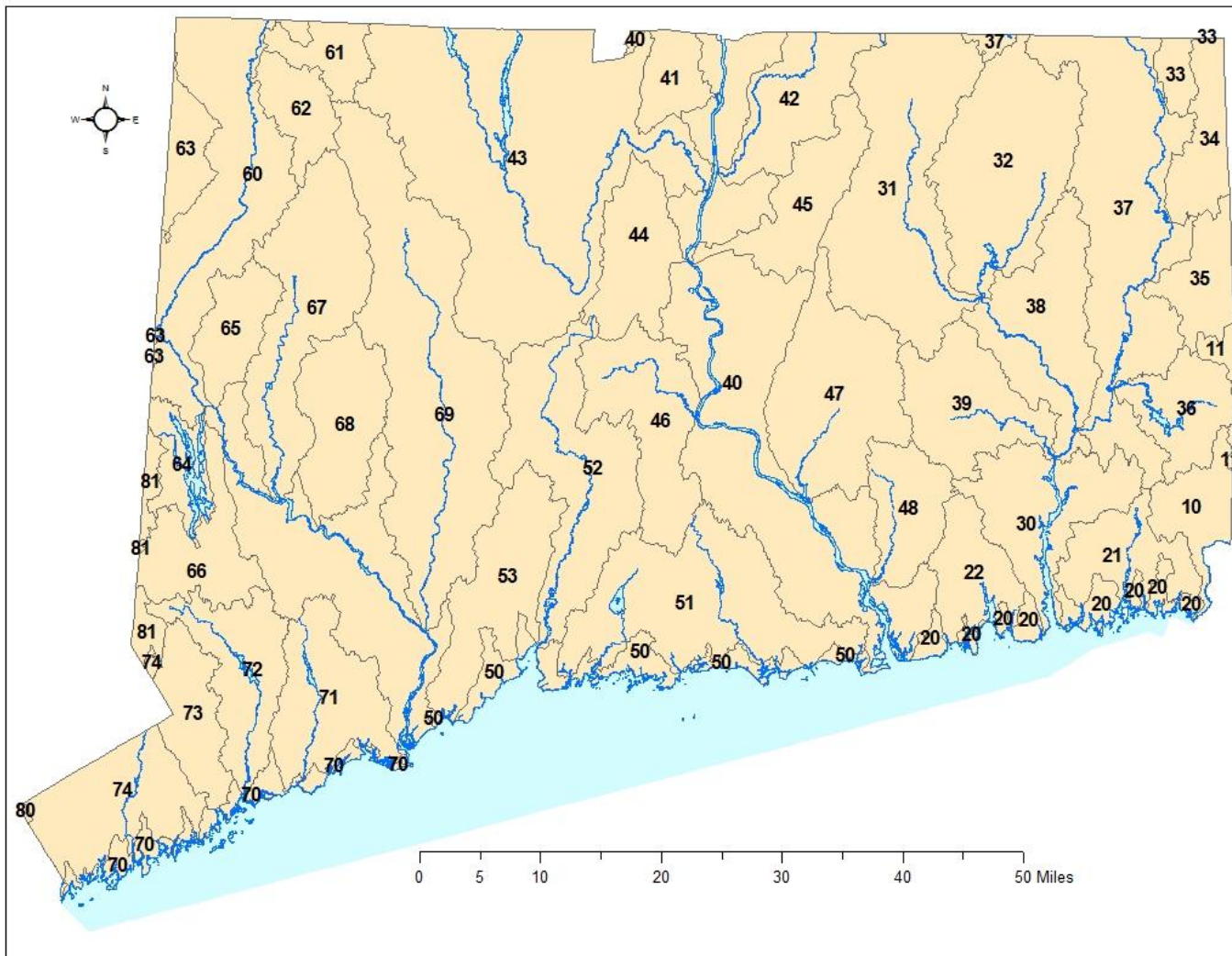
There are 64,973 acres of lakes in the State of Connecticut. Historically, Connecticut has assessed between 105 and 115 "significant public" lakes statewide for 305(b) reporting. Significance was based on a lake having state or federal public access, or providing unique or otherwise important habitats. CT DEEP reviewed assessment information on 182 lakes currently in ATTAINS. Lakes with new physical, chemical, and biological data collected during 2015-2016 were evaluated and assessed for this reporting cycle using the most recent available information from our CT DEEP water monitoring and fisheries, USGS, macrophyte data from the Connecticut Agricultural Experiment Station and CT DEEP Natural History Survey staff, municipalities, consultants, watershed groups and other quality assured volunteer groups, and surveys with data from CT DEEP administered grants applied for and awarded to local entities. Updated assessment information can be found in Appendix A-2 of this report.

Beach closure data from CT DEEP's State beach program, from the State Department of Public Health (CT DPH) and local municipalities from the summers of 2015 and 2016 were evaluated to determine recreation use support.

CT DEEP participates in the US EPA sponsored nationwide project called the [National Lakes Assessment](#) (NLA). This project is based on a probabilistic sampling design that randomly selects lakes from across the United States for the purpose of producing a comprehensive assessment of trophic status of the nation's lakes. CT DEEP samples all lakes randomly selected in Connecticut for this study, which averages 10-15 lakes every 5 years.

Connecticut Water Basin Drainage Areas

Connecticut Water Basin Drainage as explained in the CT DEEP Gazetteer of Drainage Areas of Connecticut



Number	Regional Name
10	Pawcatuck Main Stem
11	Wood
20	Southeast Shoreline
21	Southeast Eastern Complex
22	Southeast Western Complex
30	Thames Main Stem
31	Willimantic
32	Natchaug
33	French
34	Fivemile
35	Moosup
36	Pachaug
37	Quinebaug
38	Shetucket
39	Yantic
40	Connecticut Main Stem
41	Stony Brook
42	Scantic
43	Farmington
44	Park
45	Hockanum
46	Mattabesset
47	Salmon
48	Eightmile
50	South Central Shoreline
51	South Central Eastern Complex
52	Quinnipiac
53	South Central Western Complex
60	Housatonic Main Stem
61	Blackberry
62	Hollenbeck
63	Tenmile
64	Candlewood
65	Aspetuck
66	Still
67	Shepaug
68	Pomperaug
69	Naugatuck
70	Southwest Shoreline
71	Southwest Eastern
72	Saugatuck
73	Norwalk
74	Southwest Western Complex
81	Croton

Figure 1-1. Connecticut Rivers and Lake Basins Index

Connecticut Estuarine Segmentation

Connecticut Estuarine Segmentation Basins as explained in CT DEEP *Summary Report & Users Guide Connecticut Coastal Assessment and Segmentation Project Final – May 11, 2006 amended – October 3, 2007* (Streich, 2007).

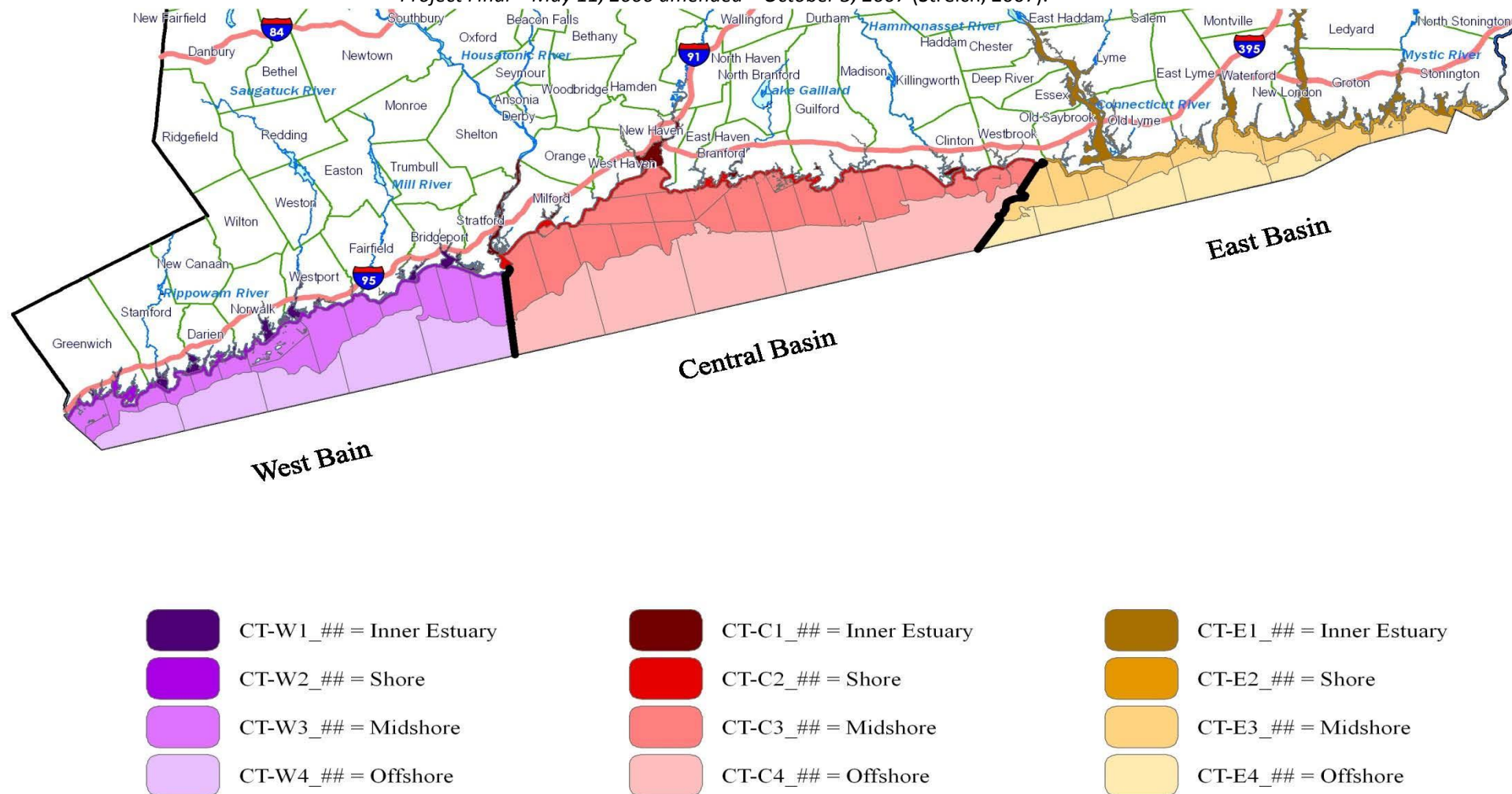


Figure 1-2. Connecticut Estuary Basins Index.

Data Used for Estuary Assessments

There are 611.91 square miles of estuarine waters in the State of Connecticut, all of which are tracked for 305(b) reporting.

[Long Island Sound \(LIS\)](#) is monitored by CT DEEP on a monthly schedule for dissolved oxygen and nutrients at 17 fixed stations. In addition, 25-30 stations are added to the core 17 stations and monitored bi-weekly monitoring during summer months for dissolved oxygen. This monitoring is funded by the US EPA [Long Island Sound Study](#). From 2000-2006 and in 2010 concurrent with this effort, CT DEEP collected water quality, sediment, biological community and tissue data at as many as 40 offshore and harbor sites for a US EPA probabilistic monitoring program, the [National Coastal Condition Assessment](#) (NCCA; Strobel, 2000). For the NCCA, representative stations in coastal harbors and offshore waters are chosen randomly to represent conditions of the entire Sound. Data from the LIS monitoring program and the NCCA provide the basis for aquatic life use assessments.

In addition to routine ambient sampling, CT DEEP has a keen interest in quantifying changes in LIS brought about by climate change. The Sentinel Monitoring for Climate Change in Long Island Sound Program is a multidisciplinary scientific team interested in climate change impacts to Long Island Sound ecosystems. A work group has been formed in partnership with EPA Long Island Sound Office, National Oceanic and Atmospheric Administration, New York Department of Environmental Conservation, Connecticut Department of Energy and Environmental Protection, New York Sea Grant and Connecticut Sea Grant. There are formal cooperative agreements/contracts pertaining to funding between these agencies. The two state technical advisory groups include over 60 federal, state, NGO, and university partners who have contributed to all stages of the strategic plan development. This project has a work plan and dedicated funding to study important aspects of climate change in LIS. More information can be found in [Sentinel Monitoring for Climate Change in the Long Island Sound Ecosystem](#).

Annual shellfish bed monitoring and sanitary surveys conducted by the CT Department of Agriculture/Bureau of Aquaculture (DA/BA) provide assessment information for shellfish use support. Beach closure information and data from volunteer organizations as well as known sources of pollution, such as CSOs, are used to determine recreation use support.

All estuarine waters were re-assessed for this reporting cycle using the most recent available information. Dissolved oxygen data collected during the summers of 2016-2017 were used for this reporting cycle assessments. Beach closure information obtained from CT DPH for the 2015-2016 beach seasons was used for the assessment cycle. The Growing Area Classification data layer supplied by CT DA/BA, and annual, triennial and 12 year reports were evaluated for this assessment. Volunteer monitoring data collected during 2016-2017 and submitted to CT DEEP from estuary groups CUSH (Clean Up Sound and Harbors), Save the Bay - Westerly, Earthplace, Save the Sound, Harbor Watch/River Watch, and the Millstone Environmental Laboratory, and local university researchers including UCONN (University of Connecticut), Yale University, and Southern Connecticut State University, were also reviewed for the 2018 assessment cycle.

Assessment Methodology

CT DEEP's assessment methodology is listed in this section by designated use. Assessment procedures generally follow guidance provided by US EPA (1997) using a variety of information and data types. CT DEEP applies a "weight of evidence" approach using best professional judgment when using multiple types of data. A waterbody is generally considered impaired when one or more sources of data or information indicate a water quality standard is not attained, providing that information is considered sufficient and credible. In resolving discrepancies in conflicting information, consideration is given to data quality, age, frequency and site-specific environmental factors. If reconciliation of conflicting data is not possible or the data are determined to be insufficient, the assessment unit is flagged for further monitoring.

Aquatic Life Use - Rivers and Streams

Because the biological community of a stream integrates the effects of pollutants and other conditions over time, biological community assessment is the best and most direct measure of Aquatic Life Use Support (ALUS), or as stated in the CT WQS "Habitat for fish and other aquatic life and wildlife". CT DEEP uses a weight of evidence approach based on biological, stream flow, and chemical indicators to make use support determinations for wadeable rivers and streams (Table 1-3). In addition, CT DEEP has developed a methodology for determining when nutrient enrichment by phosphorus is the cause of an Aquatic Life Use Support impairment. The following sections provide more details about the indicators and assessment protocols.

Table 1-3. Aquatic Life Use Support (ALUS) categories and contributing decision criteria for Wadeable streams.

Aquatic Life Use	Criteria / Indicators
Fully Supporting	<p>Biological community with ecological attributes consistent with Biological Condition Gradient Tiers 1-4 as adopted in Connecticut Water Quality Standards Section 22a-426-5 of the Regulations of Connecticut State Agencies.</p> <p>Benthic community: benthic MMI, value >48 (Gerritsen and Jessup, 2007) and meets narrative criteria in CT WQS*.</p> <p>Screening Approach data with 6 or more "Screening Taxa"</p> <p>RBV data submitted to CT DEEP listed 4 or more pollution sensitive "Most Wanted" invertebrates (see http://www.ct.gov/deep/rbv)</p> <p>Fish community: species composition, trophic structure, and age class distribution as expected for an unimpaired stream of similar watershed size.</p> <p>Conventional physical/chemical criteria are not exceeded.</p> <p>Measured toxicants do not exceed chronic toxicity criteria.</p> <p>Biological communities show no evidence of impact from anthropogenic manipulations to stream flow.</p> <p>No evidence of chronic toxicity in ambient waters.</p>
Not Supporting	<p>Biological community with ecological attributes consistent with Biological Condition Gradient Tiers 5-6 as adopted in Connecticut Water Quality Standards Section 22a-426-5 of the Regulations of Connecticut State Agencies</p> <p>Benthic community: benthic MMI < 43 (Gerritsen and Jessup, 2007), and does not meet narrative criteria in CT WQS*.</p> <p>Screening Approach data with 2 or less "Screening Taxa"</p> <p>Fish community: species composition, trophic structure and age class distribution significantly less than expected for a non-impacted stream of similar watershed size; diversity and abundance of intolerant species reduced or eliminated; top carnivores rare or absent; trophic structure skewed toward omnivory.</p> <p>Physical/chemical or toxicant criteria exceeded in $\geq 10\%$ of samples.</p> <p>Biological communities show evidence of impact from anthropogenic manipulations to stream flow.</p> <p>Stream completely enclosed in conduit or cleared concrete trough.</p>
Insufficient Information	<p>Some community data exist, but sampling was very limited and/or the results are ambiguous or conflicting, requiring follow-up monitoring.</p>

* When a bioassessment falls on the border between two use support categories, use support is determined by staff biologists giving consideration to site conditions, certain sensitive taxa present, and other available data. Occasionally, where habitat conditions are not optimal, a non-quantitative sample may be used to infer ALUS as a best professional judgment assessment.

