

4. TMDL Support Monitoring Program

(1) Introduction, Statutory, and Regulatory Framework

Section §303(d) of the 1972 Clean Water Act requires the states to identify waters not in compliance with water quality standards, establish priorities, develop a biennial list of the impaired waters, and develop Total Maximum Daily Loads (TMDLs) for the waters on the §303(d) Impaired Waters List. The US EPA promulgated regulations, 40 CFR §130.7, for §303(d) of the CWA in July of 1992 - TMDLs were consequently to be implemented as well, through existing pollution reduction regulations and voluntary strategies.

In 1997, the Virginia General Assembly enacted the [Water Quality Monitoring, Information, and Restoration Act](#) (WQMIRA) [I-0d.pdf], §62.1-44.19:4 through 19:8 of the Code of Virginia. This statute directs DEQ to develop a list of impaired waters and develop watershed clean-up plans, such as TMDLs, for these waters. The state statute also directs DEQ to develop implementation plans for the TMDLs.

The State Water Control Law, Chapter 3.1, Article 1 of the Code of Virginia, authorizes the State Water Control Board to control and plan for the reduction of pollutants impacting the chemical and biological quality of the state's waters resulting in the degradation of the swimming, fishing, shell fishing, aquatic life, and drinking water uses.

Beginning in 1998, Virginia and other States were required to prepare plans for restoring the quality of polluted waters on the 303(d) list of impaired waters. These restoration plans are called TMDLs – *Total Maximum Daily Loads*. A TMDL Report is a special study to carry out the following:

- (1) Quantify the amount of a pollutant that the impaired water can assimilate and still meet water quality standards,
- (2) Identify all sources of pollution contributing to the violation of water quality standards,
- (3) Calculate the pollutant amount entering the stream from each source, and
- (4) Calculate reductions in pollutant loads needed for attainment of Water Quality Standards.

For many years the focus of DEQ's pollution reduction efforts was the treated effluents discharged into Virginia's waters via the VPDES permit process. The TMDL process expanded the focus of DEQ's pollution reduction efforts from the effluents of wastewater treatment plants and industrial dischargers to the non-point source pollutants causing impairments of the state's streams, lakes, and estuaries. Also, the reduction methods have been expanded from the point-source permit process to include a variety of voluntary non-point strategies and Best Management Practices (BMPs).

In addition to TMDLs, Virginia is exploring methods to clean-up watersheds without completion of a full TMDL. If sources are identified and can be addressed to attain water quality standards, full TMDL development may not be necessary.

Over the past decade the focus of water quality management in Virginia has evolved from the 305(b) process of identifying polluted waters to the inclusion of the 303(d) process of restoring these waters to meet their applicable water quality standards. In further consequence, the monitoring strategy of the Department of Environmental Quality (DEQ) has placed considerable focus on providing the data needed to produce defensible watershed clean-up plans, including TMDLs, for the restoration of impaired streams.

The TMDL process involves:

- (1) Identification of impaired waters through routine ambient monitoring programs,
- (2) Conducting supplemental monitoring to identify the cause, extent and severity as part of the TMDL development process,
- (3) Development of TMDL Implementation Plans and installation of the necessary pollution control measures, and
- (4) Post TMDL implementation follow-up monitoring to determine whether implemented measures are effective and the waters are being restored to their designated use(s).

(2) Monitoring Objectives

The purpose of the TMDL Support Monitoring Program is to provide the information necessary to develop defensible Total Maximum Daily Loads (TMDLs) and associated pollution controls. These activities facilitate the accomplishment of Objectives 2, 4, 9, and 13 of the WQM Strategy. TMDL support is a high priority monitoring activity.

(3) Monitoring Design

There are three categories of monitoring that are used in TMDL development and implementation: Ambient monitoring, Supplemental monitoring and Follow-up monitoring. This categorization allows better management of DEQ's monitoring resources. Consultants responsible for the development of TMDL models may suggest potential sites for additional stations to the regional office TMDL coordinators, *e.g.* based on land use practices and/or other relevant factors specific to the impaired segments.

(i) Ambient Monitoring

The first step in the TMDL development process is listing the water as impaired on the 303(d) list. Listing of such waters is an integrated process involving ambient water quality monitoring and the Virginia Water Quality Standards. This is done by a comparative analysis of water quality data collected from the existing ambient (watershed, trend and probabilistic) stations to the relevant water quality standard. If known, the cause, source and extent of the impairment(s) are also identified in this process.

