CHAPTER 4.2 WATER QUALITY ASSESSMENT SUMMARY

The overall water quality for Virginia is assessed based on whether the condition of the waterbody being assessed allows citizens to safely enjoy its designated uses as described in Virginia's water quality standards. Table 4.2-1 briefly describes the primary designated uses and the parameters used in this assessment to demonstrate their attainment. Several additional aquatic life sub-uses have been adopted for the Chesapeake Bay and the tidal tributaries. Additional information about the Bay sub-uses can be found in Chapter 4.6.

Table 4.2-1 Designated use descriptions and indicators

DESIGNATED USE	USE DESCRIPTION/INDICATORS
Aquatic Life Use, Chesapeake Bay sub-uses	Description: The propagation, growth, and protection of a balanced indigenous population of aquatic life that may be expected to inhabit a waterbody
	Indicators: Dissolved oxygen, pH, temperature, chlorophyll a, nutrients, water column and sediment toxics, toxicity tests, benthics, submerged aquatic vegetation
Fish Consumption Use	Description: Game and marketable fish species that are safe for human health
	Indicators: VDH notices, fish tissue toxics, water column toxics
Shellfishing Use	Description: Marketable shellfish (clams, oysters, mussels) that are safe for human health
	Indicators: VDH notices
Recreation (Swimming) Use	Description: Swimming, boating, and other recreational activities
	Indicators: VDH notices, bacteria
Public Water Supply Use	Description: Drinking water safe for human health
	Indicators: VDH notices, water column toxics
Wildlife Use	Description: The propagation, growth, and protection of associated wildlife
	Indicators: Water column toxics

The six-year assessment begins with an analysis of all quality assurance/quality control (QA/QC) approved data from DEQ ambient water quality, biological, sediment and fish tissue monitoring, special studies and/or other non-DEQ water quality data, including citizen monitoring data. Non-agency monitoring data is evaluated for use in the assessment using a process outlined in Part VI, Section 6.3.1 of the 2016 Assessment Guidance Manual. The results of these comprehensive data analyses are compared to both numeric and narrative criteria related to the designated uses established by Virginia's water quality standards, which are provisions of state and/or federal regulations. A description of the assessment methodology can be found in Chapter 4.1, as well as the 2016 Assessment Guidance Manual.

Statewide summaries of the river miles, estuarine square miles, and lake/reservoir acres within and bordering Virginia are presented in Tables 4.2-2 through 4.2-4. The overall assessment of each waterbody was determined by examining the support of up to six designated uses (see Figure 4.2-1), as appropriate, for each assessed waterbody. The assessment of a specific use depends on the types of data that are available. Additionally, not all uses may exist in a given water. For instance, the public water supply use only applies to the waters designated in Virginia's water quality standards. The shellfishing use only exists in estuarine waters.

Additional geographical re-indexing and use of the National Hydrologic Database (NHD) has altered the actual number of stream miles within the state from previous reports. The stream mile delineation guidance has provided basic guidelines to the regional assessment staff for associating the mileage assessed, relative to a specific sampling station. This is especially important where there are no easily identifiable changes in watershed characteristics. In some cases, the stream miles associated with a sampling station have been conservatively reduced or in other cases, slightly expanded from previous assessment reports. In many cases, additional monitoring stations have been added in the watershed and may increase the size of some impaired segments depending on the additional data collected and assessed. The stream mile delineations found in this report are only reflective of the 2016 assessment period but follow closely with the monitoring efforts reported in previous reports.

A total of 100,974 miles of rivers, 2,848 square miles of estuarine waters, and 117,215 acres of reservoir/lakes was determined to be available for assessment this cycle. This increase reflects the on-going refinement to DEQ's Geographic Information System (GIS) tools.