Biological Indicators

CT DEEP recently developed Biological Condition Gradient models for two of Connecticut's aquatic life communities (fish and macroinvertebrates). The Biological Condition Gradient (BCG) is a conceptual model that describes changes in aquatic communities. The BCG model provides a more refined way of assigning stream health than a pass/fail approach. Incorporation of the BCG into Connecticut's water quality assessment process allows CT to better define and identify stream condition in Connecticut.

The approach for using the BGC models and other biological data for assessments are described in technical support documents. For the BCG model for macroinvertebrates, please refer to the CT DEEP report: [Calibration of the Biological Condition Gradient for High Gradient Streams of Connecticut](#). The fish community data are evaluated using one of two multimetric indices based upon upstream watershed area (Kanno *et al.* 2010), a Fish [BCG Assessment Model](#), and best professional judgment of fisheries and water quality monitoring staff biologists. Methods for fish monitoring are described in CT DEEP (2013), Plafkin *et al.* (1989) and Barbour *et al.* (1999).

Figure 1-3 shows the BCG tiers for macroinvertebrates and fish community side-by-side for each site that has been assessed for the 2018 reporting cycle. This data visualization integrates two key biological indicators which is helpful for determining the healthiest streams in the state (Tiers 1 and 2) and the most stressed streams (Tiers 5 and 6). For a closer look at the data that supports the BCG tier, CT DEEP has a web application (<https://ctdeepwatermonitoring.github.io/BCGMap/>) that allows a user to interface with the data spatially.

Starting with the 2014 Assessment Cycle, CT DEEP began using a model that predicts macroinvertebrate multi-metric index (MMI) (Bellucci *et al.*, 2013) score using GIS derived landscape variables (percent impervious land cover, percent wetlands, and stream slope) in the upstream watershed for any monitored wadeable stream location (Figure 1-4) to predict stream health across Connecticut. This model provides an expected baseline of MMI score to compare to actual results when evaluating an aquatic life assessment. This is especially helpful when sampling a stream reach for the first time without the benefit of existing data for comparison. Although not used alone to assess aquatic life, the model results can provide another line of evidence to support stream data, lending more confidence to assessments. The results shown in Figure 1-4 predicts, that 76% of stream miles should pass aquatic life goals and 24% of stream miles should fail aquatic life goals using modeled MMI values. Percent values were obtained by summing the stream miles with an MMI >48 (pass) and MMI < 48 (fail) and dividing by total stream miles.

Volunteer monitoring data from the CT DEEP-sponsored River Bioassessment for Volunteers are also used in assessments. The presence of four or more pollution sensitive “most wanted” invertebrate taxa reported at a given site can be considered for an assessment category of “Fully Supporting”. CT DEEP also developed a story map

(<http://ctdeep.maps.arcgis.com/apps/MapSeries/index.html?appid=9265f117579546678b70ff9dbd6d0854>

) to highlight work conducted by Volunteers focusing on the healthy streams in the state and to help guide future sampling using where volunteer map applications by prioritizing un-sampled watersheds that are predicted to be healthy based on the MMI Model (Bellucci *et al.* 2013).

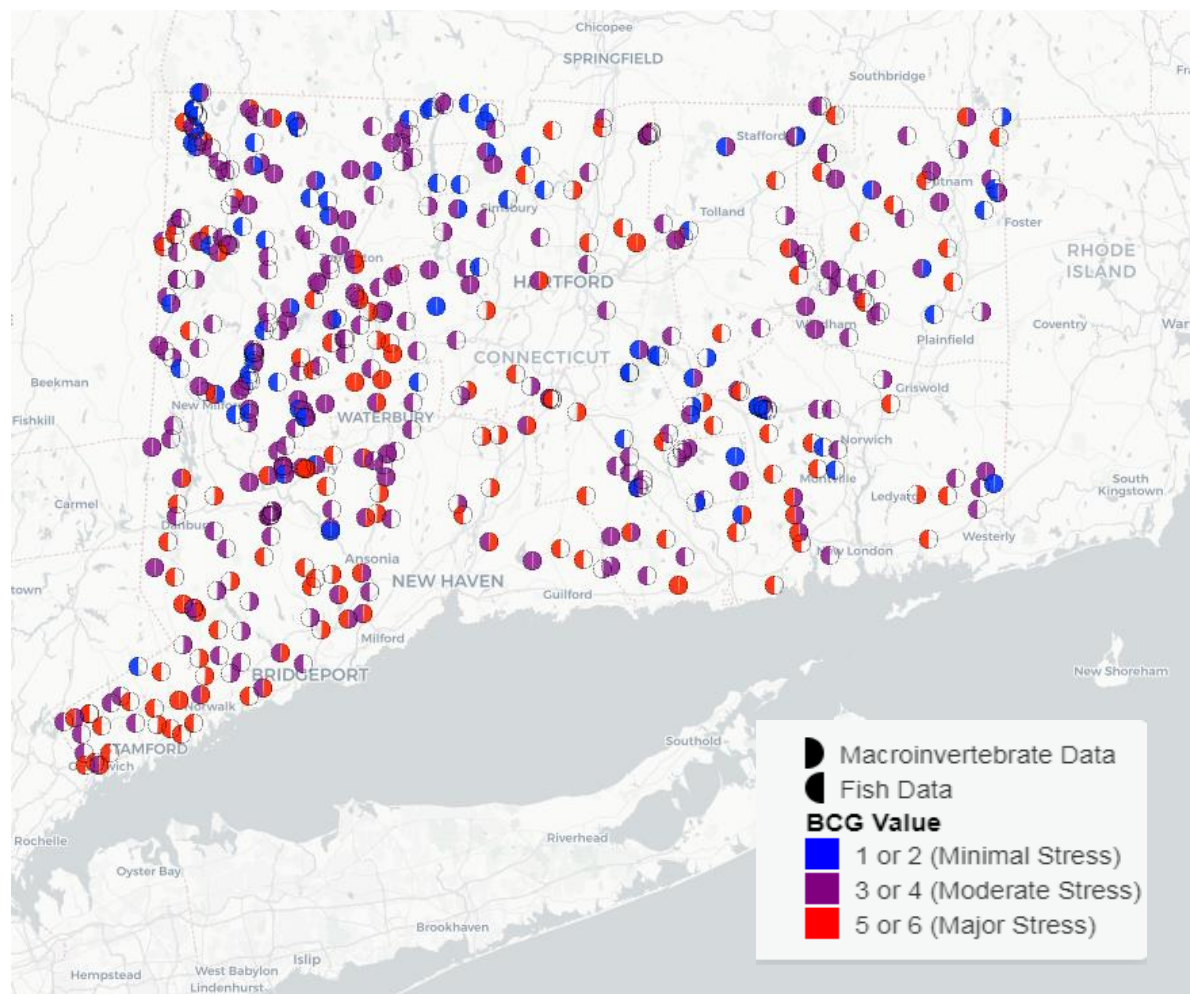


Figure 1-3. CT DEEP Monitoring BCG Value Results Map collected in 2016-2017 for the 2018 reporting cycle. For a closer look at the data that supports the BCG tier, go to <https://ctdeepwatermonitoring.github.io/BCGMap>.

Connecticut Macroinvertebrate Multimetric Index (MMI) Model

Connecticut stream health condition as predicted by CT DEEP MMI model.

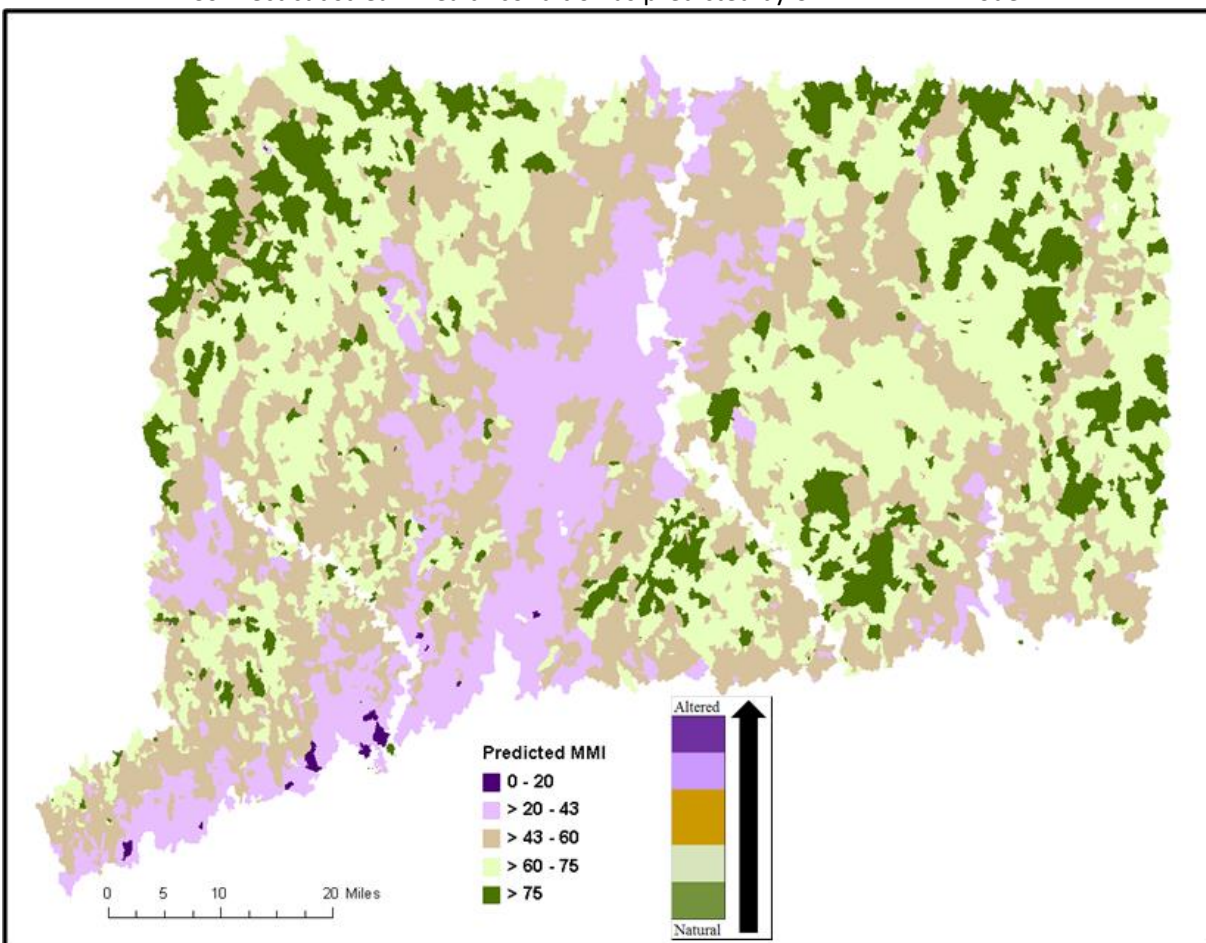


Figure 1-4. Macroinvertebrate Multimetric Index (MMI) model results showing the predicted stream health condition.

Stream Flow Indicators

CT DEEP has made a significant effort to balance human and ecological needs relative to water quantity. Stream flow classes for the entire state have been adopted under the [Connecticut Stream Flow Standards and Regulations](#). These stream flow classes can be useful to determine potential impacts due to hydrologic alteration since stream flow classes are scaled based on the natural flow paradigm (Poff et al 1997) and can provide a line of evidence to support biological community assessments that may be impacted by hydrologic alteration. Stream flow classes have narrative standards that represent a range of flow conditions (Table 1-4), and these classification can be considered when making judgments on flow altered streams.

CT DEEP staff have developed a GIS application and a method using digital photos to help with documenting low flow conditions throughout the state to assist with aquatic life assessments. Assessments metrics developed from digital images are combined with other factors in the GIS to determine flow alteration as a cause of impairment. CT DEEP uses a weight of evidence approach following metrics based on best professional judgment. Flow conditions that result in disconnected flow and that limit habitat to fish and

other aquatic life from non-natural causes are documented and listed under Category 4C. The following information is considered when making these assessments:

- ◆ Biological metrics such as MMIs and BCGs for fish and macroinvertebrates;
- ◆ Surficial geology in the watershed;
- ◆ Location of diversions and dams;
- ◆ Statistical summaries of streamflow or flow measurements in the field that indicate a deviation from the natural hydrograph that results in habitat alteration that can impact aquatic life;
- ◆ Stream flow classification adopted under the Connecticut Stream Flow Standards and Regulations;
- ◆ Dry or nearly dry streams with severely limited aquatic habitat documented by digital photos influenced by water diversions or registrations that alter the natural hydrologic regime.

Table 1-4. Stream flow classes adopted under the Connecticut Stream Flow Standards and Regulations

Stream flow Class	Narrative Standard
Class 1	River or stream segment shall exhibit, at all times, the depth, volume, velocity and variation of stream flow and water levels necessary to support and maintain habitat conditions supportive of an aquatic, biological community characteristic of that typically present in free-flowing river or stream systems of similar size and geomorphic characteristics under the prevailing climatic conditions.
Class 2	River or stream segment shall exhibit, at all times, the depth, volume, velocity and variation of stream flow and water levels necessary to support and maintain habitat conditions supportive of an aquatic, biological community minimally altered from that typically present in free-flowing river or stream systems of similar size and geomorphic characteristics under the prevailing climatic conditions.
Class 3	River or stream segment shall exhibit, at all times, the depth, volume, velocity and variation of stream flow and water levels necessary to support and maintain habitat conditions supportive of an aquatic, biological community moderately altered from that typically present in free-flowing river or stream systems of similar size and geomorphic characteristics under the prevailing climatic conditions.
Class 4	River or stream segment may exhibit substantially altered stream flow conditions caused by human activity to provide for the needs and requirements of public health and safety, flood control, industry, public utilities, water supply, agriculture and other lawful uses; and shall, while giving consideration to societal needs, economic costs, and environmental impacts, exhibit to the maximum extent practicable the depth, volume, velocity and variation of stream flow and water levels consistent with the narrative standard for Class 3 river and stream segments.

Chemical Indicators

Indirect measurements of ALUS such as ambient physical/chemical data, discharge monitoring reports, aquatic toxicity monitoring reports, and sediment chemistry data are also evaluated against water quality criteria established in CT WQS. These data may be used independently or supplement the weight of evidence for Assessment Units with benthic invertebrate or fish community data.

Nutrient Enrichment Indicators

Nutrient enrichment has also been identified as one of the most pressing water quality issues facing the nation as a whole. As a result, US EPA has directed states to take aggressive action to limit the quantity of phosphorus being discharged to surface waters. In Region 1, US EPA has mandated that all New England states establish limitations on phosphorus (TP) in all wastewater discharge permits where the potential exists for the discharge to contribute to eutrophication and impair designated uses in downstream waters.

CT DEEP has developed a weight of evidence approach to diagnose TP as a cause of impairment to aquatic life in wadeable streams. This procedure includes using a combination of three measures: stream aquatic life biological assessments, TP concentrations, and diatom TP tolerance metrics. Detail to the method is summarized in a technical support document (Becker and Bellucci 2019). The approach draws on previous research conducted on phosphorus in CT (Becker 2012, Smucker et al 2013, Becker et al 2018) and follows recommendations in the phosphorus strategy report pursuant to CT public act 12-155 to use a stressor response model with multiple response parameters to establish phosphorus impairment (PA 12-155 Coordinating Committee, 2017).

Aquatic Life Use – Lakes

The most recent available information from the CT DEEP Monitoring Program, government agencies and/or reliable contractors and lake associations are used to determine levels of support for aquatic life use in lakes. CT DEEP monitoring and assessment staff evaluate these data into lake trophic classifications to determine attainment of ALUS using a weight of evidence approach and best professional judgment. Factors taken into consideration are known problems, such as chronic algal blooms, the extent of coverage by exotic invasive plants, severe sedimentation, and results of surveys by fisheries biologists.