After the resultant TMDL has been developed, approved by EPA, and implemented, ambient monitoring in the watershed will continue at existing and future watershed stations, trend stations, and possibly at special study stations. Data from these stations will be used both to assess ambient water quality and to evaluate the implementation plan and water quality improvements in the watershed (see TMDL Follow-up Monitoring, below).

Regional monitoring staffs provide a description (with station IDs) of trend and watershed stations in the watershed for inclusion in the monitoring section of TMDL QAPPs and reports. When normal ambient or biological watershed monitoring is rotated out of a watershed where EPA has approved a TMDL, the regional monitoring staff notifies the regional TMDL coordinator.

(ii) Supplemental TMDL Monitoring

Once water body segments have been identified as impaired, and TMDL development is scheduled, supplemental water quality monitoring may be necessary to provide data on the severity, geographic extent, and potential source(s) of the pollutant(s). This supplemental monitoring can consist of adding specific parameters at existing stations and/or establishing additional stations. The DEQ regional office TMDL

Coordinator is responsible for developing an appropriate QAPP in support of supplemental monitoring (such as sedimentation studies, or diurnal DO curves, etc.). Some anticipated data needs for supplemental monitoring are provided in the “Specific Data Needs” section below. The Quality Assurance Officer of DEQ’s Water Quality Monitoring and Assessment staff must approve the QA Project Plan before sampling efforts begin (see Chapter IV - Quality Management Program).

(iii) TMDL Follow-up Monitoring

Implementation monitoring will generally be done in the same manner as that done during TMDL development. However, modifications may be made to reflect the needs of the implementation plan. The selection of sites and the frequency and duration of implementation monitoring will be determined by the TMDL staff, in cooperation with regional monitoring staff and representatives from other agencies.

If monitoring has been rotated out of the TMDL watershed following TMDL development, then follow-up monitoring will probably be needed following the actual installation of a significant portion of BMPs or following a similar event-triggered target date set by TMDL staff. The monitoring may come from ambient or supplemental station rotation at the beginning of the calendar year, if in phase with TMDL Implementation Plan needs, or via a special study.

Follow-up monitoring also may occur at ambient watershed and trend stations. Once a TMDL has been completed, ambient watershed monitoring can be temporarily discontinued until the DEQ TMDL staff, in cooperation with other state agencies involved in the TMDL program, determines that implementation measures addressing the source(s) of impairment(s) are installed. Monitoring at rotating watershed stations can resume at the start of the following calendar year, at the next scheduled monitoring station rotation, or as deemed necessary by the regional office or TMDL staff, who may specify the frequency and duration of the required monitoring.

(4) Monitoring Needs Coordination

The TMDL staff should try to plan and anticipate the supplemental monitoring needs for the program and have them incorporated into the annual DEQ Monitoring Plan by 1 December of each year. On occasion, however, an unanticipated data need may surface in the TMDL process. If this data need is essential to the integrity of the TMDL process, a request for monitoring may be made outside of the normal annual monitoring plan schedule. The TMDL group tries to minimize the frequency of such occurrences.

DCR and DMME also need to communicate their anticipated TMDL follow-up monitoring requirements for the upcoming year to the appropriate DEQ Central Office (CO) TMDL staff with sufficient lead-in time. Central Office TMDL staff must communicate with the Regional Office (RO) TMDL coordinators in time to assure that the follow-up and/or implementation monitoring is included in the RO monitoring plans by the December 1 due date.

(5) Core and Supplemental Water Quality Indicators

Due to the diversity of possible TMDL data needs, core and supplemental water quality indicators are specifically defined in each applicable TMDL QAPP. Data needed to support TMDL development may include Bacteria Source Tracking (BST) for bacteria TMDLs (the parameter of concern in freshwater streams will be *E. coli*). The collection of supplemental stream flow data is often required to perform Load Duration Analysis TMDLs for bacteria. For benthic TMDLs, the assessment should focus on biological monitoring and the ambient field parameters (temperature, pH, DO, conductivity/salinity), pollutant concentrations and toxicity. More detail is provided in the “Specific Data Needs” section below.