Table 4.2-2 Assessment Results for Rivers

Degree of Use Support	**Water Type**	**Total Miles** ***(Rounded to the Nearest Whole Number)***	**(%) Total**
Fully Support All Designated Uses **(EPA Category 1)**	River (mi.)	**34**	0.0%
Virginia Subcategory 1A		20	
Fully Support Some Uses but Insufficient Data to Assess All Uses **(EPA Category 2)**	River (mi.)	**7,082**	7%
Virginia Subcategory 2A		4,514	
Virginia Subcategory 2B		2,365	
Virginia Subcategory 2C		203	
Insufficient Data to Determine if any Uses are Being Met **(EPA Category 3)**	River (mi.)	**78,576**[1]	77.8%
Virginia Subcategory 3A		76,223	
Virginia Subcategory 3B		542	
Virginia Subcategory 3C		541	
Virginia Subcategory 3D		1,270	
Waters are Impaired or Threatened but do not need a TMDL **(EPA Category 4)***	River (mi.)	**6,924**	6.9%
EPA Subcategory 4A		6,695	
EPA Subcategory 4B		0	
EPA Subcategory 4C		228	
Waters are Impaired or Threatened and need a TMDL **(EPA Category 5)***	River (mi.)	**8,358**	8.3%

1 The conversion to the higher resolution (1:24,000) National Hydrography Dataset (NHD) resulted in a significant increase in stream mileage, and, consequently, a higher percentage of waters considered "not assessed" due to the inclusion of previously unmapped waterways—mostly small unnamed tributaries. DEQ's freshwater probabilistic monitoring program, described in chapter 4.4, includes coverage of small unnamed tributaries as part of the randomly generated station locations. Prob Mon data is used to answer questions about statewide and regional water quality conditions, and to identify problem areas for follow-up monitoring.

Degree of Use Support	Water Type	Total Miles *(Rounded to the Nearest Whole Number)*	(%) Total
Virginia Subcategory 5A		5,459	
Virginia Subcategory 5B		0	
Virginia Subcategory 5C		406	
Virginia Subcategory 5D		2,410	
Virginia Subcategory 5E		0	
Virginia Subcategory 5F		84	
Total Size	River (mi.)	**100,974**	100%

* Assessment Unit VAS-Q08R_PLR01A08 – Poplar Creek (3.03 miles) is incorrectly counted as Category 4A in the table. The aquatic life use benthic impairment could not be nested into an existing TMDL due to the lack of supporting water quality data and should remain as Category 5A. The overall Category for the Assessment Unit should be 5D.

Table 4.2-3 Assessment Results for Lakes/Reservoirs

Degree of Use Support	Water Type	Total Acres *(Rounded to the Nearest Whole Number)*	(%) Total
Fully Support All Designated Uses **(EPA Category 1)**	Lakes (acres)	**12**	0.0%
Virginia Subcategory 1A		0	
Fully Support Some Uses but Insufficient Data to Assess All Uses **(EPA Category 2)**	Lakes (acres)	**20,306**	17.3%
Virginia Subcategory 2A		6,949	
Virginia Subcategory 2B		13,357	
Virginia Subcategory 2C		0	
Insufficient Data to Determine if any Uses are Being Met **(EPA Category 3)**	Lakes (acres)	**3,373**	2.9%
Virginia Subcategory 3A		3,131	
Virginia Subcategory 3B		233	
Virginia Subcategory 3C		9	
Virginia Subcategory 3D		0	
Waters are Impaired or Threatened but do not need a TMDL **(EPA Category 4)**	Lakes (acres)	**13,622**	11.6%
EPA Subcategory 4A		13,224	
EPA Subcategory 4B		0	
EPA Subcategory 4C		398	
Waters are Impaired or Threatened and need a TMDL **(EPA Category 5)**	Lakes (acres)	**79,901**	68.2%
Virginia Subcategory 5A		72,043	
Virginia Subcategory 5B		0	
Virginia Subcategory 5C		632	
Virginia Subcategory 5D		7,139	
Virginia Subcategory 5E		0	

Degree of Use Support	Water Type	Total Acres *(Rounded to the Nearest Whole Number)*	(%) Total
Virginia Subcategory 5F		88	
Total Size	Lakes (acres)	**117,215**	100%