Lake trophic classifications, as listed in [Section 22a-426-6](#) of the CT WQS are based on ambient measurements of four parameters: total phosphorus, total nitrogen, chlorophyll a, and Secchi disc transparency in specified seasons. Lakes are classified as either oligotrophic, mesotrophic, eutrophic, or highly eutrophic based on the range of values for these four parameters. Macrophyte coverage and density are used to adjust the trophic classification based on water column data described above. While trophic status is not a direct measure of aquatic community health, highly eutrophic conditions, beyond what is naturally expected (given the relative size of the lake/pond and watershed, the origin of the lake/pond, and other physiographic parameters), or a documented trend toward cultural eutrophy may indicate impairment or a threat to aquatic life. A naturally eutrophic lake, having nutrient concentrations that support high levels of biological activity without any significant anthropogenic source, would not be considered impaired. Lake trophic classifications were assigned for all lakes that had new monitoring data collected since the previous reporting cycle.

Table 1-5. Aquatic Life Use Support (ALUS) categories and contributing decision criteria for lakes.

Aquatic Life Use	Criteria / Indicators
Fully Supporting	<p>Lake Trophic Classification: classification is as naturally expected (given the relative size of the lake/pond and watershed, the origin of the lake/pond, and other physiographic parameters).</p> <p>Fish community: species composition, and age class distribution as expected for a lake of similar watershed size.</p> <p>Conventional physical/chemical criteria are not exceeded.</p> <p>Macrophyte species composition and density supports a healthy biological community.</p> <p>Measured toxicants do not exceed chronic toxicity criteria.</p> <p>No evidence of chronic toxicity in ambient waters.</p>
Not Supporting	<p>Lake Trophic Classification: Highly eutrophic conditions, beyond what is naturally expected (given the relative size of the lake/pond and watershed, the origin of the lake/pond, and other physiographic parameters), or a documented trend toward cultural eutrophy.</p> <p>Fish community: species composition, and age class distribution significantly less than expected for a non-impacted lake of similar watershed size; diversity and abundance of intolerant species reduced or eliminated; top carnivores rare or absent; trophic structure skewed toward omnivory.</p> <p>Known problems, such as chronic algal blooms, extensive coverage by exotic invasive plants, severe sedimentation.</p> <p>Physical/chemical or toxicant criteria exceeded in $\geq 10\%$ of samples</p> <p>Evidence of chronic toxicity in ambient waters.</p>
Insufficient Information	<p>Some data exist, but sampling was very limited and/or the results are ambiguous or conflicting, requiring follow-up monitoring.</p>

Aquatic Life Use – Estuaries

Aquatic life use assessments for estuaries are based primarily on dissolved oxygen and nutrient data (eutrophication assessments) collected by CT DEEP’s Long Island Sound monitoring staff as part of the US EPA Long Island Sound Study. Evaluations are supplemented by special studies, intensive surveys, fish trawl surveys and National Coastal Assessment (NCA) samples, when available. Dissolved oxygen data used for the assessments included data from the University of Connecticut/NERACOOS MySound Western and ARTG buoys (bottom water data); and the USGS/UConn gaging station on the Connecticut River at Essex (01194750). In reviewing available data, measured values for a specific parameter are compared to water quality criteria as defined in the CT WQS. CT DEEP revised its dissolved oxygen criteria in 2011 for marine waters and this is the primary indicator evaluated. Low dissolved oxygen (Table 1-6), or hypoxia (Figure 1-5) in offshore waters and some embayments is the most frequently cited impairment of aquatic life. Benthic community analyses conducted as part of the NCA (Strobel, 2000) are being used to support other findings on ALUS, but the coverage of LIS is not yet spatially or temporally adequate to support assessments on its own. CT DEEP Marine Fisheries trawl data are also used to support low dissolved oxygen findings with respect to ALUS. Other information sources include tissue analyses, sediment analyses, irregular sampling (e.g., for spills, site assessments or research projects), and professional judgment evaluations of pollutant sources and water quality conditions. Tier 3 quality assured dissolved oxygen data collected by volunteer researchers (CUSH, Harbor Watch/River Watch, and Save the Bay-Westerly) in nearshore waters are also used to assess the Aquatic Life Use.

Assessments of Dissolved Oxygen Using Data from Individual Stations

Assessment units are evaluated against the dissolved oxygen criteria where data/measurements are available. Data are reviewed for the summer period from May-September. If more than 10% of the Dissolved oxygen concentration measurements are less than 3.0 mg/L, this results in an assessment of “Impaired” for the Aquatic Life Use (Table 1-6). The 10% exceedance allowance is based on US EPA assessment guidance (US EPA, 1997).

Table 1-6. Aquatic Life Use Support (ALUS) in estuaries as determined by dissolved oxygen levels.

Aquatic Life Use Assessment	Criteria
Fully Supporting	<p>ACUTE: Measured dissolved oxygen concentrations of 3.0 mg/L and greater in 90% or more of samples</p> <p>Map interpolations indicate at least 90% of AU area with dissolved oxygen concentrations of 3.0 mg/L and higher</p> <p>CHRONIC: Cumulative periods of dissolved oxygen in the 3.0 – 4.8 mg/L range resulting in a decimal fraction of less than 1.0.</p> <p>Benthic or fish communities are not impacted.</p> <p>No violations of water quality criteria or excessive levels of sediment contamination.</p>

<p>Not Supporting</p>	<p>ACUTE: Measured dissolved oxygen concentrations less than 3.0 mg/L in more than 10% of the samples</p> <p>Map interpolations indicate dissolved oxygen concentrations <3.0 mg/L for more than 10% of assessment unit area on multiple cruises over the assessment period</p> <p>CHRONIC: Cumulative periods of dissolved oxygen in the 3.0 – 4.8 mg/L range resulting in a decimal fraction of greater than 1.0.</p> <p>Benthic or fish communities are impacted.</p> <p>Exceedances of water quality criteria or excessive levels of sediment contamination.</p>
-----------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Assessments of Dissolved Oxygen Using Hypoxia Maps

Dissolved oxygen Hypoxia map interpolations are created based on near bottom water conditions and used to determine the ALUS status in those offshore AUs that do not contain LIS sampling stations. Using ArcGIS software, CT DEEP LIS Monitoring Program staff creates maps that depict the extent of low dissolved oxygen in the bottom waters of Long Island Sound based upon the data collected during the LISS bi-weekly hypoxia surveys from June through September. Maps are only created when concentrations fall below 4.8 mg/L. Concentrations between sampling stations are interpolated using the Spatial Analyst Tool from ESRI, Inc. (Inverse Distance Weighted Average Method, see <http://www.esri.com/>) [Hypoxia maps](#) are available on the CT DEEP website.

Additional details related to map production can be found in the Standard Operating Procedure document *Preparation of Hypoxia Maps and Summaries*. The GIS raster data files are incorporated into a GIS map document created for assessment purposes. The files are overlain on a layer file of AUs to determine the location of sampling stations relative to AUs and to determine the frequency of excursions below the dissolved oxygen criterion (Figure 1-5). Using the zonal histogram tool in ArcGIS, the area of each segment that falls within the defined dissolved oxygen concentration classification scheme for each survey/cruise is calculated. For LIS, the classifications are: 0-0.99 mg/L, 1-1.99 mg/L, 2-2.99 mg/L, 3-3.49 mg/L, 3.5-4.79 mg/L, and >4.8 mg/L. If >10% of the assessment unit area falls below 3.0 mg/L, ALUS is assessed as impaired. The frequency of low dissolved oxygen events is determined based on the number of times the maps indicate dissolved oxygen concentrations fell below the criterion (i.e., X number of cruises < criterion/total number of cruises * 100).

Assessments of Aquatic Life Use Support Using Sediment Contamination Indicators

Historic impairments based on dissolved oxygen data or sediment contamination are carried forward until new data shows parameters meeting criteria. Many of these impairments were documented in old Water Quality Reports to Congress and date back to the late 1980s/early 1990s. Impairments were based on interviews with staff engineers and reports that indicated elevated levels of sediment contaminants (Stacey, 2007). Additional historic sources of data included the National Oceanic and Atmospheric Administration's Benthic Surveillance Program and Mussel Watch Program, a project developed to analyze chemical and biological contaminant trends in sediment and bivalve tissue from over 280 coastal sites based on data collected from 1986 to the present (see <https://products.coastalscience.noaa.gov/collections/ltmonitoring/nsandt/default.aspx> for more details.) Data collected for the NCA program (Strobel 2000), data compiled into a sediment dredge geodatabase by the CT DEEP Office of Long Island Sound Program, and data provided by the CT DEEP TMDL program were also used as supplemental sources.

Connecticut Long Island Sound Hypoxia Map

CT DEEP estuarine segments with station locations and Hypoxia interpolations

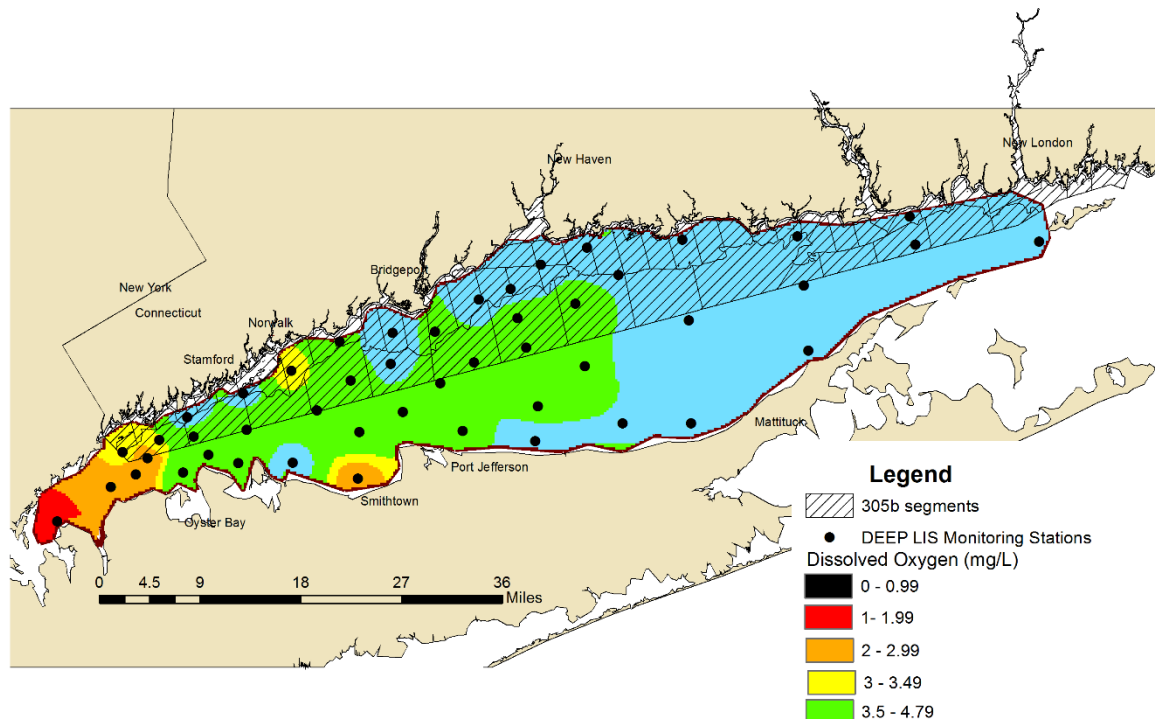


Figure 1-5. Map of Hypoxia interpolations overlain on sampling station locations and Connecticut assessment units to evaluate excursions below the dissolved oxygen criterion.

Fish Consumption

Fish consumption advisories are issued by the Connecticut Department of Public Health. The advisories are based on risk assessments conducted by CT DPH using fish tissue contaminant data. A statewide fish consumption advisory was issued for all species except trout < 15 inches in length in the mid-1990s due to mercury contamination. This advisory was based on statewide surveys of mercury contamination in fish from lakes (Neumann et. al., 1996) and rivers (CT DEP, unpublished). A follow up study was completed in 2008 (Vokoun and Perkins, 2008) and the statewide fish consumption advisory was continued based on these data.

Therefore, in addition to fish consumption use support as determined by the criteria below (Table 1-7), all freshwaters of the State have a fish consumption advisory due to mercury contamination. Likewise, all estuarine waters have fish consumption advisories due to a statewide advisory for PCB contamination in migratory striped bass and bluefish. Refer to [CT DEEP Angler's Guide](#) or [CT DPH Connecticut's Fish Consumption Advisory and the Safe Eating of Fish Caught in Connecticut](#) for more information about fish consumption advisories. Waterbodies listed in this report in Connecticut 305b Site Specific Fish Consumption Advisories (Appendix A-4), have site specific fish consumption advisories in addition to the statewide consumption advisories.

Table 1-7. Fish consumption use support and criteria.

Fish Consumption Assessment	Criteria
Fully Supporting	No site specific consumption advisory for any fish species or any consumer group.
Not Supporting	A site specific consumption advisory exists for all or some fish species or for all or certain consumer groups.

Shellfish Harvesting in Estuaries

Starting with the 2006 reporting cycle, shellfish harvesting has been divided into two designated uses as specified in the CT WQS: shellfish harvesting suitable for direct human consumption (SA waters), and shellfish harvesting suitable for commercial operations requiring depuration or relay (SB waters).

The CT DA/BA is responsible for regulating shellfish harvesting. A shellfish growing area is defined by CT DA/BA as any area that supports or could support the growth and/or propagation of molluscan shellstock. Shellfish are defined by CT DA/BA as oysters, clams, mussels, and scallops, either shucked or in the shell, fresh or frozen, whole or roe-on. All shellfish growing areas are classified by CT DA/BA in accordance with the Interstate Shellfish Sanitation Conference (ISSC) National Shellfish Sanitation Program Model Ordinance (NSSP-MO) and CT General Statutes Chapter 491, Sec 26-192e. These classifications, summarized below, are established to minimize health risks and may restrict the taking and use of shellfish from some areas. They are based on fecal coliform bacteria standards as provided in the NSSP-MO (<https://www.fda.gov/media/117080/download>).

APPROVED- Open for harvest of shellfish for direct human consumption

CONDITIONALLY APPROVED- A shellfishing area classification that predictably does not conform to "Approved" area criteria due to the occurrence of specified hydrologic or meteorological events or conditions, but will predictably return to the "Approved" area criteria.

RESTRICTED-RELAY/DEPURATION: A shellfishing area classification that conforms to NSSP-MO criteria that allows the area to be used by CT DA/BA licensed operations for the relaying of shellfish to a depuration plant for controlled purification, to designated beds in Approved or Conditionally Approved areas for natural cleansing, or to areas satisfactory to the CT DA/BA, excluding Prohibited, Conditionally Restricted-Relay, and Restricted-Relay areas. These shellfish may not be directly harvested for market nor consumed prior to the purification process involving relay or depuration.

RESTRICTED-RELAY: A shellfishing area classification where CT DA/BA allows aquaculture, relay or transplant activities in conformance to NSSP-MO criteria. Operations may be licensed to relay shellfish to designated beds in Approved or Conditionally Approved areas for natural cleansing. These shellfish may not be directly harvested for market or consumed prior to a minimum purification period of 14 consecutive days after being relayed to Approved or Conditionally Approved "open" areas with a water temperature of 50 degrees Fahrenheit (10 degrees Celsius) or greater. CT DA/BA may require the shellfish purification time to be longer than 14 consecutive days, based upon shellfish purification verification studies.

CONDITIONALLY RESTRICTED-RELAY: A shellfishing area classification that predictably does not conform to Restricted-Relay area criteria due to the occurrence of specified events or conditions, but predictably returns to the Restricted-Relay area criteria.

PROHIBITED: A shellfishing area classification that prohibits the harvesting of shellfish for any purpose except depletion or aquaculture operations (such as seed oystering) licensed by the CT DA/BA.

US EPA guidance (Grubbs and Wayland, 2000 and US EPA, 2002) identifies that areas closed to shellfish harvesting due to administrative closures, and not based on monitoring data that indicated a water quality impairment, should not be assessed as Not Supporting. These updates are incorporated into the CT CALM and were utilized for this reporting cycle. To determine attainment of water quality standards and for integrated reporting purposes, CT DEEP utilizes CT DA/BA shellfish growing area classifications as listed in Table 1-8.

Administrative closures are established in areas around potential pollution sources, such as sewage outfalls and marinas/mooring fields, as a preventative measure to safeguard human health and preclude the harvest of possibly contaminated shellfish. A marina is defined in the Nssp-MO as “any water area with a structure (docks, basin, floating docks, etc.) which is used for docking or otherwise mooring vessels, and constructed to provide temporary or permanent docking space for more than ten boats”.

