

**TOTAL MAXIMUM DAILY LOAD (TMDL)
for
Escherichia coli (E. coli)
in the
Old Hickory Lake Watershed
(HUC 05130201)**

**Davidson, Macon, Smith, Sumner, Trousdale,
and Wilson Counties, Tennessee**

Draft

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LIST OF ABBREVIATIONS

AFO	Animal Feeding Operation
ATTAINS	Assessment and TMDL Tracking Implementation System
BMP	Best Management Practices
BST	Bacteria Source Tracking
CAFO	Concentrated Animal Feeding Operation
CFR	Code of Federal Regulations
CFS	Cubic Feet per Second
CFU	Colony Forming Units
Cont'd	Continued
CSO	Combined Sewer Overflow
DA	Drainage Area
DEM	Digital Elevation Model
DS	Direct Sources
DWR	Division of Water Resources
E. coli	<i>Escherichia coli</i>
EPA	Environmental Protection Agency
GIS	Geographic Information System
HSPF	Hydrological Simulation Program - Fortran
HUC	Hydrologic Unit Code
LA	Load Allocation
LDC	Load Duration Curve
MGD	Million Gallons per Day
MOS	Margin of Safety
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
N.D.	No Date Information (Citation)
NHD	National Hydrography Dataset
NPS	Nonpoint Source
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
PCR	Polymerase Chain Reaction
PDFE	Percent of Days Flow Exceeded
PFGE	Pulsed Field Gel Electrophoresis
PLRG	Percent Load Reduction Goal
q_m	Mean daily facility (WWTP) flow (cfs)
q_d	Facility design flow (cfs)
Q	Mean daily in-stream flow (cfs)
qPCR	Quantitative Polymerase Chain Reaction
Ref	Refer to
RM	River Mile
SOP	State Operating Permit
SSO	Sanitary Sewer Overflow
STP	Sewage Treatment Plant
SW	Storm Water

LIST OF ABBREVIATIONS (cont'd)

SWMP	Storm Water Management Plan
TDA	Tennessee Department of Agriculture
TDA-NPS	Tennessee Department of Agriculture Nonpoint Source Program
TDEC	Tennessee Department of Environment & Conservation
TDOT	Tennessee Department of Transportation
TMDL	Total Maximum Daily Load
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
UCF	Unit Conversion Factor
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WBP	Watershed-Based Plan
WLA	Waste Load Allocation
WQT	Water Quality Target
WWTP	Wastewater Treatment Plant

SUMMARY SHEET

Total Maximum Daily Loads for *E. coli* in
Old Hickory Lake Watershed (HUC 05130201)

Impaired Waterbody Information

Based on TDEC's Final 2024 List of Impaired and Threatened Waters (TDEC 2024c)

State: Tennessee

Counties: Davidson, Macon, Smith, Sumner, Trousdale, and Wilson Counties

Constituents of Concern: *E. coli*

Impaired Waterbodies Addressed in This Document:

Waterbody ID	Waterbody Name	Miles Impaired
TN05130201001T_0100	Rankin Branch	3.3
TN05130201001T_0200	Town Creek	12.1
TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	2.6
TN05130201013_3000 ^{a,b}	Spring Creek	9.0
TN05130201015_1000	Cedar Creek	10.9
TN05130201021_0300 ^a	Neal Branch	3.7
TN05130201021_0400 ^a	Beech Log Creek	8.5
TN05130201021_2000 ^{a,c}	Round Lick Creek	5.7
TN05130201021_3000 ^{a,c}	Round Lick Creek	3.2
TN05130201028_0100 ^a	Little Goose Creek	12.7
TN05130201028_0150 ^a	Little Goose Creek	10.0
TN05130201028_0200	Hickerson Creek	3.9
TN05130201028_0300	Middle Fork	17.6
TN05130201028_0320	Carr Creek	8.7
TN05130201028_1000	Goose Creek	14.8
TN05130201041_0100	Liberty Branch	21
TN05130201055_0200 ^{a,d}	Sinking Creek	17.3

Notes:

- Waterbodies covered by TMDLs approved by EPA in 2008. The TMDLs included in this document supersede previous TMDLs for these waterbodies.
- TN05130201013_3000 (Spring Creek) is the renumbered Waterbody ID for the segment TN05130201013 – 4000 (Spring Creek) addressed in the 2008 Old Hickory Lake *E. coli* TMDL. This update was made during the 2019 water quality assessment cycle.
- TN05130201021_2000 (Round Lick Creek) and TN05130201021_3000 (Round Lick Creek) represent the segment TN05130201021_2000 (Round Lick Creek) addressed in the 2008 Old Hickory Lake *E. coli* TMDL split into two segments. This update was made during the 2019 water quality assessment cycle.
- TN05130201055_0200 (Sinking Creek) is the renumbered Waterbody ID combining the segments TN05130201055_0200 (Sinking Creek) and TN05130201055_0250 (Sinking Creek), both addressed in the 2008 Old Hickory Lake *E. coli* TMDL, into one segment. This update was made during the 2019 water quality assessment cycle.

Waterbodies evaluated for protection are waterbodies not currently listed as impaired but are either located within impaired drainage areas or have previously received TMDLs. Unimpaired (fully supporting) and unassessed waterbodies assigned for protection include:

Protection Waterbody ID	Protection Waterbody Name	Assessment Status for <i>E. coli</i>
TN05130201013_0200	West Fork Spring Creek	Not Assessed
TN05130201015_0100	Clendenon Branch	Not Assessed
TN05130201015_0200 ^a	Johnson Branch	Not Assessed
TN05130201021_0500	Unnamed Trib to Round Lick Creek	Not Assessed
TN05130201021_0200	Haley Branch	Not Assessed
TN05130201028_0140	Hams Branch	Not Assessed
TN05130201028_0110	Browning Creek	Not Assessed
TN05130201028_0120	Hawkins Branch	Not Assessed
TN05130201028_0130	Skillet Creek	Not Assessed
TN05130201028_0310	Echo Creek	Not Assessed
TN05130201028_0500	Ford Branch	Not Assessed
TN05130201028_0600	Sullivan Branch	Not Assessed
TN05130201028_0700	Dry Fork	Not Assessed
TN05130201028_0800	Dry Branch	Not Assessed
TN05130201028_0400	Carter Branch	Not Assessed
TN05130201028_0900	Pumpkin Branch	Not Assessed
TN05130201028_1100	Finley Branch	Not Assessed
TN05130201055_1000 ^a	Bartons Creek	Not Assessed

Notes:

- a. Waterbodies covered by TMDLs approved by EPA in 2008. The TMDLs included in this document supersede previous TMDLs for these waterbodies. Waterbodies no longer considered impaired yet previously covered by TMDLs are evaluated for protection.

Designated Uses:

Designated surface water use classifications for all waterbodies in the Old Hickory Lake watershed include Fish and Aquatic life, Recreation, Livestock Watering & Wildlife, and Irrigation.

TMDL Scope:

The waterbodies addressed by this TMDL are those in the Old Hickory Lake Watershed (HUC 05130201) identified in the Tennessee Department of Environment and Conservation's (TDEC) Final 2024 List of Impaired and Threatened Waters as impaired due to *E. coli*. TMDLs were developed for impaired waterbodies on a waterbody drainage area basis. Other waterbodies that are not currently listed as impaired, yet either lie within an impaired drainage area or have previously received a TMDL, were evaluated for protection. Protection TMDLs and allocations were developed for these unimpaired (fully supporting) and unassessed waterbodies in order to maintain good water quality and to maximize the likelihood of each protection waterbody meeting water quality standards in the future.

Water Quality Targets:

The current Tennessee general water quality criteria (version March, 2024 (Revised)) for the use of Recreation for coliform is stated as follows:

“(f) Coliform - The concentration of the E. coli group shall not exceed 126 cfu per 100 ml, as a geometric mean based on a minimum of five samples collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals of not less than 12 hours. For the purposes of determining the geometric mean, individual samples having an E. coli concentration of less than 1 cfu per 100 ml shall be considered as having a concentration of 1 cfu per 100 ml. Additionally, the concentration of the E. coli group in any individual sample shall not exceed 410 cfu per 100 ml more often than in 10% of samples during any 30-day interval.”

[Rules of the Tennessee Department of Environment and Conservation, 0400-40-03\(4\)\(f\)](#)
(TDEC 2024f)

Analysis/Methodology:

The TMDLs for the impaired waterbodies in the Old Hickory Lake watershed were developed using a load duration curve methodology to ensure compliance with the *E. coli* criteria: 126 CFU/100 mL geometric mean and 410 CFU/100 mL single sample maximum. A duration curve is a cumulative frequency graph that represents the percentage of time during which the value of a given parameter is equaled or exceeded. Load duration curves are developed from flow duration curves and can illustrate existing water quality conditions (as represented by loads calculated from monitoring data), how these conditions compare to desired targets, and the region of the waterbody flow zone represented by these existing loads. Load duration curves were also used to determine percent load reduction goals (PLRG) to meet the target maximum loading for *E. coli*.

Critical Conditions:

Water quality data collected over a period of 1 to 25 years for load duration curve analysis were used to assess the water quality standards representing a range of hydrologic and meteorological conditions. For each impaired waterbody, critical conditions were determined by evaluating the percent load reduction goals and the percent of samples exceeding TMDL target concentrations (percent exceedance), for each hydrologic flow zone, to meet the target (TMDL) loading for *E. coli*. The percent load reduction goal and/or the percent exceedance of the greatest magnitude corresponds with the critical flow zone(s). When available, water quality data collected over a period of up to 25 years were evaluated for determination of relative change (trend analysis).

Seasonal Variation:

The 10-year period used for WinHSPF model simulation and for load duration curve analysis included all seasons and a full range of flow and meteorological conditions.

Margin of Safety (MOS):

Explicit MOS = 10% of the *E. coli* water quality criteria for each impaired drainage area.

Summary of TMDLs, WLAs, & LAs expressed as daily loads for the Impaired Waterbodies in the Old Hickory Lake Watershed (HUC 05130201)

In HUC-12 (05130201_)	Impaired Waterbody ID	Impaired Waterbody Name ^a	TMDL [CFU/d]	MOS [CFU/d]	WLA: ⁱ WWTP ^b [CFU/d]	WLA: ⁱ MS4 ^{c,d} [CFU/d/acre _{MS4}]	LA ^d [CFU/d/acre _{LA}]
0502	TN05130201001T_0100	Rankin Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(7.61E+06 x Q) - (8.45E+06 x q _d)	(7.61E+06 x Q) - (8.45E+06 x q _d)
0501	TN05130201001T_0200	Town Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.53E+06 x Q) - (1.70E+06 x q _d)	(1.53E+06 x Q) - (1.70E+06 x q _d)
0604	TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.75E+06 x Q) - (6.38E+06 x q _d)	(5.75E+06 x Q) - (6.38E+06 x q _d)
0305	TN05130201013_3000 ^{e,f}	Spring Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(6.23E+05 x Q) - (6.92E+05 x q _d)	(6.23E+05 x Q) - (6.92E+05 x q _d)
0307	TN05130201015_1000	Cedar Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(4.30E+05 x Q) - (4.77E+05 x q _d)	(4.30E+05 x Q) - (4.77E+05 x q _d)
0201	TN05130201021_0300 ^e	Neal Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(7.55E+06 x Q) - (8.39E+06 x q _d)	(7.55E+06 x Q) - (8.39E+06 x q _d)
0201	TN05130201021_0400 ^e	Beech Log Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.26E+06 x Q) - (2.51E+06 x q _d)	(2.26E+06 x Q) - (2.51E+06 x q _d)
0201	TN05130201021_2000 ^{e,g}	Round Lick Creek (Lower)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.17E+05 x Q) - (5.75E+05 x q _d)	(5.17E+05 x Q) - (5.75E+05 x q _d)
0201	TN05130201021_3000 ^{e,g}	Round Lick Creek (Upper)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.11E+06 x Q) - (1.24E+06 x q _d)	(1.11E+06 x Q) - (1.24E+06 x q _d)
0103	TN05130201028_0100 ^e	Little Goose Creek (Lower)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(4.82E+05 x Q) - (5.35E+05 x q _d)	(4.82E+05 x Q) - (5.35E+05 x q _d)
0103	TN05130201028_0150 ^e	Little Goose Creek (Upper)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(6.47E+05 x Q) - (7.19E+05 x q _d)	(6.47E+05 x Q) - (7.19E+05 x q _d)
0103	TN05130201028_0200	Hickerson Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.80E+06 x Q) - (4.22E+06 x q _d)	(3.80E+06 x Q) - (4.22E+06 x q _d)
0102	TN05130201028_0300	Middle Fork	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.17E+05 x Q) - (5.74E+05 x q _d)	(5.17E+05 x Q) - (5.74E+05 x q _d)
0102	TN05130201028_0320	Carr Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.54E+06 x Q) - (2.82E+06 x q _d)	(2.54E+06 x Q) - (2.82E+06 x q _d)
0101, 0102, 0103	TN05130201028_1000	Goose Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.32E+05 x Q) - (1.47E+05 x q _d)	(1.32E+05 x Q) - (1.47E+05 x q _d)
0501	TN05130201041_0100	Liberty Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.17E+06 x Q) - (1.30E+06 x q _d)	(1.17E+06 x Q) - (1.30E+06 x q _d)
0306	TN05130201055_0200 ^{e,h}	Sinking Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(9.22E+05 x Q) - (1.02E+06 x q _d)	(9.22E+05 x Q) - (1.02E+06 x q _d)

Notes: Q = Mean Daily In-stream Flow (cfs), q_m = WWTP Mean Daily Flow (cfs), q_d = WWTP Facility Design Flow (cfs)

- Values in this table are determined using the drainage area calculated from the pour point of each impaired waterbody.
- WLAs for WWTPs are expressed as *E. coli* loads (CFU/day). All current and future WWTPs must meet water quality standards as specified in their NPDES permit. When there are no WWTPs currently discharging into or upstream of the impaired waterbody, the expression is a future term for expanding or newly designated WWTPs.

Summary of TMDLs Notes (cont'd):

- c. Applies to any MS4 discharge loading in the subwatershed. Future MS4s will be assigned waste load allocations (WLAs) consistent with load allocations (LAs) assigned to precipitation induced nonpoint sources. See Section 9.2.2 for implementation details. When there are no MS4s currently located in an impaired drainage area, the expression is a future growth term for expanding or newly designated MS4s.
- d. WLAs and LAs expressed as a “per acre” load are calculated based on the drainage area comprising each respective allocation type (MS4, LA) within the total drainage area of the impaired waterbody (see Table A-1). As regulated MS4 area increases (due to future growth and/or new MS4 designation), unregulated LA area decreases by an equivalent amount. The sum of the areas will continue to equal the total impaired waterbody drainage area.
- e. Waterbodies covered by TMDLs approved by EPA in 2008. The TMDLs included in this document supersede previous TMDLs for these waterbodies.
- f. TN05130201013_3000 (Spring Creek) is the re-numbered Waterbody ID for the same waterbody as TN05130201013 – 4000 (Spring Creek) addressed in the 2008 Old Hickory Lake *E. coli* TMDL. The TMDL for TN05130201013_3000 supersedes the TMDL for the previous Waterbody ID.
- g. TN05130201021_2000 (Round Lick Creek) and TN05130201021_3000 (Round Lick Creek) represent the segment TN05130201021_2000 (Round Lick Creek) addressed in the 2008 Old Hickory Lake *E. coli* TMDL split into two segments. The TMDLs in this document supersede the previous TMDL for this waterbody.
- h. Waterbody ID TN05130201055_0200 (Sinking Creek) is the renumbered Waterbody ID which combines the previous segments TN05130201055_0200 and TN05130201055_0250 into one segment. The TMDL in this document supersedes previous TMDLs for these waterbodies.
- i. As concentrated animal feeding operations (CAFOs) are not permitted discharge from the facility into nearby waterbodies, they receive a waste load allocation of zero. One impaired waterbody in this report has a CAFO within its drainage area: TN05130201013_3000 (Spring Creek) (ref. Section 7.1.3).

PROPOSED *E. COLI* TOTAL MAXIMUM DAILY LOAD (TMDL) Old Hickory Lake Watershed (HUC 05130201)

1.0 INTRODUCTION

Section 303(d) of the Clean Water Act requires each state to list those waters within its boundaries for which technology based effluent limitations are not stringent enough to protect any water quality standard applicable to such waters. Listed waters are prioritized with respect to designated use classifications and the severity of pollution. In accordance with this prioritization, states are required to develop Total Maximum Daily Loads (TMDLs) for those waterbodies that are not attaining water quality standards. State water quality standards consist of designated uses for individual waterbodies, appropriate numeric and narrative water quality criteria protective of the designated uses, and an antidegradation statement. The TMDL process establishes the maximum allowable loadings of pollutants for a waterbody that will allow the waterbody to maintain water quality standards. The TMDL may then be used to develop controls for reducing pollution from both point and nonpoint sources in order to restore and maintain the quality of water resources (USEPA 1991).

2.0 SCOPE OF DOCUMENT

This document presents details of TMDL development for waterbodies in the Old Hickory Lake watershed (HUC 05130201), identified in TDEC's Final 2024 303(d) List of Impaired and Threatened Waters as not supporting designated uses due to *E. coli* (TDEC 2024c). TMDLs were developed for each impaired waterbody drainage area. Other waterbodies that are located within the impaired drainage areas, but are not currently listed as impaired, were evaluated for protection. Waterbodies previously covered under approved TMDLs but that are no longer listed as impaired for *E. coli* are also evaluated for protection. TMDLs and allocations were developed for these unimpaired (fully supporting) and unassessed waterbodies in order to maintain good water quality and to maximize the likelihood of each protection waterbody meeting water quality standards in the future.

Under Tennessee's watershed management approach, each HUC-8 watershed is examined (or re-examined) on a rotating basis. The last TMDL addressing *E. coli* impaired waterbodies in this watershed was approved in 2008. Since that time, the State of Tennessee has updated the criteria for *E. coli* for the Recreation use classification to be consistent with EPA's updated national recommended water quality criteria and comparable criteria in neighboring states. This change was approved by EPA, Region 4, on June 20, 2024. In addition to re-calculating allocations as a result of the adoption of new water quality criteria, additional monitoring data have been collected, and additional waterbodies have been assessed as impaired due to *E. coli*. For these reasons, existing TMDLs have been revisited and new TMDLs developed for newly assessed impairments for the Old Hickory Lake (HUC 05130201) watershed. The *E. coli* TMDLs developed in this document supersede the *E. coli* TMDLs approved by the U.S. Environmental Protection Agency (EPA) on March 8, 2008, for selected waterbodies in the Old Hickory Lake watershed.

3.0 WATERSHED DESCRIPTION

A watershed is an area of land that drains all of the streams and rainfall to a common outlet or pourpoint. Watersheds vary in size and shape. A standardized system for organizing and collecting hydrologic data was developed in the mid-1970s by the United States Geological Survey (USGS). The system divided and subdivided the United States into successively smaller hydrologic units based on surface features (Seaber et al. 1987). The hierarchical Hydrologic Unit Code (HUC) consists of two-digit numbers for each of the nested hydrologic unit levels. The hydrologic unit code hierarchy for the Old Hickory Lake watershed is as follows:

Region	05	Ohio
Subregion	0513	Cumberland
Accounting Unit	051302	Lower Cumberland
Cataloging Unit	05130201	Old Hickory Lake

The Old Hickory Lake watershed is located in Wilson, Sumner, Trousdale, Macon, Smith, and Davidson Counties, in Middle Tennessee. The location of the Old Hickory Lake watershed (HUC 01530201) is shown in Figure 1 below.

The Old Hickory Lake watershed has a drainage area of approximately 986 square miles (mi²). Watershed land use distribution is based on the latest iteration of the National Land Cover Database available in EPA's BASINS modeling program, NLCD 2021. For more information on NLCD 2021, see [NLCD 2021 Now Available | U.S. Geological Survey](#) (USGS 2023). Land use for the Old Hickory Lake watershed is summarized in Table 1 and shown in Figure 2 below. The predominant land uses in the Old Hickory Lake watershed are Pasture/Hay (36.9%) and Deciduous Forest (30%). Land use classified as Developed constitutes 17.4% of the watershed, some of which is concentrated in impaired drainage areas. See Section 9.5 for more information on source area implementation strategies. For detailed descriptions of land use in each impaired drainage area in the Old Hickory Lake watershed, see Appendix A.

The Old Hickory Lake Watershed lies within one Level III ecoregion (Interior Plateau). It contains four Level IV ecoregions described below (USEPA 1997). The vast majority of the Old Hickory Lake watershed is composed of the Outer and Inner Nashville Basins (71h, 71i) as shown in Figure 3 below.

- **Western Pennyroyal Karst (71e)** is a flatter area of irregular plains, with fewer perennial streams, compared to the open hills of the Western Highland Rim (71f). Small sinkholes and depressions are common. The productive soils of this notable agricultural area are formed mostly from a thin loess mantle over residuum of Mississippian-age limestones. Most of the region is cultivated or in pasture; tobacco and livestock are the principal agricultural products, with some corn, soybeans, and small grains. The natural vegetation consisted of oak-hickory forest with mosaics of bluestem prairie. The barrens of Kentucky, that extended south into Stewart, Montgomery, and Robertson counties, were once some of the largest natural grasslands in Tennessee.
- **Eastern Highland Rim (71g)** has level terrain, with landforms characterized as tablelands of moderate relief and irregular plains. Mississippian-age limestone, chert, shale and dolomite predominate, and karst terrain sinkholes and depressions are especially noticeable between Sparta and McMinnville. Numerous springs and spring-associated fish fauna also typify the region. Natural vegetation for the region is transitional between the oak-hickory type to the west and the mixed mesophytic forests of the Appalachian ecoregions to the east. Bottomland hardwoods forests were once abundant in some areas, although much of the original bottomland forest has been inundated by several large impoundments. Barrens and former prairie areas are now mostly oak thickets or pasture and cropland.
- **Outer Nashville Basin (71h)** is a heterogeneous region, with rolling and hilly topography and slightly higher elevations. The region encompasses most all of the outer areas of the generally no-cherty Mississippian-age formations, and some Devonian-age Chattanooga shale, remnants of the Highland Rim. The region's limestone rocks and soils are high in phosphorus, and commercial phosphate is mined. Deciduous forest with pasture and cropland are the dominant land covers. Streams are low to moderate gradient, with productive, nutrient-rich waters, resulting in algae, rooted vegetation and occasionally high densities of fish. The Nashville Basin as a whole has a distinctive fish fauna, notable for fish that avoid the region, as well as those that are present.
- **Inner Nashville Basin (71i)** is less hilly and lower than the Outer Nashville Basin. Outcrops of the Ordovician-age limestone are common, and the generally shallow soils are redder and lower in phosphorus than those of the Outer Basin. Streams are lower gradient than surrounding regions, often flowing over large expanses of limestone bedrock. The most characteristic hardwoods within the Inner Basin are a maple-oak-hickory-ash association. The limestone cedar glades of Tennessee, a unique mixed grassland/forest/cedar glades vegetation type with many endemic species, are located primarily on the limestone of the Inner Nashville Basin. The more xeric, open characteristics and shallow soils of the cedar glades also result in a distinct distribution of amphibian and reptile species.

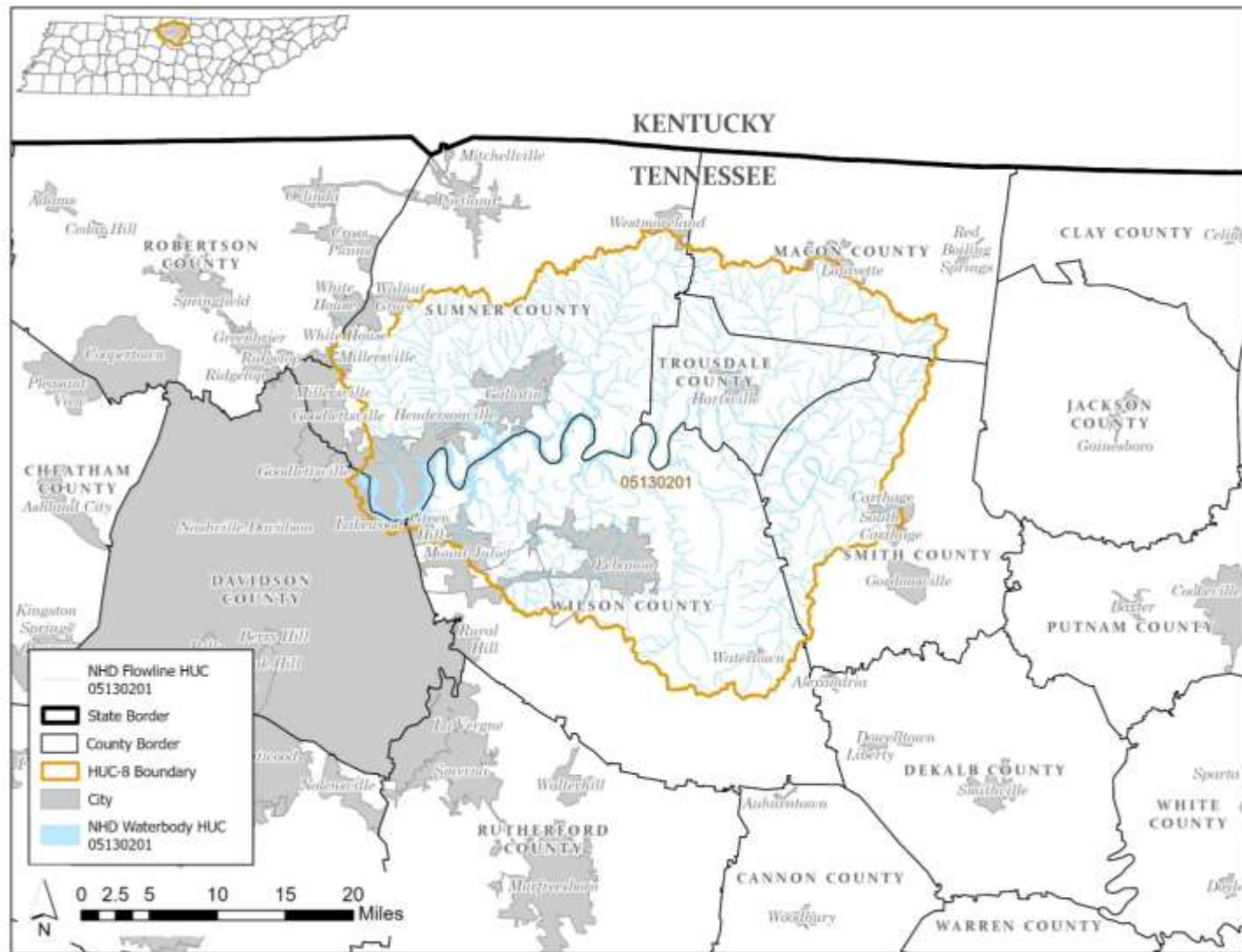


Figure 1. Location of the Old Hickory Lake Watershed (HUC 05130201)

Note: NHD Flowline and Waterbody elements refer to the USGS National Hydrography Dataset. This represents the water drainage network of the U.S. with rivers, streams, lakes, ponds, and other hydrographic features (USGS 2025b).

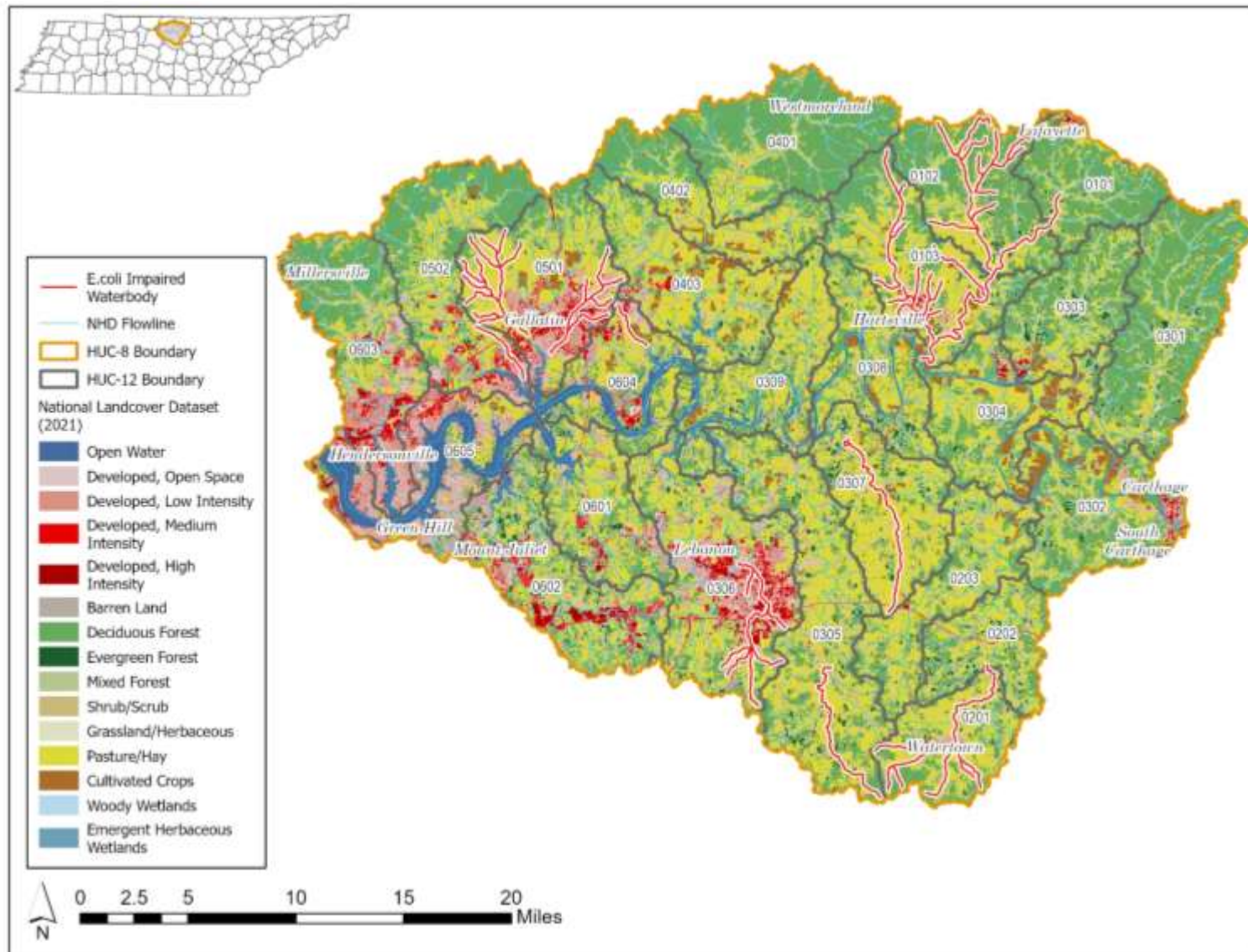


Figure 2. NLCD Land Use Description of the Old Hickory Lake Watershed

Table 1. NLCD Land Use Description – Old Hickory Lake Watershed

NLCD Code	Classification Description	Acres	%
11	Open Water	20,310	3.2%
21	Developed, Open Space	56,587	9.0%
22	Developed, Low Intensity	34,227	5.4%
23	Developed, Medium Intensity	14,258	2.3%
24	Developed, High Intensity	4,169	0.7%
31	Barren Land	727	0.1%
41	Deciduous Forest	188,967	30.0%
42	Evergreen Forest	13,177	2.1%
43	Mixed Forest	46,741	7.4%
52	Shrub/Scrub	208	0.0%
71	Grassland/Herbaceous	1,524	0.2%
81	Pasture/Hay	232,879	36.9%
82	Cultivated Crops	15,443	2.4%
90	Woody Wetlands	989	0.2%
95	Emergent Herbaceous Wetlands	622	0.1%
	Total	630,828	100.0%

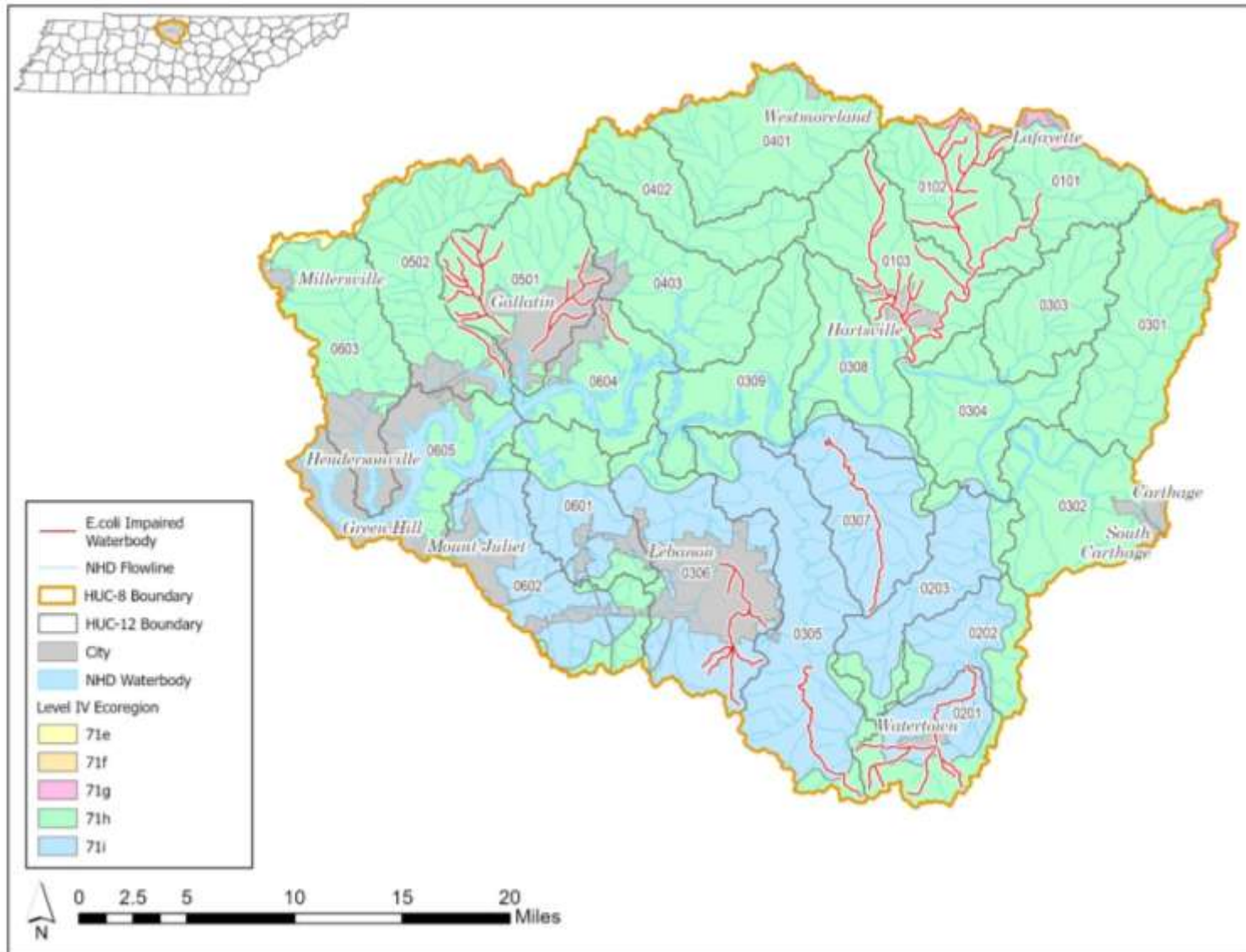


Figure 3. Level IV Ecoregions of the Old Hickory Lake Watershed

4.0 PROBLEM DEFINITION

TDEC's [Final 2024 List of Impaired and Threatened Waters](#) (TDEC 2024c) was approved by EPA, Region 4, on April 24, 2024. This list identifies 62 instances of waterbody impairment in the Old Hickory Lake watershed resulting in the respective waterbody not fully supporting designated use classifications, 17 of these impairments due to *E. coli* (see Table 2 & Figure 4 below). Tennessee [designated surface water use classifications](#) (TDEC 2024g) for these waterbodies include Fish and Aquatic life, Recreation, Livestock Watering & Wildlife, and Irrigation. Potential impairment source names are determined by TDEC staff familiar with the watershed during the assessment process and take into account land use description, imagery, historical patterns, and other criteria.

5.0 WATER QUALITY CRITERIA & TMDL TARGET

Of the use classifications with numeric criteria for *E. coli*, the Recreation use classification is the most stringent and will be used to establish target levels for TMDL development. The coliform water quality criteria, for protection of the Recreation use classification, is established by State of Tennessee Water Quality Standards, Chapter 0400-40-03, General Water Quality Criteria (TDEC 2024f). Coliform is a certain type of bacteria and *E. coli* is a sub-group of fecal coliform bacteria. Not all *E. coli* bacteria are pathogenic (i.e. meaning causing disease). *E. coli* are considered a good indicator of fecal contamination from warm-blooded animals because *E. coli* generally don't grow and reproduce in the environment (unlike fecal coliforms) and have a better correlation with gastrointestinal illness in humans than do fecal coliforms.

The current Tennessee general water quality criteria for the use of Recreation for coliform is stated as follows:

“(f) Coliform - The concentration of the E. coli group shall not exceed 126 cfu per 100 ml, as a geometric mean based on a minimum of five samples collected from a given sampling site over a period of not more than 30 consecutive days with individual samples being collected at intervals of not less than 12 hours. For the purposes of determining the geometric mean, individual samples having an E. coli concentration of less than 1 cfu per 100 ml shall be considered as having a concentration of 1 cfu per 100 ml. Additionally, the concentration of the E. coli group in any individual sample shall not exceed 410 cfu per 100 ml more often than in 10% of samples during any 30-day interval.”

[Rules of the Tennessee Department of Environment and Conservation, 0400-40-03\(4\)\(f\)](#)
(TDEC 2024f)

Following the numerical criteria established in this rule, the single sample maximum of 410 CFU/100 ml has been selected as the appropriate numerical target for TMDL development for the impaired and protection waterbodies listed in this document. For further information concerning Tennessee's general water quality criteria and Tennessee's Antidegradation Statement, including the definition of Exceptional Tennessee Water, see [Rules of the Tennessee Department of Environment and Conservation, 0400-40-03\(4\)\(f\)](#) (TDEC 2024f).

Table 2. Extract from TDEC Final 2024 List of Impaired and Threatened Waters – *E. coli* Impaired Waterbodies in the Old Hickory Lake Watershed

ID 305b Waterbody ID	Waterbody Name	Length [miles]	Impairment Cause Name	TMDL Priority	Potential Impairment Source Name
TN05130201001T_0100	Rankin Branch	3.3	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones & Unrestricted cattle access
TN05130201001T_0200	Town Creek	12.1	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Sanitary sewer overflows (collection system failures) & Municipal (urbanized high-density area)
TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	2.57	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	On-site treatment systems (septic systems and similar decentralized systems)
TN05130201013_3000	Spring Creek	9	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones & Unrestricted cattle access
TN05130201015_1000	Cedar Creek	10.9	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones & Unrestricted cattle access
TN05130201021_0300	Neal Branch	3.7	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Unrestricted cattle access
TN05130201021_0400	Beech Log Creek	8.5	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones
TN05130201021_2000	Round Lick Creek	5.71	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones & Sanitary sewer overflows (collection system failures)
TN05130201021_3000	Round Lick Creek	3.16	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones
TN05130201028_0100	Little Goose Creek	12.7	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones & Municipal (urbanized high-density area)
TN05130201028_0150	Little Goose Creek	10	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones
TN05130201028_0200	Hickerson Creek	3.9	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones
TN05130201028_0300	Middle Fork	17.6	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones
TN05130201028_0320	Carr Creek	8.7	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones
TN05130201028_1000	Goose Creek	14.8	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones
TN05130201041_0100	Liberty Branch	21	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Grazing in riparian or shoreline zones
TN05130201055_0200	Sinking Creek	17.34	<i>Escherichia coli</i> (<i>E. coli</i>)	HIGH	Municipal (urbanized high-density area) & Sanitary sewer overflows (collection system failures)

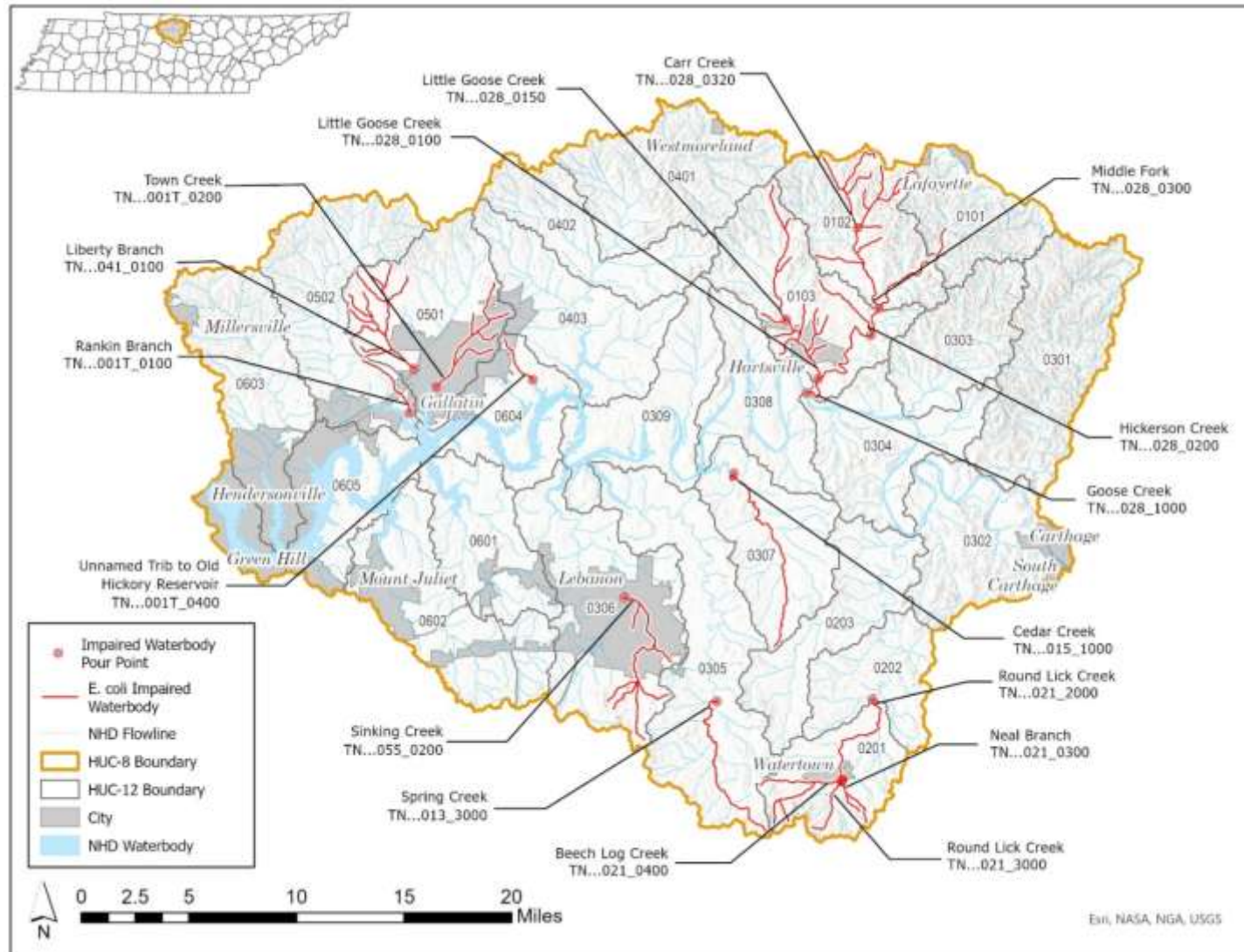


Figure 4. Waterbodies Listed as Impaired by *E. coli* on TDEC Final 2024 303(d) List of Impaired and Threatened Waters in the Old Hickory Lake Watershed

Note: For this and subsequent maps, basemaps are provided by Esri, NASA, NGA, USGS, and FEMA sources.

6.0 WATER QUALITY ASSESSMENT AND DEVIATION FROM TARGET

Water quality monitoring data for waterbodies identified as impaired for *E. coli* on the Final 2024 303(d) List in the Old Hickory Lake Watershed were collected at 17 monitoring stations. A summary of the relevant 2024 303(d) water quality monitoring data is presented in Table 3 below. In this and subsequent tables, the qualifiers “(Upper)” and “(Lower)” have been added for clarification regarding different waterbody IDs with the same name. A detailed list of the relevant water quality monitoring data, sorted by day, can be found in Appendix B. The locations of these monitoring stations are shown in Figure 5 below.

7.0 SOURCE ASSESSMENT

An important part of TMDL analysis is the identification of individual sources, or source categories of pollutants in the watershed that have the potential to affect *E. coli* loading and the amount of loading contributed by each of these sources.

Under the Clean Water Act, sources are classified as either point or nonpoint sources. Under [40 CFR §122.2](#) (CFR 2025a) a point source is defined as a discernible, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. The [National Pollutant Discharge Elimination System \(NPDES\) program](#) (USEPA 2025a) regulates point source discharges. Point sources can be described by three broad categories: (1) [NPDES regulated municipal](#) and [industrial wastewater treatment facilities](#) (WWTPs); (2) NPDES [regulated industrial](#) and [municipal stormwater](#) discharges; (3) [NPDES regulated Concentrated Animal Feeding Operations](#) (CAFOs) (USEPA 2025a).

A TMDL must provide Waste Load Allocations (WLAs) for all NPDES regulated point sources. Nonpoint sources are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. For the purposes of this TMDL, all sources of pollutant loading not regulated by NPDES permits are considered nonpoint sources. The TMDL must provide a Load Allocation (LA) for these sources.

Table 3. Summary of TDEC Water Quality Monitoring Data for *E. coli* Impaired Waterbodies in the Old Hickory Lake Watershed, 2024 303(d)

ID 305b Waterbody ID	Waterbody Name	Monitoring Station	In HUC-12 [05310201...]	River Mile	2024 303(d) Date Range	# Data Points	Min. [CFU/100ml]	Avg. [CFU/100ml]	Max. [CFU/100ml]	30d Geomean ^a [CFU/100ml]	No. Single Sample Exceedance	Date Range of Geomean Exceedance
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	0502	1.7	2019 -2020	6	13	107	308	NGD	0 ^b	
TN05130201001T_0200	Town Creek	TOWN000.3SR	0501	0.3	2019 -2020	9	66	398	1300	NGD	2	
TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	CUMBE246.5T1.5SR	0604	1.5	2019 -2020	9	108	768	2420	NGD	5	
TN05130201013_3000	Spring Creek	SPRIN024.8WS	0305	24.8	2019 -2020	10	39	338	1203	91.7	3	
TN05130201015_1000	Cedar Creek	ECO71I12	0307	4.6	2019 -2020	7	166	899	2420	802.7	5	8/8/2019 - 8/22/2019
TN05130201021_0300	Neal Branch	NEAL000.1WS	0201	0.1	2019	5	210	463	727	413.3	3	8/8/2019 - 8/29/2019
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	0201	0.6	2019	5	140	349	866	273.6	1	8/8/2019 - 8/29/2019
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	0201	19.4	2019 -2020	9	88	724	2420	NGD	5	
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	0201	21.0	2019 -2020	5	108	431	816	NGD	2	
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	0103	2.0	2019 -2020	12	27	361	1986	NGD	3	
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	0103	6.5	2019 -2020	12	102	291	687	NGD	3	
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	0103	0.9	2019 -2020	12	461	1009	1986	NGD	12	
TN05130201028_0300	Middle Fork	MFGOO000.7TR	0102	0.7	2019 -2020	12	147	1048	2420	NGD	9	
TN05130201028_0320	Carr Creek	CARR000.1MA	0102	0.1	2019 -2020	12	131	518	1414	NGD	6	
TN05130201028_1000	Goose Creek	GOOSE004.5TR	0101, 0102, 0103	4.5	2019 -2020	12	19	350	687	NGD	5	
TN05130201041_0100	Liberty Branch	LIBER001.3SR	0501	1.3	2019 -2020	9	75	260	461	NGD	3	
TN05130201055_0200	Sinking Creek	SINKI000.1WS	0306	0.1	2019 -2020	9	93	399	1414	NGD	2	

Notes:

- a. NGD = no geomean data, i.e. there were not five samples collected from one site over a period of less than 30 consecutive days at intervals of more than 12 hours.
- b. While Rankin Branch showed no instances of single sample or geomean *E. coli* exceedances for this sampling cycle, the 2024 water quality assessment determined that insufficient sampling data existed to change the waterbody classification from the impaired status as determined from the previous assessment cycle.

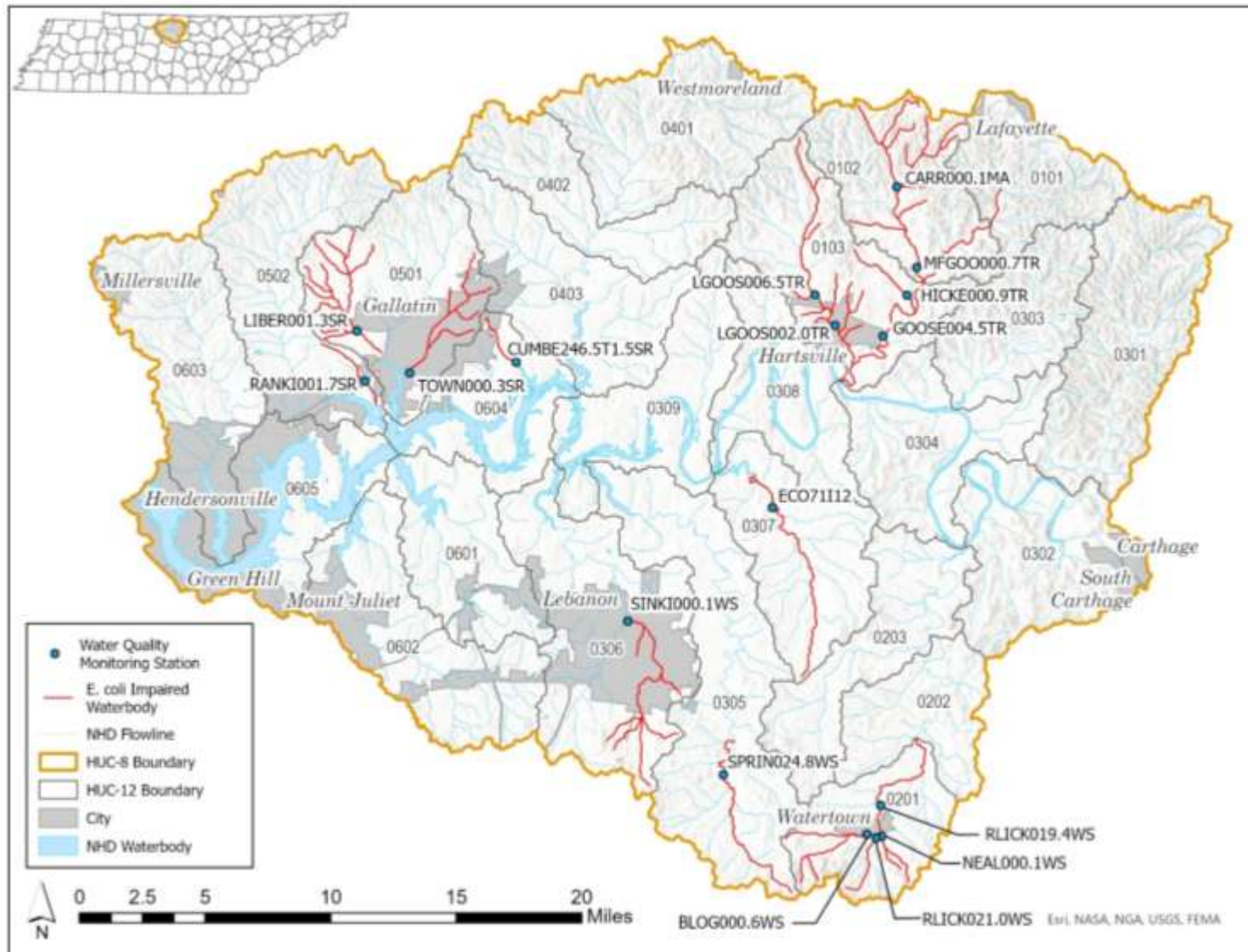


Figure 5. TDEC Water Quality Monitoring Stations for *E. coli*-impaired Waterbodies in the Old Hickory Lake Watershed

7.1 Point Sources

7.1.1 NPDES Regulated Municipal Wastewater Treatment Facilities

Both treated and untreated sanitary wastewaters contain coliform bacteria. Certain process wastewaters can also contain coliform bacteria. There is one facility located within the Old Hickory Lake Watershed that has an NPDES permit authorizing the discharge of treated sanitary or process wastewater in or upstream of an *E. coli* impaired waterbody: Watertown STP (TN0025488) (ref. Table 4 and Figure 6 below). The permit limit for discharges from this WWTP are in accordance with the coliform criteria specified in Tennessee Water Quality Standards for the protection of the Recreation use classification. Once a facility has obtained an NPDES discharge permit that meets the applicable water quality criteria, compliance with the terms of the permit is continuously monitored through influent and effluent monitoring, site inspections, and operating reports. Monitoring data are required to be submitted monthly detailing sampling results of chemical, biological, and physical parameters required in the permit. Additionally, WWTPs are required to report on facility bypasses or anticipated bypasses as well as sanitary sewer overflows, releases, upsets, and bypasses in the associated collection system. These reports are recorded via the MyTDEC Forms system, an online portal where WWTP operators can report events to be automatically updated into WaterLog and DWR DataViewer records. Permittees are required to comply with all conditions of their permit; any permit noncompliance is grounds for enforcement action. Permit limits for the facility listed in Table 4 were updated in 2024 to reflect the recent change in water quality criteria for *E. coli*.

Non-permitted point sources of (potential) *E. coli* contamination of surface waters associated with sewage treatment plant (STP) collection systems include leaking collection systems, sanitary sewer overflows (SSOs), and other unintended releases (collectively referred to as “events”). Since December 2021, Watertown STP has been reporting events to MyTDEC Forms for automatic recording into DWR systems. According to the TDEC DWR DataViewer, Watertown STP has 31 events between December 2021 and January 2026. For more information on these events, see [DWR DataViewer Events Report](#) (TDEC N.D.b). Information on earlier events may be found at the Nashville Environmental Field Office.

In addition to actively reporting events in MyTDEC Forms, Watertown STP is also currently undergoing a collection system rehabilitation project to upgrade the capacity and efficiency of its existing collection system. This rehabilitation project is part of a Capacity, Management, Operation and Maintenance (CMOM) program required by a Consent Order and Agreement that Watertown STP entered into with TDEC in 2016. The purpose of this CMOM is to improve the collection system in order to reduce sanitary sewer overflows and improve efficiency, safety, and reliability of the system. Actions undergone in this project include the development of a Corrective Action Plan – Engineering Report (CAP-ER), replacing lift pumps, smoke testing, and CCTV camera inspection. In order to reduce infiltration and inflow, the CAP-ER recommends cured-in-place pipe (CIPP) rehabilitation lining of approximately 17,000 linear feet of existing sewer lines as well as installing 3,065 linear feet of new gravity sewer to replace the existing interceptor located in the bottom of Round Lick Creek. More information regarding this project can be found in the City of Watertown CMOM Program 2023 Update Report (Water Management Services 2023). A recent update on the current state of the project provided by the City of Watertown notes that the CIPP lining and interceptor replacement activities are behind schedule but ongoing (Jennings 2026).

While Watertown STP is the only WWTP located in the Old Hickory Lake Watershed permitted to discharge to an *E. coli* impaired stream, events associated with the collection systems of other NPDES permitted facilities in the watershed have the potential to contaminate the surface waters they drain into. A summary of events in the Old Hickory Lake watershed is tabulated in Table 5 and shown in Figure 7 below. Note that some of the events recorded are for entities covered by an SOP rather than an individual permit. For more information on events in the Old Hickory Lake Watershed, see the [DWR DataViewer Events Report](#) and [DWR DataViewer Events Map](#) (TDEC N.D.b).