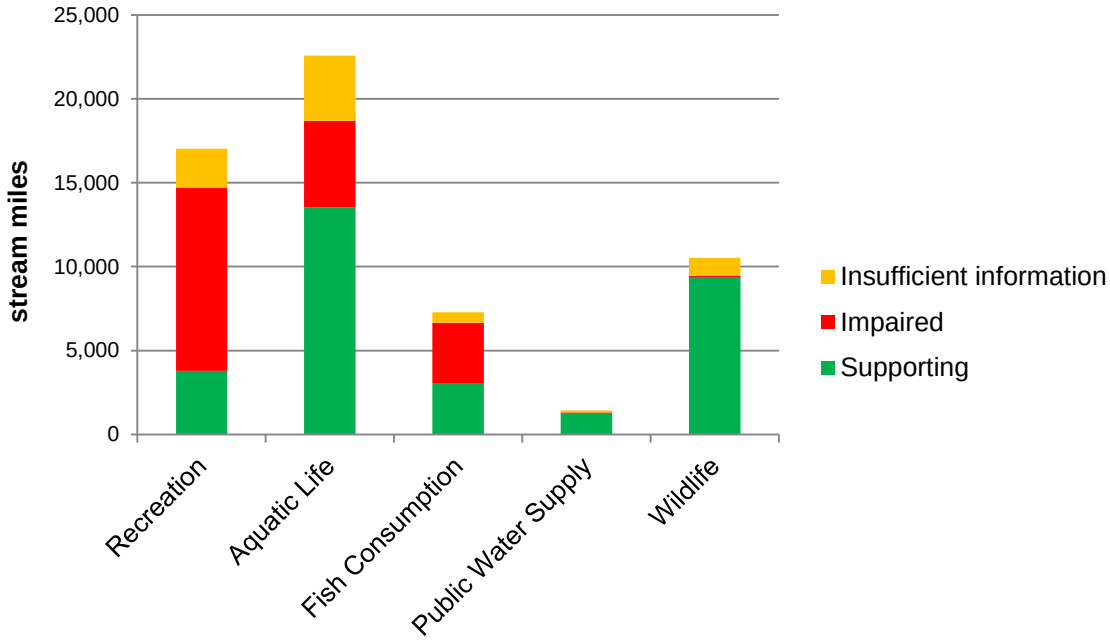
Table 4.2-4 Assessment Results for Estuarine Waters

Degree of Use Support	Water Type	Total Square Miles *(Rounded to the Nearest Whole Number)*	(%) Total
Fully Support All Designated Uses **(EPA Category 1)**	Estuary (sq. mi.)	0	0%
Virginia Subcategory 1A		0	
Fully Support Some Uses but Insufficient Data to Assess All Uses **(EPA Category 2)**	Estuary (sq. mi.)	**315**	11%
Virginia Subcategory 2A		262	
Virginia Subcategory 2B		48	
Virginia Subcategory 2C		5	
Insufficient Data to Determine if any Uses are Being Met **(EPA Category 3)**	Estuary (sq. mi.)	**400**	14%
Virginia Subcategory 3A		1	
Virginia Subcategory 3B		399	
Virginia Subcategory 3C		0	
Virginia Subcategory 3D		0	
Waters are Impaired or Threatened but do not need a TMDL **(EPA Category 4)**	Estuary (sq. mi.)	**86**	3%
EPA Subcategory 4A		86	
EPA Subcategory 4B		0	
EPA Subcategory 4C		0	
Waters are Impaired or Threatened and need a TMDL **(EPA Category 5)**	Estuary (sq. mi.)	**2,046**	72%
Virginia Subcategory 5A		41	
Virginia Subcategory 5B		0	
Virginia Subcategory 5C		0	
Virginia Subcategory 5D		1,967	
Virginia Subcategory 5E		0	
Virginia Subcategory 5F		37	
Total Size	Estuary (sq. mi.)	**2,848**	100%