Areas may also be classified as prohibited due to incomplete sanitary surveys, lack of water quality data, or insufficient resources/interest. Areas classified as prohibited for administrative reasons (i.e., around outfalls, marinas, no resources/interest) will not be considered as violating water quality standards and will be listed in the Integrated Water Quality Report as Not Assessed. Areas classified as prohibited due to incomplete sanitary surveys will also not be considered as violating water quality standards but will be listed in the Integrated Water Quality Report as Insufficient Information. This approach is consistent with US EPA guidance published in 2000 (Grubbs and Wayland, 2000) and in Chapter 3 of the 2002 US EPA document [Consolidated Assessment and Listing Methodology Toward a Compendium of Best Practices](#). Additionally other coastal states within US EPA Regions 1 and 2 have adopted this approach.

In a number of towns, the CT DA/BA has placed restrictions on direct harvest of shellfish from the shoreline out to the mid-Sound state boundary. However, beyond a depth of 50 feet, there is essentially no shellfishing conducted at this time, and these waters are not regularly monitored. Therefore, for Integrated Reporting purposes, shellfish harvesting is not evaluated as a use in waters between the 50-foot depth contour and the state line. The lack of monitoring should not be construed to mean these deeper offshore waters do not achieve applicable water quality criteria for indicator bacteria.

It should be noted that CT DA/BA shellfish growing areas do not necessarily coincide with CT DEEP waterbody segments (Figure 1-5). To determine use support, GIS is utilized. All CT DEEP segments from the various geographic areas (i.e., inner estuary, shore, midshore, and offshore) are merged into a single layer file. Then the shellfish area classifications are “unioned” with the merged layer file. The attribute table from this new layer is exported (as a .dbf file). Using Microsoft Excel, pivot tables are created that list each classification present per segment along with size of the area falling completely within the segment. A total area is calculated for each class. The segment is then assessed based on the guidelines in Table 1-8. Sources of impairment are based on shellfish reports compiled by CT DA/BA on an annual, triennial or twelve year basis.

Table 1-8. Shellfish harvesting use support as determined by shellfish growing area classifications.

<p>Class SA waters: Shellfish harvesting for direct human consumption where authorized.</p>	<p>Criteria</p>
<p>Fully Supporting</p>	<p>Waters classified by CT DA/BA as Approved.</p>
<p>Not Supporting</p>	<p>>10% of segment area classified by CT DA/BA as Prohibited, Conditionally Approved, Conditionally Restricted-relay, Restricted-relay, or Restricted-relay/depuration</p>
<p>Not Assessed</p>	<p>Waters closed administratively due to a safety management zone around wastewater treatment plants or marinas, no water quality data available, or lack of resources.</p>
<p>Insufficient Information</p>	<p>Waters closed administratively due to a lack of a current sanitary survey or insufficient monitoring data.</p>
<p>Class SB waters: Shellfish harvesting with depuration or relay where authorized.</p>	<p>Criteria</p>
<p>Fully Supporting</p>	<p>Waters classified by CT DA/BA as Approved, Conditionally Approved, Conditionally restricted-relay, Restricted-relay/depuration.</p>
<p>Not Supporting</p>	<p>>10% of segment area classified by CT DA/BA as Prohibited</p>
<p>Not Assessed</p>	<p>Waters closed administratively due to a safety management zone around wastewater treatment plants or marinas, no water quality data available, or lack of resources.</p>
<p>Insufficient Information</p>	<p>Waters closed administratively due to a lack of a current sanitary survey or insufficient monitoring data.</p>

Connecticut Long Island Sound Segment and Shellfish Map

Connecticut CT DEEP estuarine segments with shellfish growing area classifications in Long Island Sound

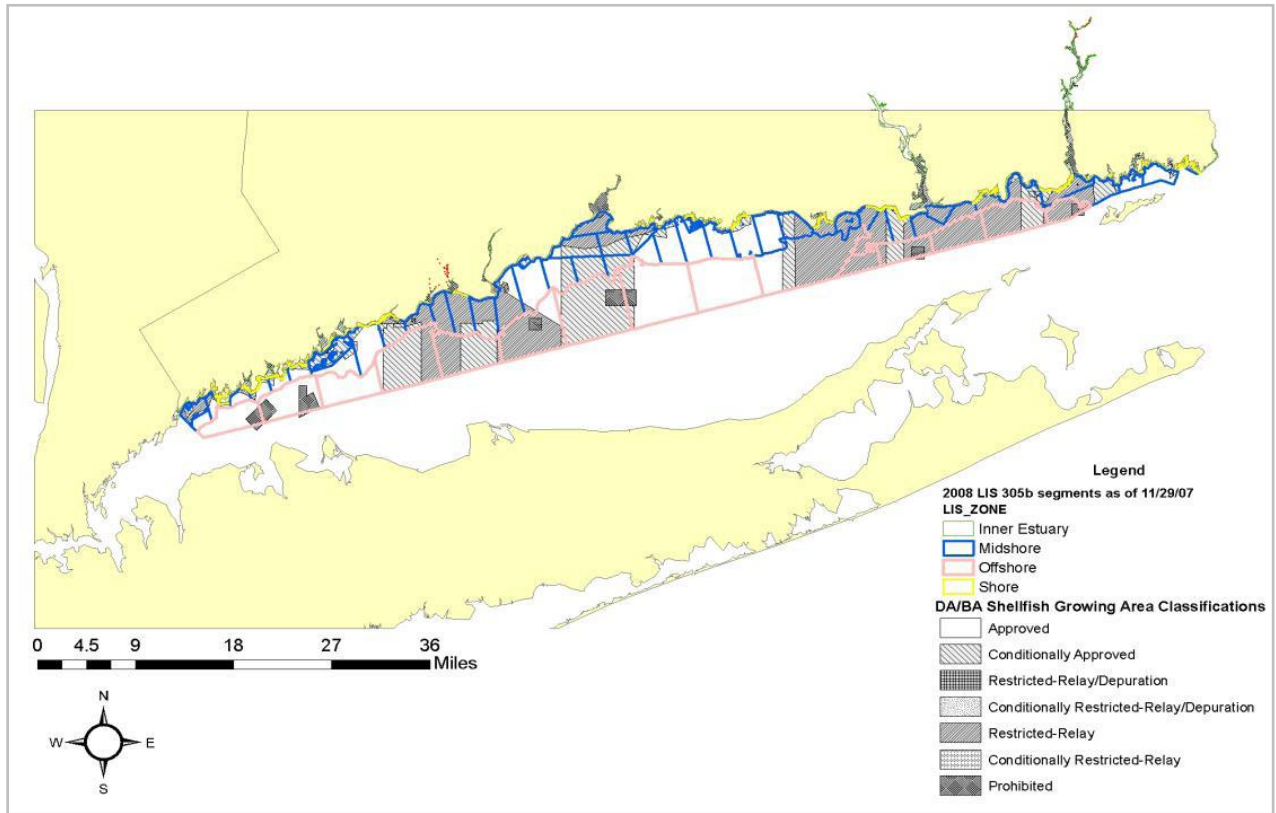


Figure 1-6. Assessment units overlain on shellfish growing area classifications in Long Island Sound.

Recreation

Recreation assessments are based on sanitary/safety considerations and aesthetic/practical usability. Sanitary condition is determined from indicator bacteria data provided by CT DEEP, USGS, volunteer, or municipal monitoring, along with sanitary surveys where appropriate (see Table 1-9 Decision criteria). For lakes, aesthetic and practical usability is considered based on algae and/or macrophyte surveys.

Enterococci group bacteria are used as the primary sanitary indicator organism in estuarine water, and *Escherichia coli* in fresh water per the most current version of [Connecticut's WQS](#). For salt water, 104 Colony Forming Units (CFU)/100 ml of *enterococci* is the single sample criterion for designated bathing areas, 500 CFU/100 ml for other recreational uses, and 35 CFU/100 ml is the geometric mean criterion for any recreational use. In fresh water, 235 Colony Forming Units or CFU/100 ml of *Escherichia coli* is the single sample criterion for designated bathing areas, 410 CFU/100 ml for non-designated swimming areas, 576 CFU/100 ml for other recreational uses, and 126 CFU/100 ml is the geometric mean criterion for any recreational use.

For AUs with designated bathing areas, beach closure information is generally used to determine use support. Closures of public bathing areas are, for the most part, based on the results of weekly sampling for indicator bacteria during the swimming season. A complete discussion of Connecticut's practices related to beach monitoring and closure may be found in "[Guidelines for Monitoring Bathing Waters and Closure Protocol](#)" developed jointly by CT DEEP, the Connecticut Department of Health, the Connecticut Environmental Health Association, and the Connecticut Association of Directors of Health (CT DPH and CT DEP, 2003).

Additionally, beach personnel conduct daily inspections of shoreline bathing areas for evidence of contamination. State and local officials also utilize sanitary surveys of shorelines and watersheds as a primary tool to determine sanitary quality. Evidence of waste materials indicative of untreated sewage or human fecal contamination can be sufficient justification to support a beach closure decision by local or state authorities. Small quantities of temporary and/or transient sources of human fecal contamination transported to a site (*e.g.*, diapers, tampons, medical items) would likely result in a beach closure. Significant sources of contamination from a fixed location within the AU, such as a CSO, would automatically result in an assessment of impairment.

In some lakes, recreation may also be impaired by excessive growth of aquatic invasive plants or algae, which hampers use by physical means (*e.g.*, dense weeds prevent boat mobility) or creates aesthetically offensive conditions. Lakes for which no bacteria data exist may be considered Fully Supporting of recreation if the lake is situated completely within an undeveloped area or if there have been no complaints of illness or excessive aquatic plant growth, or, as in the case of some urban ponds, swimming is not allowed but other recreation activities are supported.

Table 1-9. Decision criteria for various categories of recreational use support.

Recreation Assessment	Criteria / Indicators for designated public bathing areas
Fully Supporting	Designated bathing area closed 10 % of swimming seasons ^a or less for a reporting cycle, and sanitary survey indicates no significant source ^b of human fecal contamination. Recreational use is not hindered by weed or algal growth.
Not Supporting	Designated bathing area closed more than 10% of swimming seasons ^a for a reporting cycle, or sanitary survey indicates potential for significant source of human fecal contamination. Algal or exotic weed growth precludes normal recreational use.
Criteria / Indicators for areas not designated as public bathing areas	
Fully Supporting	Sanitary survey indicates no significant source of human fecal contamination, and There are a minimum of 8 samples for the assessment period, and no more than 15% of samples exceed the single sample criterion for <i>Escherichia coli</i> (410 CFU ^c / 100 ml for non-designated swimming areas, 576 CFU/100 ml for all other areas), and there is no exceedance of the geometric mean criterion (126 CFU/100 ml). Recreational use is not hindered by excessive weed or algal growth.
Not Supporting	Sanitary survey indicates potential for significant source of human fecal contamination; or There are a minimum of 8 samples for the assessment period, and more than 15% of samples exceed the single sample criterion for <i>Escherichia coli</i> (410 CFU ^c / 100 ml for non-designated swimming areas, 576 CFU/100 ml for all other areas), and there is an exceedance of the geometric mean criterion (126 CFU/100 ml) or Algal or exotic weed growth precludes normal recreational use.
Insufficient Information	Less than 8 samples in the assessment period ^d .

^a Swimming season is from Memorial Day to Labor Day. The swimming season for the report cycle consists of 2 summers of swimming days combined.

^b A significant source of human fecal contamination is one that originates from a fixed location and is transported to or within the waterbody (*e.g.*, an untreated sewage discharge or a community with failing septic systems).

^c CFU refers to colony-forming-unit, which is the unit of measure for indicator bacteria. It is the general equivalent of one bacterium (one bacterium will grow into one colony when incubated on a plate of growth medium.)

^d In certain cases, best professional judgment can result in an assessment when there are fewer than 8 samples.

Drinking Water Supply

The Connecticut Department of Public Health (CT DPH) implements the federal Safe Drinking Water Act (SDWA) in Connecticut and CT DEEP cooperates with those efforts. The CT DPH tracks and reports on the water quality of public drinking water supplies within the context of the SDWA. CT DEEP periodically surveys water utilities for updated information concerning closures, trophic status, and potential causes and sources of pollution.

Class AA drinking water reservoirs and Class AA tributaries are considered Fully Supporting for the CT DEEP Drinking Water Designated Use when filtration and disinfection are reliably maintained in accordance with State Public Drinking Water Standards (Regulations of Connecticut State Agencies Section 19-13-B102), unless CT DEEP finds chemical or physical evidence of conditions not meeting standards during targeted field assessments. These waters are regulated by programs at CT DPH that coordinate, manage, and ensure treatment and source protection through oversight of existing treatment and source protection laws and

regulations, coupled with water supply planning, education of local land use officials, and involvement with stakeholders on a continuous basis.

Many Class AA drinking water reservoirs and tributaries to drinking water reservoirs are tracked and assessed for aquatic life use support of ambient conditions (see discussion of ALUS assessment methodologies in the previous sections).

Navigation

Navigation is assumed to be fully supported for all waters suitable for navigation.

Agriculture, Industry

Agricultural uses are assumed to be fully supported for all AA, A, and B waters. Industrial use is assumed to be fully supported for all AA, A, B, SA and SB waters.

Chapter 2 – 305(b) Assessment Results

CT DEEP's assessment results by waterbody type and designated use are summarized on the following pages.

- Figure 2-1 is a map showing all waterbody type segments assessed for any designated use over the entire state of Connecticut
- Table 2-1 summarizes the total river miles or acres of lakes and estuaries that were determined to be either Fully Supporting, Not Supporting, Insufficient Information, or Not Assessed for each designated use
- Figure 2-2 is a map showing the assessment results for the Aquatic Life designated use over the entire state of Connecticut
- Figure 2-3 is a map showing the assessment results for the Recreational designated use over the entire state of Connecticut
- Figure 2-4 is a map showing the assessment results for the Shellfishing designated used in the estuaries in Connecticut
- Table 2-2 contains the assessment results for the Aquatic Life Designated Use for all of the wadeable streams in Connecticut based on a probabilistic sampling design
- A short summary of segments that were determined to be Not Supporting for the Drinking Water designated use.

Note: Not all waterbodies in Connecticut are assessed for all possible designated uses and some waterbodies that were assessed previously as Fully Supporting may have dropped to Not Assessed in this reporting cycle due to use-specific data age limitations, which are important to maintain quality control in assessment information. Any waterbody assessed as Not Supporting in a prior report retains that assessment until new monitoring data confirm that use is supported (meeting standards).

Assessment results are provided in more detailed tables by waterbody type in Appendix A. Waterbody assessment results are presented in ascending order by waterbody ID number. Inland water (rivers, streams, and lakes) are presented first in Appendix A-1 and A-2, followed by estuarine waterbody segments in Appendix A-3. Figures 1-1 and 1-2 will assist readers in spatial overview and segmentation enumeration that corresponds with assessment results and impaired waters tables found in the appendices. An interactive geographic information system map viewer and map services hosted by the University of Connecticut called [Connecticut Environmental Conditions online](#) (CTECO) can be used to view assessment results found in this report. Click to follow the link to CTECO, then using the simple map viewer, select the assessment layers for the reporting cycle you would like to view in the Water Resources tab. Layers can also be downloaded for use in GIS software. Contact the report coordinator for specific assessment questions.

