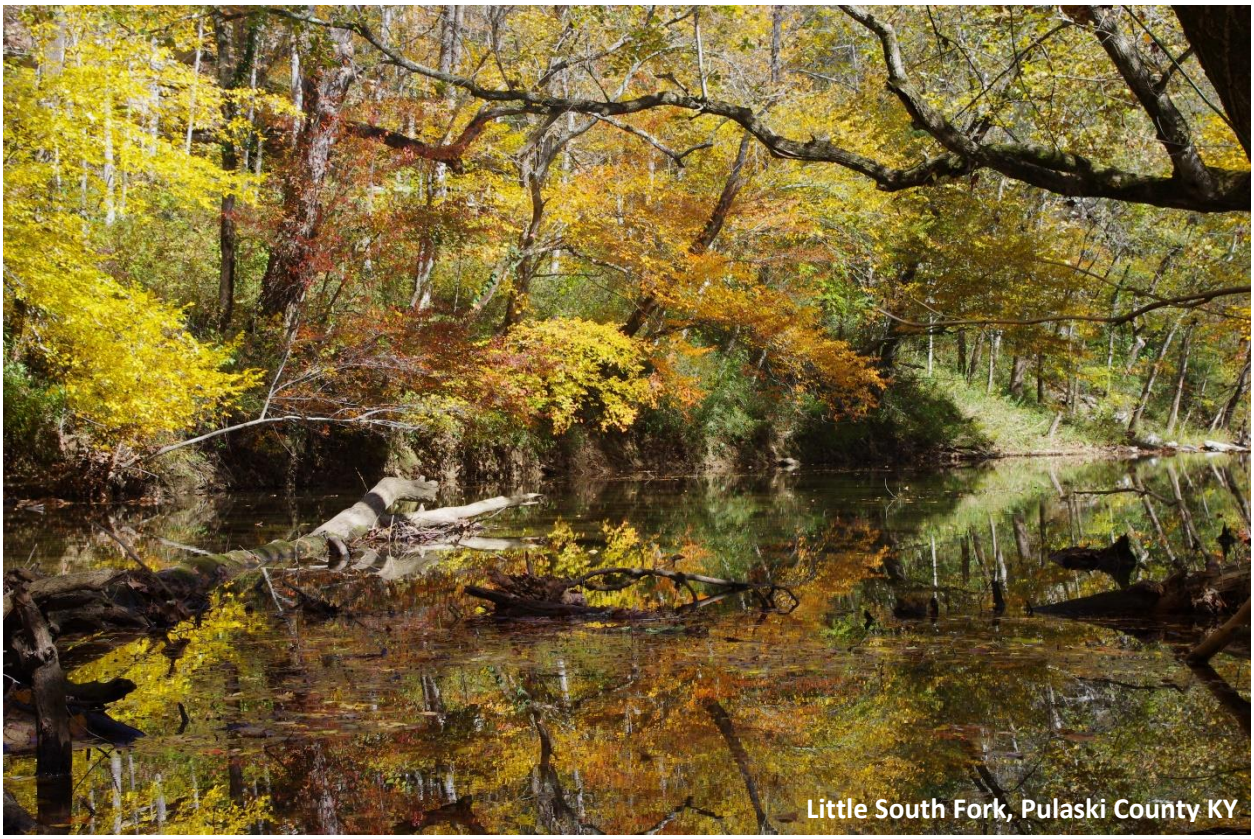
Integrated Report to Congress on the Condition of Water Resources in Kentucky, 2018 & 2020 Combined Cycle

Assessment Results with an Emphasis on the 1) Salt and Licking Rivers, 2) Upper Cumberland and Four Rivers (Lower Cumberland, Ohio River, Mississippi River and Tennessee River), and 3) Green and Tradewater Rivers, along with a Statewide Update


Little South Fork, Pulaski County KY

Kentucky Energy and Environment Cabinet
Department for Environmental Protection
Division of Water
Water Quality Branch
December 22, 2021

KENTUCKY ENERGY & ENVIRONMENT CABINET

The Energy and Environment Cabinet does not discriminate on the basis of race, color, national origin, sex, age, religion, or disability and provides, on request, reasonable accommodations including auxiliary aids and services necessary to afford an individual with a disability an equal opportunity to participate in all services, programs and activities.

Integrated Report to Congress on the Condition of Water Resources in Kentucky, 2018 & 2020 Combined Cycle

Assessment Results with an Emphasis on the 1) Salt and Licking Rivers, 2) Upper Cumberland and Four Rivers (Lower Cumberland, Ohio River, Mississippi River and Tennessee River), and 3) Green and Tradewater Rivers, along with a Statewide Update

This report has been approved for release:

Carey Johnson, Director

Kentucky Division of Water

December 22, 2021

Table of Contents

List of Tables

List of Figures

List of Acronyms

- ADB – Assessment Database
- ATTAINS – Assessment, TMDL Tracking, and Implementation System
- AU – Assessment Unit
- BMP – Best Management Practice
- BMU – Basin Management Unit
- CAH – Cold Water Aquatic Habitat
- CSO – Combined Sewer Overflow
- CWA – Clean Water Act
- CWSRF – Clean Water State Revolving Fund
- DOC – Division of Conservation
- DOW – Division of Water
- DQO – Data Quality Objective
- DWS – Domestic Water Supply
- DWSRF – Drinking Water State Revolving Fund
- EPA – Environmental Protection Agency
- ESRI – Environmental Systems Research Institute
- GIS – Geographic Information Systems
- HAB – Harmful Algal Bloom
- IR – Integrated Report
- KATTS – Kentucky's Assessment and TMDL Tracking System
- KPDES – Kentucky Pollutant Discharge Elimination System
- MRBI – Mississippi River Basin Initiative
- NPS – Nonpoint Source
- NRCS – Natural Resources Conservation Service
- NWQI – National Water Quality Initiative
- OE – Organic Enrichment
- ORSANCO – Ohio River Valley Water Sanitation Commission
- OSRW – Outstanding State Resource Water
- PCB – Polychlorinated Biphenyl
- PCR – Primary Contact Recreation
- PMP – Program Management Plan
- PSP – Project Study Plan
- REST – Representational State Transfer
- SCR – Secondary Contact Recreation
- SOP – Standard Operating Procedure
- SSO – Sanitary Sewer Overflow
- TDS – Total Dissolved Solid
- TMDL – Total Maximum Daily Load
- USACE – United States Army Corps of Engineers
- USGS – United States Geological Survey
- WAH – Warm Water Aquatic Habitat
- WQB – Water Quality Branch
- WQS – Water Quality Standards
- QA – Quality Assurance
- QAPP – Quality Assurance Project Plan

Notes for the Reader

If you are reading this, thank you for taking an interest in Kentucky's water resources.

A few important changes that occurred during this cycle are worth highlighting:

1. For the 2016 and previous Integrated Reports (IR), the Kentucky Division of Water (DOW) utilized the Assessment Database (ADB), a Microsoft Access database, to store designated use assessments and produce tables for the IR. In 2014, The U.S. Environmental Protection Agency (EPA) began redesigning the Assessment, TMDL Tracking, and Implementation System (ATTAINS). As of the 2018 cycle, EPA no longer supported ADB for IR submittal. As a result, Kentucky DOW developed its own state-specific assessment application, called the Kentucky's Assessment and TMDL Tracking System (KATTS), using money received from an Exchange Network grant. The KATTS application provides state specific needs for the assessment and Total Maximum Daily Load (TMDL) programs, and was used to submit 305(b) data and supporting documentation directly to ATTAINS for this 2018/2020 IR cycle.
    a. Because of this shift in applications, every assessment unit on Kentucky's 2018/2020 305(b) list was given a new assessment unit ID.
        i. The assessment unit modification spreadsheet defines the rename of the old assessment unit IDs and the new assessment unit IDs. This same spreadsheet can be used when reviewing assessment units that were split from their extent on the 2016 305(b) list.
2. During this 2018/2020 IR, spring assessment units were changed from points to polygons. The assessment unit is now represented by a springshed, or spring basin, with its units being in acres.
3. Fecal coliform criteria for primary contact recreation (PCR) were retired in 2019. Therefore, fecal coliform listings for the PCR designated use were replaced with pathogens or *E. coli*.
4. In previous cycles, Kentucky had a state-specific category of 5b, which was defined as 'segment does not support designated uses based on evaluated data, but based on Kentucky listing methodology, insufficient data are available to make a listing determination. No TMDL needed.' These waters had no instream data to confirm the attainment, but were suspected as impaired based on discharge monitoring report data. With the development KATTS, we now flag these waters as category 3 with a facility parameter status, where they are tracked and prioritized for instream monitoring to confirm the suspected impairment.

If you have any questions about this report, the 305(b) list, the 303(d) list, the assessment program, or the TMDL program in Kentucky, please email TMDL@ky.gov.

Acknowledgements

Many individuals and organizations contribute to the assessment process, and it is by no means a solo endeavor. Thank you to all those that contributed data, information, and assessment recommendations. Specifically, I would like to thank all the staff in the Water Quality Branch for embracing a new system and so eagerly providing valuable expertise through the scorecard process. Your dedication to the efforts of monitoring and assessing the waters of the Commonwealth is greatly appreciated. I would also like to thank all the staff in the Watershed Management Branch for their dedication to accurate geospatial data and their contributions to QAQC and public communication.

Executive Summary

The 2018/2020 Combined Cycle Integrated Report (IR) was prepared by the Kentucky Division of Water (DOW), Department for Environmental Protection (DEP), for submittal to the U.S. Environmental Protection Agency (EPA) to fulfill requirements of sections 303(d), 305(b), and 314 of the Federal Water Pollution Control Act (or Clean Water Act (CWA)) of 1972, as subsequently amended. Section 305(b) of the Act requires states to assess and report current water quality conditions to EPA every two years.

In conjunction with this IR document, an Integrated Report site has been developed to promote public engagement. To create the IR site, an Environmental Systems Research Institute (ESRI) ArcGIS (Geographic Information System) Hub was used to communicate assessments results from the 2018/2020 305(b) using representational state transfer (REST) services, online maps, ArcGIS dashboards, and story maps. The IR site also has information on topics ranging from designated uses (e.g., swimming and fish consumption), assessment categories, monitoring programs, and methodologies used for determining designated use attainment.

Designated Uses

All waterbodies in Kentucky have uses for the management and goal of attaining a minimum level of water quality. Designated uses are promulgated in 401 KAR 10:026 and the implementing (enabling) criteria are in 401 KAR 10:031. The following are applicable designated uses:

- Cold water aquatic habitat (CAH)
- Warm water aquatic habitat (WAH)
    - CAH and WAH are commonly referred to as the aquatic life designated use, and are referenced as such throughout this IR
    - Rivers and streams are either WAH or CAH
    - Lakes and reservoirs designated as CAH are both CAH and WAH
- Primary contact recreation (PCR)
- Secondary contact recreation (SCR)
- Domestic water supply (DWS)
- Outstanding state resource water (OSRW)
- Fish consumption[1]

With the exception of CAH and OSRW, the remaining designated uses apply by default to all waterbodies.

Monitoring

The Kentucky DOW uses information collected by biologists and scientists to perform assessments on waterbodies to determine if that waterbody is meeting water quality standards and therefore supporting its designated use(s). The DOW operates its primary monitoring programs with a Watershed Management Framework Initiative implemented in 1998, where Basin Management Units (BMU) are sampled on a five-year rotation. Beginning in 1998, waterbodies have been sampled in the following order: 1) Kentucky River, 2) Salt and Licking Rivers, 3) Upper Cumberland and Four Rivers (Lower

[1] Fish consumption is not a designated use, but is assessed as such and therefore included in this list.

Cumberland, Ohio River, Mississippi River and Tennessee River), 4) Green River and Tradewater River, and 5) Big Sandy River, Little Sandy River and Tygart's Creek. Ohio River minor tributary basins are assigned to the BMU of adjacent major river basins and are sampled in the same year as the rest of the BMU.

This IR represents monitoring efforts from the Salt and Licking Rivers BMU, sampled in 2014, Upper Cumberland and Four Rivers BMU, sampled in 2015, and Green and Tradewater Rivers BMU, sampled in 2016. This report also incorporates assessment data and results from monitoring that occurred during this reporting cycle (2014 – 2016) outside of the BMUs of focus by programs such as total maximum daily load (TMDL), nonpoint source (NPS), and fish tissue. For some programs, if more recent data were available, they were used in addition to the reporting cycle monitoring years.

Assessment

Before data are used in the assessment process, they are reviewed to ensure data are of sufficient quantity and quality to make designated use attainment decisions. Of the nearly 1,500 stations that were reviewed for assessment purposes, 1,106 stations had data of sufficient quantity and quality and were used to complete 915 assessments (Table 1).

Table 1. Number of samples collected and analyzed per data type where the data were used for assessment during this 2018/2020 Integrated Reporting cycle.

Water Chemistry Samples	Bacteria Samples	Chlorophyll-a Samples	Macroinvertebrate Samples	Tissue Samples	Fish Samples
4,233	1,713	401	352	153	133

To complete assessments, available data are summarized and analyzed to make final attainment decisions, which are reported in the 305(b), the 303(d), and discussed within this IR. When sampling occurs, specific information is gathered for each designated use.

- To assess PCR - bacteria levels are examined during the recreation season (May – October)
- To assess aquatic life for streams - water chemistry, habitat, and biological communities are examined
- To assess aquatic life for lakes - profile data, chlorophyll-a, and water chemistry data are examined
- To assess fish consumption – fish are collected where their tissue (usually filet) is examined for pollutants of concern, such as mercury and polychlorinated biphenyl (PCB)

For more detailed information about Kentucky's assessment and listing methodology, refer to the Consolidated Assessment and Listing Methodology (CALM): Surface Water Quality Assessment in Kentucky, the Integrated Report (KDOW 2015). In addition to this document, an update to Kentucky's Assessment Methodology for Fish Consumption (KDOW 2020) is considered an addendum to the CALM, and should be used in place of the fish consumption method outlined in section 3.6 on page 55 of the 2015 CALM document.

Categories and Attainment

The 305(b) list is a list of all waterbodies that have been assessed for one or more designated uses. Waterbodies on the 305(b) list are put into different categories depending upon the assessment

decision made for that waterbody. Categories are assigned at the parameter level, which is the level that data are collected and analyzed, the designated use level, which is the level that the water quality standards for a particular parameter apply, and the assessment unit level, which is determined from the assessed designated uses and their categories (Figure 1).

Impaired waters are those waters found to partially support or not support one or more of its designated uses due to either a pollution or a pollutant. The 303(d) list, which is a subset of the 305(b) list, is only those waters in category 5, where the cause of impairment is identified as a pollutant and a TMDL is required (Figure 1).

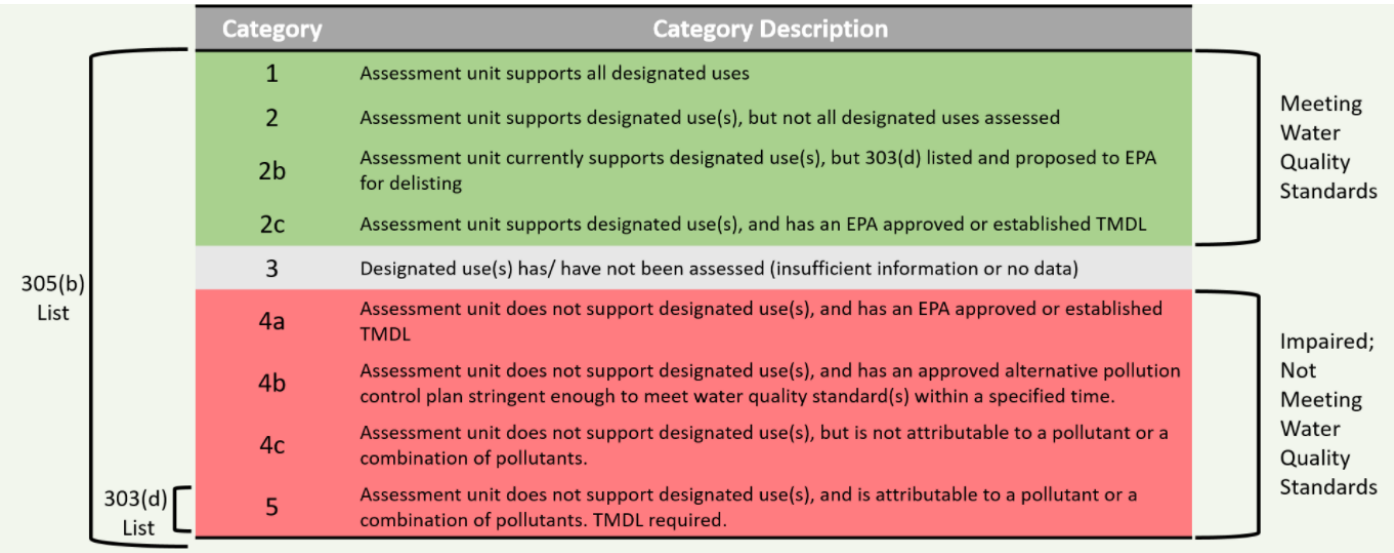


Figure 1. Category definition at the assessment unit level.

Results

305(b) Results

The 305(b) list is an inventory of all waterbodies that have been assessed for at least one designated use from this cycle and all prior cycles. The spatial extent of each assessment unit is identified within the list. Kentucky's 2018/2020 305(b) list has 2,879 assessment units, representing 13,061.6 river miles, 203,310 lake/reservoir acres, and 168,055 springshed acres. The 305(b) workbook has a tab for the 305(b) list, the 303(d) list, new listings (cycle first listed 2020), pollutants proposed to EPA for delisting, waters with a TMDL, and impaired waters.

Designated Use Level (all waterbody types)

For all 2,879 assessment units on the 2018/2020 305(b) list, regardless of waterbody type, attainment per designated use is displayed in Figure 2.

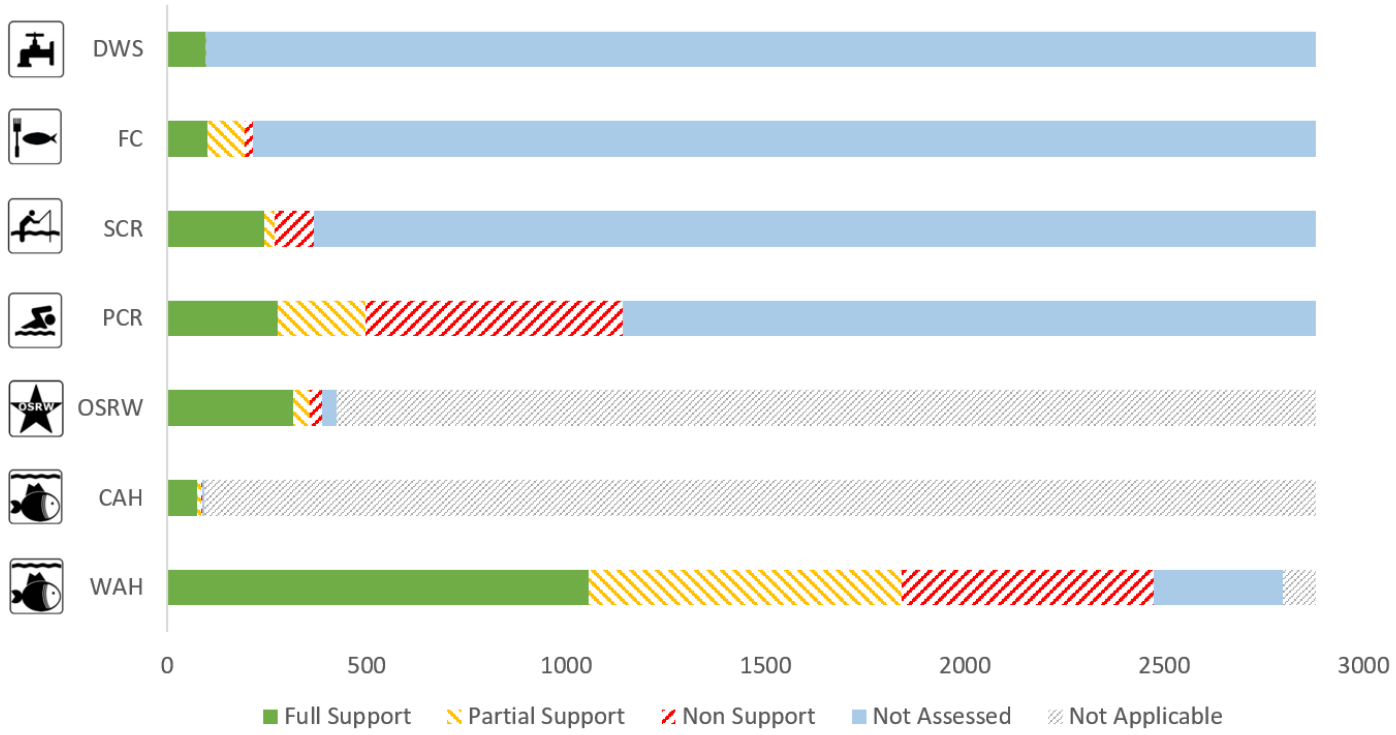


Figure 2. Assessment status and attainment for all 2,879 assessment units on the 2018/2020 305(b) per designated use.

Warm Water Aquatic Habitat

On the 2018/2020 305(b) list, 2,472 assessment units have been assessed for the WAH designated use, making it the most commonly assessed designated use on the 305(b) list. Of those assessed, 1,057 fully support the WAH designated use, while 1,415 are impaired. River and stream assessment units represent 2,374 of the assessment units, of which 998 are meeting and 1,376 are impaired. Lake and reservoir assessment units represent 97 of the assessment units, of which 58 are meeting and 39 are impaired (Figure 3).

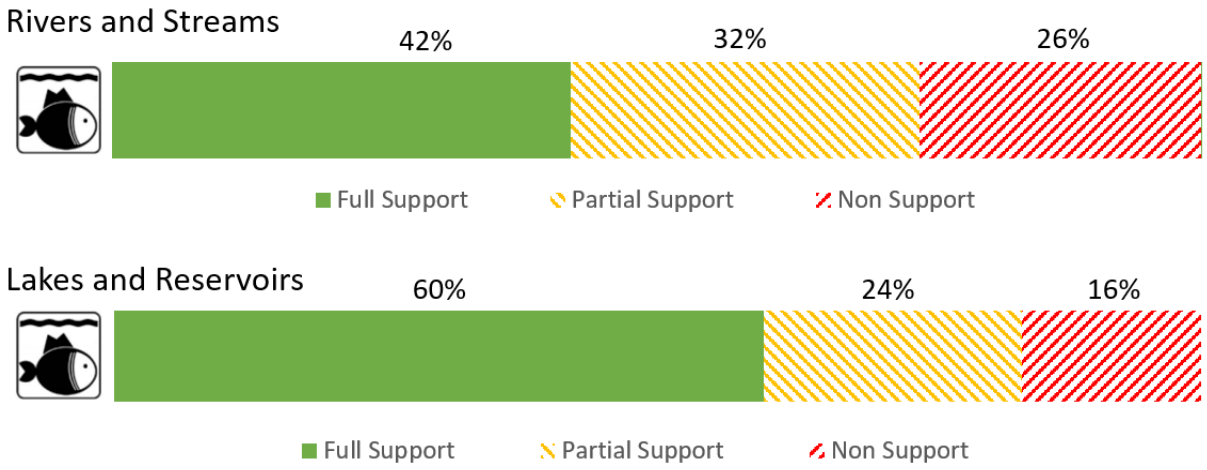


Figure 3. Proportion of rivers/streams and lakes/reservoirs assessed as full support, partial support, or nonsupport of those waterbodies assessed for the WAH designated use.

Cold Water Aquatic Habitat

On the 2018/2020 305(b) list, 92 assessment units have the CAH designated use, 88 of which have been assessed. River and stream assessment units represent 78 of the assessed assessment units, of which 65 are meeting and 13 are impaired (Figure 4). Lake and reservoir assessment units represent 10 of the assessed assessment units, all of which are meeting (100%).

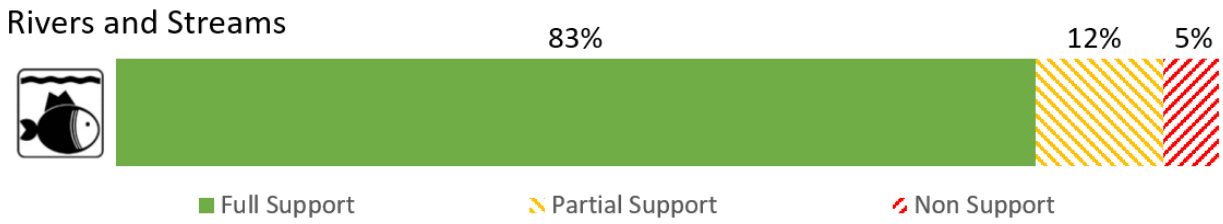


Figure 4. Proportion of rivers/streams assessed as full support, partial support, or nonsupport of those waterbodies assessed for the CAH designated use.

Outstanding State Resource Water

On the 2018/2020 305(b) list, 425 assessment units have the OSRW designated use, of which 389 have been assessed. Most of the waterbodies assessed for this use are rivers and streams (386 of the 389), with 315 assessment units found to fully support the OSRW use and 74 assessment units found to be impaired (Figure 5).

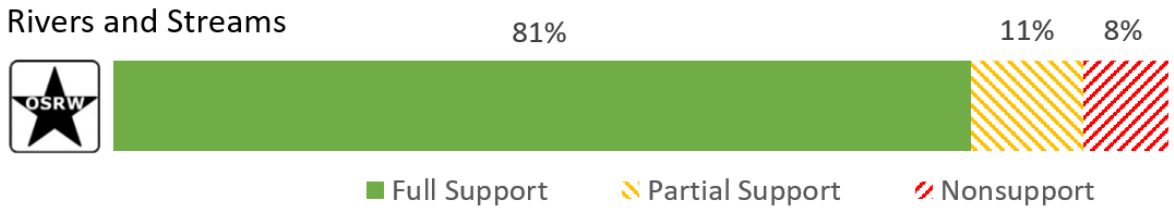


Figure 5. Proportion of rivers/streams assessed as full support, partial support, or nonsupport of those waterbodies assessed for the **outstanding state resource water (OSRW)** designated use.

Primary Contact Recreation

On the 2018/2020 305(b) list, 1,142 assessment units have been assessed for the PCR designated use. Of those assessed, 276 were found to fully support the designated use, while 866 were found to be impaired. River and stream assessment units represent 1,126 of the assessment units, of which 270 are meeting and 856 are impaired for the PCR use (Figure 6). Spring assessment units represent 11 of the assessment units, of which one is meeting and 10 are impaired for the PCR use. Lake and reservoir assessment units represent five of the assessment units, all of which are meeting the PCR use.

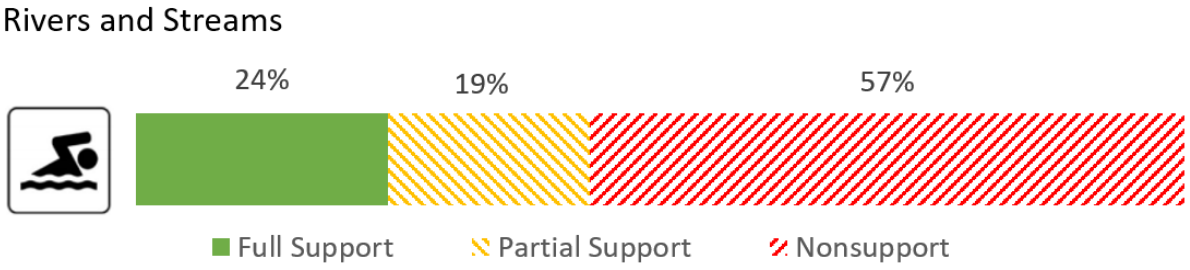


Figure 6. Proportion of rivers/streams assessed as full support, partial support, or nonsupport of those waterbodies assessed for the **PCR** designated use.

Secondary Contact Recreation

On the 2018/2020 305(b) list, 368 assessment units have been assessed for the SCR designated use. Of those assessed, 242 were found to fully support the designated use, while 126 were found to be impaired. River and stream assessment units represent 294 of the assessment units, of which 172 are meeting and 122 are impaired for the SCR use. Lake and reservoir assessment units represent 73 of the assessment units, of which 69 are meeting and four are impaired for the SCR use (Figure 7).

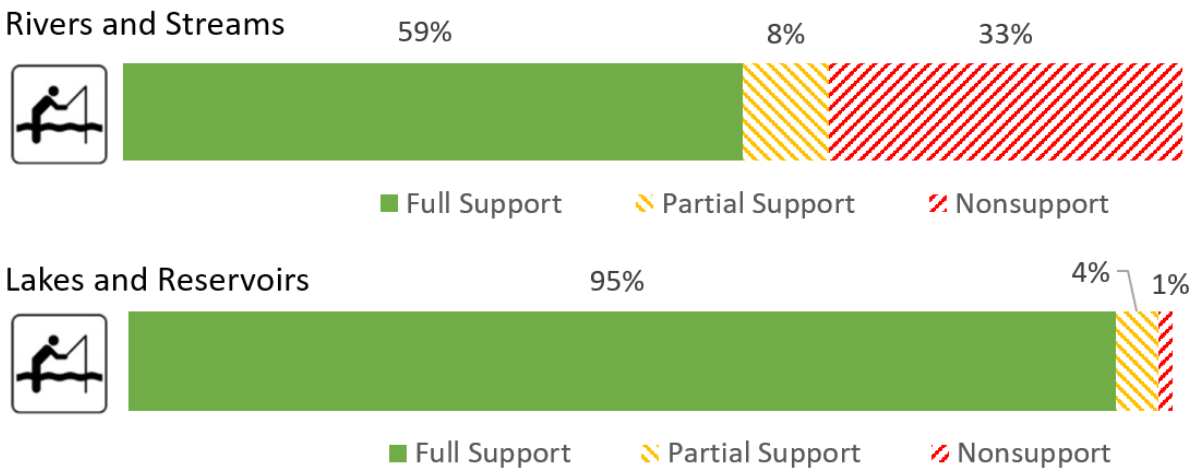


Figure 7. Proportion of rivers/streams and lakes/reservoirs assessed as full support, partial support, or nonsupport of those waterbodies assessed for the SCR designated use.

Fish Consumption

On the 2018/2020 305(b) list, 215 assessment units have been assessed for fish consumption. Of those assessed, 100 were found to fully support the designated use, while 115 were found to be impaired. River and stream assessment units represent 173 of the assessment units, of which 78 are meeting and 95 are impaired for fish consumption. Lake and reservoir assessment units represent 42 of the assessment units, of which 22 are meeting and 20 are impaired for fish consumption (Figure 8).

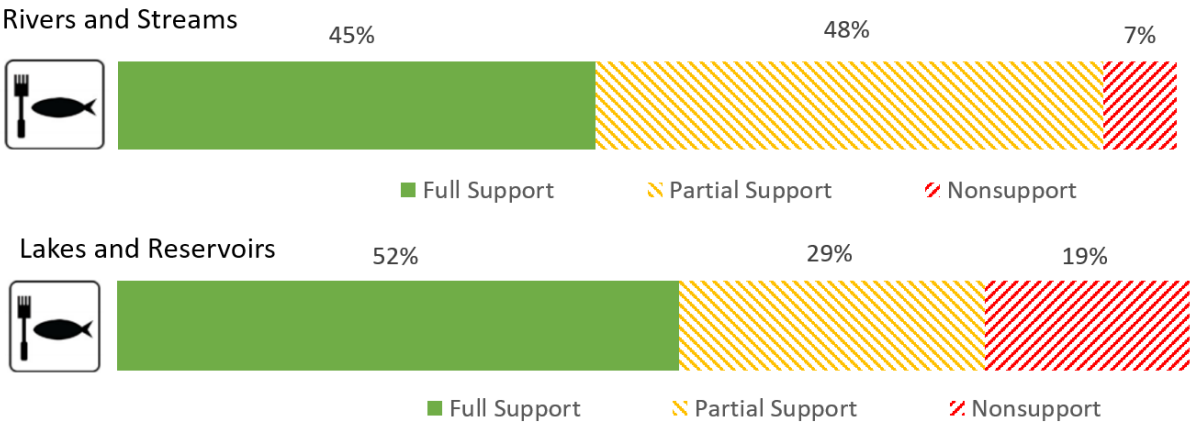


Figure 8. Proportion of rivers/streams and lakes/reservoirs assessed as full support, partial support, or nonsupport of those waterbodies assessed for fish consumption.

Impaired Waters

Impaired waters are a subset of the 305(b) list and are those waterbodies where at least one designated use is not being supported, and the cause of impairment is either a pollution (category 4c), a pollutant but a TMDL has not been developed (category 5), or a pollutant and a TMDL has been developed (category 4a).

Of the 2,879 assessment units on the 305(b) list, 1,902 assessment units are impaired for at least one designated use. Broken down by waterbody type, 1,836 rivers/streams are impaired totaling 8,945.2 river miles, 56 lakes/reservoirs are impaired totaling 89,449 acres, and 10 springs are impaired totaling 83,698 springshed acres.

The impaired waters tab of the 305(b) workbook has specific information about all assessment units identified as impaired for one or more designated uses. Parameter level information for those identified as a cause of impairment is available per assessment unit, including if that parameter has a TMDL, the parameter's category, TMDL priority rank (if applicable), cycle first listed (if applicable), and suspected sources.

Causes of Impairment

There are 4,128 parameter-waterbody combinations on the impaired waters list. Those parameters fall into three reporting categories:

1. 2,809 are in category 5, meaning the parameter is a pollutant, identified as a cause of impairment, and requires a TMDL
    a. This is the 303(d) list
2. 710 are in category 4a, meaning the parameter is a pollutant, identified as a cause of impairment, and has an EPA-approved TMDL
3. 609 are in category 4c, meaning the parameter is a pollution, identified as a cause of impairment, but does not require a TMDL

Parameters can be grouped to explore types of impairments throughout the Commonwealth. Figure 9 shows the parameters identified as a cause of impairment on the 2018/2020 305(b) list grouped into the following themes:

1. Pathogens
2. Sedimentation/Turbidity
3. Nutrients/Organic Enrichment (OE)/Dissolved Oxygen
4. Biological Integrity/Habitat/Flow
    a. All parameters in this group are pollutions
5. Salinity/Total Dissolved Solids (TDS)/Chlorides/Sulfates
6. Metals and Mercury
7. Other (including Cause Unknown)
8. Dioxins/PCBs
9. pH/Acidity

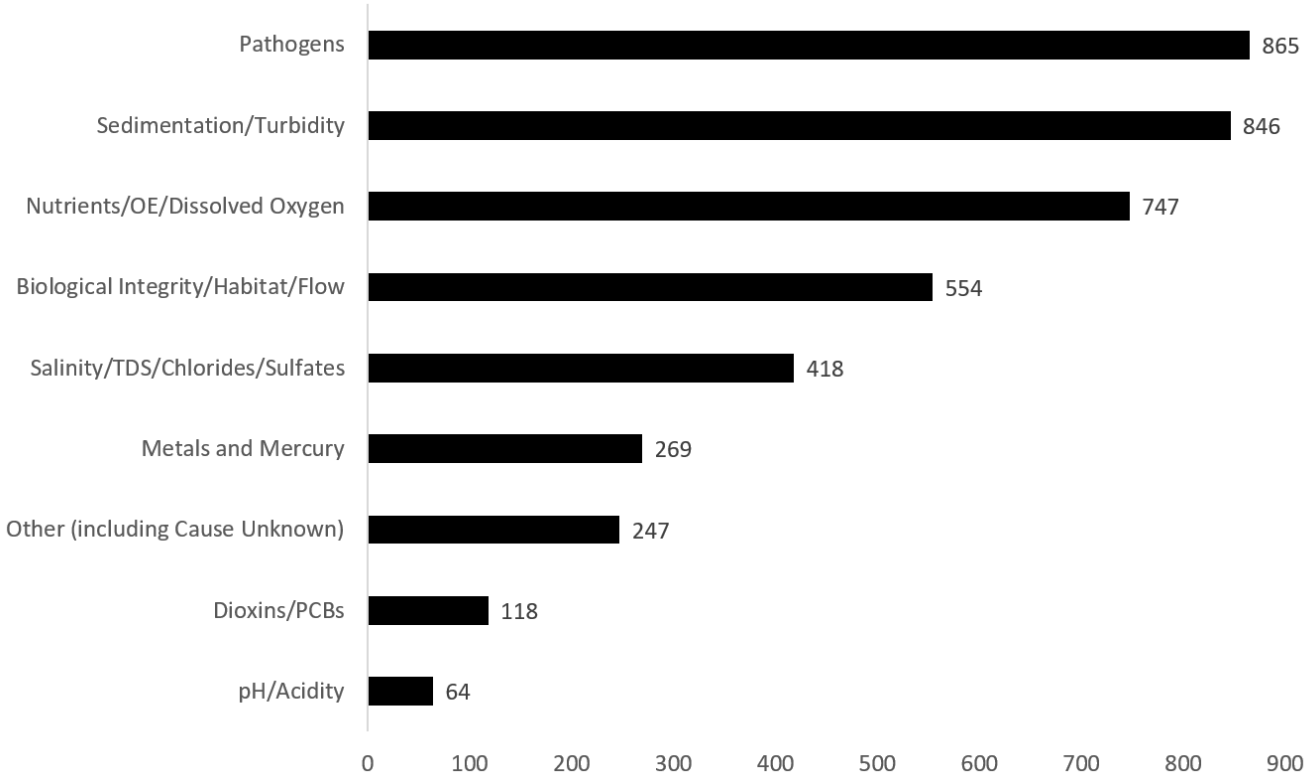


Figure 9. Types of impairments on the 2018/2020 305(b) list where parameters have been grouped into nine (9) themes to better understand the number and types of impairments throughout the Commonwealth.