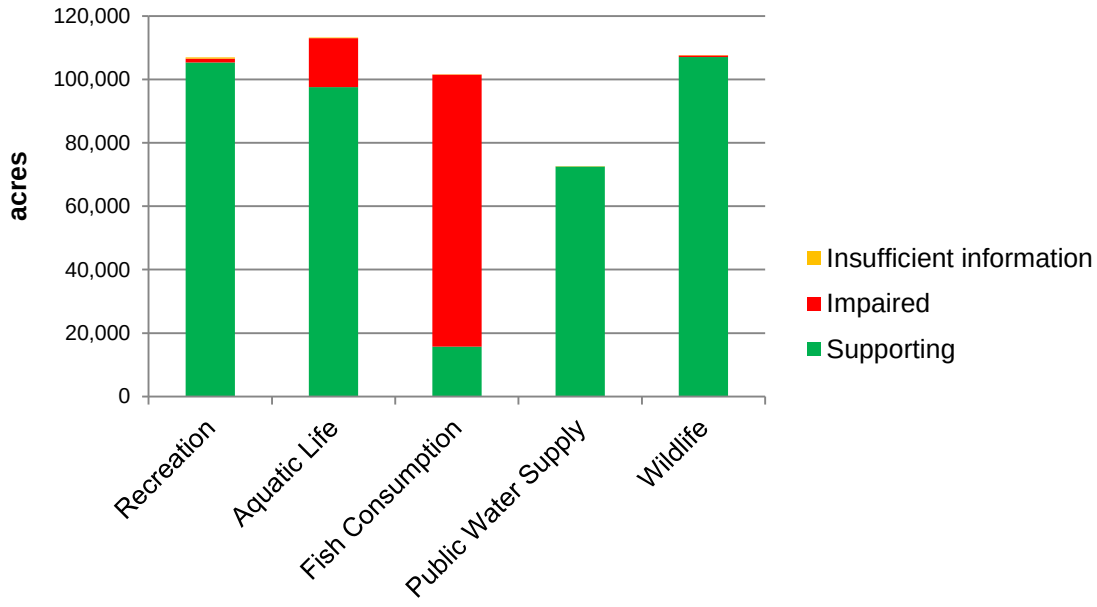
Figure 4.2-1 Designated use support summary. (Note: Waters that have some data, but not enough to determine use support, are classified as having "Insufficient information")

Size: ***All Sizes Rounded to the Nearest Whole Number***
Rivers - 100,974 miles
Lakes - 117,215 acres
Estuaries - 2,848 sq. miles

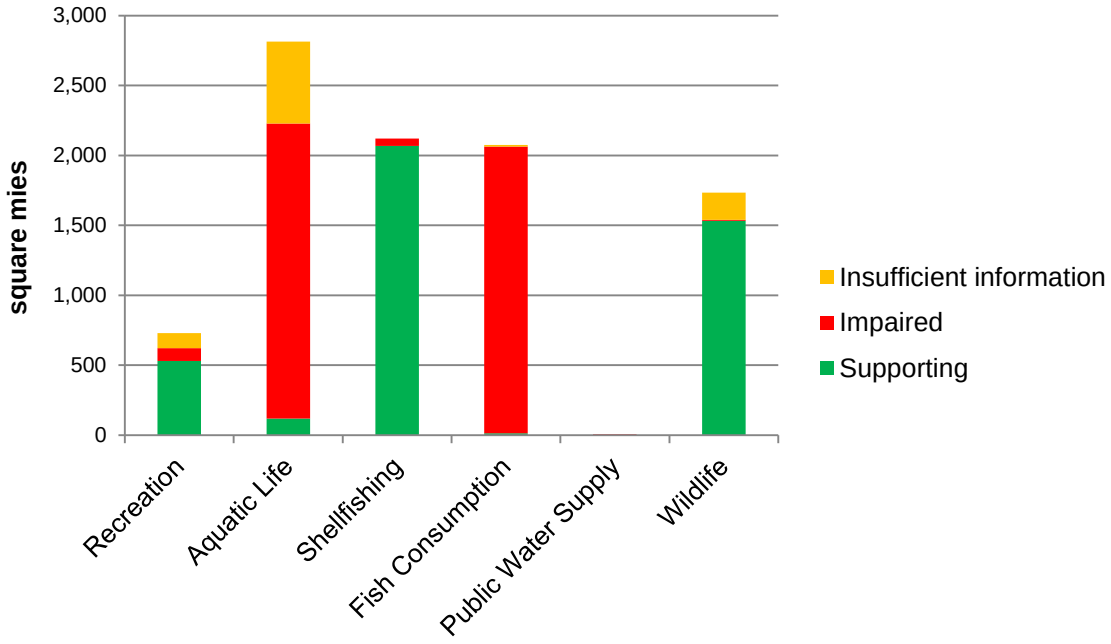
a) Rivers Assessment (78,576 miles were not assessed)