(6) Quality Assurance measures

Quality Assurance Project Plans are developed specifically for each TMDL project that requires supplemental monitoring not included in normal ambient and biological monitoring QAPPs. These TMDL QAPPs are deposited in DEQ's Comprehensive Environmental Data System (CEDS) database as documentation of those TMDL studies included in the Special Studies module. If supplemental monitoring requires parameters not already included in the approved QAPP, a revised QAPP or an addendum is produced and deposited in the same Special Studies module. The QAPP includes site selection, parameters to be monitored, and frequency and duration of sampling for the data to be collected. The collection and transportation of normal samples and of QA/QC samples (5%), as well as their subsequent laboratory analyses, are conducted in accordance with the DEQ ambient monitoring QAPP and SOP. The WQM Program QA/QC Officer is responsible for the required confirmations and laboratory and field audits.

(7) Data Management/Data Analysis

For samples collected from ambient, supplemental and follow-up TMDL monitoring, and that are subsequently submitted to the state laboratory (DCLS) for analysis, data management follows the same protocols and processes as that of the ambient monitoring program. Data management for samples analyzed by contracted consulting firms and/or laboratories will be specified in the pertinent contracts and/or QAPPs.

Regional planners review the data collected from each study as it becomes available, to determine if the goals of the study as outlined in the project plan are being met. If the study is inconclusive, it may be extended and/or appropriately modified, as documented in an updated project plan.

The RO TMDL staff, in conjunction with other affected state agencies, will review data from follow-up stations to determine if the implemented pollution control measures are effective and to make recommendations on redesign of controls (as necessary) and on the need for continued monitoring at follow-up stations. Annual recommendations must be made to the regional monitoring coordinator in time to satisfy the December 1st target date for the annual monitoring plan.

(8) Reporting Requirements

Reporting requirements for individual TMDL development projects are specified in the relevant QAPPs and/or TMDL development contracts. The results from ambient, supplemental and follow-up monitoring are also included in the normal assessment process for 305(b) / 303(d) Integrated Water Quality Reports.

(9) General Support and Infrastructure

To meet the 1999 Consent Decree (CD) that resulted from a settlement by EPA with plaintiffs regarding enforcement of the TMDL provisions of the Clean Water Act, Virginia completed TMDLs covering approximately 225 shellfish and 375 non-shellfish CD impairments, and approximately 198 non-CD impairments. Virginia received credit under the CD for an additional 145 delisted or re-categorized impairments. DEQ, assisted by DCR and DMME, met the requirements of the 1999 Consent Decree utilizing resources provided by EPA grant funds {§106, §104(b)(3), §604(b) and §319} and the Virginia General Assembly.

Since completing the requirements of the 1999 CD, Virginia has continued to develop approximately 50 TMDLs per year in accordance with a TMDL Development pace agreement with EPA. Virginia currently develops TMDLs using a "watershed approach" when possible. The watershed approach to TMDL development allows watersheds with similar characteristics to be combined under a single TMDL equation resulting in cost and time efficiencies. Virginia has also established a structure to develop TMDLs and Implementation Plans concurrently for improved TMDL outcomes and greater

efficiency. These efficiencies are very important to the continued success of the TMDL program given that DEQ has and will continue to experience reductions in federal funds.

(10) Plan and Schedule

The agency’s schedule for TMDL development was initially determined by a federal court Consent Decree²⁷. Watersheds are currently prioritized for TMDL development based on risk, public interest, available monitoring, regional input, and available funding. TMDL development schedules are developed about every two years, and posted on [Virginia’s TMDL website](http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment.aspx) [http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment.aspx].

By September of 2013, nearly 1000 TMDLs will have been developed and approved by EPA, or submitted to EPA for approval. Draft and Approved TMDL reports, plus current schedules for TMDL development projects in Virginia are also available on [DEQ’s TMDL webpage](#) at the address above. Future updates will be posted at the same Website address. DEQ will commit monitoring resources to all phases of TMDL development and implementation, as conditions permit.