The 303(d) List

The 303(d) list includes all waterbodies identified as being impaired (not meeting water quality standards) by one or more pollutants where a TMDL has not yet been developed but is required. The 2018/2020 303(d) has 2,809 pollutant-waterbody combinations in need of a TMDL. Each pollutant-waterbody combination is in category 5, has a cycle first listed, suspected sources, and a TMDL priority rank (high, medium, or low) (Table 2).

Broken down by waterbody type, 1,447 rivers/streams are on the 303(d) list totaling 7,166.1 river miles, 55 lakes/reservoirs are on the 303(d) list totaling 89,243 acres, and eight springs are on the 303(d) list totaling 80,490 springshed acres.

Although the 303(d) list is sometimes referred to as the "impaired waters list," it is specifically a subset of the impaired waters where the parameter identified as a cause of impairment is a pollutant and a TMDL has not yet been developed. Figure 10 shows the number of impairments per parameter that are in need of a TMDL, with the priority per parameter distinguished by low (light gray), medium (dark gray), and high (black).

The 303(d) tab of the 305(b) workbook has the official information about all pollutant-waterbody combinations that are on the 303(d) list.

Table 2. Definitions of TMDL priority ranks.

High	A TMDL is in development or will be in development within the next two years, and is expected to be completed during the next one to two reporting cycles (within 1-4 years). Waters ranked as "High" priority focus in part on those identified in the Division's 303(d) Long Term Vision Priorities, which established a plan for developing TMDLs and alternative restoration plans for specific waters and pollutants by 2022. Click here For more information on the 303(d) Long Term Vision Priorities.
Medium	TMDL strategies are in the planning stage for the waterbody and/or pollutant. Methodologies may be under development or data collection may be planned or ongoing. Opportunities for alternative restoration plans may be under review.
Low	A TMDL is not currently in development. This rank include TMDLs for which methodologies may be in development for the pollutant or waterbody type. Some waters ranked as "Low" priority for TMDL development have an EPA-accepted alternative restoration plan that is being implemented, or have an alternative restoration plan in development that is expected to be EPA-accepted within the next two reporting cycles. The progress of each alternative restoration plan is reviewed each cycle to ensure the plan is on track to restoring water quality. The TMDL development priority rank may be updated based on this review. See table columns in the 303(d) list related to "Restoration Plans" for information on these alternative restoration plans.

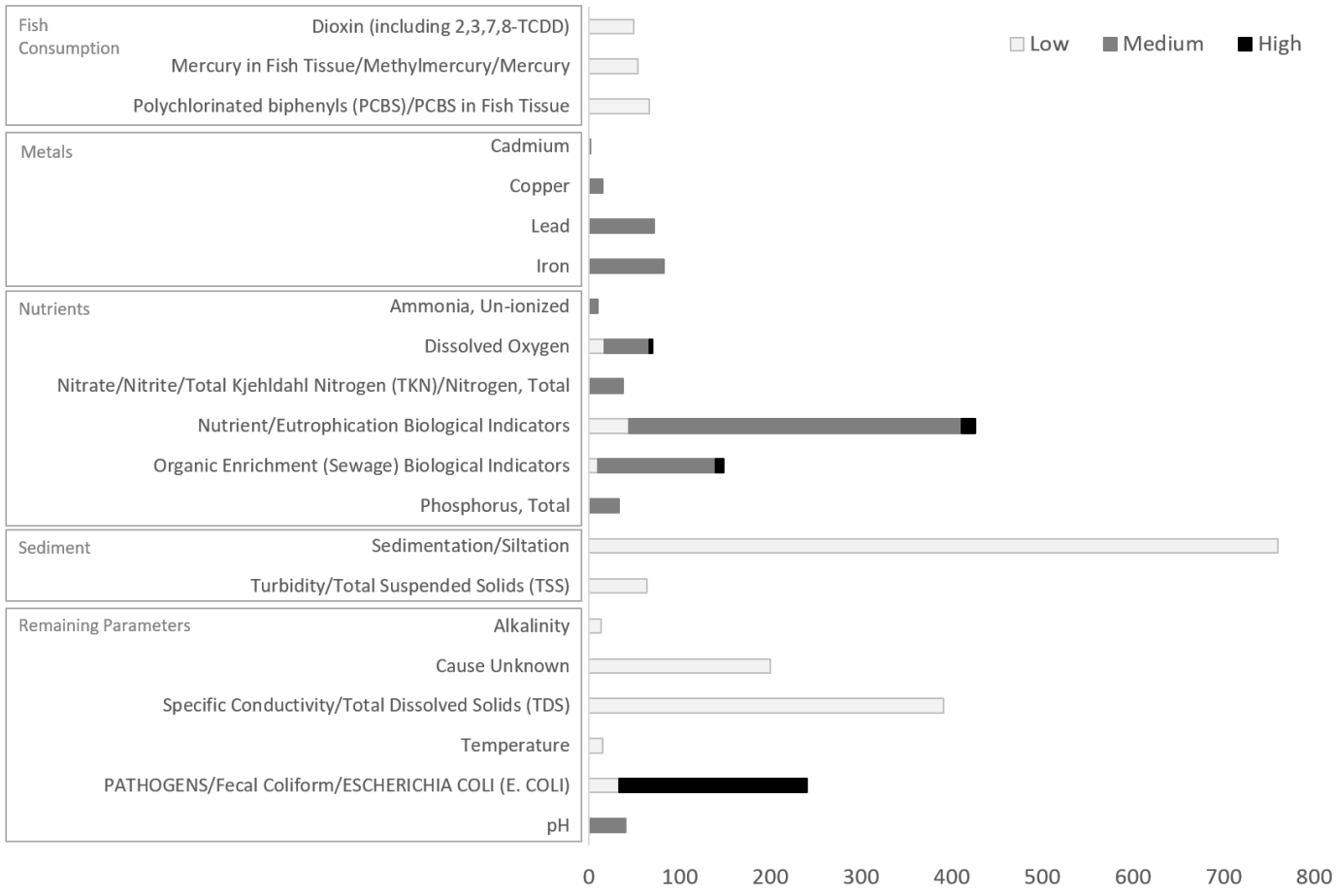


Figure 10. Number of impairments per parameter where the parameter is on the 303(d) list because a TMDL is required but has not yet been developed. TMDL priority rank distinguished by low (light gray), medium (dark gray), and high (black).

Waters with TMDLs

On the 2018/2020 305(b) list there are 742 pollutant-waterbody combinations with an EPA-approved TMDL. The 'waters with a TMDL' tab of the 305(b) workbook has the official information about all pollutant-waterbody combinations with an EPA-approved TMDL.

Since EPA approved the 2016 303(d) list on June 19, 2018, EPA has approved the following TMDLs, representing 263 pollutant-waterbody combinations:

1. Statewide TMDL for Bacteria Impaired Waters, Core Document and Green River and Tradewater River Basins (Action ID KYACT_1), approved by EPA on 2/22/2019
2. Statewide TMDL for Bacteria Impaired Waters, Big Sandy, Little Sandy, and Tygarts (Action ID KYACT_4), approved by EPA on 8/31/2021
3. Statewide TMDL for Bacteria, Kentucky River Basin (Action ID KYACT_5), approved by EPA on 8/31/21
4. Statewide TMDL for Bacteria, Salt and Licking River Basins (Action ID KYACT_6), approved by EPA on 9/23/21

The Approved TMDL Reports webpage has all EPA-approved TMDLs, with a link to each report.

Total Maximum Daily Load Program

Kentucky DOW is implementing the national CWA 303(d) Program Vision, which calls for states to prioritize impaired waters for TMDL development and to develop alternative restoration approaches where appropriate over a six-year period (2016-2022).

In 2011, the CWA 303(d) Program Vision was developed by the EPA and state TMDL program managers as means to improve the effectiveness of the TMDL program. The framework outlined in this program "vision" allows Kentucky to develop state specific priorities, encourages stakeholder engagement, and allows the TMDL section to integrate our work with other CWA program priorities. The vision fosters flexible watershed management but requires the support of many stakeholders – including public, federal, and state agencies – to attain this common goal.

In 2016, Kentucky DOW submitted its first draft of vision priorities to the EPA. The vision priorities list was updated in 2018 using the 2016 303(d) list. This vision priorities list consists of pollutant-waterbody combinations that are prioritized to have a TMDL or alternative restoration plan completed by 2022.

Kentucky DOW's top vision priority for TMDL development is to address all remaining bacteria impairments in the Commonwealth. Another vision priority includes working with stakeholders to develop alternative restoration approaches in communities with the on-the-ground resources to address water quality impairments more quickly than a TMDL approach. Kentucky's first EPA-accepted alternative restoration plan was possible with the cooperation of various stakeholders in the Gunpowder Creek Watershed.

As of this 2018/2020 Integrated Report, Kentucky has completed plans addressing 308 pollutant-waterbody combinations that are part of the vision priorities covering a watershed area of 1,333 square miles. This represents progress towards completion of 72% by pollutant-waterbody combinations

(Figure 11) and 61% by watershed area for completing DOW's commitments for plans in place by the end of 2022. Remaining plans are in development and currently on track for completion before the 2022 Integrated Report. Note that a small percentage of plans (2% of the total pollutant-waterbody combinations that were identified as priorities) will not receive a plan in this effort for a variety of reasons, including some where new data showed that water quality is now meeting standards and the waterbody is slated for delisting.

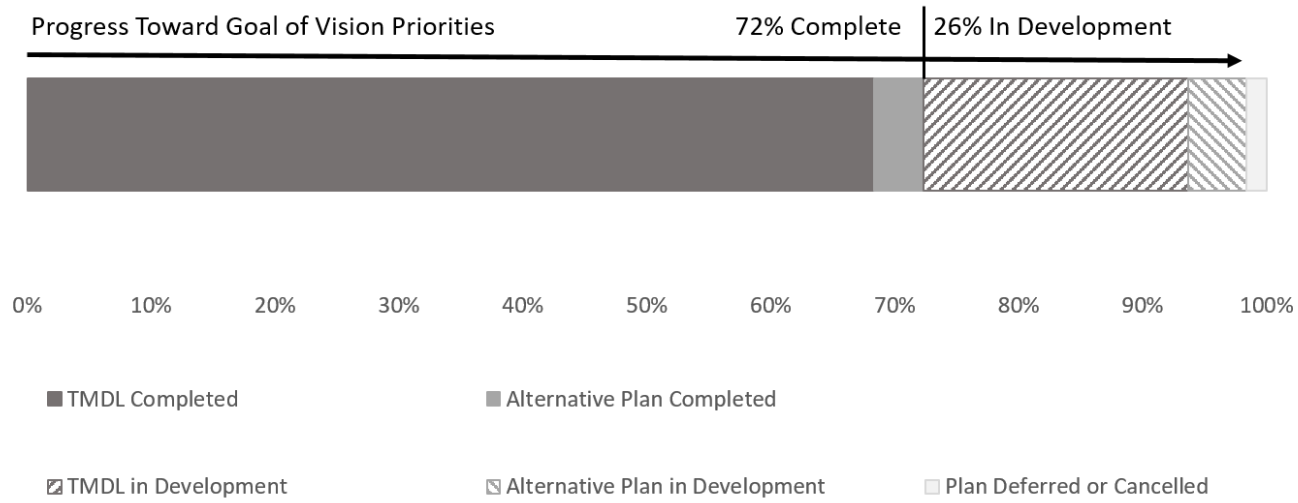


Figure 11. Progress toward completing vision priorities as of this 2018/2020 reporting cycle; the goal is to have all plans in development completed by the end of 2022, fulfilling DOW's vision priority commitments.

If you have questions about the TMDL program, the vision, or alternative restoration approaches, email TMDL@ky.gov.

Introduction

The 2018/2020 Combined Cycle Integrated Report (IR) was prepared by the Kentucky Division of Water (DOW), Department for Environmental Protection (DEP), for submittal to the U.S. Environmental Protection Agency (EPA) to fulfill requirements of sections 303(d), 305(b), and 314 of the Federal Water Pollution Control Act (or Clean Water Act (CWA)) of 1972, as subsequently amended. Section 305(b) of the Act requires states to assess and report current water quality conditions to EPA every two years.

In conjunction with this IR document, an Integrated Report site has been developed to promote public engagement. To create the IR site, an ESRI ArcGIS Hub was used to communicate assessments results from the 2018/2020 305(b) using REST services, online maps, ArcGIS dashboards, and story maps. The IR site also has information on topics ranging from designated uses (e.g., swimming and fish consumption), assessment categories, monitoring programs, and methodologies used for determining designated use attainment.

Designated Uses

All waterbodies in Kentucky have uses for the management and goal of attaining a minimum level of water quality. Designated uses are promulgated in 401 KAR 10:026 and the implementing (enabling) criteria are in 401 KAR 10:031. The following are applicable designated uses:

- Cold water aquatic habitat (CAH)
- Warm water aquatic habitat (WAH)
    - CAH and WAH are commonly referred to as the aquatic life designated use, and are referenced as such throughout this IR
    - Rivers and streams are either WAH or CAH
    - Lakes and reservoirs designated as CAH are both CAH and WAH
- Primary contact recreation (PCR)
- Secondary contact recreation (SCR)
- Domestic water supply (DWS)
- Outstanding state resource water (OSRW)
- Fish consumption[2]

With the exception of CAH and OSRW, the remaining designated uses apply by default to all waterbodies. View the designated use story map or read below for a description of each designated use.

Cold Water Aquatic Habitat (CAH)

As defined in 401 KAR 10:001, CAH means surface waters and associated substrate that are able to support indigenous aquatic life or self-sustaining or reproducing trout populations on a year-round basis. All waterbodies designated as CAH are listed in 401 KAR 10:026, Table C entitled 'Waters

[2] Fish consumption is not a designated use, but is assessed as such and therefore included in this list.

with Added Designated Uses.' There are implementing criteria specific to CAHs; however, where there are no specific criteria to CAH, those criteria promulgated for WAH apply.

Warm Water Aquatic Habitat (WAH)

WAH applies to the majority of waterbodies in the Commonwealth, and are those not designated as CAH (with the exception of lakes or reservoirs that are designated as both CAH and WAH). As defined in 401 KAR 10:001, WAH means a surface water and associated substrate capable of supporting indigenous warm water aquatic life.

Outstanding State Resource Water (OSRW)

This designated use provides additional measures for maintenance of habitat quality, including water quality, for the protection of federally threatened or endangered species that inhabit the OSRW. Additionally, select waterbodies that have water quality and habitat that support a diverse fish or macroinvertebrate community and rate excellent on either the fish (Compton et al. 2003) or macroinvertebrate (Pond et al. 2003) biological community multimetric index may be proposed for designation as an OSRW. Other attributes that qualify a waterbody for OSRW designation can be found in 401 KAR 10:031, Surface Water Standards, Section 8.

All waterbodies designated as OSRW are listed in 401 KAR 10:026, Table C entitled 'Waters with Added Designated Uses.' There are implementing criteria specific to OSRWs; however, where there are no specific criteria to OSRW, those criteria promulgated for WAH apply. Both designated and candidate OSRW are published on the DOW's special waters webpage, so this is often the most up-to-date source of OSRW listings that include candidate waterbodies or segments.

Primary Contact Recreation (PCR) – "Swimming"

PCR is the designated use for waterbodies in the Commonwealth with the implementing criteria to manage water quality for the protection of human health against pathogenic-induced gastrointestinal illnesses during the recreation season of May 1 through October 31. The bacterium *Escherichia coli* (*E. coli*) is a commonly used indicator organism to monitor water quality for safe swimming conditions, where full-body immersion is likely. *E. coli* are bacteria found in the guts of warm-blooded organisms, including humans. The presence of *E. coli* indicate there is likely waste from warm-blooded organisms present in the waterbody and with it the expectation of various pathogenic viruses, parasites and pathogenic strains of bacteria, including *E. coli*. A criterion for pH applies to this designated use during the recreation season. This criterion provides protection to the bather from extremes of both acidic and basic conditions.

Secondary Contact Recreation (SCR) – "Boating and Wading"

SCR is the designated use for waterbodies in the Commonwealth with the implementing criteria to manage water quality for the protection of human health against pathogenic gastrointestinal illnesses and maintain a safe range for pH. These criteria apply to this designated use year-round. Fecal coliforms are bacteria found in the guts of warm-blooded organisms and are the indicator used to monitor the water quality for safe boating and wading, or any form of recreation that does not include full-body immersion. The pH criterion protects against extremes of water quality with regard to acidic and basic conditions. Additional criteria exist to protect the designated use from such conditions

including nuisance algal blooms, nuisance aquatic macrophytes, or other pollutions that may deter from the aesthetic qualities of a waterbody.

Domestic Water Supply (DWS)

As defined in 401 KAR 10:001, DWS means surface waters that, with conventional domestic water supply treatment, are suitable for human consumption through a public water system as defined by 40 CFR 141.2, culinary purposes, or for use in a food or beverage processing industry; and meet state and federal regulations promulgated pursuant to the Safe Drinking Water Act, as amended, 42 U.S.C. 300f - 300j-26.

The DWS designated use applies to all waters in the Commonwealth; however, the enabling criteria that implement this designated use are only applied at the point of withdrawal by a public treatment facility. Public water systems are defined as those systems that have at least 15 service connections or regularly serve an average of 25 or more individuals (40 CFR 141.2). The human health criteria that apply are found in 401 KAR 10:031 (Section 6, Table 1, column entitled 'DWS').

Fish Consumption

Fish consumption is not a designated use per state regulation. However, there exist human health criteria in water quality standards for the protection of the population should they choose to catch local fish for consumption. Applicable criteria can be found in 401 KAR 10:031, Surface Water Standards, Sections 2 and 6. As such, the U.S. EPA agrees and requires the assessment results of fish tissue residue monitoring be reported in Section 305(b) of the CWA under the fish consumption designated use.

Monitoring

The Kentucky DOW uses information collected by biologists and scientists to perform assessments on waterbodies to determine if that waterbody is meeting water quality standards and therefore supporting its designated use(s). The DOW operates its primary monitoring programs with a Watershed Management Framework Initiative implemented in 1998, where Basin Management Units (BMU) are sampled on a five-year rotation. Beginning in 1998, waterbodies have been sampled in the following order: 1) Kentucky River, 2) Salt and Licking Rivers, 3) Upper Cumberland and Four Rivers (Lower Cumberland, Ohio River, Mississippi River and Tennessee River), 4) Green River and Tradewater River, and 5) Big Sandy River, Little Sandy River and Tygart's Creek. Ohio River minor tributary basins adjacent to the major river basins are sampled in the same year as the rest of the BMU.

This IR represents monitoring efforts from the Salt and Licking Rivers BMU, sampled in 2014, Upper Cumberland and Four Rivers BMU, sampled in 2015, and Green and Tradewater Rivers BMU, sampled in 2016. This report also incorporates assessment data and results from monitoring that occurred during this reporting cycle (2014 – 2016) outside of the BMUs of focus by programs such as total maximum daily load (TMDL), NPS, and fish tissue. For some programs, if more recent data were available, they were used in addition to the reporting cycle monitoring years.

View this monitoring program dashboard or read below for a description of each DOW monitoring program.

Ambient Streams

Following enactment of the CWA and subsequent state legislation (e.g. KRS 224.10), the Division established a network of 44 stream stations for long-term monitoring in 1979. These stations were sampled bimonthly (six visits per year), with the goals of determining and tracking water quality conditions in larger streams throughout the Commonwealth over time. In 1998, the network was expanded to 72 primary ambient water quality stations and the sampling strategy shifted to a rotating five-year Basin Management Unit (BMU) approach, where extra effort is focused on one BMU during each project year. While all primary ambient monitoring stations are sampled every year, they are sampled monthly in BMU study years and bi-monthly in non-BMU study years. These stations are located at mid- and lower watershed reaches of 8-digit HUC basins, and also occur near the inflow and outflow of major reservoirs.

In addition to the 72 stations of the primary network, the Division established a rotating watershed network in each BMU in 1998. The 104 rotating stations are situated within smaller sub-watersheds of each BMU. They are monitored for the same suite of water quality parameters as primary stations. The objectives of these stations include:

1. Obtain an overall representation of the quality of each basin's water resources
2. Determine water quality conditions associated with major land cover or land uses such as forest, urban, agriculture, and mining
3. Characterize each basin's least-impacted waters
4. Collect data to assist with establishing TMDLs as required by Section 303(d) of the CWA
5. Define water quality conditions in a watershed to answer special issues that may arise requiring long-term water quality monitoring.

Ambient Lakes

The U.S. EPA began sampling the major reservoirs in Kentucky in 1973 as a part of the National Eutrophication Survey (EPA 1972). Following enactment of the CWA, the Kentucky DOW established a network of lake and reservoir stations from 1981 to 1983. This network of lakes and reservoirs were initially selected to satisfy a U.S. EPA Cooperative Agreement Award in 1980. This award was the initial step toward the goal of Section 314(a) that each state shall prepare or establish:

1. An identification and classification according to trophic conditions of all publicly owned freshwater lakes in the state,

2. Procedures, processes, and methods (including land use requirements) to control sources of pollution to lakes, and

3. Methods and procedures, in conjunction with appropriate Federal agencies, to restore the quality of impaired lakes. By 1984, there were 73 lakes or reservoirs in the state program.

For this IR, Kentucky lakes were sampled based on a Watershed Management Framework Initiative approach. A total of 108 lakes that are listed in the Division's lakes inventory were sampled every five years by BMU. This data is primarily used for determining designated use support as defined by Kentucky's water quality standards regulations. Designated use support assessments are typically made for aquatic life and SCR.

Probabilistic Survey of Wadeable Streams

The Probabilistic Stream Bio-assessment Program, first implemented in 1998, collects data from randomly selected stations across the state for use-support designations and to assess the health of Kentucky's stream resources. Stations are randomly selected for sampling using a statistically-sound probability-based sampling design. The results from the random sample can then be applied to the entire region with a known level of uncertainty. This allows resources to be used efficiently to obtain valuable station-specific as well as entire study area condition information.

For this IR, monitoring was conducted using a five-year rotating BMU approach with 50 stations selected within the Salt and Licking Rivers BMU in 2014, and within the Upper Cumberland and Four Rivers BMU in 2015. In 2016, the probabilistic program did not sample while the program was transitioning from a BMU rotation approach to a statewide approach. During the 2024 cycle, we will be able discuss the initial results of the statewide probabilistic program for wadeable streams, which began sampling in 2017.

Reference Reach

The Reference Reach Program began in 1991, and the initial program goal was to determine a network of least-impacted streams within defined regions of the state. Reference Reaches are not necessarily pristine streams, but represent streams least impacted by human activities in each region. As such, they can be considered to represent best available conditions and can be used as benchmarks for comparing water quality parameters with other streams in the same region. Data gathered from the Reference Reach program were used primarily in the past to develop biological indices used for 305(b) assessments of aquatic life use support.

Currently, priorities for Reference Reach Monitoring center on characterizing the natural variability within the reference condition in each region, identifying new reference reach locations, and monitoring the condition of existing reference reaches as identified in 401 KAR 10:030. A firm understanding of the inherent biological variability and natural potential of the streams in a region is needed to address levels of impact to any given stream. This is accomplished using a regional reference approach, which is based on the range of natural conditions found in a population of stations or streams with similar physical characteristics and minimal human impact. The reference condition collectively refers to the range of quantifiable and naturally occurring ecological elements (i.e., chemistry, habitat and biology) present in an area.

In many regions of Kentucky, finding reference quality streams can be a difficult task because of the prevalence of human disturbance across the landscape. First, staff members identify least-impacted waters representative of geographic regions of the state known as ecoregions. Typical reference reach watersheds contain a high proportion of natural vegetation and have minimal human disturbance such as point-source discharges, agricultural land, mining and urban development. Then, data on chemical water quality, sediment quality, habitat condition and biotic communities are collected to define the quality of the streams of a particular ecoregion, and allow other streams in the same ecoregion to be compared to the reference condition.

Intensive Surveys

The Intensive Survey Monitoring Program incorporates data collection activities that support the Success Monitoring Program, the development of TMDLs and alternative restoration plans for 303(d)-listed impairments, the development of watershed plans, and monitoring for other special projects. The data collected by the Intensive Survey Program may be used by other programs within the Division for activities such as water quality standards development or water quality assessments for section 305(b).

Success Monitoring

The initial program of success monitoring in Kentucky began in the early 2000s, but did not develop into a defined program for several years. The DOW's NPS program re-introduced success monitoring in 2013 with the onset of the National Water Quality Initiative (NWQI) Program through the Natural Resources Conservation Service (NRCS). The Success Monitoring Program was then refined with an intent to track effectiveness of Best Management Practices (BMPs) implemented through the watershed planning process. Planning success monitoring for individual streams and watersheds was derived partly from EPA's water quality measures, and through DOW's mission statement.

Success at improving water quality can be demonstrated in a number of ways, but the monitoring focuses primarily on showing change in a designated use attainment. Ideally, data gathered from this program will influence decisions on types of BMPs that are most effective, remove streams from the 303(d) list, and allow the Division to demonstrate successful on-the-ground work to state and federal agencies.

Success Monitoring projects whose data were used for this IR include:

- Hinkston Creek watershed, collected in 2014 and 2015
- Little Pitman Creek watershed, collected in 2016
- Martis Branch watershed, collected in 2016
- Pleasant Run watershed, collected in 2016
- North Fork Kentucky River Tributaries in Letcher County, collected in 2017 and 2018

Monitoring 303(d)-listed waters for TMDLs and other plans

Once a lake, stream segment, or other waterbody has been assessed as impaired and placed on the 303(d) list, development of a TMDL is required. The first step in the process of addressing the impairment is to gather all existing data collected by the DOW. Data generated outside of state government may be requested from the collecting agency if the data were collected under an approved quality assurance project plan (QAPP). Once existing data have been compiled, it is frequently discovered that additional water quality, biological, bacteriological, and discharge data are necessary to confirm impairments, to identify any additional impairments in the watershed, and to collect sufficient data for development of a TMDL or to support other planning efforts that may be initiated in advance of a TMDL. In these cases, additional monitoring projects are planned and conducted.

The Intensive Survey section uses an intensive approach to monitoring in watersheds selected for the development of TMDLs and other similar plans. Monitoring will typically occur over two or three years. During the first year of sampling, data collection may focus on confirming the nature of the impairments and possible sources of those impairments. During the second year, targeted sampling for identified causes within the impaired segment(s) usually occurs. The second year also can include data collection in smaller, un-assessed tributaries that were not sampled during the first year of monitoring

but may be contributing to the identified impairment. A third year of monitoring may be warranted if data gaps still exist.

TMDL development monitoring projects whose data were used for this IR include:

- Claylick Creek watershed, data collected in 2013 and 2014
- Cypress Creek watershed, data collected 2016 - 2018
- Strodes Creek watershed, data collected in 2014 and 2015
- Damon Creek watershed, data collected in 2015
- Chestnut Creek watershed, data collected in 2016

Special Projects

The Intensive Survey section can apply the intensive approach to monitoring in watersheds for other projects, as needed. Each intensive survey project has a detailed study plan that outlines the geographic boundary of the study, the field activities involved, the types and number of samples required, and the analyses and reports to be generated. Schedules for specific activities and goals for the project are included.

Special Intensive Survey projects whose data were used for this IR include:

- Bluegrass Nutrient Study, data collected 2013 – 2015
- Marsh Creek watershed, data collected in 2013 and 2014
- Wild Rivers project, data collected 2013 – 2016

Fish Tissue

The Fish Tissue Contaminant Monitoring Program collects fish samples from across the state to assist in making recommendations to the public on the safe consumption of wild-caught fish within Kentucky. The program also provides monitoring support to meet CWA requirements.

Fish samples are collected once every five years from lakes and reservoirs that are greater than 65 acres and have a publicly accessible boat ramp. In addition, waterbodies with site-specific advisories are revisited on a rotation to determine if the specific advisories are still needed. Streams and rivers are visited as resources are available, generally associated with other Department monitoring programs.

Fish are analyzed for metals (e.g. mercury and selenium), PCBs, chlordane, pesticides and herbicides. The results are provided to the Fish Consumption Advisory Group comprised of the Kentucky Departments for Environmental Protection, Public Health and Fish and Wildlife Resources. The Group reviews the data and makes updates to consumption advisories as needed. Where applicable, and where data requirements are met, tissue data are also used for 305(b) attainment of the fish consumption designated use.

Outside Agency Data

The Kentucky DOW also uses data collected by outside agencies, such as United States Geological Survey (USGS) and United States Army Corps of Engineers (USACE). For this IR cycle, 61 stations with data collected by outside agencies contributed to attainment decisions.

Monitoring Summary

In total, 1,106 stations had data collected where the data were used for assessment for this 2018/2020 IR cycle. Those stations represent streams, rivers, lakes, and springs. Table 3 shows the number of samples collected and analyzed per data type for this cycle.

Table 3. Number of samples collected and analyzed per data type where the data were used for assessment during this 2018/2020 Integrated Reporting cycle.

Water Chemistry Samples	Bacteria Samples	Chlorophyll-a Samples	Macroinvertebrate Samples	Tissue Samples	Fish Samples
4,233	1,713	401	352	153	133

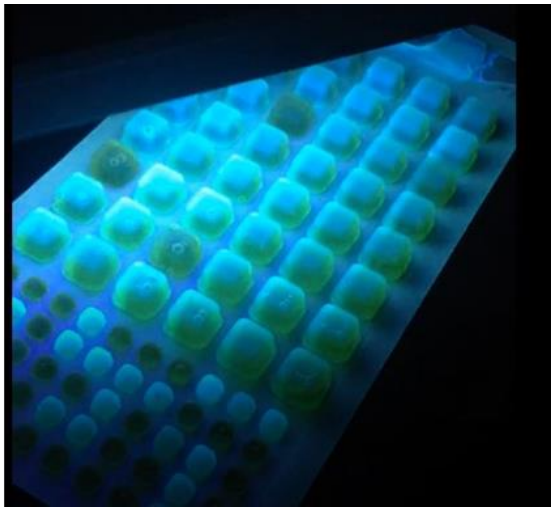
Assessment

Before data are used in the assessment process, they are reviewed to ensure data are of sufficient quantity and quality to make designated use attainment decisions. This review process includes a primary and secondary quality assurance (QA) of the data collected to ensure the following:

- Data were collected in accordance with any applicable QAPP, Program Management Plan (PMP), or Project Study Plan (PSP)
- Applicable Standard Operating Procedures (SOP) were followed
- Appropriate site(s) visited with necessary field forms and documentation (e.g. Chain of Custody)
- Meters calibrated appropriately and calibration trackable to an instrument and site visit
- Data quality objectives (DQOs) were met as supported by QA samples
- Any other project specific details in need of verification

Of the nearly 1,500 stations that were reviewed for assessment purposes, 1,106 stations had data of sufficient quantity and quality and were used to complete 915 assessments. To complete assessments, available data are summarized and analyzed to make final attainment decisions, which are reported in the 305(b), the 303(d), and discussed within this IR. When sampling occurs, specific information is gathered for each designated use.

- To assess PCR - bacteria levels are examined during the recreation season (May – October)
- To assess aquatic life for streams - water chemistry, habitat, and biological communities are examined
- To assess aquatic life for lakes - profile data, chlorophyll-a, and water chemistry data are examined
- To assess fish consumption – fish are collected where their tissue (usually filet) is examined for pollutants of concern, such as mercury and PCBs



For more detailed information about Kentucky's assessment and listing methodology, refer to the Consolidated Assessment and Listing Methodology (CALM): Surface Water Quality Assessment in Kentucky, the Integrated Report (KDOW 2015). In addition to this document, an update to Kentucky's Assessment Methodology for Fish Consumption (KDOW 2020) is considered an addendum to the CALM,

and should be used in place of the fish consumption method outlined in section 3.6 on page 55 of the 2015 CALM document.

The reader may also find EPA's factsheets on water quality parameters a helpful resource in understanding how the data collected informs attainment decisions.

Categories and Attainment

The 305(b) list is a list of all waterbodies that have been assessed for one or more designated uses. Waterbodies on the 305(b) list are put into different categories depending upon the assessment decision made for that waterbody (Figure 12). Categories are assigned at the parameter level, which is the level that data are collected and analyzed, the designated use level, which is the level that the water quality standards for a particular parameter apply, and the assessment unit level, which is determined from the assessed designated uses and their categories (Figure 12).

Impaired waters are those waters found to partially support or not support one or more of its designated uses due to either a pollution or a pollutant. The 303(d) list, which is a subset of the 305(b) list, are those waters identified as impaired where the cause of impairment is a pollutant and requires a TMDL. All pollutant-waterbody combinations on the 303(d) list are in category 5 (Figure 12).

In previous cycles, Kentucky had a state-specific category of 5b, which was defined as 'segment does not support designated uses based on evaluated data, but based on Kentucky listing methodology, insufficient data are available to make a listing determination. No TMDL needed.' These waters had no instream data to confirm the attainment, but were suspected as impaired based on discharge monitoring report data. With the creation of Kentucky's Assessment and TMDL Tracking System (KATTS), we now track these waters as category 3 waters with a facility parameter flag, where they are tracked and prioritized for instream monitoring to confirm the suspected impairment.

View this category story map to explore waterbodies within each assessment unit category.

	Category	Assessment Unit Category Definition	Designated Use Category Definition	Parameter Category Definition	
305(b)	1	Assessment unit supports all designated uses, and all applicable designated uses assessed			Meeting
	2	Assessment unit supports designated use(s), but not all designated uses assessed	Designated use is supported	Parameter meets water quality standard	
	2b	Assessment unit currently supports designated use(s), but previously impaired and proposed for delisting	Designated use is supported, but previously impaired and proposed for delisting	Parameter meets water quality standard, but previously identified as a cause of impairment and proposed for delisting	
	2c	Assessment unit supports designated use(s), and has an EPA approved or established TMDL	Designated use is supported, and has an EPA approved or established TMDL	Parameter meets water quality standard, and has an EPA approved or established TMDL	
	3	Designated use(s) has/have not been assessed (insufficient information or no data)	Designated use has not been assessed (insufficient information or no data)	Parameter level attainment has not been assessed (insufficient information or no data)	
	4a	Assessment Unit does not support designated use(s), and has an EPA approved or established TMDL	Designated use is impaired, and has an EPA approved or established TMDL	Parameter does not meet water quality standards, and has an EPA approved or established TMDL	Impaired
	4b	Assessment unit does not support designated use(s), and has an approved alternative pollution control plan stringent enough to meet water quality standard(s) within a specified time	Designated use is impaired, and has an approved alternative pollution control plan stringent enough to meet water quality standard(s) within a specified time	Parameter does not meet water quality standards, and has an approved alternative pollution control plan stringent enough to meet water quality standard(s) within a specified time	
	4c	Assessment unit does not support designated use(s), but is not attributable to a pollutant or a combination of pollutants	Designated use is impaired, but is not attributable to a pollutant or a combination of pollutants	Parameter does not meet water quality standards, and that parameter is a pollution	
303(d)	5	Assessment unit does not support designated use(s), and is attributable to a pollutant or a combination of pollutants; TMDL required	Designated use is impaired, and is attributable to a pollutant or a combination of pollutants; TMDL required	Parameter does not meet water quality standards, and that parameter is a pollutant; TMDL required	

Figure 12. Definition of each category at the assessment unit level, the designated use level, and the parameter level; the figure demonstrates how these categories relate to the 305(b), meeting versus impaired, and the 303(d).

As stated earlier, the assessment unit level category is determined from the assessed designated uses and their categories. For example, if an assessed waterbody has the following attainments and categories:

- PCR is partial support (PS in Figure 13) due to the pollutant *E. coli*, which has a TMDL; the parameter level category is 4a and the designated use category is 4a
- WAH is nonsupport (NS in Figure 13) due to the pollutants iron and sedimentation/siltation and the pollution habitat (streams)
    - The parameter category for habitat (streams) is 4c
    - Iron, which has TMDL, has a parameter category of 4a
    - The parameter category for sedimentation/siltation is 5
    - The designated use category is 5
- SCR is full support, where the parameter fecal coliform was found to meet water quality standards
    - The parameter category and designated use category are 2
- Fish consumption is full support, where the parameter mercury in fish tissue was found to meet water quality standards
    - The parameter category and designated use category are 2
- The DWS designated use is unassessed, making it category 3

The overall assessment unit is in category 5 (Figure 13).