CT DEEP Waterbody Assessment Segments

Map of CT DEEP Waterbody Assessment Segments assessed for one or more designated uses

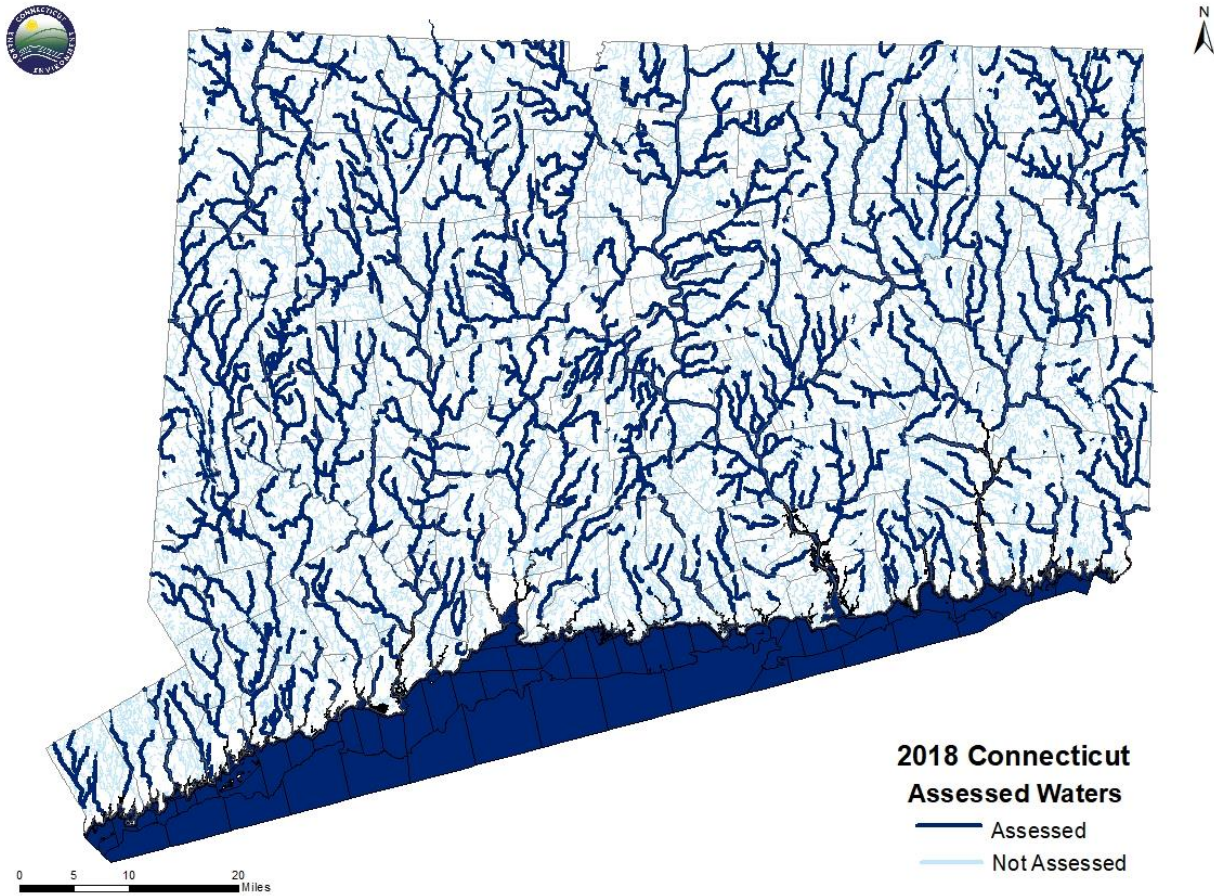


Figure 2-1. Waterbody segments assessed for one or more designated uses

Table 2-1. Designated Use support summaries for rivers, lakes, and estuaries

USE SUPPORT 2018		FULLY SUPPORTING	NOT SUPPORTING	INSUFFICIENT INFORMATION	TOTAL ASSESSED	NOT ASSESSED	TOTAL TRACKED ^a
Rivers							
Aquatic Life	Segments	526	203	130	859	242	1101
	Miles	1753.54	561.05	376.17	2690.76	393.6	3084.36
Recreation	Segments	122	263	99	484	617	1101
	Miles	444.81	871.15	260.15	1576.11	1508.25	3084.36
Fish Consumption ^b	Segments	1032	14	1	1047	54	1101
	Miles	2872.29	110.72	0.2	2983.21	101.15	3084.36
Lakes							
Aquatic Life	Segments	91	17	24	132	50	182
	Acres	23538.02	1158.90	2256.49	26953.41	3484.05	30437.46
Recreation	Segments	71	31	22	124	58	182
	Acres	16280.93	6711.70	1913.60	24906.23	5531.23	30437.46
Fish Consumption ^b	Segments	168	13		181	1	182
	Acres	26797.08	3639.01		30436.09	1.37	30437.46
Estuaries							
Marine Aquatic Life	Segments	28	76	0	104	107	211
	Mi ²	236.53	316.75	0	553.28	58.63	611.91
Recreation	Segments	55	26	1	82	129	211
	Mi ²	28.07	16.08	0.02	44.17	567.73	611.91
Fish Consumption ^b	Segments	207	4	0	211	0	211
	Mi ²	603.28	8.63	0	611.91	0	611.91
Shellfish Harvesting, Class SA Waters	Segments	7	117	0	124	10	134
	Mi ²	39.19	206.47	0	245.66	0.76	246.42
Shellfish Harvesting, Class SB Waters	Segments	21	27	0	48	12	60
	Mi ²	35.38	20.65	0	56.03	9.08	65.11

^a "Total Tracked" refers to the waterbody sizes tracked in the ATTAINS Database. The total size of estuaries in the State is accounted for, but only a fraction of river miles and lake acres are tracked in ATTAINS. The total number of river miles estimated for Connecticut is 5,830 and the total number of lake acres is 64,973.

^b All freshwaters of the State have a fish consumption advisory and addressed by a statewide limited consumption advisory for all freshwater fish, except trout, due to atmospheric deposition of mercury. Similarly, all estuarine waters have a fish consumption advisory and addressed by a statewide advisory on striped bass and bluefish due to PCB contamination. The waters summarized in these tables contain fish consumption advisories beyond the statewide advisories.

CT DEEP Waterbody Assessments, Aquatic Life Use Support

Map of Connecticut CT DEEP Waterbody Assessment Segments showing Aquatic Life Use Support

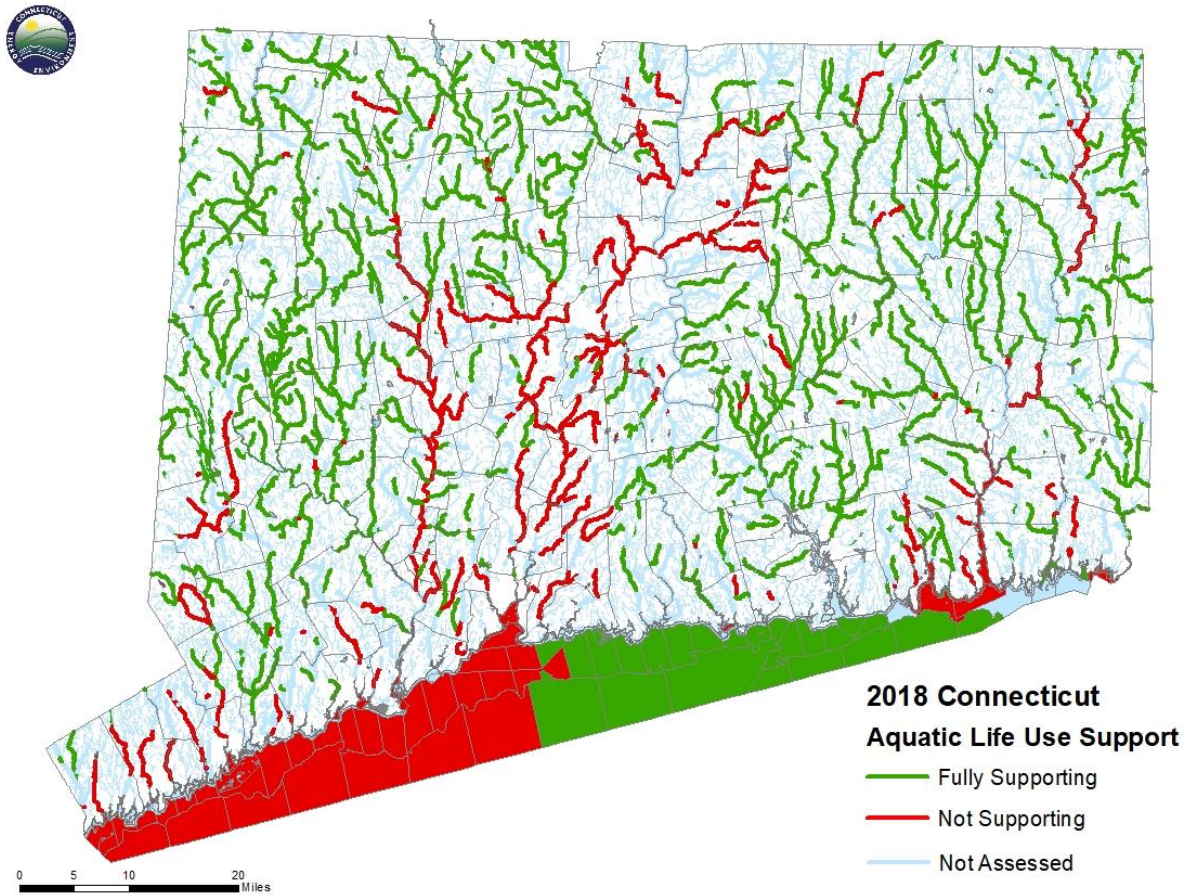


Figure 2-2. Waterbody segments assessed for Aquatic Life Use Support

CT DEEP Waterbody Assessments, Recreational Use Support

Map of Connecticut CT DEEP Waterbody Assessment Segments showing Recreational Use Support

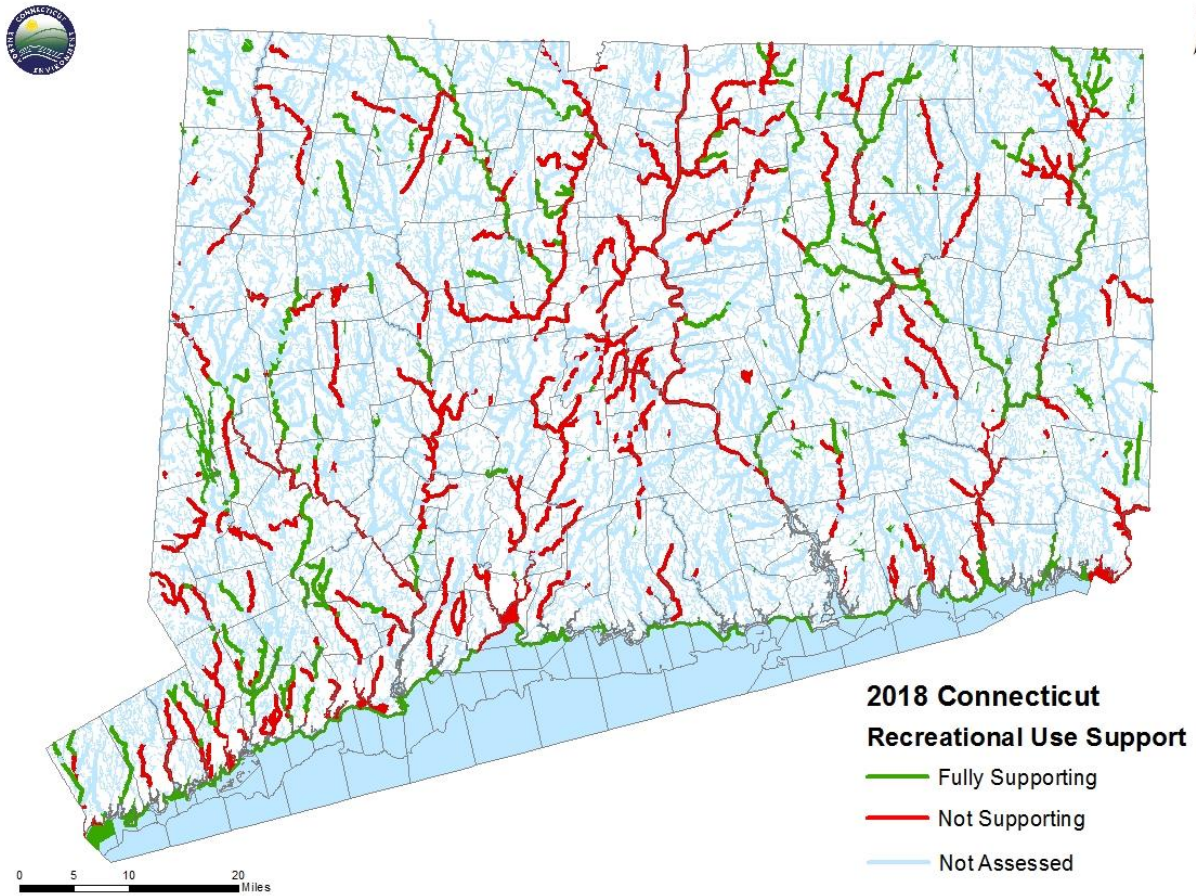


Figure 2-3. Waterbody segments assessed for Recreational Use Support

Connecticut Estuary Square Miles Assessed for Shellfish Use

Connecticut estuaries evaluated by CT DEEP for support of Shellfishing Use.

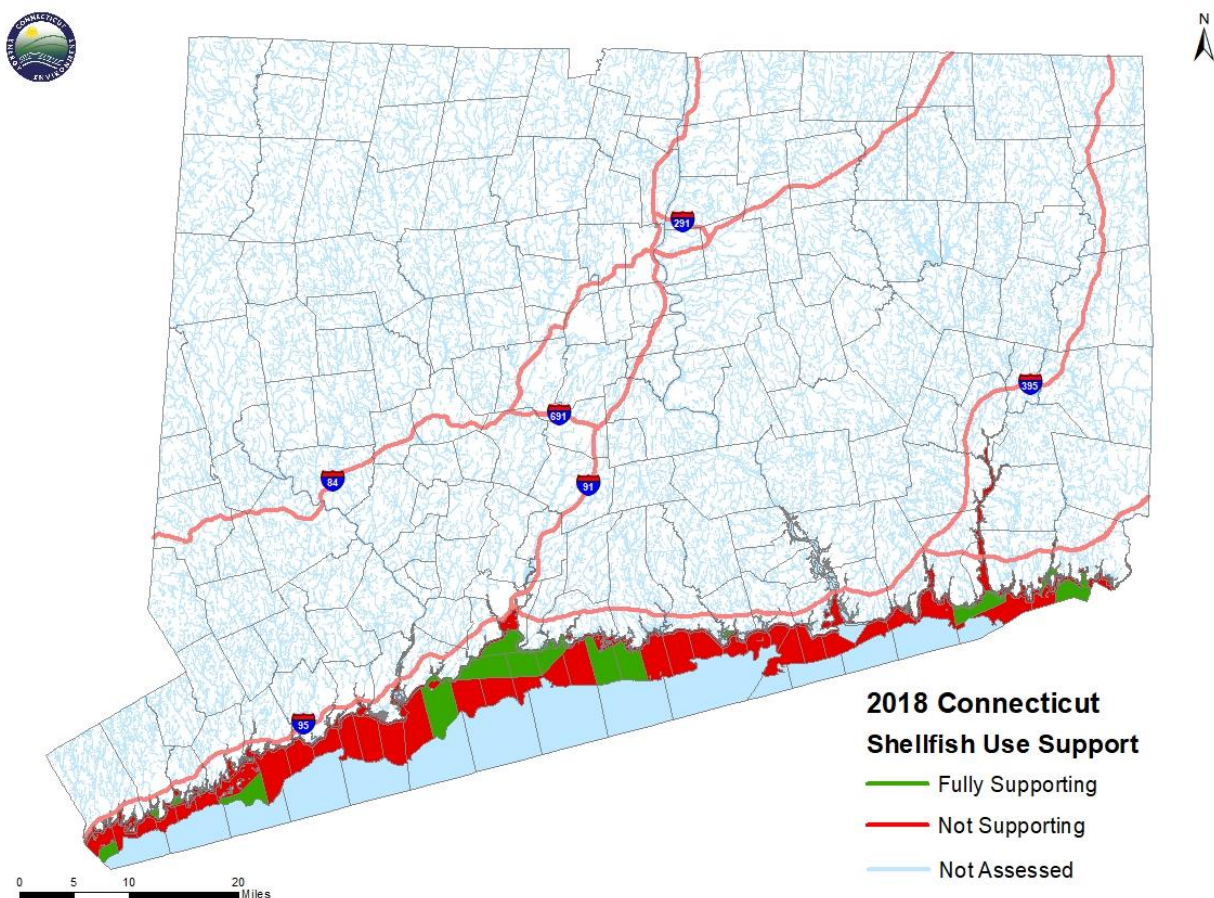


Figure 2-4. Waterbody segments assessed for Shellfishing Use Support.

CT DEEP evaluated current and available monitoring data to assess Shellfishing Use Support for 312 square miles of estuary in Connecticut (Figure 2-4). An important note for shellfish in estuarine waters is assessment criteria are only applied to inner, shore, and midshore waters where growth is viable, which is approximately 50% of Connecticut's estuarine waters. Percentages are based upon the area viable for shellfish use and not the total estuarine waters in Connecticut.