Table III-B-4-2 - TMDL Development Schedule

Year	1999 - 2010 CD TMDL	1999 - 2010 Non-CD TMDL	Post CD TMDL Schedule	Totals
2000	11	0		11
2002	24	0		24
2004	91	8		99
2006	170	36		206
2008	132	82		214
2010	172	72		244
2012			111	111
Totals	600	198	111	909

TMDL-related monitoring will continue to make increasing demands on VA-DEQ resources for the foreseeable future. Cost estimates for TMDL development depend not only on the parameters of concern, but also upon the extent and severity of the impairment and the complexity of the local hydrology. Consequently, it is challenging to estimate resource requirements over the next ten years. The draft VA 2012 Integrated Report on water quality lists roughly 3200 impairments in Virginia’s waters. Three hundred of these are listed as impaired due to “natural causes”. For example, dissolved oxygen impairments in swamp waters may be considered natural. This number (3200) represents many waters that have multiple impairments. The large number of impairments requiring TMDLs or other clean-up plans will present a significant monitoring challenge. The most significant challenges are listed in section (11) – “Specific Data Needs”, below.

²⁷ American Canoe Society and The American Littoral Society vs. the United States Environmental Protection Agency. Civil Action No. 98-979-A, filed 11 June 1999 in the US District Court for the Eastern District of Virginia, Alexandria Division.

(11) Specific Data Needs

(i) Bacteria TMDLs

When required, DEQ's Office of Surface Water Investigations conducts supplemental stream flow monitoring at stations identified by TMDL staff. Monitoring at tributaries contributing to the impairment has been scheduled as part of watershed runs or TMDL special study runs by some regional offices. Some regional offices are cooperating with citizen groups.²⁸ Follow-up monitoring during the implementation phase (both ambient and Bacterial Source Tracking - BST) will present a significant challenge, since the TMDL stations need to be retained, at least periodically, until de-listing occurs. There is some overlap with benthic TMDL stations, and field parameters needed for both bacteria and benthic impairments may be collected at the same site for both impairment studies. See "[TMDL Post Implementation Monitoring IM](#)" [III-B-4-12] for guidance in establishing post implementation monitoring for bacterial TMDLs.

If BST monitoring is determined to be necessary, it may consist of a minimum of 12 monthly BST samples collected at each station identified by the TMDL staff. BST monitoring should then also be conducted at ambient stations and in some watersheds the BST monitoring sites will be expanded to cover pollutant source diversity. TMDL staff determines the need for supplemental BST monitoring sites. Shorter term focused BST or other source studies may help DEQ differentiate humans, pets, and urban wildlife sources particularly in urban areas.

(ii) Benthic TMDLs

Biological monitoring to verify impairments or to add habitat evaluations should be conducted for all stations without habitat data or with data more than three years old, or with stations bracketing point source discharges. Relative Bed Stability is recommended for watersheds where sediment may be the pollutant of concern. Follow-up monitoring during the TMDL implementation phase, and additional monitoring to provide supplemental information or based on citizen recommendations, will also be needed for most benthic TMDLs. Lastly, a preliminary evaluation of macroinvertebrate data should be included in the biological surveys to help identify and target specific water quality parameters.

Water quality monitoring needs for benthic TMDLs will vary, based on the type of stream and watershed. Monitoring needs for benthic TMDLs can potentially be very demanding because of the large number of parameters that must be measured in order to identify the stressor(s). In areas where water quality stations are not co-located with biological stations, stressor identification analyses for benthic TMDLs need to be conducted with very limited amounts of data. The quality of stressor identification analyses would improve with additional data, including more sites, longer-term monitoring, and the inclusion of additional parameters. Ambient water quality monitoring should be performed at both impaired and reference stations to increase the number of watersheds that can be used in paired watershed TMDL studies.

A proposed parameter list for consideration with benthic TMDL development includes pH, DO, temperature, specific conductance, total solids (TS), total dissolved solids (TDS), total suspended solids (TSS), turbidity, nitrate nitrogen (NO₃-N), total nitrogen (TN), total Kjeldahl nitrogen (TKN), total organic carbon (TOC), orthophosphate (o-P), total phosphorus (TP), sulfates and chlorides. This parameter list and a specified frequency of monitoring are considered a starting point, and should be customized for each benthic TMDL project. Five-day biological oxygen demand (BOD₅) also may be needed on streams with point sources. Nutrient data may not be needed if there is no evidence of nutrient enrichment (e.g., no