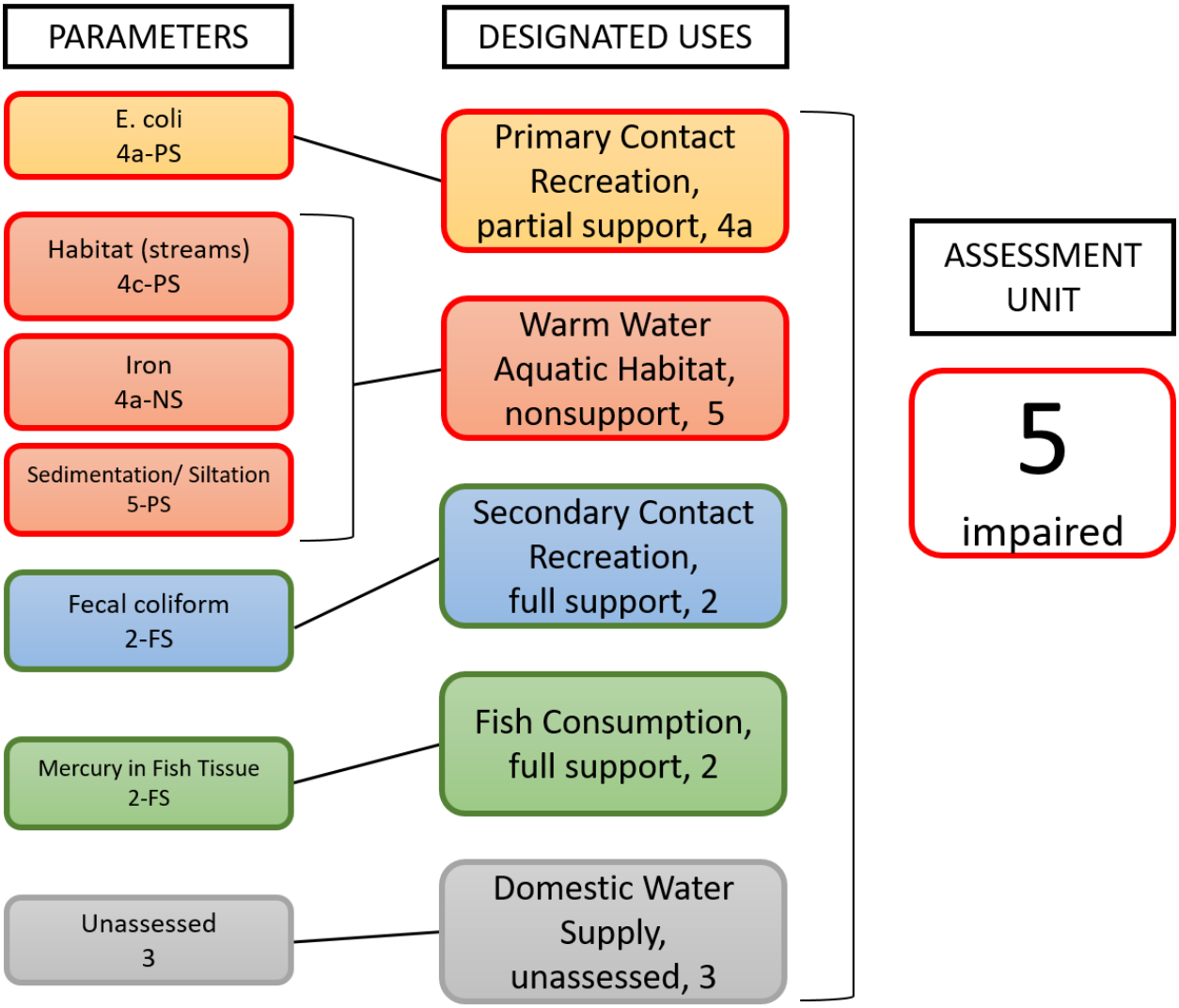


Figure 13. Schematic diagram of how categories at the parameter level determine the designated use category, and how the designated use categories determine the overall assessment unit category.

The 305(b) and the 303(d) Lists

The 305(b) list is a cumulative list; once a waterbody is on this list, it remains. A waterbody may change categories depending upon the use attainment(s), but it is always accounted for on the 305(b) list. This IR focuses on waters that had available data (of sufficient quantity and quality) to make an assessment decision for the 2018/2020 IR. Any historic assessment from the 2016 305(b) list that did not have new data collected was passed forward to the 2018/2020 305(b) list unchanged.

Results

Statewide Scale Results

The following sections discuss the 305(b) list, the 303(d) list, new listings, delistings submitted to EPA, and waters with an EPA-approved TMDL. This same information can be found in the 305(b) workbook. For a more interactive approach to these results, visit the assessment results page of the IR site.

The 305(b) List

The 305(b) list is an inventory of all waterbodies that have been assessed for at least one designated use from this cycle and all prior cycles. The spatial extent of each assessment unit is identified within the list. Kentucky's 2018/2020 305(b) list has 2,879 assessment units, representing 13,061.6 river miles, 203,310 lake/reservoir acres, and 168,055 springshed acres.

Table 4 shows how many assessment units are in each category at the designated use level and at the assessment unit level. Categories 2, 2b, and 2c relate to the assessment unit or designated use being met (full support), category 3 is unassessed, and categories 4a, 4c, and 5 relate to the assessment unit or designated use being impaired (partial support or nonsupport). Category 1 is only applicable at the assessment unit level and means all applicable designated uses have been assessed and all are meeting, of which there are six (Table 4).

Table 4. Number of assessment units (AU) in each category per designated use and per assessment unit for all assessment units on Kentucky's 2018/2020 305(b) list.

Category	WAH	CAH	OSRW	PCR	SCR	FC	DWS	AU
1	0	0	0	0	0	0	0	6
2	1045	75	314	246	228	100	95	955
2b	6	0	1	12	3	0	0	7
2c	6	0	0	18	11	0	0	9
3	325	4	36	1737	2511	2664	2783	0
4a	20	0	1	592	75	1	0	316
4c	94	0	8	0	4	0	0	76
5	1301	13	65	274	47	114	1	1510

The 305(b) list tab of the 305(b) workbook has the official information about all assessment units that are on the 305(b) list, or explore the 305(b) tab of the 305(b) dashboard for a more interactive approach.

The 303(d) List

The 303(d) list is a subset of the 305(b) list and includes all waterbodies identified as being impaired (not meeting water quality standards) by one or more pollutants where a TMDL is required. Each pollutant-waterbody combination is in category 5, has a cycle first listed, suspected sources, and a TMDL priority rank (high, medium, or low) (Table 5).

Table 5. Definitions of TMDL priority ranks.

High	A TMDL is in development or will be in development within the next two years, and is expected to be completed during the next one to two reporting cycles (within 1-4 years). Waters ranked as "High" priority focus in part on those identified in the Division's 303(d) Long Term Vision Priorities, which established a plan for developing TMDLs and alternative restoration plans for specific waters and pollutants by 2022. Click here For more information on the 303(d) Long Term Vision Priorities.
Medium	TMDL strategies are in the planning stage for the waterbody and/or pollutant. Methodologies may be under development or data collection may be planned or ongoing. Opportunities for alternative restoration plans may be under review.
Low	A TMDL is not currently in development. This rank include TMDLs for which methodologies may be in development for the pollutant or waterbody type. Some waters ranked as "Low" priority for TMDL development have an EPA-accepted alternative restoration plan that is being implemented, or have an alternative restoration plan in development that is expected to be EPA-accepted within the next two reporting cycles. The progress of each alternative restoration plan is reviewed each cycle to ensure the plan is on track to restoring water quality. The TMDL development priority rank may be updated based on this review. See table columns in the 303(d) list related to "Restoration Plans" for information on these alternative restoration plans.

On the 2018/2020 303(d), there are 2,809 pollutant-waterbody combinations that require a TMDL. Broken down by waterbody type, 1,447 rivers/streams are on the 303(d) list totaling 7,166.1 river miles, 55 lakes/reservoirs are on the 303(d) list totaling 89,243 acres, and eight springs are on the 303(d) list totaling 80,490 springshed acres.

Although the 303(d) list is sometimes referred to as the "impaired waters list", it is specifically a subset of the impaired waters where the parameter identified as a cause of impairment is a pollutant and a TMDL has not yet been developed. Figure 14 shows the number of impairments per parameter that are in need of a TMDL, with the priority per parameter distinguished by low (light gray), medium (dark gray), and high (black).

The 303(d) tab of the 305(b) workbook has the official information about all pollutant-waterbody combinations that are on the 303(d) list, or explore the 303(d) tab of the 305(b) dashboard for a more interactive approach.

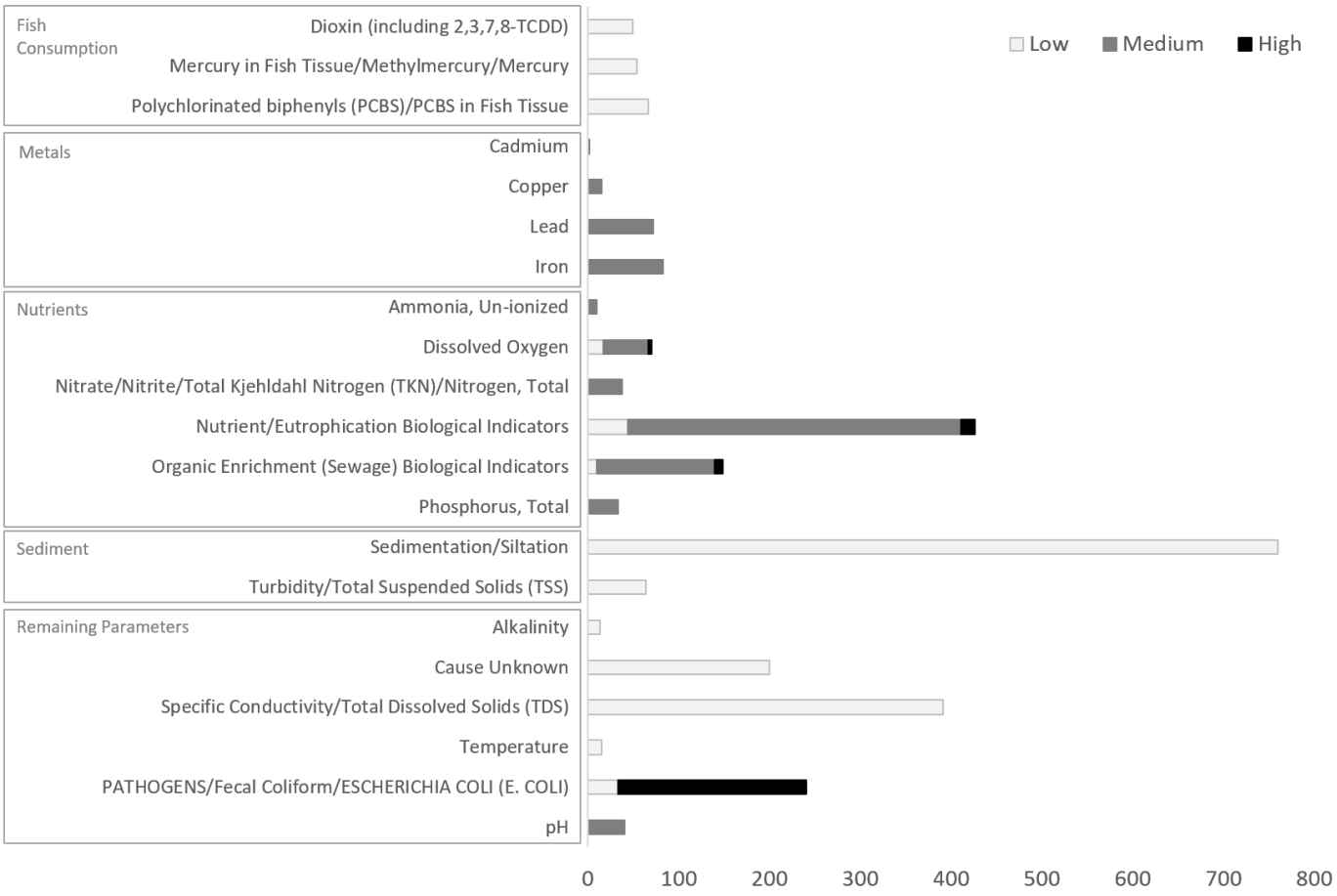


Figure 14. Number of impairments per parameter where the parameter is on the 303(d) list because it is a pollutant and a TMDL is required but has not yet been developed. TMDL priority rank distinguished by low (light gray), medium (dark gray), and high (black).

New Listings

New listings are a subset of the 303(d) and are those pollutants that are newly listed on the 2018/2020 303(d) as causes of impairment (not meeting water quality standards) and require a TMDL. Each pollutant-waterbody combination is in category 5 and has a cycle first listed of 2020 (representing the 2018/2020 IR cycle).

On the 2018/2020 303(d), there are 287 new listings, 31 of which replace the parameter fecal coliform with the parameter pathogens since fecal coliform criteria for PCR were retired in 2019 (Figure 15).

The new listings tab of the 305(b) workbook has the official information about all pollutant-waterbody combinations that are newly listed during this cycle, or explore the new listings tab of the 305(b) dashboard for a more interactive approach.

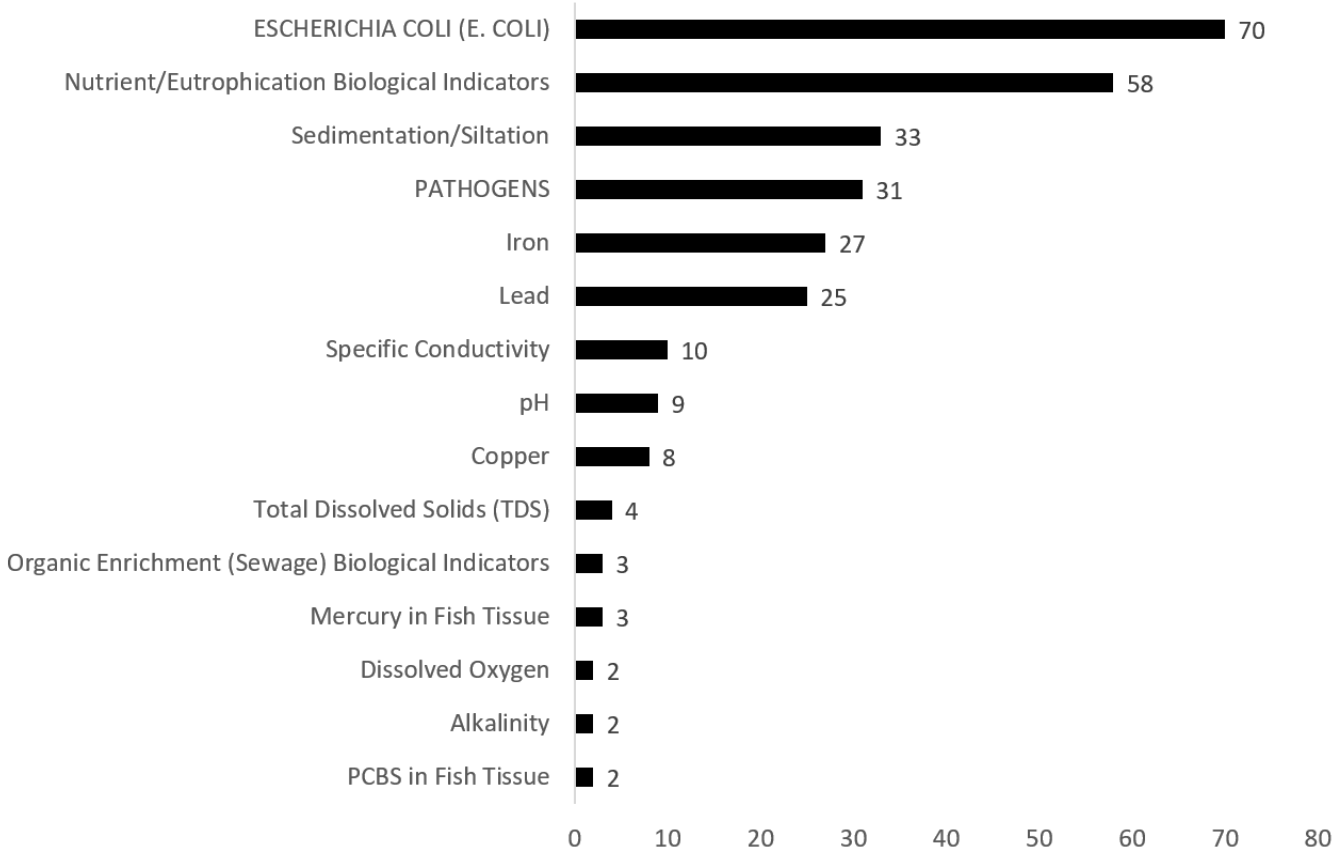


Figure 15. New listings on the 2018/2020 303(d) list per parameter.

Delistings

The delistings are those pollutants that were previously listed as impaired (not meeting water quality standards) and have been proposed for delisting as part of the 2018/2020 reporting cycle.

For this cycle, DOW has requested EPA approval to remove 193 pollutant-waterbody combinations from the 303(d) list (Figure 16). Of these, 74 replace fecal coliform with either E. coli or pathogens since fecal coliform criteria for PCR were retired in 2019. These delistings are associated with the reason 'WQS no longer applicable' (WQS is water quality standards). The remainder of the delistings are either related to clarification of listing cause, correction of a listing error, or attributed to the WQS being attained, of which there are 70 (Table 6).

The delistings tab of the 305(b) workbook has the official information about all pollutant-waterbody combinations that are proposed for delisting as part of this cycle, or explore the delistings tab of the 305(b) dashboard for a more interactive approach.

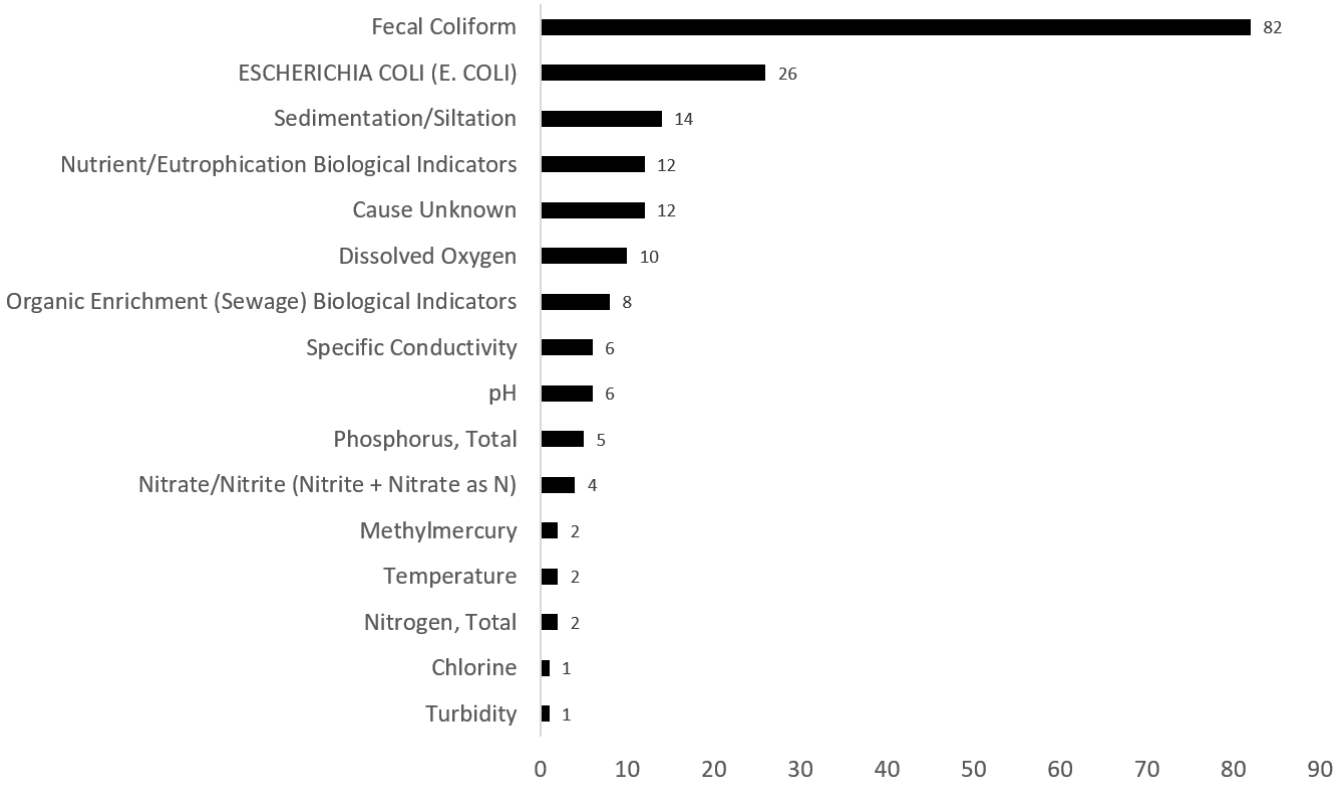


Figure 16. Parameters proposed for delisting as part of the 2018/2020 305(b).

Table 6. Number of delistings per delisting reason for those parameters proposed for delisting as part of the 2018/2020 305(b).

Delisting Reason	Count
WQS no longer applicable	74
Applicable WQS attained; based on new data	64
Data and/or information lacking to determine WQ status; original basis for listing was incorrect	27
Clarification of listing cause	22
Applicable WQS attained; original basis for listing was incorrect	4
Applicable WQS attained; reason for recovery unspecified	1
Applicable WQS attained, due to restoration activities	1

Waters with TMDLs

Waters with a TMDL are those waterbodies with an EPA-approved TMDL for one or more pollutant-waterbody combination(s). The parameter may be in category 4a, where the parameter is identified as a cause of impairment, or category 2c, where the parameter has been found to meet water quality standards since the TMDL was developed.

On the 2018/2020 305(b) list there are 742 pollutant-waterbody combinations with an EPA-approved TMDL (Figure 17). Since EPA approved the 2016 303(d) list on June 19, 2018, EPA has approved the following TMDLs, representing 263 pollutant-waterbody combinations:

1. Statewide TMDL for Bacteria Impaired Waters, Core Document and Green River and Tradewater River Basins (Action ID KYACT_1), approved by EPA on 2/22/2019
2. Statewide TMDL for Bacteria Impaired Waters, Big Sandy, Little Sandy, and Tygarts (Action ID KYACT_4), approved by EPA on 8/31/2021
3. Statewide TMDL for Bacteria, Kentucky River Basin (Action ID KYACT_5), approved by EPA on 8/31/21
4. Statewide TMDL for Bacteria, Salt and Licking River Basins (Action ID KYACT_6), approved by EPA on 9/23/21

The Approved TMDL Reports webpage has all EPA-approved TMDLs, with a link to each report.

The 'waters with a TMDL' tab of the 305(b) workbook has the official information about all pollutant-waterbody combinations with an EPA-approved TMDL; the 'waters with a TMDL tab' of the 305(b) dashboard can be explored for a more interactive approach.

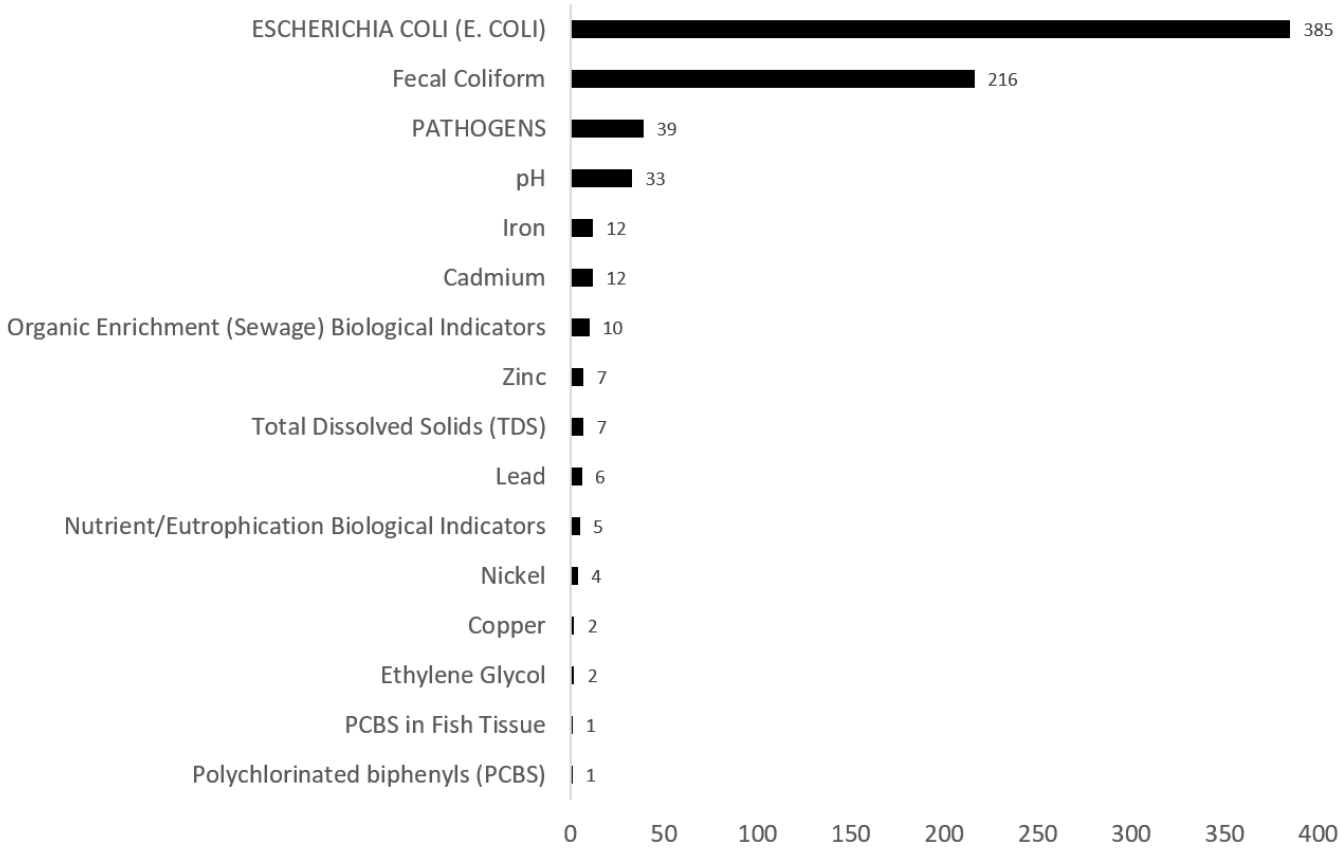


Figure 17. Parameters with an EPA-approved TMDL, where the parameter may be a cause of impairment (category 4a), or have been found to meet water quality standards since the TMDL was developed (category 2c).

Designated Use Level (all waterbody types)

For all 2,879 assessment units on the 2018/2020 305(b) list, regardless of waterbody type, attainment per designated use is outlined in Table 7 and displayed in Figure 18.

Table 7. Attainment per designated use for all 2,879 assessment units on the 2018/2020 305(b) list.

Category	WAH	CAH	OSRW	PCR	SCR	FC	DWS
Full Support	1057	75	315	276	242	100	95
Partial Support	785	9	42	222	27	95	1
Nonsupport	630	4	32	644	99	20	0
Not Assessed	325	4	36	1737	2511	2664	2783
Not Applicable	82	2787	2454	0	0	0	0

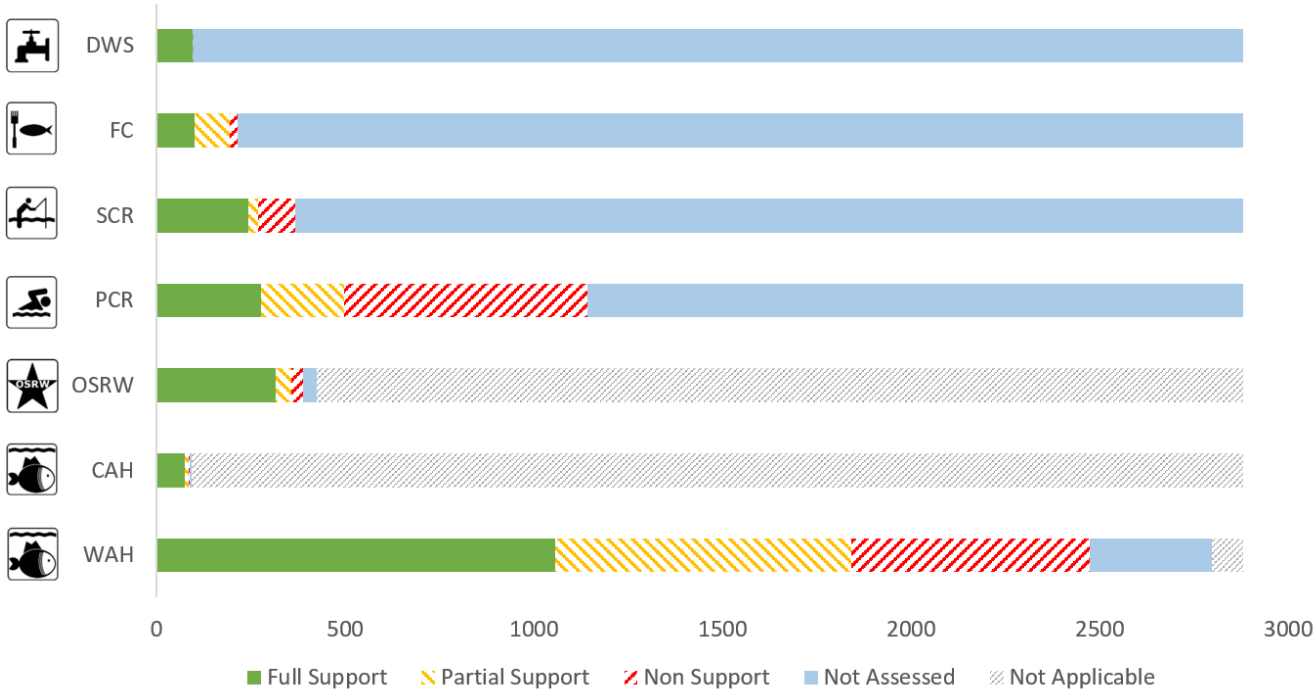


Figure 18. Assessment status and attainment for all 2,879 assessment units on the 2018/2020 305(b) per designated use.

Aquatic Life and OSRW

On the 2018/2020 305(b) list, 2,472 assessment units have been assessed for the WAH designated use, making it the most commonly assessed designated use. Of those assessed, 1,057 fully support the WAH designated use, while 1,415 are impaired. River and stream assessment units represent 2,374 of the assessment units, of which 998 are meeting and 1,376 are impaired. Lake and reservoir assessment units represent 97 of the assessment units, of which 58 are meeting and 39 are impaired.

On the 2018/2020 305(b) list, 92 assessment units have the CAH designated use, 88 of which have been assessed. River and stream assessment units represent 78 of the assessed assessment units, of which 65

are meeting and 13 are impaired. Lake and reservoir assessment units represent 10 of the assessed assessment units, all of which are meeting (100%).

On the 2018/2020 305(b) list, 425 assessment units have the OSRW designated use, of which 389 have been assessed. Most of the waterbodies assessed for this use are rivers and streams (386 of the 389) and are meeting, with 315 assessment units found to fully support OSRW and 74 assessment units found to be impaired.

Visit the aquatic life dashboard to explore these assessment results in a more interactive platform, which has a tab for WAH, CAH, and OSRW.

Fishing and Recreating

On the 2018/2020 305(b) list, 1,142 assessment units have been assessed for the PCR designated use. Of those assessed, 276 were found to fully support the designated use, while 866 were found to be impaired. River and stream assessment units represent 1,126 of the assessment units, of which 270 are meeting and 856 are impaired for the PCR use. Spring assessment units represent 11 of the assessment units, of which one is meeting and 10 are impaired for the PCR use. Lake and reservoir assessment units represent five of the assessment units, all of which are meeting the PCR use.

On the 2018/2020 305(b) list, 368 assessment units have been assessed for the SCR designated use. Of those assessed, 242 were found to fully support the designated use, while 126 were found to be impaired. River and stream assessment units represent 294 of the assessment units, of which 172 are meeting and 122 are impaired for the SCR use. Lake and reservoir assessment units represent 73 of the assessment units, of which 69 are meeting and four are impaired for the SCR use.

On the 2018/2020 305(b) list, 215 assessment units have been assessed for fish consumption. Of those assessed, 100 were found to fully support the designated use, while 115 were found to be impaired. River and stream assessment units represent 173 of the assessment units, of which 78 are meeting and 95 are impaired for fish consumption. Lake and reservoir assessment units represent 42 of the assessment units, of which 22 are meeting and 20 are impaired for fish consumption.

Visit the fishing and recreating dashboard to explore these assessment results in a more interactive platform, which has a tab for PCR, SCR, and fish consumption.

Impaired Waters

Impaired waters are a subset of the 305(b) list and are those waterbodies where at least one designated use is not being supported, and the cause of impairment does not require a TMDL (category 4c), requires a TMDL but a TMDL has not been developed (category 5), or a requires a TMDL and a TMDL has been developed (category 4a).

Of the 2,879 assessment units on the 305(b) list, 1,902 assessment units are impaired for at least one designated use. Table 8 shows the attainment (partial or nonsupport) per designated use for waterbodies impaired on the 2018/2020 305(b) list. Broken down by waterbody type, 1,836 rivers/streams are impaired totaling 8,945.2 river miles, 56 lakes/reservoirs are impaired totaling 89,449 acres, and 10 springs are impaired totaling 83,698 springshed acres.

Table 8. Number of assessment units impaired (either partial or nonsupport) for each designated use on the 2018/2020 305(b) list with the number of assessments units assessed for that designated use shown below.

Category	WAH	CAH	OSRW	PCR	SCR	FC	DWS
Partial Support	785	9	42	222	27	95	1
Nonsupport	630	4	32	644	99	20	0
Assessed	2472	88	389	1142	368	215	96

The impaired waters dashboard has a tab for each designated use, and can be used to explore waterbodies impaired for those uses throughout the commonwealth.

The impaired waters tab of the 305(b) workbook has specific information about all assessment units identified as impaired for one or more designated uses.

Causes of Impairment

There are 4,128 parameter-waterbody combinations on the impaired waters list (Figure 19). Those parameters fall into three reporting categories:

1. 2,809 are in category 5, meaning the parameter is a pollutant, identified as a cause of impairment, and requires a TMDL
    a. This is the 303(d) list
2. 710 are in category 4a, meaning the parameter is a pollutant, identified as a cause of impairment, and has an EPA-approved TMDL
3. 609 are in category 4c, meaning the parameter is a pollution, identified as a cause of impairment, but does not require a TMDL

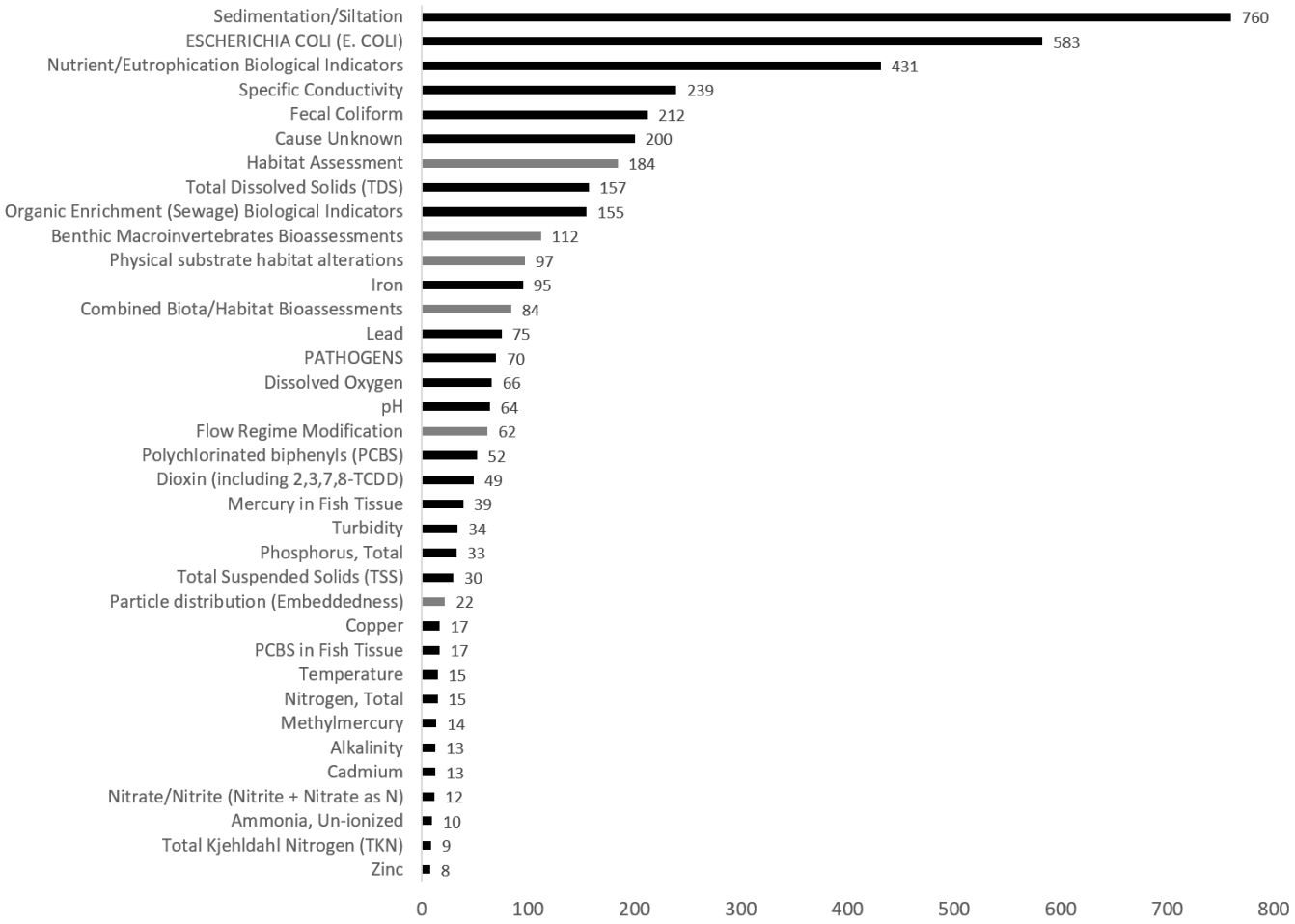


Figure 19. Number of impairments per parameter for those parameters identified as a cause on eight (8) or more occasions; **black** bars represent pollutants and gray bars represent pollutions.