Table 4. Facilities with NPDES Permits to Discharge Sanitary Wastewater Located in Impaired Drainage Areas of the Old Hickory Lake Watershed

NPDES Permit Number	Permitee, Project Name	Design Flow Rate [MGD] ^a	Receiving Stream Waterbody ID	Receiving Stream Waterbody Name
TN0025488	City of Watertown, Watertown STP	0.27	TN05130201021_2000	Round Lick at mile 20.0

Notes:

a. MGD = Million Gallons per Day

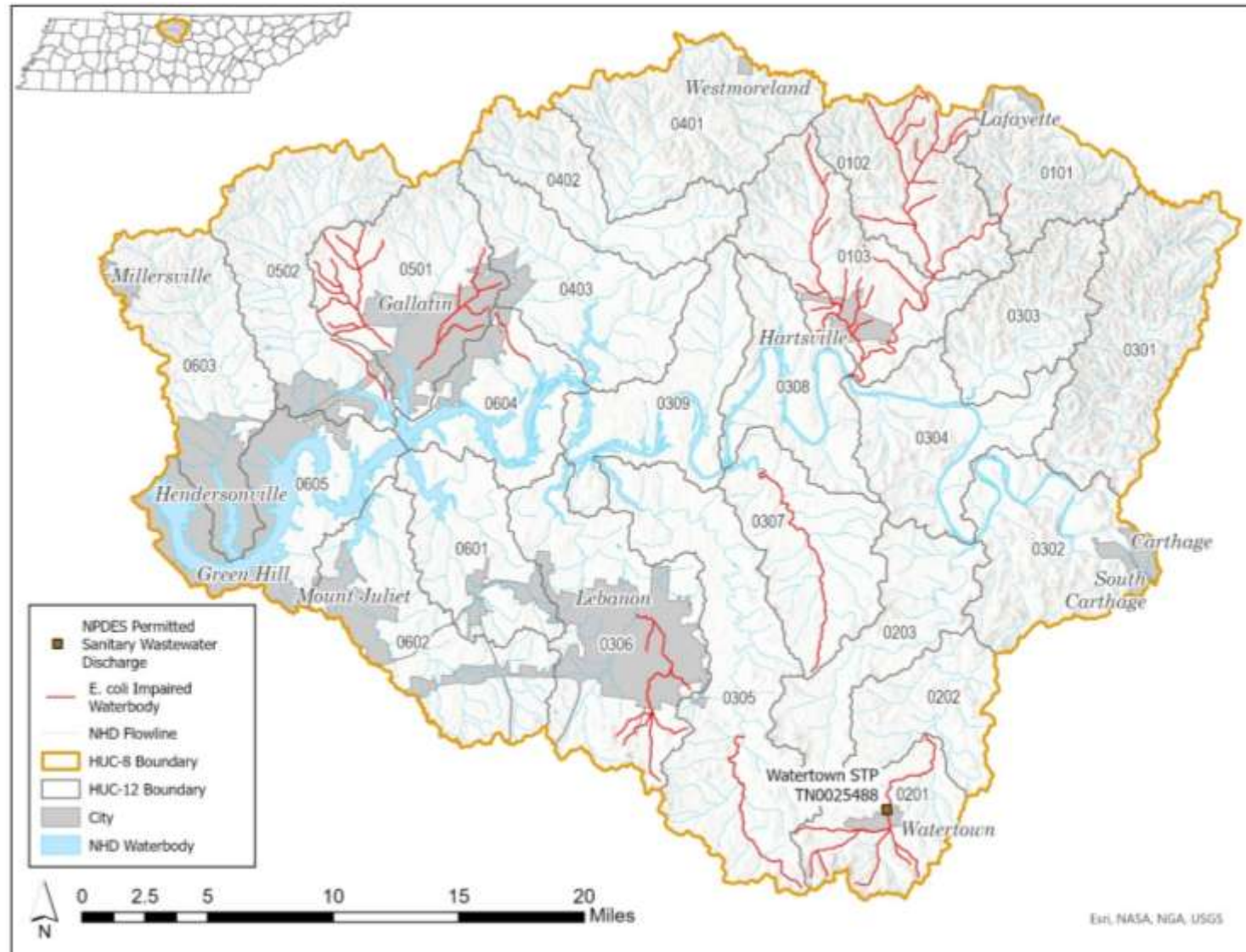


Figure 6. Facilities with NPDES Permits to Discharge Sanitary Wastewater Located in Impaired Drainage Areas of the Old Hickory Lake Watershed

Table 5. Summary of TDEC Recorded Events in the Old Hickory Lake Watershed

Permit No.	Permittee Name	Project Name	Event Count ^a	Reporting Period ^b
TN0020575	Metro Water Services	Metro Water Services - Nashville Central STP and Combined Sewer System	8	03/2023 - 03/2026
TN0020648	Metro Water Services	Metro Water Services - Dry Creek Water Reclamation Facility	8	12/2021 - 03/2026
TN0020877	City of Lafayette	Lafayette STP	1	01/2022 - 03/2026
TN0022993	Town of Carthage	Carthage STP	17	11/2021 - 03/2026
SOP-88080	Hendersonville Utility District	Municipal Collection System	110	11/2021 - 03/2026
TN0020141	Gallatin Public Utilities	Gallatin STP	26	11/2022 - 03/2026
SOP-97022	White House Utility District	White House Collection System	11	08/2022 - 03/2026
TN0060232	White House Utility District	Tanasi Shores WWTP	2	08/2021 - 03/2026
SOP-89150	City of Millersville	Municipal Collection System	1	06/2023 - 03/2026
TN0030899	Hartsville-Trousdale County Water/Sewer Utility District	Hartsville STP	6	09/2023 - 03/2026
TN0028754	City of Lebanon	Lebanon POTW	62	06/2021 - 03/2026
TN0025488	City of Watertown	Watertown STP	31	12/2021 - 03/2026
SOP-04015	Water and Wastewater Authority of Wilson County	Cedar Grove Facility	1	05/2025 - 03/2026
SOP-88074	City of Mt. Juliet	Municipal collection system	6	03/2024 - 03/2026
SOP-04044	Water and Wastewater Authority of Wilson County	Cairo Bend Treatment Facility	2	03/2022 - 03/2026

Notes:

- Events include sewer overflows, releases, bypasses, upsets, and other unintended releases.
- Reporting periods vary by facility based on when their first event occurred in this watershed after submitting reports through MyTDEC Forms. Additional events may have occurred since the creation of this report.

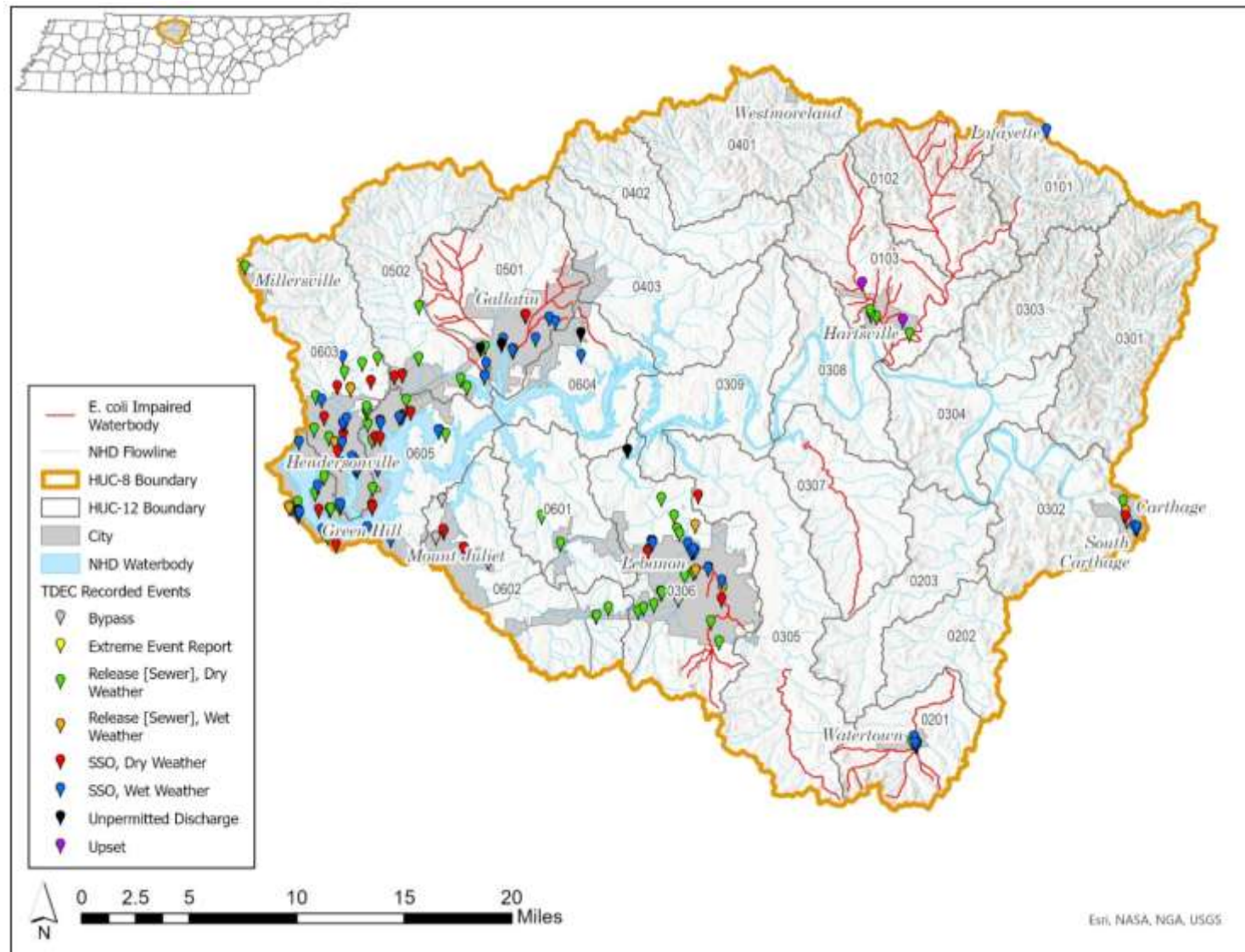


Figure 7. TDEC Recorded Events Located in the Old Hickory Lake Watershed

7.1.2 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

Municipal Separate Storm Sewer Systems (MS4s) are considered to be potential point sources of *E. coli*. As TMDLs assign loads to every potential source of pollutant in an impaired watershed, each MS4 located in an impaired drainage area receives a wasteload allocation (WLA) regardless of size. Discharges from MS4s occur in response to storm events through road drainage systems, curb and gutter systems, ditches, and storm drains. The [EPA stormwater program](#) (USEPA 2025d) requires large and medium MS4s to obtain individual NPDES stormwater permits. Large and medium MS4s (aka Phase I MS4s) are those located in incorporated places or counties serving populations greater than 100,000 people. There are no regulated large or medium MS4s discharging in the Old Hickory Lake Watershed.

EPA rules also require NPDES permit coverage for stormwater discharges from certain small MS4s (Phase II MS4s) (USEPA 2025d). A small MS4 is designated as regulated if: a) it is located within the boundaries of a defined urbanized area that has a residential population of at least 50,000 people and an overall population density of 1,000 people per square mile; b) it is located outside of an urbanized area but within a jurisdiction with a population of at least 10,000 people, a population density of 1,000 people per square mile, and has the potential to cause an adverse impact on water quality; or c) it is located outside of an urbanized area but contributes substantially to the pollutant loadings of a physically interconnected MS4 regulated by the NPDES stormwater program. Most regulated small MS4s in Tennessee obtain coverage under the [NPDES General Permit for Discharges from Small Municipal Separate Storm Sewer Systems](#) (TDEC 2024a). Table 6 and Figure 8 below show entities located in *E. coli* impaired drainage areas of the Old Hickory Lake Watershed that are covered under Tennessee's Small MS4 General Permit.

The [EPA stormwater program](#) (USEPA 2025e) requires state transportation departments to obtain NPDES stormwater permits. A state department of transportation is a regulated small MS4 per [40 CFR § 122.32 \(a\)](#) (CFR 2025b). The Tennessee Department of Transportation (TDOT) has been issued an individual MS4 permit (TNS077585) that authorizes discharges of stormwater runoff from state roads and interstate highway rights-of-way that TDOT owns or maintains, discharges of stormwater runoff from TDOT owned or operated facilities, and certain specified non-stormwater discharges. This permit covers all eligible TDOT discharges statewide, including those located outside of urbanized areas.

For information about TDOT's stormwater management program, see the [TDOT TS4/MS4 Permit & Facility Compliance Program](#) webpage (TDOT N.D.).

For information regarding stormwater permitting in Tennessee, see the [TDEC NPDES Stormwater Permitting Program](#) webpage (TDEC 2024e).

Table 6. Entities Covered Under Tennessee’s Small MS4 General Permit Located in Impaired Drainage Areas of the Old Hickory Lake Watershed

MS4 Permit No.	Permitted Entity	Receiving Stream(s) in Impaired Drainage Areas	Impaired Drainage Area(s)
TNS075426	City of Lebanon	Sinking Creek, Tarver Branch	Sinking Creek DA
TNS075680	Sumner County MS4	Town Creek, Unnamed Trib to Old Hickory Reservoir, Liberty Branch	Town Creek DA, Unnamed Trib DA, Liberty Branch DA
TNS075809	Wilson County Stormwater	Spring Creek, Johnson Branch, Neal Branch, Beech Log Creek, Round Lick Creek, Sinking Creek	Spring Creek DA, Cedar Creek DA, Neal Branch DA, Beech Log Creek DA, Round Lick Creek Upper DA, Round Lick Creek Lower DA, Sinking Creek DA
TNS077534	City of Gallatin	Town Creek	Town Creek DA

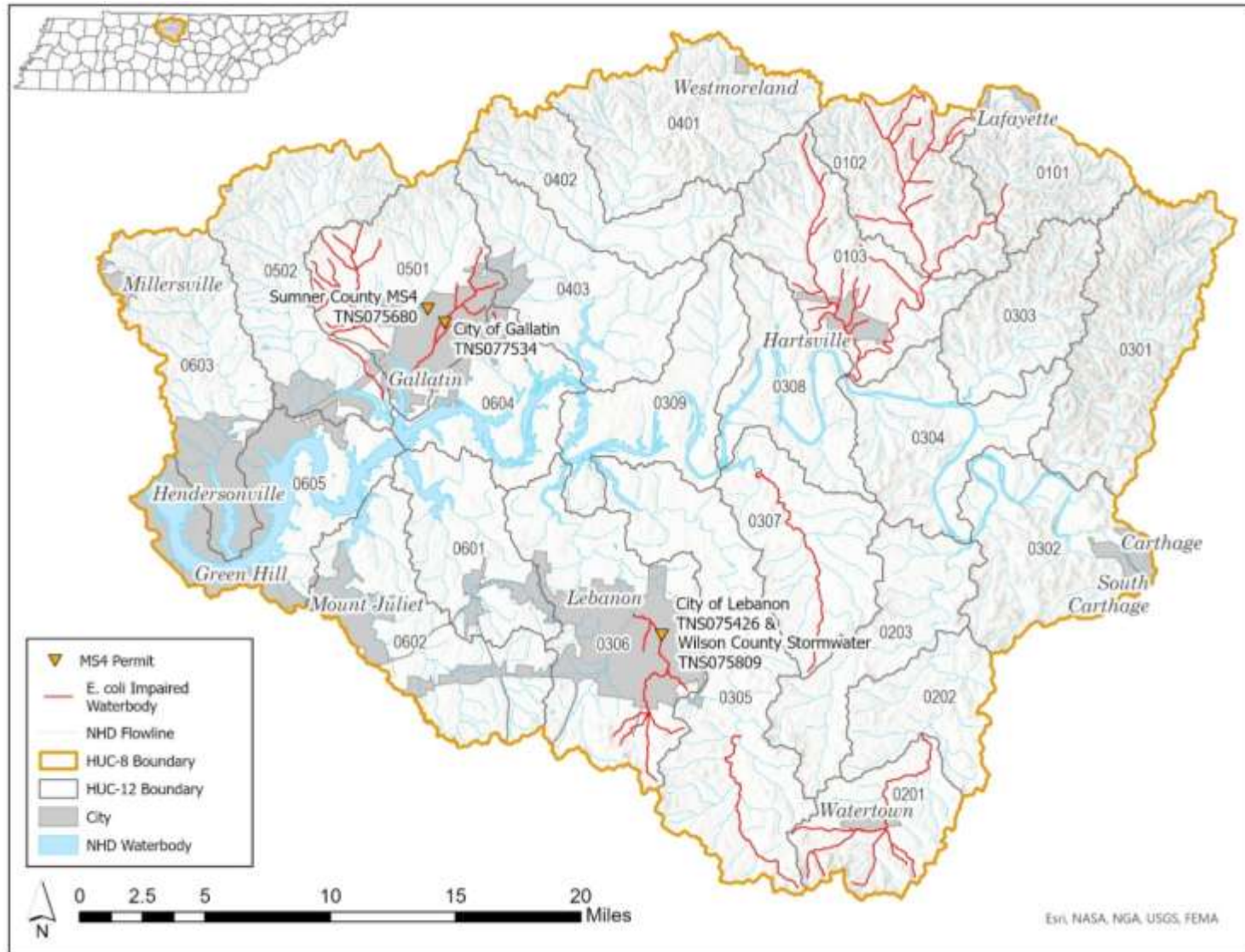


Figure 8. Entities Covered Under Tennessee's Small MS4 General Permit Located in Impaired Drainage Areas of the Old Hickory Lake Watershed

7.1.3 Concentrated Animal Feeding Operations (CAFOs)

Animal feeding operations (AFOs) are agricultural enterprises where animals are kept and raised in confined situations. AFOs congregate animals, feed, manure and urine, dead animals, and production operations on a small land area. Feed is brought to the animals rather than the animals grazing or otherwise seeking feed in pastures, fields, or on rangeland (USEPA 2002a). Concentrated Animal Feeding Operations (CAFOs) are AFOs that meet certain criteria with respect to animal type, number of animals, and type of manure management system. CAFOs are considered to be potential sources of *E. coli* loading. Due to newly passed legislation, changes to the CAFO program in Tennessee are being implemented, requiring only large CAFOs that have outdoor storage of liquid manure to obtain a State Operating Permit. However, any CAFO may voluntarily request coverage under a State Operating Permit or an NPDES permit. There is currently one permitted CAFO located within the drainage area for an *E. coli* impaired waterbody within the Old Hickory Lake watershed (see Table 7 and Figure 9 below).

Table 7. Entities Covered Under Tennessee’s CAFO Permit Located in Impaired Drainage Areas of the Old Hickory Lake Watershed

CAFO Permit Number	Permitted Entity	Description	Type	Impaired Drainage Area
SOPCD0031	Roy Major Farm	Dairy farm, 310 head	Active	Spring Creek DA

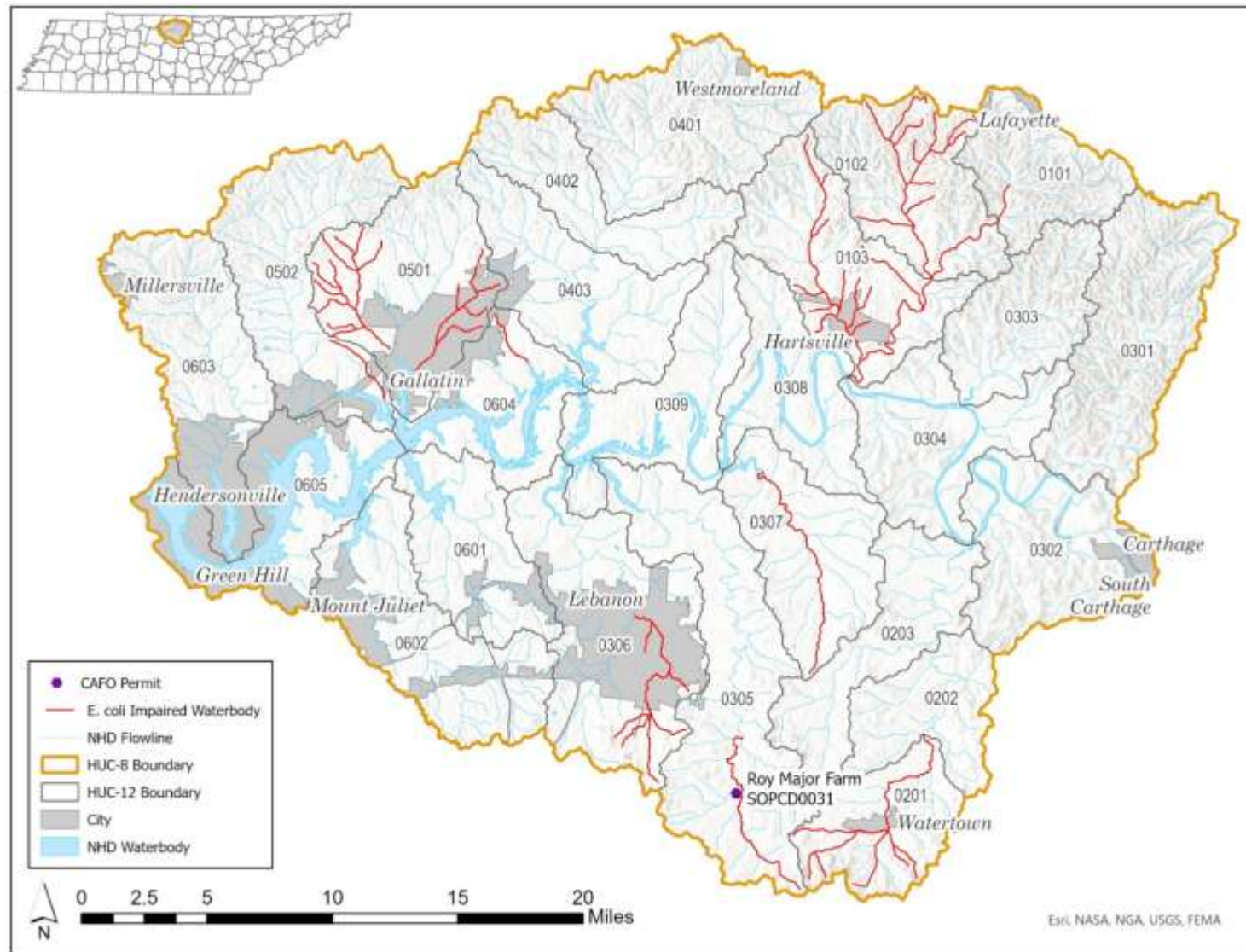


Figure 9. Entities Covered Under Tennessee's CAFO Permit Located in Impaired Drainage Areas of the Old Hickory Lake Watershed

7.2 Nonpoint Sources

Nonpoint sources of coliform bacteria are diffuse sources that cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources generally, but not always, involve accumulation of coliform bacteria on land surfaces and wash off as a result of storm events. Nonpoint sources of *E. coli* loading are primarily associated with agricultural and urban land uses. The majority of waterbodies identified on TDEC's Final 2024 List of Impaired and Threatened Waters as impaired due to *E. coli* are attributed to nonpoint agricultural or urban sources.

7.2.1 Wildlife

Wildlife feces contain coliform bacteria which can be deposited onto land surfaces where it can be transported during storm events to nearby streams. Wildlife is included in the allocation for the LA_{SW} term in the TMDL.

7.2.2 Agricultural Animals

Agricultural activities can be a significant source of coliform bacteria loading to surface waters. The activities of greatest concern are typically those associated with livestock operations:

- CAFOs, which by definition involve a certain quantity of animals, are considered point sources and are covered under the State SOP or NPDES permit (see Section 7.1.3 above). Smaller AFOs, if they exist, are unregulated. This includes some AFOs that were previously covered under a State SOP or NPDES permit. AFOs are considered potential sources if not properly controlled/managed.
- Agricultural livestock grazing in pastures deposit manure containing coliform bacteria onto land surfaces. This material accumulates during periods of dry weather and is available for washoff and transport to surface waters during storm events. The number of animals in pasture and the time spent grazing are important factors in determining the loading contribution.
- Processed agricultural manure from confined feeding operations is often applied to land surfaces and can provide a significant source of coliform bacteria loading. Guidance for issues relating to manure application is available through the University of Tennessee Agricultural Extension Service and the Natural Resources Conservation Service (USDA NRCS N.D.).
- Agricultural livestock and other unconfined animals often have direct access to waterbodies and can provide a concentrated source of coliform bacteria loading directly to a stream. Data sources related to livestock operations include the 2017 Census of Agriculture. This dataset represents the most up to date source at the time of the *E. coli* sampling period referenced in this report. Livestock data for counties located within the Old Hickory Lake watershed are summarized in Table 8 below. Note that, due to confidentiality issues, any tabulated item that identifies data reported by a respondent or allows a respondent's data to be accurately estimated or derived is suppressed and coded with a 'D' (USDA 2019).

TDEC's Final 2024 303(d) List of Impaired and Threatened Waters includes an identification of potential impairment sources as determined by TDEC staff familiar with the watershed during the assessment process. Of the 17 waterbodies listed as impaired by *E. coli* in the Old Hickory Lake watershed, 14 of them include at least one potential impairment source linked to agricultural animals (see Table 9 below). Agricultural animals are included in the allocation for the LA_{SW} term in the TMDL.

Table 8. Livestock Distribution for Counties in the Old Hickory Lake Watershed

County ^a	Cattle: Beef	Cattle: Milk	Poultry: Layers	Poultry: Broilers	Hogs	Sheep	Goats	Horse
Davidson	3,148	40	1,898	3,205	125	62	796	829
Macon	13,139	14	62,642	2,380,158	3,021	689	2,596	643
Smith	(D)	(D)	2,785	(D)	880	587	3,396	647
Sumner	17,961	602	4,980	2,650	436	813	2,210	1,720
Trousdale	(D)	(D)	675	33	288	553	635	147
Wilson	21,042	317	5,622	240	550	2,039	4,246	2,643

Notes:

- a. Livestock Population source data is the USDA 2017 Census of Agriculture: Tennessee. In keeping with the provisions of Title 7 of the United States Code, no data are published in the 2017 Census of Agriculture that would disclose information about the operations of an individual farm or ranch. Any tabulated item that identifies data reported by a respondent or allows a respondent's data to be accurately estimated or derived is suppressed and coded with a 'D' (USDA 2019).

Table 9. *E. coli* Impaired Waterbodies with Potential Impairment Sources Related to Agricultural Animals

ID 305b Waterbody ID	Waterbody Name	Potential Impairment Source Name ^a
TN05130201001T_0100	Rankin Branch	Grazing in riparian or shoreline zones
TN05130201013_3000	Spring Creek	Grazing in riparian or shoreline zones & Unrestricted cattle access
TN05130201015_1000	Cedar Creek	Grazing in riparian or shoreline zones & Unrestricted cattle access
TN05130201021_0300	Neal Branch	Unrestricted cattle access
TN05130201021_0400	Beech Log Creek	Grazing in riparian or shoreline zones
TN05130201021_2000	Round Lick Creek (Lower)	Grazing in riparian or shoreline zones
TN05130201021_3000	Round Lick Creek (Upper)	Grazing in riparian or shoreline zones
TN05130201028_0100	Little Goose Creek (Lower)	Grazing in riparian or shoreline zones
TN05130201028_0150	Little Goose Creek (Upper)	Grazing in riparian or shoreline zones
TN05130201028_0200	Hickerson Creek	Grazing in riparian or shoreline zones
TN05130201028_0300	Middle Fork	Grazing in riparian or shoreline zones
TN05130201028_0320	Carr Creek	Grazing in riparian or shoreline zones
TN05130201028_1000	Goose Creek	Grazing in riparian or shoreline zones
TN05130201041_0100	Liberty Branch	Grazing in riparian or shoreline zones

Notes:

- a. Extracted from TDEC Final 2024 List of Impaired and Threatened Waters.

7.2.3 Failing Septic Systems

Some of the coliform loading in the Old Hickory Lake watershed can be attributed to failure of septic systems and illicit discharges of raw sewage. Estimates of population utilizing septic systems for counties in the Old Hickory Lake watershed were derived using a combination of data sources including the Division of Water Resources' internal database for subsurface sewage disposal systems permits, along with currently available census data, data received from counties that maintain their own septic system assistance services and parcel data from Tennessee's Comptroller's office. Data is revisited and estimates are updated on an annual basis. As with livestock in streams, failing septic systems have the potential to provide a concentrated source of coliform bacteria directly to waterbodies. Failing septic systems must be repaired or upgraded. Therefore, failing septic tanks are recognized in the TMDL as a potential contributor to nonpoint source loading but receive an allocation of zero. Septic system data for counties in this watershed are summarized in Table 10 below.

Table 10. Estimated Population on Septic Systems for Counties in the Old Hickory Lake Watershed

County	Estimated Population on Septic Systems
Davidson	9,000
Macon	14,902
Smith	8,289
Sumner	44,574
Trousdale	3,663
Wilson	38,833

7.2.4 Urban Development

Nonpoint source loading of coliform bacteria from urban land use areas is attributable to multiple sources. These include stormwater runoff, illicit discharges of sanitary waste, runoff from improper disposal of waste materials, leaking septic systems, and domestic animals. Impervious surfaces in urban areas allow runoff to be conveyed to streams quickly, without interaction with soils and groundwater. Urban land use area in impaired subwatersheds in the Old Hickory Lake watershed ranges from 78% (Town Creek DA) to 5% (Hickerson Creek DA). Urban land use is calculated as the sum of the National Land Cover Dataset (NLCD) "Developed" classification type. Percent impervious surface cover, an important parameter in determining the *E. coli* impairment source area type, is calculated from the average estimated NLCD percent impervious surface in each Developed [NLCD classification description](#) (MRLC N.D.). Of the 17 waterbodies listed as impaired by *E. coli* in the Old Hickory Lake watershed, three of them include at least one potential impairment source categorized as due to urban or municipal sources in the Final 2024 List of Impaired and Threatened Waters (see Table 11 below). Urban areas not covered by MS4 permits are included in the allocation for the LA_{SW} term in the TMDL.

Table 11. *E. coli* Impaired Waterbodies with Potential Impairment Sources Related to Urban Sources

ID 305b Waterbody ID	Waterbody Name	Potential Impairment Source Name ^a
TN05130201001T_0200	Town Creek	Sanitary sewer overflows (collection system failures) & Municipal (urbanized high-density area)
TN05130201028_0100	Little Goose Creek	Grazing in riparian or shoreline zones & Municipal (urbanized high-density area)
TN05130201055_0200	Sinking Creek	Municipal (urbanized high-density area) & Sanitary sewer overflows (collection system failures)

Notes:

a. Extracted from TDEC Final 2024 List of Impaired and Threatened Waters

7.3 Land Use Summary

Land use for the Old Hickory Lake drainage areas is summarized in Figures 10-15 below and tabulated in Appendix A. These graphs exclude classification types with less than 1% area coverage and combines NLCD Deciduous, Evergreen and Mixed Forest landcovers into one classification, “Forest”. Amounts of Developed-Pervious and Developed-Impervious classification areas are calculated from the average impervious surface coverage described in the NLCD Developed cover classifications. The sum of Developed-Pervious and Developed-Impervious classifications is the sum of all NLCD Developed classifications. These two classifications are shown instead of the standard NLCD Developed classifications because of their significance in determining source area type used in developing implementation strategies for reducing pollutant loadings (ref. Section 9.5.1). For more information on NLCD classifications, see [Annual National Land Cover Database Collection 1 Science Product User Guide](#) (USGS 2025a).

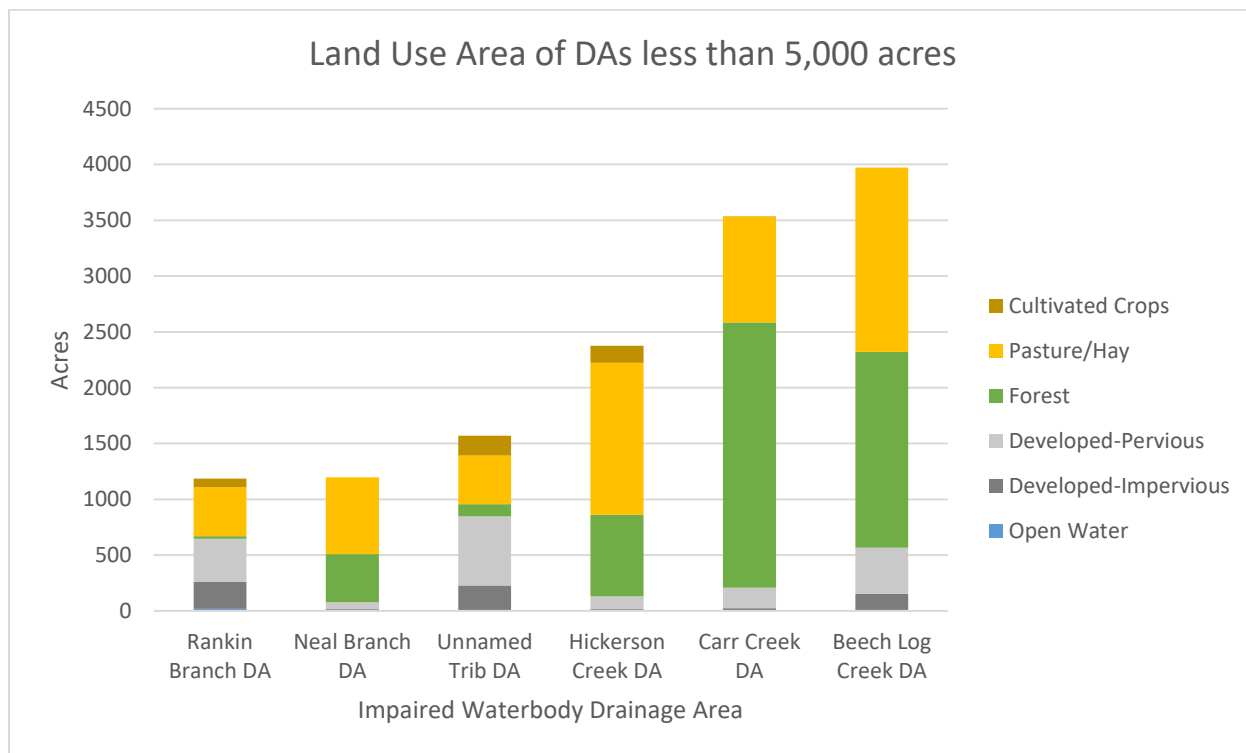


Figure 10. Land Use Area of DAs less than 5,000 acres

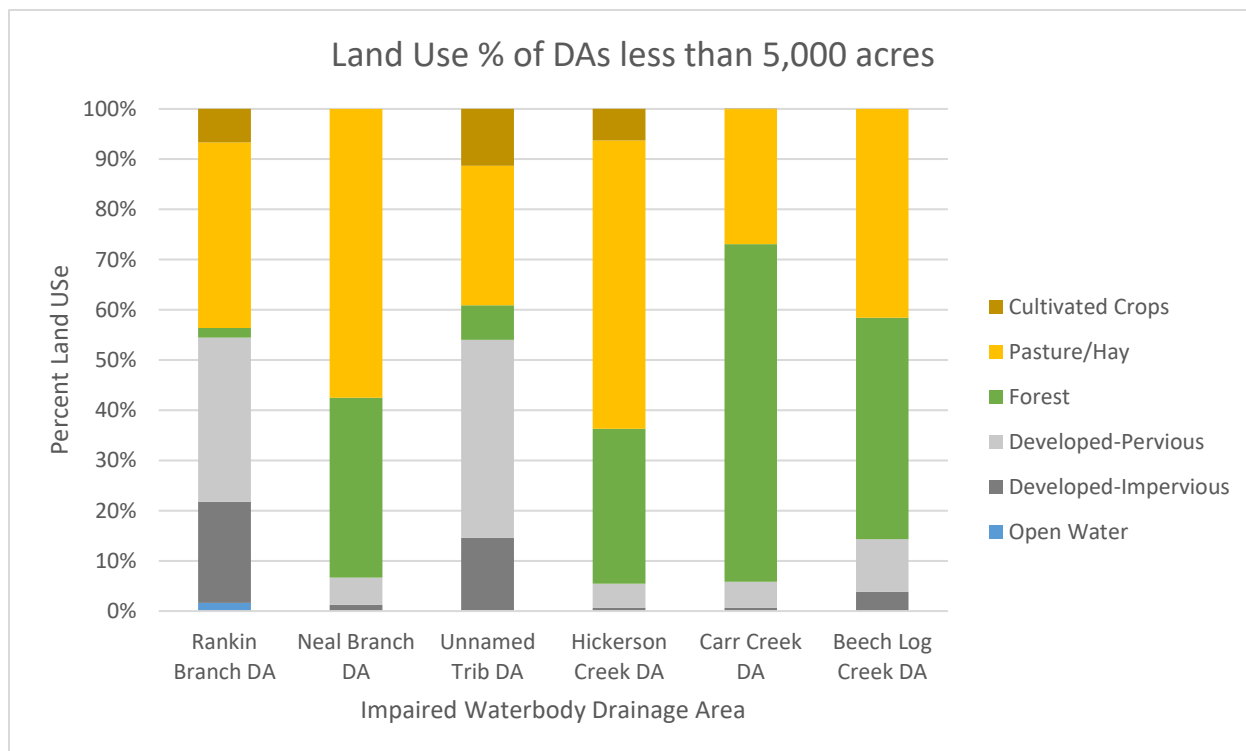


Figure 11. Land Use % of DAs less than 5,000 acres

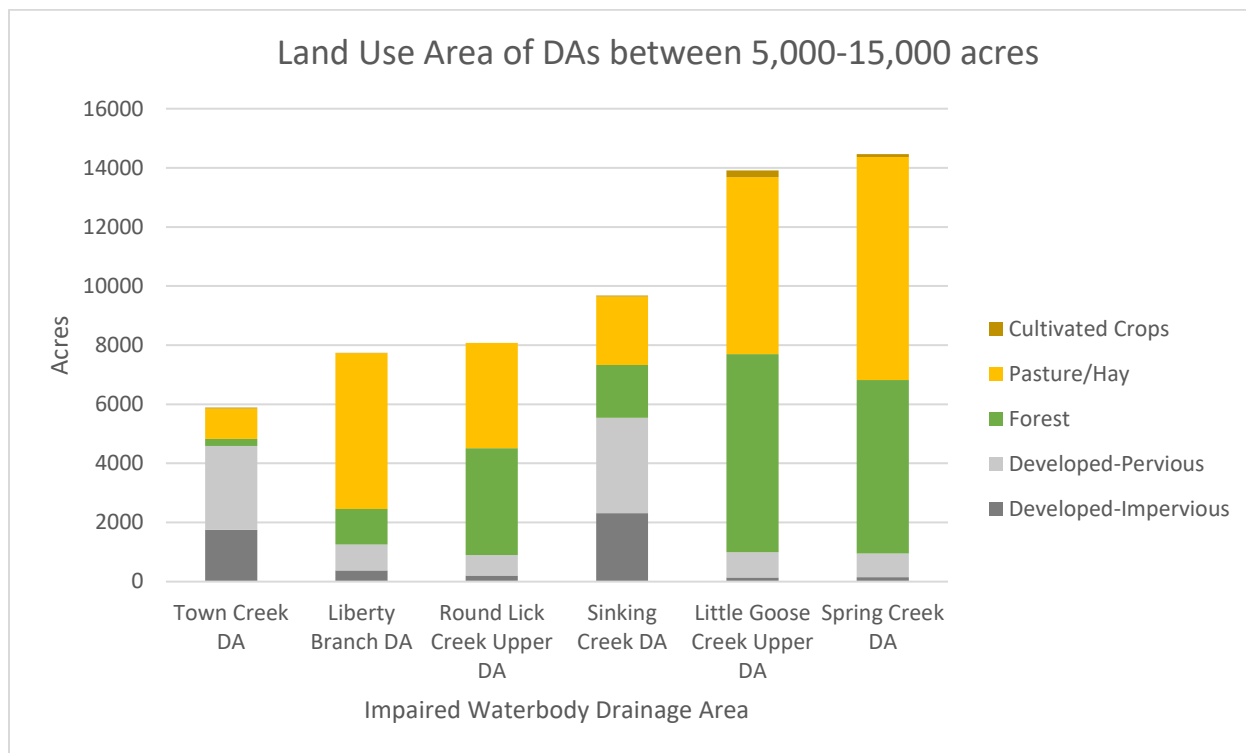


Figure 12. Land Use Area of DAs between 5,000-15,000 acres

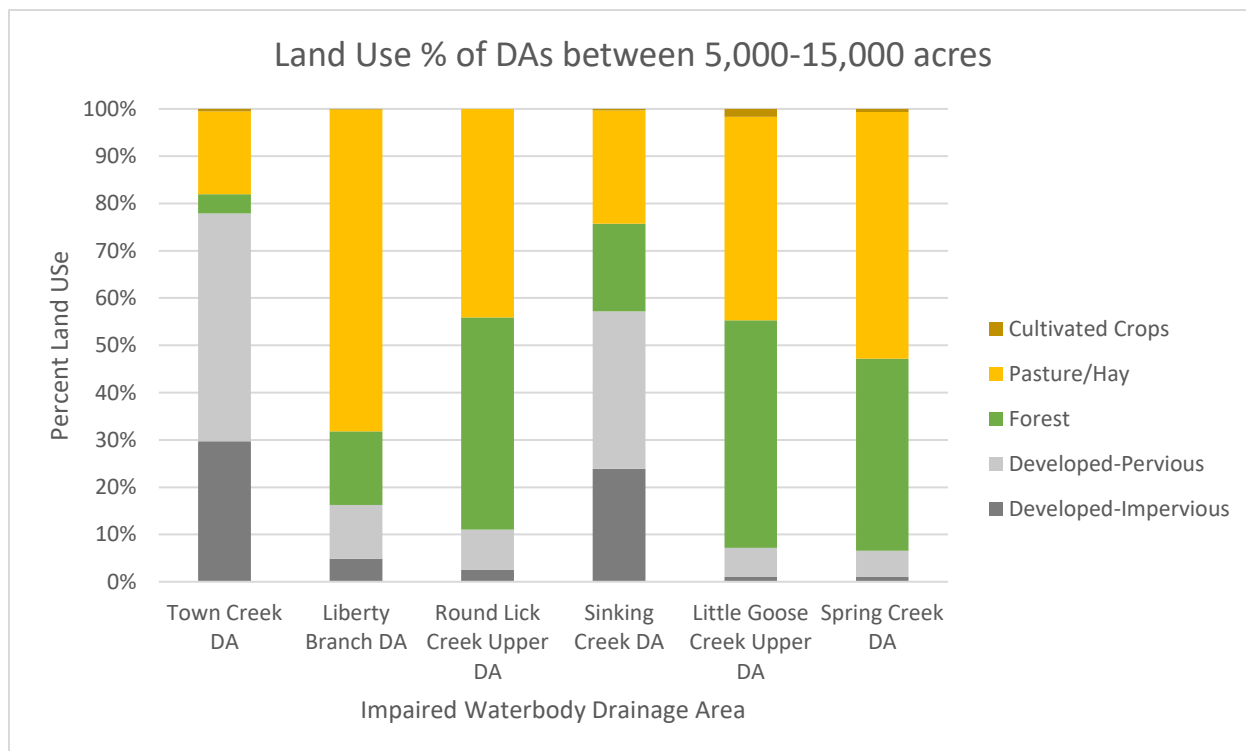


Figure 13. Land Use % of DAs between 5,000-15,000 acres

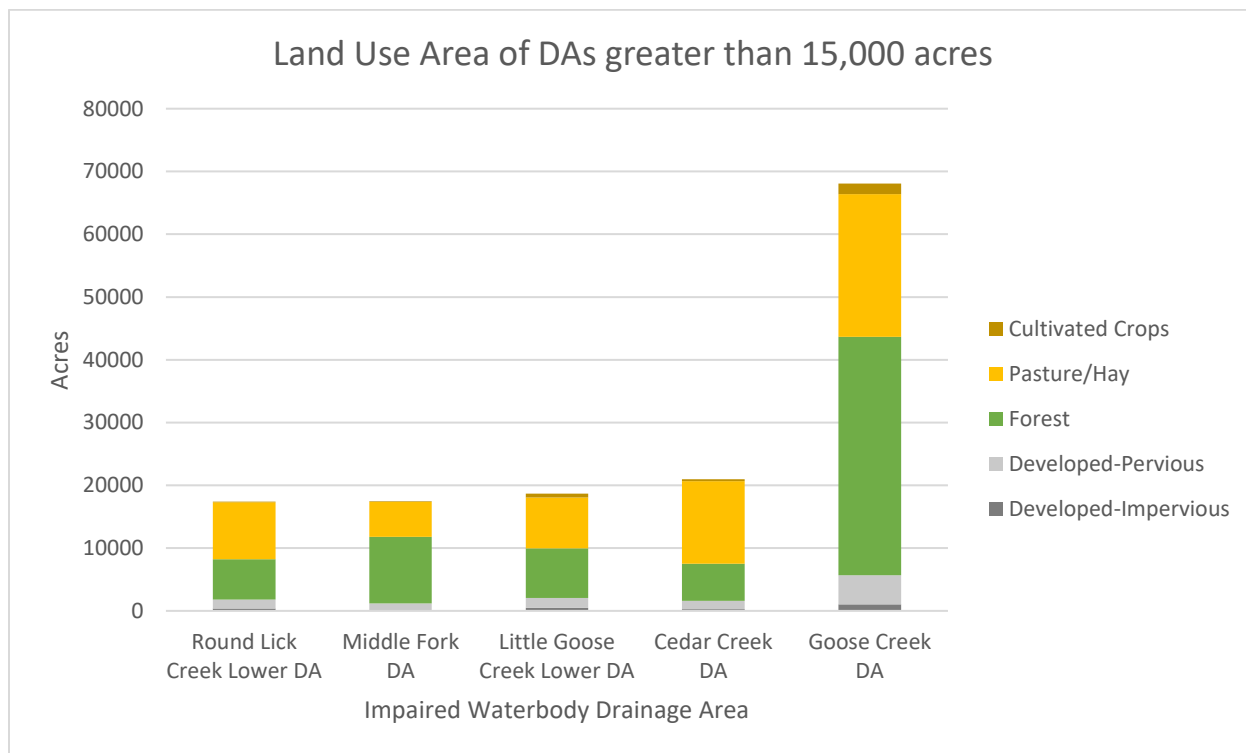


Figure 14. Land Use Area of DAs greater than 15,000 acres

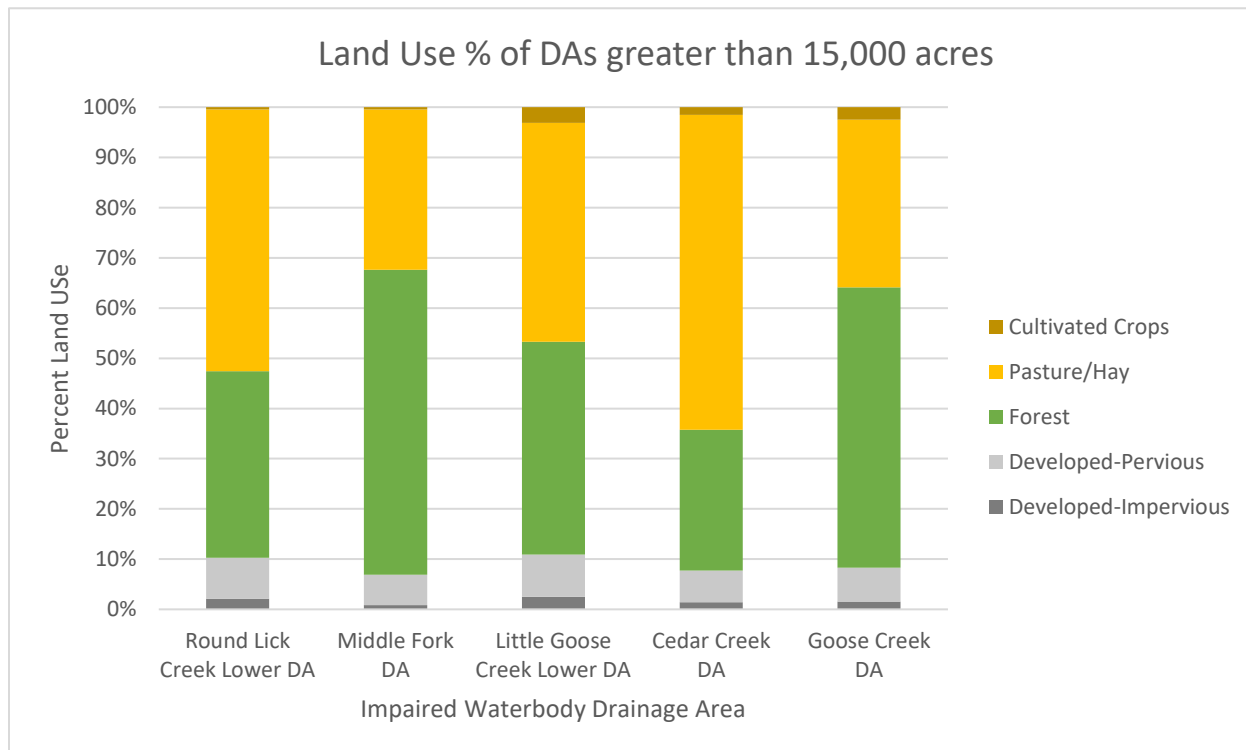


Figure 15. Land Use % of DAs greater than 15,000 acres

8.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOADS

The Total Maximum Daily Load (TMDL) process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), nonpoint source loads (Load Allocations), and an appropriate margin of safety (MOS) that takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \sum \text{WLAs} + \sum \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. [40 CFR §130.2 \(i\)](#) (CFR 2025c) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures. This document describes TMDL, Waste Load Allocation (WLA), Load Allocation (LA), and Margin of Safety (MOS) development for waterbodies identified as impaired due to *E. coli* on TDEC's Final 2024 List of Impaired and Threatened Waters. For a detailed description of the TMDL calculation process utilized for this report, see Appendix C.

8.1 Expression of TMDLs, WLAs, & LAs

In this document, the *E. coli* TMDL is a daily load expressed as a function of mean daily flow (daily loading function). For implementation purposes, corresponding percent load reduction goals (PLRGs) to decrease *E. coli* loads to TMDL target levels, within each respective flow zone, are also expressed. WLAs & LAs for precipitation-induced loading sources are also expressed as daily loading functions in CFU/day/acre. Allocations for loading that is independent of precipitation (WLAs for WWTPs and LAs for "other direct sources") are expressed as CFU/day.

8.2 Area Basis for TMDL Analysis

The area unit of analysis for the development of the following TMDLs is the impaired waterbody drainage area (DA), or subwatershed, as calculated from the pour point of each impaired waterbody (see Table 12 & Figure 16 below). The drainage area of a downstream waterbody incorporates drainage areas of upstream waterbodies. For example, Round Lick Creek Lower DA includes Neal Branch DA, Round Lick Creek Upper DA, and Beech Log Creek DA. The area basis for load duration curve analyses (see Section 9.1 & Appendix C) is the drainage area calculated from the monitoring station location for each waterbody so that flow and sampled loads can be assessed at the same location under the same conditions. Because load duration curve analyses result in proportional reductions, and assuming that no disproportionate change in loading conditions occurs in the incremental area between the monitoring station location and the pour point, it is reasonable to assume that the results of these analyses are also representative of conditions at the pour point of each impaired waterbody. Determination of each area was done using BASINS' watershed delineation tool.

Table 12. Determination of Analysis Areas of TMDL Development

ID 305b Waterbody ID	Waterbody Name	In HUC-12 [05130201...]	Drainage Area Name	Drainage Area [acres]
TN05130201001T_0100	Rankin Branch	0502	Rankin Branch DA	1,187
TN05130201001T_0200	Town Creek	0501	Town Creek DA	5,898
TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	0604	Unnamed Trib DA	1,571
TN05130201013_3000	Spring Creek	0305	Spring Creek DA	14,498
TN05130201015_1000	Cedar Creek	0307	Cedar Creek DA	21,018
TN05130201021_0300	Neal Branch	0201	Neal Branch DA	1,196
TN05130201021_0400	Beech Log Creek	0201	Beech Log Creek DA	3,994
TN05130201021_2000	Round Lick Creek (Lower)	0201	Round Lick Creek Lower DA	17,452
TN05130201021_3000	Round Lick Creek (Upper)	0201	Round Lick Creek Upper DA	8,097
TN05130201028_0100	Little Goose Creek (Lower)	0103	Little Goose Creek Lower DA	18,733
TN05130201028_0150	Little Goose Creek (Upper)	0103	Little Goose Creek Upper DA	13,950
TN05130201028_0200	Hickerson Creek	0103	Hickerson Creek DA	2,378
TN05130201028_0300	Middle Fork	0102	Middle Fork DA	17,464
TN05130201028_0320	Carr Creek	0102	Carr Creek DA	3,551
TN05130201028_1000	Goose Creek	0101, 0102, 0103	Goose Creek DA	68,259
TN05130201041_0100	Liberty Branch	0501	Liberty Branch DA	7,735
TN05130201055_0200	Sinking Creek	0306	Sinking Creek DA	9,788

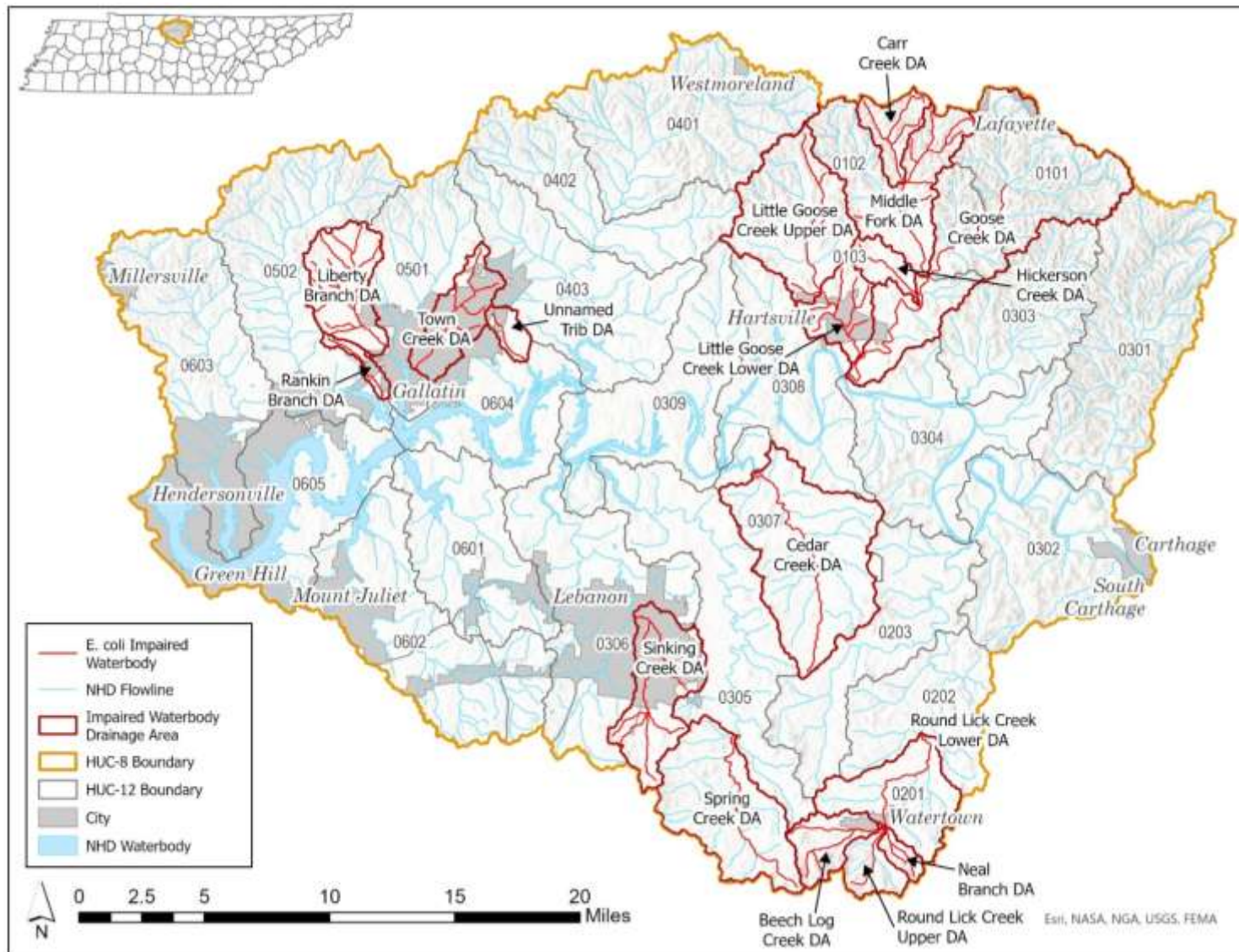


Figure 16. *E. coli*-impaired Waterbody Drainage Areas (DAs) in the Old Hickory Lake Watershed

8.3 TMDL Analysis Methodology

TMDLs for the Old Hickory Lake Watershed were developed using load duration curves for analysis of waterbody drainage areas. A load duration curve (LDC) is a cumulative frequency graph that illustrates existing water quality conditions (as represented by loads calculated from monitoring data), how these conditions compare to desired targets, and the portion of the waterbody flow zone represented by these existing loads (USEPA 2007). An advantage of LDCs is that they help visualize the flow conditions – high flow vs. low flow vs. entire range of flows – (1) during which existing data were collected, and (2) under which exceedances of the target are most likely to occur. Load duration curves are considered to be well suited for analysis of periodic monitoring data collected by grab sample. LDCs were developed for monitoring site locations in impaired waterbodies and daily loading functions were expressed for TMDLs, WLAs, LAs, and MOS. In addition, percent load reduction goals (PLRGs) for each flow zone were calculated for prioritization of implementation measures according to the methods described in Appendix F.

Waterbodies evaluated for protection include waterbodies that are not currently listed as impaired but are either located within the drainage area of an impaired waterbody or have previously received TMDLs. Protection TMDLs and allocations were developed for these unimpaired (fully supporting) and unassessed waterbodies in order to maintain good water quality and to maximize the likelihood of each protection waterbody meeting water quality standards in the future. For more information on Protection TMDLs, see Appendix E.

8.4 Critical Conditions and Seasonal Variation

The critical condition for nonpoint source *E. coli* loading is an extended dry period followed by a rainfall runoff event. During the dry weather period, *E. coli* bacteria build up on the land surface and are subsequently washed off by rainfall. The critical condition for point source loading occurs during periods of low streamflow when dilution is minimized. Both conditions are represented in the TMDL analyses.

An eleven-year period between October 1, 2009, and September 30, 2020, was used to simulate flow for each impaired waterbody. This range was selected to coincide with the ten-water year period leading up to the 2024 303(d) sampling period with an additional year for model stabilization. The USGS defines “[water year](#)” as the 12-month period from October 1 to September 30 of the following year for use in determinations regarding surface-water supply (USGS 2016). The first year of modeled flow was discarded for model stabilization, leaving a ten-water year period of modeled flow for each impaired waterbody. This period contained a range of hydrologic conditions that included both low and high streamflows. Critical conditions are accounted for in the load duration curve analyses by using the entire period of flow and water quality data available for the impaired waterbodies.