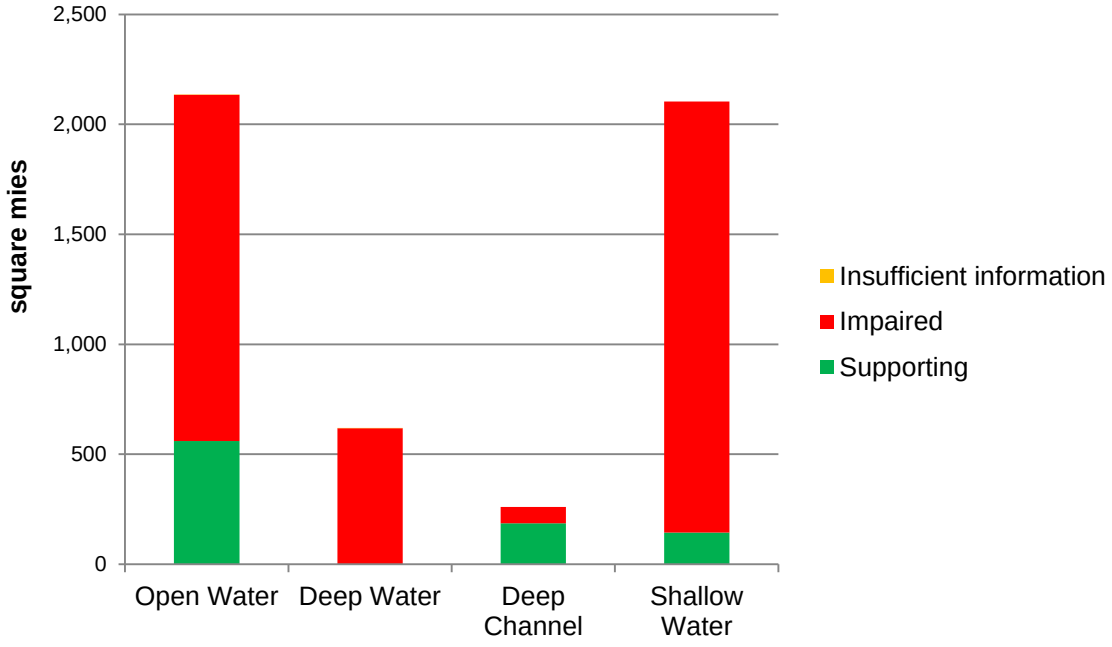
b) Lakes Assessment (3,373 acres were not assessed)



c) Estuaries assessment (400 sq miles were not assessed)



d) Assessment of Chesapeake Bay-specific designated uses (Migratory fish spawning and nursery use was not assessed.



Results

Figure 4.2-2 and Table 4.2-5 lists the major causes and sources of impairment for those waters not attaining full support for at least one designated use. Impairment causes and/or sources can be a "major impact", defined as that which causes a significant impairment to the waterbody, or moderate and minor impacts individually or in combination. Normally a major impact would be from a sole source with a large pollutant(s) contribution. Moderate and/or minor impacts have a slight to moderate effect on the waters and may be from a single moderate contributor or a combination of several minor contributors. It is important to note that moderate and minor impacts can, under certain conditions, work in conjunction to cause a major impact. Assessors take into consideration such factors as land use and co-occurring impairments when determining likely sources of pollution for a particular water.