Parameters can be grouped to explore types of impairments throughout the Commonwealth. Figure 20 shows the parameters identified as a cause of impairment on the 2018/2020 305(b) list grouped into the following themes:

1. Pathogens
2. Sedimentation/Turbidity
3. Nutrients/Organic Enrichment (OE)/Dissolved Oxygen
4. Biological Integrity/Habitat/Flow
    a. All parameters in this group are pollutions
5. Salinity/Total Dissolved Solids (TDS)/Chlorides/Sulfates
6. Metals and Mercury
7. Other (including Cause Unknown)
8. Dioxins/PCBs
9. pH/Acidity

For a more interactive approach, visit the cause of impairment dashboard, where a map is available to explore causes in the groups discussed above.

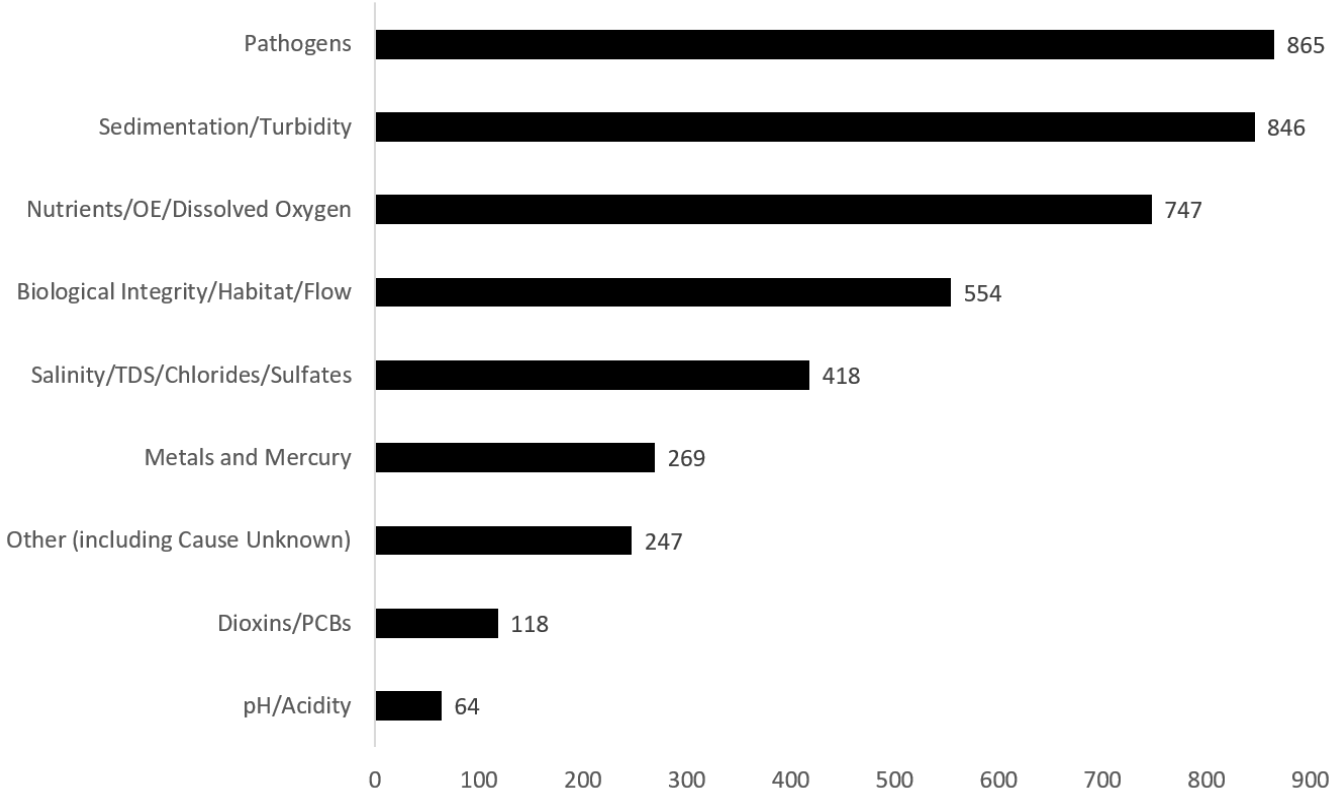


Figure 20. Types of impairments on the 2018/2020 305(b) list where parameters have been grouped into nine (9) themes to better understand the number and types of impairments throughout the Commonwealth.

The impaired waters tab of the 305(b) workbook has specific information about all assessment units identified as impaired for one or more designated uses. Parameter level information for those identified as a cause of impairment is available per assessment unit, including if that parameter has a TMDL, the parameter's category, TMDL priority rank (if applicable), cycle first listed (if applicable), and suspected sources.

Waterbody Type Results

Assessment results per waterbody type per designated use, along with parameters identified as causes of impairment, are discussed in more detail in the following sections of this IR.

Rivers and Streams

River and stream assessments are the most common, which account for 2,744 of the 2,879 assessment units on Kentucky's 305(b) list. The total mileage of streams and rivers that have been assessed is 13,061.6 river miles. For those rivers and streams that have been assessed, the attainment per designated use is displayed in Figure 21.

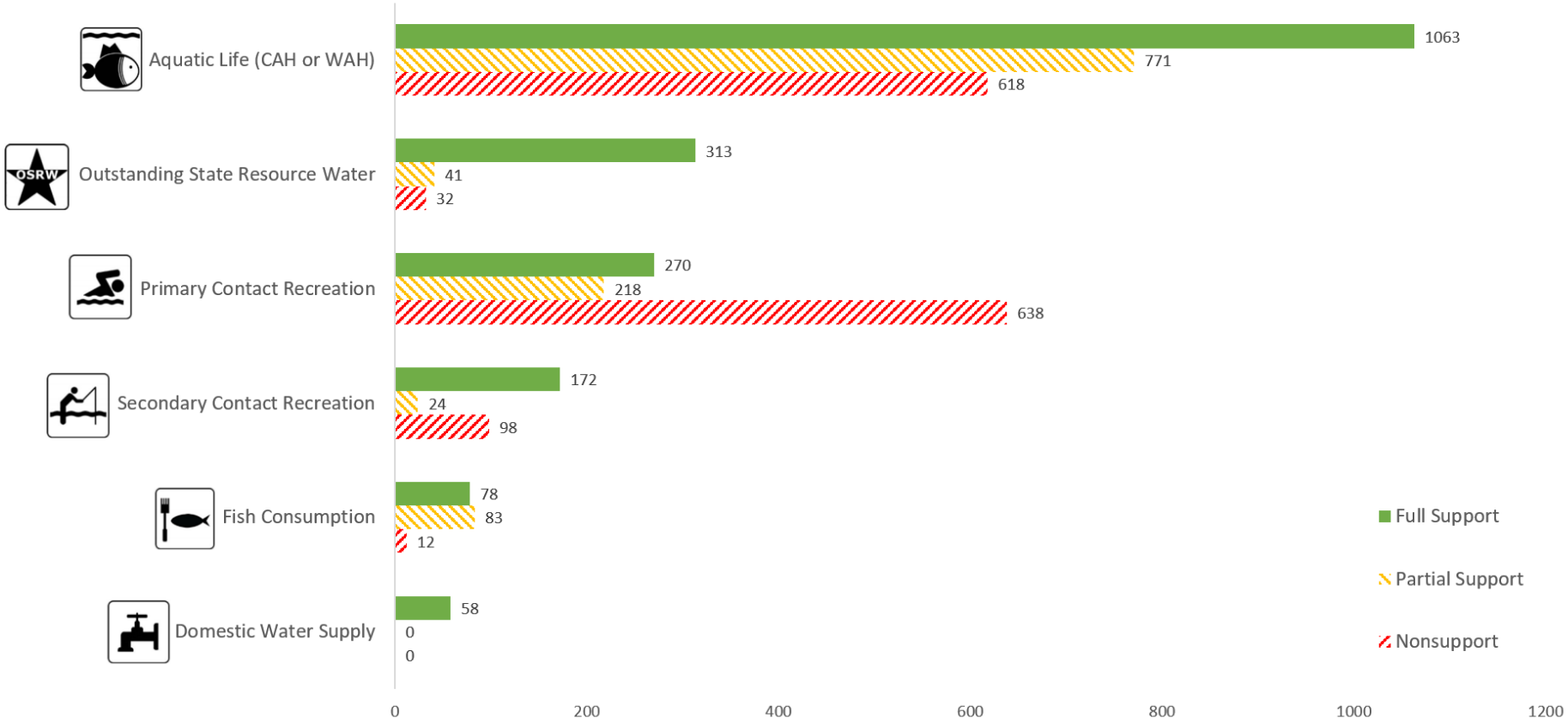


Figure 21. Number of assessment units that are full support, partial support, or nonsupport per designated use for rivers and streams that have been assessed for that use during this cycle or any prior cycle.

Rivers and Streams – Aquatic Life Uses (CAH and WAH)

For those rivers and streams that have been assessed for aquatic life, 43% fully support this designated use, while 31% partially support and 25% do not support the aquatic life designated use, meaning 57% are impaired (Figure 22).

Figure 22. Proportion of attainment for all rivers and streams that have been assessed for the aquatic life (WAH or CAH) designated use during this cycle or any prior cycle.

Looking at only the rivers and streams impaired for the aquatic life (CAH or WAH) designated use, 52 causes are associated with the impairments. Those that cause more than 20 impairments are displayed in Figure 23; (refer to the 305(b) workbook for all listing information). Some causes of impairment are pollutants (black in Figure 23), which require or have an EPA-approved TMDL, and other causes of impairment are pollutions (gray in Figure 23), which do not require a TMDL.

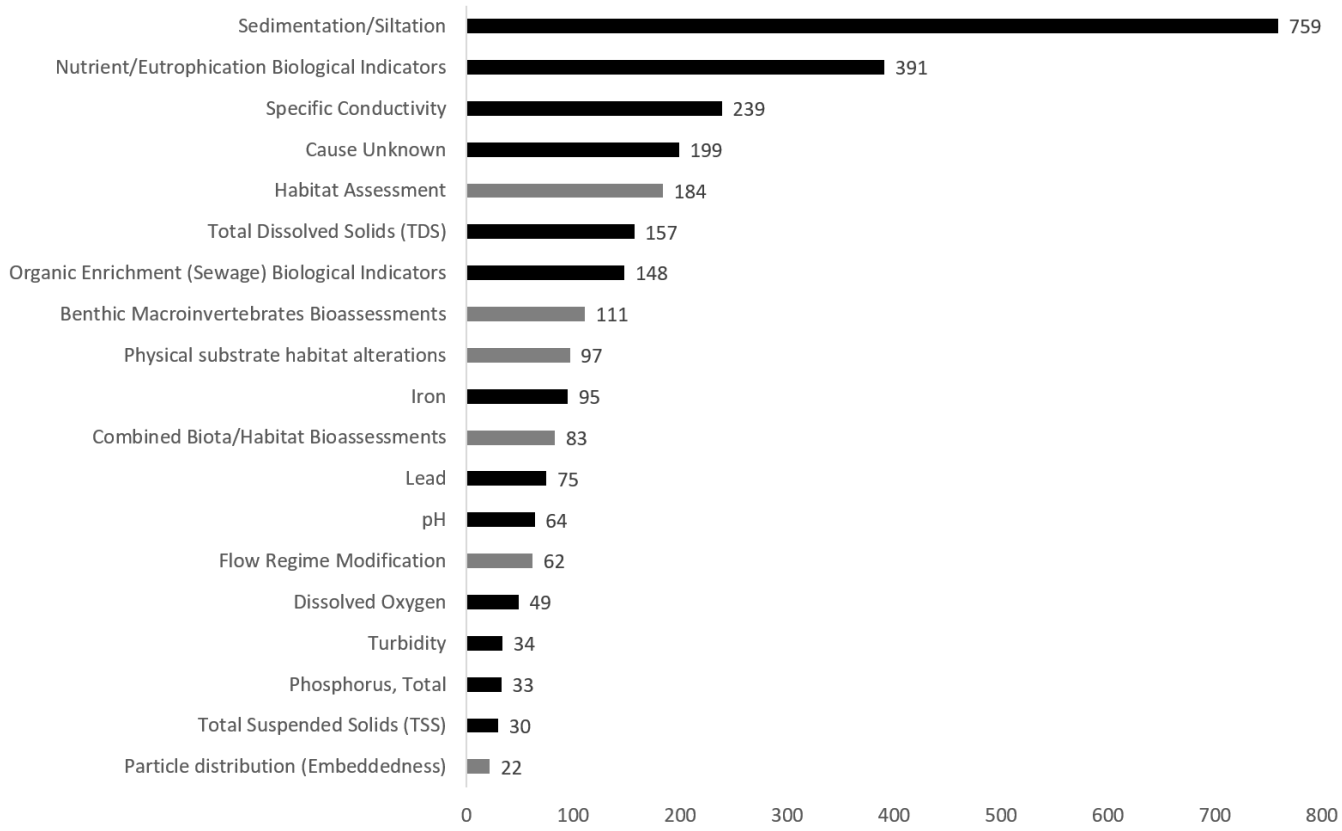


Figure 23. Number of impairments for the aquatic life (CAH or WAH) designated use by parameter for rivers and streams. Graph only shows those parameters that are identified as a cause of impairment in more than 20 assessment units. Pollutants in **black**; Pollutions in gray.

Rivers and Streams – Outstanding State Resource Water

For those rivers and streams that have been assessed for OSRW, 81% fully support this designated use, while 11% partially support and 8% do not support the OSRW designated use, meaning 19% are impaired (Figure 24).

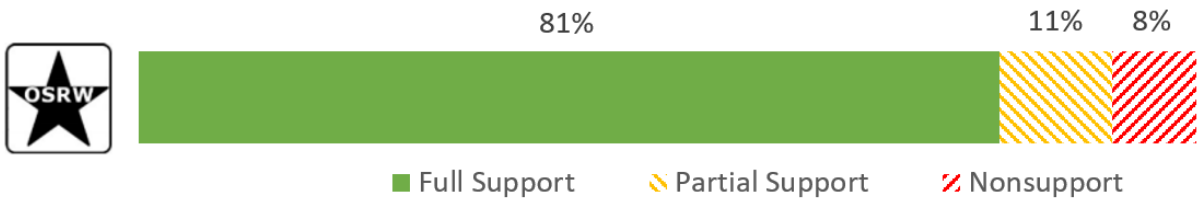


Figure 24. Proportion of attainment for all rivers and streams that have been assessed for the outstanding state resource water (OSRW) designated use during this cycle or any prior cycle.

Looking at only at the rivers and streams impaired for OSRW, 21 causes are associated with the impairments. Those that cause more than one impairment are displayed in Figure 25; (refer to the 305(b) workbook for all listing information). Some causes of impairment are pollutants (black in Figure 25), which require or have an EPA-approved TMDL, and other causes of impairment are pollutions (gray in Figure 25), which do not require a TMDL. Most OSRW impairments are associated with more than one cause of impairment, which is why there are more causes of impairments than there are rivers and streams impaired for OSRW.

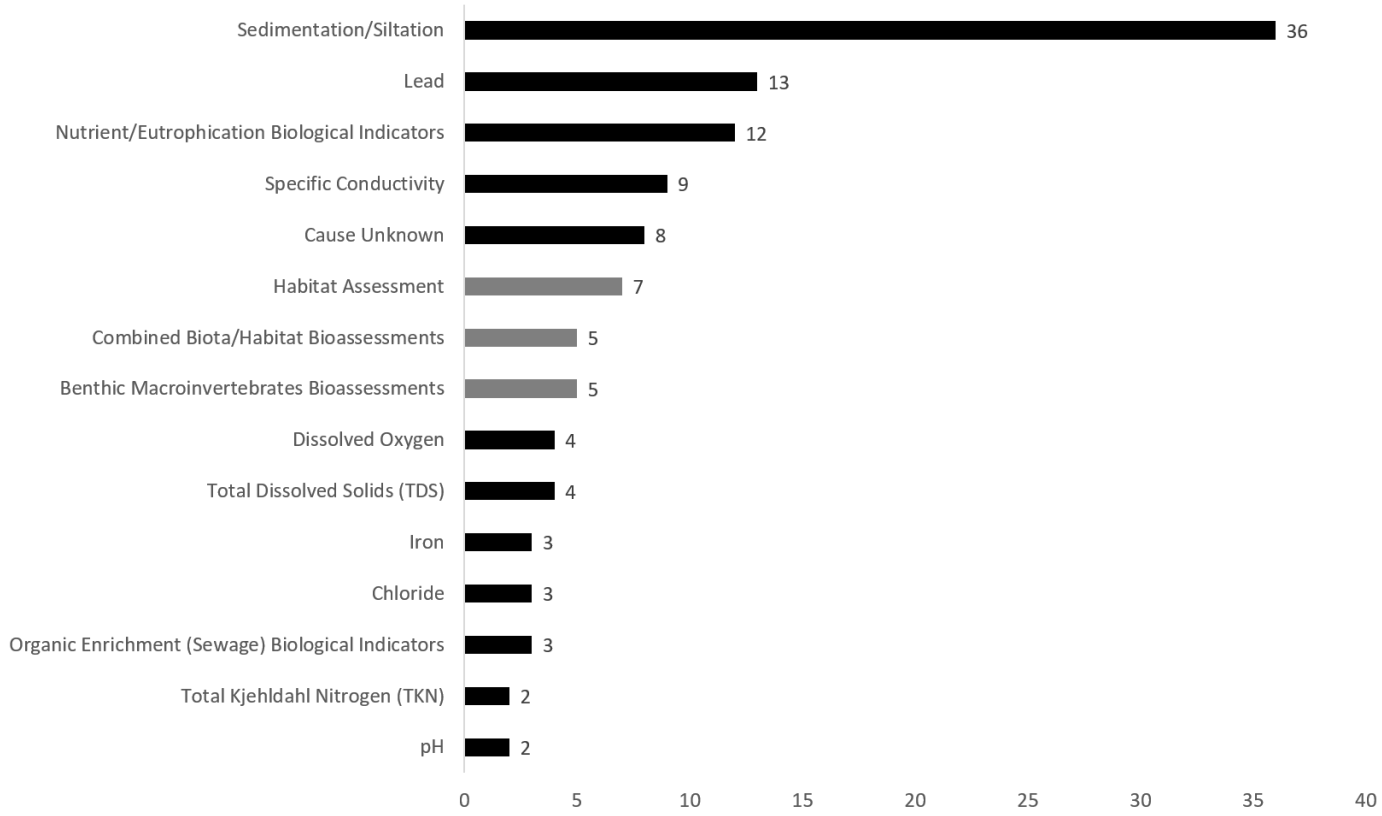


Figure 25. Number of impairments for the OSRW designated use by parameter for rivers and streams. Pollutants in black; Pollutions in gray.

Rivers and Streams – Recreational Uses (PCR and SCR)

For those rivers and streams that have been assessed for PCR, 24% fully support this designated use, while 19% partially support and 57% do not support the PCR designated use, meaning 76% are impaired (Figure 26).

For those rivers and streams that have been assessed for SCR, 59% fully support this designated use, while 8% partially support and 33% do not support the SCR designated use, meaning 41% are impaired (Figure 26).

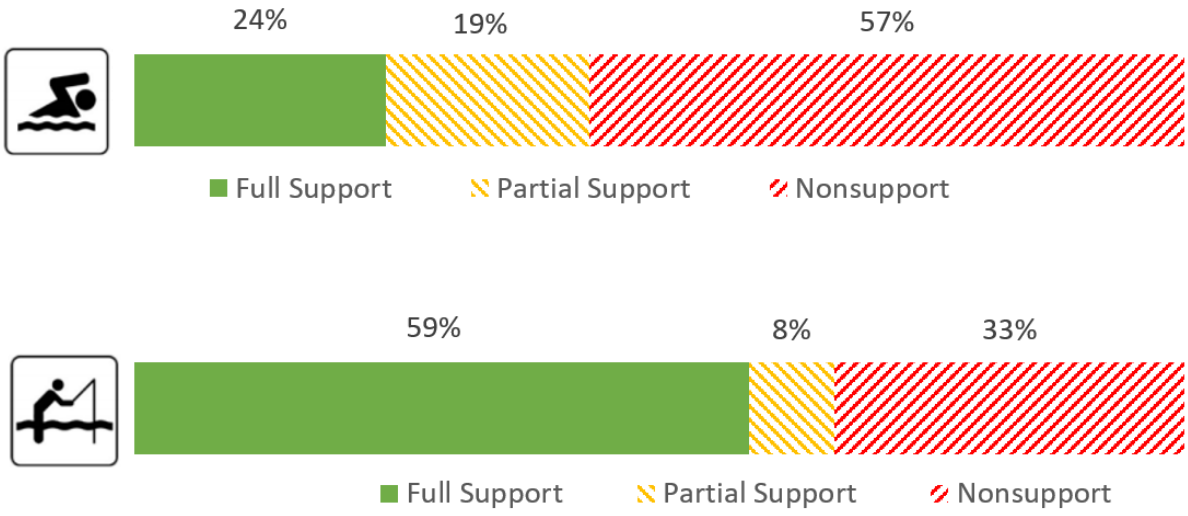


Figure 26. Proportion of attainment for all rivers and streams that have been assessed for the PCR and SCR designated uses during this cycle or any prior cycle.

Looking at only the rivers and streams impaired for the recreational uses (PCR and SCR), bacteria type impairments (*E. coli*, fecal coliform or pathogens) account for most of the listings, while there are 128 pH listings (Figure 27).

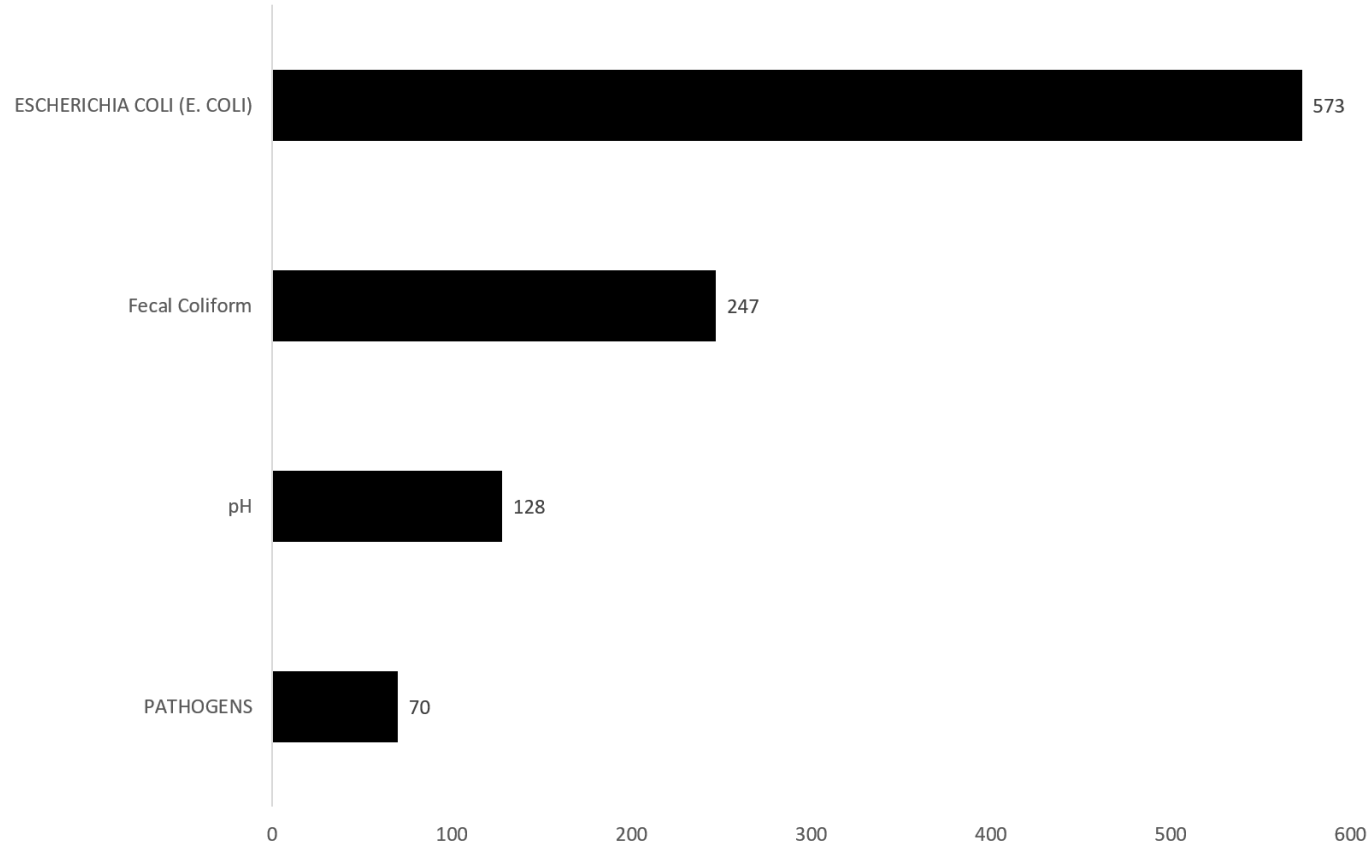


Figure 27. Number of impairments for the recreational uses (PCR and SCR) by parameter for rivers and streams.

Rivers and Streams – Fish Consumption

For those rivers and streams that have been assessed for fish consumption, 45% fully support this designated use, while 48% partially support and 7% do not support the fish consumption designated use, meaning 55% are impaired (Figure 28).

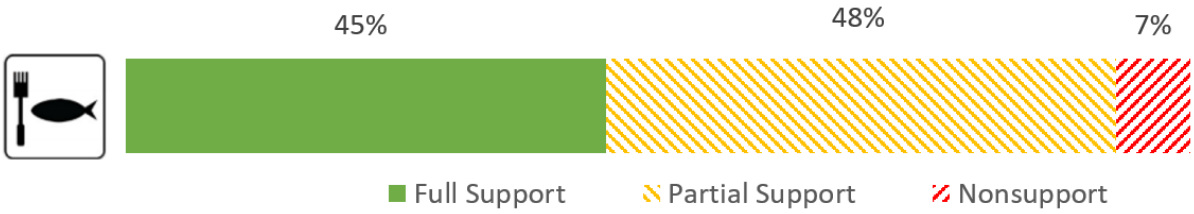


Figure 28. Proportion of attainment for all rivers and streams that have been assessed for the fish consumption designated use during this cycle or any prior cycle.

Looking at only the rivers and streams impaired for fish consumption, six causes are associated with the impairments. Those that cause 10 or more impairments are displayed in Figure 29; (refer to the 305(b) workbook for all listing information).

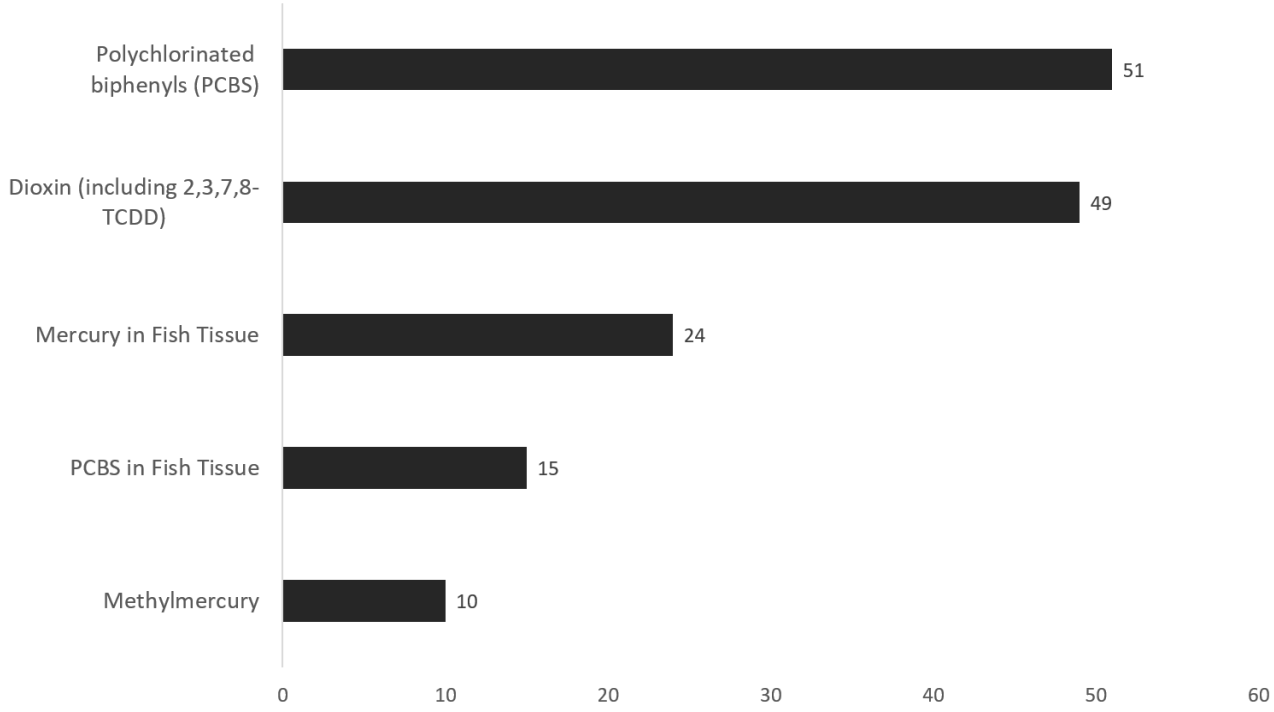


Figure 29. Number of impairments for the fish consumption designated use by parameter for rivers and streams.

Lakes and Reservoirs

Lake and reservoir assessments account for 121 of the 2,879 assessment units on Kentucky's 305(b) list. The total acres of lakes and reservoirs that have been assessed is 203,310 acres. For those lakes and reservoirs that have been assessed, the attainment per designated use is displayed in Figure 30.

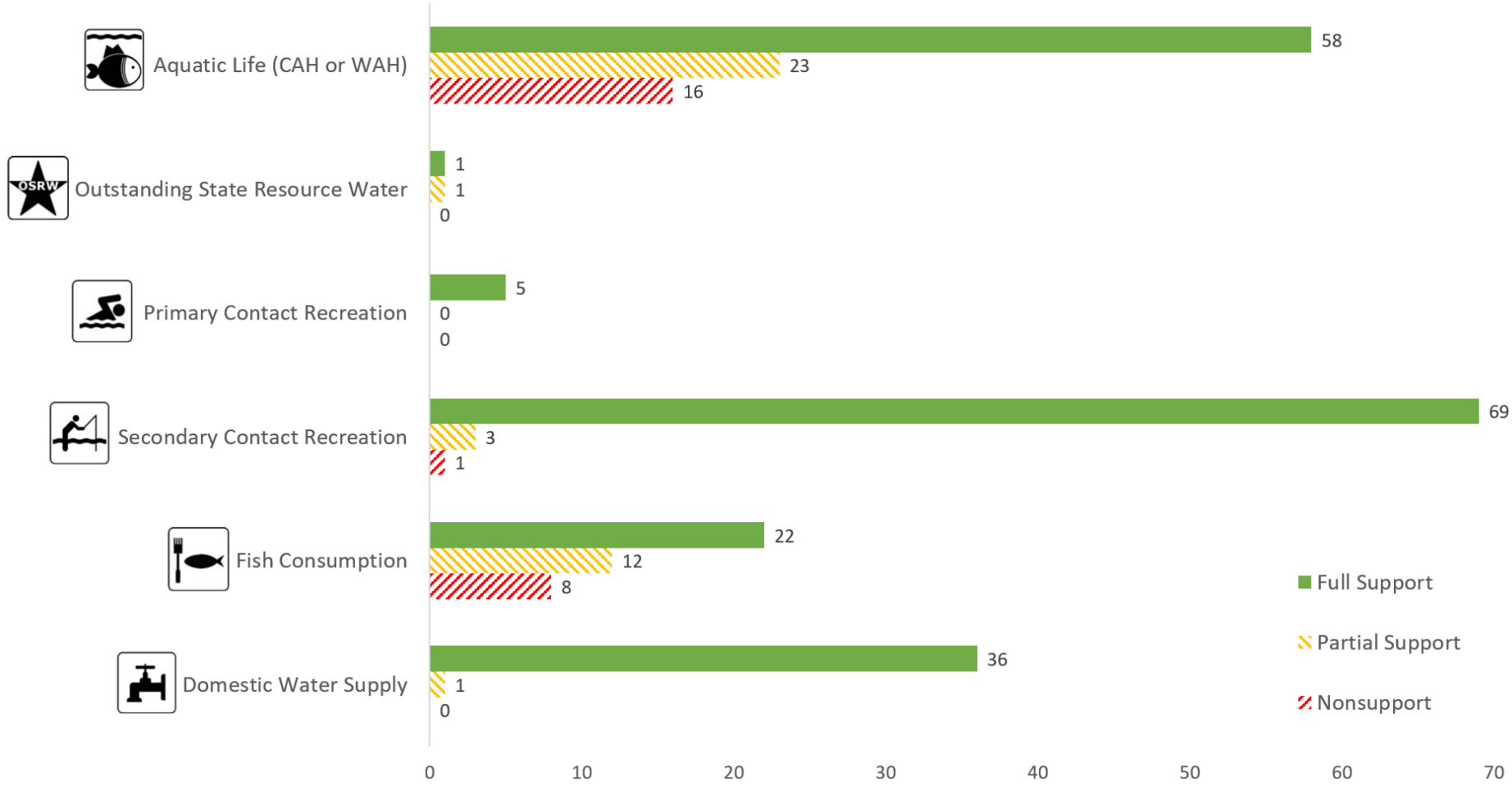


Figure 30. Number of assessment units that are full support, partial support, or nonsupport per designated use for lakes and reservoirs that have been assessed for that use during this cycle or any prior cycle.

Lakes and Reservoirs – Aquatic Life Uses (CAH and WAH)

For those lakes and reservoirs that have been assessed for aquatic life, 60% fully support this designated use, while 24% partially support and 16% do not support the aquatic life designated use, meaning 40% are impaired (Figure 31).

Figure 31. Proportion of attainment for all lakes and reservoirs that have been assessed for the aquatic life (WAH or CAH) designated use during this cycle or any prior cycle.

For most lakes and reservoirs assessed for aquatic life, a trophic status is determined from the trophic status index score (Figure 32). In Kentucky, most lakes and reservoirs assessed for the aquatic life designated use are mesotrophic or eutrophic. Most of the lakes and reservoirs identified as oligotrophic are in the mountains. For all trophic status narratives, refer to the 305(b) workbook.

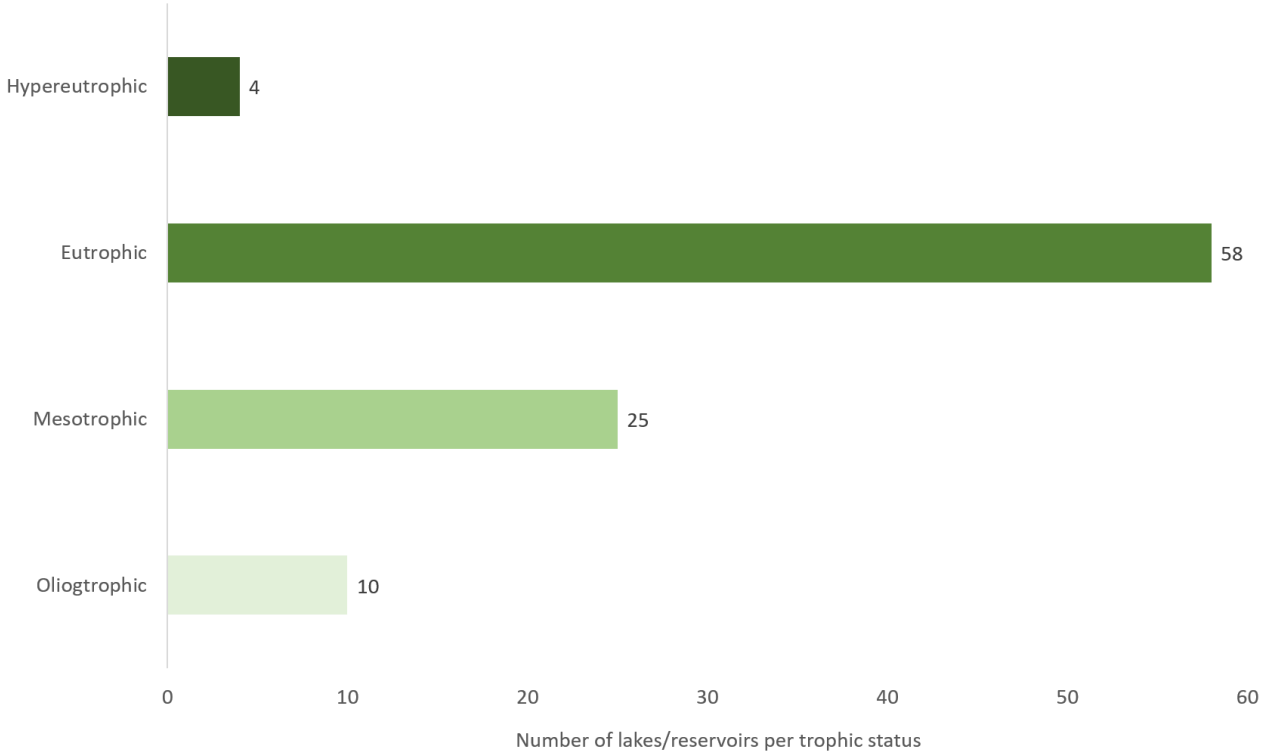


Figure 32. Trophic status for lakes and reservoirs that have been assessed for the aquatic life (CAH or WAH) designated use, where available.