For each subwatershed, the critical flow zone has been identified based on the incremental levels of impairment relative to the target loads. Based on the location of the water quality exceedances on the load duration curves and the distribution of critical flow zones, no one delivery mode for *E. coli* appears to be dominant for all waterbodies in the Old Hickory Lake watershed (see Table F-6 in Appendix F).

8.5 Margin of Safety

There are two methods for incorporating MOS in TMDL analyses: a) implicitly incorporate the MOS using conservative model assumptions; or b) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For development of *E. coli* TMDLs in the Old Hickory Lake watershed, an explicit MOS, equal to 10% of the *E. coli* numerical water quality target (ref. Section 5.0), was utilized for determination of WLAs and LAs:

$$\begin{aligned}\text{Water Quality Target (WQT)} &= 410 \text{ CFU} / 100\text{ml} \\ \text{Margin of Safety (MOS)} &= 41 \text{ CFU} / 100 \text{ ml}\end{aligned}$$

$$\begin{aligned}\text{Geomean Water Quality Target (GWQT)} &= 126 \text{ CFU} / 100\text{ml} \\ \text{Margin of Safety, Geomean (MOS GMN)} &= 12.6 \text{ CFU} / 100\text{ml}\end{aligned}$$

8.6 Determination of TMDLs

E. coli daily loading functions were calculated for impaired segments in the Old Hickory Lake watershed using LDCs to evaluate compliance with the water quality target concentrations according to the procedure in Appendix C. The TMDL loading functions for impaired segments and subwatersheds are shown in Table 13 below. Protection TMDLs were also developed for waterbodies located within the drainage area of an impaired waterbody but not currently assessed as impaired. These protection TMDLs are shown in Appendix E.

8.7 Determination of WLAs & LAs

WLAs for MS4s and LAs for precipitation induced sources of *E. coli* loading were determined according to the procedures in Appendix C. These allocations represent the available loading after application of the explicit MOS. WLAs for existing WWTPs are equal to their existing NPDES permit limits. Since WWTP permit limits require that *E. coli* concentrations must comply with water quality criteria (TMDL targets) at the point of discharge and recognition that loading from these facilities are generally small in comparison to other loading sources, further reductions were not considered to be warranted.

All waterbody IDs have a WLA term for WWTPs. The “ q_m ” term in the WLA_{WWTP} expression will be equal to the sum of the mean daily discharge for all WWTPs discharging to that waterbody ID. When there is no WWTP currently discharging to a waterbody ID, the q_m term in the WLA_{WWTP} expression will be zero. The q_m term provides a future growth allowance to the WLA_{WWTP} expression when there is not an active WWTP.

WLAs and LAs expressed as a “per acre” load are calculated based on the drainage area of the respective allocation type (MS4, LA) within the total drainage area of the impaired waterbody (see Table A-1). As regulated MS4 area increases (due to future growth and/or new MS4 designation), unregulated LA area decreases by an equivalent amount. The sum of the two allocation type drainage areas is equal to total subwatershed area. When there are no MS4s currently located in a drainage area, the expression is a future growth term for expanding or newly designated MS4s. WLAs for CAFOs and LAs for “other direct sources” (non-precipitation induced) are equal to zero. WLAs, & LAs are summarized in Table 13 below.

Table 13. TMDLs, WLAs, & LAs Expressed as Daily Loads for Impaired Waterbodies in the Old Hickory Lake Watershed

In HUC-12 (05130201_)	Impaired Waterbody ID	Impaired Waterbody Name ^a	TMDL [CFU/d]	MOS [CFU/d]	WLA: ⁱ WWTP ^b [CFU/d]	WLA: ⁱ MS4 ^{c,d} [CFU/d/acre _{MS4}]	LA ^d [CFU/d/acre _{LA}]
0502	TN05130201001T_0100	Rankin Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(7.61E+06 x Q) - (8.45E+06 x q _d)	(7.61E+06 x Q) - (8.45E+06 x q _d)
0501	TN05130201001T_0200	Town Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.53E+06 x Q) - (1.70E+06 x q _d)	(1.53E+06 x Q) - (1.70E+06 x q _d)
0604	TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.75E+06 x Q) - (6.38E+06 x q _d)	(5.75E+06 x Q) - (6.38E+06 x q _d)
0305	TN05130201013_3000 ^{e,f}	Spring Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(6.23E+05 x Q) - (6.92E+05 x q _d)	(6.23E+05 x Q) - (6.92E+05 x q _d)
0307	TN05130201015_1000	Cedar Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(4.30E+05 x Q) - (4.77E+05 x q _d)	(4.30E+05 x Q) - (4.77E+05 x q _d)
0201	TN05130201021_0300 ^e	Neal Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(7.55E+06 x Q) - (8.39E+06 x q _d)	(7.55E+06 x Q) - (8.39E+06 x q _d)
0201	TN05130201021_0400 ^e	Beech Log Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.26E+06 x Q) - (2.51E+06 x q _d)	(2.26E+06 x Q) - (2.51E+06 x q _d)
0201	TN05130201021_2000 ^{e,g}	Round Lick Creek (Lower)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.17E+05 x Q) - (5.75E+05 x q _d)	(5.17E+05 x Q) - (5.75E+05 x q _d)
0201	TN05130201021_3000 ^{e,g}	Round Lick Creek (Upper)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.11E+06 x Q) - (1.24E+06 x q _d)	(1.11E+06 x Q) - (1.24E+06 x q _d)
0103	TN05130201028_0100 ^e	Little Goose Creek (Lower)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(4.82E+05 x Q) - (5.35E+05 x q _d)	(4.82E+05 x Q) - (5.35E+05 x q _d)
0103	TN05130201028_0150 ^e	Little Goose Creek (Upper)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(6.47E+05 x Q) - (7.19E+05 x q _d)	(6.47E+05 x Q) - (7.19E+05 x q _d)
0103	TN05130201028_0200	Hickerson Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.80E+06 x Q) - (4.22E+06 x q _d)	(3.80E+06 x Q) - (4.22E+06 x q _d)
0102	TN05130201028_0300	Middle Fork	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.17E+05 x Q) - (5.74E+05 x q _d)	(5.17E+05 x Q) - (5.74E+05 x q _d)
0102	TN05130201028_0320	Carr Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.54E+06 x Q) - (2.82E+06 x q _d)	(2.54E+06 x Q) - (2.82E+06 x q _d)
0101, 0102, 0103	TN05130201028_1000	Goose Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.32E+05 x Q) - (1.47E+05 x q _d)	(1.32E+05 x Q) - (1.47E+05 x q _d)
0501	TN05130201041_0100	Liberty Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.17E+06 x Q) - (1.30E+06 x q _d)	(1.17E+06 x Q) - (1.30E+06 x q _d)
0306	TN05130201055_0200 ^{e,h}	Sinking Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(9.22E+05 x Q) - (1.02E+06 x q _d)	(9.22E+05 x Q) - (1.02E+06 x q _d)

Notes: Q = Mean Daily In-stream Flow (cfs), q_m = WWTP Mean Daily Flow (cfs), q_d = WWTP Facility Design Flow (cfs)

a. Values in this table are determined using the drainage area calculated from the pour point of each impaired waterbody.

Table 13 Notes (cont'd):

- b. WLAs for WWTPs are expressed as *E. coli* loads (CFU/day). All current and future WWTPs must meet water quality standards as specified in their NPDES permit. When there are no WWTPs currently discharging into or upstream of the impaired waterbody, the expression is a future term for expanding or newly designated WWTPs.
- c. Applies to any MS4 discharge loading in the subwatershed. Future MS4s will be assigned waste load allocations (WLAs) consistent with load allocations (LAs) assigned to precipitation induced nonpoint sources. See Section 9.2.2 for implementation details. When there are no MS4s currently located in an impaired drainage area, the expression is a future growth term for expanding or newly designated MS4s.
- d. WLAs and LAs expressed as a “per acre” load are calculated based on the drainage area comprising each respective allocation type (MS4, LA) within the total drainage area of the impaired waterbody (see Table A-1). As regulated MS4 area increases (due to future growth and/or new MS4 designation), unregulated LA area decreases by an equivalent amount. The sum of the areas will continue to equal the total impaired waterbody drainage area.
- e. Waterbodies covered by TMDLs approved by EPA in 2008. The TMDLs included in this document supersede previous TMDLs for these waterbodies.
- f. TN05130201013_3000 (Spring Creek) is the re-numbered Waterbody ID for the same waterbody as TN05130201013 – 4000 (Spring Creek) addressed in the 2008 Old Hickory Lake *E. coli* TMDL. The TMDL for TN05130201013_3000 supersedes the TMDL for the previous Waterbody ID.
- g. TN05130201021_2000 (Round Lick Creek) and TN05130201021_3000 (Round Lick Creek) represent the segment TN05130201021_2000 (Round Lick Creek) addressed in the 2008 Old Hickory Lake *E. coli* TMDL split into two segments. The TMDLs in this document supersede the previous TMDL for this waterbody.
- h. Waterbody ID TN05130201055_0200 (Sinking Creek) is the renumbered Waterbody ID which combines the previous segments TN05130201055_0200 and TN05130201055_0250 into one segment. The TMDL in this document supersedes previous TMDLs for these waterbodies.
- i. As concentrated animal feeding operations (CAFOs) are not permitted discharge from the facility into nearby waterbodies, they receive a waste load allocation of zero. One impaired waterbody in this report has a CAFO within its drainage area: TN05130201013_3000 (Spring Creek) (ref. Section 7.1.3).

9.0 IMPLEMENTATION PLAN

The TMDLs, WLAs, and LAs developed in Section 8 are intended to be the first phase of a long-term effort to restore the water quality of impaired waterbodies in the Old Hickory Lake watershed through reduction of excessive *E. coli* loading. Adaptive management methods, within the context of the State's rotating watershed management approach, will be used to modify TMDLs, WLAs, and LAs as required to meet water quality goals. TMDL implementation activities will be accomplished within the framework of [Tennessee's Watershed Approach](#) (TDEC 2025b).

The Watershed Approach is based on a five-year cycle and encompasses planning, monitoring, assessment, TMDLs, WLAs/LAs, and permit issuance. It relies on participation at the federal, state, local and non-governmental levels to be successful.

9.1 Application of Load Duration Curves for Implementation Planning

The Load Duration Curve (LDC) methodology (ref. Appendix C) is a form of water quality analysis and presentation of data that aids in guiding implementation by targeting management strategies for appropriate flow conditions. One of the strengths of this method is that it can be used to interpret possible delivery mechanisms of *E. coli* by differentiating between point and nonpoint source problems without extensive modeling. The load duration curve analysis can be utilized for implementation planning. See Cleland (2003) for further information on duration curves and TMDL development. For more details regarding load duration curve analyses, see Appendix C.

9.1.1 Flow Zone Analysis for Implementation Planning

A major advantage of the duration curve framework in TMDL development is the ability to provide meaningful connections between allocations and implementation efforts (USEPA 2007). Because the flow duration interval serves as a general indicator of hydrologic condition (i.e., wet versus dry and to what degree), allocations and reduction goals can be linked to source areas, delivery mechanisms, and the appropriate set of management practices. The use of duration curve zones (e.g., high flow, moist, mid-range, dry, and low flow) allows the development of allocation tables (ref. Appendix F), which can be used to guide potential implementation actions to most effectively address water quality concerns (USEPA 2007).

For the purposes of implementation strategy development, available *E. coli* data are grouped according to flow zones using either a five-zone or a four-zone flow duration curve (ref. Figures 17 & 18 below). In many small drainage areas, extreme dry conditions are often characterized by zero flow for a substantial portion of the time. For this reason, the low-flow regime is more appropriately represented as a broader range of conditions (or percentage of time), leading to a reduced number of distinct flow zones. As a result, for waterbodies exhibiting zero flow at the 95th percentile, the flow duration curve is divided into four zones: high flows (0–10% exceedance), moist conditions (10–40%), median or mid-range flows (40–70%), and low flows (70–100%).

A four-zone flow duration curve is also applied to effluent-dominated waterbodies that receive substantial discharges from wastewater treatment plants (WWTPs). In these systems, the 95th percentile flow may be insufficient to support allocations for both WWTP discharges and NPS. When the combined WWTP load and margin of safety exceed the TMDL load at the 95th percentile, the waterbody is expected to be effluent-dominated under low-flow conditions, and the water quality and flow are significantly influenced by WWTPs. To better represent the allocation under the low-flow conditions in effluent-dominated waterbodies, a four-zone duration

curve is used, with an expanded flow range in the low-flow zone. If neither of the two checks above are met, the waterbody receives a standard five-zone flow duration curve: high flows (0–10% exceedance), moist conditions (10–40%), median or mid-range flows (40–60%), dry conditions (60–90%) and low flows (90–100%).

Under low-flow conditions, WWTPs are not expected to discharge at their design flow rates. Design flow is intended to accommodate the maximum possible load, such as storm events and I&I, and therefore represents the upper bound of the treatment capacity rather than typical operating conditions. In practice, WWTPs generally discharge at flow rates below their design capacity. There is one STP addressed in this report, Watertown STP (TN0025488). The summer average discharge from Watertown STP in the Old Hickory Lake watershed is 0.29 cfs, compared to a design flow of 0.42 cfs (0.27 MGD). In effluent-dominated waterbodies under low-flow conditions, allocations for MS4 and LA are constrained by the daily WWTP effluent rate instead of the design flow (ref. Table F-24 and associated allocation equations).

Given adequate data, results (allocations and percent load reduction goals) will be calculated for all flow zones; however, less emphasis is placed on the upper 10% flow range for *E. coli* TMDLs and implementation plans. The highest 10 percent flows, representing flood conditions, are considered non-Recreational conditions: unsafe for wading and swimming. Humans are not expected to enter the water due to the inherent hazard from high depths and velocities during these flow conditions. As a rule of thumb, the United States Geological Survey (USGS) National Field Manual for the Collection of Water Quality Data (Lane and Fay 1997) advises its personnel not to attempt to wade a stream for which values of depth (ft) multiplied by velocity (ft/s) equal or exceed 10 ft²/s to collect a water sample. Few observations are typically available to estimate loads under these adverse conditions due to the difficulty and danger of sample collection.

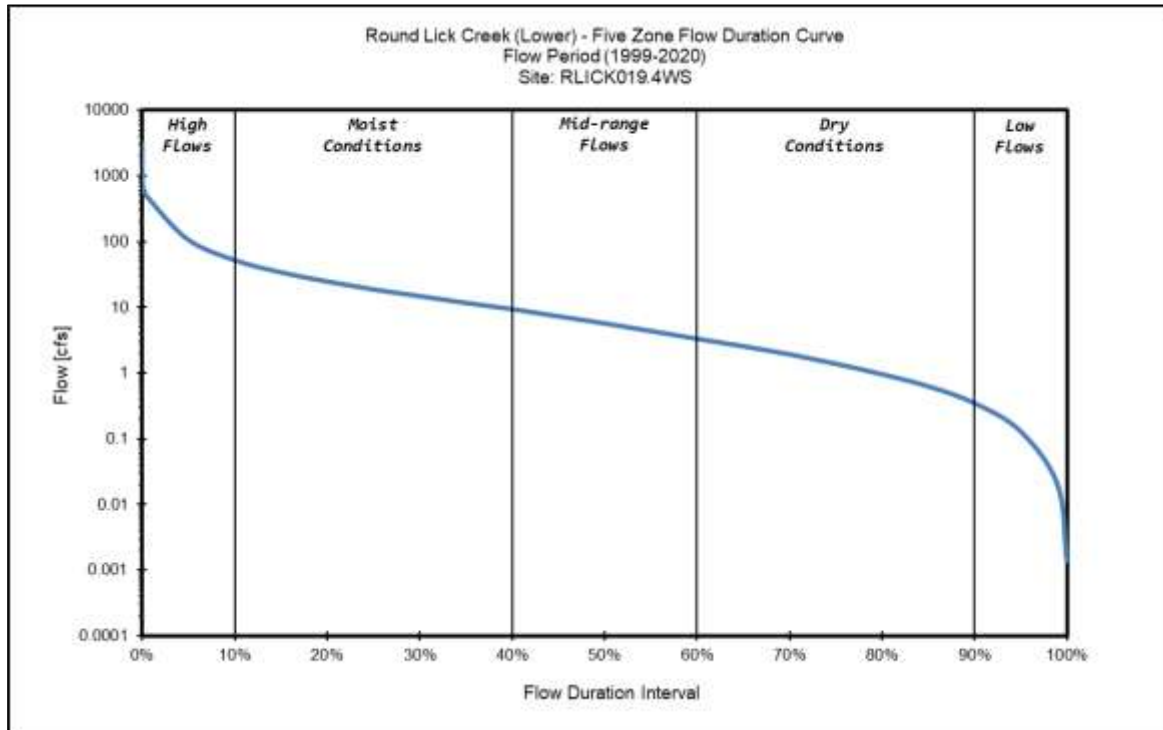


Figure 17. Example Five-Zone Flow Duration Curve for Round Lick Creek at Station RLICK019.4WS

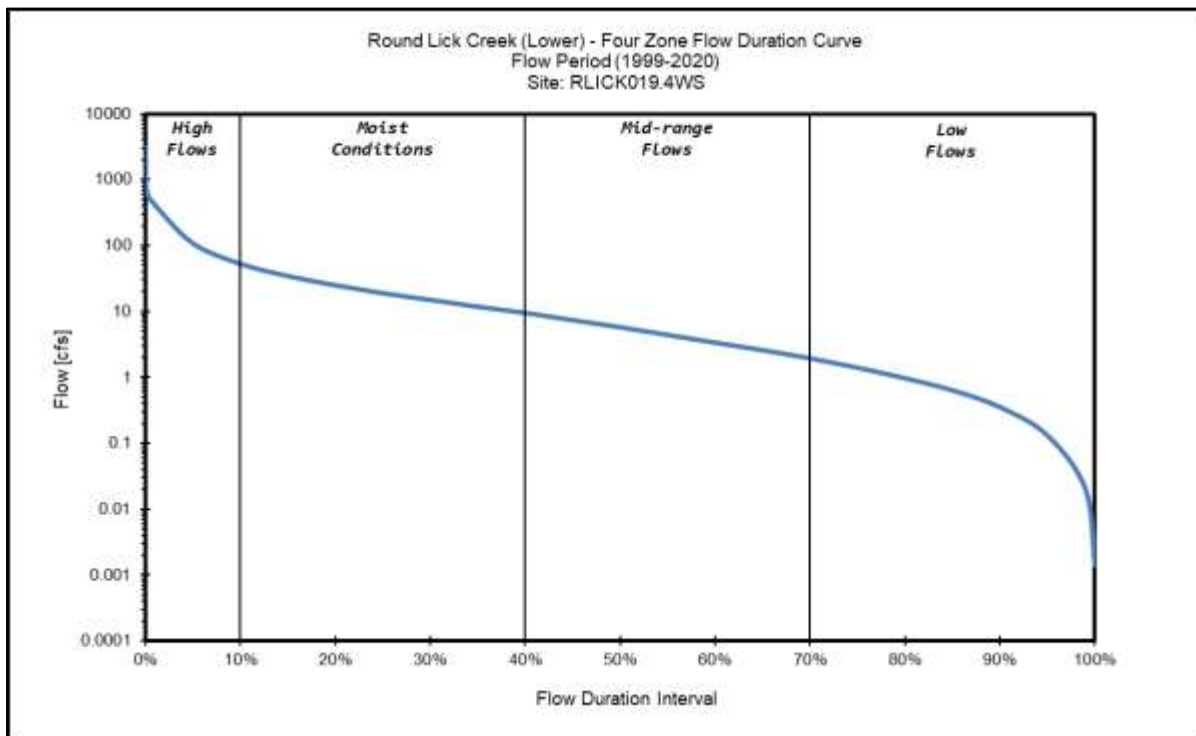


Figure 18. Example Four-Zone Flow Duration Curve for Round Lick Creek at Station RLICK019.4WS

9.1.2 Existing Loads and Percent Load Reductions

Each impaired waterbody has a characteristic set of pollutant sources and existing loading conditions that vary according to flow conditions. In addition, maximum allowable loading (assimilative capacity) of a waterbody varies with flow. Therefore, existing loading, allowable loading, and percent load reduction expressed at a single location on the LDC (for a single flow condition) do not appropriately represent the TMDL in order to address all sources under all flow conditions (i.e., at all times) to satisfy implementation objectives. The LDC approach provides a methodology for determination of assimilative capacity and existing loading conditions of a waterbody for each flow zone. Subsequently, each flow zone, and the sources contributing to impairment under the corresponding flow conditions, can be evaluated independently. Lastly, the critical flow zone (with the highest percent load reduction goal and/or the highest percent of samples exceeding the TMDL target) can be identified for prioritization of implementation actions.

Existing loading is calculated for each individual water quality sample as the product of the sample flow (cfs) times the single sample *E. coli* concentration (times a conversion factor). A percent load reduction is calculated for each water quality sample exceeding the single sample maximum water quality criterion, this load reduction being equal to the difference between the existing loading to the product of the sample flow (cfs) times the single sample maximum water quality standard (times a conversion factor). Samples with negative percent load reductions (non-exceedance: concentration below the single sample maximum water quality criterion) are not factored into the calculation of the percent load reduction goals (PLRGs). The PLRG for a given flow zone is calculated as the mean of all the percent load reductions for a given flow zone (ref. Appendix F).

9.1.3 Critical Conditions

The critical condition for each impaired waterbody is defined as the flow zone with the largest PLRG and/or percent exceedance, excluding the “high flow” zone because these extremely high flows are not representative of Recreational flow conditions, as described in Section 9.1.1. If the PLRG and/or percent exceedance in the high flow zone is greater than all the other zones, the zone with the second highest PLRG and/or percent exceedance will be considered the critical flow zone. The critical conditions are such that if water quality standards were met under those conditions, they would likely be met overall.

9.2 Point Sources

9.2.1 NPDES Regulated Municipal Wastewater Treatment Facilities

All present and future discharges from industrial and municipal wastewater treatment facilities are required to comply with the conditions defined in their NPDES permits at all times, including elimination of bypasses and overflows. With few exceptions, in Tennessee, permit limits for treated sanitary wastewater require compliance with coliform water quality standards (Ref: Section 5.0) prior to discharge. No additional reduction is required. WLAs for WWTPs are derived from mean daily facility flows and permitted *E. coli* limits and are expressed as daily loads in CFU per day. Non-permitted point sources of (potential) *E. coli* contamination of surface waters associated with sewage treatment plant (STP) collection systems include leaking collection systems, sanitary sewer overflows (SSOs), and combined sewer overflows (CSOs) where applicable. As collection system leaks, SSOs, and CSOs are not considered allowable discharges, they are included in the WLA term for WWTPs but receive a TMDL allocation of zero (ref. Section C.2.1). For additional EPA resources on municipal wastewater treatment facility permitting, see Municipal Sources Resources (USEPA 2025b).

9.2.2 NPDES Regulated Municipal Separate Storm Sewer Systems (MS4s)

For discharges from current and future regulated municipal separate storm sewer systems (MS4s), WLAs are and will be implemented through the appropriate MS4 permit. These permits typically require the development and implementation of a Storm Water Management Plan (SWMP) that will reduce the discharge of pollutants to the "maximum extent practicable" and not cause or contribute to violations of state water quality standards. A monitoring component to assess the effectiveness of BMPs is also typically included in the SWMP. Regulated MS4s that maintain compliance with the provisions of their NPDES permits are considered to be consistent with the assumptions and requirements of the WLAs of this TMDL.

For guidance on the six minimum control measures for regulated MS4s and a menu of BMPs representative of the types of practices that can successfully achieve them, a series of fact sheets are available at: [National Menu of Best Management Practices \(BMPs\) for Stormwater | US EPA](#) (USEPA 2024a). For further information on Tennessee's MS4 permitting program (including links to individual MS4 programs and DWR's Permits DataViewer) see: [NPDES Municipal Separate Storm Sewer System \(MS4\) Program](#) (TDEC 2024d).

In order to evaluate SWMP effectiveness and demonstrate compliance with specified WLAs, MS4s must develop and implement appropriate monitoring programs. An effective monitoring program could include:

- (a) Effluent monitoring at selected outfalls that are representative of particular land uses or geographical areas that contribute to pollutant loading before and after implementation of pollutant control measures.
- (b) Analytical monitoring of pollutants of concern (e.g., monthly) in receiving waterbodies, both upstream and downstream of MS4 discharges, over an extended period of time. In addition, intensive collection of pollutant monitoring data during the recreation season (June – September) at sufficient frequency to support calculation of the geometric mean.

When applicable, the appropriate DWR Environmental Field Office should be consulted for assistance in the determination of monitoring strategies, locations, frequency, and methods within 12 months after the approval date of TMDLs or designation as a regulated MS4. Details of the monitoring plans and monitoring data should be included in annual reports required by MS4 permits.

9.2.3 Regulated Concentrated Animal Feeding Operations (CAFOs)

There is currently one CAFOs present in the Old Hickory Lake watershed with coverage under either a State Operating Permit (SOP) or an NPDES permit (ref. Section 7.1.3). As CAFOs are not permitted to discharge from the facility into nearby waterbodies, they are listed as a potential point source of *E. coli* but receive a waste load allocation of zero. Future CAFOs will be addressed through the appropriate CAFO SOP or NPDES permit. For further information on TN CAFO permits, see: [Animal Feeding Operation \(AFO\) General State Operating Permit](#) (TDEC N.D.a).

9.3 Nonpoint Sources

The Tennessee Department of Environment & Conservation (TDEC) has no direct regulatory authority over most nonpoint source (NPS) discharges. Reductions of *E. coli* loading from nonpoint sources will be achieved using a phased approach. Voluntary, incentive-based mechanisms will be used to implement NPS management measures in order to ensure that measurable reductions in pollutant loadings can be achieved for the targeted impaired waters. Cooperation and active participation by the general public and various industry, business, and environmental groups is critical to successful implementation of TMDLs. There are links to a number of publications and information resources on [EPA's Nonpoint Source Pollution web page](#) regarding the implementation and evaluation of nonpoint source pollution control measures (USEPA 2025c). EPA has recently published the [CWSRF Best Practices Guide for Financing Nonpoint Source Solutions](#) (USEPA 2021). This guide is designed to help the state-level Clean Water State Revolving Fund programs apply best practices to address the challenge of NPS pollution. The guide suggests strategies and provides helpful case studies of successful and innovative partnerships underway across the country.

Effective application of agricultural, urban, and other nonpoint source (NPS) best management practices (BMPs) requires that these measures are properly planned, sited, and sized for implementation. An important aspect of the planning process is the identification of critical source areas (CSAs). EPA has recently published [Critical Source Area Identification and BMP Selection: Supplement to Watershed Planning Handbook](#) (USEPA 2018b) to assist watershed project teams in determining where appropriate BMPs and BMP systems should be implemented to achieve water quality goals in the most efficient manner possible.

Local citizen-led and implemented management measures have the potential to provide the most efficient and comprehensive avenue for reduction of loading rates from nonpoint sources. An excellent example of stakeholder involvement in the Old Hickory Lake Watershed is the Cumberland River Compact (CRC). The CRC is a 501(c)(3) non-profit organization working to enhance the health and enjoyment of the Cumberland River and its tributaries in Tennessee and Kentucky. They engage in a variety of projects including mine land reforestation, stream restoration, certifying River Friendly Farms, and implementing best management practices in both agricultural and urban settings. In addition to these projects, the CRC organizes education and community engagement initiatives to inspire and educate individuals of all ages protect their waterways. Their efforts in education, restoration, and outreach are all intended to give people the tools to be good stewards of their watershed and to constructively partner in policy planning with government agencies. Information regarding the accomplishments and ongoing work of the CRC is available at their website: [Cumberland River Compact | Home](#) (CRC 2025).

Another example of ongoing work in this watershed is the Spring Creek and Black Branch Restoration Project led by Green Interchange. Green Interchange is an organization with the mission to plant trees and foster natural systems for healthier communities, economies, and quality of life in Tennessee. The project is an initiative developed in response to the 2021 Spring Creek and Black Branch Watershed-Based Plan (WBP) authored through partnership of Green Interchange and the City of Lebanon and Wilson County stormwater programs. This WBP recommends riparian restoration through livestock exclusion and alternative water supply, stream bank stabilization in prioritized areas, and construction of water and sediment control basins (Green Interchange 2023). These activities would help reduce non-point source loading of sediment, nutrients, and *E. coli* as well as help reduce habitat loss due to streambank erosion. The restoration project is intended to target several aspects of this WBP through tree planting and live staking along 950 feet of Spring Creek. This project is ongoing and has plans to continue planting activities through winter of 2026. More information can be found at the Green Interchange website: [Spring Creek - Green Interchange Inc](#) (Green Interchange N.D.).

9.3.1 Urban Nonpoint Sources

Management measures to reduce *E. coli* loading from urban nonpoint sources are similar to those recommended for MS4s (ref. Section 9.2.2). Specific categories of urban nonpoint sources include stormwater, illicit discharges, septic systems, pet waste, and wildlife.

- Stormwater: Most mitigation measures for stormwater are not designed specifically to reduce bacteria concentrations (ENSR 2005). Instead, BMPs are typically designed to remove sediment and other pollutants. Bacteria in stormwater runoff are, however, often attached to particulate matter. Therefore, treatment systems that remove sediment may also provide reductions in bacteria concentrations.
- Illicit discharges: Removal of illicit discharges to storm sewer systems, particularly of sanitary wastes, is an effective means of reducing *E. coli* loading to receiving waters (ENSR 2005). These include intentional illegal connections from commercial or residential buildings, failing septic systems, and improper disposal of sewage from campers and boats.
- Septic systems: When properly installed, operated, and maintained, septic systems effectively reduce *E. coli* concentrations in sewage. To reduce the release of *E. coli*, practices can be employed to maximize the life of existing systems, identify failed systems, and replace or remove failed systems (USEPA 2005b). Alternatively, the installation of public sewers may be appropriate.
- Pet waste: If the waste is not properly disposed of these bacteria can wash into storm drains or directly into waterbodies and contribute to *E. coli* impairment. Encouraging pet owners to properly collect and dispose of pet waste is the primary means for reducing the impact of pet waste (USEPA 2001; USEPA 2002b).
- Wildlife: Reducing the impact of wildlife on *E. coli* concentrations in waterbodies generally requires either reducing the concentration of wildlife in an area or reducing their proximity to the waterbody (ENSR 2005). The primary means for doing this is to eliminate human inducements for wildlife congregation. In addition, in some instances wildlife population control measures may be appropriate.

Three additional urban nonpoint source resource documents provided by EPA are:

[National Management Measures to Control Nonpoint Source Pollution from Urban Areas](#) (USEPA 2005b) helps citizens and municipalities in urban areas protect bodies of water from polluted runoff that can result from everyday activities. The scientifically sound techniques it presents are among the best practices known today. The guidance will also help states to implement their nonpoint source control programs and municipalities to implement their Phase II Storm Water Permit Programs.

[The Use of Best Management Practices \(BMPs\) in Urban Watersheds](#) (USEPA 2004) is a comprehensive literature review on commonly used urban watershed Best Management Practices (BMPs) that heretofore was not consolidated (USEPA 2004). The purpose of this document is to serve as an information source to individuals and agencies/municipalities/watershed management groups/etc. on the existing state of BMPs in urban stormwater management.

The [National Menu of Stormwater Best Management Practices](#) website (USEPA 2024a) is based on the Stormwater Phase II Rule's six minimum control measures and was first released in October 2000. As recently as September 2016, EPA has renamed, reorganized, updated, and enhanced the features of the website, including addition of new fact sheets and revisions of existing fact sheets. Fact sheets can be obtained by following the directions on the above website.

9.3.2 Agricultural Nonpoint Sources

BMPs have been implemented in the Old Hickory Lake watershed to reduce the number of coliform bacteria transported to surface waters from agricultural sources. These BMPs (e.g., watering facilities, fencing, heavy use area treatment, livestock exclusion, etc.) may have contributed to reductions in in-stream concentrations of coliform bacteria in one or more Old Hickory Lake watershed *E. coli*-impaired subwatersheds during the TMDL evaluation period. The Tennessee Department of Agriculture (TDA) keeps a database of TDA-administered BMPs implemented in Tennessee. Those listed in the Old Hickory Lake watershed are shown in Figure 19 below. The NRCS has also implemented BMPs in the Old Hickory Lake watershed. Identification and quantification of agricultural sources of coliform bacteria (e.g., livestock access to streams, manure application practices, etc.) would be necessary to increase success of future remediation efforts.

Implementation and monitoring of BMPs are essential to document performance in reducing coliform bacteria loading to surface waters from agricultural sources. Demonstration sites for various types of BMPs should be established and maintained, and their performance (in source reduction) evaluated prior to recommendations for utilization for subsequent implementation. *E. coli* sampling and monitoring during low-flow (baseflow) and storm periods at sites with and without BMPs and/or before and after implementation of BMPs are necessary to document appropriate BMP operation.

The Nonpoint Source Program, created in 1987 and funded by the US-EPA through Section 319 of the [Clean Water Act](#) (USEPA 2024b), provides funds to states, territories and Indian tribes for installing Best Management Practices (BMPs) to stop NPS pollution, provide training, and monitor water quality. The Tennessee Department of Agriculture administers the Nonpoint Source Program (TDA-NPS) in Tennessee on behalf of US-EPA. It primarily funds two types of programs: watershed restoration projects, and educational projects. For more information on the TDA-NPS, see [319 NPS Grant Program](#) (TDA N.D.a).

For additional information on agricultural BMPs in Tennessee, see [Agricultural Resources Conservation Fund](#) (TDA N.D.b). An additional agricultural nonpoint source resource provided by EPA is [National Management Measures to Control Nonpoint Source Pollution from Agriculture](#) (USEPA 2003). This document provides technical guidance and reference for use by state, local, and tribal managers in the implementation of nonpoint source pollution management programs. It contains information on the best available, economically achievable means of reducing pollution of surface and groundwater from agriculture. Information about specific BMPs can be obtained at the following website: [Conservation Practice Standards | Natural Resources Conservation Service](#) (USDA NRCS 2016).

9.3.3 Other Nonpoint Sources

Additional nonpoint source references (not specifically addressing urban and/or agricultural sources) provided by EPA include:

[National Management Measures to Control Nonpoint Source Pollution from Forestry](#) which helps forest owners protect lakes and streams from polluted runoff that can result from forestry activities (USEPA 2005a). This report can help states to implement their nonpoint source control programs in areas engaged in forestry.

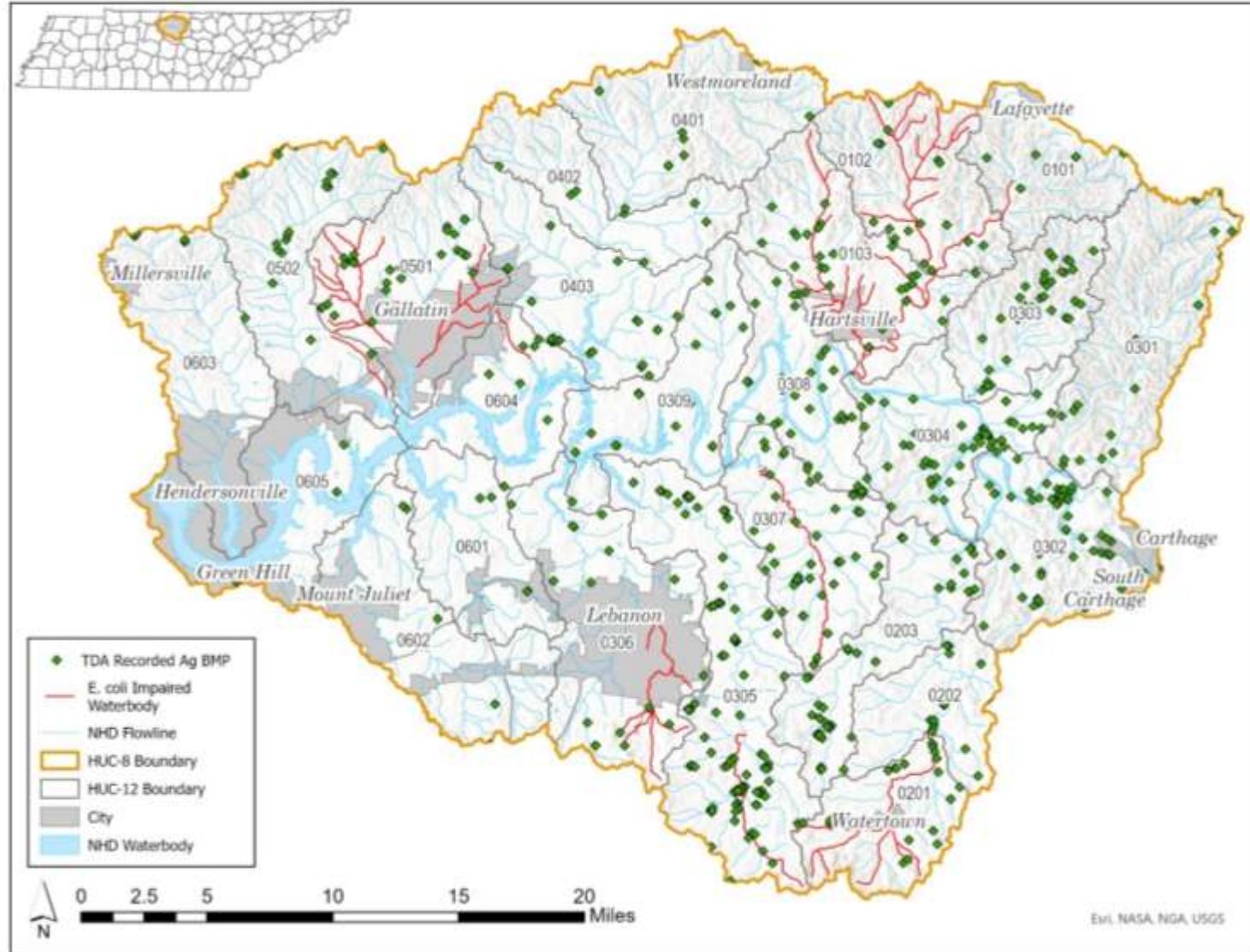


Figure 19. Tennessee Department of Agriculture Administered Best Management Practices located in the Old Hickory Lake Watershed (Updated April 2025)

9.4 Additional Monitoring

Additional monitoring and assessment activities will determine whether implementation of TMDLs, WLAs, & LAs has resulted in achievement of in-stream water quality targets for *E. coli*.

9.4.1 TMDL Monitoring

Future activities recommended for the Old Hickory Lake watershed:

- Evaluate the effectiveness of implementation measures (ref. Section 9.6) and include BMP performance analysis and monitoring by permittees and stakeholders.
- Provide additional data to clarify status of ambiguous sites for potential listing as an impaired waterbody.
- Continue ambient (long-term) monitoring at appropriate sites and key locations.

Comprehensive water quality monitoring activities include sampling during all seasons and a broad range of flow and meteorological conditions. This should be accomplished by monthly collection of *E. coli* data for a period of not less than one year. In addition, for individual monitoring locations, where historical *E. coli* data are greater than 2419 colonies/100 mL (or future samples are anticipated to be), a 1:10 (or 1:100) dilution should be performed as described in Protocol A of the Quality System Standard Operating Procedure for Chemical and Bacteriological Sampling of Surface Water (TDEC DWR 2018).

9.4.2 Source Identification

An important aspect of *E. coli* load reduction activities is the accurate identification of the actual sources of pollution. In cases where the sources of *E. coli* impairment are not readily apparent, Microbial Source Tracking (MST) is one approach to determining the sources of fecal pollution and *E. coli* affecting a waterbody. Those methods that use bacteria as target organisms are also known as Bacterial Source Tracking (BST) methods. This technology is recommended for source identification in *E. coli* impaired waterbodies.

Bacterial Source Tracking is a collective term used for various biochemical, chemical, and molecular methods that have been developed to distinguish sources of human and non-human fecal pollution in environmental samples (Shah et al. 2004). In general, these methods rely on genotypic (also known as “genetic fingerprinting”), or phenotypic (relating to the physical characteristics of an organism) distinctions between the bacteria of different sources. Three primary genotypic techniques are available for BST: ribotyping, pulsed field gel electrophoresis (PFGE), and polymerase chain reaction (PCR). Two prominent phenotypic techniques are available for BST: antibiotic resistance analysis (ARA) and carbon utilization profile (CUP) (Powell 2014).

The USEPA has published the document [Wastewater Technology Fact Sheet: Bacterial Source Tracking](#) (USEPA 2002b) that discusses BST methods and presents examples of BST application to TMDL development and implementation. Various BST projects and descriptions of the application of BST techniques used to guide implementation of effective BMPs to remove or reduce fecal contamination are presented. An article about advancements in Bacterial Source Tracking is available at: [Advancements in Bacterial Source Tracking | Stormwater Solutions](#) (Powell 2014). This article provides information about: (1) general types of BST methods, (2) the value of adopting BST techniques and (3) advances in BST technology.

A multi-disciplinary group of researchers at the University of Tennessee, Knoxville (UTK)

developed and tested a series of different microbial assay methods based on real-time PCR to detect fecal bacterial concentrations and host sources in water samples (Layton et al. 2006). The assays have been used to study fecal contamination and have proven useful in identification of areas where livestock represent a significant fecal input, and in the development of BMPs. These types of assays have broad applications in monitoring fecal impacts from Animal Feeding Operations, as well as from wildlife and human sources. The value of these assays is in identifying the host, so that the BMPs can be tailored to address human or animal sources.

The EPA has recently completed a five-year review of its 2012 Recreational Water Quality Criteria as required by the BEACH Act amendments to the Clean Water Act (CWA). Since 2012, there has been significant progress toward the implementation of human source identification technologies. Research has shown that quantitative polymerase chain reaction (qPCR) methodologies are highly reproducible, but only with standardized protocols. Currently, a draft of EPA Methods for human fecal source identification are under internal review. The EPA has also entered into an Interagency Agreement with the National Institute of Standards and Technology to develop national DNA reference material. With continuing advances and broader application of these technologies, MST has great potential to improve water quality management and help protect public health (USEPA 2018a).

9.5 Source Area Implementation Strategy

Source area implementation strategies are organized according to the dominant land use type and the affiliated sources which are estimated to be the dominant contributor of *E. coli* loads (Table 14 and Appendix F). Additional considerations for classification of source area type include waterbody assessment information from EPA's Assessment and TMDL Tracking Implementation System (ATTAINS), TDEC's internally managed database WaterLog, and the Pollutant Source designation on TDEC's Water Quality Assessment. Waterlog is an internally managed database utilized by TDEC DWR for the organization and distribution of sampling and other data. Each impaired waterbody drainage area is then grouped and targeted for implementation based on this source area classification. Three primary categories are identified: predominantly urban, predominantly agricultural, and mixed urban/agricultural. See Appendix A for information regarding land use distribution of impaired subwatersheds.

All impaired waterbodies and corresponding drainage areas have been classified according to their respective source area types in Table 14 below. The implementation for each area will be prioritized according to the guidance provided in Sections 9.5.1, 9.5.2, and 9.5.3 below. For all impaired waterbodies, the determination of source area types serves to identify the predominant sources contributing to impairment (i.e., those that should be targeted initially for implementation). However, it is not intended to imply that sources in other land use areas are not contributors to impairment and/or to grant an exemption from addressing other source area contributions with implementation strategies and a corresponding load reduction. For mixed use areas, implementation will follow the guidance established for both urban and agricultural areas, at a minimum.

Appendix F provides source area implementation examples for urban and agricultural subwatersheds, development of percent load reduction goals, and determination of critical flow zones (for implementation prioritization) for *E. coli* impaired waterbodies. Load duration curve analyses (TMDLs, WLAs, LAs, and MOS) and percent load reduction goals for all flow zones for all *E. coli* impaired waterbodies in the Old Hickory Lake watershed are summarized in Table F-24.

9.5.1 Urban Source Areas

For the purpose of implementation evaluation, an urban area is defined as residential, commercial, and industrial land use areas (land use classifications: low, medium, and high intensity development) with predominant source categories such as point sources (WWTPs), collection systems/septic systems (including SSOs and CSOs), and urban stormwater runoff associated with MS4s. A waterbody source area type was determined to be urban if the impaired waterbody met one of two criteria:

- 1) The impaired waterbody drainage area had greater than 10% impervious surface as determined from the 2021 National Land Cover Dataset. This threshold was selected because previous research has determined that streams with greater than 10% subwatershed impervious cover behave as impacted streams and show signs of declining stream health (Schueler et al. 2009).
- 2) The impaired waterbody received an urban type potential impairment source name description on the Final TDEC 2024 303(d) list (example: municipal / urbanized high-density area). These potential impairment sources are determined by TDEC staff familiar with the watershed during the assessment process.

For impaired waterbodies and corresponding drainage areas classified as predominantly urban, implementation strategies for *E. coli* load reduction will initially and primarily target source categories related to urban areas (USEPA 2007). Table 15 below presents example urban area management practices and the corresponding potential relative effectiveness under each of the hydrologic flow zones. Each implementation strategy addresses a range of flow conditions and targets point sources, nonpoint sources, or a combination of each. For each waterbody, the existing loads and corresponding PLRG for each flow zone are calculated according to the method described in Section F.2. The resulting determination of the critical flow zone further focuses the types of urban management practices appropriate for development of an effective load reduction strategy for a particular waterbody.

Of the impaired drainage areas defined in this report, the following are classified as urban source areas as defined above: Town Creek DA, Sinking Creek DA (see Table 14 below).

9.5.2 Agricultural Source Areas

For the purpose of implementation evaluation, an agricultural area is defined as cropland and pasture, with predominant source categories associated with livestock and manure management activities. A waterbody source area type was determined to be agricultural if the impaired waterbody met one of two criteria:

- 1) The impaired waterbody drainage area has greater than 33% planted/cultivated area as determined from the 2021 National Land Cover Dataset. This category includes both the Pasture/Hay and Cultivated Crops land use categories.
- 2) The impaired waterbody receives an agricultural type potential impairment source name description on the Final TDEC 2024 303(d) list (example: grazing in riparian or shoreline zones). These potential impairment sources are determined by TDEC staff familiar with the watershed during the assessment process.

For impaired waterbodies and corresponding drainage areas classified as predominantly agricultural, implementation strategies for *E. coli* load reduction will initially and primarily target source categories related to agricultural areas (USEPA 2007). Table 16 below presents example agricultural area management practices and the corresponding potential relative effectiveness under each of the hydrologic flow zones. Each implementation strategy addresses a range of flow conditions and targets point sources, nonpoint sources, or a combination of each. For each waterbody, the existing loads and corresponding PLRG for each flow zone are calculated according to the method described in Section F.2. The resulting determination of the critical flow zone further focuses the types of agricultural management practices appropriate for development of an effective load reduction strategy for a particular waterbody.

Of the impaired drainage areas defined in this report, the following are classified as agricultural source areas as defined above: Spring Creek DA, Cedar Creek DA, Neal Branch DA, Beech Log Creek DA, Round Lick Creek Lower DA, Round Lick Creek Upper DA, Little Goose Creek Upper DA, Hickerson Creek DA, Middle Fork DA, Carr Creek DA, Goose Creek DA, Liberty Branch DA (see Table 14 below).

9.5.3 Mixed Source Area Classification

For the purpose of implementation evaluation, a mixed area is defined as a source area satisfying at least one condition of both urban and agricultural source areas classification. The source categories associated with the mixed source area are therefore expected to be those from urban source areas (point sources (WWTPs), collection systems/septic systems (including SSOs and CSOs), urban stormwater runoff associated with MS4s) as well as those from agricultural source areas (source categories associated with livestock and manure management).

Of the impaired drainage areas defined in this report, the following are classified as mixed source areas as defined above: Rankin Branch DA, Unnamed Trib DA, Little Goose Creek Lower DA (see Table 14 below).

9.5.4 Forested Source Areas

A fourth category (infrequent) is associated with forested (including non-agricultural undeveloped and unaltered [by humans]) land use areas where the dominant contributor of *E. coli* loads is estimated to be the source category of wildlife.

Of the impaired drainage area defined in this report, none are classified as forested source areas.

Table 14. Source Area Types for Impaired Waterbody Drainage Area Analyses

ID 305b Waterbody ID	Drainage Area Name	Drainage Area [acres]	% Impervious Landcover	% Agricultural Landcover	303(d) Potential Source Type	Source Area Type: Urban	Source Area Type: Agriculture	Source Area Type: Mixed
TN05130201001T_0100	Rankin Branch DA	1,187	20	44	Agricultural			✓
TN05130201001T_0200	Town Creek DA	5,898	30	18	Urban	✓		
TN05130201001T_0400	Unnamed Trib DA	1,571	14	39	Other			✓
TN05130201013_3000	Spring Creek DA	14,498	1	53	Agricultural		✓	
TN05130201015_1000	Cedar Creek DA	21,018	1	64	Agricultural		✓	
TN05130201021_0300	Neal Branch DA	1,196	1	58	Agricultural		✓	
TN05130201021_0400	Beech Log Creek DA	3,994	4	41	Agricultural		✓	
TN05130201021_2000	Round Lick Creek Lower DA	17,452	2	53	Agricultural		✓	
TN05130201021_3000	Round Lick Creek Upper DA	8,097	2	44	Agricultural		✓	
TN05130201028_0100	Little Goose Creek Lower DA	18,733	2	47	Urban & Agricultural			✓
TN05130201028_0150	Little Goose Creek Upper DA	13,950	1	45	Agricultural		✓	
TN05130201028_0200	Hickerson Creek DA	2,378	1	64	Agricultural		✓	
TN05130201028_0300	Middle Fork DA	17,464	1	32	Agricultural		✓	
TN05130201028_0320	Carr Creek DA	3,551	1	27	Agricultural		✓	
TN05130201028_1000	Goose Creek DA	68,259	1	36	Agricultural		✓	
TN05130201041_0100	Liberty Branch DA	7,735	5	68	Agricultural		✓	
TN05130201055_0200	Sinking Creek DA	9,788	24	24	Urban	✓		

Table 15. Example Urban Area Management Practice per Hydrologic Flow Zone

Management Practice ^a	Flow Zone: High ^b	Flow Zone: Moist ^b	Flow Zone: Mid-Range ^b	Flow Zone: Dry ^b	Flow Zone: Low ^b
BSR: Remove illicit discharges			L	M	H
BSR: Address pet & wildlife waste		H	M	M	L
CSOM: Combined sewer separation		H	M	L	
CSOM: CSO prevention practices		H	M	L	
SSS: Infiltration/Inflow mitigation	H	M	L	L	
SSS: Inspection, maintenance, and repair		L	M	H	H
SSS: SSO repair/abatement	H	M	L		
SSM: Managing private systems		L	M	H	M
SSM: Replacing failed systems		L	M	H	M
SSM: Installing public sewers		L	M	H	M
SWIR: Infiltration basin		L	M	H	
SWIR: Infiltration trench		L	M	H	
SWIR: Infiltration/Biofilter swale		L	M	H	
SWD: Created wetland		H	M	L	
LID: Disconnecting impervious areas		L	M	H	
LID: Bioretention	L	M	H	H	
LID: Pervious pavement		L	M	H	
LID: Green Roof		L	M	H	
LID: Buffers		H	H	H	
NEOSWWTS: Permitting & installation programs		L	M	H	M
NEOSWWTS: Operation & maintenance programs		L	M	H	M
O: Point source controls		L	M	H	H
O: Landfill control		L	M	H	
O: Riparian buffers		H	H	H	
O: Pet waste education & ordinances		M	H	H	L
O: Wildlife management		M	H	H	L
O: Inspection & maintenance of BMPs	L	M	H	H	L

Notes:

- a. Management practices are grouped by general type: BSR = bacteria source reduction, CSOM = combined sewer overflow management, SSS = sanitary sewer system, SSM = septic system management, SWIR = storm water infiltration/retention, SWD = storm water detention, LID = low impact development, NEOSWWTS = new/existing on-site wastewater treatment systems, O = other.
- b. Potential relative importance of management practice effectiveness under the given hydrologic condition (H: High, M: Medium, L: Low)

Table 16. Example Agricultural Area Management Practice per Hydrologic Flow Zone

Management Practice ^a	Flow Zone: High ^b	Flow Zone: Moist ^b	Flow Zone: Mid-Range ^b	Flow Zone: Dry ^b	Flow Zone: Low ^b
GM: Prescribed Grazing (528A)	H	H	M	L	
GM: Pasture & Hayland Mgmt (510)	H	H	M	L	
GM: Deferred Grazing (352)	H	H	M	L	
GM: Planned Grazing System (556)	H	H	M	L	
GM: Proper Grazing Use (528)	H	H	M	L	
GM: Proper Woodland Grazing (530)	H	H	M	L	
LAL: Livestock Exclusion (472)			M	H	H
LAL: Fencing (382)			M	H	H
LAL: Stream Crossing			M	H	H
AWS: Pipeline (516)			M	H	H
AWS: Pond (378)			M	H	H
AWS: Trough or Tank (614)			M	H	H
AWS: Well (642)			M	H	H
AWS: Spring Development (574)			M	H	H
MM: Managing Barnyards	H	H	M	L	
MM: Manure Transfer (634)	H	H	M	L	
MM: Land Application of Manure	H	H	M	L	
MM: Composting Facility (317)	H	H	M	L	
VS: Pasture & Hayland Planting (512)	H	H	M	L	
VS: Range Seeding (550)	H	H	M	L	
VS: Channel Vegetation (322)	H	H	M	L	
VS: Brush (& Weed) Mgmt (314)	H	H	M	L	
VS: Conservation Cover (327)		H	H	H	
VS: Riparian Buffers (391)		H	H	H	
VS: Critical Area Planting (342)		H	H	H	
VS: Wetland Restoration (657)		H	H	H	

Notes:

- a. Numbers in parentheses are the U.S. Soil Conservation Service practice number. Management practices are grouped by general type: GM = grazing management, LAL = livestock access limitation, AWS = alternate water supply, MM = manure management, VS = vegetative stabilization, CM = CAFO management.
- b. Potential relative importance of management practice effectiveness under the given hydrologic condition (H: High, M: Medium, L: Low)

Table 16 (cont'd). Example Agricultural Area Management Practice per Hydrologic Flow Zone

Management Practice ^a	Flow Zone: High ^b	Flow Zone: Moist ^b	Flow Zone: Mid-Range ^b	Flow Zone: Dry ^b	Flow Zone: Low ^b
CM: Waste Management System (312)	H	H	M		
CM: Waste Storage Structure (313)	H	H	M		
CM: Waste Storage Pond (425)	H	H	M		
CM: Waste Treatment Lagoon (359)	H	H	M		
CM: Mulching (484)	H	H	M		
CM: Waste Utilization (633)	H	H	M		
CM: Water & Sediment Control Basin (638)	H	H	M		
CM: Filter Strip (393)	H	H	M		
CM: Sediment Basin (350)	H	H	M		
CM: Grassed Waterway (412)	H	H	M		
CM: Diversion (362)	H	H	M		
CM: Dikes (356)	H	H	M		
CM: Lined Waterway or Outlet (468)	H	H	M		
CM: Roof Runoff Mgmt (558)	H	H	M		
CM: Floodwater Diversion (400)	H	H	M		
CM: Terrace (600)	H	H	M		

Notes:

- a. Numbers in parentheses are the U.S. Soil Conservation Service practice number.
- b. Potential relative importance of management practice effectiveness under given hydrologic condition (H: High, M: Medium, L: Low)

9.6 Evaluation of TMDL Implementation Effectiveness

Evaluation of the effectiveness of TMDL implementation strategies should be conducted on multiple levels, as appropriate:

- HUC-12 or waterbody drainage area (i.e., TMDL analysis location)
- Subwatersheds or intermediate sampling locations
- Specific land use areas (urban, pasture, etc.)
- Specific facilities (WWTP, CAFO, uniquely identified portion of MS4, etc.)
- Individual BMPs

In order to conduct an implementation effectiveness analysis on measures to reduce *E. coli* source loading, monitoring results should be evaluated in at least one of several ways. Sampling results can be compared to water quality standards (e.g., load duration curve analysis) for determination of impairment status, results can be compared on a before and after basis (temporal), or results can be evaluated both upstream and downstream of source reduction measures or source input (spatial) (USEPA 2014). Considerations include period of record, data collection frequency, representativeness of data, and sampling locations. In general, periods of record greater than 5 years (given adequate sampling frequency) can be evaluated for determination of relative change (trend analysis). For watersheds in second or successive TMDL cycles, data collected from multiple cycles can be compared. See Appendix G for detailed trend analysis of the impaired waterbodies mentioned in this report. If implementation efforts have been initiated to reduce loading, evaluation of routine monitoring data may indicate improving or worsening conditions over time and corresponding effectiveness of implementation efforts. Water quality data for implementation effectiveness analysis can be presented in multiple ways.

The following examples are taken from the Hiwassee River watershed because the monitoring site (Oostanaula Creek at mile 28.4) has a large quantity of monitoring data available and the data demonstrate clear improvement. Figure 20 shows best fit curve analyses (regressions) of flow (percent time exceeded) versus *E. coli* loading, for a historical (1999-2004) period versus a recent post-implementation period of sampling data (2005-2013). The LDCs of the single sample maximum and geometric mean water quality standards are also plotted to illustrate the relative degree of impairment for each period. Figure 21 shows an LDC analysis of *E. coli* loading statistics for Oostanaula Creek for the same two periods. In addition, the 90th percentiles for each flow zone are plotted for comparison. Lastly, Figure 22 shows *E. coli* concentration data statistics for recent versus historical data. The individual flow zone analyses are presented in a box and whisker plot of recent [2] versus historical [1] data. Note that Figures 20-22 present the same data, each clearly illustrating improving conditions between historical and recent periods.