One major cause of impairment of the aquatic life use is low dissolved oxygen concentration. All aquatic life depends on oxygen, and when it is depleted to the point where aquatic life is no longer sustainable, a water is said to be hypoxic. Hypoxia can result from natural processes, such as in slow-moving swamp waters that have large amounts of decaying plant material. It can also naturally occur in lakes/reservoirs when the water column becomes thermally stratified. However, chronic hypoxia often occurs for anthropogenic reasons. Nutrient pollution can cause hypoxia by promoting the growth of algae blooms. Excessive algae produce floating mats on the water surface which keep light from reaching rooted vegetation, therefore limiting its growth. Moreover, as algae die and settle to the bottom, decay processes reduce oxygen levels and create unfavorable conditions for other aquatic organisms. Fish kills often result from hypoxic conditions. Stormwater runoff, which often carries lawn/agricultural fertilizers and nutrient-rich animal wastes, is a major contributor of nitrogen and phosphorus pollution.

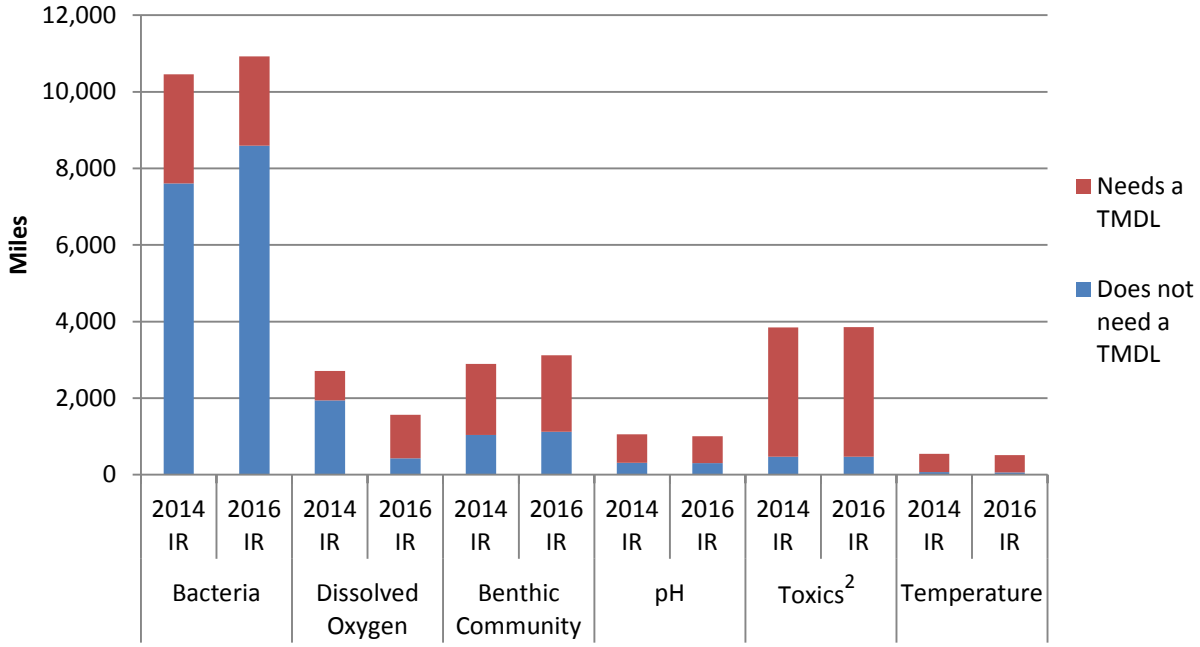
The major cause of impairment of the recreation and shellfishing uses is excessive bacteria. *Escherichia coli* (*E. coli*) is the pathogenic indicator used in freshwater, while enterococci is used in estuarine/coastal waters. These bacteria are associated with the fecal matter of warm-blooded animals. Bacteria and other microorganisms are found naturally in water, but can become harmful to human health in high concentrations. Exposure to water-borne pathogens can cause various gastrointestinal, skin, neurological, and other serious diseases. Stormwater runoff often carries domestic and livestock animal wastes, and it is a major source of impairment. Inadequate sewerage and combined sewer overflows are other major sources.