Statewide Assessments using a Probabilistic Sampling Design

Probabilistic Monitoring of Rivers and Streams

Statistical surveys were implemented in accordance with [Connecticut's Ambient Water Quality Monitoring Strategy](#) (CTDEEP 2015) to characterize use support in wadeable streams for aquatic life and recreation on a statewide basis. A Generalized Random Tessellation Stratified (GRTS) survey design (Stevens and Olsen 2004) was provided to CT DEEP from EPA and implemented with a target population of streams based on the National Hydrography Dataset at the 1:24,000 scale. No stratification was included in the survey design.

A total of 62 wadeable stream sites were sampled from 2011-2015 to obtain a statewide estimate of aquatic life use attainment. In 2017, these stream samples were evaluated and summarized for Aquatic Life Use support assessment (Table 2-2) resulting in 76% Fully Supporting and 24% Not Supporting the designated use.

Table 2-2. CT DEEP Probabilistic Monitoring Aquatic Life Use Support in Wadeable Streams 2011-2015 Summary

Use Support Category	Percent of Target	Standard Error	Upper and Lower 95% Confidence Intervals
Fully Supporting	76	4.3	67.3-84.3
Not Supporting	24	4.3	15.7-32.7

Drinking Water Use

Connecticut has 1 waterbody assessed as not supporting drinking water use. The segment named Farm River (North Branford)-02 is a 1.24 mile section of the Farm River, number CT5112-00_02, described as from confluence Burrs Brook just DS Route 80 crossing, upstream to Pages Mill Pond outlet dam, Upstream side of Mill Road crossing, North Branford. Issues in this watershed are heavily influenced by commercial operations and are being reviewed and evaluated to identify best management practices to support water quality improvements.

Chapter 3 - Waterbodies Identified for Restoration and Protection Strategies Pursuant to Section 303 of the Clean Water Act

Background Information

Using information provided by the statewide assessment of water quality described in Chapters 1 and 2 of this document, the Department conducts an evaluation of the State's surface water bodies for the development of restoration and protection strategies in accordance with the requirements of Section 303 of the federal Clean Water Act (CWA). The CWA is the primary federal law that protects our nation's surface waters, including lakes, rivers, and coastal areas. Through passage of the CWA, the United States Congress established a national goal of restoring and maintaining the chemical, physical and biological integrity of the Nation's waters by achieving and maintaining "water quality which provides for the protection and propagation of fish, shellfish, and wildlife, and recreation in and on the water wherever attainable" and preventing the discharge of toxic substances in toxic amounts (CWA Section 101).

Development of restoration and protection strategies is part of a broad effort to achieve these goals. This effort includes: 1) adoption of Connecticut Water Quality Standards (CT WQS); 2) monitoring and assessment of surface waters to evaluate consistency with those standards; 3) evaluating and prioritizing those waters for development of action plans, such as Total Maximum Daily Load (TMDL) analyses or other management plans to restore or protect water quality consistent with CT WQS; and (4) implementation of those TMDLs or action plans, achieving consistency with the CT WQS.

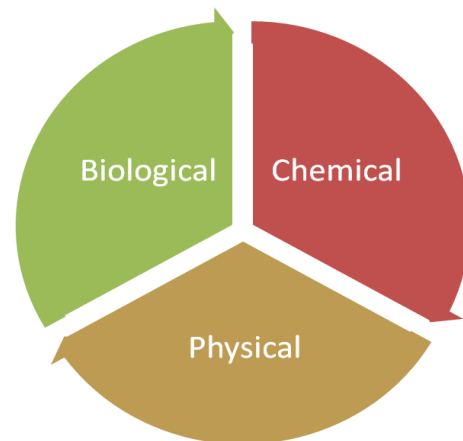



Figure 3-1 Key Components of Water Quality



Figure 3-2: Water Quality Planning and Implementation Process

Connecticut has adopted CT WQS as required under Section 22a-426 of the Connecticut General Statutes and CWA Section 303. The CT WQS contains policy statements concerning the protection of water quality and describe the system used by Connecticut to classify all waters in the State based on use of the waterbodies. Two elements of the CT WQS critical to the development of restoration or protection strategies are the establishment of waterbody designated uses (Table 3-1) and the specified narrative and numeric Water Quality Criteria and Standards to protect and support those uses. Physical, chemical, and biological monitoring data or other applicable information is compared to the Water Quality Criteria and Standards to assess whether or not a waterbody is meeting the attainment of designated uses.

Table 3-1: Designated Uses for Surface Waters in Connecticut

Designated Uses →	Existing or Proposed Drinking Water Supply	Potential Drinking Water Supply	Habitat for Fish, Other Aquatic Life and Wildlife	Shellfish Harvesting for Direct Human Consumption	Commercial Shellfish Harvesting	Recreation	Industrial and / or Agricultural Supply	Navigation
↓ Classifications								
AA								
A								
B								
SA								
SB								
 Established Use								

The Connecticut Consolidated Assessment and Listing Methodology (CT CALM, found in Chapter 1 of this report) for 305(b) and 303(d) reporting was used as a guidance document for the assessment of surface waters in accordance with the CT WQS. Assessments of individual waterbody segments (i.e. Assessment Units, AUs) were conducted using relevant data that met requirements specified by the CT CALM.

Integrated Water Resource Management

In order to improve the effectiveness of the Department’s water quality restoration and protection actions, Connecticut has undertaken a new effort called Integrated Water Resource Management. This effort is an outgrowth of a national collaboration between the States and EPA. The States and EPA have been working together to develop enhancements to the 303d Program, within the current framework of the Federal Clean Water Act, to improve protection and restoration efforts of water quality in our nation’s waters. EPA calls this updated approach the “Long-Term Vision for Assessment, Restoration and Protection under the Clean Water Act Section 303(d) Program” or the 303d Vision in short. Connecticut has taken this updated approach and used it as the basis to enhance our efforts in restoring and protecting Connecticut’s waters through Integrated Water Resource Management. This approach is helping to focus state resources through a comprehensive review of ecological, pollution stressors and social use information and by building on new partnerships to protect and restore water quality.

These new actions to improve water quality include:

- ◆ Reviewing information to choose waterbodies with the most likely successful restoration potential

- ◆ Focusing on certain water resource areas while maintaining statewide water quality efforts
- ◆ Identifying alternative action plans that will lead to effective water quality improvement
- ◆ Enhancing protection of high quality water resources from pollution impacts
- ◆ Building on existing partnerships and collaborations

Integrated Water Resource Management includes identifying waterbodies (and their watersheds) for focused water quality efforts. CT DEEP is focusing on landscape features and pollutants that influence water quality. Additional focus is placed on aquatic resources and features of important value to the public.

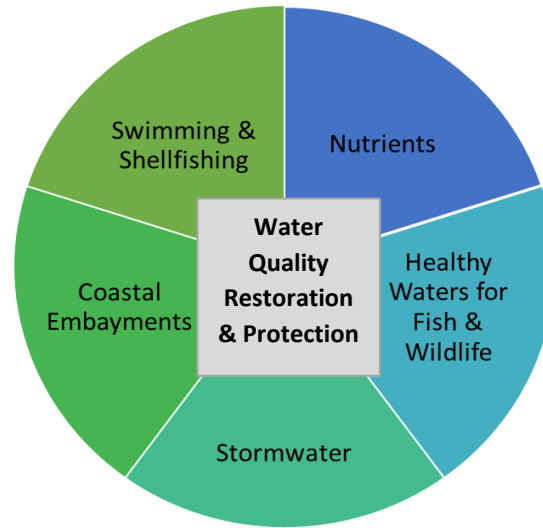


Figure 3-3. CT DEEP Water Quality Concerns

CT DEEP used a practical approach to screen waterbodies using ecological, stressor, social and partnership data. This approach resulted in a list of waterbodies with a high likelihood of restoring or protecting water quality.

During the waterbody selection process many groups within CT DEEP worked together to review ecological conditions, social values, and existing management efforts. Priority data used to select waterbodies for focused efforts included:

- ◆ Ecological information showing the health of fish and other aquatic life
- ◆ Social values such as fishing, swimming, other recreation, and drinking water sources
- ◆ Sources of potential pollution such as industrial discharges and sewage treatment plants
- ◆ Land use conditions, amount of hard surfaces, and stormwater runoff
- ◆ Existing planning efforts within the watershed
- ◆ Existing and potential partnerships

In addition to the internal process, a Draft list of waterbodies was shared with the public for additional input and feedback. After incorporating the suggestions from this public process, a final list of Selected Waterbodies was published to be used as the base for prioritizing CT DEEP planning and water quality work.

States, with support from EPA, are encouraged to develop the best type of plans in order to restore or protect selected waters. States can develop traditional TMDL plans or use other innovative approaches such as alternatives or protection plans. CTDEEP has typically developed traditional TMDL plans to address impaired

water quality for specific waters. However, under Integrated Water Resource Management other types of action plans may be selected to achieve water quality restoration or protection goals.

CT DEEP has been working on projects in several of the watersheds that were selected for the initial list in 2016. Many of the water quality issues that were prioritized in this process are more technically complex than the pathogen issues that have driven the TMDL process for CT DEEP in recent history. The project work that is underway by CT DEEP, is not only to address the water quality in the specific watershed, but also to develop template approaches or technical tools that can be applied to other waterbodies on the selected list.

Through an influx of some additional funding resources, multiple projects are underway in Connecticut. CT DEEP is currently developing an outreach and communications strategy to update all interested parties on this initial batch of project work. These outreach efforts will serve to strengthen the relationships with existing partners and remind potential partners in the additional watersheds of future collaborative opportunities.

More information on the Integrated Water Resources Management approach can be found on the CT DEEP website: <http://www.ct.gov/deep/iwrm>

Identification of Waters for Action Plan Development

Integrated Water Resource Management is a planning effort to identify waters for action plan development through 2022 (see Appendix C-2). For this reporting cycle, CT DEEP is proposing waters for action plan development based on continuing work in support of key statewide TMDL initiatives including the Long Island Sound TMDL, Statewide Bacteria TMDL and New England Regional Mercury TMDL as well as supporting the cleanup of the Housatonic River as a result of PCB contamination. These waters were selected because they were either part of long-standing projects or sufficient data, information and resources were available to develop action plans during the next two years.

Despite CT DEEP's focus on the selected water bodies for action plans, some level of water quality program effort will continue for all waters of Connecticut. Not all efforts require the development of a new plan under Section 303d of the Clean Water Act. This includes other program work in CT DEEP, assistance from Department staff and sharing resources with non-government organizations and municipalities, as they are available. Projects already underway will continue. In addition to the waters identified in the List of Waters for Action Plan Development as an Appendix C-2, CT DEEP also support various implementation programs such as the Watershed Management Program, as well as State NPDES permitting and Remediation Programs through development of risk-based approaches to water quality restoration and protection.

Connecticut's Impaired Waterbodies

In addition to requiring states to provide a list of waters for action plan development within the next two years, the CWA requires states to track attainment of water quality goals for each waterbody using a five-category approach (Categories 1,2,3,4, and 5) developed by the US EPA. Categories 1, 2 and 3 do not pertain to impaired waters, but may include water bodies prioritized for action plans based on water quality protection or for which TMDLs have been developed to identify pollutant loadings to either have restored the water quality or ensure continued attainment of water quality. Waterbodies that have been identified as impaired are assigned to Categories 4 and 5 under the reporting requirements of CWA Section 303(d). Category 4 has been assigned to waterbodies where the planning and implementation of pollution control and management measures have been initiated with the expectation to achieve CT WQS attainment in future assessments. Category 5 waters are those for which a TMDL or equivalent plan is required. Information regarding Categories 4 and 5 has been summarized in Table 3-2 as applicable to waterbodies in Connecticut.

Table 3-2. Definitions of US EPA Categories 4 and 5 for Assessed Waterbodies in Connecticut

Category	Definition	Number of Waterbodies in CT in this Category
4a	Waterbodies impaired for one or more designated uses that have an established TMDL and where a pollutant has been identified as the cause of the impairment.	325*
4b	Waterbodies impaired for one or more designated uses by a pollutant that is being addressed by pollution control requirements other than a TMDL which are expected to address the impairment.	11
4c	Waterbodies impaired for one or more designated uses which is the result of pollution but is not caused by a pollutant.	83
5	Available data and/or information indicate that one or more designated uses are not being supported and a TMDL or action plan is needed.	307

*Additional segments were reported in Category 4a in the 2016 report, see the section on *Pollution Control Plans and Implementation for Impaired Waterbodies in Category 4* for details.

US EPA reviews the rationale and supporting assessment information for inclusion of any waterbody segment impairment in Category 4 to ensure that these waters are appropriately categorized. However, formal approval of waterbodies in Category 4 is not required under Section 303(d) of the CWA. Waterbody impairments listed in Category 5 constitute the regulatory 303(d) list of impaired waterbodies which is subject to US EPA review and approval pursuant to federal regulation 40 CFR 130.7.

The Impaired Waters List is updated by CT DEEP and approved by US EPA every two years as required under the CWA. Updates to impaired waterbodies may include changes to waterbody assessments in Category 5, and also revisions to segments in Category 4a, 4b, and 4c. Totals for impaired waterbodies that were identified within Categories 4 and 5 have been compiled in Table 3-2 and Figure 3-4.

It is expected that the biannual review of surface waters for 305(b) and 303(d) reporting may result in a change in the US EPA category for any given waterbody as new information is obtained. For example, a waterbody listed in Category 5 may be reassigned to Category 4b if other pollution control requirements, such as a consent order for remedial action, are determined to be the most effective option for attaining water quality standards in place of a TMDL. Thus, the 305(b) and 303(d) reporting is an iterative process that may result in the re-classification of waterbodies to different categories based on new assessment data or changes in US EPA regulations or guidance relating to the assessment and listing process.

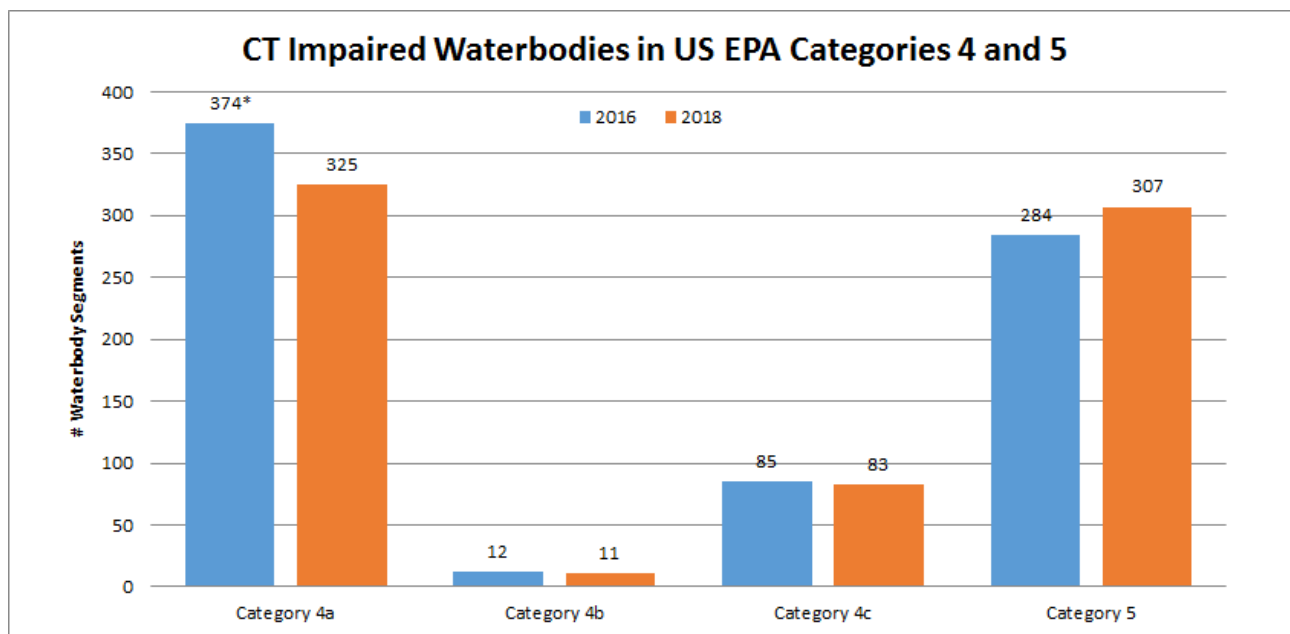


Figure 3-4. Total segments in US EPA Category 4 and 5 (*Additional segments were reported in Category 4a in the 2016 report, see the section on *Pollution Control Plans and Implementation for Impaired Waterbodies in Category 4* for details.)