Looking at only the lakes or reservoirs impaired for the aquatic life (CAH or WAH) designated use, three causes are associated with the impairments: nutrient/eutrophication biological indicators, dissolved oxygen, and organic enrichment (sewage) biological indicators (Figure 33). For all listing information, refer to the 305(b) workbook.

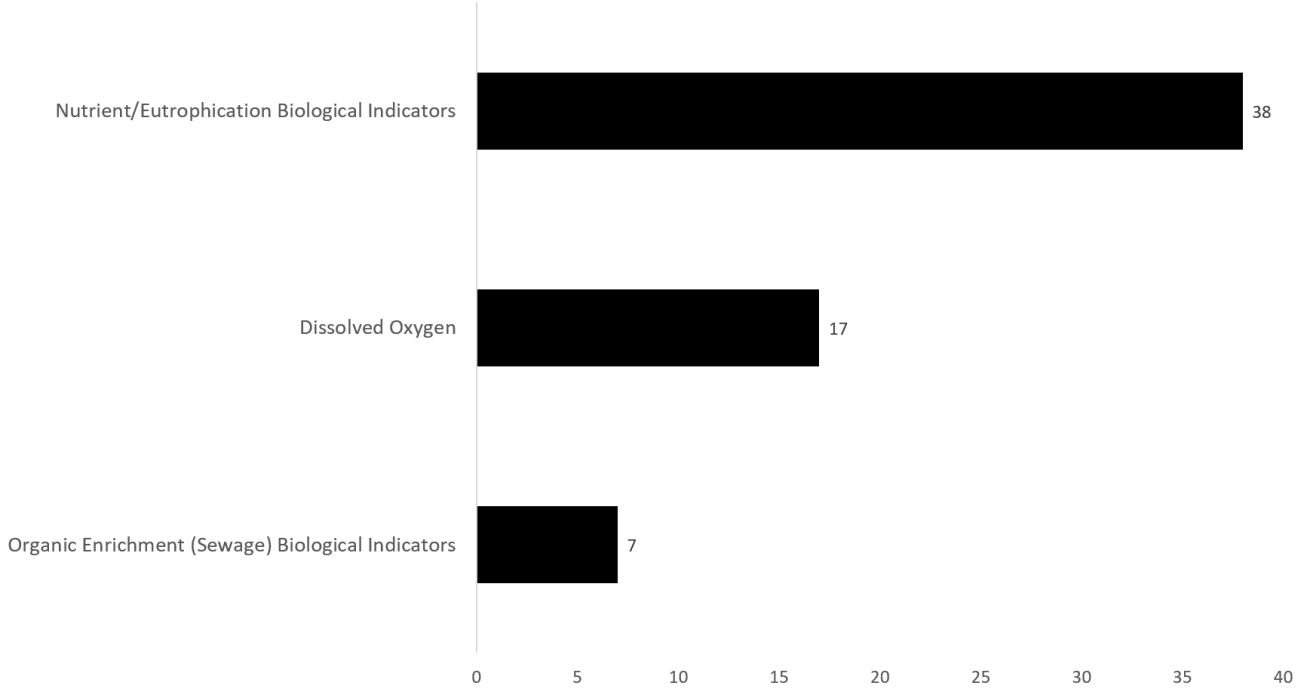


Figure 33. Number of impairments for the aquatic life (CAH or WAH) designated use by parameter for lakes and reservoirs.

Lakes and Reservoirs – Secondary Contact Recreation

For those lakes and reservoirs that have been assessed for SCR, 95% fully support this designated use, while 4% partially support and 1% do not support the SCR designated use, meaning 5% are impaired (Figure 34).

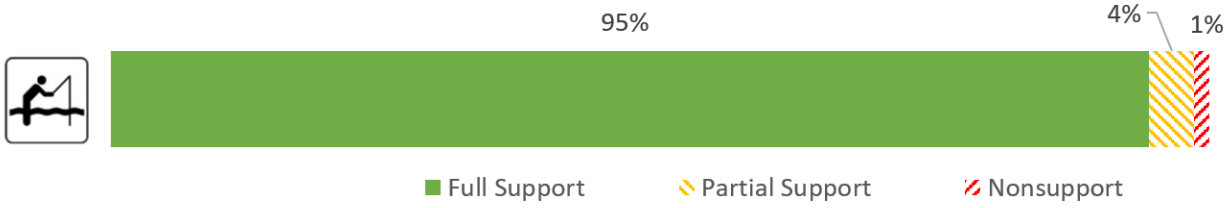


Figure 34. Proportion of attainment for all lakes and reservoirs that have been assessed for the secondary contact recreation designated use during this cycle or any prior cycle.

Looking at only the lakes or reservoirs impaired for SCR, three impairments are due to the pollution aquatic plants (macrophytes), one impairment is due to the pollutant nutrient/eutrophication biological indicators, and one impairment is due to the pollutant sedimentation/siltation. For all listing information, refer to the 305(b) workbook.

Lakes and Reservoirs – Fish Consumption

For those lakes and reservoirs that have been assessed for fish consumption, 52% fully support this designated use, while 29% partially support and 19% do not support the fish consumption designated use, meaning 48% are impaired (Figure 35).

Figure 35. Proportion of attainment for all lakes and reservoirs that have been assessed for the fish consumption designated use during this cycle or any prior cycle.

Looking at only the lakes or reservoirs impaired for fish consumption, three causes are associated with the impairments: mercury in fish tissue, methylmercury, and PCBs in fish tissue (Figure 36). For all listing information, refer to the 305(b) workbook.

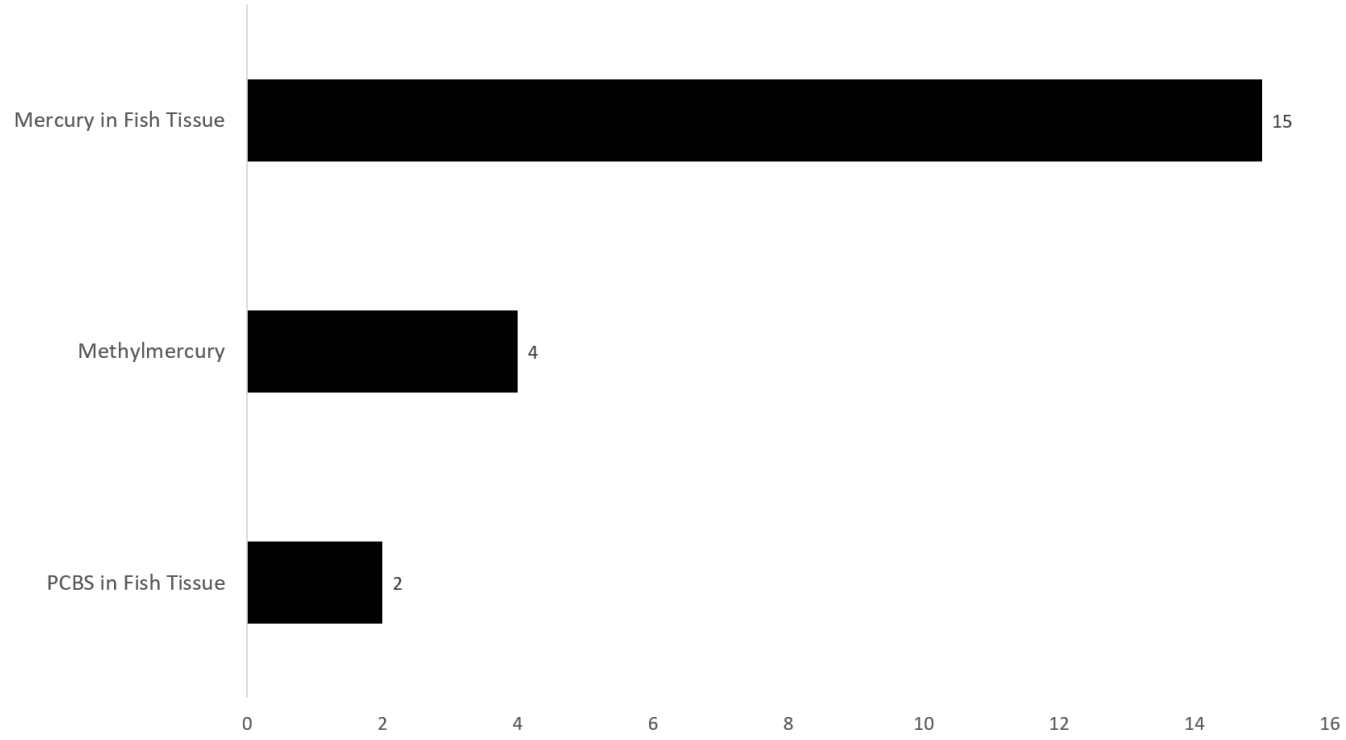


Figure 36. Number of impairments for the fish consumption designated use by parameter for lakes and reservoirs.

Springs

Spring assessments account for 14 of the 2,879 assessment units on Kentucky's 305(b) list. The total size of spring assessments (as represented by the springshed) is 168,055 acres.

Springs – Primary Contact Recreation

PCR is the most commonly assessed designated use for spring assessment units. Of the 14 spring assessment units on Kentucky's 2018/2020 305(b) list, 11 have been assessed for PCR. Of these 11 assessment units, one spring is full support, four springs are partial support, and six springs are nonsupport for PCR. The cause of impairment was always identified as E. coli. For all listing information, refer to the 305(b) workbook.

Program Level Results

Ambient Rivers and Streams

The ambient rivers and streams network is a network of sites throughout the Commonwealth where the same 72 primary sites and 104 rotating sites are sampled on a BMU sampling framework. These sites have their data used for assessment purposes when a new 5-year period is available for review. This is what determines what BMU is the BMU of focus for each IR. Below is a summary of attainment and the causes related to impairment for the aquatic life (CAH or WAH) and PCR designated uses for each BMU of focus for this IR (Salt-Licking, Upper Cumberland and Four Rivers, Green-Tradewater). Since the Ambient Rivers and Streams program focuses on collecting water chemistry and bacteria, most of the causes of impairment are related to these two data types.

Salt-Licking BMU

Aquatic Life (CAH or WAH)

Of the 33 waterbodies assessed for aquatic life (CAH or WAH) by the Ambient Rivers and Streams program in the Salt-Licking BMU, 39% were found to be impaired for the aquatic life (CAH or WAH) designated use, which relates to partial or nonsupport, while 61% were found to fully support the use (Figure 37).

Figure 37. Proportion of attainment for rivers and streams assessed for the aquatic life (CAH or WAH) designated use where data collected by the Ambient Rivers and Streams program from the Salt-Licking BMU contributed to the attainment decision.

Looking at only the impaired segments from the Salt-Licking BMU where data from the Ambient Rivers and Streams program were used as part of the assessment decision, the top three causes of impairment are by the pollutants lead, iron, and sedimentation/siltation (Figure 38). Organic enrichment (sewage) biological indicators, nutrient/eutrophication biological indicators, and cause unknown are also identified as causes of impairment for assessment units related to the Ambient Rivers and Streams network from this BMU (Figure 38).

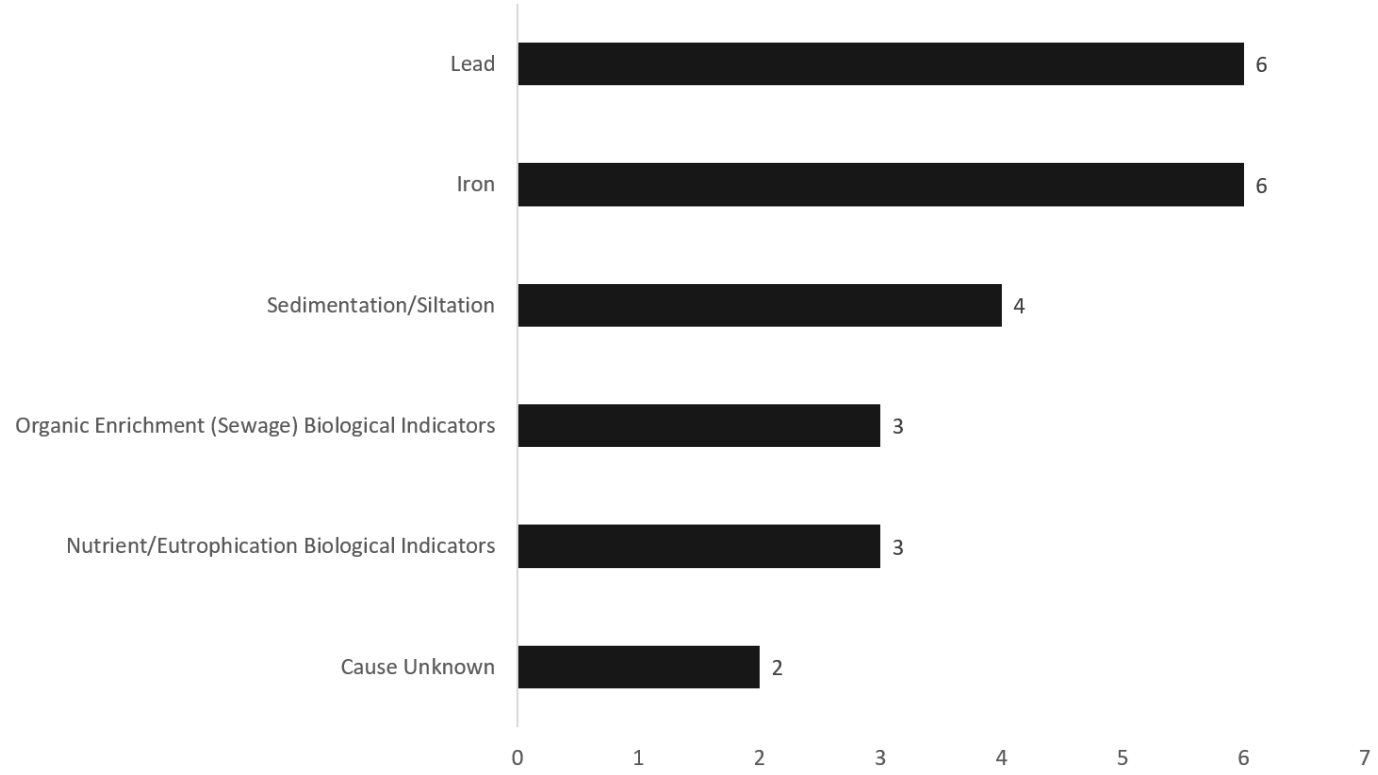


Figure 38. Number of impairments for the aquatic life (CAH or WAH) designated use by pollutant where data collected by the Ambient Rivers and Streams program from the Salt-Licking BMU contributed to the attainment decision.

Primary Contact Recreation

Of the 34 waterbodies assessed for PCR by the Ambient Rivers and Streams program in the Salt-Licking BMU, 79% were found to be impaired for the PCR designated use, which relates to partial or nonsupport, while 21% were found to fully support the use (Figure 39).

Figure 39. Proportion of attainment for rivers and streams assessed for the primary contact recreation designated use where data collected by the Ambient Rivers and Streams program from the Salt-Licking BMU contributed to the attainment decision.

Looking at only the impaired segments from the Salt-Licking BMU where data from the Ambient Rivers and Streams program were used as part of the assessment decision, all PCR impairments are due to bacteria-related parameters, such as pathogens or *E. coli.*

Upper Cumberland and Four Rivers BMU

Aquatic Life (CAH or WAH)

Of the 44 waterbodies assessed for aquatic life (CAH or WAH) by the Ambient Rivers and Streams program in the Upper Cumberland and Four Rivers BMU, 50% were found to be impaired for the aquatic life (CAH or WAH) designated use, which relates to partial or nonsupport, while 50% were found to fully support the use (Figure 40).

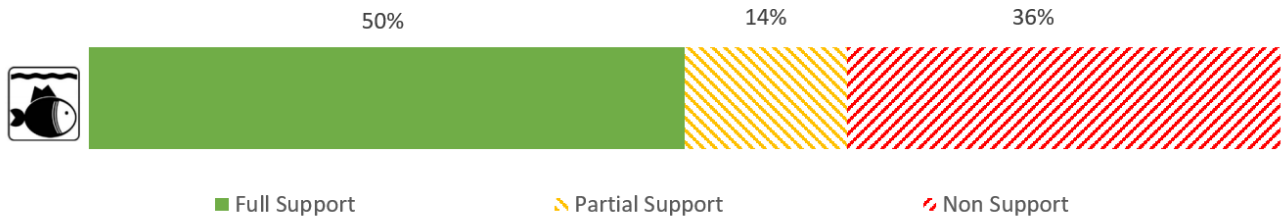


Figure 40. Proportion of attainment for rivers and streams assessed for the aquatic life (CAH or WAH) designated use where data collected by the Ambient Rivers and Streams program from the Upper Cumberland and Four Rivers BMU contributed to the attainment decision.

Looking at only the impaired segments from the Upper Cumberland and Four Rivers BMU where data from the Ambient Rivers and Streams program were used as part of the assessment decision, the top three causes of impairment are by the pollutants lead, iron, and copper (Figure 41). Sedimentation/siltation and nutrient/eutrophication biological indicators are identified as causes for seven and six assessment units, respectively, related to the Ambient Rivers and Streams network from this BMU (Figure 41).

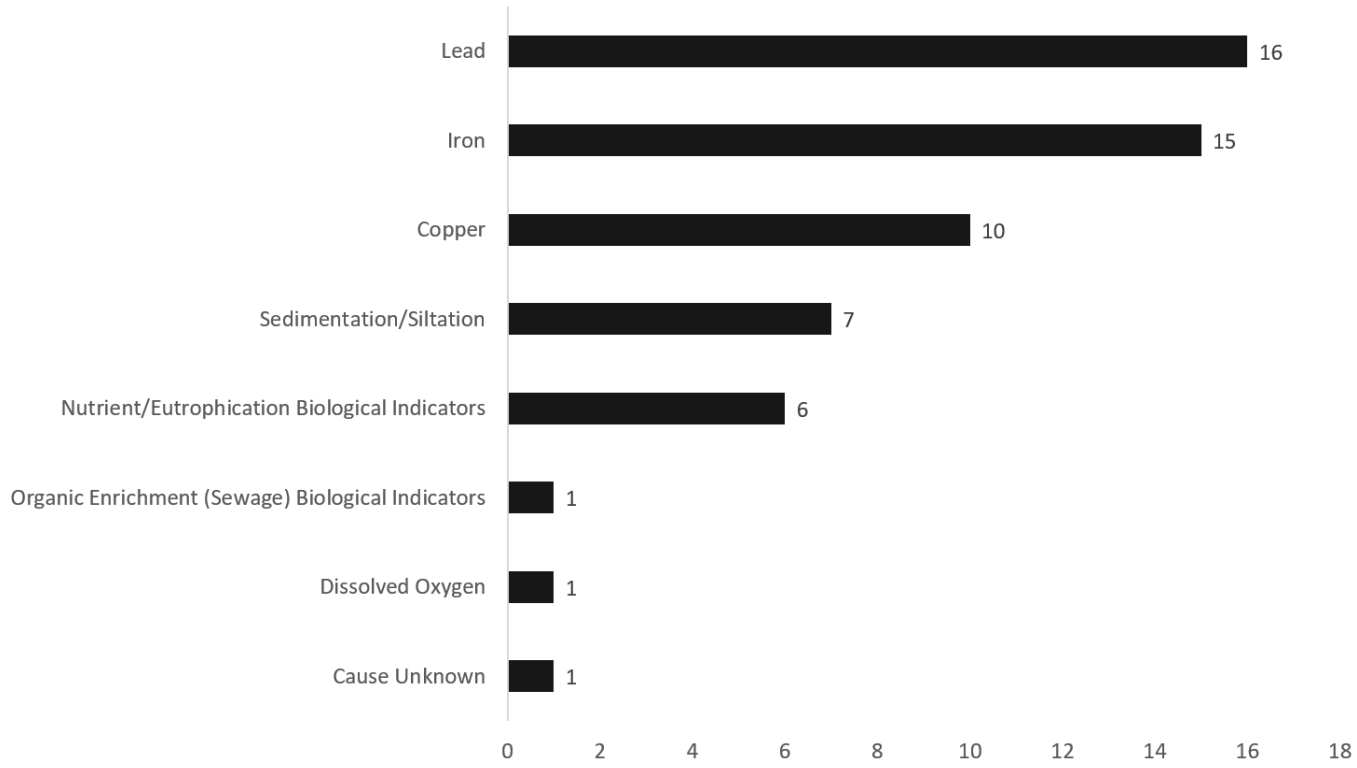


Figure 41. Number of impairments for the aquatic life (CAH or WAH) designated use by pollutant where data collected by the Ambient Rivers and Streams program from the Upper Cumberland and Four Rivers BMU contributed to the attainment decision.

Primary Contact Recreation

Of the 45 waterbodies assessed for PCR by the Ambient Rivers and Streams program in the Upper Cumberland and Four Rivers BMU, 44% were found to be impaired for the PCR designated use, which relates to partial or nonsupport, while 56% were found to fully support the use (Figure 42).

Figure 42. Proportion of attainment for rivers and streams assessed for the primary contact recreation designated use where data collected by the Ambient Rivers and Streams program from the Upper Cumberland and Four Rivers BMU contributed to the attainment decision.

Looking at only the impaired segments from the Upper Cumberland and Four Rivers BMU where data from the Ambient Rivers and Streams program were used as part of the assessment decision, all PCR impairments are due to bacteria-related parameters, such as pathogens or *E. coli.*

Green-Tradewater BMU

Aquatic Life (CAH or WAH)

Of the 57 waterbodies assessed for aquatic life (CAH or WAH) by the Ambient Rivers and Streams program in the Green-Tradewater BMU, 42% were found to be impaired for the aquatic life (CAH or WAH) designated use, which relates to partial or nonsupport, while 58% were found to fully support the use (Figure 43).

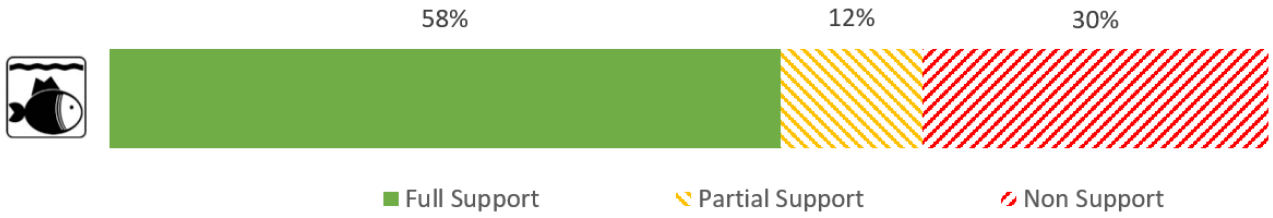


Figure 43. Proportion of attainment for rivers and streams assessed for the aquatic life (CAH or WAH) designated use where data collected by the Ambient Rivers and Streams program from the Green-Tradewater BMU contributed to the attainment decision.

Looking at only the impaired segments from the Green-Tradewater BMU where data from the Ambient Rivers and Streams program were used as part of the assessment decision, the top three causes of impairment are by the pollutants iron, lead, and dissolved oxygen (Figure 44). Sedimentation/siltation, organic enrichment (sewage) biological indicators, nutrient/eutrophication biological indicators, and specific conductivity are identified as causes for three or more assessment units related to the Ambient Rivers and Streams network from this BMU (Figure 44).

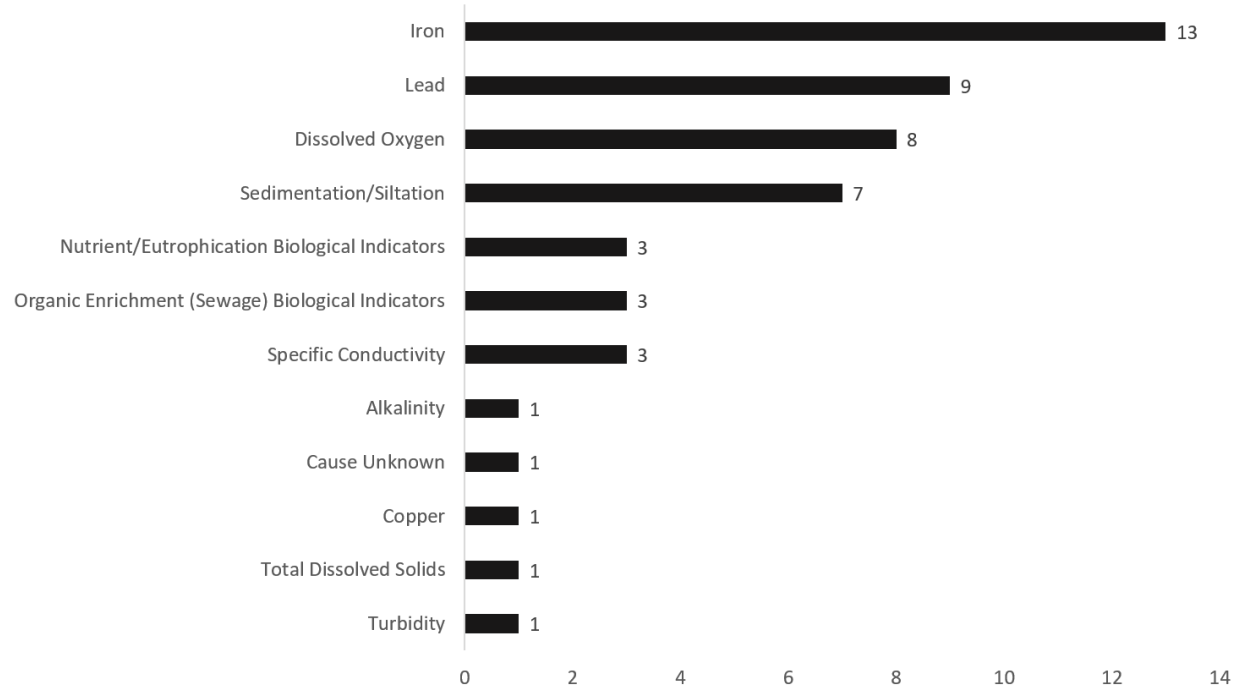


Figure 44. Number of impairments for the aquatic life (CAH or WAH) designated use by pollutant where data collected by the Ambient Rivers and Streams program from the Green-Tradewater BMU contributed to the attainment decision.

Primary Contact Recreation

Of the 59 waterbodies assessed for PCR by the Ambient Rivers and Streams program in the Green-Tradewater BMU, 58% were found to be impaired for PCR designated use, which relates to partial or nonsupport, while 42% were found to fully support the use (Figure 45).

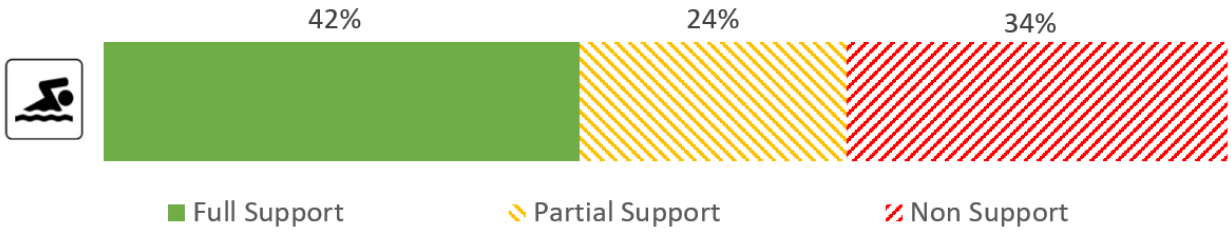


Figure 45. Proportion of attainment for rivers and streams assessed for the primary contact recreation designated use where data collected by the Ambient Rivers and Streams program from the Green-Tradewater BMU contributed to the attainment decision.

Looking at only the impaired segments from the Green-Tradewater BMU where data from the Ambient Rivers and Streams program were used as part of the assessment decision, all PCR impairments are due to bacteria-related parameters, such as pathogens or *E. coli.*

Ambient Lakes

Kentucky lakes assessed during this IR cycle were sampled on a Watershed Management Framework Initiative approach, where the same 108 lakes are sampled on a 5-year BMU sampling rotation. For this IR, 60 lakes from the Salt-Licking, Upper Cumberland and Four Rivers, or Green-Tradewater BMUs were sampled and had their data used for assessment. Below is a summary of attainment and the causes related to impairment for the aquatic life (CAH or WAH) and SCR designated uses, the two designated uses most often assessed using data collected by the Ambient Lake program.

Aquatic Life (CAH or WAH)

Of the 50 waterbodies assessed by the Ambient Lakes program, 58% were found to be impaired for the aquatic life (CAH or WAH) designated use, which relates to partial or nonsupport, while 42% were found to fully support the use during this reporting cycle (Figure 46).

Figure 46. Proportion of attainment for lakes and reservoirs assessed for the aquatic life (CAH or WAH) designated use where data collected by the Ambient Lakes program contributed to the attainment decision.

Looking at only the impaired waterbodies, three parameters are identified as causes of impairment: nutrient/eutrophication biological indicators, dissolved oxygen, and organic enrichment (sewage) biological indicators (Figure 47).

Secondary Contact Recreation

Of the 33 waterbodies assessed by the Ambient Lakes program, 100% were found to fully support the SCR use during this reporting cycle.

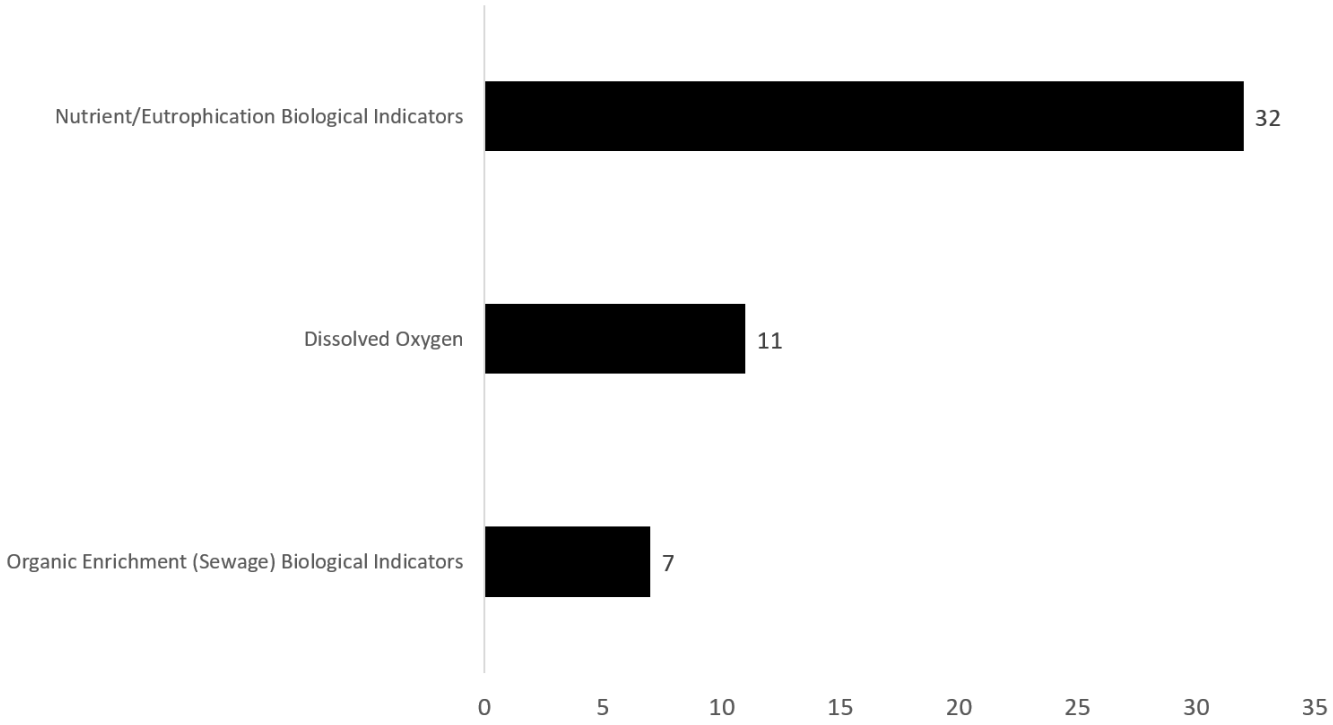


Figure 47. Number of impairments for the aquatic life (CAH or WAH) designated use by pollutant where data collected by the Ambient Lakes program contributed to the attainment decision.

Probabilistic Survey of Wadeable Streams

The probabilistic program sampled 50 random sites from wadeable streams within the Salt-Licking BMU in 2014 and the Upper Cumberland and Four Rivers BMU in 2015. During a site visit, the probabilistic program collects biological community data, collects a one-time grab sample for water chemistry, takes *in situ* measurements, makes field observations, and completes a habitat assessment form.

Attainment decisions made where data from the probabilistic program contributed to the assessment are presented below for the aquatic life (CAH or WAH) designated use. For those waters found to be impaired, parameters identified as causes are also discussed. Since this program focuses on biological community data and habitat assessment, many of the impairments are related to this data type.

Attainment

Salt-Licking BMU

Of the approximately 50 sites randomly selected and sampled by the probabilistic program in the Salt-Licking BMU, 38% were found to fully support the aquatic life (CAH or WAH) designated use, 61% were found to be impaired (partial or nonsupport), and 2% could not be assessed (Figure 48).

Upper Cumberland and Four Rivers BMU

Of the approximately 50 sites randomly selected and sampled by the probabilistic program in the Upper Cumberland and Four Rivers BMU, 31% were found to fully support the aquatic life (CAH or WAH)

designated use, 63% were found to be impaired (partial or nonsupport), and 6% could not be assessed (Figure 48).

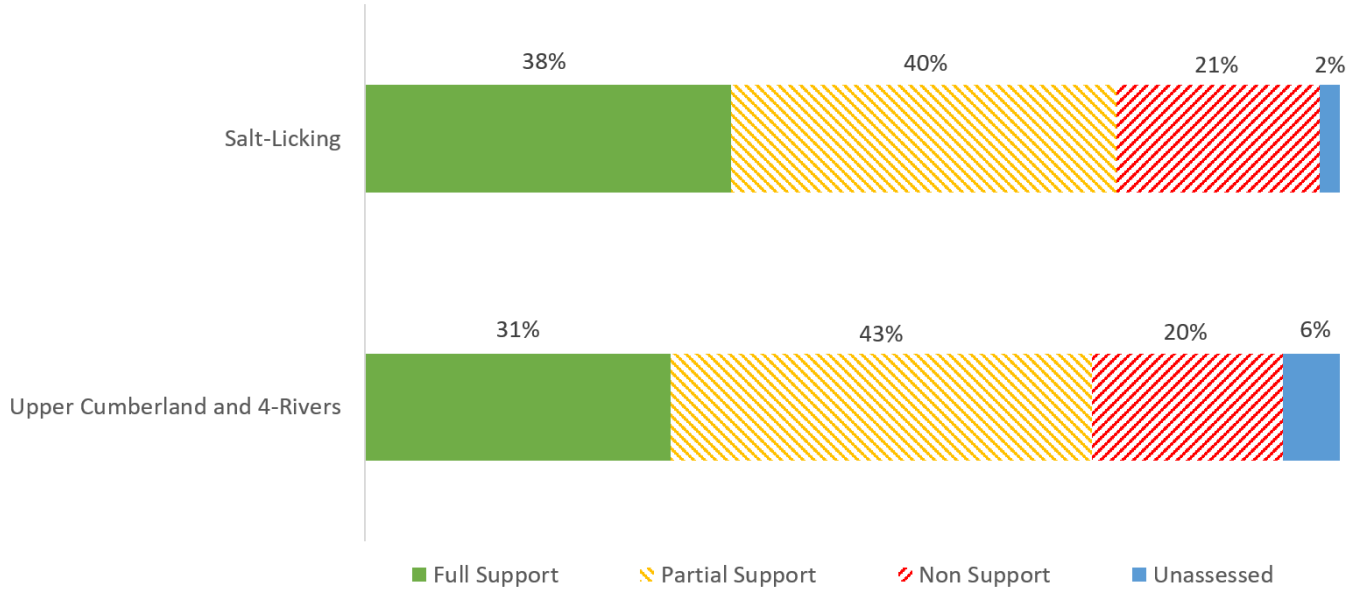


Figure 48. Proportion of attainment for rivers and streams assessed for the aquatic life (CAH or WAH) designated use where data collected by the probabilistic program from the Salt-Licking and Upper Cumberland and Four Rivers BMUs contributed to the attainment decision.

Cause of Impairment

Salt-Licking BMU

Looking at only the impaired segments from the Salt-Licking BMU where data from probabilistic program were used as part of the assessment decision, most of the impairments are attributed to pollutions, such as combined biota/habitat assessments, combination benthic/fishes bioassessments, and habitat assessment (Figure 49). The four pollutants identified as causes of impairment for this BMU were sedimentation/siltation, nutrient/eutrophication biological indicators, pH, and specific conductivity (Figure 49).