²⁸ In a number of cases, DEQ is providing citizen monitoring groups with resources for the purchase of bacterial test kits and with training in their use.

excessive algal growth or no low DO values during the nocturnal phase of the diurnal curve). Diurnal DO monitoring should be performed on all benthic impairments (between June and September if possible) to rule out significant nutrient impacts. In those instances where toxic pollutants are considered possible stressors, water and/or sediment toxicity tests should be performed at ambient stations to either rule out or support toxicity impacts, based on best professional judgment. However, a contractual laboratory will have to be procured to perform these tests. Specialized studies for sediment (DCLS parameter group codes SVS, PES1, and MET1S) and water column parameter-specific toxicity should be initiated in cases with high (current or past) urban and/or industrial influence. An evaluation should be conducted of TSS as an appropriate surrogate parameter for sediment. Data collection needs should be defined for benthic TMDLs, preferably two years prior to the TMDL due date.

(iii) Natural pH and DO

Monitoring to support site-specific criteria is necessary for impairments due to low pH and DO caused by natural conditions. Based on the Piedmont RO (PRO) experience and on recommendations from TMDL studies in the Appomattox River Basin, each impairment required seven monthly runs averaging 20 stations each (140 stations/mo.) during 12 months, using a Hydrolab, including monthly sampling of group codes TNUTL and NUT4, usually at the original listing station, to satisfy the low nutrient criteria for Class VII Swampwater designation. Supplemental monitoring for low DO impairments consists of nutrients, BOD₅, chlorophyll (for lakes), and TOC. Supplemental monitoring for low pH impairments consists of alkalinity and hardness measurements.

(iv) Special Studies

Within the Valley RO (VRO) there is one TMDL completed for Hg (South River) and one scheduled for PCBs. These studies have and will require additional monitoring efforts that will include more costly analyses, such as sediment and possibly fish tissue analysis. Multiple monitoring sites will also be needed to identify the locations of source(s) and/or environmental accumulations. The Hg monitoring of the South River/Shenandoah River has been underway for some time as part of the South River Science Team efforts. PCB monitoring of the Maury River will need to be initiated. Additional monitoring in Lewis Creek for PAHs, Hg and pesticides was required, due to findings during the investigation of the benthic impairment there. The final benthic stressors and subsequent TMDLs for the benthic impairment on Lewis Creek were determined to be sediment, PAHs, and lead. Additionally, VRO has several pH and benthic impairments due to atmospheric deposition (acid rain) that will need to be addressed and will require additional monitoring fieldwork.

Piedmont Regional Office (PRO) currently has one PCB TMDL and four mercury (Hg) source assessment studies, and completed four other Hg assessment studies in 2012. Each of these may result in a TMDL within the next 10 years. These source assessment studies are forecasted to last through 2013.

Within Blue Ridge RO (BRRO, Roanoke) there is one TMDL scheduled for PCBs. This study will require additional monitoring efforts that will include more costly analyses, such as sediment and fish tissue analysis. Multiple monitoring sites will be needed to identify locations of source(s) or accumulation(s).

Blue Ridge RO (BRRO, Lynchburg) currently has four PCB impairments that require additional sediment and fish tissue work to fully characterize the spatial extent of the problem, as well as source identification studies throughout the watersheds. Several TMDL studies are scheduled to occur in the coming years. The name of the study and planned year of study initiation include the following: the James River PCB study, due in 2016, the Dan River PCB study due in 2014, Kerr Reservoir due in 2014, Lake Gaston due in 2016.

At present there are nine Mercury impaired water bodies that will require additional sediment and fish work to fully characterize the spatial extent of the impairment, as well as source identification studies throughout the various watersheds. These watersheds are located throughout the BRRO-L coverage area and range is due date from 2020-2022.

Southwest RO (SWRO) currently has ten PCB impairments, with additional fish tissue and sediment work scheduled. SWRO is collaborating with BRRO, Roanoke on the development of a PCB TMDL for the New River. Sampling in both regions is scheduled to begin in Spring/Summer 2013. They expect to complete the project over the next 24 months. SWRO is also scheduled to begin collecting chloride data on the North Fork of the Holston River. This data will be used to assist with tracking chloride levels after the modification of the Upper North Fork Holston River Chloride TMDL.