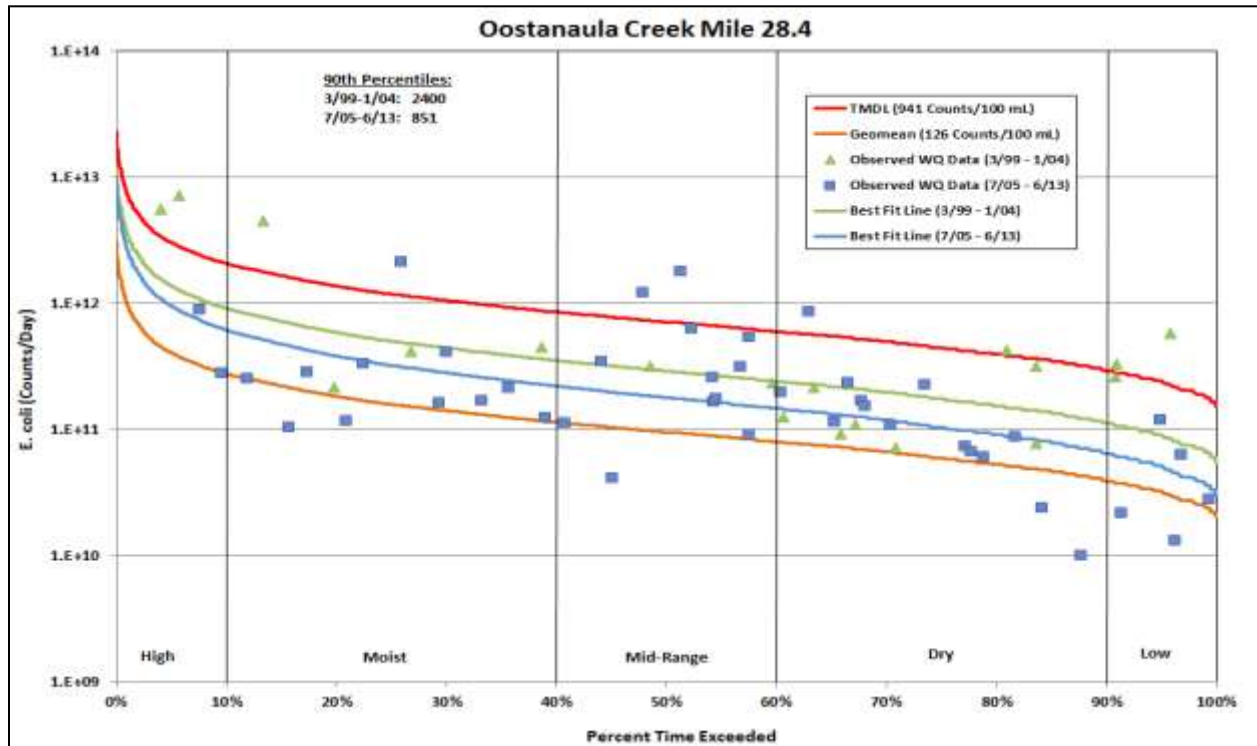


Figure 20. Example Graph of TMDL Implementation Effectiveness (LDC regression analysis)

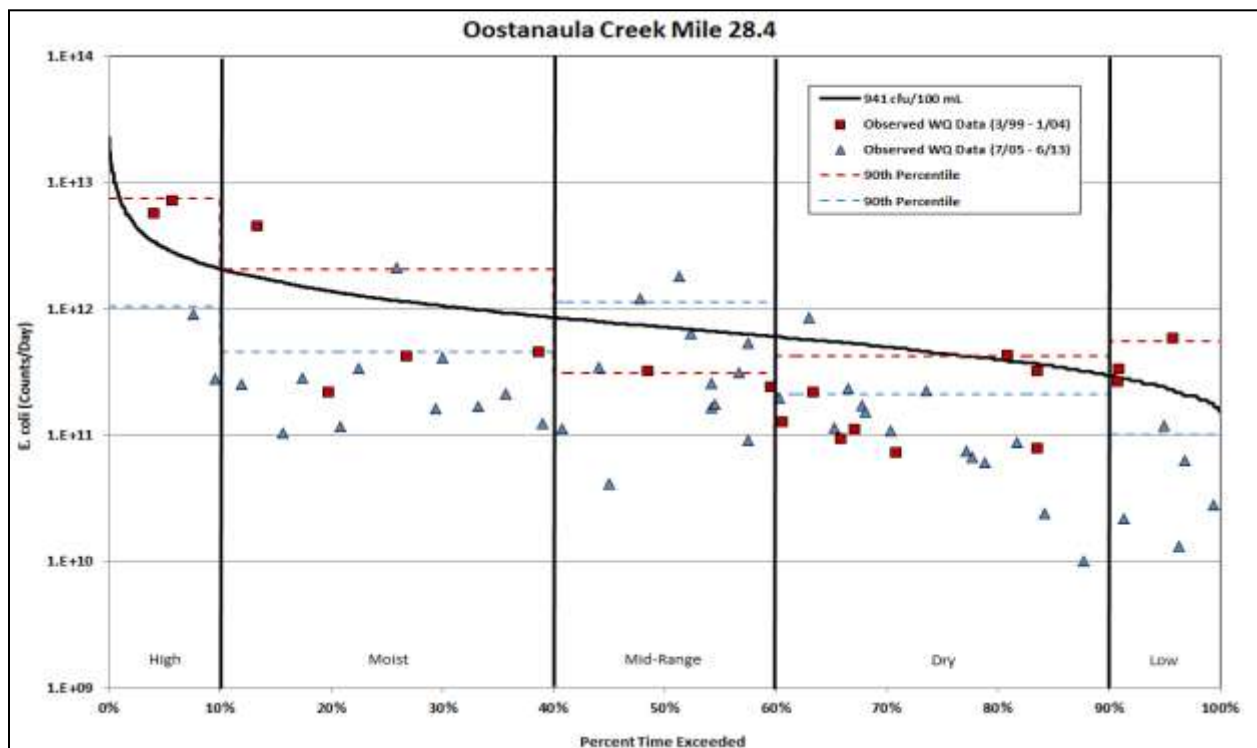


Figure 21. Example Graph of TMDL Implementation Effectiveness (LDC analysis)

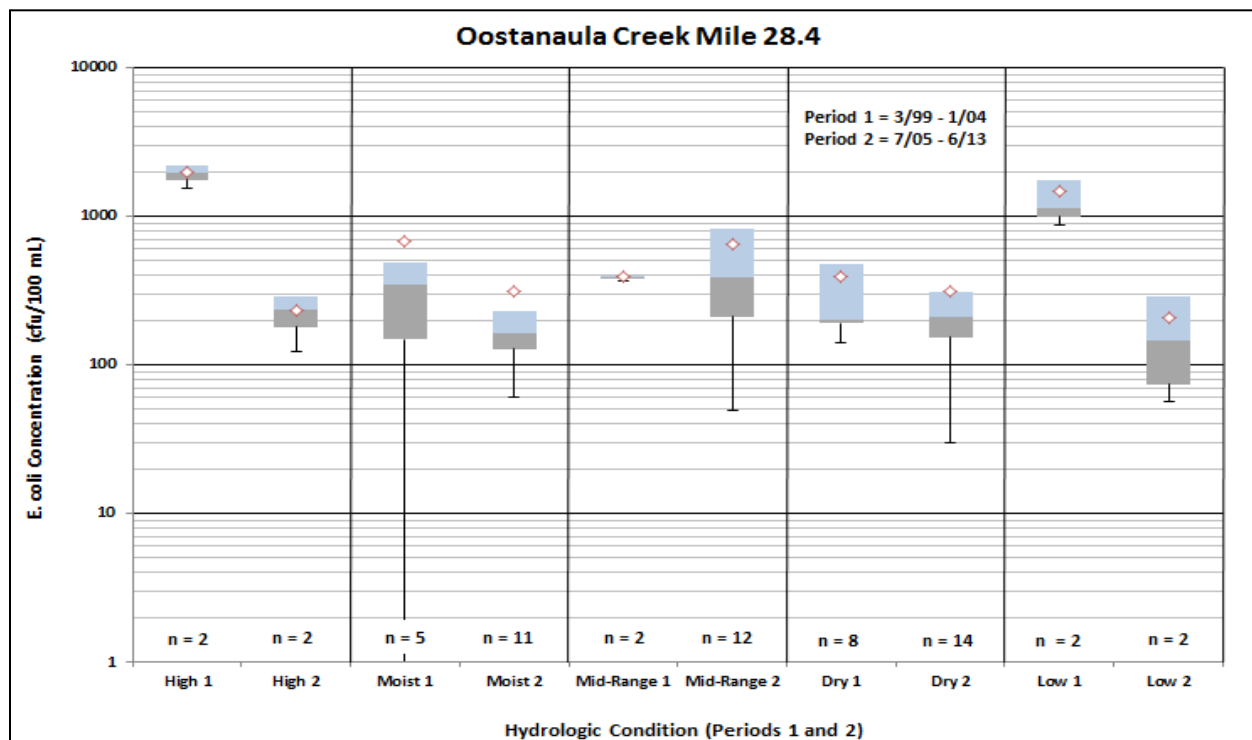


Figure 22. Example Graph of TMDL Implementation Effectiveness (box and whisker plot)

10.0 PUBLIC PARTICIPATION

In accordance with [40 CFR §130.7](#) (CFR 2025d), the proposed *E. coli* TMDLs for the Old Hickory Lake watershed will be placed on Public Notice for a 35-day period and comments solicited. The public notice process will include:

- 1) Notice of the proposed TMDLs will be posted on the Tennessee Department of Environment and Conservation website. The announcement will invite public and stakeholder comment and provide a link to a downloadable version of the TMDL document.
- 2) Notice of the availability of the proposed TMDLs (similar to the website announcement) will be sent to the division's e-mail distribution list which includes stakeholders who have requested to receive public notices.
- 3) Letters will be sent via email to the following facilities permitted to discharge treated effluent containing *E. coli* into an *E. coli*-impaired drainage area described in this report:

Watertown STP (TN0025488)

- 4) Letters will be sent via email to the following MS4s that are wholly or partially located in an *E. coli*-impaired drainage area described in this report:

City of Lebanon (TNS075426)
Sumner County MS4 (TNS075680)
Wilson County Stormwater (TNS075809)
City of Gallatin (TNS077534)
Tennessee Department of Transportation (TNS077585)

- 5) Letters will be sent via email to the following CAFOs located in an *E. coli*-impaired drainage area described in this report:

Roy Major Farm (SOPCD0031)

A copy of this document will be made available to other stakeholders upon request. See Appendix H for records of public notice announcements and communications regarding this report.

11.0 FURTHER INFORMATION

Further information concerning Tennessee's TMDL program can be found on the Internet at the Tennessee Department of Environment and Conservation website: [Tennessee's Total Maximum Daily Load \(TMDL\) Program](#) (TDEC 2025a).

Technical questions regarding this TMDL should be directed to the following members of the DWR staff:

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e-mail: Richard.Cochran@tn.gov

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APPENDIX A

Land Use Distribution

Table A-1. 2021 NLCD Land Use Description of Impaired Drainage Areas

NLCD 2021: Code	NLCD 2021: Type	Rankin Branch DA [acres]	Rankin Branch DA [%]	Town Creek DA [acres]	Town Creek DA [%]	Unnamed Trib DA [acres]	Unnamed Trib DA [%]	Spring Creek DA [acres]	Spring Creek DA [%]
11	Open Water	19.6	1.6	4.6	0.1	2.5	0.2	10.4	0.1
21	Developed, Open Space	216.9	18.3	1323.1	22.4	470.6	30.0	751.3	5.2
22	Developed, Low Intensity	190.6	16.1	2001.9	33.9	237.3	15.1	186.3	1.3
23	Developed, Medium Intensity	186.5	15.7	872.9	14.8	110.7	7.0	6.8	0.0
24	Developed, High Intensity	32.8	2.8	383.8	6.5	27.1	1.7	0.5	0.0
31	Barren Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	Deciduous Forest	5.9	0.5	192.1	3.3	79.3	5.0	3501.2	24.1
42	Evergreen Forest	3.3	0.3	0.3	0.0	5.9	0.4	731.2	5.0
43	Mixed Forest	13.6	1.1	47.1	0.8	23.1	1.5	1631.6	11.3
52	Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	11.2	0.1
71	Grassland/Herbaceous	0.0	0.0	10.7	0.2	0.2	0.0	22.0	0.2
81	Pasture/Hay	438.6	37.0	1031.0	17.5	436.7	27.8	7547.6	52.1
82	Cultivated Crops	79.1	6.7	30.7	0.5	177.6	11.3	97.7	0.7
90	Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
95	Emergent Herbaceous Wetlands	0.0	0.0	0.1	0.0	0.0	0.0	0.5	0.0
Subtotal - Urban		626.8	52.8	4581.7	77.7	845.7	53.8	944.9	6.5
Subtotal - Agriculture		517.7	43.6	1061.7	18.0	614.4	39.1	7645.4	52.7
Subtotal - Forest		22.7	1.9	239.5	4.1	108.3	6.9	5864.0	40.4
Total		1,187	100	5,898	100	1,571	100	14,498	100

Table A-1 (cont'd). 2021 NLCD Land Use Description of Impaired Drainage Areas

NLCD 2021: Code	NLCD 2021: Type	Cedar Creek DA [acres]	Cedar Creek DA [%]	Neal Branch DA [acres]	Neal Branch DA [%]	Beech Log Creek DA [acres]	Beech Log Creek DA [%]	Round Lick Creek Lower DA [acres]	Round Lick Creek Lower DA [%]
11	Open Water	20.4	0.1	0.0	0.0	0.0	0.0	2.4	0.0
21	Developed, Open Space	1210.4	5.8	66.4	5.6	301.9	7.6	1208.0	6.9
22	Developed, Low Intensity	319.1	1.5	6.2	0.5	177.5	4.4	431.1	2.5
23	Developed, Medium Intensity	71.8	0.3	2.6	0.2	71.0	1.8	103.8	0.6
24	Developed, High Intensity	1.5	0.0	4.7	0.4	17.1	0.4	34.8	0.2
31	Barren Land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	Deciduous Forest	2900.4	13.8	391.0	32.7	1310.9	32.8	3860.5	22.1
42	Evergreen Forest	802.1	3.8	0.9	0.1	107.0	2.7	571.0	3.3
43	Mixed Forest	2184.2	10.4	36.0	3.0	335.6	8.4	2033.4	11.7
52	Shrub/Scrub	3.8	0.0	0.0	0.0	2.0	0.0	10.0	0.1
71	Grassland/Herbaceous	17.8	0.1	0.0	0.0	17.6	0.4	31.8	0.2
81	Pasture/Hay	13162.2	62.6	688.1	57.5	1650.5	41.3	9086.8	52.1
82	Cultivated Crops	318.9	1.5	0.0	0.0	0.0	0.0	74.4	0.4
90	Woody Wetlands	4.0	0.0	0.0	0.0	2.9	0.1	4.0	0.0
95	Emergent Herbaceous Wetlands	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal - Urban		1602.9	7.6	79.9	6.7	567.5	14.2	1777.7	10.2
Subtotal - Agriculture		13481.2	64.1	688.1	57.5	1650.5	41.3	9161.2	52.5
Subtotal - Forest		5886.6	28.0	427.9	35.8	1753.5	43.9	6464.9	37.0
Total		21,018	100	1,196	100	3,994	100	17,452	100

Table A-1 (cont'd). 2021 NLCD Land Use Description of Impaired Drainage Areas

NLCD 2021: Code	NLCD 2021: Type	Round Lick Creek Upper DA [acres]	Round Lick Creek Upper DA [%]	Little Goose Creek Lower DA [acres]	Little Goose Creek Lower DA [%]	Little Goose Creek Upper DA [acres]	Little Goose Creek Upper DA [%]
11	Open Water	0.0	0.0	9.3	0.0	5.2	0.0
21	Developed, Open Space	587.2	7.3	1338.5	7.1	867.1	6.2
22	Developed, Low Intensity	206.3	2.5	461.7	2.5	108.5	0.8
23	Developed, Medium Intensity	76.3	0.9	166.7	0.9	15.4	0.1
24	Developed, High Intensity	22.3	0.3	61.2	0.3	2.7	0.0
31	Barren Land	0.0	0.0	0.0	0.0	0.0	0.0
41	Deciduous Forest	2690.5	33.2	6525.0	34.8	5739.6	41.1
42	Evergreen Forest	174.4	2.2	214.9	1.1	151.3	1.1
43	Mixed Forest	756.1	9.3	1165.1	6.2	803.0	5.8
52	Shrub/Scrub	2.3	0.0	12.2	0.1	10.3	0.1
71	Grassland/Herbaceous	21.4	0.3	31.9	0.2	31.5	0.2
81	Pasture/Hay	3557.5	43.9	8138.3	43.4	5986.7	42.9
82	Cultivated Crops	0.0	0.0	587.9	3.1	228.5	1.6
90	Woody Wetlands	3.0	0.0	19.8	0.1	0.0	0.0
95	Emergent Herbaceous Wetlands	0.0	0.0	0.2	0.0	0.2	0.0
Subtotal - Urban		892.1	11.0	2028.1	10.8	993.7	7.1
Subtotal - Agriculture		3557.5	43.9	8726.2	46.6	6215.3	44.6
Subtotal - Forest		3621.0	44.7	7904.9	42.2	6693.8	48.0
Total		8,097	100	18,733	100	13,950	100

Table A-1 (cont'd). 2021 NLCD Land Use Description of Impaired Drainage Areas

NLCD 2021: Code	NLCD 2021: Type	Hickerson Creek DA [acres]	Hickerson Creek DA [%]	Middle Fork DA [acres]	Middle Fork DA [%]	Carr Creek DA [acres]	Carr Creek DA [%]
11	Open Water	0.0	0.0	0.0	0.0	0.0	0.0
21	Developed, Open Space	121.3	5.1	1121.5	6.4	199.3	5.6
22	Developed, Low Intensity	7.4	0.3	80.5	0.5	6.3	0.2
23	Developed, Medium Intensity	1.3	0.1	5.8	0.0	1.7	0.0
24	Developed, High Intensity	0.0	0.0	0.2	0.0	0.0	0.0
31	Barren Land	0.0	0.0	0.4	0.0	0.5	0.0
41	Deciduous Forest	546.3	23.0	9028.6	51.7	2182.6	61.5
42	Evergreen Forest	26.5	1.1	312.9	1.8	16.5	0.5
43	Mixed Forest	159.1	6.7	1243.7	7.1	190.4	5.4
52	Shrub/Scrub	1.2	0.0	9.3	0.1	2.9	0.1
71	Grassland/Herbaceous	2.8	0.1	12.8	0.1	1.1	0.0
81	Pasture/Hay	1363.0	57.3	5575.3	31.9	949.2	26.7
82	Cultivated Crops	149.5	6.3	73.4	0.4	0.4	0.0
90	Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
95	Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal - Urban		130.0	5.5	1208.1	6.9	207.4	5.8
Subtotal - Agriculture		1512.5	63.6	5648.7	32.3	949.7	26.7
Subtotal - Forest		731.9	30.8	10585.2	60.6	2389.5	67.3
Total		2,378	100	17,464	100	3,551	100

Table A-1 (cont'd). 2021 NLCD Land Use Description of Impaired Drainage Areas

NLCD 2021: Code	NLCD 2021: Type	Goose Creek DA [acres]	Goose Creek DA [%]	Liberty Branch DA [acres]	Liberty Branch DA [%]	Sinking Creek DA [acres]	Sinking Creek DA [%]
11	Open Water	35.7	0.1	11.5	0.1	6.2	0.1
21	Developed, Open Space	4320.1	6.3	618.5	8.0	1638.9	16.7
22	Developed, Low Intensity	935.0	1.4	374.1	4.8	1837.7	18.8
23	Developed, Medium Intensity	274.0	0.4	216.2	2.8	1407.2	14.4
24	Developed, High Intensity	90.7	0.1	38.1	0.5	647.4	6.6
31	Barren Land	13.0	0.0	0.0	0.0	96.1	1.0
41	Deciduous Forest	31987.0	46.9	1092.8	14.1	1189.9	12.2
42	Evergreen Forest	1164.5	1.7	4.7	0.1	85.3	0.9
43	Mixed Forest	4837.0	7.1	104.0	1.3	516.7	5.3
52	Shrub/Scrub	25.3	0.0	1.0	0.0	0.0	0.0
71	Grassland/Herbaceous	109.1	0.2	0.6	0.0	3.9	0.0
81	Pasture/Hay	22727.7	33.3	5264.4	68.1	2321.4	23.7
82	Cultivated Crops	1687.2	2.5	8.8	0.1	31.4	0.3
90	Woody Wetlands	42.4	0.1	0.0	0.0	2.5	0.0
95	Emergent Herbaceous Wetlands	9.9	0.0	0.6	0.0	3.4	0.0
Subtotal - Urban		5619.9	8.2	1246.8	16.1	5531.3	56.5
Subtotal - Agriculture		24414.8	35.8	5273.2	68.2	2352.8	24.0
Subtotal - Forest		37988.5	55.7	1201.5	15.5	1791.8	18.3
Total		68,259	100	7,735	100	9,788	100

APPENDIX B

Water Quality Monitoring Data

Table B-1. Summary Table for TDEC Water Quality Monitoring Data

Impaired Waterbody ID	Impaired Waterbody Name	Monitoring Station ^a	Previous Cycles Date Range	Most Recent Cycle Date Range ^b
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	9/28/2009 – 6/16/2015	7/9/2019 – 3/5/2020
TN05130201001T_0200	Town Creek	TOWN000.3SR	7/19/2000 – 5/25/2010	7/9/2019 – 6/24/2020
TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	CUMBE246.5T1.5SR	7/22/2014 – 6/16/2015	7/9/2019 – 6/24/2020
TN05130201013_3000	Spring Creek	SPRIN024.8WS	10/22/2014 – 6/9/2015	8/8/2019 – 6/24/2020
TN05130201015_1000	Cedar Creek	ECO71I12	1/3/2000 – 6/9/2015	8/8/2019 – 1/30/2020
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/2/2000 – 6/9/2015	8/8/2019 – 8/29/2019
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	8/2/2000 – 6/9/2015	8/8/2019 – 8/29/2019
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	7/26/2000 - 6/24/2020	7/9/2019 – 6/24/2020
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	11/29/2000 – 6/9/2015	11/5/2019 – 6/24/2020
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	8/23/2004 – 6/16/2015	7/1/2019 – 6/10/2020
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	NONE	7/1/2019 – 6/10/2020
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	NONE	7/1/2019 – 6/10/2020
TN05130201028_0300	Middle Fork	MFGOO000.7TR	NONE	7/1/2019 – 6/10/2020
TN05130201028_0320	Carr Creek	CARR000.1MA	NONE	7/1/2019 – 6/10/2020
TN05130201028_1000	Goose Creek	GOOSE004.5TR	8/23/2004 – 6/16/2015	7/1/2019 – 6/10/2020
TN05130201041_0100	Liberty Branch	LIBER001.3SR	7/27/2009 – 6/15/2010	7/30/2019 – 6/9/2020
TN05130201055_0200	Sinking Creek	SINKI000.1WS	7/21/2009 – 6/9/2015 ^c	7/9/2019 – 6/24/2020

Notes:

- a. Represents the DWR Station ID used in the most recent cycle of monitoring data. It is possible that other station IDs have collected *E. coli* samples utilized for period of record (POR) analysis for the same waterbody ID - see Note c below for a list of alternative monitoring sites included.
- b. Represents the most recent cycle of monitoring data available for the determination of the final 2024 303(d) listings. More recent monitoring data may be available at the time of this report.
- c. Includes data from station SINKI000.4WS (ref. Table B-2, Note d).

The location of *E. coli* monitoring stations for impaired waterbodies in the Old Hickory Lake watershed is shown in Figure 5 in the report above. *E. coli* monitoring data recorded by TDEC at these stations is tabulated in Table B-2 below, sorted by Waterbody ID and date of sampling. The most recent cycle of monitoring data available for the determination of the final 2024 303(d) listing for each waterbody is highlighted in grey. Exceedances of relevant *E. coli* single sample Recreational standards are shown in red.

Table B-2. TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	9/28/2009	517	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	10/29/2009	727	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	11/9/2009	488	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	12/2/2009	2420	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	1/13/2010	86	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	2/25/2010	40	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	3/17/2010	387	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	10/21/2014	162	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	11/13/2014	228	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	12/11/2014	99	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	1/6/2015	57	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	2/25/2015	58	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	3/17/2015	72	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	4/21/2015	488	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	6/16/2015	2420	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	7/9/2019	133	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	10/8/2019	308	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	11/5/2019	108	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	12/4/2019	26	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	1/21/2020	13	N.G.
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	3/5/2020	53	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	7/19/2000	580	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	8/8/2000	100	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	9/7/2000	93	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	11/30/2000	110	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	11/30/2000	70	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	12/12/2000	200	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	8/23/2004	340	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	9/21/2004	32	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201001T_0200	Town Creek	TOWN000.3SR	10/19/2004	920	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	11/29/2004	230	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	12/16/2004	110	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	1/10/2005	580	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	2/15/2005	79	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	3/14/2005	31	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	4/27/2005	110	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	5/24/2005	160	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	6/21/2005	340	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	5/10/2010	411	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	5/12/2010	816	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	5/19/2010	1553	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	5/25/2010	461	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	7/9/2019	313	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	9/17/2019	326	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	9/24/2019	152	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	10/8/2019	1046	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	11/5/2019	142	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	12/4/2019	66	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	1/21/2020	75	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	3/5/2020	1300	N.G.
TN05130201001T_0200	Town Creek	TOWN000.3SR	6/24/2020	158	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	7/22/2014	435	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	8/14/2014	770	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	9/17/2014	2420	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	10/21/2014	179	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	11/13/2014	49	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	12/11/2014	66	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	1/6/2015	49	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	2/25/2015	46	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	3/17/2015	29	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	4/21/2015	63	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	5/12/2015	73	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	6/16/2015	122	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	7/9/2019	687	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	9/17/2019	517	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	9/24/2019	2420	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	10/8/2019	1733	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	11/5/2019	1046	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	12/4/2019	152	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	1/21/2020	108	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	3/5/2020	127	N.G.
TN05130201001T_0400	Unnamed Tributary	CUMBE246.5T1.5SR	6/24/2020	124	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	10/22/2014	387	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	11/6/2014	1986	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	12/9/2014	517	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	1/21/2015	148	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	2/3/2015	105	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	3/17/2015	179	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	4/28/2015	93	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	5/6/2015	78	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	6/9/2015	2420	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	8/8/2019	46	91.7
TN05130201013_3000	Spring Creek	SPRIN024.8WS	8/12/2019	150	91.7
TN05130201013_3000	Spring Creek	SPRIN024.8WS	8/15/2019	74	91.7
TN05130201013_3000	Spring Creek	SPRIN024.8WS	8/19/2019	39	91.7
TN05130201013_3000	Spring Creek	SPRIN024.8WS	8/22/2019	326	91.7
TN05130201013_3000	Spring Creek	SPRIN024.8WS	11/5/2019	548	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	12/4/2019	501	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	1/21/2020	272	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	3/5/2020	1203	N.G.
TN05130201013_3000	Spring Creek	SPRIN024.8WS	6/24/2020	219	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	1/3/2000	40	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	4/19/2000	110	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	7/19/2000	580	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	11/2/2000	1200	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	8/25/2004	330	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	9/8/2004	390	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	10/25/2004	160	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	11/15/2004	180	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	12/15/2004	96	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	1/13/2005	190	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	E. coli ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201015_1000	Cedar Creek	ECO71I12	2/24/2005	130	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	3/30/2005	280	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	4/6/2005	160	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	5/25/2005	200	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	6/22/2005	200	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	7/21/2009	173	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	8/20/2009	488	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	9/29/2009	411	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	10/13/2009	727	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	11/17/2009	649	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	12/16/2009	201	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	1/28/2010	73	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	2/23/2010	613	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	3/4/2010	39	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	4/13/2010	238	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	6/15/2010	111	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	7/15/2014	687	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	8/5/2014	816	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	8/27/2014	488	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	9/23/2014	167	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	10/22/2014	186	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	11/6/2014	2420	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	12/9/2014	308	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	1/21/2015	56	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	1/22/2015	162	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	2/3/2015	127	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	3/17/2015	41	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	4/28/2015	209	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	5/6/2015	727	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	6/9/2015	1046	N.G.
TN05130201015_1000	Cedar Creek	ECO71I12	8/8/2019	2420	802.7
TN05130201015_1000	Cedar Creek	ECO71I12	8/12/2019	649	802.7
TN05130201015_1000	Cedar Creek	ECO71I12	8/15/2019	1414	802.7
TN05130201015_1000	Cedar Creek	ECO71I12	8/19/2019	365	802.7
TN05130201015_1000	Cedar Creek	ECO71I12	8/22/2019	411	802.7
TN05130201015_1000	Cedar Creek	ECO71I12	10/10/2019	866	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	E. coli ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201015_1000	Cedar Creek	ECO71112	1/30/2020	166	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/2/2000	870	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	9/26/2000	650	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	11/29/2000	2400	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	12/6/2000	1100	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	1/22/2001	2400	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	9/8/2004	550	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	10/25/2004	2400	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	11/15/2004	2000	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	12/15/2004	410	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	1/13/2005	2400	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	2/24/2005	490	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	3/30/2005	610	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	4/6/2005	1200	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	5/25/2005	870	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	6/22/2005	2000	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/11/2009	649	403.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/13/2009	1500	403.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/17/2009	115	403.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/19/2009	866	403.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/25/2009	548	403.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	9/2/2009	81	403.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	6/8/2010	1450	1210.6
TN05130201021_0300	Neal Branch	NEAL000.1WS	6/14/2010	1203	1210.6
TN05130201021_0300	Neal Branch	NEAL000.1WS	6/16/2010	800	1210.6
TN05130201021_0300	Neal Branch	NEAL000.1WS	6/22/2010	860	1210.6
TN05130201021_0300	Neal Branch	NEAL000.1WS	6/29/2010	1410	1210.6
TN05130201021_0300	Neal Branch	NEAL000.1WS	7/1/2010	1860	1210.6
TN05130201021_0300	Neal Branch	NEAL000.1WS	9/23/2014	27	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	10/22/2014	2420	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	11/6/2014	2420	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	12/9/2014	238	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	1/21/2015	2420	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	2/3/2015	248	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	3/17/2015	206	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	4/28/2015	144	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	E. coli ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201021_0300	Neal Branch	NEAL000.1WS	5/6/2015	2420	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	6/9/2015	2420	N.G.
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/8/2019	210	413.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/12/2019	727	413.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/15/2019	548	413.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/19/2019	249	413.3
TN05130201021_0300	Neal Branch	NEAL000.1WS	8/29/2019	579	413.3
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	8/2/2000	650	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	9/26/2000	330	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	10/24/2000	370	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	11/20/2000	53	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	12/6/2000	520	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	1/22/2001	110	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	9/8/2004	190	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	10/25/2004	490	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	11/15/2004	190	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	12/15/2004	120	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	1/13/2005	2400	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	2/24/2005	370	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	3/30/2005	290	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	4/6/2005	80	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	5/25/2005	150	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	6/8/2010	360	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	6/14/2010	770	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	6/29/2010	9800	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	7/1/2010	530	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	10/22/2014	980	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	11/6/2014	866	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	12/9/2014	104	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	1/21/2015	39	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	2/3/2015	80	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	3/17/2015	34	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	4/28/2015	138	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	5/6/2015	236	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	6/9/2015	2420	N.G.
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	8/8/2019	308	273.6

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	8/12/2019	140	273.6
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	8/15/2019	285	273.6
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	8/19/2019	144	273.6
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	8/29/2019	866	273.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	12/6/2000	130	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	1/22/2001	2000	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	9/8/2004	1200	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	10/25/2004	520	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	12/15/2004	160	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	1/13/2005	2400	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	2/24/2005	150	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	3/30/2005	550	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	4/6/2005	86	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	5/25/2005	920	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/22/2005	120	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	8/11/2009	285	302.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	8/13/2009	280	302.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	8/17/2009	2420	302.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	8/19/2009	291	302.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	8/25/2009	79	302.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	9/2/2009	173	302.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	5/11/2010	921	1339.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	5/13/2010	2600	1339.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	5/19/2010	1414	1339.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	5/24/2010	980	1339.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	5/27/2010	1300	1339.6
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/1/2010	435	405.0
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/8/2010	170	405.0
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/14/2010	192	405.0
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/16/2010	270	405.0
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/22/2010	280	405.0
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/29/2010	4110	405.0
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	7/1/2010	330	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	7/15/2014	61	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	8/5/2014	161	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	9/23/2014	31	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	10/22/2014	687	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	11/6/2014	2420	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	12/9/2014	225	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	1/21/2015	53	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	2/3/2015	91	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	3/17/2015	104	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	4/28/2015	258	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	5/6/2015	61	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/9/2015	2420	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	7/9/2019	517	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	9/17/2019	88	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	9/24/2019	206	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	10/8/2019	2420	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	11/5/2019	214	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	12/4/2019	921	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	1/21/2020	259	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	3/5/2020	914	N.G.
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	6/24/2020	980	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	11/29/2000	70	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	1/22/2001	160	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	6/29/2010	15530	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	10/22/2014	194	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	11/6/2014	1203	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	12/9/2014	228	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	1/21/2015	47	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	2/3/2015	130	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	3/17/2015	153	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	4/28/2015	420	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	5/6/2015	548	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	6/9/2015	2420	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	11/5/2019	179	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	12/4/2019	727	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	1/21/2020	108	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	3/5/2020	326	N.G.
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	6/24/2020	816	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	8/23/2004	820	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	9/21/2004	650	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	10/19/2004	2400	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	11/29/2004	390	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	12/16/2004	160	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	1/10/2005	920	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	2/15/2005	260	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	3/14/2005	130	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	4/27/2005	1200	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	5/24/2005	140	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	6/21/2005	96	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	11/12/2006	143	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	7/21/2009	155	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	8/18/2009	1986	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	9/23/2009	387	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	10/29/2009	613	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	12/14/2009	649	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	1/27/2010	74	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	2/17/2010	65	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	3/9/2010	1046	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	4/5/2010	83	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	5/10/2010	214	458.7
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	5/12/2010	687	458.7
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	5/19/2010	613	458.7
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	5/25/2010	687	458.7
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	5/27/2010	328	458.7
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	6/10/2010	1120	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	7/22/2014	2420	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	8/14/2014	272	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	9/17/2014	78	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	10/21/2014	148	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	11/13/2014	55	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	12/11/2014	167	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	1/6/2015	155	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	2/25/2015	44	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	3/17/2015	76	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	4/21/2015	517	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	E. coli ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	5/12/2015	91	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	6/16/2015	548	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	7/1/2019	411	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	9/3/2019	214	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	9/23/2019	27	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	11/4/2019	548	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	12/3/2019	276	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	1/6/2020	172	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	2/20/2020	102	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	3/12/2020	67	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	4/7/2020	172	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	5/7/2020	167	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	6/2/2020	190	N.G.
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	6/10/2020	1986	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	7/1/2019	435	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	9/3/2019	236	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	9/23/2019	102	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	11/4/2019	199	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	12/3/2019	261	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	1/6/2020	157	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	2/20/2020	158	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	3/12/2020	548	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	4/7/2020	148	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	5/7/2020	276	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	6/2/2020	285	N.G.
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	6/10/2020	687	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	7/1/2019	1203	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	9/3/2019	1553	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	9/23/2019	461	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	11/4/2019	1414	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	12/3/2019	1300	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	1/6/2020	816	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	2/20/2020	517	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	3/12/2020	921	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	4/7/2020	770	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	5/7/2020	649	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	6/2/2020	517	N.G.
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	6/10/2020	1986	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	7/1/2019	2420	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	9/3/2019	1733	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	9/23/2019	147	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	11/4/2019	435	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	12/3/2019	548	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	1/6/2020	238	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	2/20/2020	261	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	3/12/2020	1300	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	4/7/2020	649	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	5/7/2020	1120	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	6/2/2020	1733	N.G.
TN05130201028_0300	Middle Fork	MFGOO000.7TR	6/10/2020	1986	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	7/1/2019	613	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	9/3/2019	326	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	9/23/2019	173	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	11/4/2019	214	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	12/3/2019	272	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	1/6/2020	225	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	2/20/2020	1414	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	3/12/2020	131	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	4/7/2020	613	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	5/7/2020	548	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	6/2/2020	1203	N.G.
TN05130201028_0320	Carr Creek	CARR000.1MA	6/10/2020	488	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	8/23/2004	50	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	9/21/2004	140	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	10/19/2004	650	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	11/29/2004	180	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	12/16/2004	100	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	7/21/2009	166	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	8/18/2009	1300	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	9/23/2009	727	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	10/29/2009	816	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	11/12/2009	111	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201028_1000	Goose Creek	GOOSE004.5TR	12/14/2009	816	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	1/27/2010	63	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	2/17/2010	23	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	3/9/2010	22	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	4/5/2010	46	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	6/10/2010	488	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	7/22/2014	53	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	8/14/2014	435	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	9/17/2014	46	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	10/21/2014	119	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	11/13/2014	75	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	12/11/2014	125	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	1/6/2015	86	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	2/25/2015	59	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	3/17/2015	411	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	4/21/2015	365	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	5/12/2015	56	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	6/16/2015	79	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	7/1/2019	687	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	9/3/2019	115	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	9/23/2019	19	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	11/4/2019	387	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	12/3/2019	411	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	1/6/2020	260	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	2/20/2020	236	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	3/12/2020	192	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	4/7/2020	548	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	5/7/2020	613	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	6/2/2020	291	N.G.
TN05130201028_1000	Goose Creek	GOOSE004.5TR	6/10/2020	435	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	7/27/2009	272	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	8/13/2009	120	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	9/28/2009	461	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	10/29/2009	770	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	11/9/2009	313	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	12/2/2009	2420	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201041_0100	Liberty Branch	LIBER001.3SR	1/13/2010	16	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	2/25/2010	172	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	3/17/2010	148	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	4/21/2010	23	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	6/15/2010	308	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	7/30/2019	201	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	8/20/2019	276	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	9/5/2019	153	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	11/6/2019	249	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	11/7/2019	435	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	12/19/2019	461	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	1/21/2020	83	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	2/27/2020	75	N.G.
TN05130201041_0100	Liberty Branch	LIBER001.3SR	6/9/2020	411	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	7/21/2009	70	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	8/20/2009	101	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	9/29/2009	461	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	10/13/2009	166	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	11/17/2009	517	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	12/16/2009	210	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	1/28/2010	40	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	2/23/2010	120	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	3/4/2010	199	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	4/13/2010	82	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	5/11/2010	236	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	5/13/2010	238	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	5/19/2010	411	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	6/15/2010	980	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	7/15/2014	921	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	8/5/2014	261	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	9/23/2014	142	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	10/22/2014	152	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	11/6/2014	1553	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	12/9/2014	201	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	1/21/2015	17	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	2/3/2015	75	N.G.

Table B-2 (cont'd). TDEC Water Quality Monitoring Data

ID 305b Waterbody ID	Waterbody Name	DWR Station ID	DATE ^a	<i>E. coli</i> ^b [CFU/100ml]	30d Geomean ^c [CFU/100ml]
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	3/17/2015	32	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	4/28/2015	205	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	5/6/2015	41	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.4WS ^d	6/9/2015	1300	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	7/9/2019	344	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	9/17/2019	517	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	9/24/2019	285	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	10/8/2019	1414	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	11/5/2019	272	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	12/4/2019	219	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	1/21/2020	93	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	3/5/2020	238	N.G.
TN05130201055_0200	Sinking Creek	SINKI000.1WS	6/24/2020	211	N.G.

Notes:

- a. The most recent cycle of monitoring data available for the determination of the final 2024 303(d) listing for each waterbody is highlighted in grey.
- b. Exceedances of appropriate *E. coli* standards for each sampling date are shown in red, taking into account changes between previous and current TN Recreational Coliform standards (ref. Section 2.0).
- c. N.G. = no geomean calculated.
- d. In order to account for changes in TDEC monitoring sites, previous monitoring data from different stations on the same waterbody is included in the period of record (POR) dataset for impaired waterbodies if (1) previous stations are within +/- 10% of the drainage area of the current monitoring station, (2) the previous monitoring data is within 10 years of the start of the current cycle sampling period, and (3) no alternative reasons (e.g. point source discharge between the two sites) preclude the inclusion of alternative monitoring location data. According to this criterion, monitoring data from station SINKI000.4WS for the two cycles between 7/21/2009 and 6/9/2015 was added to the data from the most recent station (SINKI000.1WS) to create the period of record (POR) dataset for Sinking Creek.

APPENDIX C

LDC Development and Determination of Daily Loading

C.1 Development of TMDLs

The TMDL process quantifies the amount of a pollutant that can be assimilated in a waterbody, identifies the sources of the pollutant, and recommends regulatory or other actions to be taken to achieve compliance with applicable water quality standards, based on the relationship between pollution sources and in-stream water quality conditions. A TMDL can be expressed as the sum of all point source loads (Waste Load Allocations), nonpoint source loads (Load Allocations), and an appropriate margin of safety (MOS) that takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS}$$

The objective of a TMDL is to allocate loads among all of the known pollutant sources throughout a watershed so that appropriate control measures can be implemented and water quality standards achieved. [40 CFR §130.2 \(i\)](#) (CFR 2025c) states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measure.

E. coli TMDLs, WLAs, and LAs were developed for impaired subwatersheds and drainage areas in the Old Hickory Lake watershed using Load Duration Curves (LDCs). Daily loads for TMDLs, WLAs, and LAs are expressed as a function of daily mean in-stream flow (daily loading function).

C.1.1 Development of Flow Duration Curves

A flow duration curve is a cumulative frequency graph, constructed from historic flow data at a particular location, which represents the percentage of time a particular flow is equaled or exceeded. Flow duration curves are developed for a waterbody from daily discharges of flow over an extended period of record. In general, there is a higher level of confidence that curves derived from data over a long period of record accurately represent the entire range of flow. The preferred method of flow duration curve computation uses daily mean data from USGS continuous-record gages located on the waterbody of interest. USGS gage stations can be found at the [USGS National Water Dashboard](#) (USGS 2025c). For ungaged streams, alternative methods must be used to estimate daily mean flow. These include: (1) regression equations (using drainage area as the independent variable) developed from continuous record stations in the same ecoregion; (2) drainage area extrapolation of data from a nearby continuous-record station of similar size and topography; and (3) calculation of daily mean flow using a dynamic computer model, such as the Windows version of Hydrologic Simulation Program - Fortran (WinHSPF).

Flow duration curves for impaired waterbodies in the Old Hickory Lake watershed were derived from WinHSPF hydrologic simulations based on parameters derived from calibrations at a USGS gaging station near the Old Hickory Lake watershed (see Appendix D for details of calibration). For example, a flow duration curve for Rankin Branch at station RANKI001.7SR was constructed using simulated daily mean flow for the period from 10/1/1999 through 9/30/2020. Monitoring stations were selected as the point of flow analysis so that the locations of modeled flow values coincide with the locations of sample collection for each waterbody.

These flow duration curves represent the cumulative distribution of daily discharges arranged to show the percentage of time that specific flows were exceeded during the flow period of record (the highest daily mean flow during this period is exceeded 0% of the time and the lowest daily mean flow is equaled or exceeded 100% of the time) across multiple flow zones. For a description of the criteria used to select between applying a five-zone or four-zone flow duration curve, see Section 9.1.1 above.

C.1.2 Development of Load Duration Curves and TMDLs

When a water quality target concentration is applied to the flow duration curve, the resulting load duration curve (LDC) represents the allowable pollutant loading in a waterbody over the entire range of flow. Pollutant monitoring data, plotted on the LDC, provides a visual depiction of stream water quality as well as the frequency and magnitude of any exceedances. Load duration curve intervals can be grouped into several broad categories or zones in order to provide additional insight about conditions and patterns associated with the impairment. For example, the duration curve could be divided into five zones: high flows (exceeded 0-10% of the time), moist conditions (10-40%), median or mid-range flows (40-60%), dry conditions (60-90%), and low flows (90-100%). Load duration curves can also be divided into four zones according to the criteria detailed in Section 9.1.1 above. Impairments observed in the low flow zone typically indicate the influence of point sources, while those further left on the LDC (representing zones of higher flow) predominantly reflect potential nonpoint source contributions (Stiles and Cleland 2003).

E. coli load duration curves for impaired waterbodies in the Old Hickory Lake watershed were developed from the flow duration curves developed in Section C.1.1, *E. coli* target concentrations, and available water quality monitoring data. Load duration curves for each impaired waterbody can be found in Section F.3. Load duration curves and required load reductions were developed using the following procedure (Rankin Branch, DWR Station ID: RANKI001.7SR is shown as an example):

1. A target load duration curve was generated for Rankin Branch by applying the *E. coli* target concentration (410 CFU/100ml) to each of the ranked flows developed in the flow duration curve. Plotting these values resulted in the load duration curve (ref. Section F.3). The same process was done with the *E. coli* Geomean concentration criteria (126 CFU/100ml) in order to better illustrate the waterbody water quality relative to all pertinent state criteria.

$$\text{Target Load}_{\text{Rankin Branch}} = (410 \text{ CFU/100ml}) \times (Q) \times (\text{UCF})$$

where:

$$\begin{aligned} \text{Target Load} &= \text{TMDL [CFU/day]} \\ Q &= \text{daily in-stream flow [cfs]} \\ \text{UCF} &= \text{unit conversion factor} = 28317 \text{ ml/ft}^3 \times 86400 \text{ s/day} \\ &= 2.45 \times 10^9 \text{ ml} \cdot \text{s/ft}^3 \cdot \text{d} \end{aligned}$$

$$\text{TMDL [CFU/day]} = (1.00 \times 10^{10}) \times (Q)$$

2. Daily loads were calculated for each of the water quality sampled collected at monitoring station RANKI001.7SR (ref. Table B-1) by multiplying the sample concentration by the daily mean flow for the sampling date and the required unit conversion factor. In order to be consistent for all analyses, the derived daily mean flow was used to compute sampling data loads, even if measured (“instantaneous”) flow data were available for some sampling dates. One daily load at station RANKI001.7SR is shown as an example below:

$$\text{Daily Load [CFU/day]} = \text{Sample Concentration} \times \text{Modeled Flow} \times \text{UCF}$$

where: Sampling Location = RANKI001.7SR
 Sampling Date = 7/9/2019, Modeled Flow on 7/9/2019 = 0.10 cfs
 Sample Concentration on 7/9/2019 = 133 CFU/100ml
 UCF = unit conversion factor [$2.45 \times 10^9 \text{ ml}^3/\text{s} \cdot \text{ft}^3 \cdot \text{d}$]

$$\text{Daily Load [CFU/day]} = 3.26 \times 10^8$$

3. Using the flow duration curves developed in C.1.1, the “percent of days the flow was exceeded” (PDFE) was determined for each sampling event. This PDFE corresponds to the location of each sample modeled flow from 0% (highest flow) to 100% (lowest flow). Each sample load was then plotted on the load duration curves developed in Step 1 according to the PDFE of that sample. See appendix F-3 for load duration curves for impaired waterbodies.

C.2 Development of MOS, WLAs, & LAs

As previously discussed, a TMDL can be expressed as the sum of all point source loads (WLAs), nonpoint source loads (LAs), and an appropriate margin of safety (MOS) that takes into account any uncertainty concerning the relationship between effluent limitations and water quality:

$$\text{TMDL} = \Sigma \text{WLAs} + \Sigma \text{LAs} + \text{MOS}$$

Expanding the terms:

$$\text{TMDL} = [\Sigma \text{WLAs}]_{\text{WWTP}} + [\Sigma \text{WLAs}]_{\text{MS4}} + [\Sigma \text{WLAs}]_{\text{CAFO}} + [\Sigma \text{LAs}]_{\text{DS}} + [\Sigma \text{LAs}]_{\text{SW}} + \text{MOS}$$

C.2.1 WLA Terms

For *E. coli* TMDLs in each impaired subwatershed or drainage area, **WLA terms include:**

- $[\Sigma \text{WLAs}]_{\text{WWTP}}$ is the allowable load associated with discharges of NPDES permitted WWTPs located in impaired subwatersheds or drainage areas. Since NPDES permits for these facilities specify that treated wastewater must meet in-stream water quality standards at the point of discharge, no additional load reduction is required. WLAs for WWTPs are calculated from the mean daily facility flow (expressed as “qm”) and the Daily Maximum permit limit. A future growth term for potential new WWTPs is included. Non-permitted point sources of (potential) *E. coli* contamination of surface waters associated with WWTP collection systems include leaking collection systems, sanitary sewer overflows (SSOs), and combined sewer overflows (CSOs) where applicable. As collection system leaks, SSOs, and CSOs are not considered allowable discharges, they are included in the $[\Sigma \text{WLAs}]_{\text{WWTP}}$ but receive a waste load allocation of zero. For calculation of the $[\Sigma \text{WLAs}]_{\text{WWTP}}$ term, see Section C.2.4.
- $[\Sigma \text{WLAs}]_{\text{CAFO}}$ is the allowable load for all permitted CAFOs in an impaired subwatershed or drainage area. All wastewater discharges from a CAFO to waters of the state of Tennessee are prohibited, except when either chronic or catastrophic rainfall events cause an overflow of process wastewater from a facility properly designed, constructed, maintained, and operated to contain:
 - (a) All process wastewater resulting from the operation of the CAFO (such as wash water, parlor water, watering system overflow, etc.); plus,
 - (b) All runoff from a 25-year, 24-hour rainfall event (CFR 2025e).

Therefore, a waste load allocation of zero has been assigned to this class of facilities.

- $[\Sigma \text{WLAs}]_{\text{MS4}}$ is the allowable *E. coli* load for discharges from MS4s. *E. coli* loading from MS4s is the result of buildup/wash-off processes associated with storm events. For calculation of the $[\Sigma \text{WLAs}]_{\text{MS4}}$ term, see Section C.2.4.

C.2.2 LA Terms

For *E. coli* TMDLs in each impaired subwatershed or drainage area, **LA terms include:**

- $[\Sigma LAs]_{DS}$ is the allowable *E. coli* load from “other direct sources”. These sources include leaking septic systems, illicit discharges, and animals access to streams. The load allocation specified for all sources of this type is zero CFU/day (or to the maximum extent feasible).
- $[\Sigma LAs]_{SW}$ represents the allowable *E. coli* loading from nonpoint sources indirectly going to surface waters from all land use areas (except areas covered by a MS4 permit) as a result of the buildup/wash-off processes associated with storm events (i.e., precipitation induced). For calculation of the $[\Sigma LAs]_{SW}$ term, see Section C.2.4.

Since $[\Sigma WLAs]_{CAFO} = 0$ and $[\Sigma LAs]_{DS} = 0$, the expression relating TMDLs to non-precipitation-based point sources and precipitation-based point and nonpoint sources may be simplified to:

$$\text{TMDL} - \text{MOS} = [\Sigma WLAs]_{WWTP} + [\Sigma WLAs]_{MS4} + [\Sigma LAs]_{SW}$$

C.2.3 MOS Terms

As stated in Section 8.5, an explicit MOS, equal to 10% of the *E. coli* water quality targets (ref. Section 5.0), was utilized for determination of the percent load reductions necessary to achieve WLAs and LAs:

$$\begin{aligned} \text{Target} - \text{MOS} &= (410 \text{ CFU}/100 \text{ ml}) - 0.1(410 \text{ CFU}/100 \text{ ml}) \\ \text{Target} - \text{MOS} &= 369 \text{ CFU}/100 \text{ ml} \end{aligned}$$

C.2.4 Daily Load Calculation

Since WWTPs discharge must comply with in-stream water quality criteria (TMDL target) at the point of discharge, WLAs for WWTPs are expressed as a function of the mean daily facility flow (“qm”) and the Daily Maximum permit limit. In addition, WLAs for MS4s and LAs for precipitation-based nonpoint sources are equal on a per unit area basis and may be expressed as the daily allowable load per unit area (acre) resulting from a decrease in in-stream *E. coli* concentrations to TMDL target values minus MOS:

$$[\Sigma \text{WLAs}]_{\text{MS4}} = [\Sigma \text{LAs}]_{\text{SW}} = \{ \text{TMDL} - \text{MOS} - [\Sigma \text{WLAs}]_{\text{WWTP}} \} / \text{DA}$$

where: DA = waterbody drainage area (acres)

Using Rankin Branch (at station RANKI001.7SR) as an example:

TMDL: $\text{TMDL}_{\text{Rankin Branch}} = (410 \text{ CFU}/100 \text{ mL}) \times Q \times \text{UCF}$
 $\text{TMDL}_{\text{Rankin Branch}} (\text{CFU}/\text{day}) = (1.00 \times 10^{10}) \times Q$

MOS: $\text{MOS}_{\text{Rankin Branch}} = \text{TMDL} \times 0.10 = 0.1 \times 1.00 \times 10^{10} \times Q$
 $\text{MOS}_{\text{Rankin Branch}} (\text{CFU}/\text{day}) = (1.00 \times 10^9) \times Q$

$[\Sigma \text{WLAs}]_{\text{WWTP}}$: $\text{WLA}[\text{WWTPs}]_{\text{Rankin Branch}} = q_m (\text{cfs}) \times 410 (\text{CFU}/100 \text{ mL}) \times \text{UCF}$
 $\text{WLA}[\text{WWTPs}]_{\text{Rankin Branch}} (\text{CFU}/\text{day}) = (1.00 \times 10^{10}) \times q_m$

$[\Sigma \text{WLAs}]_{\text{MS4}},$ $\text{WLA}[\text{MS4}]_{\text{Rankin Branch}} = \text{LA}_{\text{Rankin Branch}}$
 $[\Sigma \text{LAs}]_{\text{SW}}:$ $= \{ \text{TMDL} - \text{MOS} - [\Sigma \text{WLAs}]_{\text{WWTP}} \} / \text{DA}$
 $= \{ (1.00 \times 10^{10} \times Q) - (1.00 \times 10^9 \times Q) - (1.00 \times 10^{10} \times q_d) \} / \text{DA}$
 where: DA = 1,187 acres

$\text{WLA}[\text{MS4}]_{\text{Rankin Branch}} = (7.61\text{E}+06 \times Q) - (8.45\text{E}+06 \times q_d) \text{ [CFU}/\text{day}/\text{acre}_{\text{MS4}}]$

$\text{LA}[\text{sw}]_{\text{Rankin Branch}} = (7.61\text{E}+06 \times Q) - (8.45\text{E}+06 \times q_d) \text{ [CFU}/\text{day}/\text{acre}_{\text{LA}}]$

*Note: Values are not rounded until final calculation. Thus, the value of 2,446,588,800 ml*s/ft³*d is used for UCF, the value of 1.0031014080x10¹⁰ CFU/day is used for TMDL, and the value of 1.003101408x10⁹ CFU/day is used for MOS in calculations involving these values.*

TMDLs, WLAs, & LAs for other impaired subwatersheds and drainage areas were derived in a similar manner and are summarized in Table C-1 below.

Mass Numbers to Concentration Compliance Check Using the Above Example:

$$\begin{aligned}
 \text{WLA[MS4]} = \text{LA[sw]} &= (7.61\text{E}+06 \times Q) - (8.45\text{E}+06 \times q_d) && [\text{CFU/day/acre}] \\
 &= (9.00 \times 10^9 \times Q) - (1.00 \times 10^{10} \times q_d) && [\text{CFU/day}] \\
 &= (1.00 \times 10^{10} \times Q) - (1.00 \times 10^9 \times Q) - (1.00 \times 10^{10} \times q_d) && [\text{CFU/day}] \\
 &= \text{TMDL} - \text{MOS} - [\Sigma \text{WLAs}]_{\text{WWTP}} && [\text{CFU/day}]
 \end{aligned}$$

$$\text{Concentration} = \text{Load} / (\text{Flow} \times \text{UCF})$$

$$\text{TMDL Concentration} = (1.00 \times 10^{10} \times Q) / (Q \times \text{UCF}) = 410 \text{ CFU/100mL}$$

$$[\Sigma \text{WLAs}]_{\text{WWTP}} \text{ Concentration} = (1.00 \times 10^{10} \times q_d) / (q_d \times \text{UCF}) = 410 \text{ CFU/100mL}$$

MOS Concentration: Because the MOS does not represent a discrete source with its own flow, a direct load-to-concentration conversion of the MOS term in isolation $[(1.00 \times 10^9 \times Q) / (Q \times \text{UCF}) = 41 \text{ CFU/100mL}]$ does not reflect a meaningful in-stream concentration standard. This result is an artifact of the MOS being a fractional load reservation rather than an independent allocation. The appropriate interpretation is that the MOS operates at the load level, not the concentration level. By withholding 10 percent of the allowable load from allocation, the MOS ensures that even under conditions of model uncertainty or natural variability, the combined effect of all allocations achieves the 410 CFU/100mL criterion with a conservative factor of safety.

Note: The concentrations derived in the compliance check above reflect the numerical water quality target established for TMDL development (see Section 5.0) and are not representative of measured in-stream conditions.