Upper Cumberland and Four Rivers BMU

Looking at only the impaired segments from the Upper Cumberland and Four Rivers BMU where data from probabilistic program were used as part of the assessment decision, most of the impairments are attributed to pollutions, such as combined biota/habitat assessments, combination benthic/fishes bioassessments, and habitat assessment (Figure 49). The four pollutants identified as causes of impairment for this BMU were sedimentation/siltation, nutrient/eutrophication biological indicators, iron, and lead (Figure 49).

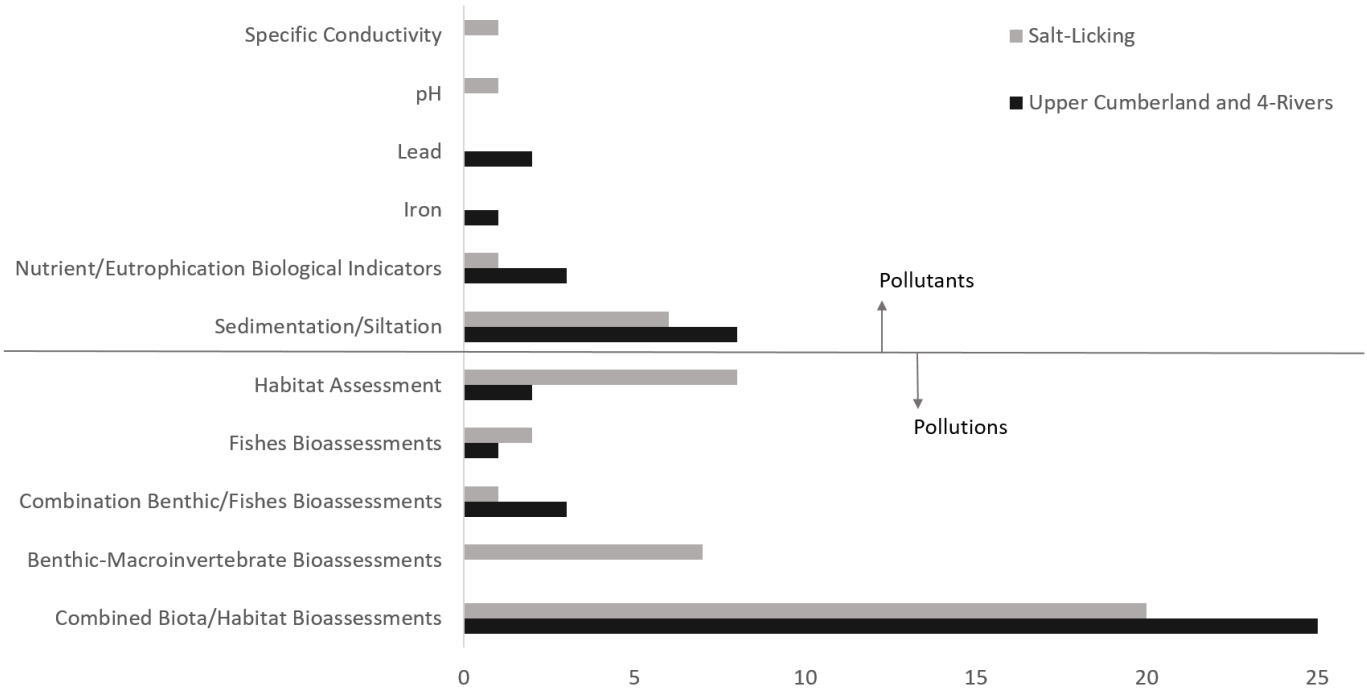


Figure 49. Number of impairments for the aquatic life (CAH or WAH) designated use by parameter where data collected by the probabilistic program from the Salt-Licking and Upper Cumberland and Four Rivers BMUs contributed to the attainment decision. Pollutants and pollutions are separated in figure, top to bottom.

Reference Reach

During this 2018/2020 reporting cycle, 61 assessment units had their assessments updated using data collected by the reference reach monitoring program. This program collects data on water quality, sediment quality, habitat condition, and biological communities.

Attainment decisions are presented below for the aquatic life (CAH or WAH) designated use and the OSRW designated use, where applicable (47 of the 61 assessment units). For those waters found to be impaired, parameters identified as causes are also discussed. Since the reference reach program focuses on biological community data and habitat assessment, many of the impairments are related to this data type.

Attainment

Of the approximately 61 sites sampled by the reference reach program where the data contributed to an assessment decision for the aquatic life (CAH or WAH) designated use, 67% were found to be full support, while 33% were found to be impaired (partial or nonsupport) (Figure 50).

Some of the reference reach sites are located on waterbodies designated as OSRWs. For these reference reach sites that are located along OSRW waterbodies, where data collected by the reference reach program contributed to an assessment decision, 72% were found to fully support the OSRW designated

use, 23% were found to be impaired (partial or nonsupport), and 4% were not assessed for the use (Figure 50).

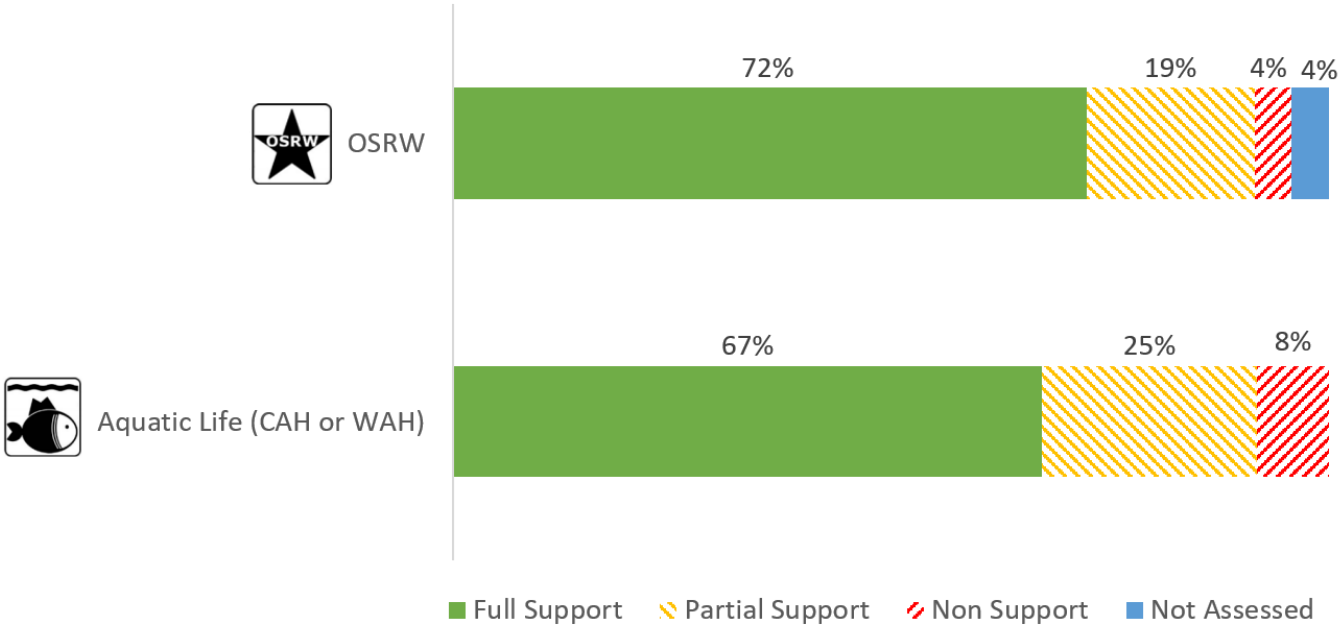


Figure 50. Proportion of attainment for rivers and streams assessed for the aquatic life (CAH or WAH) and outstanding state resource water (OSRW) designated uses where data collected by the reference reach program contributed to the attainment decision.

Cause of Impairment

Looking at only the impaired segments where data from the reference reach program were used as part of the assessment decision, most of the impairments are attributed to pollutions, such as combined biota/habitat assessments, combination benthic/fishes bioassessments, and habitat assessment (Figure 51). The pollutants impairing the aquatic life (CAH or WAH) designated use are copper, iron, lead, mercury, nutrient/eutrophication biological indicators, sedimentation/siltation, specific conductivity, and total dissolved solids (TDS) (Figure 51). The pollutants impairing the OSRW designated use are lead, nutrient/eutrophication biological indicators, and sedimentation/siltation (Figure 51).

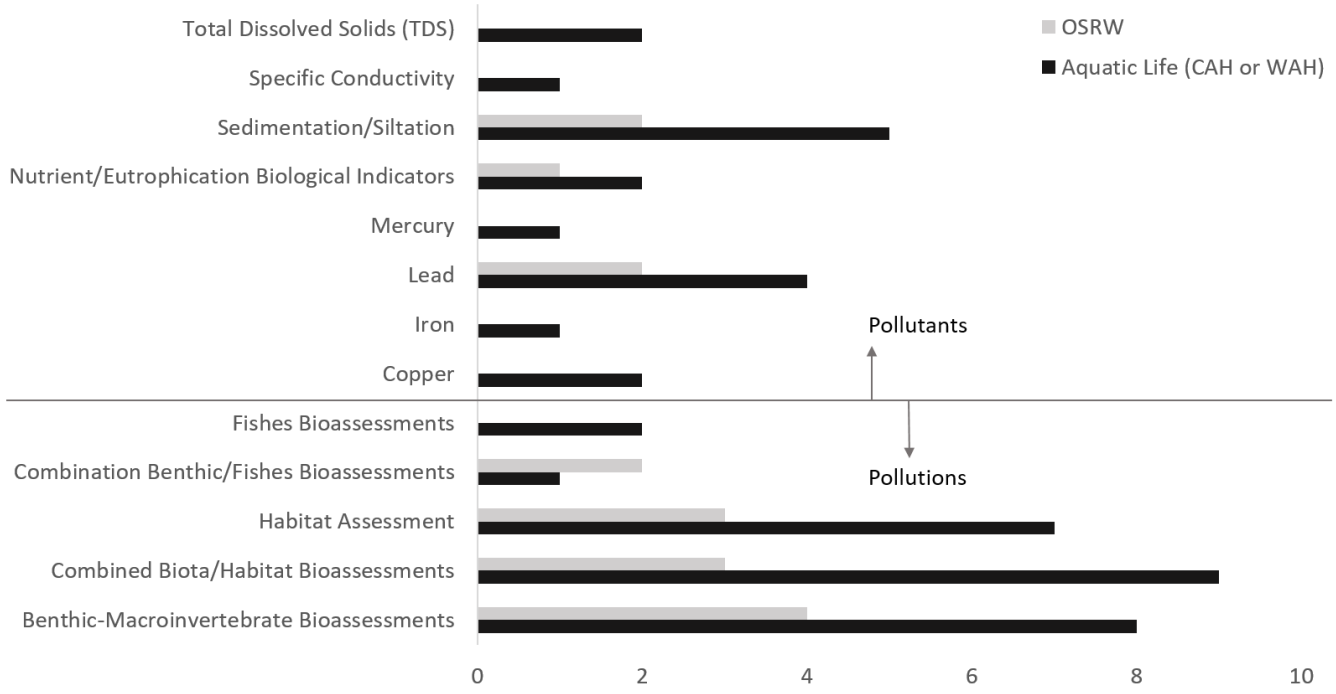


Figure 51. Number of impairments for the aquatic life (CAH or WAH) designated use by parameter where data collected by the probabilistic program from the Salt-Licking and Upper Cumberland and Four Rivers BMUs contributed to the attainment decision. Pollutants and pollutions are separated in figure, top to bottom.

Intensive Surveys

Intensive Surveys refers to programs within the Division that seek to have a better understanding of a particular waterbody, watershed, or region. This program typically collects monthly water chemistry for 1 to 3 years, bacteria during at least 1 recreation season, and biological community data. The following Intensive Surveys per program had their data used in this 2018/2020 IR cycle.

Success Monitoring:

- Hinkston Creek watershed, collected in 2014 and 2015
- Little Pitman Creek watershed, collected in 2016
- Martis Branch watershed, collected in 2016
- Pleasant Run watershed, collected in 2016
- North Fork Kentucky River Tributaries in Letcher County, collected in 2017 and 2018

TMDL:

- Claylick Creek watershed, data collected in 2013 and 2014
- Cypress Creek watershed, data collected 2016 - 2018
- Strodes Creek watershed, data collected in 2014 and 2015
- Damon Creek watershed, data collected in 2015

- Chestnut Creek watershed, data collected in 2016

Other Intensive Survey projects:

- Bluegrass Nutrient Study, data collected 2013 - 2015
- Marsh Creek watershed, data collected in 2013 and 2014
- Wild Rivers project, data collected 2013 – 2016

Below is a summary of the designated use attainment and causes of impairment where data collected as part of an intensive survey were used for assessment in this 2018/2020 IR. This program typically assesses previously unassessed waters, and often focuses in areas with known impairments where water quality improvement plans, such as TMDLs or watershed plans, have been developed or may be developed in the future. Therefore, the high proportion of impairment is expected, and these types of monitoring programs significantly contribute to Kentucky's 303(d) list each reporting cycle.

Aquatic Life (CAH or WAH)

Of the 165 assessment units where sampling completed by an intensive survey program contributed to an aquatic life (CAH or WAH) attainment decision, 30% were found to be full support, while 70% were found to be impaired (partial or nonsupport) (Figure 52).

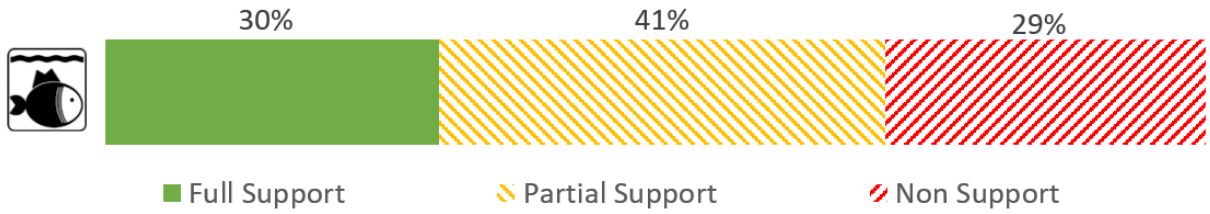


Figure 52. Proportion of attainment for rivers and streams assessed for the aquatic life (CAH or WAH) designated use where data collected as part of an intensive survey contributed to the attainment decision.

Looking at only the impaired segments where data collected as part of an intensive survey contributed to an attainment decision for aquatic life (CAH or WAH), there is a greater mix of pollutions and pollutants contributing to the impairments, and the type of pollutants are more varied when compared to other programs (Figure 53). This is expected from intensive survey programs, where the watersheds selected are monitored extensively for one to three years, and a variety of data types are collected. The pollutants contributing to more than 10 impairments are nutrient/eutrophication biological indicators, sedimentation/siltation, specific conductivity, iron, organic enrichment (sewage) biological indicators, and lead (Figure 53).

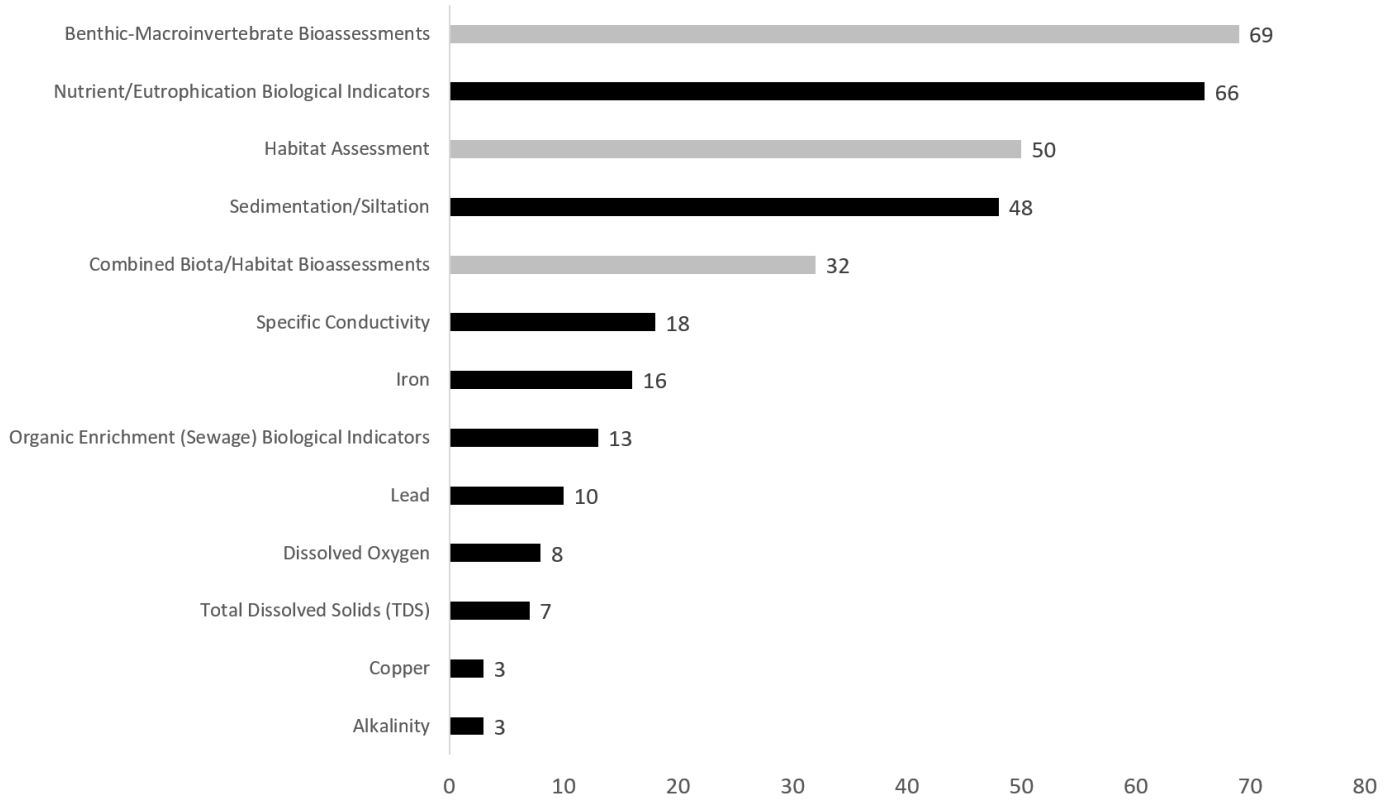


Figure 53. Number of impairments for the aquatic life (CAH or WAH) designated use by parameter where data collected as part of an intensive survey contributed to the attainment decision. Graph only shows those parameters that are identified as a cause of impairment in more than one (1) assessment unit. Pollutants in **black**; Pollutions in gray.

Primary Contact Recreation

Of the 81 assessment units where sampling completed by an intensive survey program contributed to a PCR attainment decision, 16% were found to be full support, while 84% were found to be impaired (partial or nonsupport) (Figure 54).

Figure 54. Proportion of attainment for rivers and streams assessed for the primary contact recreation designated use where data collected as part of an intensive survey contributed to the attainment decision.

Looking at only the impaired segments where data collected as part of an intensive survey contributed to an attainment decision for PCR during this cycle, all impairments are related to the pollutant *E. coli*.

Outside Agency Contribution

Data collected by outside agencies (such as USACE and USGS) contributed to the attainment decision for one or more designated uses along 67 assessment units. Data were used to assess the waterbody types rivers/streams and lakes/reservoirs. Below is a summary of the aquatic life use attainment and causes of impairment where data collected by an outside agency were used for assessment in this 2018/2020 IR.

Aquatic Life (CAH or WAH)

Of the 62 assessment units where sampling completed by an outside agency contributed to an aquatic life (CAH or WAH) attainment decision, 31% were found to be full support, while 69% were found to be impaired (partial or nonsupport). The parameters identified as a cause of impairment in more than one waterbody were benthic-macroinvertebrate bioassessments, habitat assessment, pH, and nutrient/eutrophication biological indicators.

Public Health

Harmful Algal Bloom Monitoring

Cyanobacteria are photosynthetic bacteria that live in all types of water in Kentucky and around the world. They are also known as blue-green algae because of their blue-green appearance, which is caused by the presence of the blue pigment, phycocyanin. During certain times of the year, cyanobacteria can be the dominant component of the algae community in a river or lake. Certain environmental conditions allow for the prolific reproduction of blue-green cells forming a “bloom.” Most of the year, their presence causes minimal negative impact to water quality or human/animal health. However, when blue-green algal blooms form, water quality and human/animal health can be negatively impacted in several ways. Water quality is negatively impacted by the bloom causing discoloration of the water, drastic reductions and wide fluctuations in dissolved oxygen levels, increased turbidity, and decreased light penetration. Fish may be negatively affected by an overall reduction in food availability or when oxygen levels drop and become limited in lakes. Public recreation is negatively impacted by blooms because the nuisance scums and mats make swimming or wading in the water less desirable. In lakes that serve as sources of drinking water, blue-green algal blooms can cause taste and odor problems resulting in increased lake management (i.e. application of copper sulfate or other algaecide) and filtration costs. Additionally, blooms can clog filters at the intake structure, causing increased maintenance costs.

Although the above-mentioned impacts are important issues to consider when cyanobacteria blooms form, the most significant issue may be the presence of toxins produced by the cyanobacteria cells as the bloom is occurring and during the dying-off process. These blooms are known as harmful algal blooms (HABs) due to their potential impacts on public health. Cyanobacteria may cause skin irritation and flu-like symptoms from endotoxins located within the cell walls. Additionally, these taxa can produce liver and nerve toxins, called cyanotoxins. The most common of these cyanotoxins, microcystin, is a liver toxin that can cause illness or death in animals and humans. Over the past twenty

years, more than a dozen complaints have been received by the Water Quality Branch (WQB) of the Kentucky DOW concerning deaths of pets or livestock as a result of drinking tainted water. (These blooms have always been associated with farm ponds where livestock had unlimited access to the pond.) Although not directly implicated in human death, exposure to cyanotoxins has been linked to liver disease, respiratory problems, and nervous system problems. Health risks from contact or ingestion exposure of cyanotoxins are increased for the elderly, young children, pregnant women, and persons with suppressed immune systems.

Although some HABs occur during the cold seasons, they most frequently occur during the late summer when temperatures are high, sunlight is ample, and water flow is low. In addition, one of the most influential factors of HAB growth is the concentration of nutrients such as nitrogen and phosphorus. Most nitrogen and phosphorus pollution (also known as nutrient overloading) comes from the runoff of fertilizers (lawns, agriculture, golf courses), untreated human sewage (storm overflows), and untreated animal sewage. Many lakes and reservoirs in Kentucky that are eutrophic (high nutrient/high algal production) are at elevated risk for having HABs.

The Division and the USACE began testing and documenting cyanobacteria in 2013 in 5 USACE reservoirs and 14 additional non-USACE reservoirs using cell counts (the number of cyanobacteria cells in a milliliter of water). Based on elevated cell counts in 2014, DOW and USACE identified the presence of potential HABs at Barren River Reservoir, Beaver Lake, Campbellsville City Reservoir, Carpenters Lake, General Butler State Park Reservoir, Green River Reservoir, Greenbrier Creek Reservoir, Guist Creek Lake, Lake Reba, Long Run Lake, McNeely Lake, Nolin Reservoir, Reformatory Lake, Rough River Reservoir, Taylorsville Reservoir, and Willisburg Lake.

In 2015, DOW began working with other agencies in the state to develop protocols for sampling and issuing HAB-related advisories based on microcystin and cylindrospermopsin toxin concentrations in recreational waters. Cyanotoxin concentrations are a more reliable indicator of potential health concerns than relying on cell counts alone, as the presence of cyanobacteria does not necessarily indicate that toxins are present also. For the 2015 recreation season, DOW and USACE revisited the reservoirs that had HAB recreational advisories in 2014 and collected samples for cyanotoxin testing during June-August of 2015. Most of the reservoirs had toxin levels that were below the laboratory detection limit at the time sampled. However, Herrington Lake and Lake Reba experienced microcystin toxin levels above 20 µg/L during the 2015 season. Additionally, the Ohio River had elevated toxin levels in multiple pools in the state in August-October 2015.

In 2016, three advisories were issued: a Future Farmers of America (FFA) Camp lake in Breckinridge Co., Briggs Lake in Logan Co., and Boltz Lake in Grant Co. The FFA Lake and Briggs Lake advisories were based on total microcystin concentrations above the warning and watch thresholds respectively. Boltz Lake had cylindrospermopsin concentrations over 500 µg/L. The advisory was the first cylindrospermopsin-based advisory in Kentucky. The advisories on Briggs and the FFA Lakes were lifted during 2016, but the advisory on Boltz Lake was not lifted until June 2017. There were no new advisories in 2017.

The DOW does not have the resources to routinely visit all public lakes across the state. The Division utilizes remote sensing, reports from the public or other agencies, and a new volunteer monitoring network initiated in 2017 to identify lakes with potential HABs. Once a possible HAB is identified, grab samples are collected if possible and sent to the lab for analysis. Results are reviewed to determine if a recreational advisory is warranted.

Advisories

HABS

Action levels for HAB watch and warning advisories are detailed in Table 9. Recreational advisories will be placed when the action limits in this table are exceeded. Action levels for total microcystins (all congeners) and cylindrospermopsin recommended by EPA were adopted by the Kentucky HAB Work Group in 2019. Action levels for anatoxin-a utilized by Ohio were adopted by the Kentucky HAB Work Group in 2019.

Table 9. Thresholds for advisories for total microcystins, cylindrospermopsin, and anatoxin-a.

Advisory Type	Cyanotoxin Thresholds (µg/L)			
	Total Microcystins	Cylindrospermopsin	Anatoxin-a	HAB Viewer Color
Recreational Public Health Advisory - Algal toxins present at unsafe levels. Swimming, wading, and water activities that create spray are not recommended.	8	15	80	Red

Current HAB advisories can be located using the Harmful Algal Bloom Viewer.

If you suspect that you have seen a HAB, please report the bloom to the Kentucky DOW by calling 502-564-3410 or emailing water@ky.gov. After hours and on weekends, you may contact the 24-hour hotline at 502-564-2380 or 1-800-928-2380. Blooms can also be reported using the BloomWatch app.

Fish Consumption

The Kentucky Departments for Environmental Protection, Public Health, and Fish and Wildlife Resources jointly issue fish consumption advisories to the public when fish are found with trace contaminants of mercury, PCBs, and chlordane.

These advisories caution citizens about potential health problems that may result from eating fish caught statewide as well as from a particular waterbody. These advisories do not ban eating fish; it is a guide to help citizens reduce risk and make informed decisions about eating fish from Kentucky waters. This guidance provides information on how often fish may be safely eaten. Most fish are healthy to eat and are an excellent source of low-fat protein.

Kentucky's fish consumption advisories

A multi-agency workgroup that consists of representatives from the main stem states, EPA and the Ohio River Valley Water Sanitation Commission (ORSANCO) establish advisories for the Ohio River.

Ohio River Fish Consumption Advisories

Swimming

The Kentucky DOW in the Energy and Environment Cabinet and the Division of Public Health Protection and Safety in the Cabinet for Health and Family Services agree that swimming advisories that have been

in place for several years in different areas of the state because of high levels of E. coli bacteria should remain in effect until further notice.

People should avoid recreational contact with waters in the areas specified because of the bacteria, which occur in human and animal waste and indicate the presence of untreated or inadequately treated sewage. The bacteria create a potential for diarrheal illnesses and other infectious diseases.

Swimming advisories remain in effect for the following:

Upper Cumberland River

- The Cumberland River from Four Mile Bridge (Highway 2014) to Pineville at the Highway 66 Bridge and from Wallins Creek Bridge (Highway 219) to Harlan
- Martins Fork from Harlan to the Cawood Water Plant
- All of Catron Creek, all of Clover Fork and all of Straight Creek
- Poor Fork from Harlan to Looney Creek
- Looney Creek from the mouth to Lynch Water Plant Bridge

Kentucky River

North Fork of the Kentucky River upstream of Chavies. Although still above recommended levels, water quality has continued to improve and is approaching an acceptable level for swimming in some stretches of the river.

Licking River

Banklick Creek to the confluence with the Ohio River. The swimming advisory includes all of Banklick Creek and Three Mile Creek. Inadequate or failing sewage treatment systems can contribute to water quality problems along Kentucky waterways. Efforts by the Cabinet for Health and Family Services and local environmental health staff to ensure all new septic system installations are installed properly, and work by DOW and wastewater plant operators to monitor wastewater treatment plant compliance are reducing bacterial pollution from these possible sources. Work by both agencies is gradually reducing the number of discharges and improving water quality.

Residential and Agricultural Areas

The agencies also recommend against swimming or other full-body contact with surface waters immediately following heavy rainfall events, especially in dense residential, urban and livestock production areas. This recommendation is due to an increased potential for exposure to pollution from urban NPS pollution, bypasses from sewage collection systems, combined sewer overflows (CSO), and pollution from livestock waste. The public should avoid recreating in stream segments below wastewater treatment facility outfalls, confined animal feedlots or other obvious sources of pollution during any time of the year.

The agencies urge the public to use a common-sense approach to water recreation. Avoid areas with obvious green or brown surface scums or obvious foul odors. The cabinets want everyone to be safe and healthy while enjoying the Commonwealth's water resources.

Planning, Protection, and Pollution Control

Total Maximum Daily Load Program

The TMDL program, established under Section 303(d) of the CWA, focuses on identifying and restoring polluted Kentucky waterbodies such as rivers, lakes and streams.

States must develop a TMDL calculation for each pollutant identified as a cause of impairment on 303(d) list. TMDL calculations are found in TMDL reports. A TMDL Report is a water quality restoration plan that describes how pollutant loads can be reduced to meet water quality standards.

Impaired Waters Restoration Process

The TMDL program coordinates with several other CWA programs such as permitting, monitoring and the 319 NPS Pollution Control Program to accomplish water quality restoration goals in Kentucky. TMDLs are an integral part of the Impaired Waters Restoration Process (Figure 55).

Figure 55. Schematic of impaired water restoration process.

Waterbodies identified as impaired by pollutants are placed on the 303(d) list in the 305(b)/303(d) IR. Once these waters are 303(d)-listed, water quality restoration planning can begin.

Kentucky is required to develop a TMDL calculation for each pollutant causing a waterbody to be placed on the 303(d) list. These calculations can be found in water quality restoration plans called TMDL reports. TMDL reports describe how pollutant loads can be reduced to meet water quality standards. TMDL implementation plans and watershed management plans can be incorporated into TMDL reports or prepared separately. Under some circumstances, other types of water quality restoration plans may be developed for waterbodies on the 303(d) list, in advance of TMDL development. These "alternative restoration approaches" (see next section) are most appropriate in cases where activities are planned or in progress that are expected to fully restore water quality in which case the water would be delisted and a TMDL not needed.

After the planning phase, facilitated by the TMDL, pollution control practices from the water quality restoration plan are implemented to reduce the amount of pollutants entering a waterbody. Discharge of pollutants can be limited by setting permit limits for point sources or implemented BMPs for non-point sources pollution.

Once the pollution control practices have had time to take effect, the impaired waterbodies will be monitored and tracked to determine if water quality is improving. An impaired waterbody is considered fully recovered or restored when water quality standards have been met and designated uses have been achieved. This generally occurs many years after a plan was put in place.

Alternative Restoration Plans

An alternative restoration plan is a near-term water quality restoration plan with a schedule of actions and milestones that are more immediately beneficial or practicable to achieving water quality standards than a TMDL.

Kentucky communities that take initiative to develop and implement water quality restoration plans to clean up impaired waters may successfully restore water quality to meeting standards, thereby removing the need and requirement for a TMDL. Alternative approaches are developed and carried out by the local community, which allows for flexibility in the water quality restoration process.

Alternative restoration plans are submitted to and accepted by the EPA. The impaired waters in an alternative restoration plan will remain in category 5 on the 303(d) list, but will typically be assigned a lower priority for TMDL development while the plan is underway. If water quality standards are not achieved by the plan, a TMDL is still required. Plan progress is reviewed regularly by DOW to ensure that the TMDL development priority should remain low.

The EPA-accepted alternative restoration plans for Kentucky may be downloaded from the table on the alternative approaches webpage. There is currently one EPA-accepted plan available but several more are in development with expected completion in 2022.

TMDL Program Priorities

Kentucky DOW is implementing the national CWA 303(d) Program Vision, which calls for states to prioritize impaired waters for TMDL development and to develop alternative restoration approaches where appropriate over a six-year period (2016-2022).

In 2011, the CWA 303(d) Program Vision was developed by the EPA and state TMDL program managers as means to improve the effectiveness of the TMDL program. The framework outlined in this program "vision" allows Kentucky to develop state specific priorities, encourages stakeholder engagement, and allows the TMDL section to integrate our work with other CWA program priorities. The vision fosters flexible watershed management but requires the support of many stakeholders – including public, federal, and state agencies – to attain this common goal.

In 2016, Kentucky DOW submitted its first draft of vision priorities to the EPA. The vision priorities list was updated in 2018 using the 2016 303(d) list. This vision priorities list consists of pollutant-waterbody combinations that are prioritized to have a TMDL or alternative restoration plan completed by 2022.

Kentucky DOW's top vision priority for TMDL development is to address all remaining bacteria impairments in the Commonwealth. Another vision priority includes working with stakeholders to develop alternative restoration approaches in communities with the on-the-ground resources to address water quality impairments more quickly than a TMDL approach. Kentucky's first EPA-accepted alternative restoration plan was possible with the cooperation of various stakeholders in the Gunpowder Creek Watershed.

As of this 2018/2020 Integrated Report, Kentucky has completed plans addressing 308 pollutant-waterbody combinations that are part of the vision priorities covering a watershed area of 1,333 square miles. This represents progress towards completion of 72% by pollutant-waterbody combinations (Figure 56) and 61% by watershed area for completing DOW's commitments for plans in place by the

end of 2022. Remaining plans are in development and currently on track for completion before the 2022 Integrated Report. Note that a small percentage of plans (2% of the total pollutant-waterbody combinations that were identified as priorities) will not receive a plan in this effort for a variety of reasons, including some where new data showed that water quality is now meeting standards and the waterbody is slated for delisting.

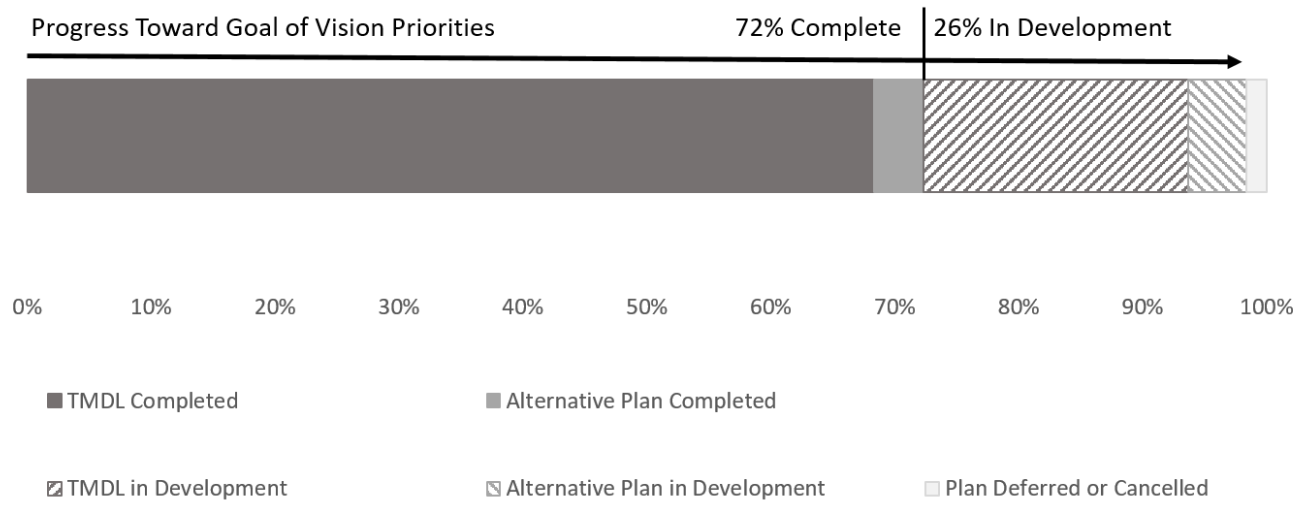


Figure 56. Progress toward completing vision priorities as of this 2018/2020 reporting cycle; the goal is to have all in development plans completed by the end of 2022, fulfilling DOW's vision priority commitments.

For additional information on the vision, read "Questions and Answers" on the Long-term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program.

If you have questions about the TMDL program, the vision, or alternative restoration approaches, email TMDL@ky.gov.

Nonpoint Source Program

The Kentucky Nonpoint Source Pollution Control Program (NPS Program) is authorized under Section 319 of the CWA amendments of 1987. The Section 319(h) Grant program was established to provide funding for efforts to reduce nonpoint source pollution. Each year DOW applies to EPA to receive 319(h) funding. Funds may be used to demonstrate innovative BMPs, support education and outreach programs, develop Watershed Based Plans, and to implement Watershed Based Plans.

The mission of the NPS Program is to protect the quality of Kentucky's surface and groundwater from known NPS pollution, to abate NPS threats, and to restore degraded waters to meet water quality standards. To support this vision, the NPS Program coordinates statewide efforts to minimize nutrient, sediment, and bacteria pollution through partnerships with federal, state, and local entities.