Mercury and polychlorinated biphenyls (PCBs) are the major causes of impairment of the fish consumption and public water supply uses. Mercury, specifically in the form of methylmercury, causes damage to the human central nervous system and brain. The metal can be found naturally, but its appearance in the environment is often due to anthropogenic reasons. Mercury commonly enters water through atmospheric deposition. Air particles can travel vast distances, so locating a single source is not possible in most cases. Some anthropogenic sources of atmospheric mercury are coal combustion, waste incineration, and metal processing. PCBs are another common cause of impairment. While the toxicity of individual PCBs depends on the specific form (or congener), this class of organic compounds contains endocrine disruptors, neurotoxins, and carcinogens. Like methylmercury, PCBs accumulate in fish tissues. The production of PCBs, used mainly as coolants and insulating fluids, was banned in the US in the late 1970s. However, PCBs are still quite ubiquitous, frequently appearing as "legacy contaminants" in soils close to where dischargers once used PCBs in industrial processes. These soils can then enter nearby water sources through stormwater runoff.

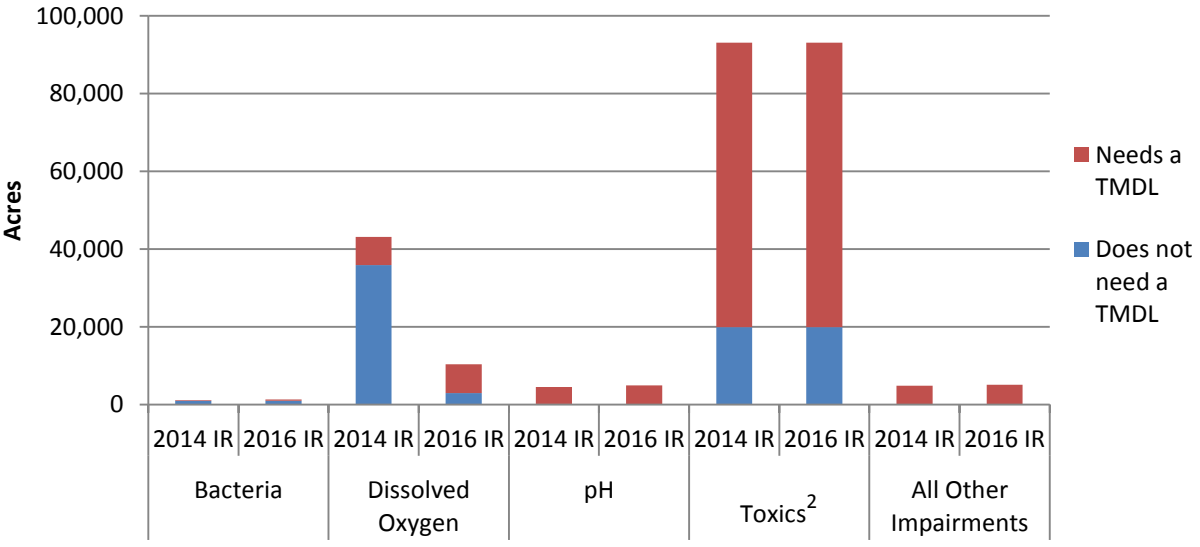
As evident in Figure 4.2-2, below, the Commonwealth has made significant progress on completing TMDL plans for many impairments, including bacteria, benthics, and dissolved oxygen, while other impairments, such as toxics in fish tissue, still require a TMDL. DEQ currently has TMDL projects underway to address toxics in fish tissue in the New River and lower James River basins, and is initiating a TMDL study to address toxics in fish tissue in the upper James River. Chapter 7.2 provides more information on the prioritization process for TMDL development through 2022.