Table C-1. TMDLs, WLAs, & LAs for Impaired Waterbodies in the Old Hickory Lake Watershed

In HUC-12 (05130201_)	Impaired Waterbody ID	Impaired Waterbody Name ^a	TMDL [CFU/d]	MOS [CFU/d]	WLA: ⁱ WWTP ^b [CFU/d]	WLA: ⁱ MS4 ^{c,d} [CFU/d/acre _{MS4}]	LA ^d [CFU/d/acre _{LA}]
0502	TN05130201001T_0100	Rankin Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(7.61E+06 x Q) - (8.45E+06 x q _d)	(7.61E+06 x Q) - (8.45E+06 x q _d)
0501	TN05130201001T_0200	Town Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.53E+06 x Q) - (1.70E+06 x q _d)	(1.53E+06 x Q) - (1.70E+06 x q _d)
0604	TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.75E+06 x Q) - (6.38E+06 x q _d)	(5.75E+06 x Q) - (6.38E+06 x q _d)
0305	TN05130201013_3000 ^{e,f}	Spring Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(6.23E+05 x Q) - (6.92E+05 x q _d)	(6.23E+05 x Q) - (6.92E+05 x q _d)
0307	TN05130201015_1000	Cedar Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(4.30E+05 x Q) - (4.77E+05 x q _d)	(4.30E+05 x Q) - (4.77E+05 x q _d)
0201	TN05130201021_0300 ^e	Neal Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(7.55E+06 x Q) - (8.39E+06 x q _d)	(7.55E+06 x Q) - (8.39E+06 x q _d)
0201	TN05130201021_0400 ^e	Beech Log Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.26E+06 x Q) - (2.51E+06 x q _d)	(2.26E+06 x Q) - (2.51E+06 x q _d)
0201	TN05130201021_2000 ^e	Round Lick Creek (Lower)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.17E+05 x Q) - (5.75E+05 x q _d)	(5.17E+05 x Q) - (5.75E+05 x q _d)
0201	TN05130201021_3000 ^{e,g}	Round Lick Creek (Upper)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.11E+06 x Q) - (1.24E+06 x q _d)	(1.11E+06 x Q) - (1.24E+06 x q _d)
0103	TN05130201028_0100 ^{e,g}	Little Goose Creek (Lower)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(4.82E+05 x Q) - (5.35E+05 x q _d)	(4.82E+05 x Q) - (5.35E+05 x q _d)
0103	TN05130201028_0150 ^e	Little Goose Creek (Upper)	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(6.47E+05 x Q) - (7.19E+05 x q _d)	(6.47E+05 x Q) - (7.19E+05 x q _d)
0103	TN05130201028_0200	Hickerson Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.80E+06 x Q) - (4.22E+06 x q _d)	(3.80E+06 x Q) - (4.22E+06 x q _d)
0102	TN05130201028_0300	Middle Fork	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.17E+05 x Q) - (5.74E+05 x q _d)	(5.17E+05 x Q) - (5.74E+05 x q _d)
0102	TN05130201028_0320	Carr Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.54E+06 x Q) - (2.82E+06 x q _d)	(2.54E+06 x Q) - (2.82E+06 x q _d)
0101, 0102, 0103	TN05130201028_1000	Goose Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.32E+05 x Q) - (1.47E+05 x q _d)	(1.32E+05 x Q) - (1.47E+05 x q _d)
0501	TN05130201041_0100	Liberty Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.17E+06 x Q) - (1.30E+06 x q _d)	(1.17E+06 x Q) - (1.30E+06 x q _d)
0306	TN05130201055_0200 ^{e,h}	Sinking Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(9.22E+05 x Q) - (1.02E+06 x q _d)	(9.22E+05 x Q) - (1.02E+06 x q _d)

Notes: Q = Mean Daily In-stream Flow (cfs), q_m = WWTP Mean Daily Flow (cfs), q_d = WWTP Facility Design Flow (cfs)

a. Values in this table are determined using the drainage area calculated from the pour point of each impaired waterbody.

Table C-1 Notes (cont'd):

- b. WLAs for WWTPs are expressed as *E. coli* loads (CFU/day). All current and future WWTPs must meet water quality standards as specified in their NPDES permit. When there are no WWTPs currently discharging into or upstream of the impaired waterbody, the expression is a future term for expanding or newly designated WWTPs
- c. Applies to any MS4 discharge loading in the subwatershed. Future MS4s will be assigned waste load allocations (WLAs) consistent with load allocations (LAs) assigned to precipitation induced nonpoint sources. See Section 9.2.2 for implementation details. When there are no MS4s currently located in an impaired drainage area, the expression is a future growth term for expanding or newly designated MS4s.
- d. WLAs and LAs expressed as a “per acre” load are calculated based on the drainage area comprising each respective allocation type (MS4, LA) within the total drainage area of the impaired waterbody (see Table A-1). As regulated MS4 area increases (due to future growth and/or new MS4 designation), unregulated LA area decreases by an equivalent amount. The sum of the areas will continue to equal the total impaired waterbody drainage area.
- e. Waterbodies covered by TMDLs approved by EPA in 2008. The TMDLs included in this document supersede previous TMDLs for these waterbodies.
- f. TN05130201013_3000 (Spring Creek) is the re-numbered Waterbody ID for the same waterbody as TN05130201013 – 4000 (Spring Creek) addressed in the 2008 Old Hickory Lake *E. coli* TMDL. The TMDL for TN05130201013_3000 supersedes the TMDL for the previous Waterbody ID.
- g. TN05130201021_2000 (Round Lick Creek) and TN05130201021_3000 (Round Lick Creek) represent the segment TN05130201021_2000 (Round Lick Creek) addressed in the 2008 Old Hickory Lake *E. coli* TMDL split into two segments. The TMDLs in this document supersede the previous TMDL for this waterbody.
- h. Waterbody ID TN05130201055_0200 (Sinking Creek) is the renumbered Waterbody ID which combines the previous segments TN05130201055_0200 and TN05130201055_0250 into one segment. The TMDL for this waterbody supersedes previous TMDLs for these waterbodies.
- i. As concentrated animal feeding operations (CAFOs) are not permitted discharge from the facility into nearby waterbodies, they receive a waste load allocation of zero. One impaired waterbody in this report has a CAFO within its drainage area: TN05130201013_3000 (Spring Creek) (ref. Section 7.1.3).

APPENDIX D

Hydrodynamic Modeling Methodology

D.1 Model Selection

The Windows version of Hydrologic Simulation Program - Fortran (WinHSPF) was selected for flow simulation of pathogen-impaired waters in the subwatersheds of the Old Hickory Lake watershed. HSPF is a watershed model capable of performing flow routing through stream reaches.

D.2 Model Set Up

The Old Hickory Lake watershed was delineated into subwatersheds in order to facilitate model hydrologic calibration. Boundaries were constructed so that subwatershed “pour points” coincided with the drainage area for each 303(d)-listed waterbody and their respective water quality monitoring stations. Watershed delineation was based on the NHD stream coverage and Digital Elevation Model (DEM) data. This discretization facilitates simulation of daily flows at water quality monitoring stations.

Several computer-based tools were utilized to generate input data for the WinHSPF model. ArcGIS Pro and BASINS, GIS tools, were used to display, analyze, and compile available information to support hydrology model simulations for selected subwatersheds. This information includes land use categories, point source dischargers, soil types and characteristics, population data (human and livestock), and stream characteristics.

Weather data from the Nashville International Airport was available for the time period from October 2009 through September 2020, coinciding with an 11-water year period. Meteorological data for this 11-water year period was used for all simulations. The first year of this period was used for model stabilization with simulation data from the subsequent 10-year period used for TMDL analysis.

D.3 Model Calibration

Hydrologic calibration of the watershed model involves comparison of simulated streamflow to historic streamflow data from USGS stream gaging stations for the same period of time. Because no continuous record gages with the necessary period of record were located in the Old Hickory watershed, a reference gage with a suitable period of data was selected as the basis of the hydrology calibration. The selected reference station was USGS station 03597590 located on Wartrace Creek below County Road at Wartrace, TN. This station was selected because it shares similar hydrologic characteristics with most impaired drainage areas of the Old Hickory Lake watershed, including the same Level IV Ecoregion (71h), same primary hydrologic soil group (C), same G-Factor (32 & 35), and similar mean weighted average slope gradient (~10.9%). Station 03597590 has a drainage area of 35.7 square miles. Meteorological data from the Nashville International Airport was used for the calibration. Initial values for hydrologic variables were taken from an EPA developed default data set. During the calibration process, model parameters were adjusted within reasonable constraints until acceptable agreement was achieved between simulated and observed streamflow. Model parameters adjusted include evapotranspiration, infiltration, upper and lower zone storage, groundwater storage, recession, losses to the deep groundwater system, and interflow discharge. The results of the hydrologic calibration for Wartrace Creek below County Road at Wartrace, TN (USGS Station 03597590) are shown in Table D-1 and Figures D-1 and D-2.

Table D-1. 10 Year Analysis Hydrologic Calibration Summary: Wartrace Creek below County Road at Wartrace, TN (USGS Station 03597590)

Simulation Name	RefGage_03597590
Model Start Date	10/1/2009
Model End Date	9/30/2020
Begin Date	10/01/10
End Date	09/30/20
Watershed Area (ac)	22,717
Watershed Area (mi²)	35.5
Baseflow Percentile	2.5
Total Simulated In-stream Flow	254.60
Total of highest 10% flows	165.28
Total of lowest 50% flows	9.55
Simulated Summer Flow Volume (months 7-9)	27.41
Simulated Fall Flow Volume (months 10-12)	65.76
Simulated Winter Flow Volume (months 1-3)	105.13
Simulated Spring Flow Volume (months 4-6)	56.30
Total Simulated Storm Volume	254.25
Simulated Summer Storm Volume (7-9)	27.32
Error in total volume	-2.76 (Recommended Criteria = 10)
Error in 50% lowest flows	2.15 (Recommended Criteria = 10)
Error in 10% highest flows	-2.36 (Recommended Criteria = 15)
Seasonal volume error – Summer	9.84 (Recommended Criteria = 30)
Seasonal volume error – Fall	2.37 (Recommended Criteria = 30)
Seasonal volume error – Winter	-11.92 (Recommended Criteria = 30)
Seasonal volume error – Spring	5.67 (Recommended Criteria = 30)
Error in storm volumes	-2.88 (Recommended Criteria = 20)
Error in summer storm volumes	9.53 (Recommended Criteria = 50)

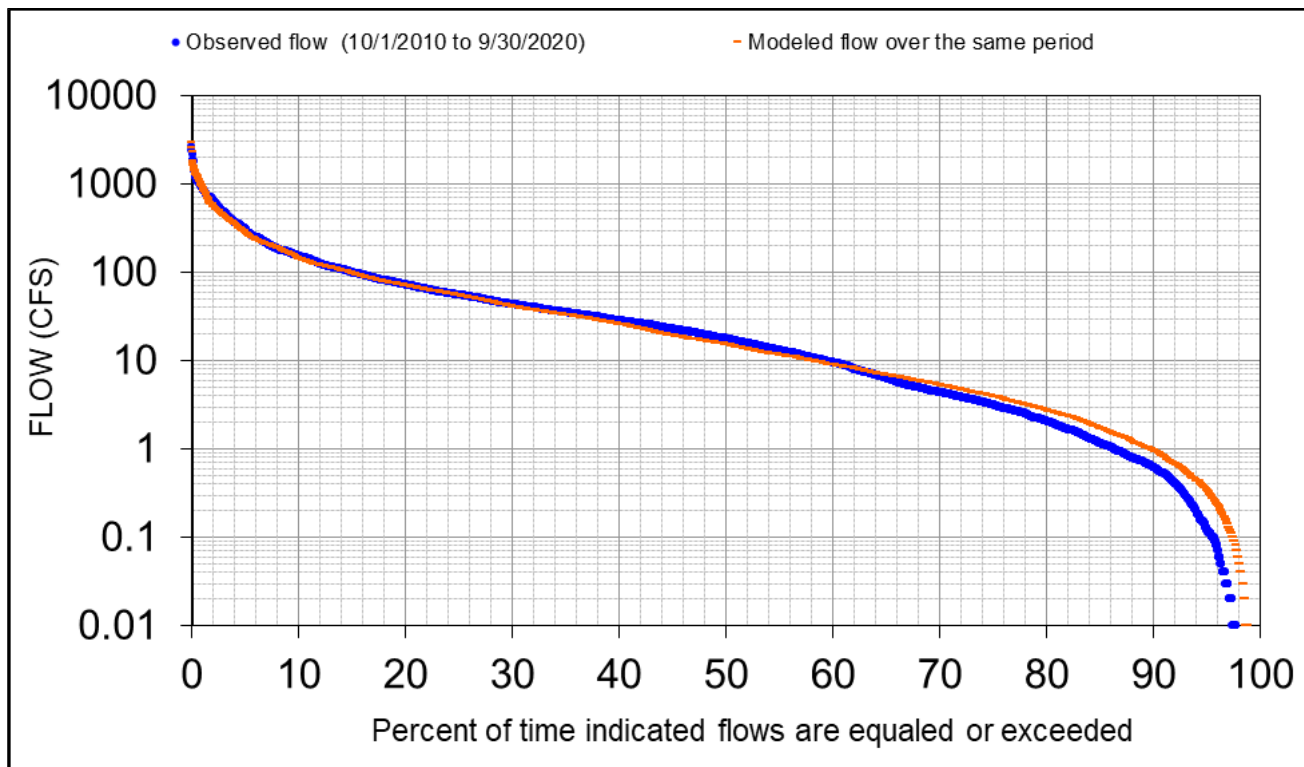


Figure D-1. Hydrologic Calibration: Wartrace Creek, USGS 03597590 (Water Years 2010-2020)

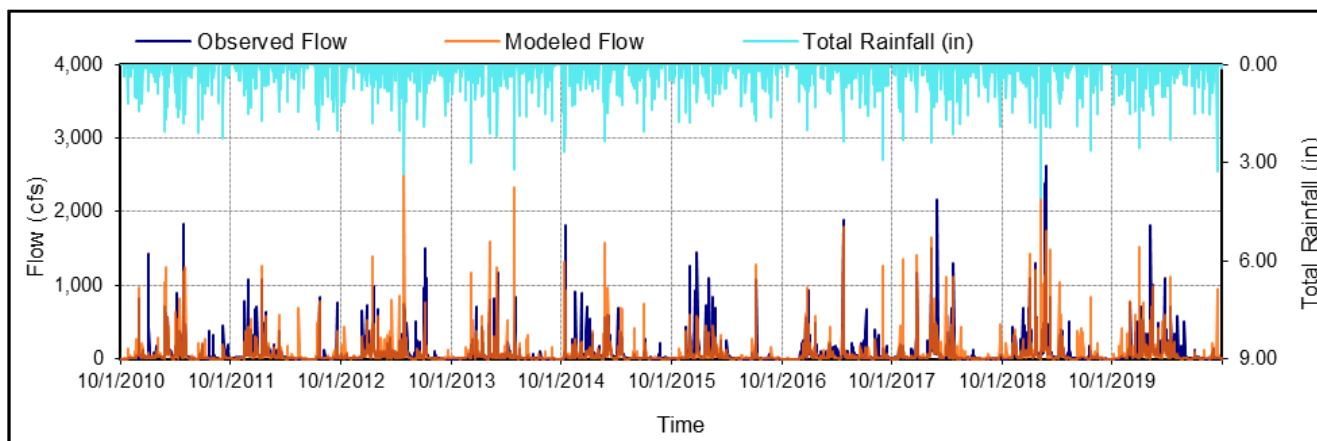


Figure D-2. 10-Year Hydrologic Comparison: Wartrace Creek, USGS 03597590

APPENDIX E

Protection TMDL Analysis

E.1 Overview of Protection TMDL Analysis

Waterbodies that are not currently listed as impaired, yet either lie within an impaired drainage area or have previously received a TMDL, were evaluated for protection. (See Table E-1 and Figure E-1 below). Only waterbodies with unique assessment unit IDs are shown below. TMDLs and allocations were developed for these unimpaired (fully supporting) and unassessed waterbodies using the same methodology as for impaired waterbodies. Development of the protection TMDLs will help assure maintenance of good water quality and will maximize the likelihood of each protection waterbody meeting water quality standards in the future. TMDLs, WLAs, & LAs for protection waterbodies are summarized in Table E-2 below.

Table E-1. Waterbodies Evaluated for Protection in the Old Hickory Lake Watershed

In Impaired DA	In HUC-12 (05130201...)	Protection Waterbody ID ^a	Protection Waterbody Name ^a	Assessment Status for <i>E. coli</i>
Spring Creek DA	0305	TN05130201013_0200	West Fork Spring Creek	Not Assessed
Cedar Creek DA	0307	TN05130201015_0100	Clendenon Branch	Not Assessed
Cedar Creek DA	0307	TN05130201015_0200 ^b	Johnson Branch	Not Assessed
Round Lick Creek (Lower) DA	0201	TN05130201021_0500	Unnamed Trib to Round Lick Creek	Not Assessed
Round Lick Creek (Lower) DA	0201	TN05130201021_0200	Haley Branch	Not Assessed
Little Goose Creek (Upper) DA	0103	TN05130201028_0140	Hams Branch	Not Assessed
Little Goose Creek (Upper) DA	0103	TN05130201028_0110	Browning Creek	Not Assessed
Little Goose Creek (Upper) DA	0103	TN05130201028_0120	Hawkins Branch	Not Assessed
Little Goose Creek (Upper) DA	0103	TN05130201028_0130	Skillet Creek	Not Assessed
Middle Fork DA	0102	TN05130201028_0310	Echo Creek	Not Assessed
Goose Creek DA	0101	TN05130201028_0500	Ford Branch	Not Assessed
Goose Creek DA	0101	TN05130201028_0600	Sullivan Branch	Not Assessed
Goose Creek DA	0101	TN05130201028_0700	Dry Fork	Not Assessed
Goose Creek DA	0101	TN05130201028_0800	Dry Branch	Not Assessed
Goose Creek DA	0102	TN05130201028_0400	Carter Branch	Not Assessed
Goose Creek DA	0102	TN05130201028_0900	Pumpkin Branch	Not Assessed
Goose Creek DA	0103	TN05130201028_1100	Finley Branch	Not Assessed
NA ^c	0306	TN05130201055_1000 ^b	Bartons Creek	Not Assessed

Notes:

- a. Waterbody IDs and names for protection waterbodies are identified according to their documentation on TDEC's Division of Water Resources [Public Data Viewer](#) (TDEC 2024b). Other sources may have other names and/or IDs.
- b. Waterbodies covered by TMDLs approved by EPA in 2008. The TMDLs included in this document supersede previous TMDLs for these waterbodies. Waterbodies no longer considered impaired yet previously covered by TMDLs are evaluated for protection.
- c. Bartons Creek is not located in an impaired drainage area but receives a protection TMDL because it was assigned a TMDL in the 2008 report approved by EPA and is no longer considered impaired.

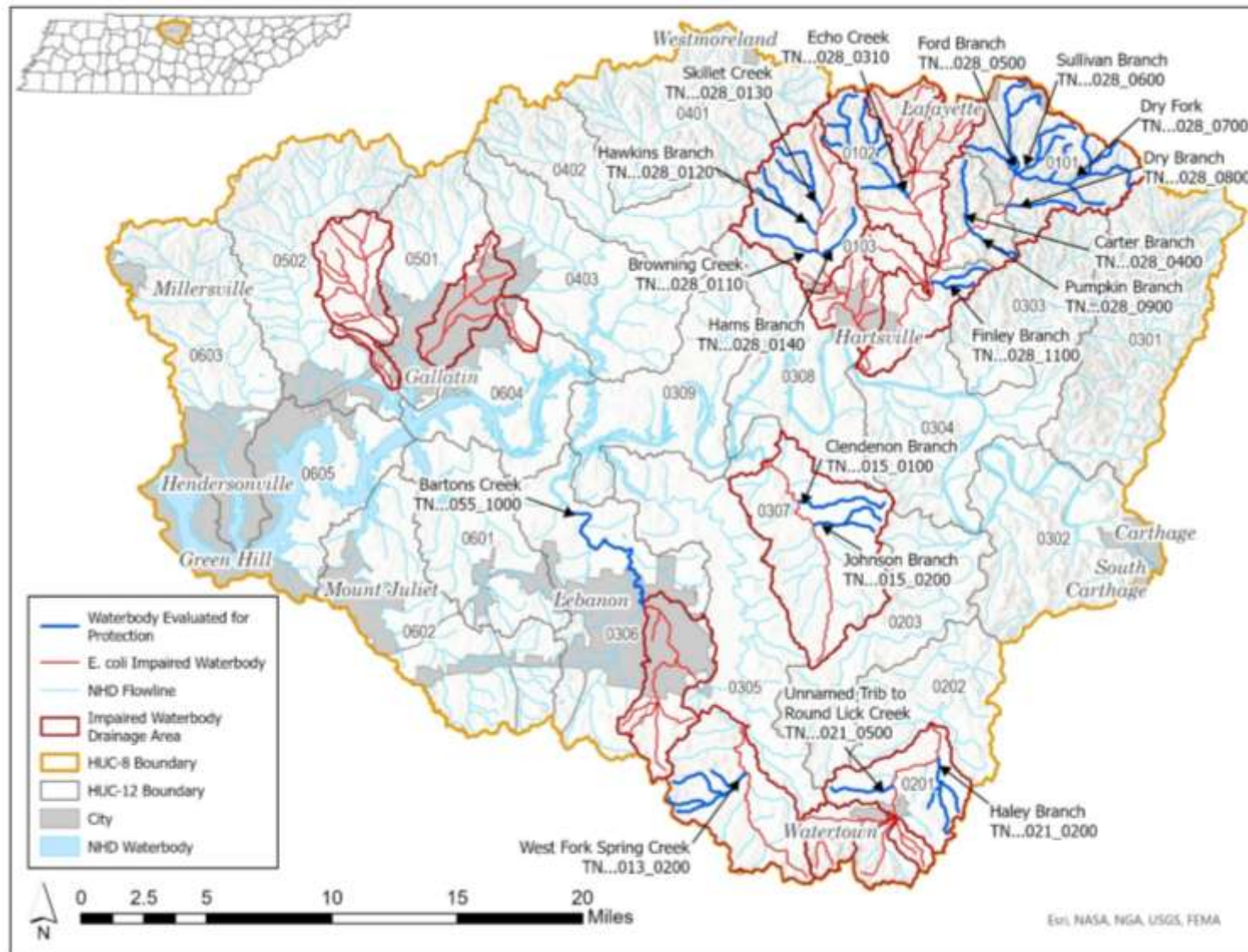


Figure E-1. Waterbodies Evaluated for Protection in the Old Hickory Lake Watershed

Table E-2. Protection TMDLs, WLAs, and LAs for Unimpaired and Unassessed Waterbodies Located in Impaired Drainage Areas of the Old Hickory Lake Watershed

In HUC-12 (05130201_)	Protection Waterbody ID	Protection Waterbody Name ^a	TMDL [CFU/d]	MOS [CFU/d]	WLA: ^f WWTP ^b [CFU/d]	WLA: ^f MS4 ^{c,d} [CFU/d/acre _{MS4}]	LA ^d [CFU/d/acre _{LA}]
0305	TN05130201013_0200	West Fork Spring Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.70E+06 x Q) - (3.00E+06 x q _d)	(2.70E+06 x Q) - (3.00E+06 x q _d)
0307	TN05130201015_0100	Clendenon Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.97E+06 x Q) - (4.42E+06 x q _d)	(3.97E+06 x Q) - (4.42E+06 x q _d)
0307	TN05130201015_0200 ^e	Johnson Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.78E+06 x Q) - (3.09E+06 x q _d)	(2.78E+06 x Q) - (3.09E+06 x q _d)
0201	TN05130201021_0200	Haley Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.56E+06 x Q) - (3.96E+06 x q _d)	(3.56E+06 x Q) - (3.96E+06 x q _d)
0201	TN05130201021_0500	Unnamed Trib to Round Lick Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(4.90E+06 x Q) - (5.44E+06 x q _d)	(4.90E+06 x Q) - (5.44E+06 x q _d)
0103	TN05130201028_0110	Browning Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.39E+06 x Q) - (3.77E+06 x q _d)	(3.39E+06 x Q) - (3.77E+06 x q _d)
0103	TN05130201028_0120	Hawkins Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.40E+06 x Q) - (3.78E+06 x q _d)	(3.40E+06 x Q) - (3.78E+06 x q _d)
0103	TN05130201028_0130	Skillet Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.51E+06 x Q) - (3.90E+06 x q _d)	(3.51E+06 x Q) - (3.90E+06 x q _d)
0103	TN05130201028_0140	Hams Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.69E+06 x Q) - (6.32E+06 x q _d)	(5.69E+06 x Q) - (6.32E+06 x q _d)
0102	TN05130201028_0310	Echo Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.56E+06 x Q) - (1.73E+06 x q _d)	(1.56E+06 x Q) - (1.73E+06 x q _d)
0101	TN05130201028_0400	Carter Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(3.88E+06 x Q) - (4.31E+06 x q _d)	(3.88E+06 x Q) - (4.31E+06 x q _d)
0101	TN05130201028_0500	Ford Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.77E+06 x Q) - (1.97E+06 x q _d)	(1.77E+06 x Q) - (1.97E+06 x q _d)
0101	TN05130201028_0600	Sullivan Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(4.09E+06 x Q) - (4.54E+06 x q _d)	(4.09E+06 x Q) - (4.54E+06 x q _d)
0101	TN05130201028_0700	Dry Fork	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(1.52E+06 x Q) - (1.69E+06 x q _d)	(1.52E+06 x Q) - (1.69E+06 x q _d)
0102	TN05130201028_0800	Dry Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(6.72E+06 x Q) - (7.46E+06 x q _d)	(6.72E+06 x Q) - (7.46E+06 x q _d)
0102	TN05130201028_0900	Pumpkin Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(8.20E+06 x Q) - (9.11E+06 x q _d)	(8.20E+06 x Q) - (9.11E+06 x q _d)
0103	TN05130201028_1100	Finley Branch	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(5.78E+06 x Q) - (6.42E+06 x q _d)	(5.78E+06 x Q) - (6.42E+06 x q _d)
0306	TN05130201055_1000 ^e	Bartons Creek	1.00E+10 x Q	1.00E+09 x Q	1.00E+10 x q _m	(2.68E+05 x Q) - (2.98E+05 x q _d)	(2.68E+05 x Q) - (2.98E+05 x q _d)

Notes: Q = Mean Daily In-stream Flow (cfs), q_m = WWTP Mean Daily Flow (cfs), q_d = WWTP Facility Design Flow (cfs)

a. Values for waterbodies in this table are calculated using drainage area calculated from the protection waterbody pour point.

b. WLAs for WWTPs are expressed as *E. coli* loads (CFU/day). All current and future WWTPs must meet water quality standards as specified in their NPDES permit. When there are no WWTPs currently discharging into or upstream of the impaired waterbody, the expression is a future term for expanding or newly designated WWTPs.

Table E-2 Notes (cont'd):

- c. Applies to any MS4 discharge loading in the subwatershed. Future MS4s will be assigned waste load allocations (WLAs) consistent with load allocations (LAs) assigned to precipitation induced nonpoint sources. See Section 9.2.2 for implementation details. When there are no MS4s currently located in an impaired drainage area, the expression is a future growth term for expanding or newly designated MS4s.
- d. WLAs and LAs expressed as a “per acre” load are calculated based on the drainage area comprising each respective allocation type (MS4, LA) within the total drainage area of the impaired waterbody (see Table A-1). As regulated MS4 area increases (due to future growth and/or new MS4 designation), unregulated LA area decreases by an equivalent amount. The sum of the areas will continue to equal the total impaired waterbody drainage area.
- e. Waterbodies covered by TMDLs approved by EPA in 2008. The TMDLs included in this document supersede previous TMDLs for these waterbodies. Waterbodies no longer considered impaired yet previously covered by TMDLs are evaluated for protection.
- f. As concentrated animal feeding operations (CAFOs) are not permitted discharge from the facility into nearby waterbodies, they receive a waste load allocation of zero.

APPENDIX F

Source Area Implementation Strategy

F.1 Source Area Classification

All impaired waterbodies and corresponding drainage areas have been classified according to their respective source area types in Section 9.5, Table 14. The implementation for each will be prioritized according to the source area classifications and the information provided in Sections 9.5.1 and 9.5.2, with examples provided in Sections F.1.1 and F.1.2, below. For all impaired waterbodies, the determination of source area types serves to identify the predominant sources contributing to impairment (i.e., those that should be targeted initially for implementation). It is not intended to imply that sources in other land use areas are not contributors to impairment and/or to grant an exemption from addressing other source area contributions with implementation strategies and corresponding load reduction. For mixed use areas, implementation will address both urban and agricultural areas, at a minimum.

F.1.1 Urban Source Areas

For impaired waterbodies and drainage areas identified as predominantly urban source area types, Town Creek provides an example for implementation analysis. Town Creek was selected because of its high proportion (30%) of impervious land cover (ref. Section 9.5.1). The Town Creek subwatershed lies in HUC-12 051302010501 and is in an urbanized area of Sumner County. The drainage area for Town Creek at river mile 0.3 (DWR monitoring station TOWN000.3SR) is approximately 5,887 acres (9.20 mi²). Four flow zones were used for the duration curve analysis (ref. Section 9.1.1).

The flow duration curve for Town Creek was constructed using simulated daily mean flow for the period from 10/1/1999 through 9/30/2020. This flow duration curve is shown in Figure F-1 and represents the cumulative distribution of daily discharges arranged to show percentage of time specific flows were exceeded during the most recent sampling period.

The *E. coli* LDC for Town Creek (Figure F-2) was analyzed to determine the frequency with which observed daily water quality loads exceed the *E. coli* target maximum daily loading (410 CFU/100 mL x flow [cfs] x conversion factor) under four flow conditions (low, mid-range, moist, and high). Observation of the plot illustrates that, over the entire period of record, monitoring and exceedances occurred in all flow zones (Figure F-2, Table F-1), indicating that the Town Creek subwatershed may be impacted by primarily nonpoint sources.

Results indicate the implementation strategy for the Town Creek subwatershed will require BMPs targeting nonpoint sources. Table F-1 presents an allocation table of LDC analysis statistics for Town Creek *E. coli* and implementation strategies for each source category covering the entire range of flow and entire period of record (Stiles and Cleland 2003). The implementation strategies listed in Table F-1 are a subset of the categories of BMPs and implementation strategies available for application to the Old Hickory Lake watershed for reduction of *E. coli* loading and mitigation of water quality impairment from urban sources. Targeted implementation strategies and LDC analysis statistics for other impaired waterbodies and drainage areas identified as predominantly urban source area types can be derived from the information and results available in Tables 14 and F-6.

LDCs for other impaired waterbodies were developed using a similar procedure (ref. Appendix C) and are shown in Figures F-5 through F-21. The LDCs shown in Figures F-5 through F-21 (and the associated Tables F-7 through F-23) are based on the most recent sampling period, which falls within the 2019-2020 timespan. Table F-24 presents LDC analyses (TMDLs, WLAs, LAs, and MOS) and PLRGs for all flow zones for all *E. coli* impaired waterbodies in the watershed.

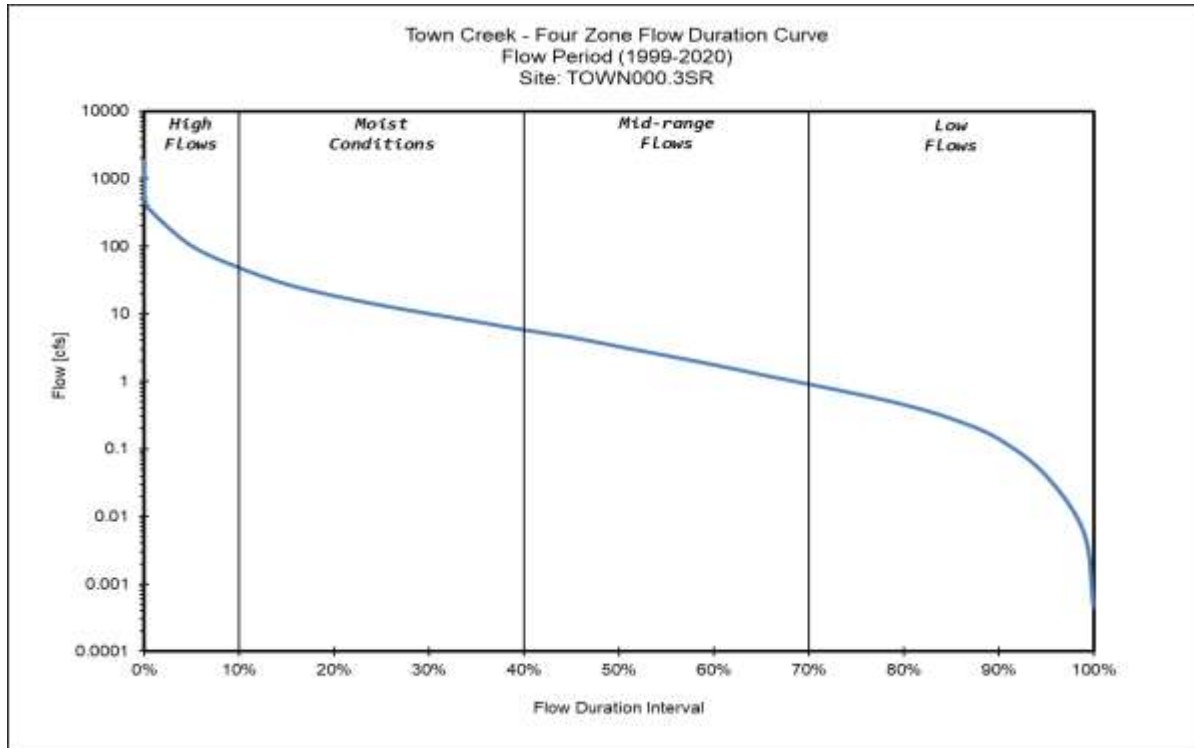


Figure F-1. Flow Duration Curve for Town Creek – Station TOWN000.3SR, Flow Period

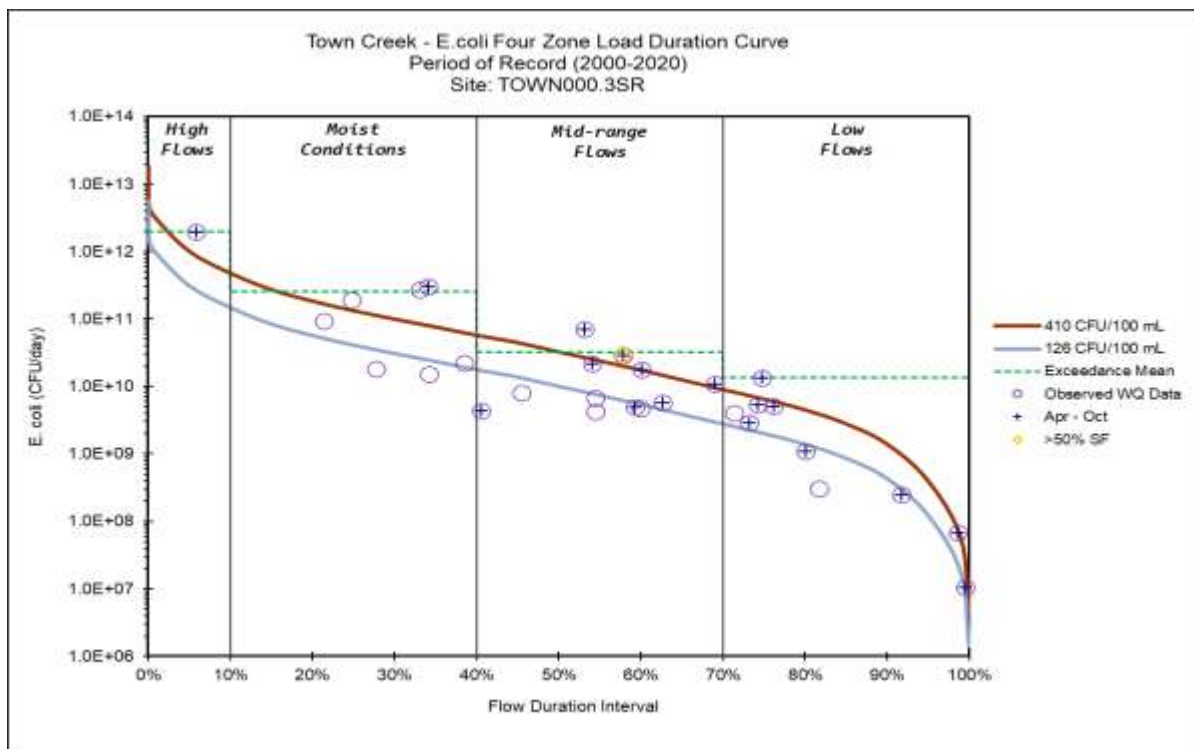


Figure F-2. *E. coli* Load Reduction Curve for Town Creek – Station TOWN000.3SR, Period of Record

Table F-1. LDC Summary for Urban Area Implementation Strategies (Example: Town Creek at Station TOWN000.3SR, Period of Record: 2000-2020)

Hydrologic Condition	High	Moist ^e	Mid-range	Low ^f
% Time Flow Exceeded (PDFE)	0-10	10-40	40-70	70-100
Total Number of Samples	1	7	12	10
Number Samples > 410 CFU/100ml ^a	1	3	4	1
Load Reduction ^b	55%	57%	25%	50%
TMDL [CFU/day]	1.00E+12	1.32E+11	2.41E+10	3.01E+09
Margin of Safety [CFU/day]	1.00E+11	1.32E+10	2.41E+09	3.01E+08
WLA(WWTPs) [CFU/day]	1.00E+10 x q _m	1.00E+10 x q _m	1.00E+10 x q _m	1.00E+10 x q _m
WLA(MS4) [CFU/day/acre_{MS4}] ^c	(1.53E+08) - (1.70E+06 x q _d)	(2.02E+07) - (1.70E+06 x q _d)	(3.68E+06) - (1.70E+06 x q _d)	(4.60E+05) - (1.70E+06 x q _m)
LA [CFU/day/acre_{LA}] ^c	(1.53E+08) - (1.70E+06 x q _d)	(2.02E+07) - (1.70E+06 x q _d)	(3.68E+06) - (1.70E+06 x q _d)	(4.60E+05) - (1.70E+06 x q _m)
Implementation Strategy: ^d Remove illicit discharges			L	M/H
Implementation Strategy: CSO prevention practices		H	M	L
Implementation Strategy: SSO repair/abatement	H	M	L	
Implementation Strategy: Created wetland		H	M	L
Implementation Strategy: Riparian buffers		H	H	H

Notes: q_m = Mean Daily WWTP Discharge (cfs), q_d = Facility (WWTP) Design Flow (cfs)

- Tennessee maximum daily water quality criterion for *E. coli*.
- Percent load reduction based on mean of observed percent load reductions in range.
- LAs and MS4s are expressed as daily load per unit area in order to provide for future changes in the distribution of LAs and MS4s (WLAs).
- Example Best Management Practices for Urban Source reduction. Actual BMPs applied may vary and should not be limited according to this grouping. Values are given as potential for source area contribution under the given flow condition (H: High, M: Medium, L: Low, Blank: No impact).
- Critical conditions are highlighted in orange.
- For low flow conditions, mean daily WWTP discharge (q_m) is used in place of facility design flow (q_d) (Ref. Section 9.1.1)

F.1.2 Agricultural Source Areas

For impaired waterbodies and corresponding drainage areas identified as predominantly agricultural source area types, Liberty Branch provides an example for implementation analysis.

The Liberty Branch analysis area, part of HUC-12 051302010501, lies in a rural area of Sumner County. The drainage area for Liberty Branch at river mile 1.3 (DWR monitoring station LIBER001.3SR) is approximately 6,903 acres (10.79 mi²). Five flow zones were used for the duration curve analysis (ref. Section 9.1.1). The land use for Liberty Branch is approximately 68% agricultural, with the remainder split between forest (16%) and urban (16%). Note that impervious surface cover represents a fraction of urban land use (ref. Section 7.2.4).

The flow duration curve for Liberty Branch at river mile 1.30 (DWR monitoring station LIBER001.3SR) was constructed using simulated daily mean flow for the period from 10/1/1999 through 9/30/2020. This flow duration curve is shown in Figure F-3 and represents the cumulative distribution of daily discharges arranged to show percentage of time specific flows were exceeded during the period of record.

The *E. coli* LDC for Liberty Branch (Figure F-4) was analyzed to determine the frequency with which observed daily water quality loads exceed the *E. coli* target maximum daily loading (410 CFU/100 mL x flow [cfs] x conversion factor) under five flow conditions (low, dry, mid-range, moist, and high). Observation of the plot illustrates that monitoring over the entire period of record occurred during all flow conditions with the highest exceedances occurring in the moist conditions zone. There is also a minor exceedance in the dry conditions flow zone. The Liberty Branch drainage area appears to be impacted primarily by nonpoint sources.

Results indicate the implementation strategy for the Liberty Branch drainage area will require BMPs targeting nonpoint type sources. Table F-2 presents an allocation table of LDC analysis statistics for Liberty Branch *E. coli* and targeted implementation strategies for each source category covering the entire range of flow and entire period of record (Stiles and Cleland 2003). The implementation strategies listed in Table F-2 are a subset of the categories of BMPs and implementation strategies available for application to the Old Hickory Lake watershed for reduction of *E. coli* loading and mitigation of water quality impairment from agricultural sources. Targeted implementation strategies and LDC analysis statistics for other impaired waterbodies and corresponding drainage areas identified as predominantly agricultural source area types can be derived from the information and results available in Tables 14 and F-6.

LDCs for other impaired waterbodies were developed using a similar procedure (Appendix C) and are shown in Figures F-5 through F-21. These LDCs and the associated Tables F-7 through F-23 are based on the period of record for each waterbody. Table F-24 presents LDC analyses (TMDLs, WLAs, LAs, and MOS) and PLRGs for all flow zones for all *E. coli* impaired waterbodies in the Old Hickory Lake watershed.

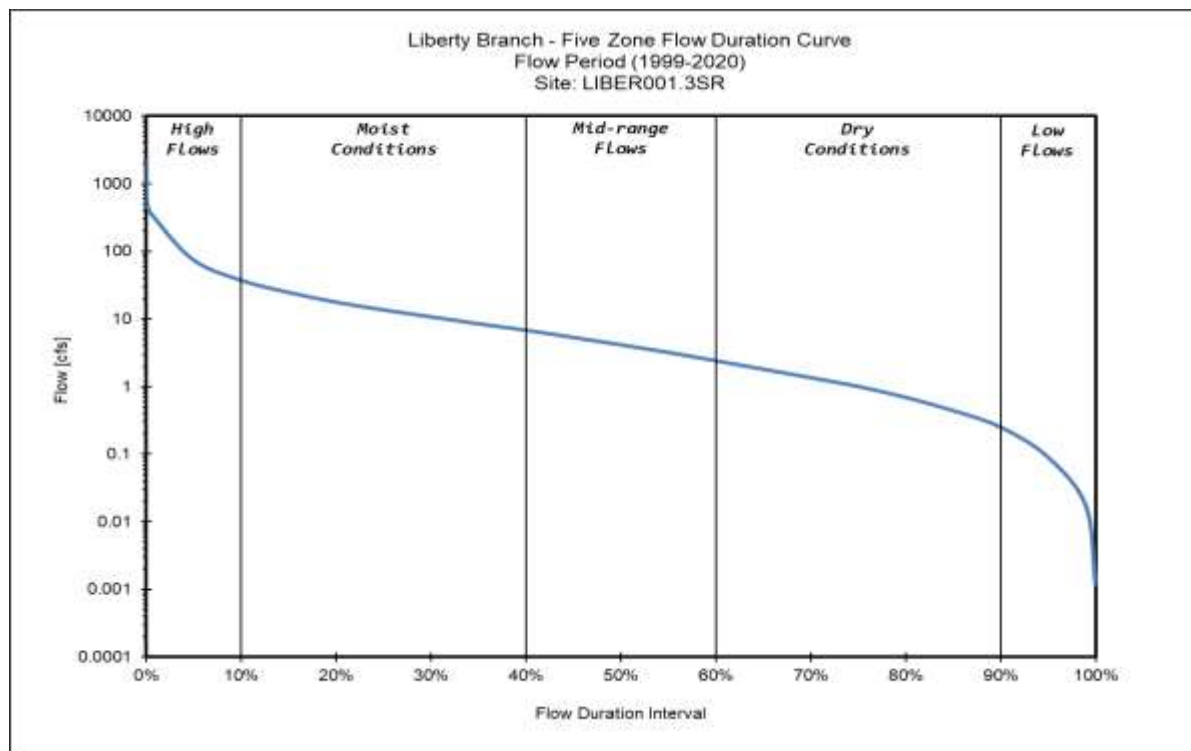


Figure F-3. Flow Duration Curve for Liberty Branch – Station LIBER001.3SR, Flow Period

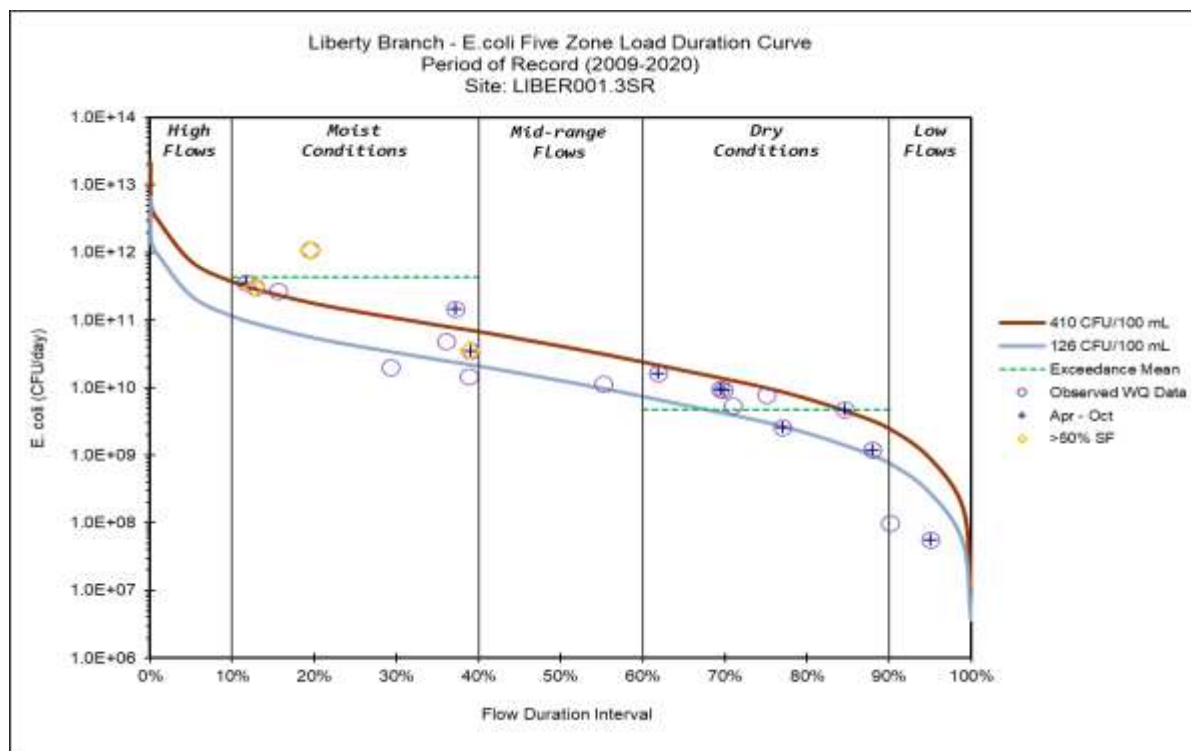


Figure F-4. *E. coli* Load Reduction Curve for Liberty Branch – Station LIBER001.3SR, Period of Record

Table F-2. LDC Summary for Agricultural Area Implementation Strategies (Example: Liberty Branch at Station LIBER001.3SR, Period of Record: 2009-2020)

Hydrologic Condition	High	Moist ^e	Mid-range	Dry	Low ^f
% Time Flow Exceeded (PDFE)	0-10	10-40	40-60	60-90	90-100
Total Number of Samples	0	9	1	8	2
Number Samples > 410 CFU/100ml ^a	0	5	0	1	0
Load Reduction ^b	NR	32%	NR	0%	NR
TMDL [CFU/day]	7.37E+11	1.35E+11	4.11E+10	1.00E+10	1.00E+09
Margin of Safety [CFU/day]	7.37E+10	1.35E+10	4.11E+09	1.00E+09	1.00E+08
WLA(WWTPs) [CFU/day]	1.00E+10 x q _m	1.00E+10 x q _m	1.00E+10 x q _m	1.00E+10 x q _m	1.00E+10 x q _m
WLA(MS4) [CFU/day/acre_{MS4}] ^c	(9.61E+07) - (1.45E+06 x q _d)	(1.77E+07) - (1.45E+06 x q _d)	(5.36E+06) - (1.45E+06 x q _d)	(1.31E+06) - (1.45E+06 x q _d)	(1.31E+05) - (1.45E+06 x q _m)
LA [CFU/day/acre_{LA}] ^c	(9.61E+07) - (1.45E+06 x q _d)	(1.77E+07) - (1.45E+06 x q _d)	(5.36E+06) - (1.45E+06 x q _d)	(1.31E+06) - (1.45E+06 x q _d)	(1.31E+05) - (1.45E+06 x q _m)
Implementation Strategy: ^d Prescribed Grazing (528A)	H	H	M	L	
Implementation Strategy: Livestock Exclusion (472)			M	H	H
Implementation Strategy: Land Application of Manure	H	H	M	L	
Implementation Strategy: Channel Vegetation (322)	H	H	M	L	
Implementation Strategy: Conservation Cover (327)		H	H	H	

Notes: q_m = Mean Daily WWTP Discharge (cfs), q_d = Facility (WWTP) Design Flow (cfs)

a. Tennessee maximum daily water quality criterion for *E. coli*.

b. Percent load reduction based on mean of observed percent load reductions in range.

c. LAs and MS4s are expressed as daily load per unit area in order to provide for future changes in the distribution of LAs and MS4s (WLAs).

d. Example Best Management Practices for Urban Source reduction. Actual BMPs applied may vary and should not be limited according to this grouping. Values are given as potential for source area contribution under the given flow condition (H: High, M: Medium, L: Low, Blank: No impact).

e. Critical conditions are highlighted in orange.

f. For low flow conditions, mean daily WWTP discharge (q_m) is used in place of facility design flow (q_d) (Ref. Section 9.1.1)

F.1.3 Forested Source Areas

There are no impaired waterbodies with a corresponding drainage area classified as source area type predominantly forested, with the predominant source category being wildlife, in the Old Hickory Lake watershed.

F.2 Calculation of Percent Load Reduction Goals and Critical Flow Zones

In order to facilitate implementation, corresponding percent reductions in loading required to decrease existing, in-stream *E. coli* loads to TMDL target levels (percent load reduction goals, PLRG) were calculated. As a result, critical flow zones were determined and subsequently verified by secondary analyses. The following example is from Town Creek at station TOWN000.3SR (ref. Figure F-2).

For each individual sampling date, the percent load reduction required to reduce each exceedance to its respective target maximum load is calculated. For each flow zone, the mean of the percent load reductions was calculated. Individual loads with no required load reduction are not included in the mean calculation. The following illustrates the calculation of the PLRG for the high flow zone for the most recent sampling cycle:

Table F-3. Example Percent Load Reduction Goal (PLRG) Calculation, Station TOWN000.3SR

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	PERCENT REDUCTION
10/8/2019	2.73	53%	MID- RANGE	1046	6.99×10^{10}	2.74×10^{10}	61%

- The first step in determining the critical flow zone requires examination of data for the most recent sampling cycle. The PLRGs calculated for each of the flow zones, not including the high flow zone (ref. Section 9.1.1), were compared and the PLRG of the greatest magnitude indicates the critical flow zone for prioritizing implementation actions for Town Creek at station TOWN000.3SR for the most recent sampling period (2019-2020). See Table F-4 below for PLRG per flow zone for the most recent cycle for TOWN000.3SR.

Example – High Flow Zone Percent Load Reduction Goal = NR
Moist Conditions Flow Zone Percent Load Reduction Goal = 68%
Mid-Range Flow Zone Percent Load Reduction Goal = 61%
Low Flow Zone Percent Load Reduction Goal = NR

Therefore, based on the highest PLRG for the most recent sampling cycle, the critical flow zone for prioritization of Town Creek implementation activities is the **moist condition** (and subsequently actions primarily targeting non-point source controls).

2. Due to the frequently limited availability of sampling data and subsequent randomness of distribution of samples by flow zone, the determination of the critical flow zone by PLRG calculation often has a high degree of uncertainty. Therefore, the second step in determining the critical flow zone requires examination of the same data as step 1 but focusing on the percent of samples that exceed the *E. coli* TMDL target levels in each flow zone rather than the PLRGs in each flow zone. The percent of samples that exceed the *E. coli* TMDL target levels during the most recent sampling cycle (2019-2020), for each flow zone, was calculated for Town Creek at station TOWN000.3SR. See Table F-4 below for the percent of samples above the target concentration per flow zone for the most recent cycle for TOWN000.3SR.

Based on the percentage of samples that exceed the *E. coli* TMDL target levels in each flow zone for each flow zone in the most recent sampling cycle, the critical flow zone for prioritization of Town Creek implementation activities is identified as the **moist zone**. When the two methods of determining critical flow zone produce different results, both flow zones should be targeted for implementation activities. If the percent of samples in exceedance between two or more flow zones are equivalent, the flow zone with the highest PLRG will be prioritized.

3. Lastly, emphasis (priority) should be placed on recent data versus historical data. Therefore, the third step in determining the critical flow zone requires comparison of the results of the methods described in steps 1 and 2 as applied both to recent data (current cycle) and to the entire period of record, or previous cycles. See Table F-5 below for the PLRG and percent of samples above the target concentration per flow zone for previous sampling cycles (2000-2010).

Based on the greatest magnitude PLRG and percent of samples exceeding the target concentration for each flow zone in previous cycles, the critical flow zone for prioritization of Town Creek implementation activities is identified as the **moist zone**. When a different flow zone, or zones, is identified, the flow zone(s) from analysis of recent data would have primary emphasis for implementation prioritization.

PLRGs and critical flow zones of the other impaired waterbodies were derived in a similar manner and are shown in Table F-24 below. For a summary of critical conditions for impaired watersheds in the Old Hickory Lake watershed, see Table F-6 below.

Table F-4. Summary Percent Reductions per Flow Zone for Town Creek, Station TOWN000.3SR, Most Recent Sampling Cycle (2019-2020)

FLOW ZONE	PDFE RANGE [%]	FLOW RANGE [cfs]	# SAMPLES	# SAMPLES > 410 CFU/100mL	% SAMPLES > 410 CFU/100mL	% REDUCTION (PLRG)
HIGH	0-10	1851.7 - 47.6	0	0	0%	NR
MOIST	10-40	47.6 - 5.7	3	1	33%	68%
MID-RANGE	40-70	5.7 – 0.9	3	1	33%	61%
LOW	70-100	0.9 - 0.0	3	0	0%	NR
TOTAL:			9	2	22%	

Table F-5. Summary Percent Reductions per Flow Zone for Town Creek, Station TOWN000.3SR, Previous Sampling Cycles (2000-2010)

FLOW ZONE	PDFE RANGE [%]	FLOW RANGE [cfs]	# SAMPLES	# SAMPLES > 410 CFU/100mL	% SAMPLES > 410 CFU/100mL	% REDUCTION (PLRG)
HIGH	0-10	1851.7 - 47.6	1	1	100%	55%
MOIST	10-40	47.6 - 5.7	4	2	50%	51%
MID-RANGE	40-70	5.7 – 0.9	9	3	33%	14%
LOW	70-100	0.9 - 0.0	7	1	14%	50%
TOTAL:			21	7	33%	

Table F-6. Summary of Critical Conditions for Impaired Waterbodies in the Old Hickory Lake Watershed

Impaired Waterbody ID	Impaired Waterbody Name	Associated Monitoring Station	Impaired Waterbody DA ^a [acre]	Critical Condition: High ^b	Critical Condition: Moist	Critical Condition: Mid-Range	Critical Condition: Dry	Critical Condition: Low
TN05130201001T_0100	Rankin Branch	RANKI001.7SR	1,187					✓
TN05130201001T_0200	Town Creek	TOWN000.3SR	5,898		✓			
TN05130201001T_0400	Unnamed Trib to Old Hickory Reservoir	CUMBE246.5T1.5SR	1,571			✓		✓
TN05130201013_3000	Spring Creek	SPRIN024.8WS	14,498		✓			
TN05130201015_1000	Cedar Creek	ECO71I12	21,018		✓			
TN05130201021_0300	Neal Branch	NEAL000.1WS	1,196			✓		
TN05130201021_0400	Beech Log Creek	BLOG000.6WS	3,994				✓	
TN05130201021_2000	Round Lick Creek (Lower)	RLICK019.4WS	17,452			✓		
TN05130201021_3000	Round Lick Creek (Upper)	RLICK021.0WS	8,097			✓		
TN05130201028_0100	Little Goose Creek (Lower)	LGOOS002.0TR	18,733		✓		✓	
TN05130201028_0150	Little Goose Creek (Upper)	LGOOS006.5TR	13,950				✓	
TN05130201028_0200	Hickerson Creek	HICKE000.9TR	2,378		✓			
TN05130201028_0300	Middle Fork	MFGOO000.7TR	17,464				✓	
TN05130201028_0320	Carr Creek	CARR000.1MA	3,551		✓	✓		
TN05130201028_1000	Goose Creek	GOOSE004.5TR	68,259			✓		
TN05130201041_0100	Liberty Branch	LIBER001.3SR	7,735		✓			
TN05130201055_0200	Sinking Creek	SINKI000.1WS	9,788			✓		

Notes:

- a. DA = drainage area
- b. High conditions are generally not considered as critical conditions according to the process above (ref. Section F.2) due to the lack of sampling data in high flow conditions (ref. Section 9.1.1) and the unlikely use of the waterbody for recreation during high flow conditions.