Effective NPS pollution reduction requires the participation of a variety of stakeholders and often leveraging the resources of multiple partnering agencies beyond DOW. The Kentucky NRCS selects NWQI watersheds for long-term investment in agriculture BMPs that improve water quality. DOW collaborated with the NRCS to identify Gunpowder Creek as a strong candidate for NWQI and assisted with implementation strategies, partnership opportunities and procurement of water quality data. The additional funding provided by NRCS supplemented ongoing watershed plan implementation and contributed to faster recovery in the basin. In addition, this collaboration helped Gunpowder Creek become Kentucky's first EPA-accepted alternative restoration plan. In 2020, the NPS Program worked with NRCS on Focused Conservation Projects, which seek to quantify water quality benefits of agricultural BMPs in watersheds across the state, while assisting with selection of new NWQI and Mississippi River Basin Initiative (MRBI) watersheds.

DOW also has a long-standing relationship with the state Division of Conservation (DOC), where coordinated investments in state soil and water cost-share practices help match federal funding for BMP implementation of NPS watershed plans. These collaborations help amplify individual programmatic objectives and broaden the impacts of dollars spent in the watershed. NPS Program staff are instrumental in facilitating these types of interagency projects, allowing stakeholders who share the goal of reducing NPS pollution to maximize their impact on water quality by working together.

Implementation

The state NRCS office and DOC regularly provide DOW with reports on water quality management practices implemented at the HUC-12 scale, which help track concerted public and private efforts that improve water quality (Figure 57).

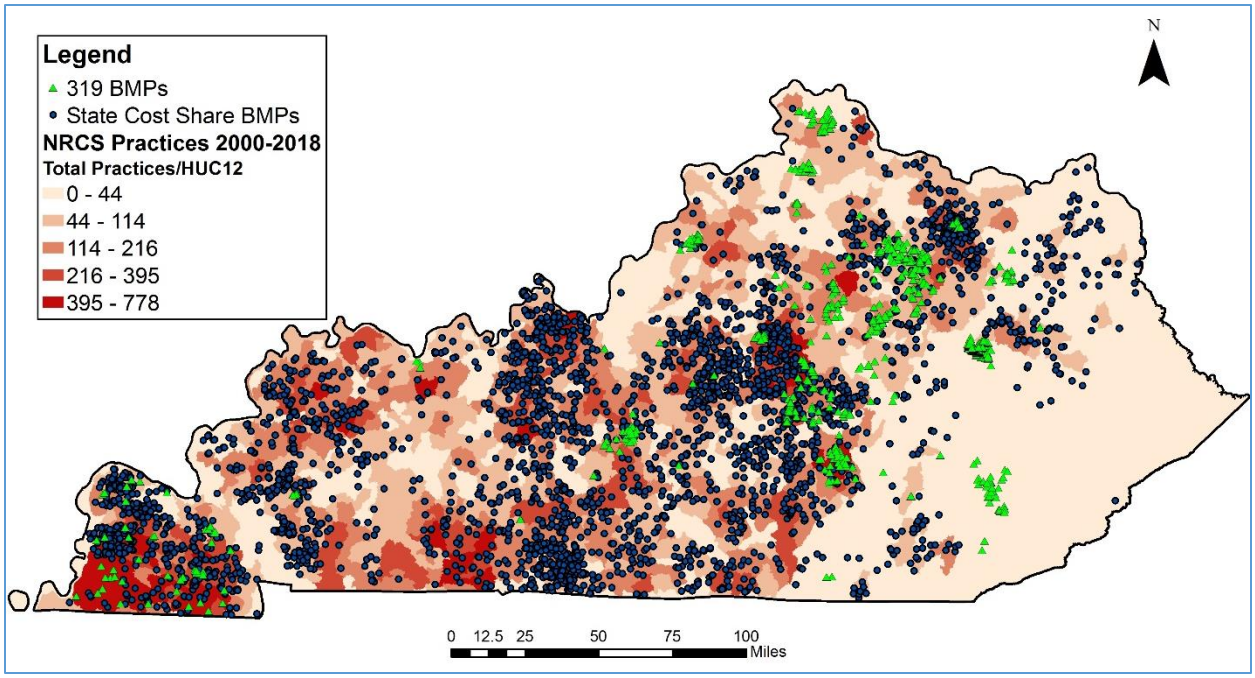


Figure 57. 319-Funded best management practices installed through 2018.

Through the state Agriculture Water Quality Act (AWQA) Authority, Kentucky made recent updates and refinements to BMPs in the State Water Quality Plan and continues to post stories from producers highlighting local implementation activities. DOW is working with DOC and the AWQA Authority to roll out an updated tool to assist farmers to protect water quality with farm-specific AWQA plans. This tool will incorporate updates to the State Water Quality Plan in a more user-friendly format to improve planning and BMP adoption.

Looking specifically at implementation activities that took place between September 2014 and September 2016 (the data collection period for this IR), over 35 types of BMPs were installed in more than 330 locations. DOW estimates these 319-funded BMPs reduced nutrient loading to waterways by 55,810 pounds per year of total nitrogen, 12,949 pounds per year of total phosphorus, and 9,567 tons per year of sediment between 2014 and 2016. The NPS Program Annual Reports provide regular updates on implementation of the NPS Management Plan.

Success Stories

DOW works with partners to track and monitor water quality where implemented BMPs are anticipated to reduce NPS pollution. Water quality improvements that result in a waterbody delisting in the biennial IR are reported as success stories to EPA. Due to the lag time between BMP installation and observable water quality improvement, each success story reflects NPS Program efforts many years prior to publication. For example, the NPS Program 2019 success story highlights BMPs installed from 2009-2013 and monitoring in 2013 that led to a 2016 delisting of Stoner Creek. Where the 2016 IR included the NPS success stories from 2013 and 2014, this combined 2018-2019 IR focuses on success stories from 2015-2019.

In 2015, DOW highlighted Eagle Creek as a 319 Program success story where septic system installations and upgrades, education and outreach activities and watershed planning reduced bacteria loading. As a result, Elk Creek was delisted in the 2010 IR. The full story is available on the EPA's NPS Program Success Story website.

In 2016, DOW identified Yellowbank Creek as a 319 Program success story where agricultural BMPs and pesticide education programs reduced pesticide, nutrient and sediment pollution. These actions improved stream quality to the point that Yellowbank Creek was delisted in the 2012 IR. The full story is available on the EPA's NPS Program Success Story website.

In 2017, DOW identified Bayou de Chien as a 319 Program success story where agricultural BMPs reduced bacteria loading and led to the stream delisting in the 2012 IR. The full story is available on the EPA's NPS Program Success Story website.

In 2018, DOW identified the Dix River as a 319 Program success story resulting from agricultural BMPs, septic system upgrades, and watershed planning that reduced bacteria loading. This work ultimately led to a stream delisting in the 2016 IR. The full story is available on the EPA's NPS Program Success Story website.

In 2019, DOW identified Stoner Creek as a 319 Program success story resulting from agricultural BMPs that reduced bacteria loads and led to the stream delisting in the 2016 IR. The full story is available on the EPA's NPS Program Success Story website.

Nutrient Reduction Strategy

DOW drafted the Nutrient Reduction Strategy (NRS) in 2014 to provide an initial strategy to address nutrient pollution. The 2019 Loads and Yields Study of watershed nutrients provides a core strategic metric for the NRS. Data collected between 2005-2017 from DOW's ambient rivers monitoring network and the USGS stream gauge network provides estimated loads (tons per year) and yields (tons per year per square mile) of total nitrogen and total phosphorus in Kentucky watersheds (see Figures 58 and 59). Kentucky's NRS prioritizes watershed planning and BMP funding in these high yield watersheds where agency resources, partners, and local capacity can deliver results.

In June of 2021, the Division updated its 2019 Loads and Yields Study that determines ongoing trends and evaluates progress in reducing Kentucky's nutrient load contribution to the Gulf of Mexico. This update uses new DOW data (2018-2019) and partner data from ORSANCO. Overlapping the two data sets expands coverage of Kentucky's drainage area from 76% to 82%, while identifying out-of-state nutrient contributions.

The DOW 2021 Update to the 2019 Nutrient Loads and Yields in Kentucky Study serves as a critical foundation for Kentucky's upcoming 2021 Nutrient Reduction Strategy (NRS) Update. The 2021 NRS Update prioritizes high yield watersheds in a data-driven approach to nutrient reduction in Kentucky. The DOW interactive Nutrient Reduction in Kentucky map improves nutrient data and decision-making transparency by allowing users to explore nutrient loads in local watersheds, review land use, and view watershed investments from the DOW and EPA 319 Non-Point Source Program.

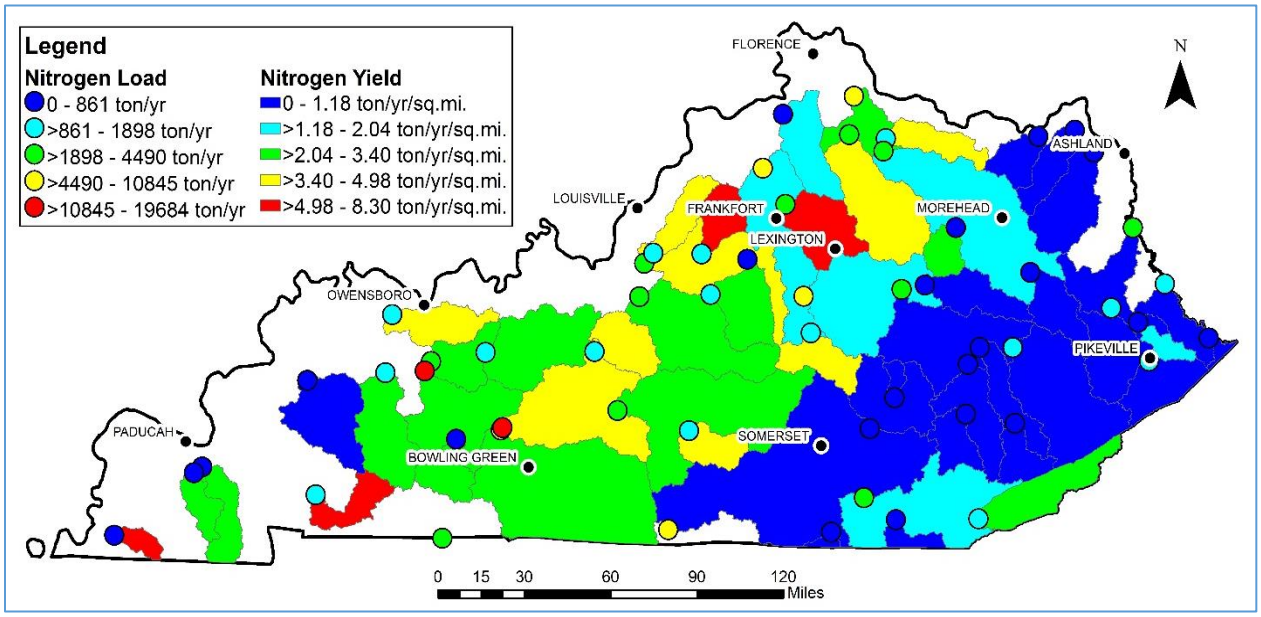


Figure 58. Total Nitrogen Loads and Yields, 2005-2017.

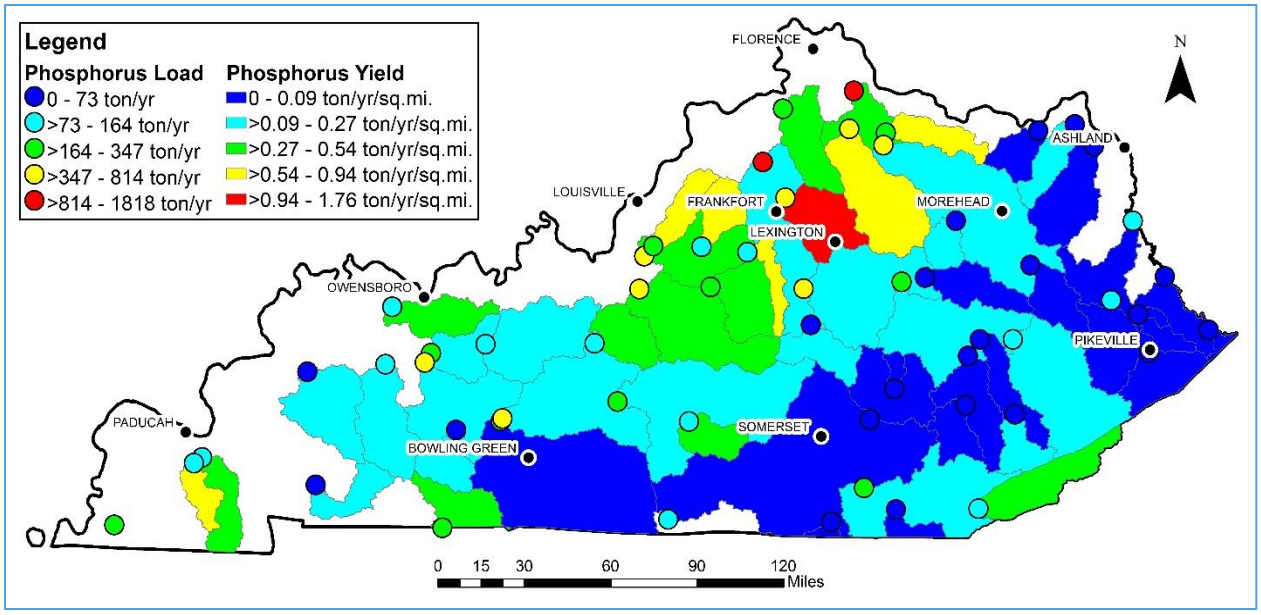


Figure 59. Total Phosphorus Loads and Yields, 2005-2017.

Water Pollution Control Program

There are four (4) Kentucky Communities under federal Consent Decrees and fifteen (15) Kentucky communities that are under state consent judgements to eliminate sanitary sewer overflows (SSO) and to repair systems to reduce CSOs. Communities implement projects to manage wastewater capacity and develop long-term control plans (LTCPs). The projects often include repairing sewer lines and increasing the storage capacity in the sewer system. Completion dates of these projects vary depending on the scope of work and financial considerations (Table 10).

There are 238 Kentucky communities that have varying degrees of aging infrastructure that cause bypasses and overflows at wastewater treatment plants. DOW personnel inspect approximately 7% (not including MS4 inspections or Pretreatment Inspections that are not related to the CSO/SSO aspects) of the systems in these communities, focusing on systems with frequent and recurring incidents and complaints. During inspections, DOW staff educate communities on identifying causes of overflows, prioritizing corrective actions, finding funding resources, and returning collection systems to compliance with the CWA.

Nutrients

Excess nutrients impede water quality by causing adverse effects on natural water chemistry and indigenous aquatic community. At a minimum, monitoring of the influent and effluent for total phosphorus and total nitrogen is included on Kentucky Pollutant Discharge Elimination System (KPDES) permits. The monitoring requirements for these parameters are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions in accordance with numeric and narrative standards.

Table 10. Combined Sewer Overflows (CSO) and Sanitary Sewer Overflows (SSO) mitigation projects in Kentucky.

Community	Expected Completion Date
Ashland STP	12/31/2025
Catlettsburg STP	Completed, 1/31/2019
Frankfort Municipal STP	12/31/2023
Harlan STP	2020, but pending new date 12/31/2025
Henderson STP	Completed, 3/31/2015
LFUCG: Lexington Town Branch STP; Lexington West Hickman. Not CSOs	12/31/2026
Louisville MSD: Morris Forman WQTC	12/31/2024 but this will change with new dates when approved
Loyall STP	2020, but pending new date 12/27/2025
Maysville STP	2015, but pending new date June 2023
Morganfield WWTP	2018, but pending new date 12/31/2021
Northern KY SD1	12/31/2025
Owensboro RWRA: Max Rhoads WWTP	12/31/2026
Paducah/McCracken County JSA	12/31/2038
Pikeville WWTP was CSO	Completed, 07/01/2014
Pineville STP	2017, but pending new date 9/5/2022
Prestonsburg STP was CSO	Completed, 10/01/2015
Vanceburg STP was CSO	Completed, 12/31/2012
Winchester Municipal Utilities (not CSO)	12/31/2025
Worthington WWTP	12/31/2015

Cost/Benefit Analysis

A cost-benefit analysis is a process that is used to measure benefits of an action in comparison to the cost associated with that action. Even though both cost and water quality data are available, the benefits of improved water quality are challenging to quantify, as most impacts are non-monetary. Below is a summary of costs and benefits associated with both the Clean and Drinking Water State Revolving Fund (DWSRF) Program.

Costs: The Clean Water State Revolving Fund (CWSRF) and DWSRF are environmental programs implemented by the states with support from EPA. These programs address the costs associated with wastewater and drinking water, respectively.

The CWSRF program was created in 1988 to establish a water pollution control revolving fund that would provide financial assistance for construction of publicly owned treatment works under section 212 of the CWA, implementation of watershed management plans under section 319 of the CWA, and development and implementation of conservation and management plans under section 320 of the CWA. The funds are provided by EPA in the form of capitalization grants to all states annually. Every year Kentucky identifies water pollution control priorities and ranks infrastructure projects based on these priorities. These projects are funded through the CWSRF in the form of low interest loans. As of April 2020, Kentucky's CWSRF program has funded 544 clean water infrastructure projects, totaling more than $1.55 billion, since the inception of the program.

The DWSRF was created in 1996, to further the goals of the Safe Drinking Water Act (SDWA). Like the CWSRF, every year Kentucky identifies its drinking water priorities and ranks infrastructure projects based on these priorities. These projects are funded through the DWSRF in the form of low interest loans. Kentucky has funded 250 drinking water projects, totaling more than $460 million since the inception of the program. Table 11 lists the dollar amounts spent each year since the inception of both programs.

Table 11. Funds spent using the Clean Water State Revolving Fund and Drinking Water State Revolving Fund in Kentucky.

	Clean Water State Revolving Fund	Drinking Water State Revolving Fund
2007 and prior	$479,991,442	$98,011,339
2008	$250,499,329	$53,702,151
2009	$67,267,880	$6,519,566
2010	$82,000,089	$36,227,115
2011	$81,162,663	$20,791,942
2012	$99,156,727	$23,670,604
2013	$73,950,436	$46,847,854
2014	$21,816,396	$10,083,876
2015	$139,841,765	$39,181,612
2016	$40,389,815	$26,095,763
2017	$48,140,377	$21,963,652
2018	$37,543,203	$18,126,139
2019	$91,123,225	$27,275,882
2020	$37,466,003	$31,614,113
Since 2008	$1,070,357,908	$362,100,269
Cumulative	$1,550,349,350	$460,111,608

Benefits: Most of the benefits of wastewater and drinking water infrastructure take the form of improved water quality and public health, both of which are difficult to quantify. Since the inception of both programs, Kentucky has funded projects that address these beneficial goals. In the past two years (2018-2020), the CWSRF has funded the following projects:

- Replacement, upgrade, or expansion of at least eight old and dilapidated wastewater systems that were polluting the waterways across the Commonwealth of Kentucky.
- Thirteen projects that reduced inflow and infiltration; five projects that eliminated SSOs; and one project that eliminated a CSO. All these projects helped systems achieve compliance, resulting in improved water quality.
- Seven failing package treatment plants are in the process of being eliminated through regionalization. Two such package plants are polluting Cane Run, and the CWSRF provided essential funding to eliminate the source of pollution. Regionalization of these plants has resulted in the reduction of system operation costs.
- Several projects provided services to areas that were served by failing septic systems, thus reducing the nutrient and pollutant loading in the waters of the Commonwealth.

- Kentucky, like other states, has been facing algal blooms that have impacted the drinking water treatment plants and increased their costs. As projects funded through the state revolving fund reduce the amount of nutrients and pollutants in Kentucky's waterways, treatment plants will see a decline in operational costs.
- The funding through the state revolving fund is also being invested in new, green, energy-efficient technologies. This is increasing the long-term sustainability of Kentucky's water infrastructure.

Overall, these programs are geared towards improving the quality of Kentucky's natural resources, resulting in long-term benefits including diverse ecosystems, increased tourism, and economic development.

The following resources are provided for the reader interested in learning more about this topic.

- The economic benefits of protecting healthy watersheds (EPA 2012)
- Linking water quality and well-bring for improved assessment and valuation of ecosystem services (Keeler et al. 2012)
- A compilation of cost data associated with the impacts and control of nutrient pollution (EPA 2015)
- Healthy Watersheds Protection webpage (EPA 2021)
- Life Cycle and Cost Assessments of Nutrient Removal Technologies in Wastewater Treatment Plants (EPA 2021)

Program Enhancement

KATTS

The 2018/2020 IR cycle was the first cycle to use KATTS from the beginning to the end of the cycle process. Throughout the two years, bugs were found and fixed, enhancements were developed and implemented, and XML generation and submittal to EPA's ATTAINS occurred for the first time.

With the development of KATTS, the Kentucky DOW could, for the first time, query data related to programs, station-assessment unit relationships, and parameter groups. The Division could also accurately report on applicable designated uses at the assessment unit level, where some uses (e.g. CAH and OSRW) only apply to some waterbodies.

KATTS also stores the GIS data for each assessment unit. Therefore, REST services were used to develop websites with interactive maps to provide public notice of the 303(d) and to develop an ArcGIS Hub Site for this IR. These same services will be used to populate the Water Health Portal with Kentucky's 2018/2020 305(b) assessment results.

The Division continues to prioritize enhancements to KATTS as it moves toward future cycles. Enhancements to tracking of actions (e.g. TMDLs) and other water quality improvement programs are underway, while additional QAQC and role-specific tasks are planned for future work to reduce potential sources of error and improve further the quality of the data being managed, stored, and shared through the KATTS application.

Wetlands

The Wetland Monitoring and Assessment Program began in 2010, and the initial program goal was to develop an assessment method for rapidly determining wetland condition to inform permitting decisions. Since then, the program has expanded to include development of indices of biological integrity (IBIs), a Kentucky Wetland Rapid Assessment Method (KY-WRAM), and evaluation of Kentucky's Surface Water Criteria for wetlands. Currently, three IBIs have been developed for use in the Wetland Monitoring and Assessment Program. These include IBIs for vegetation (VIBI), avifauna (AIBI), and amphibians (AmphIBI). The VIBI and AIBI methods were completed in December 2017, and the AmphIBI was completed in November 2020.

Although there has been considerable progress made in creating these wetland assessment tools, further testing is needed before they can be fully implemented to assess designated use attainment, track trends, and assess the success of restoration and protection efforts. Once development and testing is complete, the tools will be used to assess and report on wetland condition statuses and trends. DOW anticipates that assessment of designated use attainment will be based on water chemistry, physicochemistry, rapid condition assessment, and biological community data. In addition, a significant priority of the Wetland Monitoring and Assessment Program is to collaborate with federal and state agencies, as well as private entities, to adopt the wetland assessment tools that have been developed. Through these collaborations, DOW strives to improve the regulatory decision-making process, and to support voluntary restoration and protection of wetland habitat.

Finally, DOW made substantial progress toward increasing the capacity to perform monitoring activities internally. For the majority of its existence, 2011-2019, the Monitoring and Assessment Program primarily contracted out data collection. Over the last two years, additional staffing resources have been allocated to the Monitoring and Assessment Program. This provided the resources needed for DOW to begin collecting water chemistry and *in situ* data in 2019, which will help lay the foundation for an ambient monitoring program and provide baseline data for evaluation of existing water quality standards for wetlands. In addition, for the first time since the program was created, DOW performed all of its wetland vegetation and avifauna surveys during the 2019 field season.

Visit these wetland resources for more information:

- Wetland Program Plan
- Wetland Story Map
- KY-WRAM
- Permits for Wetland Fill or Alteration
- National Wetland Condition Assessments

Public Participation

Public Notice

On June 4, 2021, DOW published the 2018/2020 draft 303(d) list of impaired waters requiring a TMDL for public comment, as required by KRS 224.70-150. New to this combined 2018/2020 reporting cycle was a dedicated public notice site for the public to view the draft 303(d) list, new listings, proposed

delistings, waters with completed TMDLs, and the 305(b) list. Spreadsheets and interactive maps with video tutorials were available through the site. Links to assessment summaries and TMDL documents were available through the map dashboards or in the provided spreadsheets.

Notification was sent through a Commonwealth of Kentucky Energy and Environment Cabinet blog post. Additionally, the public notice was distributed electronically through the TMDL Listserv and NPS Listserv, which is a list of persons interested in TMDL and/or NPS-related issues. The official public notice announcement can be found in Appendix A.

Comments received and responses to comments are included in Appendix B.

Water Health Portal

To find information about any waterway in Kentucky, visit the Water Health Portal at http://watermaps.ky.gov/WaterHealthPortal/. Type in your location, click on a stream, and learn about the health of any assessed waterway. There are easily identifiable color-coded icons that indicate whether a stream or lake supports a particular use, such as swimming, fishing, and drinking.

Stay Informed / Get Involved

TMDL Information Distribution List

If you are interested in being kept up to date with public notice periods for future draft 303(d) lists or TMDL activities, please email TMDL@ky.gov to be added to the TMDL information distribution list.

Watershed Planning Webpage (basin coordinators)

You can also visit the Watershed Planning webpage to see what is going on in your basin. Each basin has a coordinator, and they are happy to help and answer any questions you may have.

Volunteer

Watershed Watch in Kentucky (WWKY) is a statewide citizens monitoring effort to improve and protect water quality by raising community awareness and by supporting implementation of the goals of the CWA and other water quality initiatives. They are always looking for new volunteers; visit the WWKY webpage to learn more.

References

Compton, M.C., G.J. Pond, and J.F. Brumley. 2003. Development and application of the Kentucky Index of Biotic Integrity (KIBI). Kentucky Department for Environmental Protection, Division of Water, Frankfort, Kentucky. <https://eec.ky.gov/Environmental-Protection/Water/QA/BioLabSOPs/Development%20and%20Application%20of%20the%20KY%20Index%20of%20Biotic%20Integrity.pdf>

EPA. 1972. The National Eutrophication Survey. A working paper of the Office of Research and Monitoring, Special Projects Staff. US Environmental Protection Agency, Washington D.C. <https://nepis.epa.gov/Exe/ZyPDF.cgi/910225BF.PDF?Dockey=910225BF.PDF>

EPA. 2002. Consolidated assessment and listing methodology – toward a compendium of best practices. U.S. Environmental Protection Agency, First edition. Office of Wetlands, Oceans and Watersheds, Washington D.C.

EPA. 1997. Guidelines for preparation of the comprehensive state water quality assessments (305(b) Reports) and electronic updates: Report contents. Assessment and Watershed Protection Division (4503F), U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington D.C.

EPA. 2012. The Economic Benefits of Protecting Healthy Watersheds. U.S. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds, Washington D.C. <https://www.epa.gov/sites/default/files/2015-10/documents/economic_benefits_factsheet3.pdf>

EPA. 2015. A Compilation of Cost Data Associated with the Impacts and Control of Nutrient Pollution. U.S. Environmental Protection Agency, Office of Water (EPA 820-F-15-096), Washington D.C. <https://www.epa.gov/sites/default/files/2015-04/documents/nutrient-economics-report-2015.pdf>

EPA. 2021. Life Cycle and Cost Assessments of Nutrient Removal Technologies in Wastewater Treatment Plants. U.S. Environmental Protection Agency, Office of Water (EPA 832-R-21-006), Washington D.C. <https://www.epa.gov/system/files/documents/2021-08/life-cycle-nutrient-removal.pdf>

Keeler, Bonnie L. Stephen Polasky, Kate A. Brauman, Kris A. Johnson, Jacques C. Finlay, Ann O'Neill, Kent Kovacs, and Brent Dalzell. 2012. Linking water quality and well-being for improved assessment and valuation of ecosystem services. Proceedings of the National Academy of Sciences of the United States of America. < https://www.pnas.org/content/pnas/109/45/18619.full.pdf>

Kentucky Division of Water (KDOW). 2015. Consolidated assessment and listing methodology: surface water quality assessment in Kentucky, the Integrated Report. Kentucky Department for Environmental Protection, Division of Water. Frankfort, Kentucky. <https://eec.ky.gov/Environmental-Protection/Water/QA/BioLabSOPs/Consolidated%20Assessment%20and%20Listing%20Methodology%20Surface%20Water%20Quality%20Assessments.pdf>

Kentucky Division of Water (KDOW). 2020. Addendum to the CALM: Kentucky's Updated Fish Consumption Methodology. Kentucky Department for Environmental Protection, Division of Water. Frankfort, Kentucky. <https://eec.ky.gov/Environmental-Protection/Water/QA/BioLabSOPs/Addendum%20to%20the%20CALM%20-%20Kentucky's%20Updated%20Fish%20Consumption%20Methodology.pdf>

Pond, G.J., S.M. Call, J.F. Brumley and M.C. Compton. 2003. The Kentucky macroinvertebrate bioassessment index: derivation of regional narrative ratings for wadeable and headwater streams. Kentucky Department for Environmental Protection, Division of Water, Frankfort, KY. <https://eec.ky.gov/Environmental-Protection/Water/QA/BioLabSOPs/KY%20Macroinvertebrate%20Bioassessment%20Index.pdf>

Appendices

Appendix A - Public Notice Announcement

Draft 2018/2020 303(d) List at Public Notice, June 4, 2021

The Kentucky Division of Water has opened a 60-day comment period on the draft 2018/2020 303(d) list of impaired waters as required by KRS 224.70-150. Comments received by email or mail must be dated or postmarked no later than August 3, 2021. Comments on the draft 303(d) list may be sent:

- Via email (*preferred method*) to: TMDL@ky.gov (Subject line: "303(d) List")
- Via U.S. Mail to: Water Quality Branch (ATTN: 303(d) List)
  Kentucky Division of Water
  300 Sower Blvd., 3rd Floor
  Frankfort, KY 40601

New to this combined 2018/2020 reporting cycle is a dedicated public notice site (https://2018-2020-303d-public-notice-kygis.hub.arcgis.com/) to view the draft 303(d) list, new listings, proposed delistings, waters with completed total maximum daily loads (TMDLs), and the 305(b) list. Spreadsheets and interactive maps with video tutorials are available through this site. Links to assessment summaries and TMDL documents are available through the map dashboards or in the provided spreadsheets.

Section 305(b) of the Clean Water Act (CWA) requires states to report to Congress every two years on the health of waters in the state, and whether the water quality of individual waterbodies is sufficient to support their designated uses. In Kentucky, these designated uses include primary contact recreation, secondary contact recreation, aquatic life, domestic water supply, fish consumption, and outstanding state resource waters. The determination of designated use attainment is based on water quality sampling and assessment methodologies developed by the state and approved by the U.S. Environmental Protection Agency (EPA).

Section 303(d) of the CWA requires states to identify impaired waters, the pollutant(s) causing the impairment, and to develop a TMDL for each of those pollutants. Section 303(d) also requires states to prioritize waters for TMDL development. The TMDL, which is a daily maximum allowance for a pollutant, supports plans and strategies for restoring water quality.

Monitoring that occurred to update assessments for the draft 2018/2020 305(b) and 303(d) lists was primarily from streams, rivers, and reservoirs in the Green and Tradewater Rivers Basin Management Unit (BMU), the Kentucky River BMU, and the Upper Cumberland and Four Rivers BMU. Monitoring also occurred outside of the BMUs of focus to provide statewide assessment updates. In total, 1,106 stations had data collected for assessment and 915 assessments were completed.

As a reference, assessment results from the 2016 Integrated Report can be accessed at the Kentucky Water Health Portal (https://watermaps.ky.gov/WaterHealthPortal/). Upon EPA approval of the 2018/2020 303(d) list, the Water Health Portal will be updated with the 2018/2020 305(b) assessment information.

Appendix B – Comments Received and Response to Comments

The purpose of this appendix is to document the public comments received and provide a response to these comments in writing. There were two submittals on the draft 2018/2020 303(d) list. Comments are reproduced as received in gray text below and DOW responses are in black text.

Dear Commenters,

Thank you for your participation in the public notice process by providing comments on the draft 2018/2020 303(d) list of impaired waters requiring a Total Maximum Daily Load (TMDL). The Kentucky Division of Water (DOW) continues to have interest in engaging the public in the assessment and listing process, as well as the prioritization of waterbodies for TMDL development. The Division encourages and welcomes public participation; if you are interested in engaging with the Division on these topics, please email TMDL@ky.gov.

Commenter 1

Westlake Vinyls, Inc. (Westlake) is submitting these comments based on our review of the Kentucky Division of Water's (KDOW's) Cypress Creek Total Maximum Daily Load (TMDL) Study Plan (effective date: 3/1/2016), sampling results and field notes from the field work, and the proposed 303(d) listing of Cypress Creek iron, lead, *E. coli*, dissolved oxygen (DO), nutrient/eutrophication biological indicators, sedimentation/siltation, and specific conductivity. The 303(d) listing indicates "industrial point source discharge" may be one of the sources for iron (previously listed), DO, and specific conductivity exceedances between 0 and 6.25 mile points along Cypress Creek.

General Comment and Statement

Westlake continues to have interest in the 303(d) listing process and subsequent TMDLs that will be developed. We continue to encourage KDOW to base the listings on sound scientific studies and quality data collection. We have provided comments and participated in meetings with KDOW over the last few years to understand both the process and possible outcomes for the Cypress Creek Study. The original listing was based on one sample collection with an analyzed exceedance for iron. An open records request led to the discovery that the information existed in a database but there was no documentation of the quality data.

According to KDOW's "Consolidated Assessment and Listing Methodology", "data older than five years should generally not be used to make a use support decision (U.S EPA 1997), unless it can be determined the data are still representative of current conditions" (p.40). The acute Iron result of 5.6 mg/L for one sample collected in 2006 was more than 5 years old when Cypress Creek was listed on the 303(d) list for iron impairment in 2014. No other provided results from 2000-2011 exceeded the acute water quality standard of 4 mg/L. This would indicate that the 2006 iron concentration used to list the stream is not "still representative of current conditions."

Except for one sediment sample on November 10, 2005, sampling data used for the stream impairment listing consists only of in-stream chemical data. The sediment sample contained 17,200 mg/kg by dry weight of iron, which is slightly below the mean iron value of 22,456 mg/kg for generic statewide ambient background for Kentucky (Kentucky Guidance for Ambient Background Assessment, 2004).

KDOW conducted a study of Cypress Creek from 2016 to 2018 over a period of 27 months. Selected locations were not all consistently sampled on a monthly basis during the study. Stream segment 0-6.25-mile points encompass the industrial area in which Westlake operates a stormwater outfall.

With the ubiquitous nature of iron and lead detected in the Cypress Creek watershed because of natural conditions, Westlake urges KDOW to assess the stream conditions and evaluate the listing under category 4c — segment does not support designated use(s), but this is not attributable to a pollutant or combination of pollutants.

DOW Response to General Comment and Statement

In accordance with 401 KAR 10:031 Surface Water Standards and the Kentucky DOW's Consolidated Assessment and Listing Methodology, designated use attainment has been determined by the Division where data of sufficient quality, quantity, and appropriate age were available. If a designated use has been determined to be impaired, the cause of impairment and suspected sources are identified.

The suspected sources used for the impaired waters list are provided by EPA and can be found at http://iaspub.epa.gov/pls/waters/f?p=ASKWATERS:SOURCE_LUT. The DOW uses suspected sources to best describe the observed conditions at each monitoring location and resulting assessment unit.

Iron was first listed as a cause of impairment on the 2008 303(d) list based on monthly data collected from 4/13/2005 to 3/15/2006. This impairment was passed forward to the 2010 303(d) list. New data were collected between 4/13/2010 to 3/28/2011, which confirmed the iron impairment, and updated the assessment during the 2012 cycle. No new data were available for this segment during the 2014 and 2016 cycles.

New data were available for the 2018/2020 cycle throughout the Cypress Creek watershed. Per 40 CFR § 130.7(b)(5), "Each State shall assemble and evaluate all existing and readily available water quality-related data and information to develop the list required by §§ 130.7(b)(1) and 130.7(b)(2)."

A rigorous quality assurance and quality control process was completed as outlined by Kentucky DOW's Quality Assurance Project Plan (QAPP), Standard Operating Procedures (SOP), and Consolidated Assessment and Listing Methodology (CALM). The data used for assessment within the Cypress Creek watershed were deemed appropriate, sufficient in both quality and quantity.

Per 40 CFR § 130.7(b)(6), "Each State shall provide documentation to the Regional Administrator to support the State's determination to list or not to list its waters as required by §§ 130.7(b)(1) and 130.7(b)(2)." Furthermore, per 40 CFR § 130.7(b)(6)(iv), "each State must demonstrate good cause for not including a water or waters on the list. Good cause includes, but is not limited to, more recent or accurate data; more sophisticated water quality modeling; flaws in the original analysis that led to the water being listed in the categories in § 130.7(b)(5); or changes in conditions, e.g., new control equipment, or elimination of discharges."

For the 2018/2020 reporting cycle, new data of sufficient quantity and quality were available to update the assessment for Cypress Creek 0.0 to 6.25. The *in situ*, water chemistry, and macroinvertebrate results continued to indicate warm water aquatic life impairment and exceedance of the iron criteria. Therefore, there is not good cause for removing this water from the 303(d) list.

When completing assessments within the Cypress Creek watershed, DOW reviewed potential sources of iron and lead and referenced EPA sources and guidelines. EPA's 2014 IR guidance states the following: "When a State evaluates whether a potential designated use impairment is the result of natural conditions, the State should consider all sources of the pollutant being evaluated. If the pollutant concentrations do not meet the EPA-approved water quality standards, and anthropogenic sources of the pollutant are present, the water is considered impaired and should be included on the State's Section 303(d) list even if natural sources of the pollutant are present."