Impaired Waters in Category 5

The List of Impaired Waters is an account of Connecticut’s waterbody segments that do not support at least one designated use which is provided as an Appendix B-1. The List of Impaired Waters identifies the waterbody impairment information for the designated use(s) and impairment cause(s) as required under CWA Section 303(d). A total of 307 segments were identified in the List of Impaired Waters (US EPA Category 5) for this reporting cycle. Figure 3-5 depicts the total impaired segments for each of the assessed designated uses in Connecticut. Generally, the colored bars in Figure 3-5 fluctuate by small amounts when comparing back-to-back report cycles, but it is difficult to consider trends because the total segments and available data varies between report cycles. Often, there are a number of impaired waterbody segments added (“listed”) in each report cycle. This number varies depending on the results of assessments from the new monitoring data. At the same time, a number of waterbody segments are removed (“delisted”) due to established TMDLs, restoration activities and/or new data indicating improved water quality conditions.

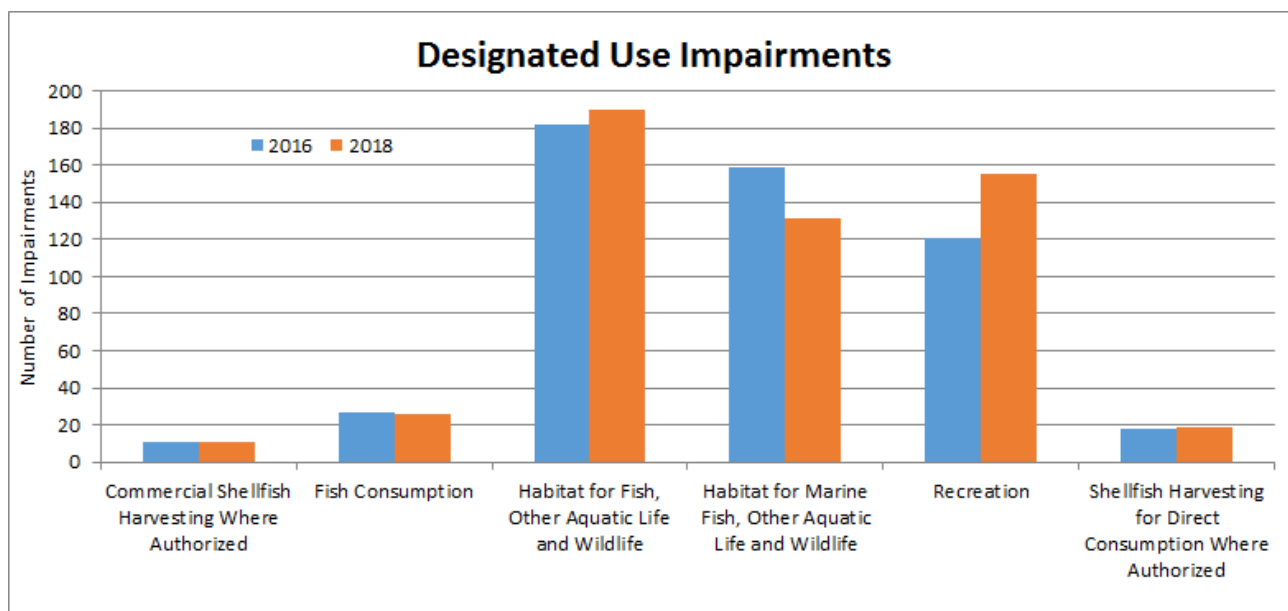


Figure 3-5. Total segments by Designated Use that require a TMDL or equivalent plan

This report cycle also includes a revised reporting structure from US EPA which in some cases consolidated terminology for impairments (Causes). For example, “dissolved oxygen” and “oxygen, dissolved” were separate terms that were used but they are essentially the same. These two terms were consolidated into “dissolved oxygen” which reduced the total impairments when both terms were used. This is evident in Figure 3-5 for “Habitat for Marine Fish, Other Aquatic Life and Wildlife”. The figure suggests a significant decrease in impairments from 2016 to 2018, however this decrease is mostly caused by the consolidation of these two terms. Additionally, the new reporting structure introduced a new term called “Parameter”. Under this reporting structure, a “Cause” from past CT reports is now a “Parameter” with a status that is identified as either “Meeting Criteria”, “Cause”, “Observed Effect” or “Insufficient Information”. For impairments in Category 5, the impaired designated use will have a “Parameter” identified as a “Cause”. As an example, if a freshwater waterbody has an impaired designated use for “Recreation” due to bacteria, it will have “E. coli” selected as the “Parameter” and the status identified as a “Cause”, and the waterbody would be included on the Impaired Waters List (Category 5).

Pollution Control Plans and Implementation for Impaired Waterbodies in Category 4

Water quality for many Connecticut waterbodies is being addressed in various pollution control and management programs within CT DEEP. Information about waters for which TMDLs have been established and approved by USEPA is provided as Appendix B-2. This includes impaired segments in EPA Category 4a (*Impaired waters with adopted TMDLs*) for which a TMDL has been established but water quality has not yet been restored. A TMDL can be specific to a designated use and impairment cause, so segments can have a number of TMDLs for each designated use and/or cause.

Figure 3-4 suggests a reduction in the number of segments in Category 4a between 2016 and 2018. However in previous reporting cycles, the total reported segments for Category 4a included any waterbody with a TMDL that was established for the waterbody, even waterbodies that had been restored. This practice was changed for the 2018 IWQR which affected the total segments in Category 4a. If there is an established TMDL, but the impairment is restored, then the segment was reported in Category 1 or 2, and not Category 4a. Regardless, the

TMDL document and implementation management remains in effect to ensure protection of designated uses in the waterbody. This leads to a mismatch between the number of TMDLs and the number of segments in Category 4a. Consequently, there are a total of 415 established TMDLs on CT waterbody segments and 325 of which have impaired designated uses within Category 4a.

Figure 3-6 depicts the cumulative development of TMDLs for Connecticut waterbodies. In recent years, there was an increase in established TMDLs mostly due to a number of bacteria TMDLs. Connecticut was able to establish a more efficient process for developing bacteria TMDLs. There was a significant increase in TMDLs in 2012 because of the completion of the Statewide Bacteria TMDL which included TMDLs for 180 waterbody segments. Conversely, some TMDLs are more complex and require significant time and effort to complete.

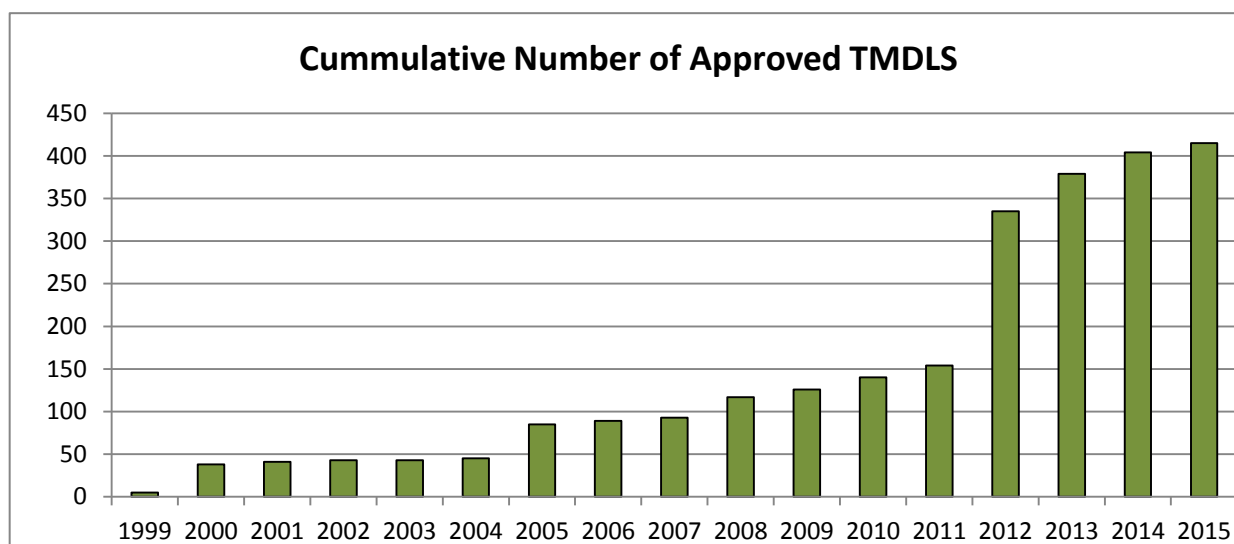


Figure 3-6 Cumulative Number of Approved TMDLs in Connecticut

Segments assigned to US EPA Category 4b (*Pollution Control Measures for Waterbody Segments*) are provided as Appendix B-3 and includes a description of the non TMDL-based pollution control requirements expected to result in full attainment of CT WQS. Examples of other pollution control requirements include Consent Orders, Combined Sewer Overflow Control Plans, Remedial Action Plans, Restoration Plans, other plans or studies where activities in progress are expected to result in attainment of the applicable water quality standards and designated uses. Waters are not assigned to this category unless there is reasonable assurance that compliance with the requirements will result in attainment of uses and there are provisions for follow-up monitoring to track progress. In the event that follow-up monitoring indicates that the other pollution control requirements will fall short of achieving the goal of attaining standards, segments will be reassigned to Category 5 for TMDL development. There are many other waters, not listed under Category 4b, for which water quality based pollution control measures have been established. There are a variety of these alternative measures, such as water quality based permitting or ecological risk assessment activities. These efforts are designed to support restoration or protection of water quality but may not be selected for inclusion in Category 4b.

Information on the segments identified in US EPA Category 4c with impairment not due to a pollutant is provided as Appendix B-4. The Clean Water Act defines pollution as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water". In this case, the pollution is not from a chemical contaminant, but it is from a human impact. While a TMDL is not typically prepared for 4c waters, this

type of pollution does require management measures to meet the applicable water quality standards. Some examples of this pollution include flow alterations, stream channelization, and invasive species.

Category 4c for nonpollutant causes includes waterbodies that are impacted by flow alterations. CT DEEP has developed a methodology for assessing flow impairments when sufficient information is available (Aquatic Life Use - Rivers and Streams, Assessment Methodology, p.16). CT DEEP previously reported the cause of these types of flow impaired waters as “other flow regimes” or “flow alterations” based on the reporting structure that was available at the time. However, the term “other flow regimes” does not accurately reflect the impairments which are predominantly due to flow alterations that serve public needs and safety. While the historical assessments remain the same, US EPA has modified the reporting structure such that “other flow regimes” and “flow alterations” were consolidated into the term “flow regime modification”. For this report cycle, Connecticut waterbodies with flow impairments were reported in Category 4c as a “flow regime modification” impairment. .

Appendix B-4 of Category 4c segments is not to be considered a comprehensive listing of all known impaired segments in this category. Current assessment protocols have not covered the entirety of waterbodies across the State of Connecticut to determine all impairments due to nonpollutant sources.

Alternative Approaches to Restoring and Protecting Water Quality

Through the EPA 303d Vision and Connecticut Integrated Water Resource Management approaches, States have the flexibility to take alternative actions to restore or protect water quality, separate from establishing a traditional TMDL. CT DEEP is actively using alternative approaches to restore water quality in several watersheds. While these alternative actions are pursued, the waters have continued to be designated as part of Category 5, if impaired.

One instance in which CT DEEP may advocate the use of alternative approaches to water quality restoration is for waterbodies that are impaired due to historical pollution from site activities. At these locations, CT DEEP works within various remediation programs such as the EPA Superfund Program (<https://www.epa.gov/superfund>) or Connecticut Remediation Programs (www.ct.gov/deep/remediation) to work with responsible parties to develop strategies to address and remediate the contamination in order to ensure protection of the environment and attainment of water quality goals. Planning and implementation of remedial strategies are very complex and often takes several years to achieve. In the end, the remedial action strategies at these sites are anticipated to 1) address the impairment of the waterbody and 2) provide the conditions that fully support the designated uses within the waterbody. Appendix C-3 provides examples of alternative approaches and actions which are being developed the address water quality impairments in Connecticut.

Determining Causes and Sources of Impairment

Monitoring and assessment data used to determine the attainment of CT WQS and designated uses are generally insufficient to provide specific indication of causes or sources of impairment or potential sources of stress to a water body. The causes and sources contributing to waterbody impairments or stress can best be determined through a stressor identification study conducted in support of development of TMDLs or alternative approaches. Once a segment is designated for development of a TMDL or alternative, an investigative study is conducted to identify causes and sources of impairment. These investigations may include more intensive ambient water quality sampling, aquatic toxicity studies, sediment or fish tissue analysis and/or dilution calculations of known discharges.

One water quality concern which is receiving attention on a national level as a cause and/or source of impairments is nutrients. Nutrients, such as phosphorus and nitrogen, are naturally occurring elements and are essential to support plant growth. However, when present in excessive amounts, nutrients contribute to a

process called “cultural eutrophication” that can impair aquatic life, water supply and recreational use of Connecticut’s water resources. Cultural eutrophication, or nutrient enrichment, is a serious threat to water quality in Connecticut. Excessive loading of nutrients to surface waters as a result of discharges from industrial and municipal water pollution control facilities (WPCF), stormwater or nonpoint sources such as runoff from urban and agricultural lands, or other sources, can lead to algal blooms, including blooms of noxious blue green algae, reduction in water clarity, habitat modification, aquatic life impairments and in extreme cases depletion of oxygen and fish kills. Understanding the impacts of nutrients on attainment of designated uses as well as potential sources of nutrient inputs to the environment informs both TMDL and other implementation plans to address the effects that excess nutrients can have on water quality.

In Connecticut, nutrient reductions have been targeted for point and non-point sources of both phosphorus and nitrogen in order to address water quality concerns associated with nutrients. For nitrogen in particular, CT DEEP is actively involved in the interstate effort to update and enhance the implementation activities for the Long Island Sound TMDL, which focuses on nitrogen impacts and associated hypoxia. For phosphorus, CT DEEP led an extensive effort under Connecticut Public Act 12-155 to evaluate the impact and control of phosphorus in freshwater non- tidal streams.

As part of the PA 12-155 effort, CT DEEP has developed a new methodology to identify where total phosphorus (TP) should be considered a cause of aquatic life impairment in high gradient, non-tidal, wadeable rivers and streams using a weight of evidence approach.

The methodology was used to assess data from 125 sites from 2012 through 2017 for aquatic life impairment caused by TP. TP was determined to be the cause of the aquatic life use impairment at 17 of these sites in 15 different stream segments. Only three of these sites were not downstream of discharges containing TP, while the remaining 13 sites are downstream of wastewater treatment plants at which phosphorus load reductions are already taking place as part of the CT Phosphorus Strategy for Non-Tidal Waste Receiving Streams (TP Strategy) (Becker, 2014) (Figure 3-7). However, final limits are still not being met at the majority of these plants. The objective of the TP Strategy is to reduce or cap the phosphorus loading from point sources in waste receiving streams. All of the NPDES permittees discharging to the impaired segments currently have TP limits in the permits for their facilities and are in the process of making upgrades to meet the final limits. As these upgrades for final limits are completed, the TP concentrations in the stream are expected to decrease.