F.3 *E. coli* Load Duration Curves for Impaired Waterbodies

The following figures display the load duration curve for each impaired waterbody using *E. coli* sample data from the most recent sampling cycle referenced in the 2024 303(d) determinations (ref. Table 3).

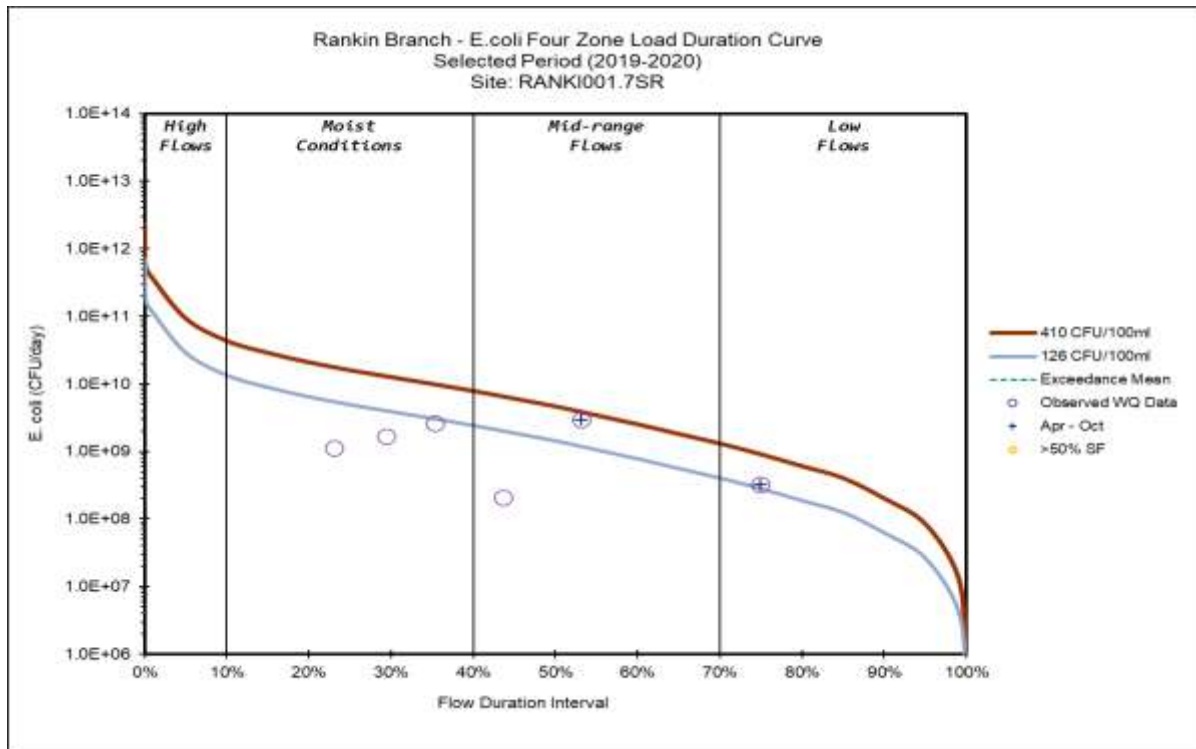


Figure F-5. *E. coli* Load Duration Curve for Rankin Branch – Station RANKI001.7SR, Most Recent Sampling Cycle

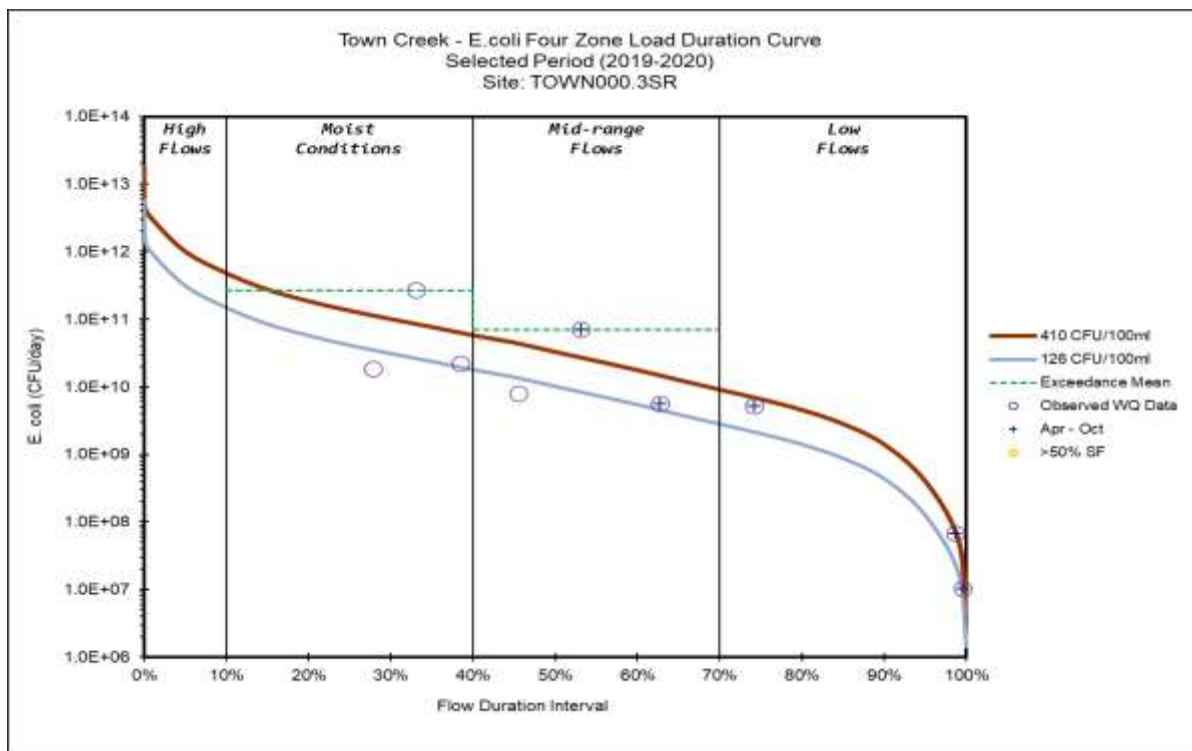


Figure F-6. *E. coli* Load Duration Curve for Town Creek – Station TOWN000.3SR, Most Recent Sampling Cycle

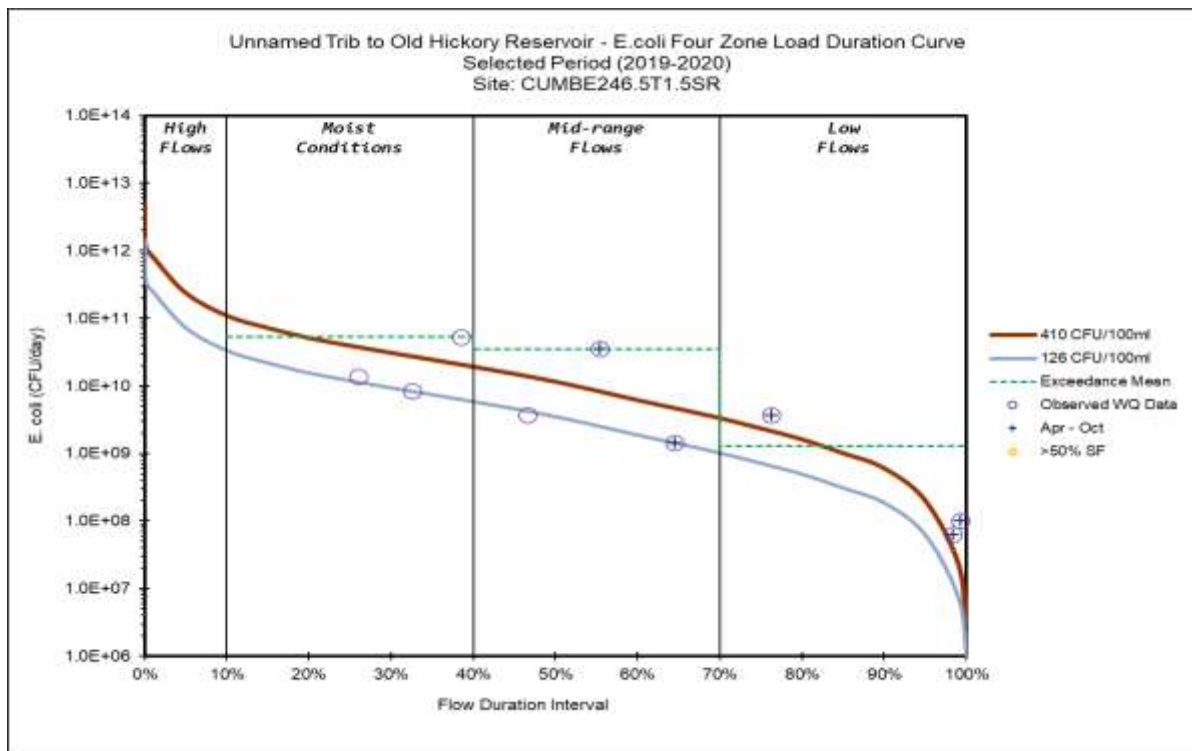


Figure F-7. *E. coli* Load Duration Curve for Unnamed Trib to Old Hickory Reservoir – Station CUMBE246.5T1.5SR, Most Recent Sampling Cycle

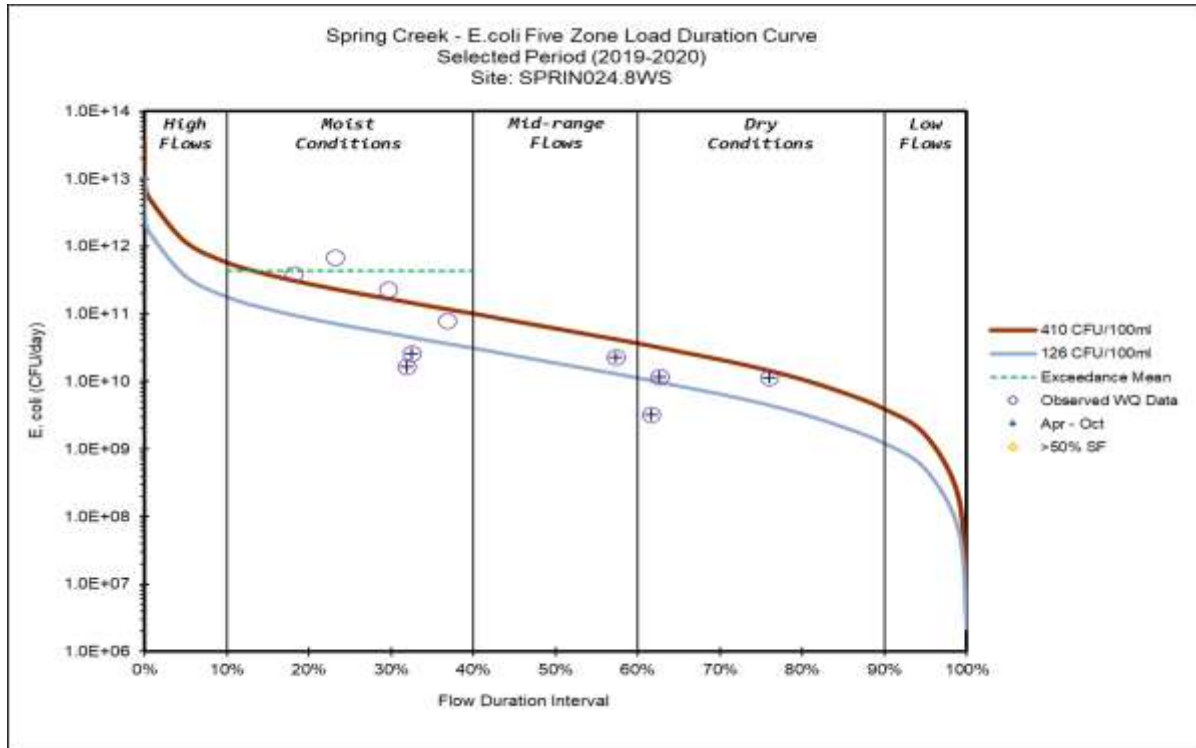


Figure F-8. *E. coli* Load Duration Curve for Spring Creek – Station SPRIN024.8WS, Most Recent Sampling Cycle

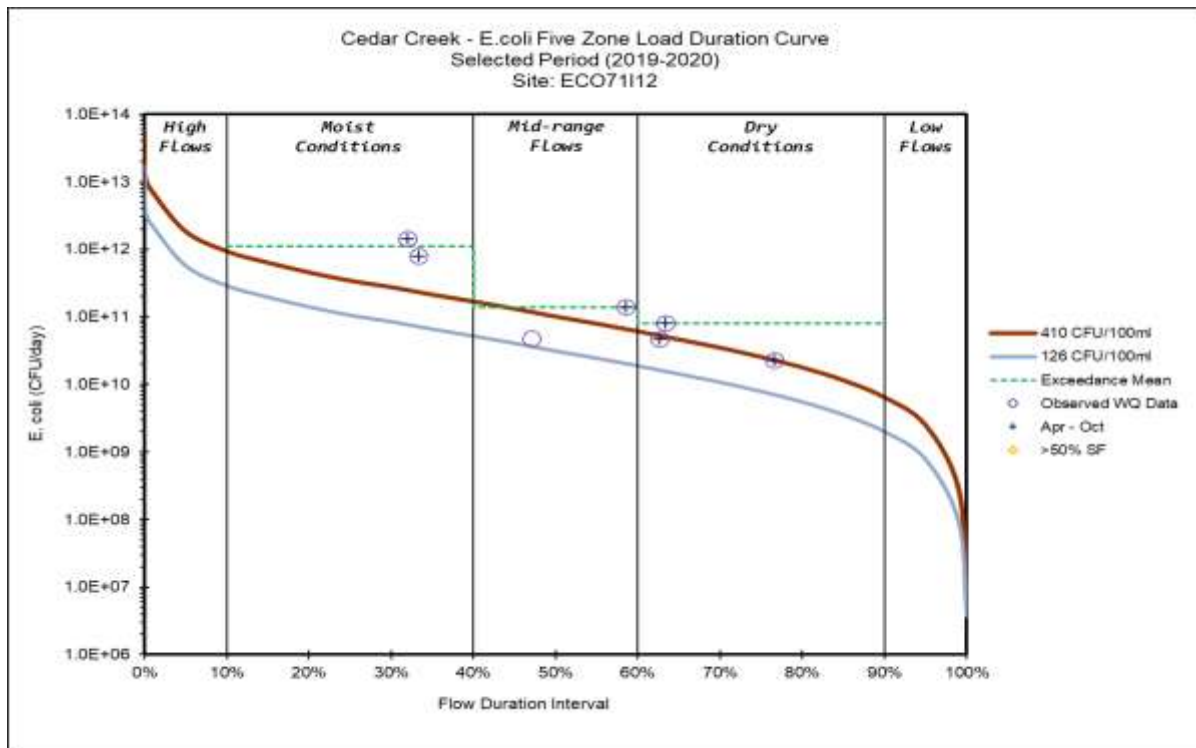


Figure F-9. *E. coli* Load Duration Curve for Cedar Creek – Station ECO71112, Most Recent Sampling Cycle

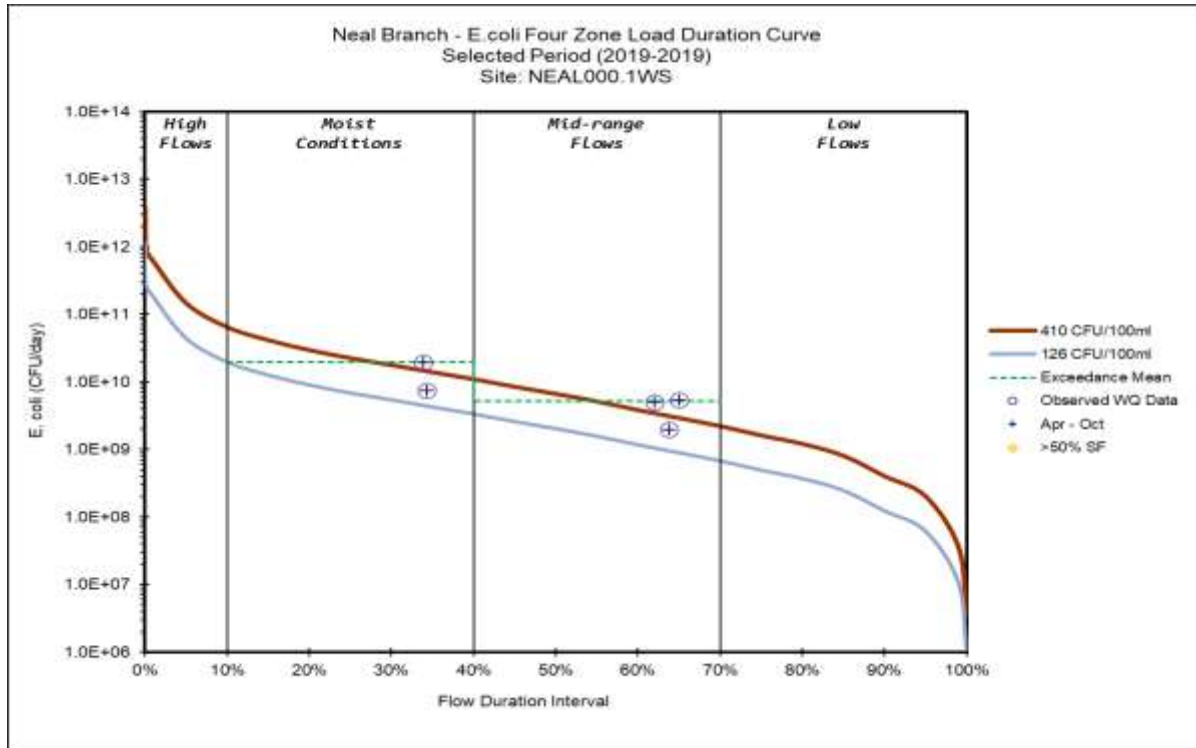


Figure F-10. *E. coli* Load Duration Curve for Neal Branch – Station NEAL000.1WS, Most Recent Sampling Cycle

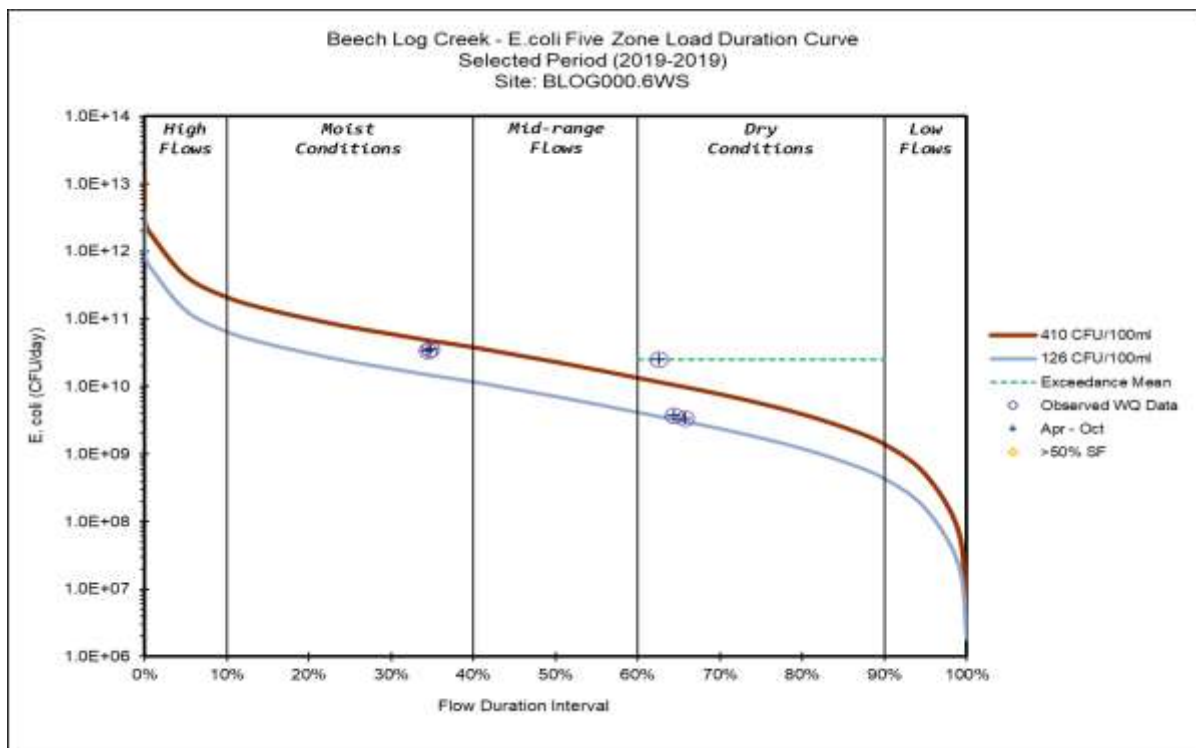


Figure F-11. *E. coli* Load Duration Curve for Beech Log Creek – Station BLOG000.6WS, Most Recent Sampling Cycle

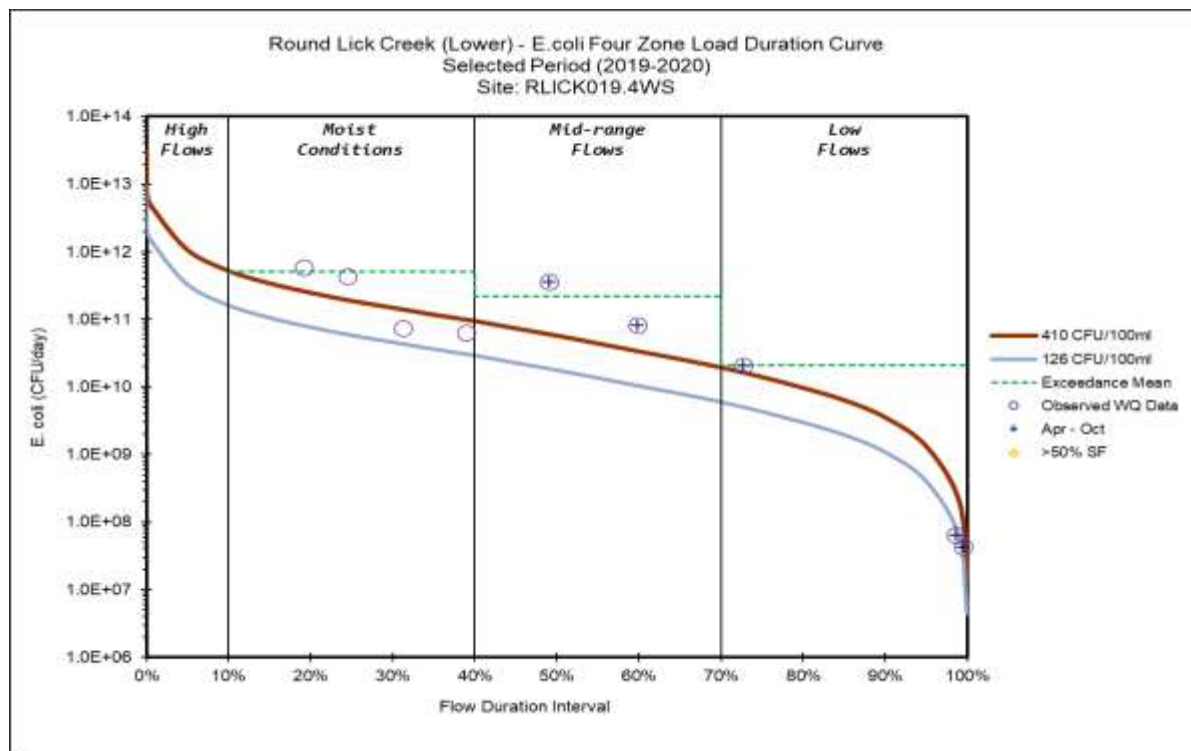


Figure F-12. *E. coli* Load Duration Curve for Round Lick Creek (Lower) – Station RLICK019.4WS, Most Recent Sampling Cycle

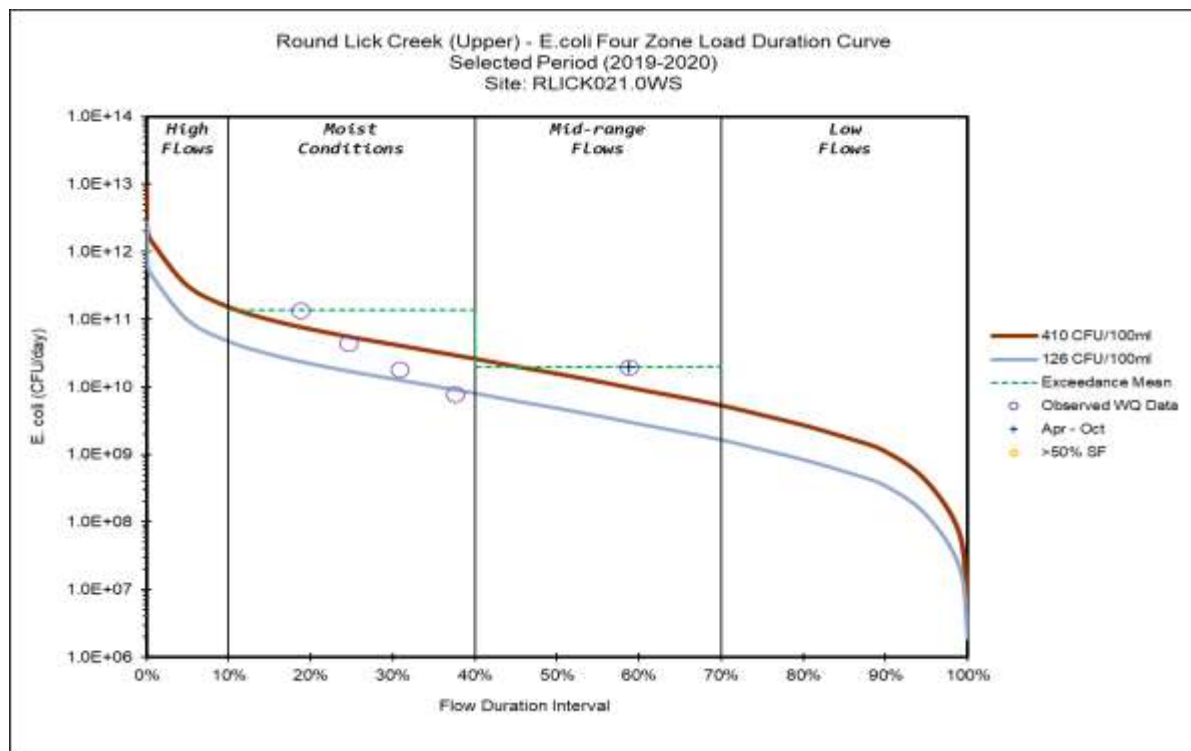


Figure F-13. *E. coli* Load Duration Curve for Round Lick Creek (Upper) – Station RLICK021.0WS, Most Recent Sampling Cycle

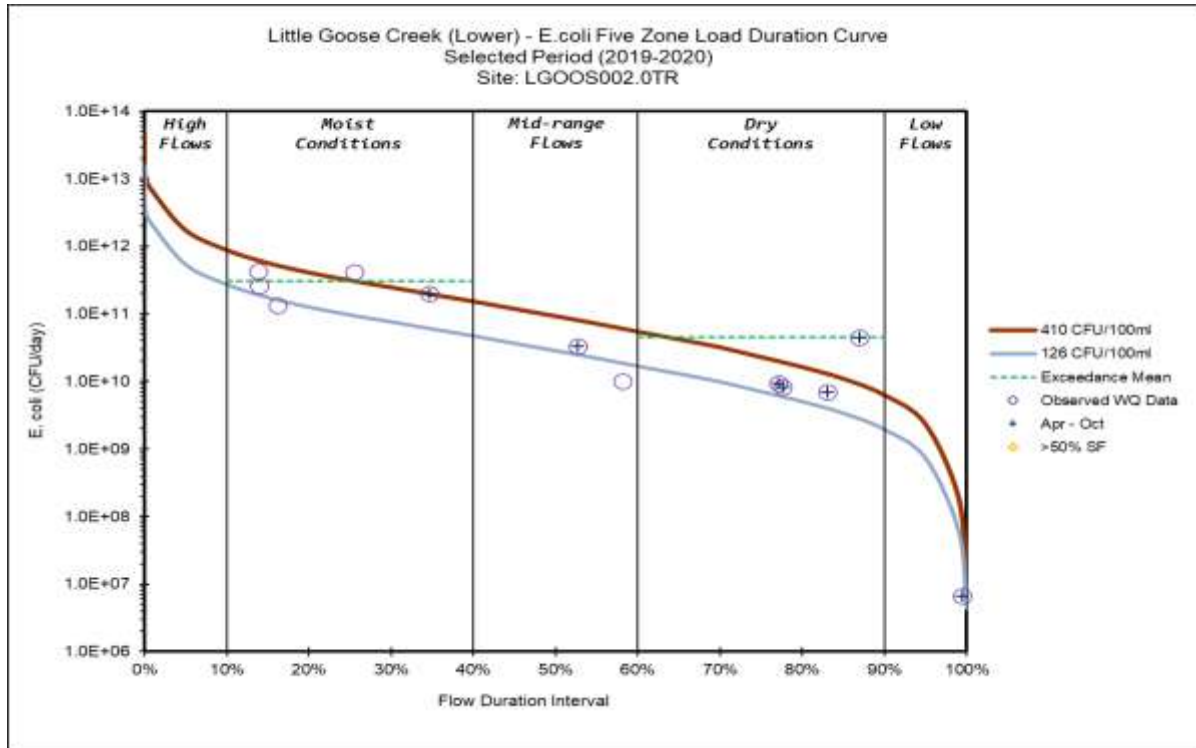


Figure F-14. *E. coli* Load Duration Curve for Little Goose Creek (Lower) – Station LGOOS002.0TR, Most Recent Sampling Cycle

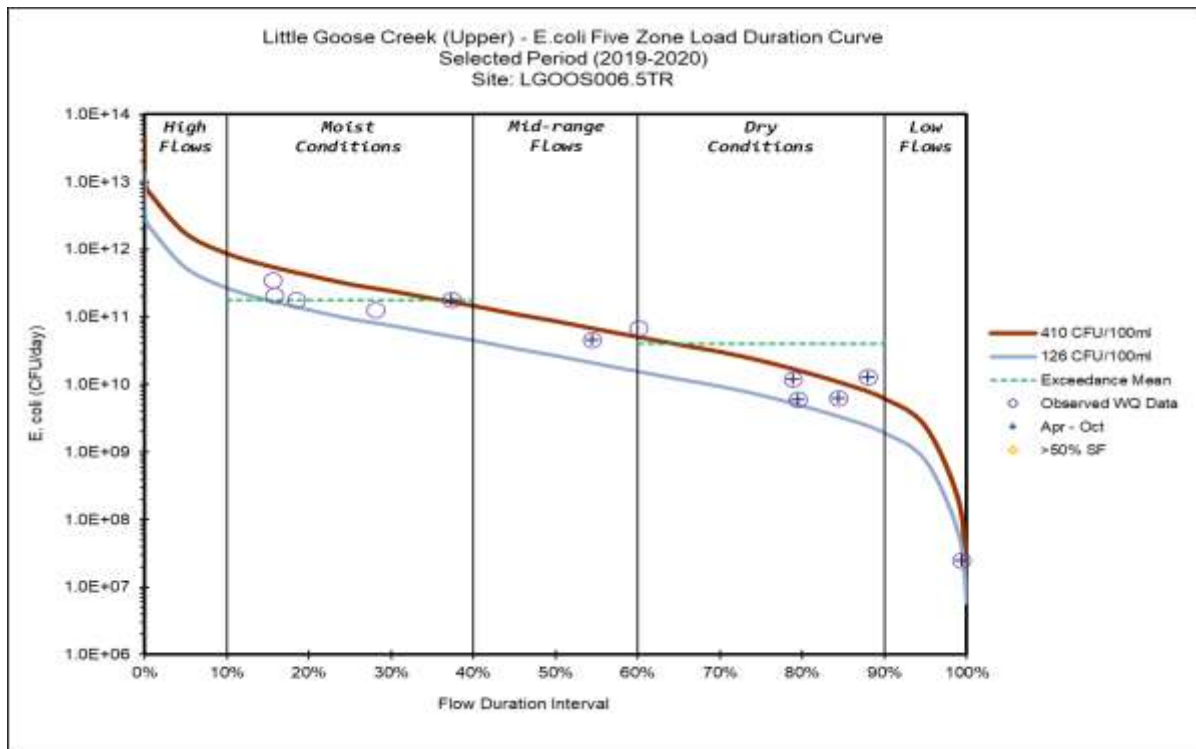


Figure F-15. *E. coli* Load Duration Curve for Little Goose Creek (Upper) – Station LGOOS006.5TR, Most Recent Sampling Cycle

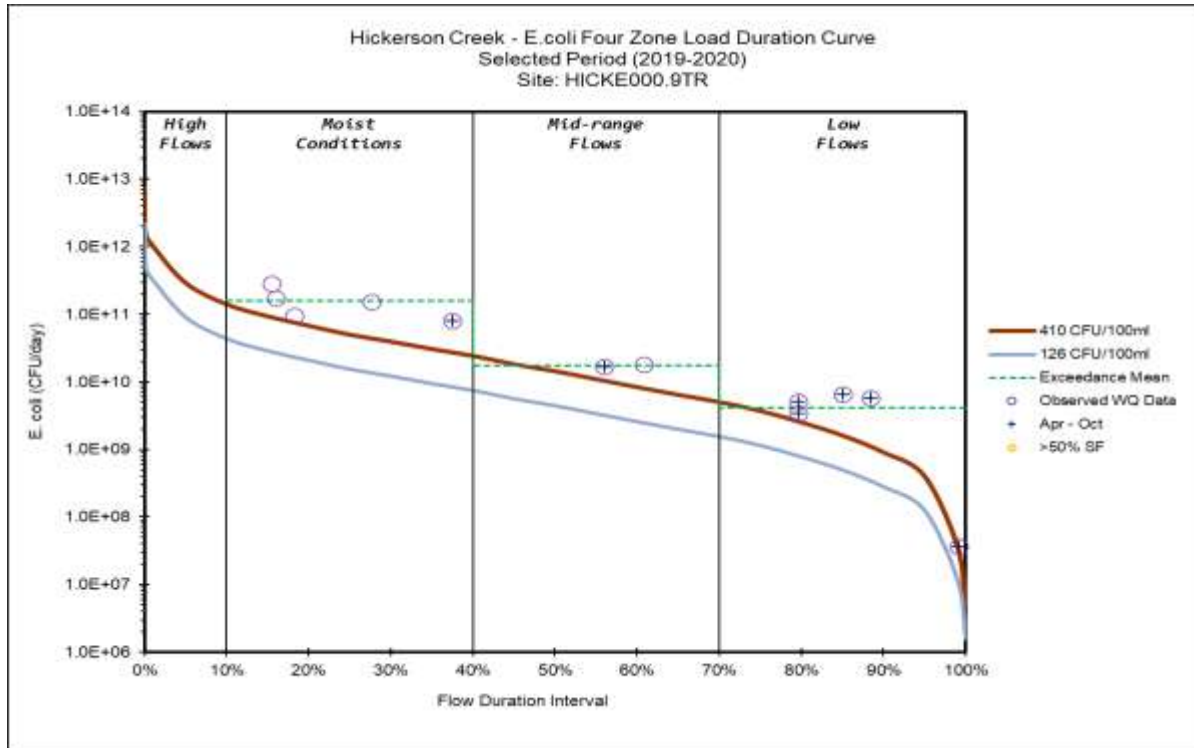


Figure F-16. *E. coli* Load Duration Curve for Hickerson Creek – Station HICKE000.9TR, Most Recent Sampling Cycle

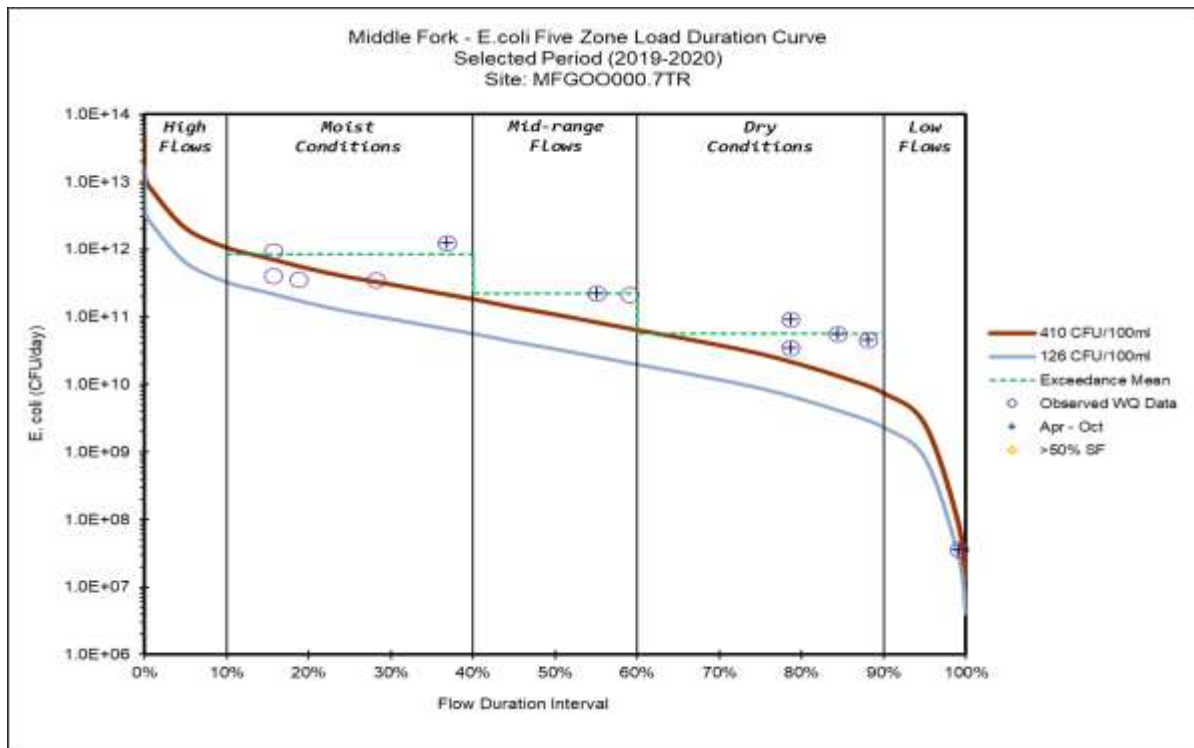


Figure F-17. *E. coli* Load Duration Curve for Middle Fork – Station MFGOO000.7TR, Most Recent Sampling Cycle

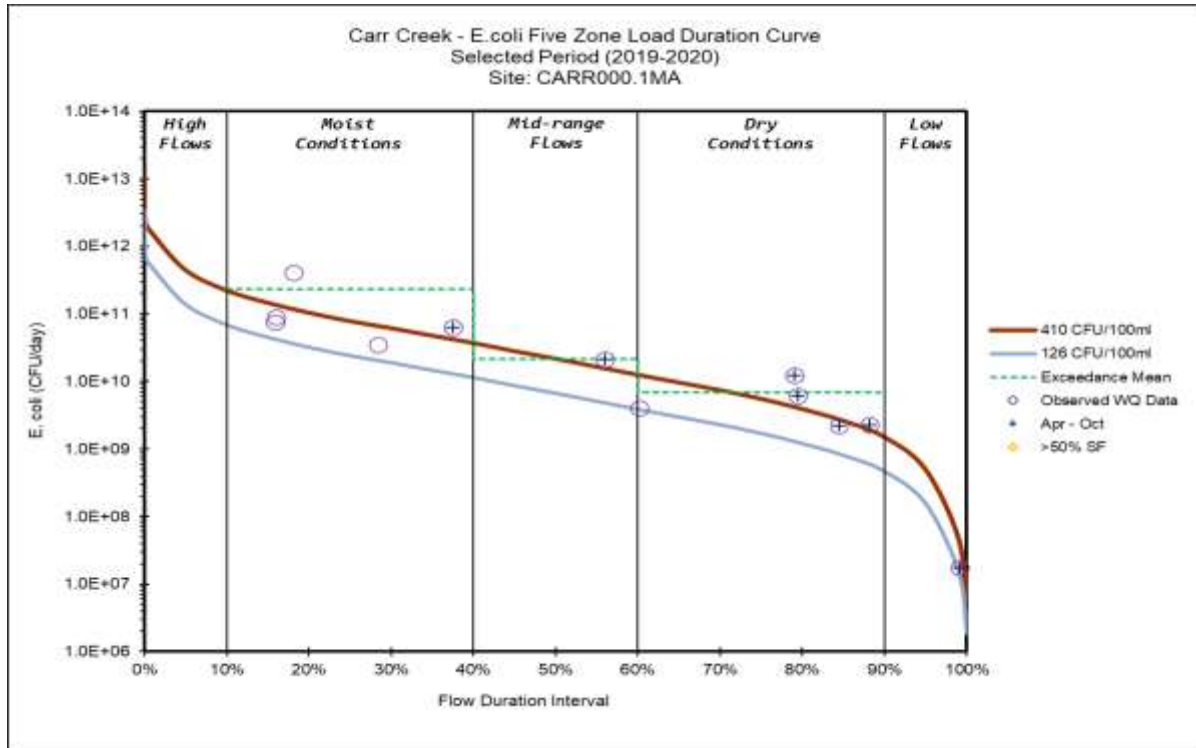


Figure F-18. *E. coli* Load Duration Curve for Carr Creek – Station CARR000.1MA, Most Recent Sampling Cycle

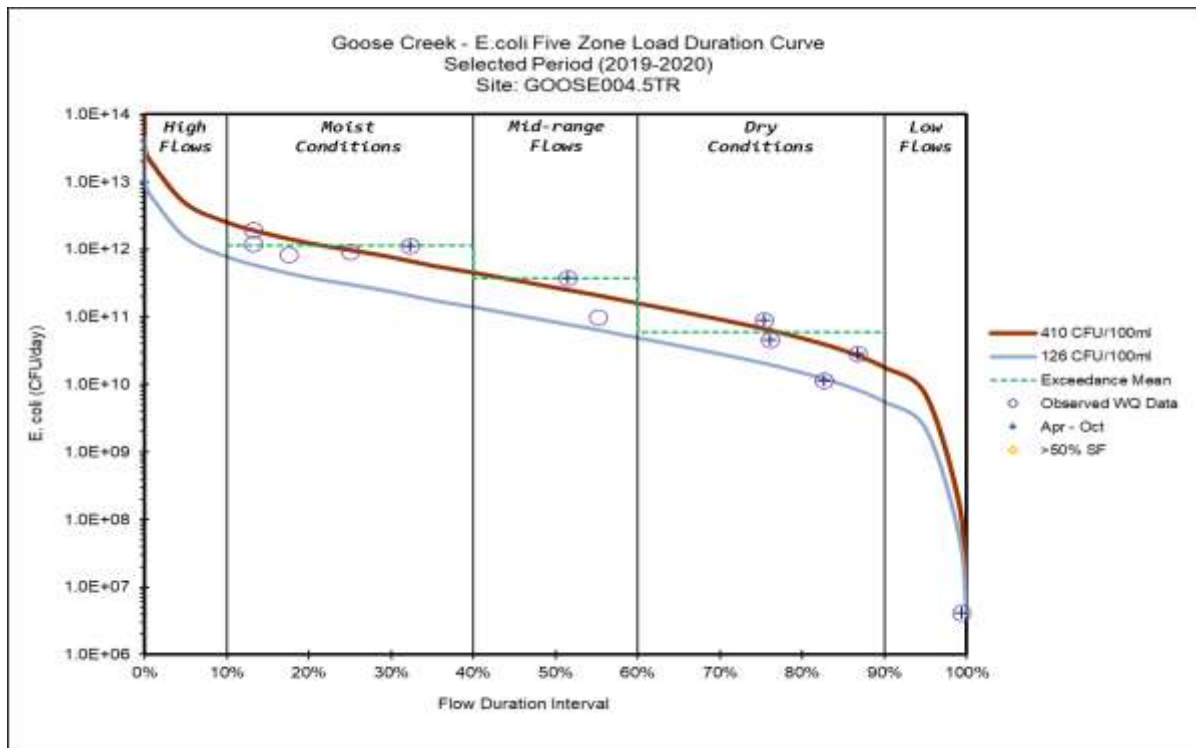


Figure F-19. *E. coli* Load Duration Curve for Goose Creek – Station GOOSE004.5TR, Most Recent Sampling Cycle

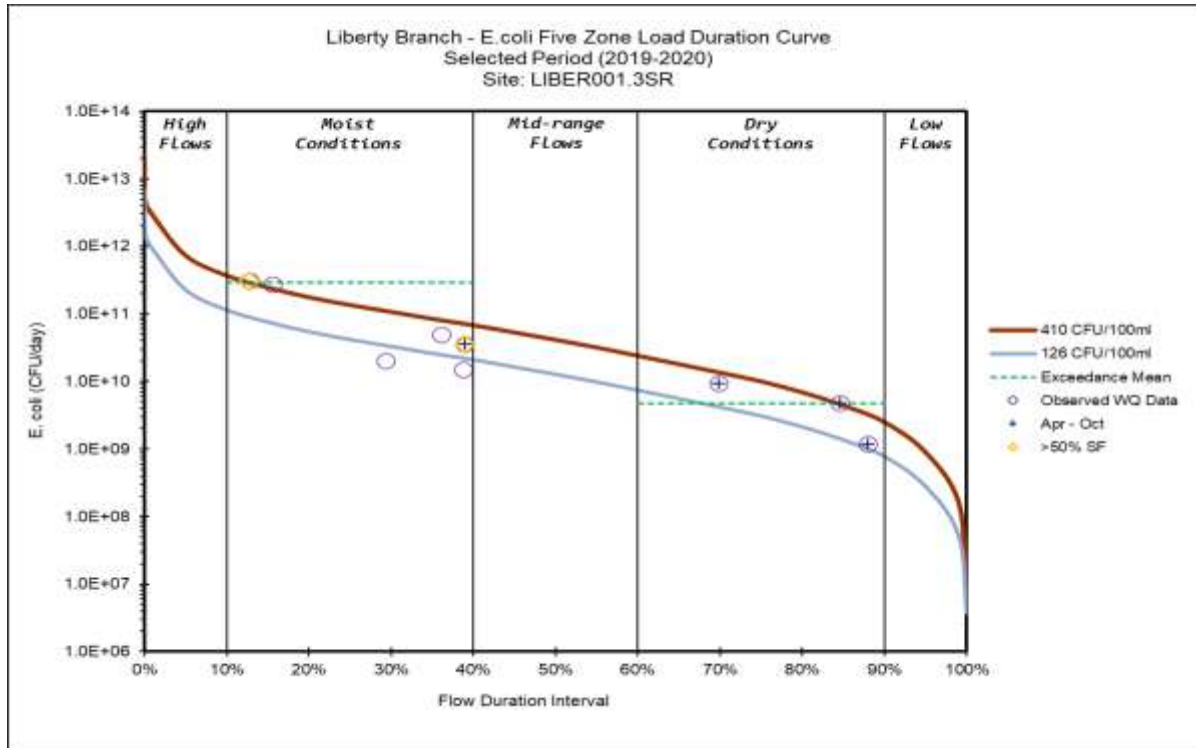


Figure F-20. *E. coli* Load Duration Curve for Liberty Branch – Station LIBER001.3SR, Most Recent Sampling Cycle

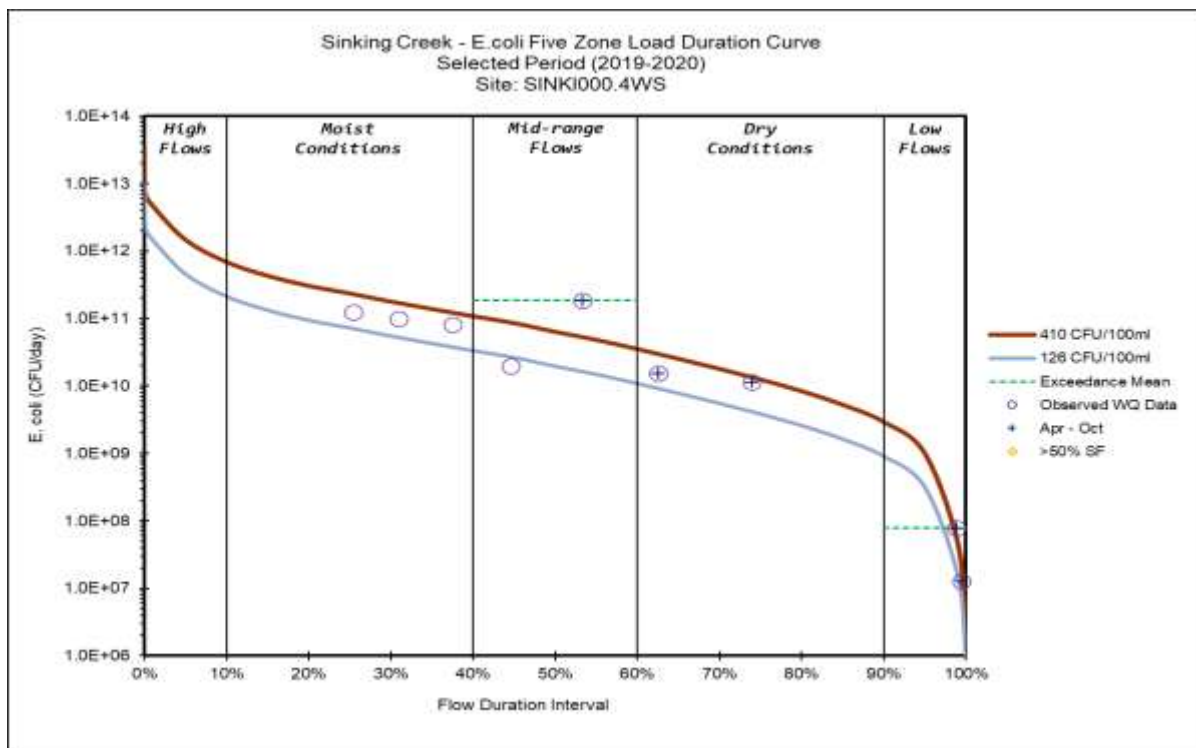


Figure F-21. *E. coli* Load Duration Curve for Sinking Creek – Station SINKI000.1WS, Most Recent Sampling Cycle

F.4 Calculated Load Reductions Based on Daily Loading for Impaired Waterbodies

The following tables present load reductions based on daily loading calculated for each impaired waterbody using *E. coli* sample data from the most recent sampling cycle referenced in the 2024 303(d) determinations (ref. Table 3).