Throughout the Cypress Creek watershed, the most recent data demonstrated that iron and lead do not meet water quality criteria along one or more assessment units, and potential anthropogenic sources are present. Sources of metals in waterbodies include, but are not limited to, municipal wastewater treatment effluent, industrial point sources, urban runoff, landfills, junkyards, and dredging (U.S. EPA 2021). Therefore, it is not appropriate to categorize these impairments as 4c due to natural conditions and they must instead be listed on the 303(d) list in category 5.

40 CFR § 130.7 requires waters on the 303(d) list be given a priority ranking. 40 CFR § 130.7 (b)(4) specifically states, "The list required under §§ 130.7(b)(1) and 130.7(b)(2) of this section shall include a priority ranking for all listed water quality-limited segments still requiring TMDLs."

As part of the 2018/2020 303(d) public notice, DOW provided definitions for TMDL priority rankings (Table 1). On the 2018/2020 303(d) list, impairments in the Cypress Creek watershed were given the following TMDL priority rankings by parameter:

- *E. coli* impairments have a priority rank of high
- Iron, lead, copper, nutrient eutrophication/biological indicators, organic enrichment (sewage) biological indicators, and dissolved oxygen impairments have a priority rank of medium
- Sedimentation/siltation and specific conductivity impairments have a priority rank of low

Table 1. Definition of TMDL priority rankings on the 2018/2020 303(d) list.

Rank	Definition
High	A TMDL is in development or will be in development within the next two years, and is expected to be completed during the next one to two reporting cycles (within 1-4 years). Waters ranked as "High" priority focus in part on those identified in the Division's 303(d) Long Term Vision Priorities, which established a plan for developing TMDLs and alternative restoration plans for specific waters and pollutants by 2022.
Medium	TMDL strategies are in the planning stage for the waterbody and/or pollutant. Methodologies may be under development or data collection may be planned or ongoing. Opportunities for alternative restorations plans may be under review.
Low	A TMDL is not currently in development. This rank include TMDLs for which methodologies may be in development for the pollutant or waterbody type. Some waters ranked as "Low" priority for TMDL development have an EPA-accepted alternative restoration plan (or "TMDL Alternative") that is being implemented, or have an alternative restoration plan in development that is expected to be EPA-accepted within the next two reporting cycles. The progress of each alternative restoration plan is reviewed each cycle to ensure the plan is on track to restoring water quality. The TMDL development priority rank may be updated based on this review. See table columns in the 303(d) list related to "Restoration Plans" for information on these alternative restoration plans.

Specific Comments - Comment 1

EPA has defined seven reasons to remove an impaired water from the 303(d) list. When a waterbody satisfies any of these seven criteria as determined by the state, a request can be made to EPA to delist the pollutant-waterbody combination from the 303(d) list. One of those reasons is a flaw in the original 303(d) listing.

No chain-of-custody forms, laboratory analytical data reports, or other documentation were provided for field sampling performed in 2006, including the sampling event with a reported iron result of 5.6 mg/L, which was stated as the reason for listing Cypress Creek on the 303(d) list in 2014. No macroinvertebrate samples were provided by KDOW under our open records request for sampling between 2000 and 2011. Additionally, field observation forms appear to be limited to the 2010-2011 sampling years, with no field forms provided for prior years.

According to KDOW's "Consolidated Assessment and Listing Methodology", "data older than five years should generally not be used to make a use support decision (U.S EPA 1997), unless it can be determined the data are still representative of current conditions" (p.40). The acute Iron result of 5.6 mg/L for one sample collected in 2006 was more than 5 years old when Cypress Creek was listed on the 303(d) list for iron impairment in 2014. No other provided results from 2000-2011 were above the acute water quality standard for iron of 4 mg/L to indicate that this sample was "still representative of current conditions."

Therefore, Westlake requests the original listing for iron at mile points 0-6.2 along Cypress Creek be removed.

DOW Response to Comment 1

Iron was first listed as a cause of impairment on the 2008 303(d) list based on monthly data collected from 4/13/2005 to 3/15/2006. This impairment was passed forward to the 2010 303(d) list. New data were collected between 4/13/2010 to 3/28/2011, which confirmed the iron impairment, and updated the assessment during the 2012 cycle. No new data were available for this segment during the 2014 and 2016 cycles.

New data were available for the 2018/2020 cycle throughout the Cypress Creek watershed. Per 40 CFR § 130.7(b)(5), “Each State shall assemble and evaluate all existing and readily available water quality-related data and information to develop the list required by §§ 130.7(b)(1) and 130.7(b)(2).”

A rigorous quality assurance and quality control process was completed as outlined by Kentucky DOW’s Quality Assurance Project Plan (QAPP), Standard Operating Procedures (SOP), and Consolidated Assessment and Listing Methodology (CALM). The data used for assessment within the Cypress Creek watershed were deemed appropriate, sufficient in both quality and quantity.

Per 40 CFR § 130.7(b)(6), “Each State shall provide documentation to the Regional Administrator to support the State's determination to list or not to list its waters as required by §§ 130.7(b)(1) and 130.7(b)(2).” Furthermore, per 40 CFR § 130.7(b)(6)(iv), “each State must demonstrate good cause for not including a water or waters on the list. Good cause includes, but is not limited to, more recent or accurate data; more sophisticated water quality modeling; flaws in the original analysis that led to the water being listed in the categories in § 130.7(b)(5); or changes in conditions, e.g., new control equipment, or elimination of discharges.”

For the 2018/2020 reporting cycle, new data of sufficient quantity and quality were available to update the assessment for Cypress Creek 0.0 to 6.25. The *in situ*, water chemistry, and macroinvertebrate results continued to indicate warm water aquatic life impairment and exceedance of the iron criteria. Therefore, there is not good cause for removing this water from the 303(d) list.

Specific Comments - Comment 2

KDOW's Cypress Creek TMDL Study Plan states that "three years of data are required to list for metals" with the first year of sampling focused on "confirming the nature of the impairments and possible sources of those impairments." "The second and third years of sampling may also include data collection in smaller, un-assessed tributaries that may be contributing to the identified impairment" (p. 3). In the first year (2016), KDOW sampled sites 1-9. KDOW then dropped Sites 2, 3, 7, and 9 and added Sites 10, 11, and 12 in 2017. Sites 11 and 12 represent "smaller, un-assessed tributaries" feeding into Site 9, and Site 10 is at an upper reach of the same stream represented by Site 9. It appears the additional sites (10-12) are intended to further evaluate these "un-assessed tributaries" as identified in the TMDL Study Plan.

Samples were collected between March 2016 and May 2018, which is 27 months total. Out of the 27-month study, samples were only collected during 16 events. However, the most any one site was sampled was 12 months at Site 2, and only 10 of those 12 months were consecutive.

Since KDOW has not followed its own TMDL Study Plan by collecting 3 years' worth of data, the current proposed listings for Cypress Creek and its tributaries based on the TMDL Study results should be withdrawn until a complete and full study is conducted.

DOW Response to Comment 2

Monitoring project study plans are intended to outline project goals and objectives, but they are not the guiding documents for completing assessments. Kentucky's Water Quality Standards (401 KAR 10:031) and Consolidated Assessment and Listing Methodology (CALM) define the criteria and methodologies for assessment and listing. The CALM notes that "[e]ven a short period of record can indicate a high confidence of impairment based on [physical/chemical] data; 3 years of data are not required to demonstrate impairment" (p. 72).

A rigorous quality assurance and quality control process was completed as outlined by Kentucky DOW's Quality Assurance Project Plan (QAPP), Standard Operating Procedures (SOP), and Consolidated Assessment and Listing Methodology (CALM). The data used for assessment within the Cypress Creek watershed were deemed appropriate, sufficient in both quality and quantity.

Specific Comments - Comment 3

Watershed management and watershed studies should be inclusive of all sources and reasons for chronic or acute exceedances. Iron and most likely lead in this watershed are naturally occurring based on data collected and references sited. Therefore, chronic exceedances are common along the entire sampled watershed with acute exceedances occurring frequently at Site 9 and Site 10 where the stream has been incised and straightened.

The greater Cypress Creek watershed encompasses primarily 5 iron-rich geologic units according to the Kentucky Geological Survey (KGS). These units include loess deposits, continental deposits, Clayton and McNairy Formation, alluvium, and lacustrine and fluvial deposits within the Breinsburg, Calvert City, Elva, and Little Cypress quadrangles. Loess deposits in the Calvert City quadrangle can locally contain iron oxide concretions. Continental deposits in the Breinsburg, Elva, and Little Cypress quadrangles contain layers cemented with ferruginous material. The Clayton and McNairy formation can be cemented by ferruginous material and contain iron oxide concretions. Alluvium deposits are cemented by iron oxide in the Breinsburg quadrangle and contain sparse to abundant iron oxide concretions in the soil zone of the Calvert City quadrangle. Lacustrine and fluvial deposits along waterways in the Calvert City quadrangle contain abundant iron oxide "buckshot" concretions in the soil zone.

Iron oxide (ferruginous) cementation and iron oxide concretions present in formations within the watershed provide sources of naturally occurring iron that can be dissolved into surface water or be a part of sediment loading. The streambed of Cypress Creek is predominately incised within lacustrine and fluvial deposits, including the area upstream of sites 9 & 10, where significant channelization and erosion are present and 66% of acute iron exceedances occurred. This erosion causes increased exposure to the abundant iron oxide concretions present in the formation.

Additionally, KDOW field notes indicate that multiple stream segments consistently do not flow or are dry during portions of the year. KDOW field notes also indicate evidence of flooding at multiple sites indicating a large variation in stream flow that would not only affect the viability of macroinvertebrate populations in these streams but also dissolved oxygen and specific conductivity.

Were these facts taken into consideration when listing parameters and potential sources? If the current stream conditions dictated by precipitation and geology show impacts, how does KDOW attribute that to industrial activities?

DOW Response to Comment 3

The DOW considered a variety of factors when completing assessments in the Cypress Creek watershed.

- DOW reviewed potential sources of iron and referenced EPA sources and guidelines. The DOW agrees with the commenters that channelization can contribute additional iron, and that these anthropogenic disturbances to the channel are not natural.
- DOW also considered the impact of low or variable stream flow on parameters such as benthic macroinvertebrates, dissolved oxygen, and specific conductivity.
- Generally, excursions of water quality criteria were not limited to a particular hydrologic condition. Potential sources of the pollutant are present and those potential sources are located along and/or upstream of the sampling location and the resulting assessment unit's watershed.
- DOW was not targeting any specific sources but meeting a 303(d) listing responsibility to identify potential sources based on the information available. To be inclusive of all sources and reasons for chronic or acute exceedances was beyond the scope of the study.
- Based on comments received, DOW has replaced occurrences of the source "Industrial Point Source Discharge" with "Industrial/Commercial Site Stormwater Discharge (Permitted)" in the watershed.

The data used for assessment were deemed appropriate, sufficient in both quality and quantity. DOW has an obligation under the Clean Water Act sections 305(b) and 303(d) to 1) assess whether the water quality of individual waterbodies is sufficient to support its designated uses, 2) identify impaired waters, and 3) identify causes of impairment and suspected sources.

Specific Comments - Comment 4

Previously dissolved oxygen was listed on the 305(b) list for Cypress Creek. It is now proposed to be listed under 303(d) with a TMDL. What is the reason for moving the parameter to the 303(d) list?

Additionally, Dissolved oxygen exceedances in the KDOW data were dissolved oxygen concentrations < 4.0 mg/L. Based on review of KDOW data the dissolved oxygen instrument was not always calibrated properly and documented. The dissolved oxygen data used to make decisions should be reviewed again for quality assurance and quality control. Were dissolved oxygen measurements reviewed to ensure proper calibration?

DOW Response to Comment 4

Dissolved oxygen saturation (as percent) and dissolved oxygen (as concentration) are different parameters. Dissolved oxygen as a parameter has numeric water quality criteria for the warm water aquatic habitat designated use ("instantaneous minimum shall not be less than four and zero-tenths (4.0) mg/L in water with WAH use.").

Dissolved oxygen saturation was first identified as an impaired parameter for the Cypress Creek 0.0 to 6.25 assessment unit on the 2008 305(b), where the assessor listed the parameter under category 4c. Dissolved oxygen saturation has been identified as an impaired parameter for this assessment unit for all cycles since the 2008 cycle, either by being confirmed with new data or being carried forward.

The most recent data considered for assessment demonstrated that dissolved oxygen (concentration) is a more appropriate parameter because the numeric water quality criteria were not met (data collected by the Ambient Rivers program and the TMDL program supported this listing). Therefore, dissolved oxygen saturation was removed as a parameter (category 4c parameters do not require a delisting request), and dissolved oxygen was added as a cause of impairment. Low dissolved oxygen is a parameter that requires a TMDL, and since a TMDL has not been developed for this parameter, it is in category 5 and can be found on the 2018/2020 303(d) list.

Meter calibration and documentation were reviewed as part of the quality assurance process outlined in the Quality Assurance Project Plan (QAPP). Field sheets, data reports, and meter calibration were reviewed before assessment and listing. In the rare circumstances that the meter was not calibrated properly or the calibration was not documented, the field measurements were not used for assessment purposes.

Specific Comments - Comment 5

Copper appears to have exceeded chronic values in the UT of Cypress Creek 0.0-2.75 (AU # KY3274). In reviewing the data collected by KDOW, it was noted that hardness values for this

segment of water is appreciably lower than the rest of Cypress Creek watershed. Did KDOW ascertain the reason for the lower hardness values used to calculate copper?

DOW Response to Comment 5

The lower hardness at this location was noted by staff, which prompted an additional review of the quality assurance/quality control samples associated with this assessment unit. Hardness was consistently low across sampling events, and no anomalies were observed. DOW concluded that the sample results accurately represent the hardness at this location and were therefore appropriate for use in evaluating the data against the copper criteria. DOW was not able to ascertain why this waterbody had lower hardness, which is a question outside the scope of the assessment.

Specific Comments - Comment 6

Specific Conductivity is listed for Cypress Creek 0.0-6.25 and the UT of Cypress Creek 0.1-1.3 (AU #KY-3275). Were these measurements taken in flowing water or stagnant water conditions? Specific conductivity is measured in the field, how does total dissolved solids (TDS) analyses compare to the field measurements? The conductive ions measured come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. What particular ions (pollutants) are contributing to the higher specific conductivity?

DOW Response to Comment 6

Specific conductivity measurements were taken over a variety of flow conditions. A definitive determination of the particular ions contributing to the elevated conductivity is beyond the scope of the assessment process. According to 401 KAR 10:031, conductivity "shall not be changed to the extent that the indigenous aquatic community is adversely affected."

DOW did examine accompanying results, including the ratio of TDS to specific conductivity and lab determined specific conductivity results, when available. The data used for assessment were deemed appropriate, sufficient in both quality and quantity.

- For UT of Cypress Creek 0.1 to 1.3 (AU # KY-3275), specific conductivity ranged from 529-2820 µS/cm, and sulfate was elevated above concentrations found in other streams in the watershed. This site is located near a staging area for coal before it is transported on barges along the Tennessee River; the waterbody or substrate was noted to be black with coal dust.
- For Cypress Creek 0.0 to 6.2 (AU # KY-617) elevated specific conductivity was limited to base flow to low flow conditions and ranged from 428 to 802 µS/cm during those conditions. This assessment unit is located below the confluence with the UT of Cypress Creek 0.1 to 1.3 where specific conductivity was more consistently and highly elevated. As a comparison, the assessment unit Cypress Creek 6.25 to 7.8, which is upstream of the confluence with the UT of Cypress Creek 0.1 to 1.3, ranged from 121 to 398 µS/cm.

Westlake appreciates the opportunity to provide these comments and looks forward to KDOW's responses.

Commenter 2

The Calvert City Environmental Consortium (the Consortium) is comprised of individuals and organizations that represent the regulated community in the Calvert City, KY area. The Consortium includes representatives from Arkema, Inc.; Ashland, Inc.; Calvert City Metals and Alloys; Carbide Industries LLC; City of Calvert City; Cymetech Corporation; Estron Chemical, Inc.; Evonik Corporation; Ingevity; Lubrizol Advanced Materials, Inc.; Phoenix Paper Wickliffe LLC; Sekisui SC; Vanderbilt Chemicals, LLC; Wacker Chemical Corporation; Waste Path Sanitary Landfill; and Westlake Vinyls, Inc.

The Consortium's comments are based on our review of the Kentucky Division of Water's (KDOW's) Cypress Creek Total Maximum Daily Load (TMDL) Study Plan (effective date: 3/1/2016), sampling results and field notes from the field work, and the proposed 303(d) listing of Cypress Creek iron, lead, *E. coli*, dissolved oxygen (DO), nutrient/eutrophication biological indicators, sedimentation/siltation, and specific conductivity. The 303(d) listing indicates "industrial point source discharge" may be one of the sources for iron (previously listed), DO, and specific conductivity exceedances between 0 and 6.25 mile points along Cypress Creek.

General Comment and Statement

The Consortium continues to have interest in the 303(d) listing process and subsequent TMDLs that will be developed. We continue to encourage KDOW to base the listings on sound scientific studies and quality data collection. We have provided comments and participated in meetings with KDOW over the last few years to understand both the process and possible outcomes for the Cypress Creek Study. The original listing was based on one sample collection with an analyzed exceedance for iron. An open records request led to the discovery that the information existed in a database but there was no documentation of the quality data.

According to KDOW's "Consolidated Assessment and Listing Methodology", "data older than five years should generally not be used to make a use support decision (U.S EPA 1997), unless it can be determined the data are still representative of current conditions" (p.40). The acute Iron result of 5.6 mg/L for one sample collected in 2006 was more than 5 years old when Cypress Creek was listed on the 303(d) list for iron impairment in 2014. No other provided results from 2000-2011 exceeded the acute water quality standard of 4 mg/L. This would indicate that the 2006 iron concentration used to list the stream is not "still representative of current conditions."

Except for one sediment sample on November 10, 2005, sampling data used for the stream impairment listing consists only of in-stream chemical data. The sediment sample contained 17,200 mg/kg by dry weight of iron, which is slightly below the mean iron value of 22,456 mg/kg for generic statewide ambient background for Kentucky (Kentucky Guidance for Ambient Background Assessment, 2004).

KDOW conducted a study of Cypress Creek from 2016 to 2018 over a period of 27 months. Selected locations were not all consistently sampled on a monthly basis during the study. Stream segment 0-6.25-mile points encompass the industrial areas that the Consortium members operate. Note that only stormwater outfalls are located along Cypress Creek. No industrial outfalls are present.

With the ubiquitous nature of iron and lead detected in the Cypress Creek watershed because of natural conditions, the Consortium urges KDOW to assess the stream conditions and evaluate

the listing under category 4c — segment does not support designated use(s), but this is not attributable to a pollutant or combination of pollutants.

DOW Response to General Comment and Statement

In accordance with 401 KAR 10:031 Surface Water Standards and the Kentucky DOW's Consolidated Assessment and Listing Methodology, designated use attainment has been determined by the Division where data of sufficient quality, quantity, and appropriate age were available. If a designated use has been determined to be impaired, the cause of impairment and suspected sources are identified.

The suspected sources used for the impaired waters list are provided by EPA and can be found at http://iaspub.epa.gov/pls/waters/f?p=ASKWATERS:SOURCE_LUT. The DOW uses suspected sources to best describe the observed conditions at each monitoring location and resulting assessment unit. As for a lack of industrial point source discharges in the watershed; comment noted and all occurrences of the source "Industrial Point Source Discharge" have been replaced with "Industrial/Commercial Site Stormwater Discharge (Permitted)."

Iron was first listed as a cause of impairment on the 2008 303(d) list based on monthly data collected from 4/13/2005 to 3/15/2006. This impairment was passed forward to the 2010 303(d) list. New data were collected between 4/13/2010 to 3/28/2011, which confirmed the iron impairment, and updated the assessment during the 2012 cycle. No new data were available for this segment during the 2014 and 2016 cycles.

New data were available for the 2018/2020 cycle throughout the Cypress Creek watershed. Per 40 CFR § 130.7(b)(5), "Each State shall assemble and evaluate all existing and readily available water quality-related data and information to develop the list required by §§ 130.7(b)(1) and 130.7(b)(2)."

A rigorous quality assurance and quality control process was completed as outlined by Kentucky DOW's Quality Assurance Project Plan (QAPP), Standard Operating Procedures (SOP), and Consolidated Assessment and Listing Methodology (CALM). The data used for assessment within the Cypress Creek watershed were deemed appropriate, sufficient in both quality and quantity.

Per 40 CFR § 130.7(b)(6), "Each State shall provide documentation to the Regional Administrator to support the State's determination to list or not to list its waters as required by §§ 130.7(b)(1) and 130.7(b)(2)." Furthermore, per 40 CFR § 130.7(b)(6)(iv), "each State must demonstrate good cause for not including a water or waters on the list. Good cause includes, but is not limited to, more recent or accurate data; more sophisticated water quality modeling; flaws in the original analysis that led to the water being listed in the categories in § 130.7(b)(5); or changes in conditions, e.g., new control equipment, or elimination of discharges."

For the 2018/2020 reporting cycle, new data of sufficient quantity and quality were available to update the assessment for Cypress Creek 0.0 to 6.25. The *in situ*, water chemistry, and macroinvertebrate results continued to indicate warm water aquatic life impairment and exceedance of the iron criteria. Therefore, there is not good cause for removing this water from the 303(d) list.

When completing assessments within the Cypress Creek watershed, DOW reviewed potential sources of iron and lead and referenced EPA sources and guidelines. EPA's 2014 IR guidance states the following: "When a State evaluates whether a potential designated use impairment is the result of natural conditions, the State should consider all sources of the pollutant being evaluated. If the pollutant

concentrations do not meet the EPA-approved water quality standards, and anthropogenic sources of the pollutant are present, the water is considered impaired and should be included on the State's Section 303(d) list even if natural sources of the pollutant are present."

Throughout the Cypress Creek watershed, the most recent data demonstrated that iron and lead do not meet water quality criteria along one or more assessment units, and potential anthropogenic sources are present. Sources of metals in waterbodies include, but are not limited to, municipal wastewater treatment effluent, industrial point sources, urban runoff, landfills, junkyards, and dredging (U.S. EPA 2021). Therefore, it is not appropriate to categorize these impairments as 4c due to natural conditions and they must instead be listed on the 303(d) list in category 5.

40 CFR § 130.7 requires waters on the 303(d) list be given a priority ranking. 40 CFR § 130.7 (b)(4) specifically states, "The list required under §§ 130.7(b)(1) and 130.7(b)(2) of this section shall include a priority ranking for all listed water quality-limited segments still requiring TMDLs."

As part of the 2018/2020 303(d) public notice, DOW provided definitions for TMDL priority rankings (Table 1). On the 2018/2020 303(d) list, impairments in the Cypress Creek watershed were given the following TMDL priority rankings by parameter:

- *E. coli* impairments have a priority rank of high
- Iron, lead, copper, nutrient eutrophication/biological indicators, organic enrichment (sewage) biological indicators, and dissolved oxygen impairments have a priority rank of medium
- Sedimentation/siltation and specific conductivity impairments have a priority rank of low

Table 1. Definition of TMDL priority rankings on the 2018/2020 303(d) list.

Rank	Definition
High	A TMDL is in development or will be in development within the next two years, and is expected to be completed during the next one to two reporting cycles (within 1-4 years). Waters ranked as "High" priority focus in part on those identified in the Division's 303(d) Long Term Vision Priorities, which established a plan for developing TMDLs and alternative restoration plans for specific waters and pollutants by 2022.
Medium	TMDL strategies are in the planning stage for the waterbody and/or pollutant. Methodologies may be under development or data collection may be planned or ongoing. Opportunities for alternative restorations plans may be under review.
Low	A TMDL is not currently in development. This rank include TMDLs for which methodologies may be in development for the pollutant or waterbody type. Some waters ranked as "Low" priority for TMDL development have an EPA-accepted alternative restoration plan (or "TMDL Alternative") that is being implemented, or have an alternative restoration plan in development that is expected to be EPA-accepted within the next two reporting cycles. The progress of each alternative restoration plan is reviewed each cycle to ensure the plan is on track to restoring water quality. The TMDL development priority rank may be updated based on this review. See table columns in the 303(d) list related to "Restoration Plans" for information on these alternative restoration plans.

Specific Comments - Comment 1

EPA has defined seven reasons to remove an impaired water from the 303(d) list. When a waterbody satisfies any of these seven criteria as determined by the state, a request can be made to EPA to delist the pollutant-waterbody combination from the 303(d) list. One of those reasons is a flaw in the original 303(d) listing.

No chain-of-custody forms, laboratory analytical data reports, or other documentation were provided for field sampling performed in 2006, including the sampling event with a reported iron result of 5.6 mg/L, which was stated as the reason for listing Cypress Creek on the 303(d) list in 2014. No macroinvertebrate samples were provided by KDOW under our open records request for sampling between 2000 and 2011. Additionally, field observation forms appear to be limited to the 2010-2011 sampling years, with no field forms provided for prior years.

According to KDOW's "Consolidated Assessment and Listing Methodology", "data older than five years should generally not be used to make a use support decision (U.S EPA 1997), unless it can be determined the data are still representative of current conditions" (p.40). The acute Iron result of 5.6 mg/L for one sample collected in 2006 was more than 5 years old when Cypress Creek was listed on the 303(d) list for iron impairment in 2014. No other provided results from 2000-2011 were above the acute water quality standard for iron of 4 mg/L to indicate that this sample was "still representative of current conditions."

Therefore, the Consortium requests the original listing for iron at mile points 0-6.2 along Cypress Creek be removed.

DOW Response to Comment 1

Iron was first listed as a cause of impairment on the 2008 303(d) list based on monthly data collected from 4/13/2005 to 3/15/2006. This impairment was passed forward to the 2010 303(d) list. New data were collected between 4/13/2010 to 3/28/2011, which confirmed the iron impairment, and updated the assessment during the 2012 cycle. No new data were available for this segment during the 2014 and 2016 cycles.

New data were available for the 2018/2020 cycle throughout the Cypress Creek watershed. Per 40 CFR § 130.7(b)(5), “Each State shall assemble and evaluate all existing and readily available water quality-related data and information to develop the list required by §§ 130.7(b)(1) and 130.7(b)(2).”

A rigorous quality assurance and quality control process was completed as outlined by Kentucky DOW’s Quality Assurance Project Plan (QAPP), Standard Operating Procedures (SOP), and Consolidated Assessment and Listing Methodology (CALM). The data used for assessment within the Cypress Creek watershed were deemed appropriate, sufficient in both quality and quantity.

Per 40 CFR § 130.7(b)(6), “Each State shall provide documentation to the Regional Administrator to support the State's determination to list or not to list its waters as required by §§ 130.7(b)(1) and 130.7(b)(2).” Furthermore, per 40 CFR § 130.7(b)(6)(iv), “each State must demonstrate good cause for not including a water or waters on the list. Good cause includes, but is not limited to, more recent or accurate data; more sophisticated water quality modeling; flaws in the original analysis that led to the water being listed in the categories in § 130.7(b)(5); or changes in conditions, e.g., new control equipment, or elimination of discharges.”

For the 2018/2020 reporting cycle, new data of sufficient quantity and quality were available to update the assessment for Cypress Creek 0.0 to 6.25. The *in situ*, water chemistry, and macroinvertebrate results continued to indicate warm water aquatic life impairment and exceedance of the iron criteria. Therefore, there is not good cause for removing this water from the 303(d) list.

Specific Comments - Comment 2

KDOW's Cypress Creek TMDL Study Plan states that "three years of data are required to list for metals" with the first year of sampling focused on "confirming the nature of the impairments and possible sources of those impairments." "The second and third years of sampling may also include data collection in smaller, un-assessed tributaries that may be contributing to the identified impairment" (p. 3). In the first year (2016), KDOW sampled sites 1-9. KDOW then dropped Sites 2, 3, 7, and 9 and added Sites 10, 11, and 12 in 2017. Sites 11 and 12 represent "smaller, un-assessed tributaries" feeding into Site 9, and Site 10 is at an upper reach of the same stream represented by Site 9. It appears the additional sites (10-12) are intended to further evaluate these "un-assessed tributaries" as identified in the TMDL Study Plan.

Samples were collected between March 2016 and May 2018, which is 27 months total. Out of the 27-month study, samples were only collected during 16 events. However, the most any one site was sampled was 12 months at Site 2, and only 10 of those 12 months were consecutive.

Since KDOW has not followed its own TMDL Study Plan by collecting 3 years' worth of data, the current proposed listings for Cypress Creek and its tributaries based on the TMDL Study results should be withdrawn until a complete and full study is conducted.

DOW Response to Comment 2

Monitoring project study plans are intended to outline project goals and objectives, but they are not the guiding documents for completing assessments. Kentucky's Water Quality Standards (401 KAR 10:031) and Consolidated Assessment and Listing Methodology (CALM) define the criteria and methodologies for assessment and listing. The CALM notes that "[e]ven a short period of record can indicate a high confidence of impairment based on [physical/chemical] data; 3 years of data are not required to demonstrate impairment" (p. 72).

A rigorous quality assurance and quality control process was completed as outlined by Kentucky DOW's Quality Assurance Project Plan (QAPP), Standard Operating Procedures (SOP), and Consolidated Assessment and Listing Methodology (CALM). The data used for assessment within the Cypress Creek watershed were deemed appropriate, sufficient in both quality and quantity.

Specific Comments - Comment 3

Watershed management and watershed studies should be inclusive of all sources and reasons for chronic or acute exceedances. Iron and most likely lead in this watershed are naturally occurring based on data collected and references sited. Therefore, chronic exceedances are common along the entire sampled watershed with acute exceedances occurring frequently at Site 9 and Site 10 where the stream has been incised and straightened.

The greater Cypress Creek watershed encompasses primarily 5 iron-rich geologic units according to the Kentucky Geological Survey (KGS). These units include loess deposits, continental deposits, Clayton and McNairy Formation, alluvium, and lacustrine and fluvial deposits within the Breinsburg, Calvert City, Elva, and Little Cypress quadrangles. Loess deposits in the Calvert City quadrangle can locally contain iron oxide concretions. Continental deposits in the Breinsburg, Elva, and Little Cypress quadrangles contain layers cemented with ferruginous material. The Clayton and McNairy formation can be cemented by ferruginous material and contain iron oxide concretions. Alluvium deposits are cemented by iron oxide in the Breinsburg quadrangle and contain sparse to abundant iron oxide concretions in the soil zone of the Calvert City quadrangle. Lacustrine and fluvial deposits along waterways in the Calvert City quadrangle contain abundant iron oxide "buckshot" concretions in the soil zone.

Iron oxide (ferruginous) cementation and iron oxide concretions present in formations within the watershed provide sources of naturally occurring iron that can be dissolved into surface water or be a part of sediment loading. The streambed of Cypress Creek is predominately incised within lacustrine and fluvial deposits, including the area upstream of sites 9 & 10, where significant channelization and erosion are present and 66% of acute iron exceedances occurred. This erosion causes increased exposure to the abundant iron oxide concretions present in the formation.

Additionally, KDOW field notes indicate that multiple stream segments consistently do not flow or are dry during portions of the year. KDOW field notes also indicate evidence of flooding at multiple sites indicating a large variation in stream flow that would not only affect the viability of macroinvertebrate populations in these streams but also dissolved oxygen and specific conductivity.

Were these facts taken into consideration when listing parameters and potential sources? If the current stream conditions dictated by precipitation and geology show impacts, how does KDOW attribute that to industrial activities?

DOW Response to Comment 3

The DOW considered a variety of factors when completing assessments in the Cypress Creek watershed.

- DOW reviewed potential sources of iron and referenced EPA sources and guidelines. The DOW agrees with the commenters that channelization can contribute additional iron, and that these anthropogenic disturbances to the channel are not natural.
- DOW also considered the impact of low or variable stream flow on parameters such as benthic macroinvertebrates, dissolved oxygen, and specific conductivity.
- Generally, excursions of water quality criteria were not limited to a particular hydrologic condition. Potential sources of the pollutant are present and those potential sources are located along and/or upstream of the sampling location and the resulting assessment unit's watershed.
- DOW was not targeting any specific sources but meeting a 303(d) listing responsibility to identify potential sources based on the information available. To be inclusive of all sources and reasons for chronic or acute exceedances was beyond the scope of the study.
- Based on comments received, DOW has replaced occurrences of the source "Industrial Point Source Discharge" with "Industrial/Commercial Site Stormwater Discharge (Permitted)" in the watershed.

The data used for assessment were deemed appropriate, sufficient in both quality and quantity. DOW has an obligation under the Clean Water Act sections 305(b) and 303(d) to 1) assess whether the water quality of individual waterbodies is sufficient to support its designated uses, 2) identify impaired waters, and 3) identify causes of impairment and suspected sources.

Specific Comments - Comment 4

Previously dissolved oxygen was listed on the 305(b) list for Cypress Creek. It is now proposed to be listed under 303(d) with a TMDL. What is the reason for moving the parameter to the 303(d) list?

Additionally, Dissolved oxygen exceedances in the KDOW data were dissolved oxygen concentrations < 4.0 mg/L. Based on review of KDOW data the dissolved oxygen instrument was not always calibrated properly and documented. The dissolved oxygen data used to make decisions should be reviewed again for quality assurance and quality control. Were dissolved oxygen measurements reviewed to ensure proper calibration?

DOW Response to Comment 4

Dissolved oxygen saturation (as percent) and dissolved oxygen (as concentration) are different parameters. Dissolved oxygen as a parameter has numeric water quality criteria for the warm water aquatic habitat designated use ("instantaneous minimum shall not be less than four and zero-tenths (4.0) mg/L in water with WAH use.").

Dissolved oxygen saturation was first identified as an impaired parameter for the Cypress Creek 0.0 to 6.25 assessment unit on the 2008 305(b), where the assessor listed the parameter under category 4c. Dissolved oxygen saturation has been identified as an impaired parameter for this assessment unit for all cycles since the 2008 cycle, either by being confirmed with new data or being carried forward.

The most recent data considered for assessment demonstrated that dissolved oxygen (concentration) is a more appropriate parameter because the numeric water quality criteria were not met (data collected by the Ambient Rivers program and the TMDL program supported this listing). Therefore, dissolved oxygen saturation was removed as a parameter (category 4c parameters do not require a delisting request), and dissolved oxygen was added as a cause of impairment. Low dissolved oxygen is a parameter that requires a TMDL, and since a TMDL has not been developed for this parameter, it is in category 5 and can be found on the 2018/2020 303(d) list.

Meter calibration and documentation were reviewed as part of the quality assurance process outlined in the Quality Assurance Project Plan (QAPP). Field sheets, data reports, and meter calibration were reviewed before assessment and listing. In the rare circumstances that the meter was not calibrated properly or the calibration was not documented, the field measurements were not used for assessment purposes.

Specific Comments - Comment 5

Copper appears to have exceeded chronic values in the UT of Cypress Creek 0.0-2.75 (AU # KY3274). In reviewing the data collected by KDOW, it was noted that hardness values for this

segment of water is appreciably lower than the rest of Cypress Creek watershed. Did KDOW ascertain the reason for the lower hardness values used to calculate copper?

DOW Response to Comment 5

The lower hardness at this location was noted by staff, which prompted an additional review of the quality assurance/quality control samples associated with this assessment unit. Hardness was consistently low across sampling events, and no anomalies were observed. DOW concluded that the sample results accurately represent the hardness at this location and were therefore appropriate for use in evaluating the data against the copper criteria. DOW was not able to ascertain why this waterbody had lower hardness, which is a question outside the scope of the assessment.

Specific Comments - Comment 6

Specific Conductivity is listed for Cypress Creek 0.0-6.25 and the UT of Cypress Creek 0.1-1.3 (AU # KY3275). Were these measurements taken in flowing water or stagnant water conditions? Specific conductivity is measured in the field, how does total dissolved solids (TDS) analyses compare to the field measurements? The conductive ions measured come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds. What particular ions (pollutants) are contributing to the higher specific conductivity?

DOW Response to Comment 6

Specific conductivity measurements were taken over a variety of flow conditions. A definitive determination of the particular ions contributing to the elevated conductivity is beyond the scope of the assessment process. According to 401 KAR 10:031, conductivity "shall not be changed to the extent that the indigenous aquatic community is adversely affected."

DOW did examine accompanying results, including the ratio of TDS to specific conductivity and lab determined specific conductivity results, when available. The data used for assessment were deemed appropriate, sufficient in both quality and quantity.

- For UT of Cypress Creek 0.1 to 1.3 (AU # KY-3275), specific conductivity ranged from 529-2820 µS/cm, and sulfate was elevated above concentrations found in other streams in the watershed. This site is located near a staging area for coal before it is transported on barges along the Tennessee River; the waterbody or substrate was noted to be black with coal dust.
- For Cypress Creek 0.0 to 6.2 (AU # KY-617) elevated specific conductivity was limited to base flow to low flow conditions and ranged from 428 to 802 µS/cm during those conditions. This assessment unit is located below the confluence with the UT of Cypress Creek 0.1 to 1.3 where specific conductivity was more consistently and highly elevated. As a comparison, the assessment unit Cypress Creek 6.25 to 7.8, which is upstream of the confluence with the UT of Cypress Creek 0.1 to 1.3, ranged from 121 to 398 µS/cm.

The Consortium appreciates the opportunity to provide these comments and looks forward to continued participation in the 303(d) proposed listing process.