Figure 4.2-2. Summary of impaired waters as reported in the 2014 and 2016 Integrated Reports. Differences between reporting periods reflect both proposed delistings and new impairment listings. Blue shading indicates the size of the waterbody that does not require a TMDL because one has been developed, other pollution controls are in place or the condition in considered natural (category 4). Red shading indicates that a TMDL is required (category 5).

a. Stream miles.



b. Acres of lakes.



[2] The overwhelming majority of toxics impairments in rivers, lakes and estuaries are due to exceedences of thresholds for PCBs and Mercury in fish tissue.

c. Square miles of estuarine waters.

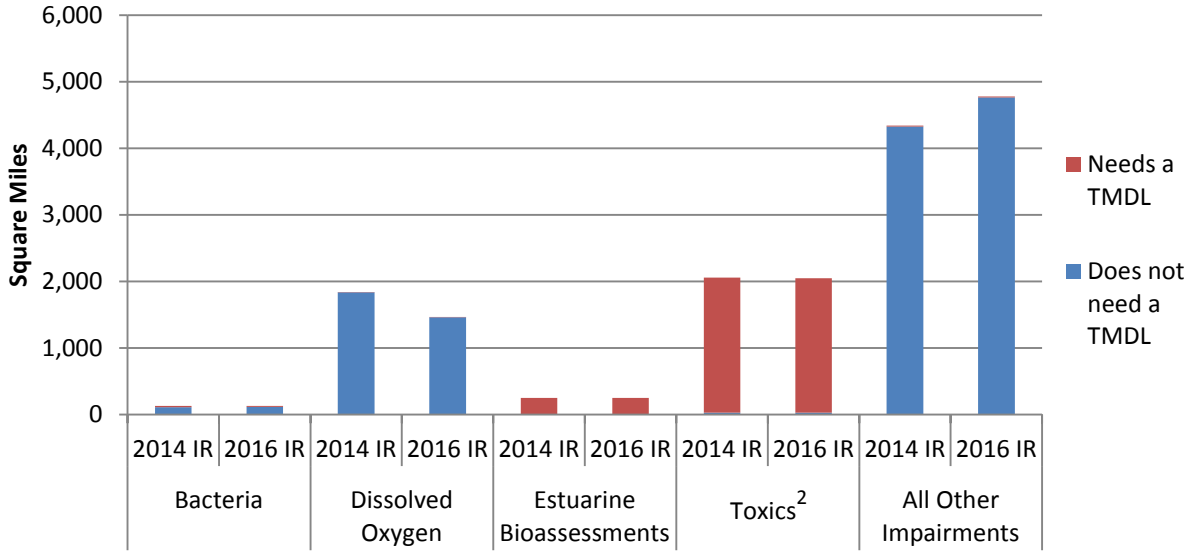


Table 4.2-5 Suspected sources of designated use impairment, by water body type, ranked by percentage of impaired water size. (Note: Waters can have multiple sources of pollution.)

Rivers		***Lakes***		***Estuaries***	
Source Unknown	39%	**Source Unknown**	96%	**Source Unknown**	96%
Wildlife other than Waterfowl	39%	**Natural Conditions**	5%	**Industrial Point Source Discharge**	95%
Livestock Grazing or Feeding Operations	29%	**Atmospheric Deposition (Toxics)**	3%	**Internal Nutrient Recycling**	89%
Non-Point Sources	27%	**Wildlife other than Waterfowl**	1%	**Loss of Riparian Habitat**	89%
Unspecified Domestic Waste	20%	**Dam or Impoundment**	1%	**Atmospheric Deposition (Nitrogen)**	89%
Wastes from Pets	19%	**Urbanized High Density Areas**	1%	**Sources Outside State Borders**	89%