Table F-7. Calculated Load Reduction Based on Daily Loading – Rankin Branch, Station RANKI001.7SR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/4/2019	1.75	23%	MOIST	26	1.11E+09	1.76E+10	1.58E+10	NR	NR
3/5/2020	1.29	29%	MOIST	53	1.67E+09	1.29E+10	1.16E+10	NR	NR
11/5/2019	0.99	35%	MOIST	108	2.62E+09	9.93E+09	8.94E+09	NR	NR
1/21/2020	0.66	44%	MID-RANGE	13	2.10E+08	6.62E+09	5.96E+09	NR	NR
10/8/2019	0.39	53%	MID-RANGE	308	2.94E+09	3.91E+09	3.52E+09	NR	NR
7/9/2019	0.10	75%	LOW	133	3.25E+08	1.00E+09	9.03E+08	NR	NR

Table F-8. Calculated Load Reduction Based on Daily Loading – Town Creek, Station TOWN000.3SR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/4/2019	11.32	28%	MOIST	66	1.83E+10	1.14E+11	1.02E+11	NR	NR
3/5/2020	8.48	33%	MOIST	1300	2.70E+11	8.51E+10	7.66E+10	68%	72%
11/5/2019	6.32	39%	MOIST	142	2.20E+10	6.34E+10	5.71E+10	NR	NR
1/21/2020	4.33	46%	MID-RANGE	75	7.95E+09	4.34E+10	3.91E+10	NR	NR
10/8/2019	2.73	53%	MID-RANGE	1046	6.99E+10	2.74E+10	2.46E+10	61%	65%
6/24/2020	1.47	63%	DRY	158	5.68E+09	1.47E+10	1.33E+10	NR	NR
7/9/2019	0.69	74%	LOW	313	5.28E+09	6.92E+09	6.23E+09	NR	NR
9/17/2019	0.01	99%	LOW	326	6.78E+07	8.53E+07	7.67E+07	NR	NR
9/24/2019	0.00	100%	LOW	152	1.04E+07	2.81E+07	2.53E+07	NR	NR

Table F-9. Calculated Load Reduction Based on Daily Loading – Unnamed Trib to Old Hickory Reservoir to Old Hickory Reservoir, Station CUMBE246.5T1.5SR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/4/2019	3.66	26%	MOIST	152	1.36E+10	3.67E+10	3.30E+10	NR	NR
3/5/2020	2.70	33%	MOIST	127	8.39E+09	2.71E+10	2.44E+10	NR	NR
11/5/2019	2.07	39%	MOIST	1046	5.30E+10	2.08E+10	1.87E+10	61%	65%
1/21/2020	1.39	47%	MID-RANGE	108	3.67E+09	1.39E+10	1.25E+10	NR	NR
10/8/2019	0.83	55%	MID-RANGE	1733	3.52E+10	8.33E+09	7.49E+09	76%	79%
6/24/2020	0.47	65%	DRY	124	1.43E+09	4.71E+09	4.24E+09	NR	NR
7/9/2019	0.22	76%	LOW	687	3.70E+09	2.21E+09	1.99E+09	40%	46%
9/17/2019	0.01	98%	LOW	517	6.32E+07	5.02E+07	4.51E+07	21%	29%
9/24/2019	0.00	99%	LOW	2420	1.01E+08	1.71E+07	1.53E+07	83%	85%

Table F-10. Calculated Load Reduction Based on Daily Loading – Spring Creek, Station SPRIN024.8WS, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/4/2019	31.33	18%	MOIST	501	3.84E+11	3.14E+11	2.83E+11	18%	26%
3/5/2020	23.38	23%	MOIST	1203	6.88E+11	2.35E+11	2.11E+11	66%	69%
11/5/2019	16.98	30%	MOIST	548	2.28E+11	1.70E+11	1.53E+11	25%	33%
8/8/2019	14.84	32%	MOIST	46	1.67E+10	1.49E+11	1.34E+11	NR	NR
8/15/2019	14.42	33%	MOIST	74	2.61E+10	1.45E+11	1.30E+11	NR	NR
1/21/2020	11.90	37%	MOIST	272	7.92E+10	1.19E+11	1.07E+11	NR	NR
6/24/2020	4.22	57%	MID-RANGE	219	2.26E+10	4.23E+10	3.81E+10	NR	NR
8/19/2019	3.38	62%	DRY	39	3.23E+09	3.39E+10	3.05E+10	NR	NR
8/12/2019	3.18	63%	DRY	150	1.17E+10	3.19E+10	2.87E+10	NR	NR
8/22/2019	1.44	76%	DRY	326	1.15E+10	1.44E+10	1.30E+10	NR	NR

Table F-11. Calculated Load Reduction Based on Daily Loading – Cedar Creek, Station ECO71112, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
8/8/2019	24.33	32%	MOIST	2420	1.44E+12	2.44E+11	2.20E+11	83%	85%
8/15/2019	23.05	33%	MOIST	1414	7.97E+11	2.31E+11	2.08E+11	71%	74%
1/30/2020	11.79	47%	MID-RANGE	166	4.79E+10	1.18E+11	1.06E+11	NR	NR
10/10/2019	6.52	59%	MID-RANGE	866	1.38E+11	6.54E+10	5.89E+10	53%	57%
8/19/2019	5.26	63%	DRY	365	4.70E+10	5.28E+10	4.75E+10	NR	NR
8/12/2019	5.03	63%	DRY	649	7.99E+10	5.05E+10	4.54E+10	37%	43%
8/22/2019	2.27	77%	DRY	411	2.28E+10	2.28E+10	2.05E+10	0%	10%

Table F-12. Calculated Load Reduction Based on Daily Loading – Neal Branch, Station NEAL000.1WS, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
8/15/2019	1.46	34%	MOIST	548	1.96E+10	1.46E+10	1.32E+10	25%	33%
8/8/2019	1.43	34%	MOIST	210	7.35E+09	1.43E+10	1.29E+10	NR	NR
8/29/2019	0.35	62%	MID-RANGE	579	4.96E+09	3.51E+09	3.16E+09	29%	36%
8/19/2019	0.32	64%	MID-RANGE	249	1.95E+09	3.21E+09	2.89E+09	NR	NR
8/12/2019	0.30	65%	MID-RANGE	727	5.34E+09	3.01E+09	2.71E+09	44%	49%

Table F-13. Calculated Load Reduction Based on Daily Loading – Beech Log Creek, Station BLOG000.6WS, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
8/15/2019	4.86	35%	MOIST	285	3.39E+10	4.88E+10	4.39E+10	NR	NR
8/8/2019	4.78	35%	MOIST	308	3.60E+10	4.79E+10	4.32E+10	NR	NR
8/29/2019	1.18	63%	DRY	866	2.50E+10	1.18E+10	1.07E+10	53%	57%
8/19/2019	1.06	64%	DRY	144	3.73E+09	1.06E+10	9.57E+09	NR	NR
8/12/2019	0.99	66%	DRY	140	3.39E+09	9.93E+09	8.94E+09	NR	NR

Table F-14. Calculated Load Reduction Based on Daily Loading – Round Lick Creek (Lower), Station RLICK019.4WS, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/4/2019	26.05	19%	MOIST	921	5.87E+11	2.61E+11	2.35E+11	55%	60%
3/5/2020	19.15	25%	MOIST	914	4.28E+11	1.92E+11	1.73E+11	55%	60%
11/5/2019	14.05	31%	MOIST	214	7.36E+10	1.41E+11	1.27E+11	NR	NR
1/21/2020	10.00	39%	MOIST	259	6.34E+10	1.00E+11	9.03E+10	NR	NR
10/8/2019	6.00	49%	MID-RANGE	2420	3.55E+11	6.02E+10	5.42E+10	83%	85%
6/24/2020	3.37	60%	MID-RANGE	980	8.08E+10	3.38E+10	3.04E+10	58%	62%
7/9/2019	1.64	73%	LOW	517	2.07E+10	1.65E+10	1.48E+10	21%	29%
9/17/2019	0.03	99%	LOW	88	6.46E+07	3.01E+08	2.71E+08	NR	NR
9/24/2019	0.01	100%	LOW	206	4.23E+07	8.43E+07	7.58E+07	NR	NR

Table F-15. Calculated Load Reduction Based on Daily Loading – Round Lick Creek (Upper), Station RLICK021.0WS, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/4/2019	7.60	19%	MOIST	727	1.35E+11	7.62E+10	6.86E+10	44%	49%
3/5/2020	5.53	25%	MOIST	326	4.41E+10	5.55E+10	4.99E+10	NR	NR
11/5/2019	4.07	31%	MOIST	179	1.78E+10	4.08E+10	3.67E+10	NR	NR
1/21/2020	2.94	38%	MOIST	108	7.77E+09	2.95E+10	2.65E+10	NR	NR
6/24/2020	0.98	59%	MID-RANGE	816	1.96E+10	9.83E+09	8.85E+09	50%	55%

Table F-16. Calculated Load Reduction Based on Daily Loading – Little Goose Creek (Lower), Station LGOOS002.0TR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/3/2019	62.67	14%	MOIST	276	4.23E+11	6.29E+11	5.66E+11	NR	NR
1/6/2020	62.08	14%	MOIST	172	2.61E+11	6.23E+11	5.60E+11	NR	NR
2/20/2020	52.67	16%	MOIST	102	1.31E+11	5.28E+11	4.76E+11	NR	NR
11/4/2019	30.81	26%	MOIST	548	4.13E+11	3.09E+11	2.78E+11	25%	33%
7/1/2019	19.82	35%	MOIST	411	1.99E+11	1.99E+11	1.79E+11	0%	10%
5/7/2020	8.08	53%	MID-RANGE	167	3.30E+10	8.11E+10	7.29E+10	NR	NR
3/12/2020	6.06	58%	MID-RANGE	67	9.93E+09	6.08E+10	5.47E+10	NR	NR
6/2/2020	2.01	77%	DRY	190	9.34E+09	2.02E+10	1.81E+10	NR	NR
4/7/2020	1.95	78%	DRY	172	8.21E+09	1.96E+10	1.76E+10	NR	NR
9/3/2019	1.32	83%	DRY	214	6.91E+09	1.32E+10	1.19E+10	NR	NR
6/10/2020	0.92	87%	DRY	1986	4.47E+10	9.23E+09	8.31E+09	79%	81%
9/23/2019	0.01	100%	LOW	27	6.61E+06	1.00E+08	9.03E+07	NR	NR

Table F-17. Calculated Load Reduction Based on Daily Loading – Little Goose Creek (Upper), Station LGOOS006.5TR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/3/2019	54.55	16%	MOIST	261	3.48E+11	5.47E+11	4.92E+11	NR	NR
1/6/2020	53.77	16%	MOIST	157	2.07E+11	5.39E+11	4.85E+11	NR	NR
2/20/2020	45.74	19%	MOIST	158	1.77E+11	4.59E+11	4.13E+11	NR	NR
11/4/2019	26.25	28%	MOIST	199	1.28E+11	2.63E+11	2.37E+11	NR	NR
7/1/2019	16.67	37%	MOIST	435	1.77E+11	1.67E+11	1.50E+11	6%	15%
5/7/2020	6.74	55%	MID-RANGE	276	4.55E+10	6.76E+10	6.08E+10	NR	NR
3/12/2020	5.02	60%	DRY	548	6.73E+10	5.04E+10	4.53E+10	25%	33%
6/2/2020	1.71	79%	DRY	285	1.19E+10	1.72E+10	1.54E+10	NR	NR
4/7/2020	1.64	80%	DRY	148	5.94E+09	1.65E+10	1.48E+10	NR	NR
9/3/2019	1.10	84%	DRY	236	6.35E+09	1.10E+10	9.93E+09	NR	NR
6/10/2020	0.77	88%	DRY	687	1.29E+10	7.72E+09	6.95E+09	40%	46%
9/23/2019	0.01	99%	LOW	102	2.50E+07	1.00E+08	9.03E+07	NR	NR

Table F-18. Calculated Load Reduction Based on Daily Loading – Hickerson Creek, Station HICKE000.9TR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/3/2019	8.92	16%	MOIST	1300	2.84E+11	8.95E+10	8.05E+10	68%	72%
1/6/2020	8.69	16%	MOIST	816	1.73E+11	8.72E+10	7.85E+10	50%	55%
2/20/2020	7.58	18%	MOIST	517	9.59E+10	7.60E+10	6.84E+10	21%	29%
11/4/2019	4.41	28%	MOIST	1414	1.53E+11	4.42E+10	3.98E+10	71%	74%
7/1/2019	2.69	38%	MOIST	1203	7.92E+10	2.70E+10	2.43E+10	66%	69%
5/7/2020	1.05	56%	MID-RANGE	649	1.67E+10	1.05E+10	9.48E+09	37%	43%
3/12/2020	0.80	61%	LOW	921	1.80E+10	8.02E+09	7.22E+09	55%	60%
4/7/2020	0.27	80%	LOW	770	5.09E+09	2.71E+09	2.44E+09	47%	52%
6/2/2020	0.27	80%	LOW	517	3.42E+09	2.71E+09	2.44E+09	21%	29%
9/3/2019	0.17	85%	LOW	1553	6.46E+09	1.71E+09	1.53E+09	74%	76%
6/10/2020	0.12	88%	LOW	1986	5.83E+09	1.20E+09	1.08E+09	79%	81%
9/23/2019	0.00	99%	LOW	461	3.61E+07	3.21E+07	2.89E+07	11%	20%

Table F-19. Calculated Load Reduction Based on Daily Loading – Middle Fork, Station MFGOO000.7TR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/3/2019	69.65	16%	MOIST	548	9.34E+11	6.99E+11	6.29E+11	25%	33%
1/6/2020	69.61	16%	MOIST	238	4.05E+11	6.98E+11	6.28E+11	NR	NR
2/20/2020	55.99	19%	MOIST	261	3.58E+11	5.62E+11	5.05E+11	NR	NR
11/4/2019	32.67	28%	MOIST	435	3.48E+11	3.28E+11	2.95E+11	6%	15%
7/1/2019	21.10	37%	MOIST	2420	1.25E+12	2.12E+11	1.90E+11	83%	85%
5/7/2020	8.23	55%	MID-RANGE	1120	2.26E+11	8.26E+10	7.43E+10	63%	67%
3/12/2020	6.66	59%	MID-RANGE	1300	2.12E+11	6.68E+10	6.01E+10	68%	72%
4/7/2020	2.17	79%	DRY	649	3.45E+10	2.18E+10	1.96E+10	37%	43%
6/2/2020	2.15	79%	DRY	1733	9.12E+10	2.16E+10	1.94E+10	76%	79%
9/3/2019	1.33	84%	DRY	1733	5.64E+10	1.33E+10	1.20E+10	76%	79%
6/10/2020	0.93	88%	DRY	1986	4.52E+10	9.33E+09	8.40E+09	79%	81%
9/23/2019	0.01	99%	LOW	147	3.60E+07	1.00E+08	9.03E+07	NR	NR

Table F-20. Calculated Load Reduction Based on Daily Loading – Carr Creek, Station CARR000.1MA, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
1/6/2020	13.56	16%	MOIST	225	7.46E+10	1.36E+11	1.22E+11	NR	NR
12/3/2019	13.49	16%	MOIST	272	8.98E+10	1.35E+11	1.22E+11	NR	NR
2/20/2020	11.67	18%	MOIST	1414	4.04E+11	1.17E+11	1.05E+11	71%	74%
11/4/2019	6.60	28%	MOIST	214	3.46E+10	6.62E+10	5.96E+10	NR	NR
7/1/2019	4.19	38%	MOIST	613	6.28E+10	4.20E+10	3.78E+10	33%	40%
5/7/2020	1.59	56%	MID-RANGE	548	2.13E+10	1.59E+10	1.44E+10	25%	33%
3/12/2020	1.24	60%	DRY	131	3.97E+09	1.24E+10	1.12E+10	NR	NR
6/2/2020	0.42	79%	DRY	1203	1.24E+10	4.21E+09	3.79E+09	66%	69%
4/7/2020	0.41	80%	DRY	613	6.15E+09	4.11E+09	3.70E+09	33%	40%
9/3/2019	0.28	85%	DRY	326	2.23E+09	2.81E+09	2.53E+09	NR	NR
6/10/2020	0.19	88%	DRY	488	2.27E+09	1.91E+09	1.72E+09	16%	24%
9/23/2019	0.00	99%	LOW	173	1.74E+07	4.11E+07	3.70E+07	NR	NR

Table F-21. Calculated Load Reduction Based on Daily Loading – Goose Creek, Station GOOSE004.5TR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/3/2019	192.23	13%	MOIST	411	1.93E+12	1.93E+12	1.74E+12	0%	10%
1/6/2020	191.69	13%	MOIST	260	1.22E+12	1.92E+12	1.73E+12	NR	NR
2/20/2020	145.05	18%	MOIST	236	8.38E+11	1.45E+12	1.31E+12	NR	NR
11/4/2019	97.87	25%	MOIST	387	9.27E+11	9.82E+11	8.84E+11	NR	5%
7/1/2019	66.82	32%	MOIST	687	1.12E+12	6.70E+11	6.03E+11	40%	46%
5/7/2020	24.98	52%	MID-RANGE	613	3.75E+11	2.51E+11	2.26E+11	33%	40%
3/12/2020	20.75	55%	MID-RANGE	192	9.75E+10	2.08E+11	1.87E+11	NR	NR
4/7/2020	6.69	75%	DRY	548	8.97E+10	6.71E+10	6.04E+10	25%	33%
6/2/2020	6.39	76%	DRY	291	4.55E+10	6.41E+10	5.77E+10	NR	NR
9/3/2019	4.00	83%	DRY	115	1.13E+10	4.01E+10	3.61E+10	NR	NR
6/10/2020	2.70	87%	DRY	435	2.87E+10	2.71E+10	2.44E+10	6%	15%
9/23/2019	0.01	99%	LOW	19	4.18E+06	9.03E+07	8.13E+07	NR	NR

Table F-22. Calculated Load Reduction Based on Daily Loading – Liberty Branch, Station LIBER001.3SR, Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION to ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
11/7/2019	28.82	13%	MOIST	435	3.07E+11	2.89E+11	2.60E+11	6%	15%
12/19/2019	23.98	16%	MOIST	461	2.70E+11	2.41E+11	2.16E+11	11%	20%
2/27/2020	10.98	29%	MOIST	75	2.01E+10	1.10E+11	9.91E+10	NR	NR
11/6/2019	8.07	36%	MOIST	249	4.92E+10	8.10E+10	7.29E+10	NR	NR
1/21/2020	7.28	39%	MOIST	83	1.48E+10	7.30E+10	6.57E+10	NR	NR
7/30/2019	7.17	39%	MOIST	201	3.53E+10	7.19E+10	6.47E+10	NR	NR
8/20/2019	1.38	70%	DRY	276	9.32E+09	1.38E+10	1.25E+10	NR	NR
6/9/2020	0.47	85%	DRY	411	4.73E+09	4.71E+09	4.24E+09	0%	10%
9/5/2019	0.32	88%	DRY	153	1.20E+09	3.21E+09	2.89E+09	NR	NR

Table F-23. Calculated Load Reduction Based on Daily Loading – Sinking Creek, Station SINKI000.4WS & SINKI000.1WS (ref. Table B-2, Note d), Most Recent Sampling Cycle

DATE	FLOW [cfs]	FLOW RANK (PDFE)	FLOW ZONE	SAMPLE CONC. [CFU/100mL]	CURRENT LOAD [CFU/day]	TARGET LOAD [CFU/day]	TARGET LOAD - MOS [CFU/day]	% REDUCTION TO ACHIEVE TMDL	% REDUCTION TO ACHIEVE TMDL - MOS
12/4/2019	22.94	25%	MOIST	219	1.23E+11	2.30E+11	2.07E+11	NR	NR
3/5/2020	16.83	31%	MOIST	238	9.80E+10	1.69E+11	1.52E+11	NR	NR
11/5/2019	12.15	38%	MOIST	272	8.09E+10	1.22E+11	1.10E+11	NR	NR
1/21/2020	8.67	45%	MID-RANGE	93	1.97E+10	8.70E+10	7.83E+10	NR	NR
10/8/2019	5.32	53%	MID-RANGE	1414	1.84E+11	5.34E+10	4.80E+10	71%	74%
6/24/2020	2.97	63%	DRY	211	1.53E+10	2.98E+10	2.68E+10	NR	NR
7/9/2019	1.35	74%	DRY	344	1.14E+10	1.35E+10	1.22E+10	NR	NR
9/17/2019	0.01	99%	LOW	517	7.84E+07	6.22E+07	5.60E+07	21%	29%
9/24/2019	0.00	100%	LOW	285	1.26E+07	1.81E+07	1.63E+07	NR	NR

F.5 Summary of TMDLs, WLAs, & LAs by Flow Regime

The following table presents a summary of PLRGs, TMDLs, WLAs, & LAs by flow regime calculated for each impaired waterbody using *E. coli* sample data from the most recent sampling cycle referenced in the 2024 303(d) determinations (ref. Table 3). Flow zone groupings for each waterbody vary between five-zone and four-zone depending on the criteria check described in Section 9.1.1 above.

Table F-24. Summary of TMDLs, WLAs, & LAs by Flow Regime for Most Recent Sampling Cycle

Waterbody Description ^a	Flow Zone	PDFE Range [%]	Flow Range [cfs]	Flow ^b [cfs]	PLRG ^c [%]	TMDL [CFU/d]	MOS [CFU/d]	WWTPs ^d [CFU/d]	MS4s ^{e,f,h} [CFU/d/acre _{MS4}]	LA ^{e,h} [CFU/d/acre _{LA}]
Rankin Branch^g TN05130201001T_0100 HUC-12: 0502 Station: RANKI001.7SR Station DA: 717 acres	HIGH	0-10	226.7 - 4.3	9.2	NR	9.23E+10	9.23E+09	1.00E+10 x qm	(1.16E+08) - (1.40E+07 x q _d)	(1.16E+08) - (1.40E+07 x q _d)
	MOIST	10-40	4.3 - 0.8	1.6	NR	1.60E+10	1.60E+09		(2.01E+07) - (1.40E+07 x q _d)	(2.01E+07) - (1.40E+07 x q _d)
	MID-RANGE	40-70	0.8 - 0.1	0.3	NR	3.01E+09	3.01E+08		(3.78E+06) - (1.40E+07 x q _d)	(3.78E+06) - (1.40E+07 x q _d)
	LOW	70-100	0.1 - 0.0	0.04	NR	4.01E+08	4.01E+07		(5.04E+05) - (1.40E+07 x q _m)	(5.04E+05) - (1.40E+07 x q _m)
Town Creek TN05130201001T_0200 HUC-12: 0501 Station: TOWN000.3SR Station DA: 5887 acres	HIGH	0-10	1851.7 - 47.6	99.7	NR	1.00E+12	1.00E+11	1.00E+10 x qm	(1.53E+08) - (1.70E+06 x q _d)	(1.53E+08) - (1.70E+06 x q _d)
	MOIST	10-40	47.6 - 5.7	13.2	68%	1.32E+11	1.32E+10		(2.02E+07) - (1.70E+06 x q _d)	(2.02E+07) - (1.70E+06 x q _d)
	MID-RANGE	40-70	5.7 - 0.9	2.4	61%	2.41E+10	2.41E+09		(3.68E+06) - (1.70E+06 x q _d)	(3.68E+06) - (1.70E+06 x q _d)
	LOW	70-100	0.9 - 0.0	0.3	NR	3.01E+09	3.01E+08		(4.60E+05) - (1.70E+06 x q _m)	(4.60E+05) - (1.70E+06 x q _m)
Unnamed Trib to Old Hickory Reservoir TN05130201001T_0400 HUC-12: 0604 Station: CUMBE246.5T1.5SR Station DA: 1540 acres	HIGH	0-10	484.5 - 10.8	23.4	NR	2.35E+11	2.35E+10	1.00E+10 x qm	(1.37E+08) - (6.51E+06 x q _d)	(1.37E+08) - (6.51E+06 x q _d)
	MOIST	10-40	10.8 - 1.9	3.9	61%	3.91E+10	3.91E+09		(2.29E+07) - (6.51E+06 x q _d)	(2.29E+07) - (6.51E+06 x q _d)
	MID-RANGE	40-70	1.9 - 0.3	0.8	76%	8.02E+09	8.02E+08		(4.69E+06) - (6.51E+06 x q _d)	(4.69E+06) - (6.51E+06 x q _d)
	LOW	70-100	0.3 - 0.0	0.1	48%	1.00E+09	1.00E+08		(5.86E+05) - (6.51E+06 x q _m)	(5.86E+05) - (6.51E+06 x q _m)

Table F-24 (cont'd). Summary of TMDLs, WLAs, & LAs by Flow Regime for Most Recent Sampling Cycle

Waterbody Description ^a	Flow Zone	PDFE Range [%]	Flow Range [cfs]	Flow ^b [cfs]	PLRG ^c [%]	TMDL [CFU/d]	MOS [CFU/d]	WWTPs ^d [CFU/d]	MS4s ^{e,f,h} [CFU/d/acre _{MS4}]	LA ^{e,h} [CFU/d/acre _{LA}]
Spring Creek TN05130201013_3000 HUC-12: 0305 Station: SPRIN024.8WS Station DA: 11049 acres	HIGH	0-10	3460.6 - 57.8	116.7	NR	1.17E+12	1.17E+11	1.00E+10 x q _m	(9.54E+07) - (9.08E+05 x q _d)	(9.54E+07) - (9.08E+05 x q _d)
	MOIST	10-40	57.8 - 10.1	21.1	36%	2.12E+11	2.12E+10		(1.72E+07) - (9.08E+05 x q _d)	(1.72E+07) - (9.08E+05 x q _d)
	MID-RANGE	40-60	10.1 - 3.7	6.1	NR	6.12E+10	6.12E+09		(4.98E+06) - (9.08E+05 x q _d)	(4.98E+06) - (9.08E+05 x q _d)
	DRY	60-90	3.7 - 0.4	1.5	NR	1.50E+10	1.50E+09		(1.23E+06) - (9.08E+05 x q _d)	(1.23E+06) - (9.08E+05 x q _d)
	LOW	90-100	0.4 - 0.0	0.2	NR	2.01E+09	2.01E+08		(1.63E+05) - (9.08E+05 x q _m)	(1.63E+05) - (9.08E+05 x q _m)
Cedar Creek TN05130201015_1000 HUC-12: 0307 Station: ECO711I12 Station DA: 17527 acres	HIGH	0-10	5456.6 - 92.8	183.4	NR	1.84E+12	1.84E+11	1.00E+10 x q _m	(9.45E+07) - (5.72E+05 x q _d)	(9.45E+07) - (5.72E+05 x q _d)
	MOIST	10-40	92.8 - 16.8	34.0	77%	3.41E+11	3.41E+10		(1.75E+07) - (5.72E+05 x q _d)	(1.75E+07) - (5.72E+05 x q _d)
	MID-RANGE	40-60	16.8 - 6.1	10.0	53%	1.00E+11	1.00E+10		(5.15E+06) - (5.72E+05 x q _d)	(5.15E+06) - (5.72E+05 x q _d)
	DRY	60-90	6.1 - 0.6	2.5	19%	2.51E+10	2.51E+09		(1.29E+06) - (5.72E+05 x q _d)	(1.29E+06) - (5.72E+05 x q _d)
	LOW	90-100	0.6 - 0.0	0.3	NR	3.01E+09	3.01E+08		(1.55E+05) - (5.72E+05 x q _m)	(1.55E+05) - (5.72E+05 x q _m)
Neal Branch TN05130201021_0300 HUC-12: 0201 Station: NEAL000.1WS Station DA: 1183 acres	HIGH	0-10	373.4 - 6.4	14.4	NR	1.44E+11	1.44E+10	1.00E+10 x q _m	(1.10E+08) - (8.48E+06 x q ^d)	(1.10E+08) - (8.48E+06 x q ^d)
	MOIST	10-40	6.4 - 1.1	2.2	25%	2.21E+10	2.21E+09		(1.68E+07) - (8.48E+06 x q ^d)	(1.68E+07) - (8.48E+06 x q ^d)
	MID-RANGE	40-70	1.1 - 0.2	0.5	36%	5.02E+09	5.02E+08		(3.82E+06) - (8.48E+06 x q ^d)	(3.82E+06) - (8.48E+06 x q ^d)
	LOW	70-100	0.2 - 0.0	0.1	NR	1.00E+09	1.00E+08		(7.63E+05) - (8.48E+06 x q _m)	(7.63E+05) - (8.48E+06 x q _m)
Beech Log Creek TN05130201021_0400 HUC-12: 0201 Station: BLOG000.6WS Station DA: 3920 acres	HIGH	0-10	1215.3 - 21.0	43.2	NR	4.33E+11	4.33E+10	1.00E+10 x q _m	(9.95E+07) - (2.56E+06 x q _d)	(9.95E+07) - (2.56E+06 x q _d)
	MOIST	10-40	21.0 - 3.8	7.6	NR	7.62E+10	7.62E+09		(1.75E+07) - (2.56E+06 x q _d)	(1.75E+07) - (2.56E+06 x q _d)
	MID-RANGE	40-60	3.8 - 1.3	2.3	NR	2.31E+10	2.31E+09		(5.30E+06) - (2.56E+06 x q _d)	(5.30E+06) - (2.56E+06 x q _d)
	DRY	60-90	1.3 - 0.1	0.6	53%	6.02E+09	6.02E+08		(1.38E+06) - (2.56E+06 x q _d)	(1.38E+06) - (2.56E+06 x q _d)
	LOW	90-100	0.1 - 0.0	0.1	NR	1.00E+09	1.00E+08		(2.30E+05) - (2.56E+06 x q _m)	(2.30E+05) - (2.56E+06 x q _m)

Table F-24 (cont'd). Summary of TMDLs, WLAs, & LAs by Flow Regime for Most Recent Sampling Cycle

Waterbody Description ^a	Flow Zone	PDFE Range [%]	Flow Range [cfs]	Flow ^b [cfs]	PLRG ^c [%]	TMDL [CFU/d]	MOS [CFU/d]	WWTPs ^d [CFU/d]	MS4s ^{e,f,h} [CFU/d/acre _{MS4}]	LA ^{e,h} [CFU/d/acre _{LA}]
Round Lick Creek (Lower) TN05130201021_2000 HUC-12: 0201 Station: RLICK019.4WS Station DA: 9677 acres	HIGH	0-10	2996.4 - 52.2	106.1	NR	1.06E+12	1.06E+11	1.00E+10 x qm	(9.90E+07) - (1.04E+06 x q _d)	(9.90E+07) - (1.04E+06 x q _d)
	MOIST	10-40	52.2 - 9.4	18.7	55%	1.88E+11	1.88E+10		(1.74E+07) - (1.04E+06 x q _d)	(1.74E+07) - (1.04E+06 x q _d)
	MID-RANGE	40-70	9.4 - 1.9	4.4	71%	4.41E+10	4.41E+09		(4.10E+06) - (1.04E+06 x q _d)	(4.10E+06) - (1.04E+06 x q _d)
	LOW	70-100	1.9 - 0.0	0.6	21%	6.02E+09	6.02E+08		(5.60E+05) - (1.04E+06 x q _m)	(5.60E+05) - (1.04E+06 x q _m)
Round Lick Creek (Upper) TN05130201021_3000 HUC-12: 0201 Station: RLICK021.0WS Station DA: 2836 acres	HIGH	0-10	886.0 - 15.1	31.0	NR	3.11E+11	3.11E+10	1.00E+10 x qm	(9.87E+07) - (3.54E+06 x q _d)	(9.87E+07) - (3.54E+06 x q _d)
	MOIST	10-40	15.1 - 2.6	5.4	44%	5.42E+10	5.42E+09		(1.72E+07) - (3.54E+06 x q _d)	(1.72E+07) - (3.54E+06 x q _d)
	MID-RANGE	40-70	2.6 - 0.5	1.2	50%	1.20E+10	1.20E+09		(3.82E+06) - (3.54E+06 x q _d)	(3.82E+06) - (3.54E+06 x q _d)
	LOW	70-100	0.5 - 0.0	0.2	NR	2.01E+09	2.01E+08		(6.37E+05) - (3.54E+06 x q _m)	(6.37E+05) - (3.54E+06 x q _m)
Little Goose Creek (Lower) TN05130201028_0100 HUC-12: 0103 Station: LGOOS002.0TR Station DA: 16278 acres	HIGH	0-10	5036.1 - 88.8	175.2	NR	1.76E+12	1.76E+11	1.00E+10 x qm	(9.72E+07) - (6.16E+05 x q _d)	(9.72E+07) - (6.16E+05 x q _d)
	MOIST	10-40	88.8 - 15.4	31.4	13%	3.15E+11	3.15E+10		(1.74E+07) - (6.16E+05 x q _d)	(1.74E+07) - (6.16E+05 x q _d)
	MID-RANGE	40-60	15.4 - 5.5	9.3	NR	9.33E+10	9.33E+09		(5.16E+06) - (6.16E+05 x q _d)	(5.16E+06) - (6.16E+05 x q _d)
	DRY	60-90	5.5 - 0.6	2.3	79%	2.31E+10	2.31E+09		(1.28E+06) - (6.16E+05 x q _d)	(1.28E+06) - (6.16E+05 x q _d)
	LOW	90-100	0.6 - 0.0	0.2	NR	2.01E+09	2.01E+08		(1.11E+05) - (6.16E+05 x q _m)	(1.11E+05) - (6.16E+05 x q _m)
Little Goose Creek (Upper) TN05130201028_0150 HUC-12: 0103 Station: LGOOS006.5TR Station DA: 13371 acres	HIGH	0-10	4284.6 - 86.7	172.5	NR	1.73E+12	1.73E+11	1.00E+10 x qm	(1.16E+08) - (7.50E+05 x q _d)	(1.16E+08) - (7.50E+05 x q _d)
	MOIST	10-40	86.7 - 14.6	30.4	6%	3.05E+11	3.05E+10		(2.05E+07) - (7.50E+05 x q _d)	(2.05E+07) - (7.50E+05 x q _d)
	MID-RANGE	40-60	14.6 - 5.0	8.6	NR	8.63E+10	8.63E+09		(5.81E+06) - (7.50E+05 x q _d)	(5.81E+06) - (7.50E+05 x q _d)
	DRY	60-90	5.0 - 0.6	2.3	33%	2.31E+10	2.31E+09		(1.55E+06) - (7.50E+05 x q _d)	(1.55E+06) - (7.50E+05 x q _d)
	LOW	90-100	0.6 - 0.0	0.2	NR	2.01E+09	2.01E+08		(1.35E+05) - (7.50E+05 x q _m)	(1.35E+05) - (7.50E+05 x q _m)

Table F-24 (cont'd). Summary of TMDLs, WLAs, & LAs by Flow Regime for Most Recent Sampling Cycle

Waterbody Description ^a	Flow Zone	PDFE Range [%]	Flow Range [cfs]	Flow ^b [cfs]	PLRG ^c [%]	TMDL [CFU/d]	MOS [CFU/d]	WWTPs ^d [CFU/d]	MS4s ^{e,f,h} [CFU/d/acre _{MS4}]	LA ^{e,h} [CFU/d/acre _{LA}]
Hickerson Creek TN05130201028_0200 HUC-12: 0103 Station: HICKE000.9TR Station DA: 2291 acres	HIGH	0-10	711.5 - 14.0	29.0	NR	2.91E+11	2.91E+10	1.00E+10 x q _m	(1.14E+08) - (4.38E+06 x q _d)	(1.14E+08) - (4.38E+06 x q _d)
	MOIST	10-40	14.0 - 2.4	5.0	55%	5.02E+10	5.02E+09		(1.97E+07) - (4.38E+06 x q _d)	(1.97E+07) - (4.38E+06 x q _d)
	MID-RANGE	40-70	2.4 - 0.5	1.1	46%	1.10E+10	1.10E+09		(4.34E+06) - (4.38E+06 x q _d)	(4.34E+06) - (4.38E+06 x q _d)
	LOW	70-100	0.5 - 0.0	0.2	46%	2.01E+09	2.01E+08		(7.88E+05) - (4.38E+06 x q _m)	(7.88E+05) - (4.38E+06 x q _m)
Middle Fork TN05130201028_0300 HUC-12: 0102 Station: MFGOO000.7TR Station DA: 17260 acres	HIGH	0-10	5315.9 - 105.3	205.2	NR	2.06E+12	2.06E+11	1.00E+10 x q _m	(1.07E+08) - (5.81E+05 x q _d)	(1.07E+08) - (5.81E+05 x q _d)
	MOIST	10-40	105.3 - 18.2	38.1	38%	3.82E+11	3.82E+10		(1.99E+07) - (5.81E+05 x q _d)	(1.99E+07) - (5.81E+05 x q _d)
	MID-RANGE	40-60	18.2 - 6.3	10.8	66%	1.08E+11	1.08E+10		(5.65E+06) - (5.81E+05 x q _d)	(5.65E+06) - (5.81E+05 x q _d)
	DRY	60-90	6.3 - 0.7	2.8	67%	2.81E+10	2.81E+09		(1.46E+06) - (5.81E+05 x q _d)	(1.46E+06) - (5.81E+05 x q _d)
	LOW	90-100	0.7 - 0.0	0.3	NR	3.01E+09	3.01E+08		(1.57E+05) - (5.81E+05 x q _m)	(1.57E+05) - (5.81E+05 x q _m)
Carr Creek TN05130201028_0320 HUC-12: 0102 Station: CARR000.1MA Station DA: 3546 acres	HIGH	0-10	1093.3 - 22.1	44.4	NR	4.45E+11	4.45E+10	1.00E+10 x q _m	(1.13E+08) - (2.83E+06 x q _d)	(1.13E+08) - (2.83E+06 x q _d)
	MOIST	10-40	22.1 - 3.7	7.8	52%	7.82E+10	7.82E+09		(1.99E+07) - (2.83E+06 x q _d)	(1.99E+07) - (2.83E+06 x q _d)
	MID-RANGE	40-60	3.7 - 1.2	2.2	25%	2.21E+10	2.21E+09		(5.60E+06) - (2.83E+06 x q _d)	(5.60E+06) - (2.83E+06 x q _d)
	DRY	60-90	1.2 - 0.2	0.6	38%	6.02E+09	6.02E+08		(1.53E+06) - (2.83E+06 x q _d)	(1.53E+06) - (2.83E+06 x q _d)
	LOW	90-100	0.2 - 0.0	0.1	NR	1.00E+09	1.00E+08		(2.55E+05) - (2.83E+06 x q _m)	(2.55E+05) - (2.83E+06 x q _m)
Goose Creek TN05130201028_1000 HUC-12: 0101, 0102, 0103 Station: GOOSE004.5TR Station DA: 47049 acres	HIGH	0-10	14591.0 - 252.4	480.5	NR	4.82E+12	4.82E+11	1.00E+10 x q _m	(9.22E+07) - (2.13E+05 x q _d)	(9.22E+07) - (2.13E+05 x q _d)
	MOIST	10-40	252.4 - 45.3	97.8	20%	9.81E+11	9.81E+10		(1.88E+07) - (2.13E+05 x q _d)	(1.88E+07) - (2.13E+05 x q _d)
	MID-RANGE	40-60	45.3 - 15.9	27.0	33%	2.71E+11	2.71E+10		(5.18E+06) - (2.13E+05 x q _d)	(5.18E+06) - (2.13E+05 x q _d)
	DRY	60-90	15.9 - 1.8	6.8	15%	6.82E+10	6.82E+09		(1.30E+06) - (2.13E+05 x q _d)	(1.30E+06) - (2.13E+05 x q _d)
	LOW	90-100	1.8 - 0.0	0.7	NR	7.02E+09	7.02E+08		(1.34E+05) - (2.13E+05 x q _m)	(1.34E+05) - (2.13E+05 x q _m)

Table F-24 (cont'd). Summary of TMDLs, WLAs, & LAs by Flow Regime for Most Recent Sampling Cycle

Waterbody Description ^a	Flow Zone	PDFE Range [%]	Flow Range [cfs]	Flow ^b [cfs]	PLRG ^c [%]	TMDL [CFU/d]	MOS [CFU/d]	WWTPs ^d [CFU/d]	MS4s ^{e,f,h} [CFU/d/acre _{MS4}]	LA ^{e,h} [CFU/d/acre _{LA}]
Liberty Branch TN05130201041_0100 HUC-12: 0501 Station: LIBER001.3SR Station DA: 6903 acres	HIGH	0-10	2157.8 - 37.0	73.5	NR	7.37E+11	7.37E+10	1.00E+10 x q _m	(9.61E+07) - (1.45E+06 x q _d)	(9.61E+07) - (1.45E+06 x q _d)
	MOIST	10-40	37.0 - 6.8	13.5	8%	1.35E+11	1.35E+10		(1.77E+07) - (1.45E+06 x q _d)	(1.77E+07) - (1.45E+06 x q _d)
	MID-RANGE	40-60	6.8 - 2.4	4.1	NR	4.11E+10	4.11E+09		(5.36E+06) - (1.45E+06 x q _d)	(5.36E+06) - (1.45E+06 x q _d)
	DRY	60-90	2.4 - 0.3	1.0	0%	1.00E+10	1.00E+09		(1.31E+06) - (1.45E+06 x q _d)	(1.31E+06) - (1.45E+06 x q _d)
	LOW	90-100	0.3 - 0.0	0.1	NR	1.00E+09	1.00E+08		(1.31E+05) - (1.45E+06 x q _m)	(1.31E+05) - (1.45E+06 x q _m)
Sinking Creek TN05130201055_0200 HUC-12: 0306 Station: SINKI000.1WS Station DA: 9771 acres	HIGH	0-10	3075.6 - 67.9	145.6	NR	1.46E+12	1.46E+11	1.00E+10 x q _m	(1.35E+08) - (1.03E+06 x q _d)	(1.35E+08) - (1.03E+06 x q _d)
	MOIST	10-40	67.9 - 10.7	23.2	NR	2.33E+11	2.33E+10		(2.14E+07) - (1.03E+06 x q _d)	(2.14E+07) - (1.03E+06 x q _d)
	MID-RANGE	40-60	10.7 - 3.5	6.3	71%	6.32E+10	6.32E+09		(5.82E+06) - (1.03E+06 x q _d)	(5.82E+06) - (1.03E+06 x q _d)
	DRY	60-90	3.5 - 0.3	1.2	NR	1.20E+10	1.20E+09		(1.11E+06) - (1.03E+06 x q _d)	(1.11E+06) - (1.03E+06 x q _d)
	LOW	90-100	0.3 - 0.0	0.1	21%	1.00E+09	1.00E+08		(9.24E+04) - (1.03E+06 x q _m)	(9.24E+04) - (1.03E+06 x q _m)

Notes: NFR = No Flows Recorded for sampling instances in this flow zone, NR = No Reduction required, q_m = Mean Daily WWTP Discharge (cfs), q_d = Facility (WWTP) Design Flow (cfs)

- The summaries presented in this table are calculated using the most recent cycle of *E. coli* sample values and the modeled flow at the monitoring station location. Critical conditions are highlighted in orange (ref. Table F-6).
- Flow applied to TMDL, MOS, and allocation (WLA[MS4] and LA) calculations. Flows represent the midpoint PDFE value in each respective hydrologic flow regime as modeled from the monitoring station location for each waterbody.
- PLRG = Percent Load Reduction Goal to achieve TMDL.
- WLAs for WWTPs are expressed as *E. coli* loads (CFU/day). All current and future WWTPs must meet water quality standards as specified in their NPDES permit. When no WWTPs are currently discharging into or upstream of the waterbody, WLA[WWTPs] expression is future growth term for new WWTPs.
- WLAs and LAs expressed as a “per acre” load are calculated based on the drainage area comprising each respective allocation type (MS4, LA) within the total drainage area of the impaired waterbody (see Table A-1). As regulated MS4 area increases (due to future growth and/or new MS4 designation), unregulated LA area decreases by an equivalent amount. The sum of the areas will continue to equal the total impaired waterbody drainage area.
- When there are no MS4s currently located in a subwatershed drainage area, the expression is future growth term for expanding or newly designated MS4s.
- While Rankin Branch showed no instances of single sample or geomean *E. coli* exceedances for the most recent sampling cycle, analysis of period of record data determined that the dry flow zone should be targeted as the critical condition.
- For low flow conditions, mean daily WWTP discharge (q_m) is used in place of facility design flow (q_d) (Ref. Section 9.1.1)

APPENDIX G

Trend Analysis for Impaired Waterbodies

G.1 Overview of Trend Analysis

In the Old Hickory Lake watershed, periods of record greater than 5 years (given adequate sampling frequency) were evaluated for trend analysis. For watersheds in second or successive TMDL cycles, data collected from multiple cycles were compared. If implementation efforts have been initiated to reduce loading, evaluation of routine monitoring data may indicate improving or worsening conditions over time and corresponding effectiveness of implementation efforts.

Water quality data for implementation effectiveness analysis can be presented in multiple ways. Several examples are shown in Section 9.6. Load duration curve methodology is most appropriate when monthly monitoring data, representative of all flow regimes, have been collected. However, in cases where not all flow regimes are represented, box and whisker plots may be a more appropriate method of presenting the monitoring data than a load duration curve.

Geomean sampling can only be used to determine the condition of a given waterbody during a 30-day period and, by itself, is inadequate to determine an overall trend. Data covering a period of time greater than 30 days are grouped together by sampling cycle, a 12-month period usually not coincident with the calendar year. As stated in Section 9.4.1, “comprehensive water quality monitoring activities include sampling during all seasons and a broad range of flow and meteorological conditions.”

All but four of the waterbodies in the Old Hickory Lake watershed listed as impaired by *E. coli* had sufficient monitoring data to perform trend analysis – these four impaired waterbodies without sufficient data are Little Goose Creek (Upper), Hickerson Creek, Middle Fork, and Carr Creek.

11 of the 17 impaired waterbody drainage areas had occurrences of “>2419”. As stated in Section 9.4.1, for individual monitoring locations, where historical *E. coli* data are greater than 2419 colonies/100 mL, dilutions should be performed in order to accurately assess the magnitude of the impairment.

G.2 Summary of Trend Analysis for Impaired Waterbodies

Based on the analysis of data from 2009 through 2020, the condition of **Rankin Branch (TN05130201001T_0100)** appears to be improving (Figures G-1 and G-2). It is currently attaining water quality standards (ref. Table 3, Note b).

Based on the analysis of data from 2000 through 2020, the condition of **Town Creek (TN05130201001T_0200)** appears to be improving (Figures G-3 and G-4).

Based on the analysis of data from 2014 through 2020, the condition of **Unnamed Trib to Old Hickory Reservoir (TN05130201001T_0400)** appears to be worsening (Figures G-5 and G-6).

Based on the analysis of data from 2014 through 2020, the condition of **Spring Creek (TN05130201013_3000)** appears to be worsening (Figures G-7 and G-8). Note that TN05130201013_3000 (Spring Creek) is the renumbered ID for the same waterbody as TN05130201013 – 4000 (Spring Creek) with a TMDL approved by EPA in 2008 (ref. Table 13).

Based on the analysis of data from 2000 through 2020, the condition of **Cedar Creek (TN05130201015_1000)** appears to be worsening (Figures G-9 and G-10).

Based on the analysis of data from 2000 through 2019, the condition of **Neal Branch (TN05130201021_0300)** appears to be improving (Figures G-11 and G-12). Neal Branch previously received a TMDL approved by EPA in 2008 (ref. Table 13).

Based on the analysis of data from 2000 through 2019, the condition of **Beech Log Creek (TN05130201021_0400)** appears to be slightly improving (Figures G-13 and G-14). Beech Log Creek previously received a TMDL approved by EPA in 2008 (ref. Table 12).

Based on the analysis of data from 2000 through 2020, the condition of **Round Lick Creek (Lower) (TN05130201021_2000)** appears to be slightly worsening (Figures G-15 and G-16). Round Lick Creek (Lower) previously received a TMDL approved by EPA in 2008 (ref. Table 13).

Based on the analysis of data from 2000 through 2020, the condition of **Round Lick Creek (Upper) (TN05130201021_3000)** appears to be slightly improving (Figures G-17 and G-18). Round Lick Creek (Upper) previously received a TMDL approved by EPA in 2008 (ref. Table 13).

Based on the analysis of data from 2004 through 2020, the condition of **Little Goose Creek (Lower) (TN05130201028_0100)** appears to be unchanging (Figures G-19 and G-20). Segments TN05130201021_2000 and TN05130201021_3000 represent the segment TN05130201021_2000 addressed in the 2008 Old Hickory Lake *E. coli* TMDL split into two segments (ref. Table 13).

There is not enough data to suggest a trend for the condition of **Little Goose Creek (Upper) (TN05130201028_0150)**. Segments TN05130201021_2000 and TN05130201021_3000 represent the segment TN05130201021_2000 addressed in the 2008 Old Hickory Lake *E. coli* TMDL split into two segments (ref. Table 13).

There is not enough data to suggest a trend for the condition of **Hickerson Creek (TN05130201028_0200)**.

There is not enough data to suggest a trend for the condition of **Middle Fork (TN05130201028_0300)**.

There is not enough data to suggest a trend for the condition of **Carr Creek (TN05130201028_0320)**.

Based on the analysis of data from 2004 through 2020, the condition of **Goose Creek (TN05130201028_1000)** appears to be slightly worsening (Figures G-21 and G-22).

Based on the analysis of data from 2009 through 2020, the condition of **Liberty Branch (TN05130201041_0100)** appears to be unchanging (Figures G-23 and G-24).

Based on the analysis of data from 2009 through 2020, the condition of **Sinking Creek (TN05130201055_0200)** appears to be unchanging (Figures G-25 and G-26). Note that Waterbody ID TN05130201055_0200 (Sinking Creek) is the renumbered Waterbody ID combining the previous Waterbody IDs TN05130201055_0200 and TN05130201055_0250 into one segment. These two waterbodies previously received a TMDL approved by EPA in 2008 (ref. Table 13).

G.3 Time Series and Box and Whisker Plots for Trend Analysis in Impaired Waterbodies

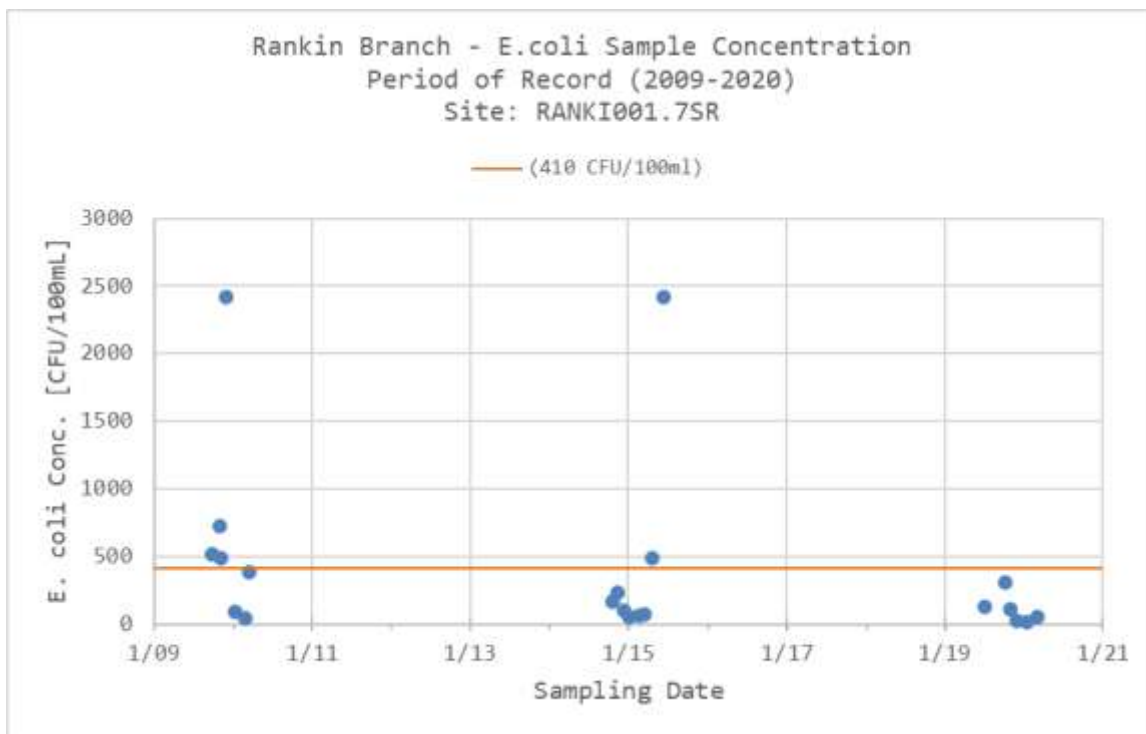


Figure G-1. Time Series Plot for Rankin Branch, Station RANKI001.7SR

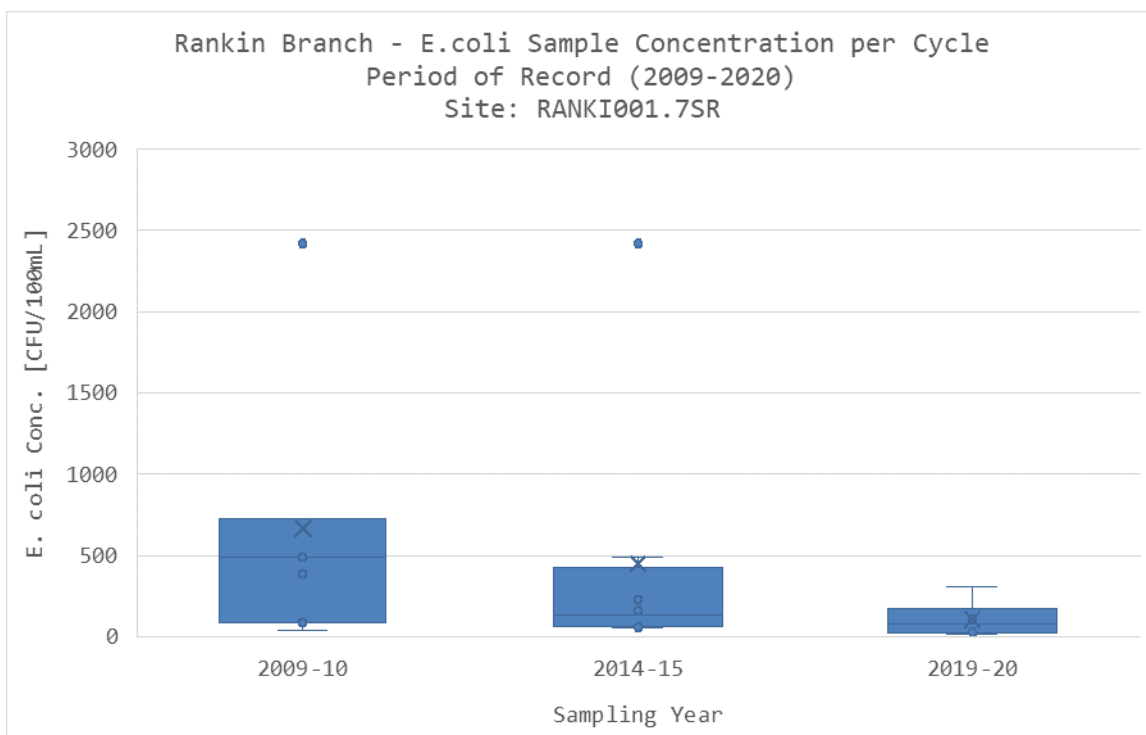


Figure G-2. Box and Whisker Plot for Rankin Branch, RANKI001.7SR

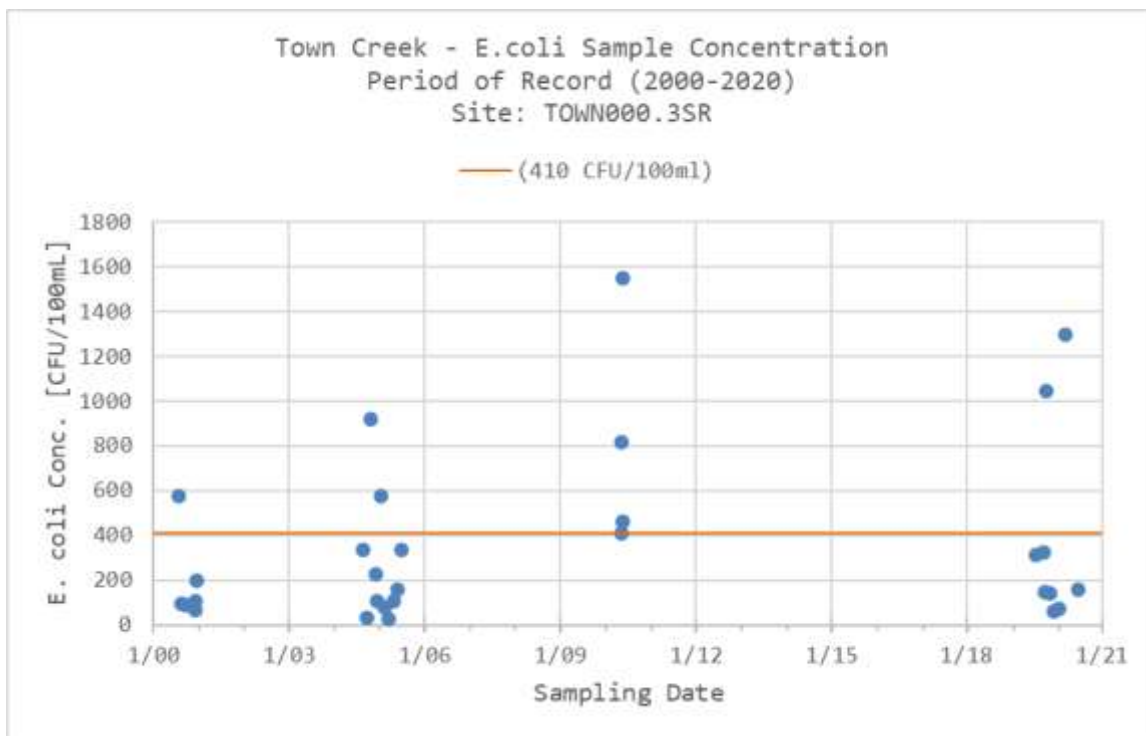


Figure G-3. Time Series Plot for Town Creek, Station TOWN000.3SR

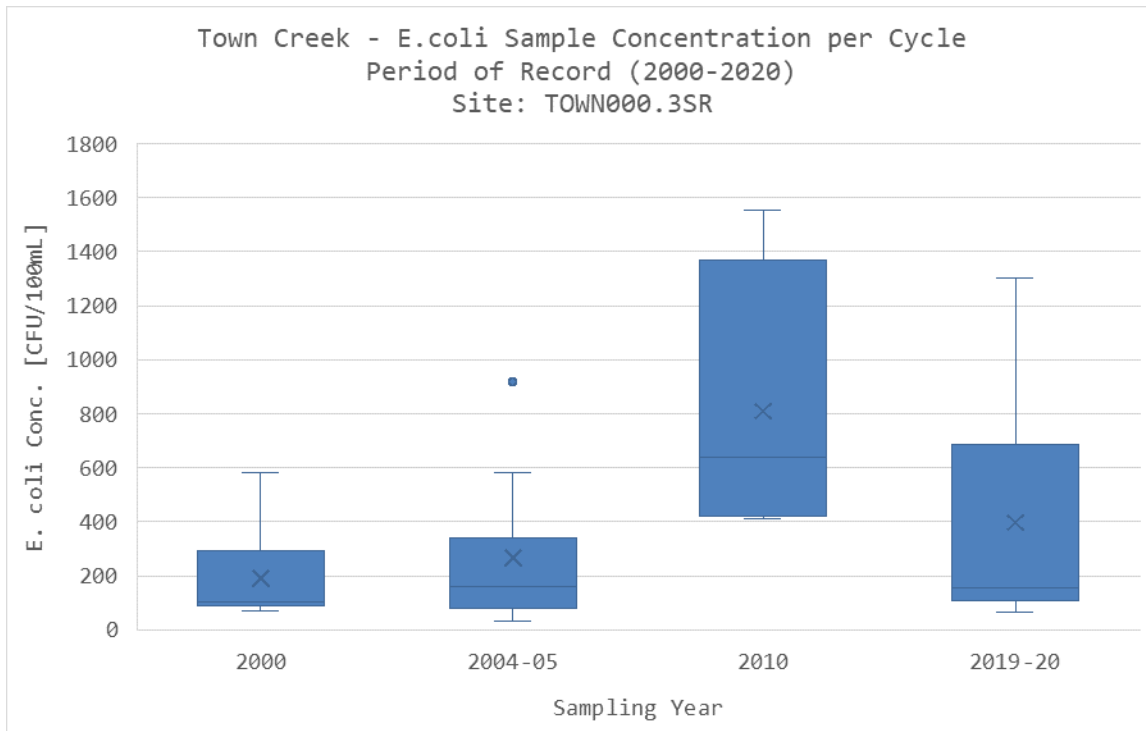


Figure G-4. Box and Whisker Plot for Town Creek, TOWN000.3SR

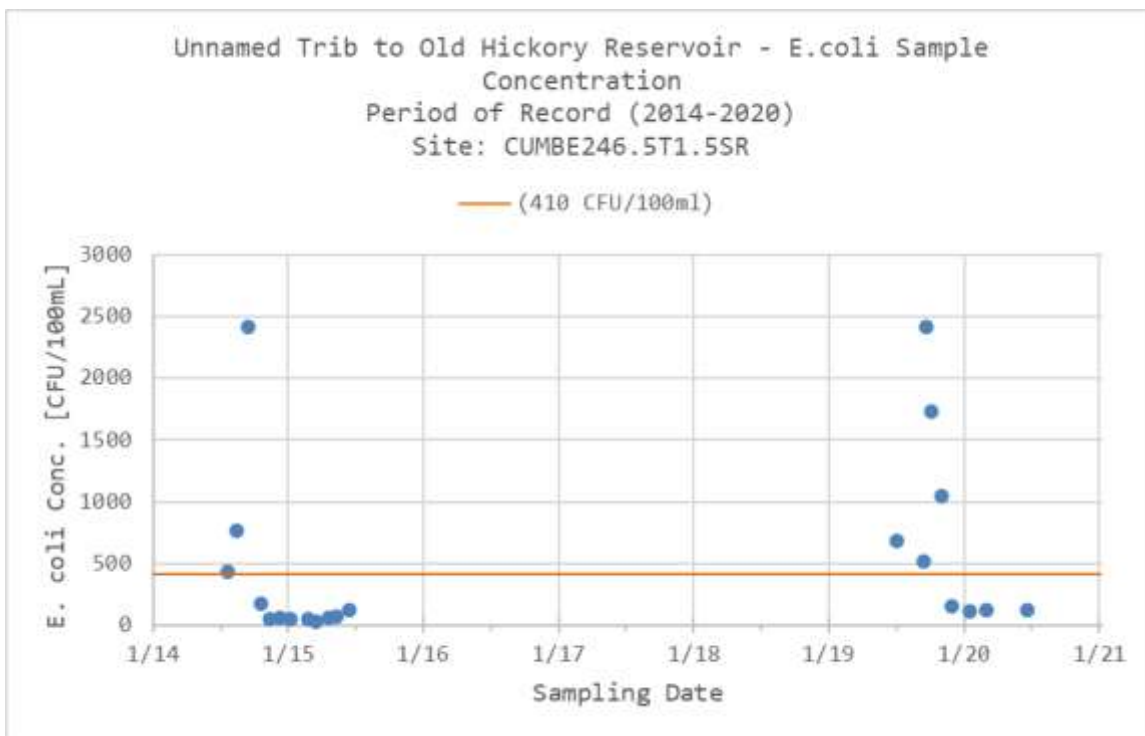


Figure G-5. Time Series Plot for Unnamed Trib to Old Hickory Reservoir, Station CUMBE246.5T1.5SR