Northern RO (NRO) is in the process of collecting PCB water column and fish tissue samples to support development of a PCB TMDL for Mountain Run, located in Culpeper, VA. The TMDL development process is scheduled to begin in 2017. Additionally, major VPDES municipal point sources in the tidal freshwater Rappahannock River watershed are conducting low-level PCB monitoring during their current permit cycle to support the development of the PCB TMDL for the Tidal Freshwater Rappahannock River. This TMDL will be a joint effort with PRO and is expected to take place sometime after 2018.

(12) Implementation Plan (IP) Development/TMDL Follow-up Monitoring

Another significant challenge that must be added to ongoing TMDL study needs is related to TMDL monitoring associated with the development of implementation plans. As more TMDLs are completed, the list of TMDLs that will undergo implementation will grow. Implementation is planned as a phased process, where the success of implementation is routinely evaluated by monitoring data. Monitoring plans will be developed along with each TMDL Implementation Plan. Due to the length of time necessary for implementation and for implementation to take effect, these monitoring plans will likely last for five to ten years. See "[TMDL Post Implementation Monitoring IM](#)" [III-B-4-12] for an example. This will be a considerable TMDL monitoring load added to those above for all regional offices. As of March 2013 IP planning for 53 waters had been completed, and eight plans were in development.

(13) Resource Needs and Leverages

The major resource needs lie in the manpower requirements for additional data collection necessary for TMDL development and follow-up monitoring, as well as in the analytical cost for toxicity, bacteria BST and nutrient analyses. The manpower to collect sufficient DO and pH measurements data for site-specific criteria is also expected to be significant. In terms of equipment needs, 'Stowaway Tidbit' temperature recorders and 'In-Situ' recorders capable of logging continuous readings over an established period of time (for diurnal DO studies, for example) are useful tools that should be available at each regional office.

Some TMDL program funding is available to cover analytical costs. The main target for TMDL program funds, however, is TMDL analysis and development, severely limiting the amounts available for supplemental monitoring. DEQ regional and central office staffs are pursuing different avenues to leverage available resources as much as possible. Some potential sources that are already being pursued include:

1. Citizen monitoring groups can be a resource for supplemental bacteria monitoring (prior to DEQ data collection) to allow better spatial and temporal resolution of bacteria concentrations. The Coliscan method has been approved by DEQ for screening purposes.
2. Depending upon the monitoring time frame prior to TMDL development, basic data needs could be covered by appropriate siting of watershed stations.

3. In some special cases, permit holders may be able to collect data useful for TMDL development.
4. Regarding follow-up monitoring, it is consistent with TMDL implementation planning to initiate monitoring only after some implementation measures have been completed. This could occur as part of watershed runs. Continual monitoring is not typically envisioned, unless listing stations are in the trend network.

Contact: For further general information on the TMDL Program contact:

TMDL Development

Liz McKercher
 629 East Main Street
 Richmond, Virginia 23219
 (804) 698-4291
Elizabeth.Mckercher@deq.virginia.gov

Monitoring Requirements

Roger E. Stewart II
 629 East Main Street
 Richmond, Virginia 23219
 (804) 698-4440
Roger.Stewart@deq.virginia.gov

For more precise information about TMDLs in specific regions of the state, contact the TMDL coordinators at the nearest DEQ Regional Office:

Northern Regional Office, NRO
 Woodbridge

Jennifer Carlson 703-583-3859
Jennifer.Carlson@deq.virginia.gov

Piedmont Regional Office, PRO
 Glen Allen

Margaret Smigo 804-527-5124
Margaret.Smigo@deq.virginia.gov

Southwest Regional Office, SWRO
 Abingdon

Martha Chapman 276-676-4845
Martha.Chapman@deq.virginia.gov

Tidewater Regional Office, TRO
 Virginia Beach

Jennifer Howell 757-518-2111
Jennifer.Howell@deq.virginia.gov

Valley Regional Office, VRO
 Harrisonburg

Tara Sieber 540-574-7840
Tara.Sieber@deq.virginia.gov

Blue Ridge Regional Office, BRRO
Former WCRO, Roanoke

Mary Dail 540-562-6715
Mary.Dail@deq.virginia.gov

Former SCRO, Lynchburg

Paula Nash 434-582-6216
Paula.Nash@deq.virginia.gov