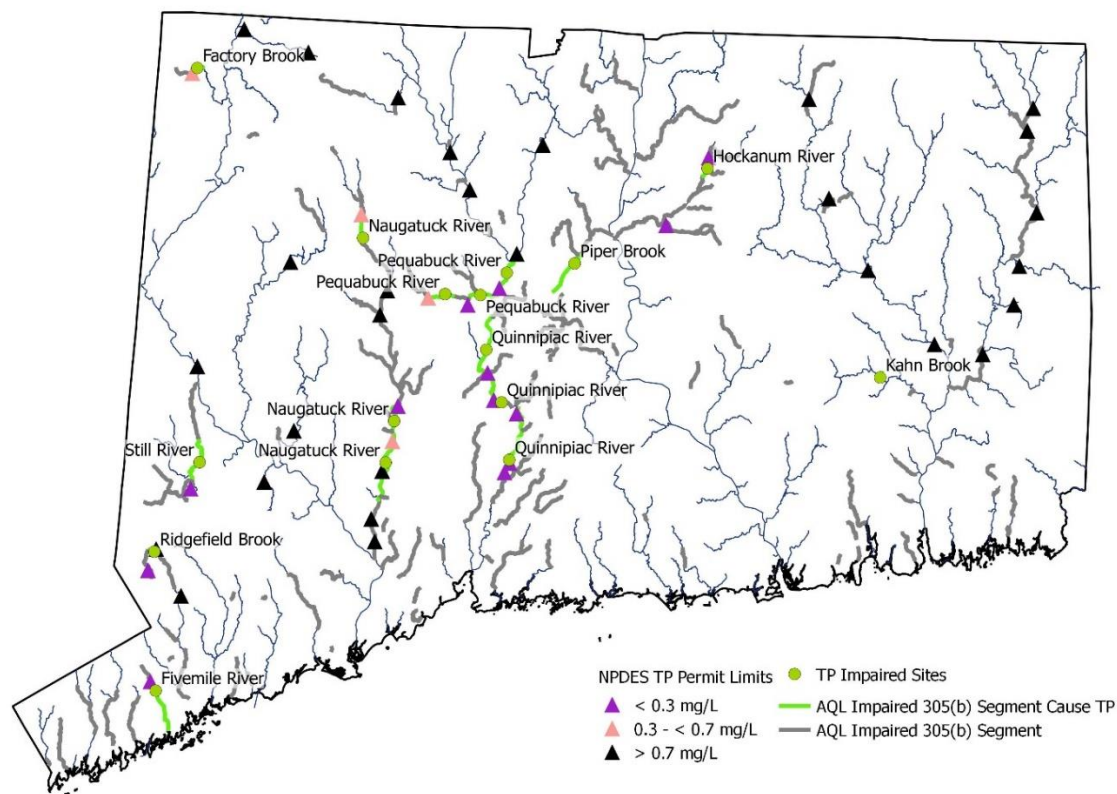


Figure 3-7. Sites impaired for aquatic life caused in part by Total Phosphorus (TP). Sites are shown in relation to wastewater discharges with TP permit limits and 305(b) segments impaired for aquatic life.

General information, where available, can help to identify sources potentially contributing to the observed impairments. For example, there are circumstances that are generally prone to contribute pollutants to waterbodies which may have an impact on designated uses. Some examples include:

Bacterial contamination that poses a risk to human health can originate from waterfowl, wildlife, domestic animals (dogs, horses, poultry, swine and cattle) and human waste from malfunctioning septic systems, private/public sewers, and sewage discharges from watercraft. Potential sources of bacteria are recognized by US EPA as Non-Point Source Pollution, Urban Stormwater, Sources Outside State Jurisdiction or Borders, Illicit Connections/Hook-ups to Storm Sewers, Combined Sewer Overflows, and Municipal Point Source Discharges.

Land uses can contribute pollutants that vary depending on the type of land cover or activity. Developed areas whether industrial, commercial, residential or urban can contribute pollutants through stormwater runoff. These pollutants originate from human activities that generally include heavy metals, nutrients, and petroleum based products. Impervious cover, stormwater drainage systems and over land flow are primary factors in the transport of these pollutants to surface waters. Small and large agricultural operations can contribute nutrients, pesticides, bacteria and sediment to surface waters.

Point Source Discharges are regulated by the State through applicable wastewater discharge permits. Industrial and municipal permittees may generate wastewater that is treated and discharged to a waterbody which has been determined to have a specific discharge assimilative capacity. However short term discharge violations of the permit limits can occur due to equipment malfunction, changes to wastewater processes and human error. The pollutants contributed to surface waters vary depending on the type of wastewater generated.

Industrial contamination is persistent in Connecticut which has had a long history of industrial activities such as textiles, firearms, glassware, metal finishing, and much more. Unfortunately, historical contamination from many industrial activities contributed pollutants directly to surface waters and sediments as well as groundwater which eventually discharge to surface water. Many sites have been remediated by eliminating the contaminant source, but others remain or need further investigation to determine the contaminant(s) that may be present and may be contributing to impairments.

Some of the more common sources of stressors associated with the various use impairments are identified in Table 3-3. Reporting the sources of impairment is not a requirement of Section 303(d), and is not subject to US EPA review and approval. As stated above, identifying sources is most appropriately done within a TMDL or similar evaluation. Generally the identification of potential sources is not comprehensive, however in certain situations a source of an impairment could be identified if the weight of evidence is more conclusive. Source contributions will be refined within the stressor identification and TMDL/Action Plan development process.

Table 3-3. Summary of Designated Uses with Common Stressors

Impaired Use	Potential Stressors Types			Examples of Common Stressors	Examples of Common Sources
	Physical	Chemical	Biological		
Existing or Proposed Drinking Water		X	X	Bacteria	Stormwater, illicit discharges, agricultural runoff
Fish Consumption		X		Mercury, PCBs, Pesticides	Atmospheric deposition, industrial discharges, municipal wastewater treatment discharges hazardous waste sites, oil and chemical spills, land use
Habitat for Fish, Other Aquatic Life and Wildlife	X	X	X	Habitat alterations, flow regime changes, Toxics, Nutrients, Interactions between multiple pollutants, Low Dissolved Oxygen	Industrial discharges, municipal wastewater treatment discharges hazardous waste sites, oil and chemical spills, land use, stormwater
Habitat for Marine Fish, Other Aquatic Life and Wildlife	X	X	X	Habitat alterations, flow regime changes, Toxics, Nutrients, Interactions between multiple pollutants, Low dissolved oxygen	Industrial discharges, municipal wastewater treatment discharges hazardous waste sites, oil and chemical spills, land use, stormwater
Recreation	X	X	X	Bacteria	Stormwater, illicit discharges, agricultural runoff
Shellfish Harvesting for Direct Consumption Where Authorized		X	X	Bacteria	Stormwater, illicit discharges, agricultural runoff
Commercial Shellfish Harvesting Where Authorized		X	X	Bacteria	Stormwater, illicit discharges, agricultural runoff

Reconciliation List of 303(d) Delistings and Listings

The assessment of surface waters is an on-going process that will result in the removal of some waterbodies from the 303(d) reporting, and the addition of others. A waterbody is no longer impaired when an assessment of relevant data conducted in accordance with the CT CALM confirms attainment of water quality standards.

Additionally, waterbodies may be delisted when:

- ◆ An error was made in the initial listing causing an incorrect listing. These listings include those based on anecdotal information (information, often transmitted orally and undocumented, which cannot be confirmed through direct observation or measurement using generally accepted, reproducible analytical methods). In these circumstances, the waterbody usually was moved into US EPA Category 2 (supporting for some uses, other uses not assessed) or more often Category 3 (no or insufficient data available to make any assessment).
- ◆ Quality controlled data, which are acceptable to CT DEEP, demonstrate that designated uses are being met for the waterbody (with or without implementation of a TMDL).
- ◆ Revisions in Water Quality Standards and Criteria and/or assessment methodologies result in a change in assessment from non-attainment to attainment.
- ◆ The waterbody meets conditions described in Categories 4a, 4b, 4c as described above, however it will continue to be considered Not Supporting for one or more designated uses until water quality standards and designated uses are met, although the regulatory requirement to adopt a TMDL will no longer apply.

Based on the waterbody assessments where data were available for this reporting cycle, these changes include all segments that were proposed for the listing and delisting of impaired waterbodies. Appendix B-5 *Reconciliation List of Impaired Waters (Delistings and Listings)* was compiled where a change in an assessment affected the status of the impaired waterbodies (US EPA Categories 4 or 5). A total of 11 segments have been delisted from the Impaired Waters List. While 47 impairments were listed for CT waterbodies based on new data or assessments. One additional segment was listed for aquatic life use due to a category change from 4b to 5 (both impaired categories) because the schedule lapsed for the implementation to restore water quality in the segment.

IWQR Appendices

In previous report cycles, many of the tables (Assessment Results, TMDLs approved, Impaired Waters, etc.) were found within the report as one large electronic file, but now these tables are included as appendices and as separate electronic files for this report cycle. The list of appendices can be found in the Table of Contents (p. iii) of this report.

References

- Barbour, M.T., J. Gerritsen, B.D. Snyder and J.B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition*. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington D.C.
- Becker, M. 2012. Quality Assurance Project Plan-Aquatic Life Response to Cultural Eutrophication in Connecticut Freshwater Wadeable Rivers and Stream (2012-2015). Department of Energy and Environmental Protection, Bureau of Water Protection and Land Reuse, Planning and Standards Division Hartford, CT.
- Becker, M.E., Becker, T.J., Bellucci, C.J., 2018. Diatom tolerance metrics to identify total phosphorus as candidate cause of aquatic life impairment in Connecticut, USA freshwater streams. *Ecol. Indic.* 93.
- Becker, M.E., and Bellucci, C.J., 2019. A Method to Identify Total Phosphorus as a Cause of Aquatic Life Impairment in Connecticut Freshwater High Gradient Non-Tidal Streams. Technical Support Document. CT DEEP
- Bellucci, C. TMDL information. CT Department of Environmental Protection, Bureau of Water Protection and Land Reuse, Planning and Standards Division, Hartford, CT. Personal communication to P. Stacey, CT Department of Environmental Protection, Bureau of Water Protection and Land Reuse, Planning and Standards Division Hartford, CT.
- Bellucci, C.J., M.E. Becker, M. Beauchene, and L. Dunbar. 2013. Classifying the Health of Connecticut Streams Using Benthic Macroinvertebrates with Implications for Water Management. *Environmental Management* 51:1274-1283.
- Canavan, R.W. IV and P.A. Siver. 1995. *Connecticut Lakes: A Study of Chemical and Physical Properties of Fifty-six Connecticut lakes*. Connecticut College Arboretum, New London, CT.
- CT DEEP. *Water Quality Standards*. CT Department of Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT. www.ct.gov/deep/wqsc
- CTDEEP. 2015. Ambient Water Quality Monitoring Program Strategy, 2015-2024. Connecticut Department of Energy and Environmental Protection. Hartford, CT 06106.
- CT DEP. 1996. *Quality Assurance Project Plan for Ambient Biological Monitoring*. CT Department of Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT.
- CT DEP. 1998. *Trophic Classifications of Twelve Connecticut Lakes*. CT Department of Environmental Protection, Bureau of Water Management, Lakes Program, Hartford, CT.
- CT DEP. 1999. *Ambient Monitoring Strategy for Rivers and Streams: Rotating Basin Approach*. CT Department of Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT.

- CTDEEP. 2013. Standard Operating Procedures for the Collection of Fish Community Data from Wadeable Streams for Aquatic Life Assessment. Bureau of Water Protection and Land Reuse, Planning and Standards Division, Hartford, CT.
- CT DEP. 2005. *Connecticut Comprehensive Ambient Water Quality Monitoring Strategy*. CT Department of Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT.
- CT DEP. Unpublished data. CT Department of Environmental Protection, Bureau of Water Management, Planning Division, Hartford, CT
- CT DPH and CT DEP. 2003. *State of Connecticut Guidelines for Monitoring Bathing Water and Closure Protocol: revised 2003*. CT Department of Health Services, CT Department of Environmental Protection, Hartford, CT.
- CT DPH. 2016. *If I Catch It, Can I Eat It? A Guide to Eating Fish Safely Connecticut Fish Consumption Advisory*. Connecticut Department of Public Health, Hartford, CT. www.ct.gov/dph/fish
- Frink, C.R. and W.A. Norvell. 1984. *Chemical and Physical Properties of Connecticut Lakes*. The Connecticut Agricultural Experiment Station, New Haven, CT.
- Gerritsen, J. and B. Jessup. 2007. *Calibration of the Biological Condition Gradient for High Gradient Streams of Connecticut*. Tetra Tech, Inc. Owings Mills, MD. Prepared for US EPA, Office of Science and Technology and the CT DEP.
- Grubbs, G. H. and R.H. Wayland. 2000. [Online] *Guidance: Use of Fish and Shellfish Advisories and Classifications in 303(d) and 305(b) Listing Decisions (October 24, 2000) WQSP-00-03* United States Environmental Protection Agency, Office of Water, Washington, DC. <https://www.epa.gov/sites/production/files/2015-01/documents/standards-shellfish.pdf>
- Healy, D.F. and K.P. Kulp. 1995. *Water Quality Characteristics of Selected Public Recreational Lakes and Ponds in Connecticut*. U.S. Geologic Survey Water-Resources Investigations Report 95-4098, prepared in cooperation with the State of Connecticut Department of Environmental Protection, Hartford, CT.
- Interstate Shellfish Sanitation Conference. 2017. [Online] *NSSP Guide for the Control of Molluscan Shellfish 2017 Revision*. U.S. Department of Health and Human Services, Public Health Service, Food and Drug Administration. <https://www.fda.gov/media/117080/download>
- Kanno, Y., J.C. Vokoun, and M. Beauchene. 2010. *Development of dual fish multi-metric indices of biological condition for streams with characteristic thermal gradients and low species richness*. Ecol. Indicators.
- Neumann, R.M., R.J. Carley, C.P. Perkins, and R. Pirrie. 1996. *Preliminary Assessment of Total Mercury Concentrations in Fishes from Connecticut Water Bodies*. Department of Natural Resource Management and Engineering and Environmental Research Institute. University of Connecticut, Storrs, CT.

- Nosal, T. 1997. *Gazetteer of Drainage Areas of Connecticut*. Water Resources Bulletin Number 35. CT Department of Environmental Protection. Available at http://www.cteco.uconn.edu/docs/wrb/WRB45_Gazetteer_of_Drainage_Areas_of_Connecticut.pdf
- O'Brien, K. undated. *OLISP sediment geodatabase*. CT Department of Environmental Protection Bureau of Water Protection and Land Reuse, Office of Long Island Sound Programs, Hartford, CT.
- PA 12-155 Coordinating Committee – Phosphorus Reduction Strategy. Recommendations for Phosphorus Strategy Pursuant to PA 12-155 Final Report [WWW Document]. URL https://www.ct.gov/deep/lib/deep/water/water_quality_standards/p/pa12_155_fullccreport.pdf
- Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. *Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish*. EPA/444/4-89-00. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
- Poff, N.L., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The Natural Flow Regime-A Paradigm for River Conservation and Restoration. *Bioscience* 47:769-784.
- Smucker, N.J., Becker, M., Detenbeck, N.E., Morrison, A.C., 2013. Using algal metrics and biomass to evaluate multiple ways of defining concentration-based nutrient criteria in streams and their ecological relevance. *Ecol. Indic.* 32, 51–61.
- Stacey, P. 2007. *RE: determination of impairment based on sediment contamination- CALM update* State of Connecticut, Department of Environmental Protection, Bureau of Water Protection and Land Reuse, Division Director, Hartford, CT. Email to Katie O'Brien-Clayton, Department of Environmental Protection, Bureau of Water Protection and Land Reuse dated 12/27/2007.
- Stevens, D. L., Jr. and A. R. Olsen. 2004. Spatially-balanced sampling of natural resources. *Journal of American Statistical Association* 99(465): 262-278.
- Streich, K. 2007. *Summary Report & Users Guide Connecticut Coastal Assessment And Segmentation Project Final - May 11, 2006 Amended - October 3, 2007* State of Connecticut. Department of Environmental Protection. Hartford, CT
- Strobel, C.J. 2000. *Coastal 2000 - Northeast Component: Field Operation Manual*. EPA/620/R-00.002. U.S. Environmental Protection Agency, National Health and Environmental Effects Research Laboratory, Atlantic Ecology Division, Narragansett, RI.
- US EPA. Clean Water Act. <https://www.epa.gov/laws-regulations/summary-clean-water-act>
- US EPA. 1997. *Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates: Report Contents*. EPA-841-B-97-002A. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
- US EPA. 2000. *Ambient aquatic life water quality criteria for dissolved oxygen (saltwater): Cape Cod to Cape Hatteras*. EPA-822-R-00-012. U.S. Environmental Protection Agency, Office of Water, Washington, DC. 49 p.

- US EPA. 2002. [Online] *Consolidated Assessment and Listing Methodology Toward a Compendium of Best Practices/*. First Edition. July 2002. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, D.C. <http://www.epa.gov/owow/monitoring/calm.html>
- US EPA. 2005. *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act*. U.S. Environmental Protection Agency, Assessment and Watershed Protection Division, Office of Water, United States Protection Agency, Washington, DC.
- US EPA. 2013. *Long-Term Vision for Assessment, Restoration and Protection under the Clean Water Act Section 303(d) Program*. U.S. Environmental Protection Agency, Office of Water, Washington, DC. <https://www.epa.gov/tmdl/new-vision-cwa-303d-program-updated-framework-implementing-cwa-303d-program-responsibilities>
- Vokoun, J.C and C.R. Perkins. 2008. *Second Statewide Assessment of Mercury Contamination in Fish Tissue from Connecticut Lakes (2005-2006)* Department of Natural Resource Management and Center for Environmental Sciences and Engineering. University of Connecticut, Storrs, CT.