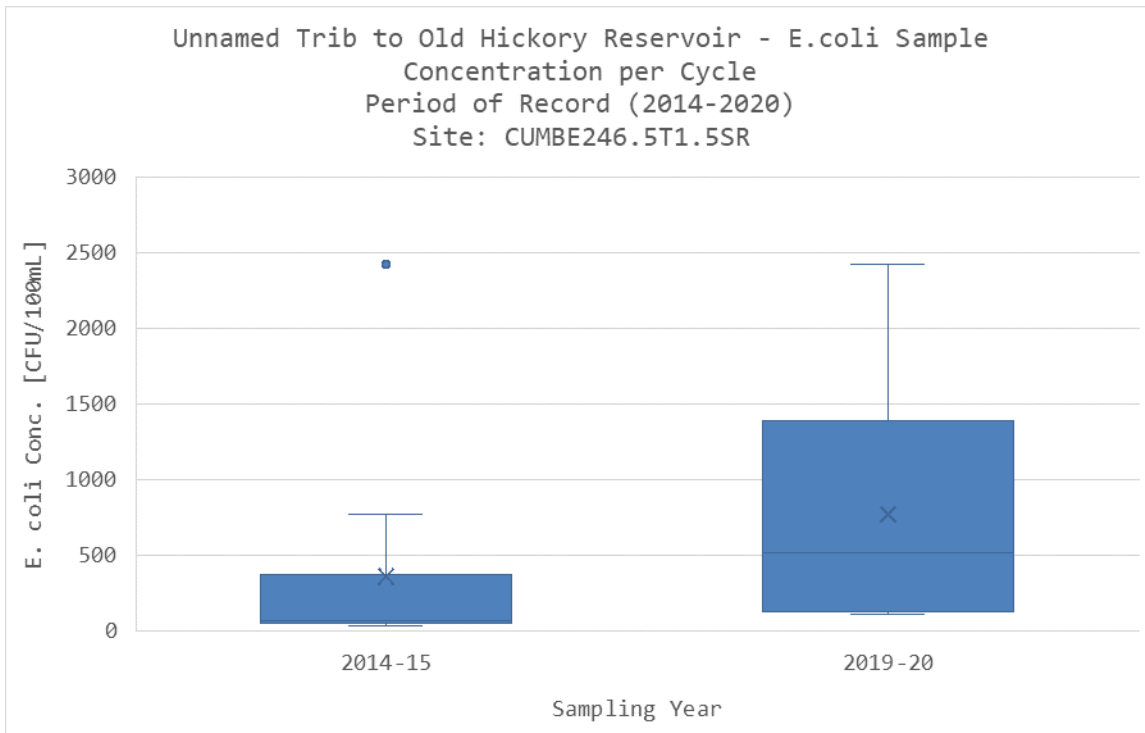


Figure G-6. Box and Whisker Plot for Unnamed Trib to Old Hickory Reservoir, Station CUMBE246.5T1.5SR

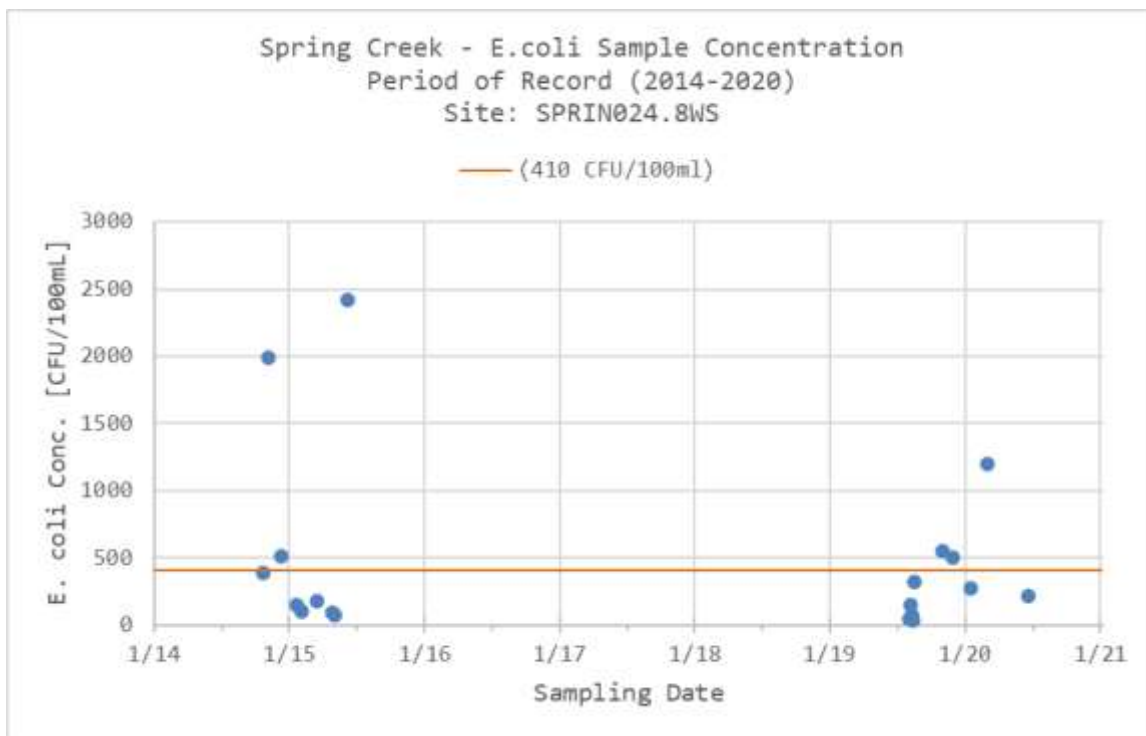


Figure G-7. Time Series Plot for Spring Creek, Station SPRIN024.8WS

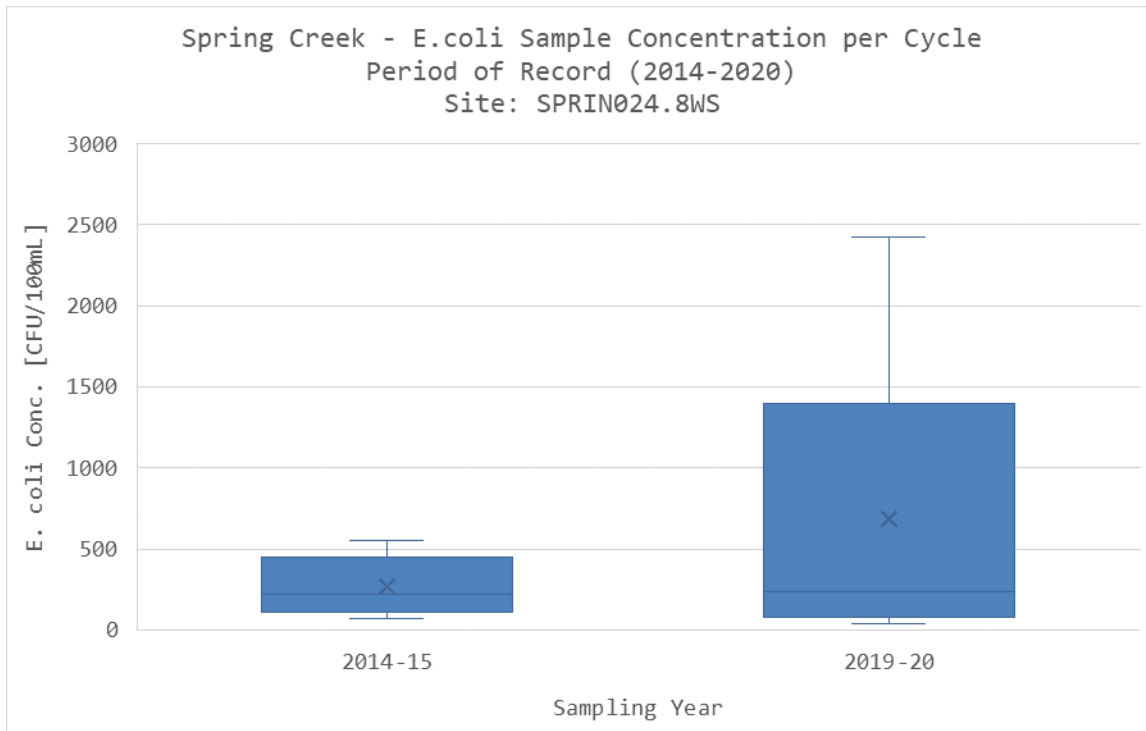


Figure G-8. Box and Whisker Plot for Spring Creek, Station SPRIN024.8WS

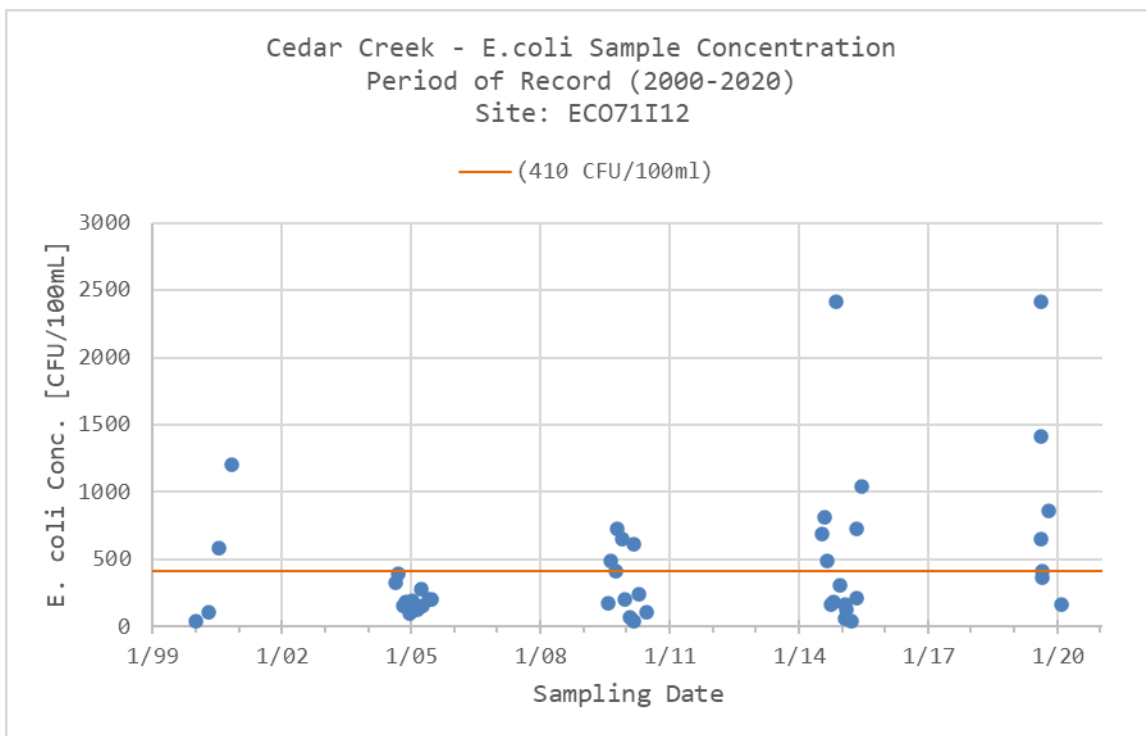


Figure G-9. Time Series Plot for Cedar Creek, Station ECO71I12

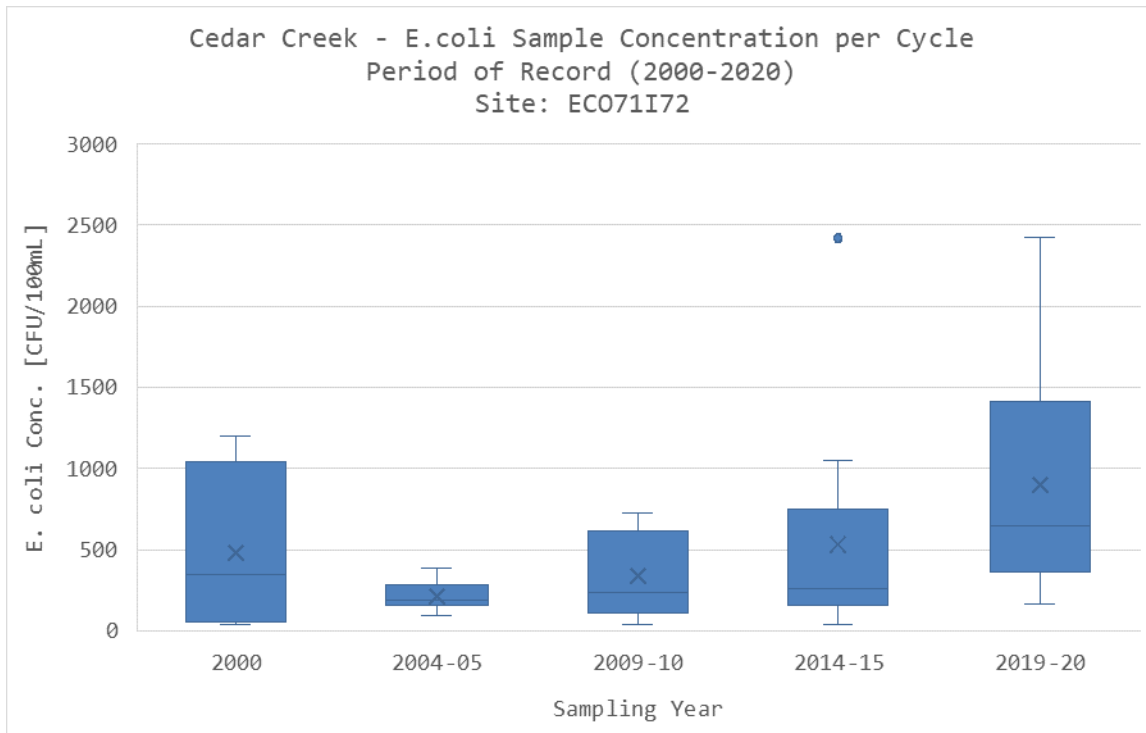


Figure G-10. Box and Whisker Plot for Cedar Creek, Station ECO71I12

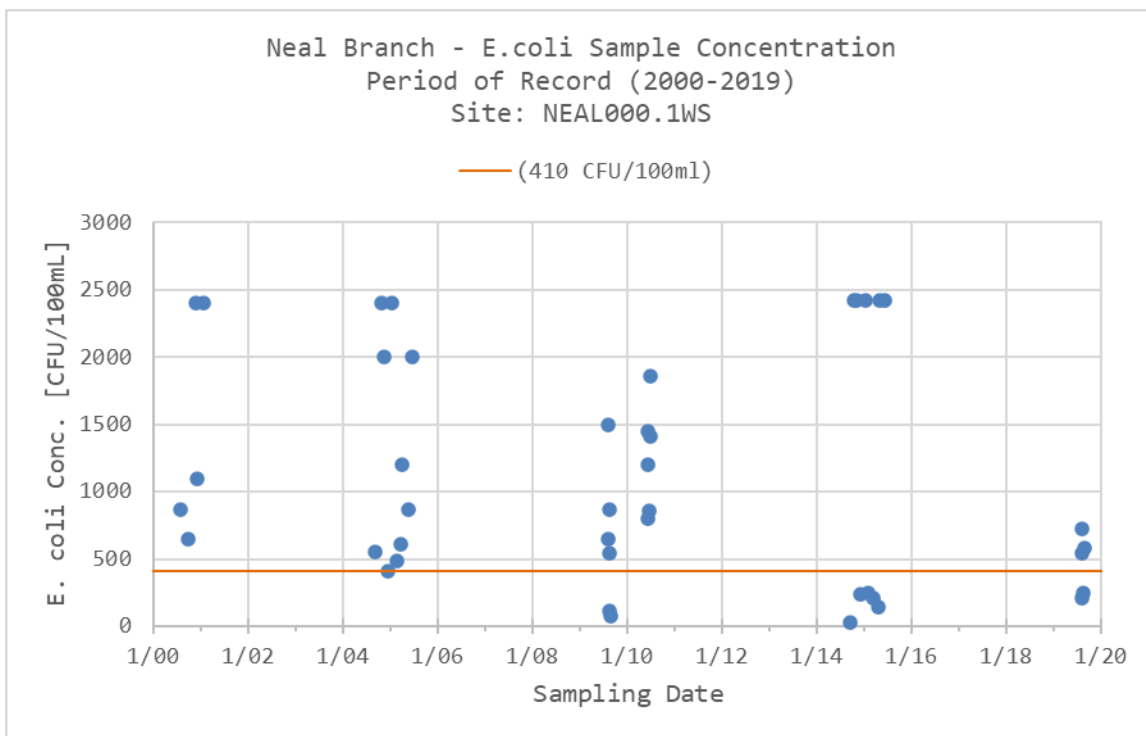


Figure G-11. Time Series Plot for Neal Branch, Station NEAL000.1WS

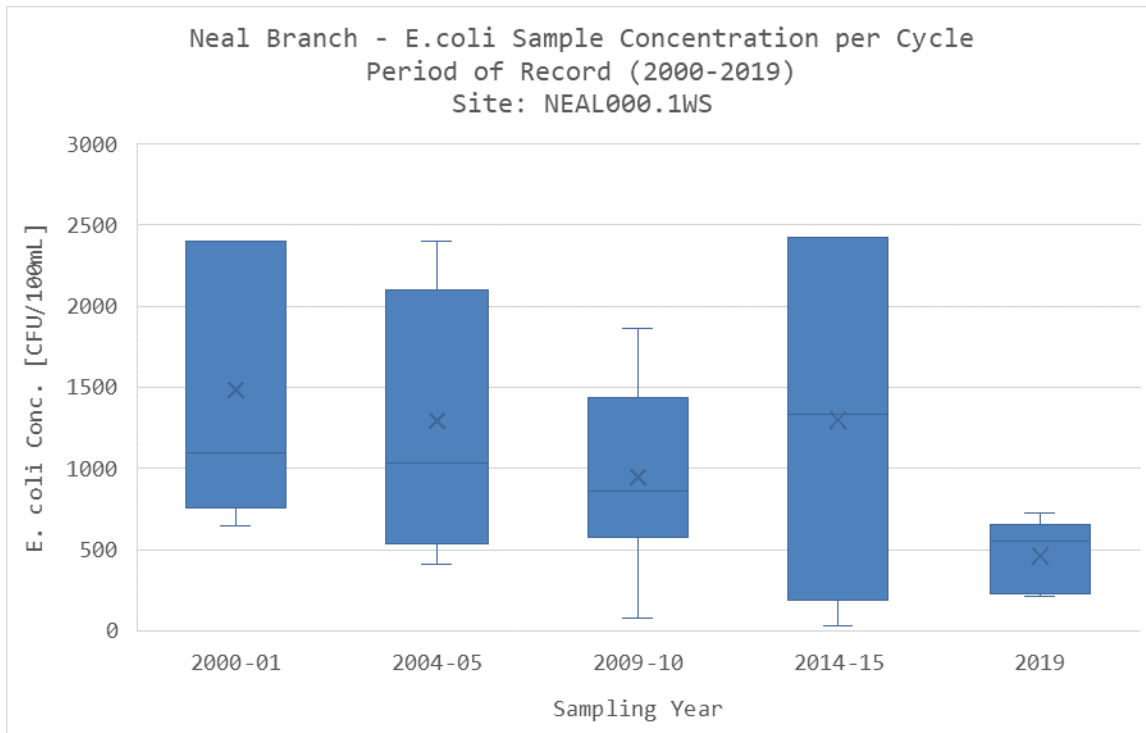


Figure G-12. Box and Whisker Plot for Neal Branch, Station NEAL000.1WS

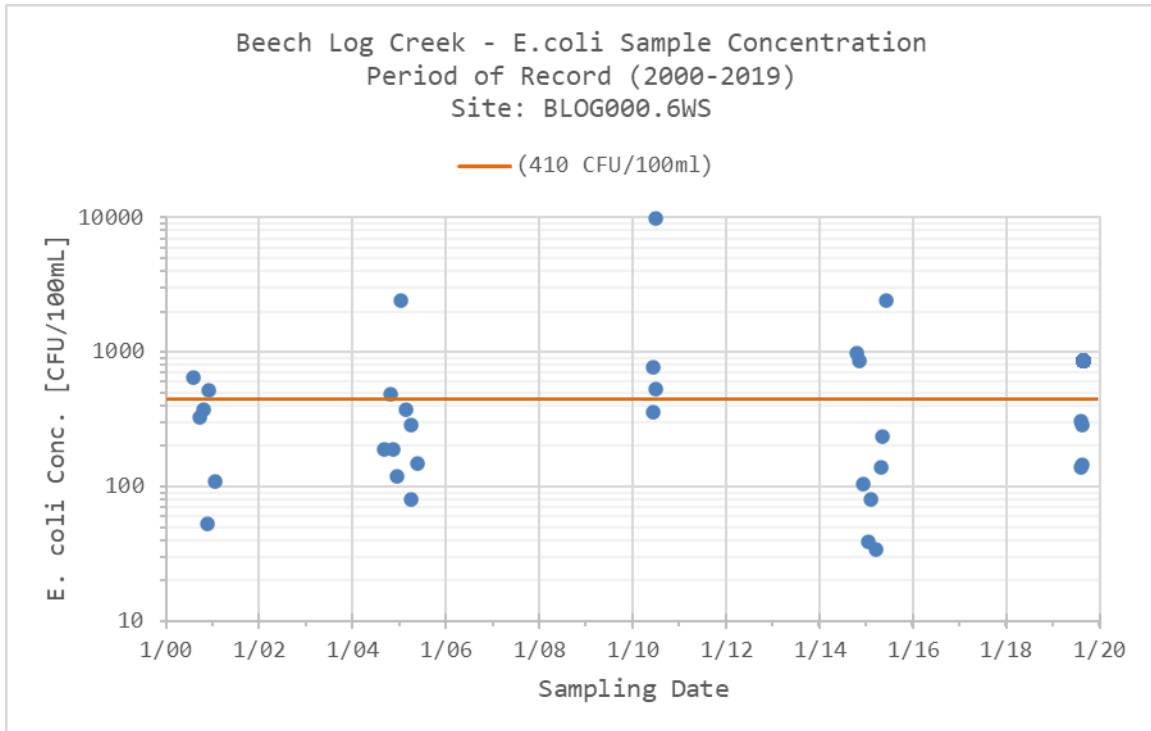


Figure G-13. Time Series Plot for Beech Log Creek, BLOG000.6WS

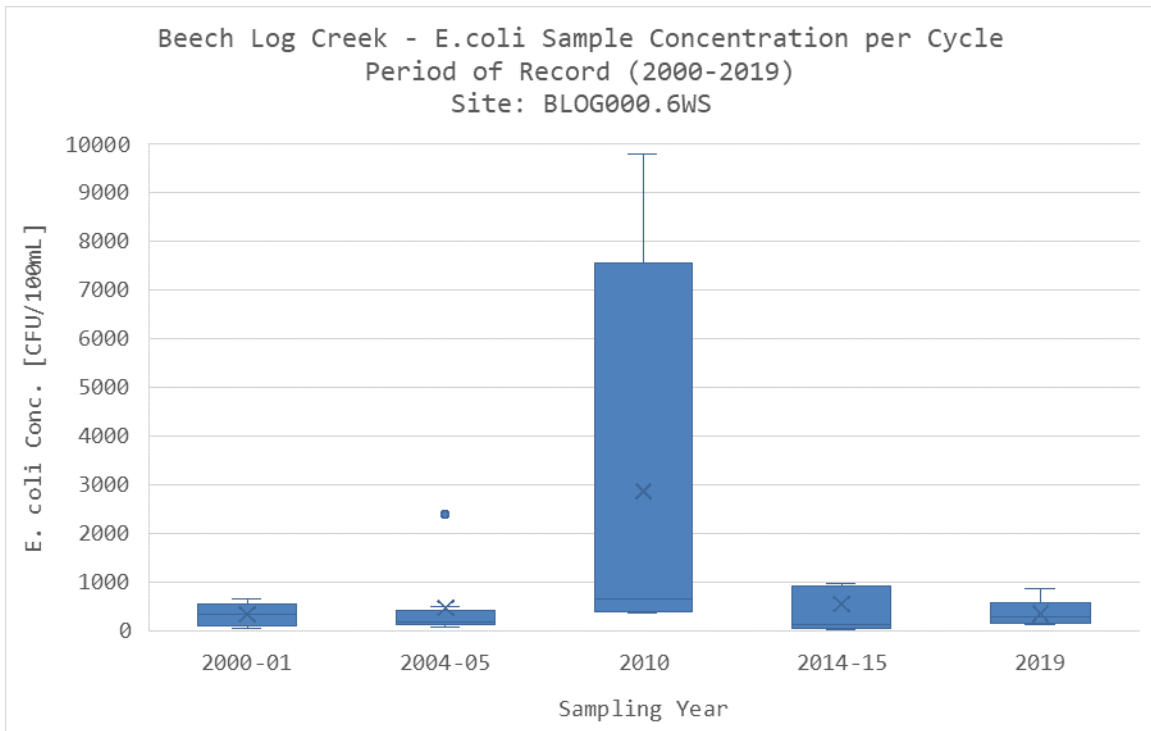


Figure G-14. Box and Whisker Plot for Beech Log Creek, BLOG000.6WS

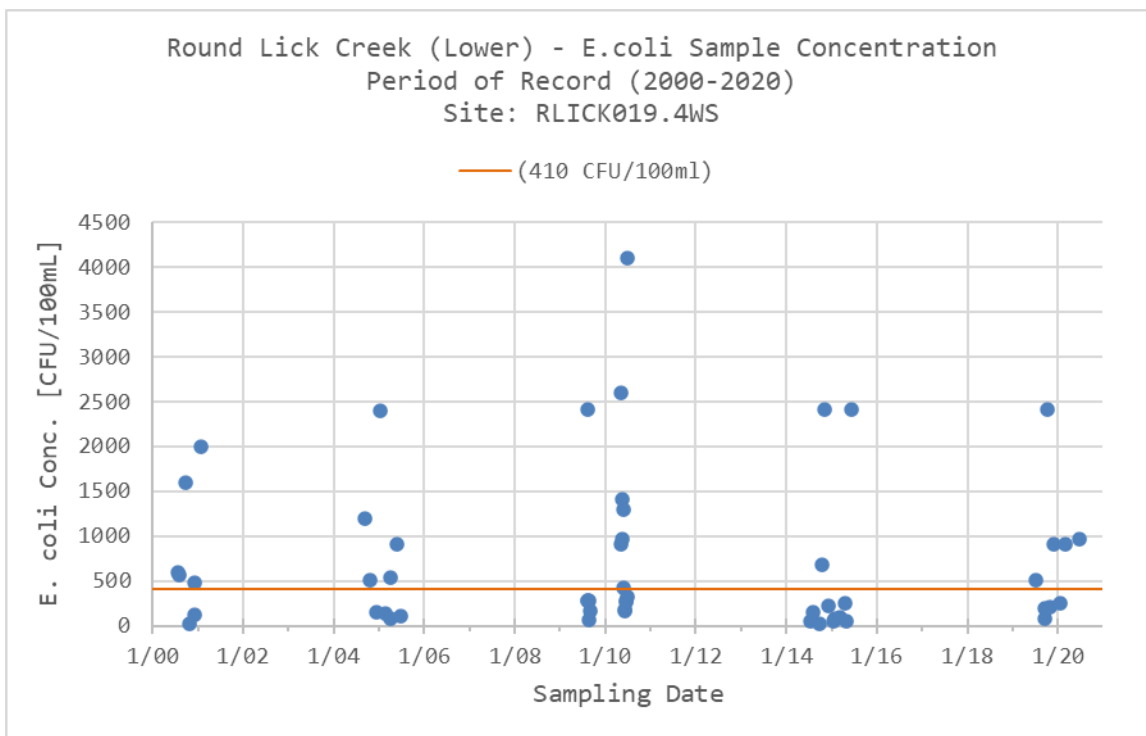


Figure G-15. Time Series Plot for Round Lick Creek (Lower), Station RLICK019.4WS

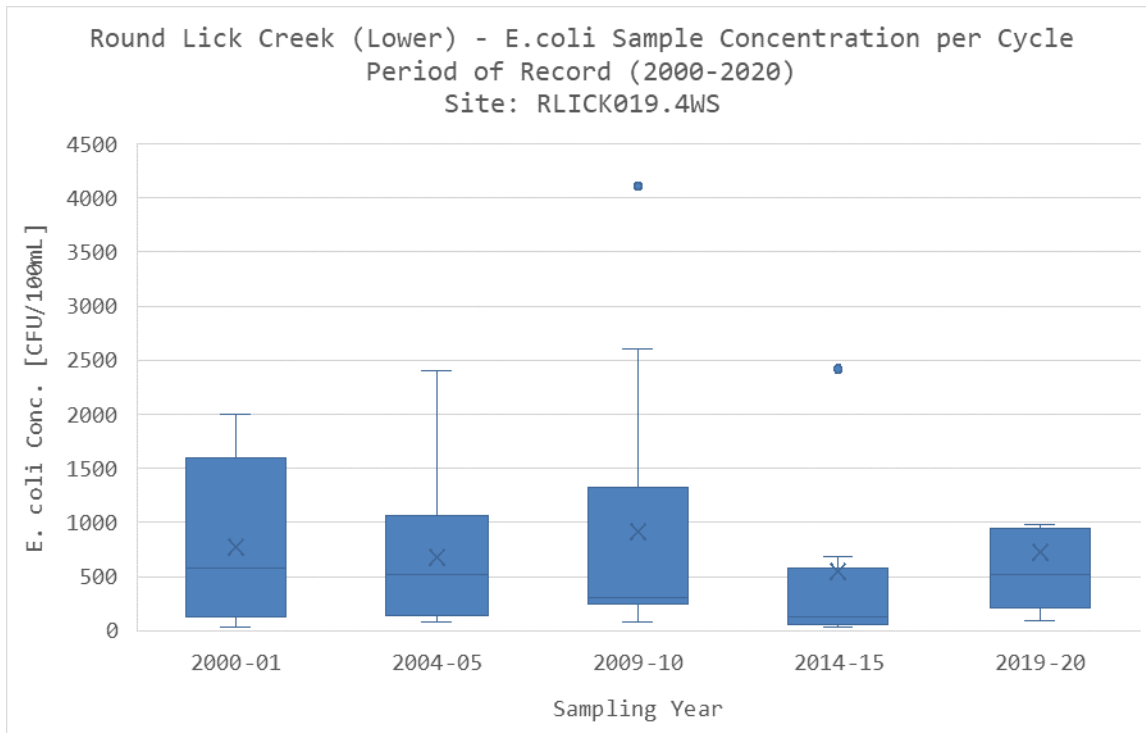


Figure G-16. Box and Whisker Plot for Round Lick Creek (Lower), Station RLICK019.4WS

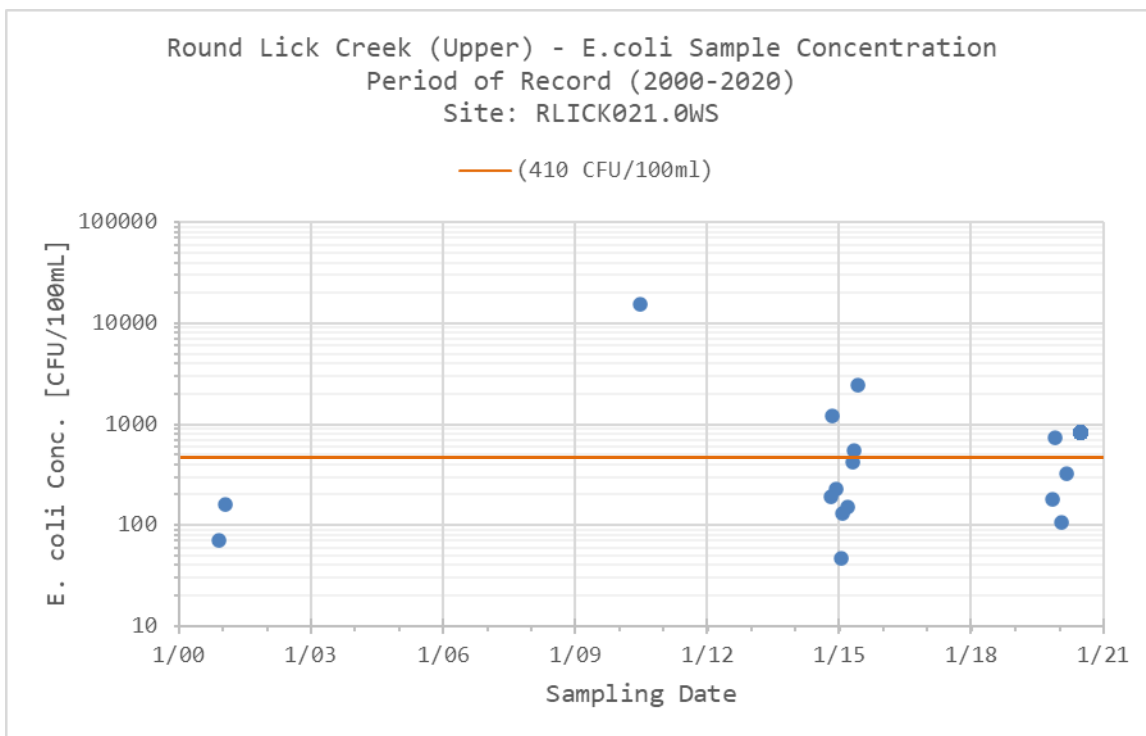


Figure G-17. Time Series Plot for Round Lick Creek (Upper), Station RLICK021.0WS

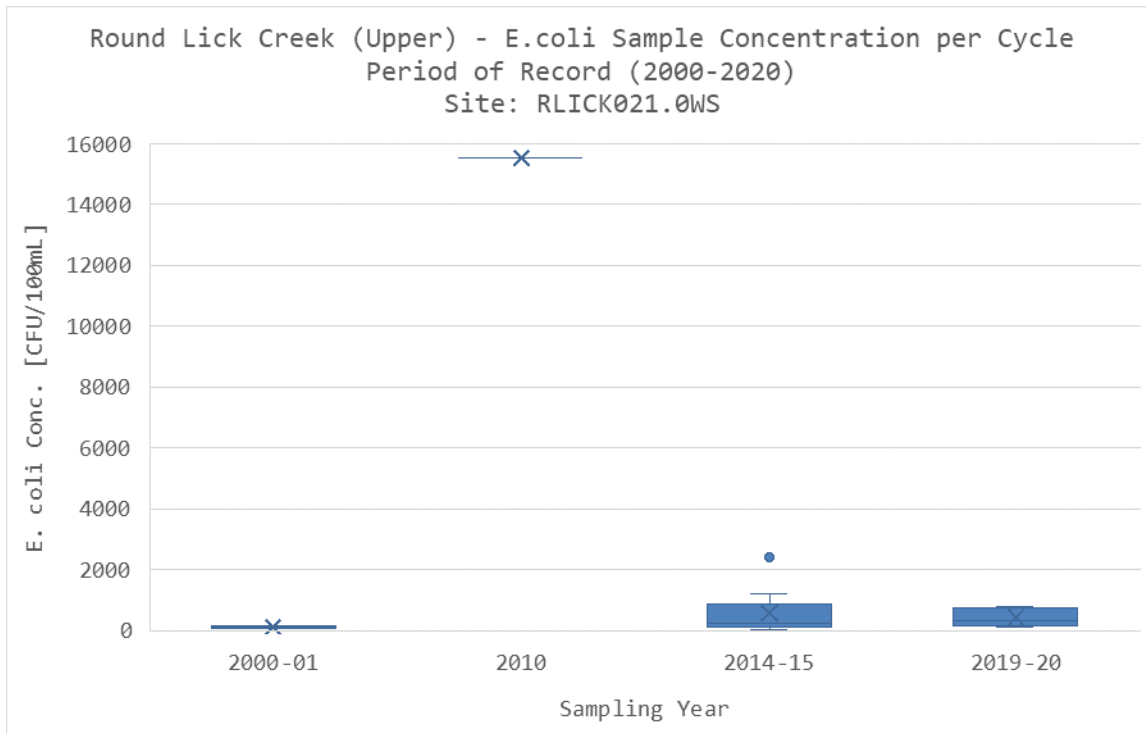


Figure G-18. Box and Whisker Plot for Round Lick Creek (Upper), Station RLICK021.0WS

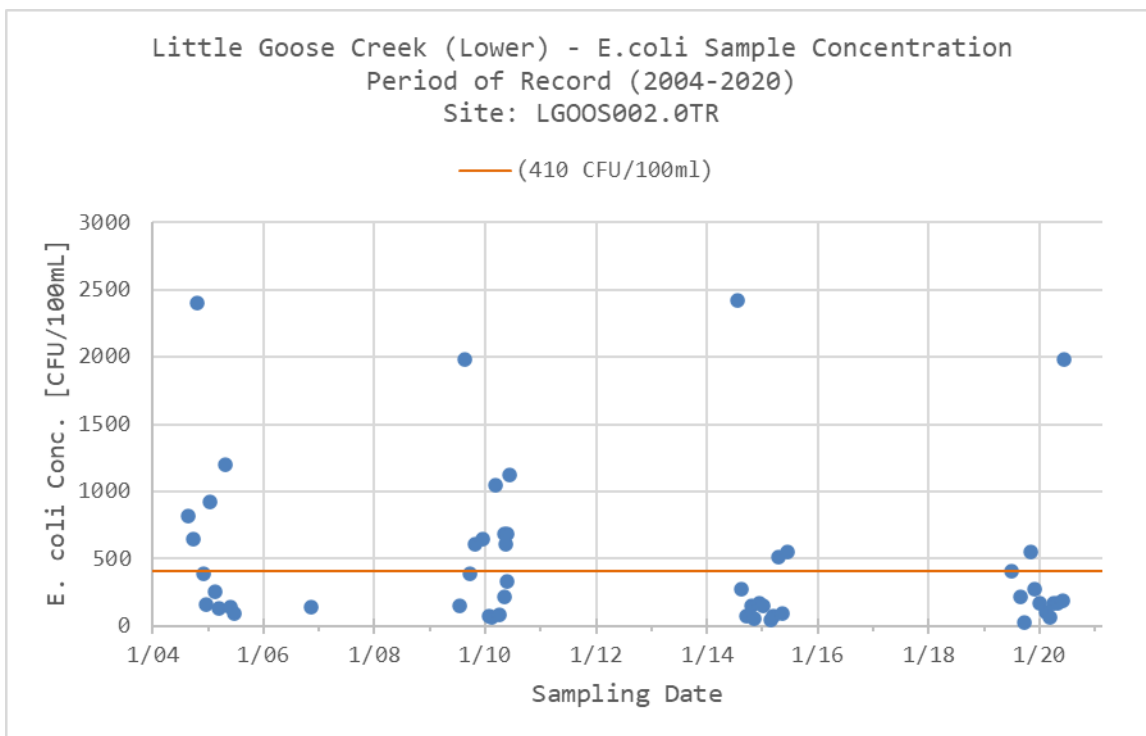


Figure G-19. Time Series Plot for Little Goose Creek (Lower), Station LGOOS002.0TR

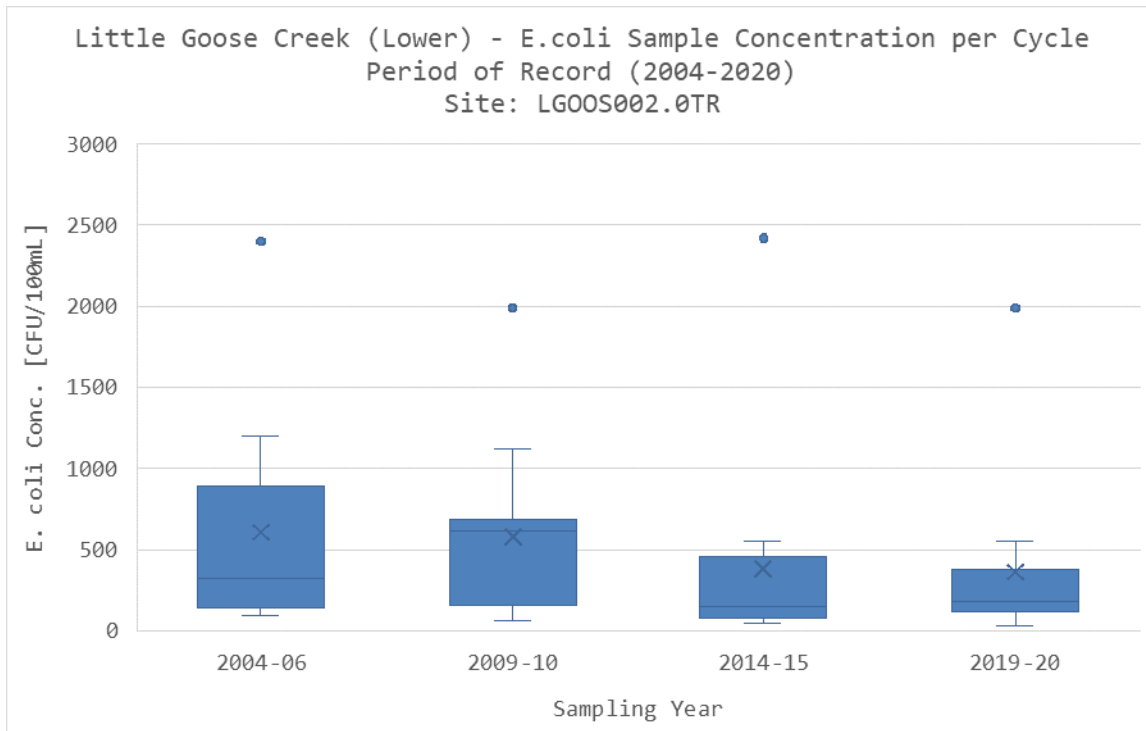


Figure G-20. Box and Whisker Plot for Little Goose Creek (Lower), Station LGOOS002.0TR

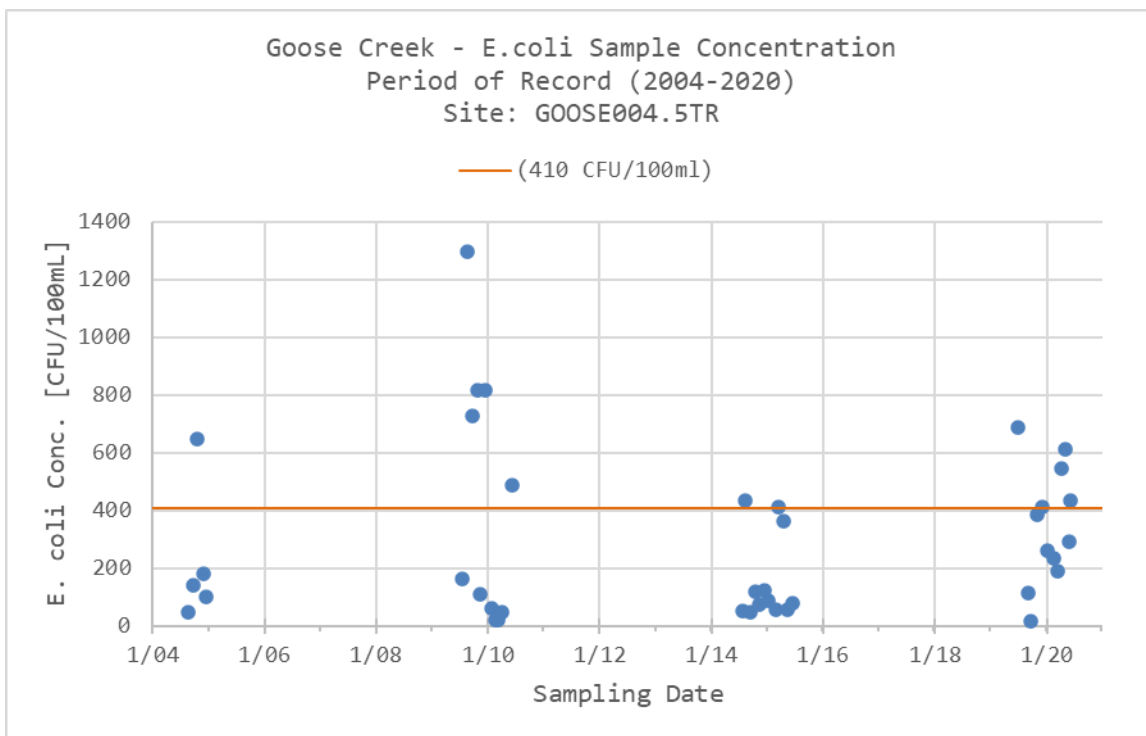


Figure G-21. Time Series Plot for Goose Creek, Station GOOSE004.5TR

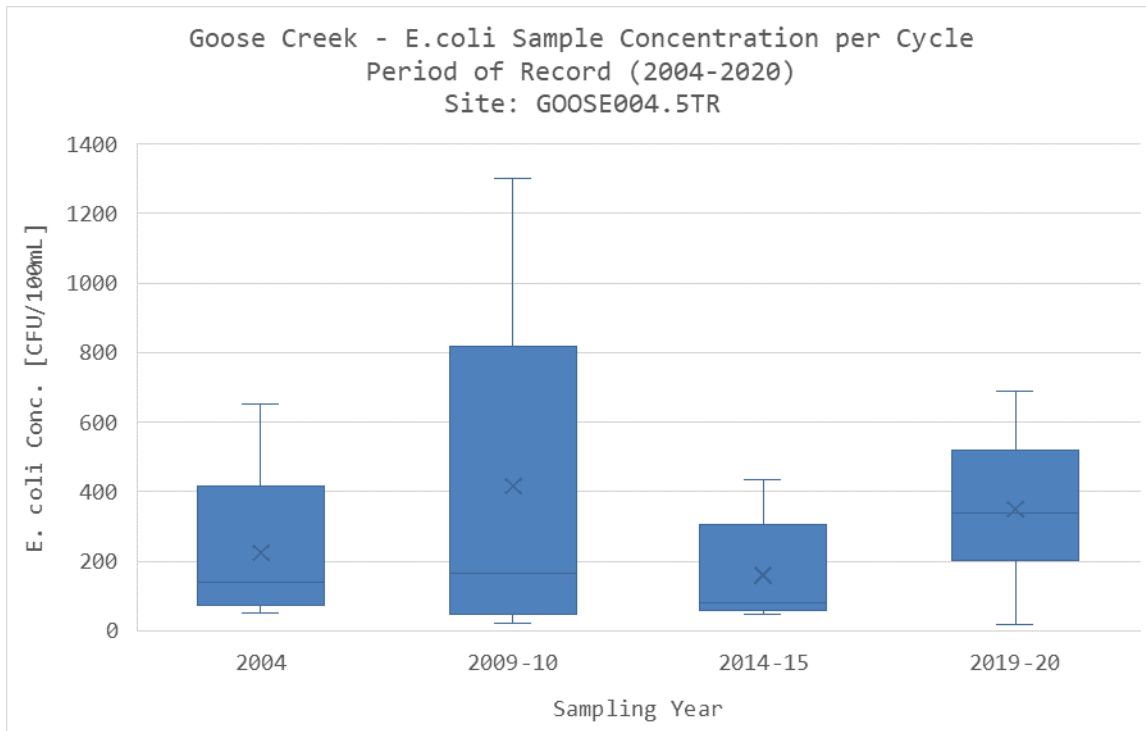


Figure G-22. Box and Whisker Plot for Goose Creek, Station GOOSE004.5TR

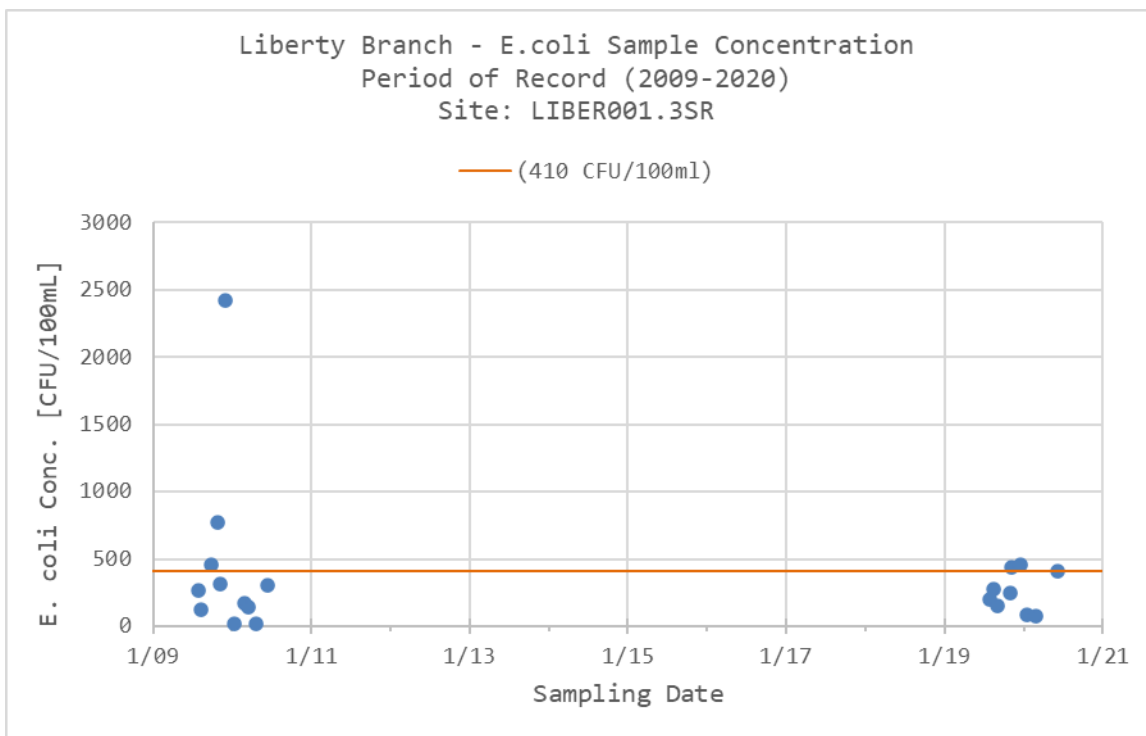


Figure G-23. Time Series Plot for Liberty Branch, Station LIBER001.3SR

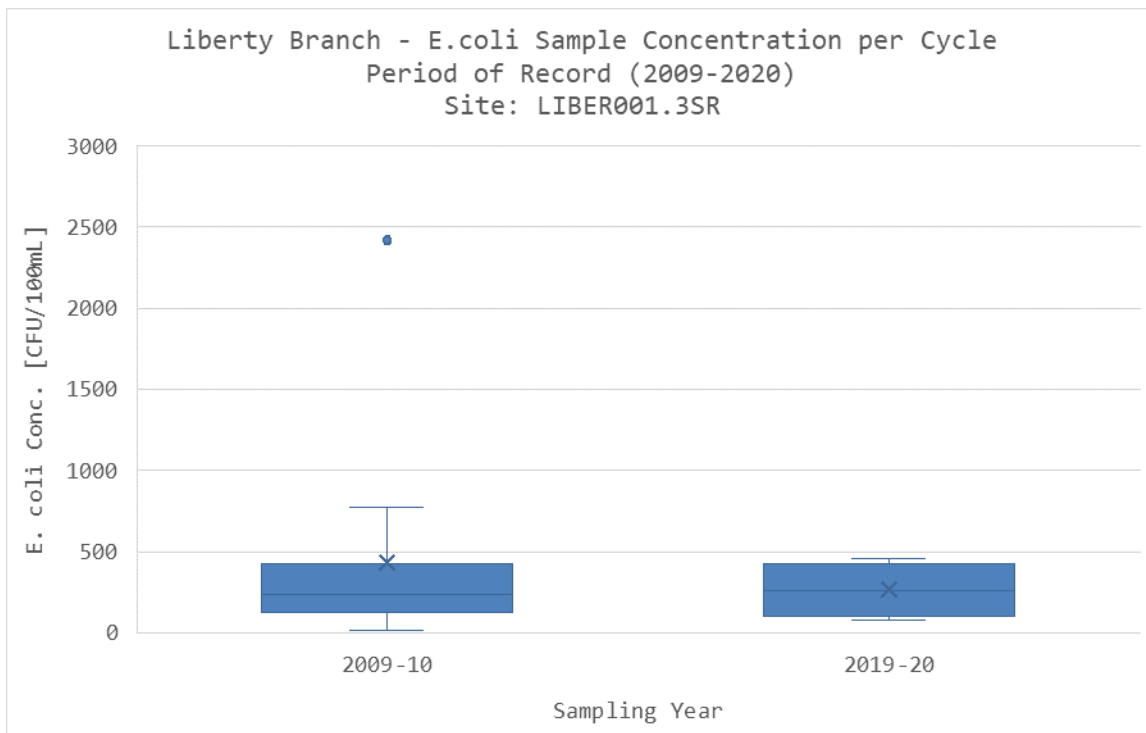


Figure G-24. Box and Whisker Plot for Liberty Branch, Station LIBER001.3SR

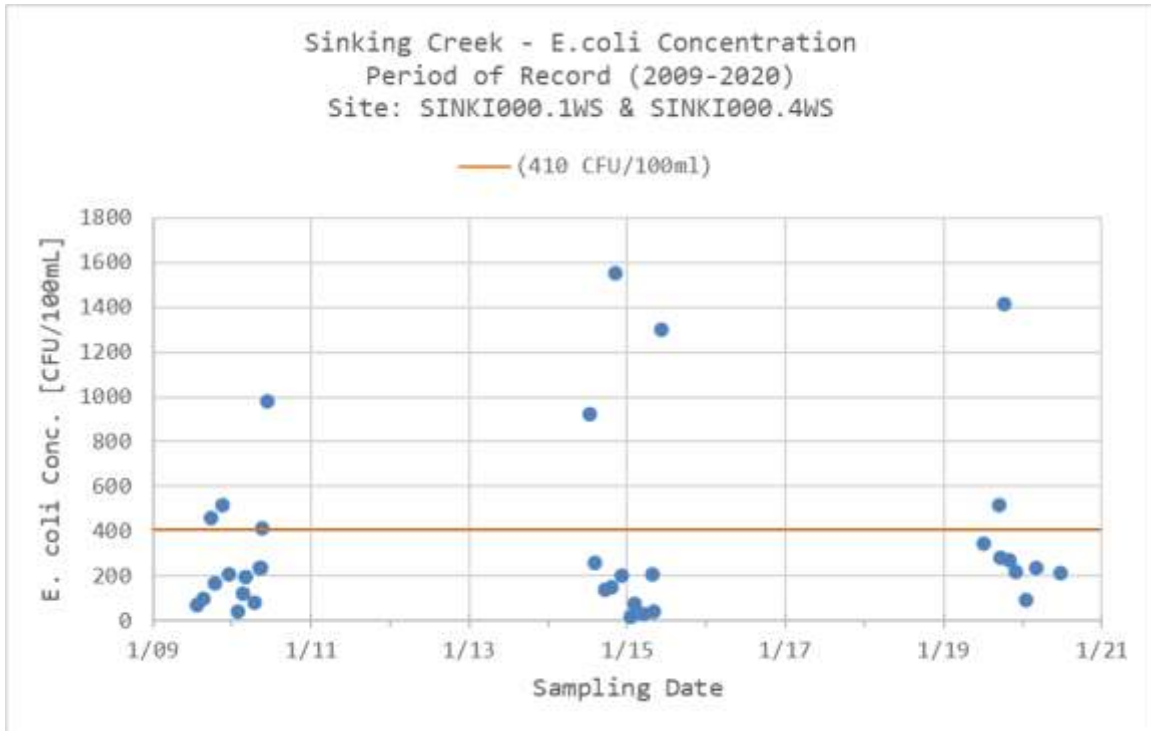


Figure G-25. Time Series Plot for Sinking Creek, Station SINKI000.1WS & SINKI000.4WS (ref. Table B-2, Note d)

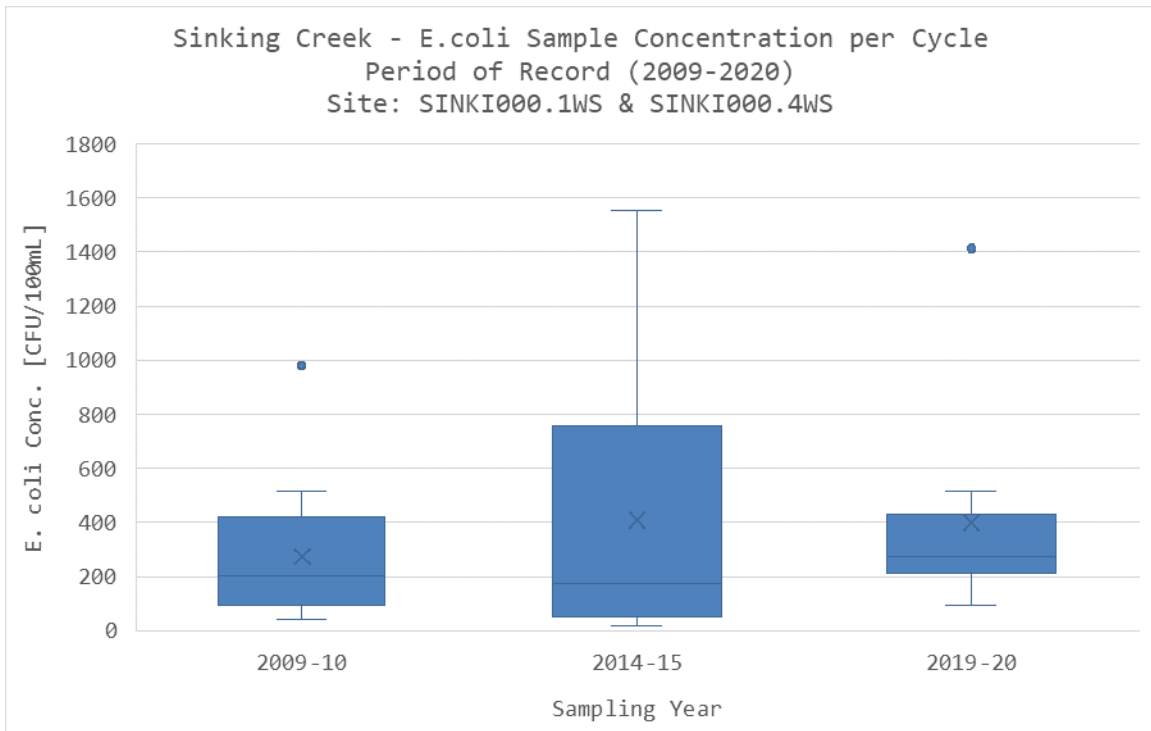


Figure G-26. Box and Whisker Plot for Sinking Creek, Station SINKI000.1WS & SINKI000.4WS (ref. Table B-2, Note d)

APPENDIX H

Public Participation

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