

**COMMONWEALTH OF VIRGINIA  
DEPARTMENT OF ENVIRONMENTAL QUALITY  
WATER DIVISION**


**ELLEN GILINSKY, PhD  
DIRECTOR**

**P.O.BOX 1105**

**Richmond, Virginia 23218**

**Subject:** Water Guidance Memo No. 09-2005  
Monitoring and Assessment of Lakes and Reservoirs

**To:** Regional Directors,  
Regional Water Monitoring Managers

**From:** Ellen Gilinsky, Ph.D., Director 

**Date:** April 23, 2009

**Copies:** Darryl Glover, Alan Pollock, WQS, WQMA, Regional Water Monitoring and Assessment Staff

**Summary:**

This guidance supersedes all agency Lake Monitoring Guidance prior to 2009 and provides direction to agency staff on how to implement lake/reservoir water quality monitoring. Significant updates to this guidance since 2002 include implementing the new surface water quality standard regulation (9 VAC 25-260-187), effective as of August 14, 2007, which added nutrient criteria for significant man-made lakes and reservoirs and the two natural lakes in Virginia. Current Triennial Review updates to this Standard include the definition of lacustrine zone, which allows for dissolved oxygen sampling throughout the lake and adds several additional lakes (6) to the significant lakes list.

**Electronic Copy:**

An electronic copy of this guidance is available on DEQ's website at <http://www.deq.virginia.gov/water/>.

**Contact Information:**

Please contact Darryl Glover, Director of the Office of Water Monitoring and Assessment at [dmglover@deq.virginia.gov](mailto:dmglover@deq.virginia.gov), or via phone at (804) 698-4321 with any questions regarding the application of this guidance.

**Disclaimer: This document is provided as guidance and, as such, sets forth standard operating procedures for the agency. However, it does not mandate any particular method nor does it prohibit any alternative method. If alternative proposals are made, such proposals should be reviewed and accepted or denied based on their technical adequacy and compliance with appropriate laws and regulations.**

## Table of Contents

Part I	<b>Introduction</b>	P.4
Part II	<b>Background</b>	P.4
Part III	<b>Authority</b>	P.4
Part IV	<b>Definitions</b>	P.5
Part V	<b>Guidance</b>	P.6
	A. Sources for Lakes and Reservoirs Listed in the Table in 9 VAC 25-260-187	P.6
	B. Basis for Nutrient Criteria Assignment by Fishery Type and Nutrient Ecoregion in Section 187.B	P.6
	C. Monitoring	P.7
	C.1 Determination of Section 187 Lake/Reservoir Boundaries	
	C.2 Guidelines for identification of lake/reservoir zones for assessment	
	C.3 Sampling littoral zone and coves and inlets	
	C.4 Determination of stratification	
	C.5 Monitoring period, frequency of sampling, and location of monitoring stations	
	C.6 Parameter Selection for Lab Analysis	
	C.7 Field Measurements	
	D. Assessment	P.12
	D.1 Assessment of nutrient criteria for aquatic life (fishery) use impairments	
	D.2 Assessment of dissolved oxygen, temperature and pH criteria for aquatic life use impairments	
	E. Process for confirmation of use impairments when nutrient criteria are exceeded	P.14
	F. Lake Selection	P.15
	G. Additional Information	P.16

## List of Tables

Table 1	Applicable Criteria by Fishery Type and Ecoregion in Virginia	P.7
Table 2	Minimum Required Parameter List by Type of Assessment 305(b)	P.11
Table 3	Lake Monitoring Suggested Parameter Group Codes for Samples Submitted to DCLS for Analysis	P.12
Table 4	Trophic Index and ADB Categories in Virginia	P.13

## List of Figures

Figure 1	Virginia Nutrient Ecoregions	P.6
Figure 2	Generalized Zones along Longitudinal Gradients in Reservoirs (Wetzel, 2001)	P.7
Figure 3	General Characteristics of the Riverine, Transitional and Lacustrine Zones in Reservoirs	P.8
Figure 4	Annual temperature cycles in stratified lakes, Wisconsin DNR (WDNR) and University of Illinois	P.10
Figure 5	Flow Chart of WQS for 187 Lakes and reservoirs	P.15

## Appendices

Appendix I	Listing of Fishery Type and Ecoregion for Man-made Lakes and Reservoirs in Virginia	P.18
Appendix II	Lakes Prioritization Ranking Procedure	P.22
Appendix III	Significant Lakes and Reservoirs by Region	P.29

## **MONITORING AND ASSESSMENT OF LAKES AND RESERVOIRS**

### **I. Introduction**

The purpose of this guidance is to ensure that consistent and accurate processes are employed for the monitoring and assessments of lakes and reservoirs. In particular, this guidance focuses on proper implementation of the amended nutrient criteria for these waterbodies.

### **II. Background**

The Water Quality Standards regulation was amended in August 2007 to add numerical and narrative criteria to protect the designated aquatic life (fishery) use of man-made lakes/reservoirs, as well as the two natural lakes in the Commonwealth, Mountain Lake and Lake Drummond, from the impacts of nutrients. The rulemaking:

- clarified that the dissolved oxygen (DO) criterion applies ONLY to the epilimnion ONLY during times of thermal stratification; at all other times DO criteria applies throughout the water column within all zones of the water body.
- clarified that water quality assessment of the applicable nutrient criteria (chlorophyll *a* and total phosphorus) for lakes and reservoirs listed in Section 187 of the regulation will be based on the results of two out of three monitoring years with available data that are in agreement.
- added a process for confirmation of use impairments when the criteria in Section 187 are exceeded
- allowed for site specific regulatory modifications to the criteria if the nutrient criteria specified for a lake or reservoir do not provide for the attainment and maintenance of the water quality standards of downstream waters,

This guidance is intended to:

1. provide additional technical information related to the development of the adopted nutrient criteria,
2. address when and where (temporally and spatially) within a lake or reservoir the nutrient and dissolved oxygen criteria should be applied for assessment purposes,
3. make recommendations on how to determine where to monitor within a lake or reservoir to gather the data needed for assessments, and
4. provide information on monitoring of all lakes and reservoirs in Virginia.

### **III. Authority**

§ 62.1-44.15(3a) of the Code of Virginia, as amended, mandates and authorizes the State Water Control Board to establish water quality standards and policies for any State waters consistent with the purpose and general policy of the State Water Control Law, and to modify, amend or cancel any such standards or policies established. Section 303(c) of the federal Clean Water Act mandates the State Water Control Board to review and, as appropriate, modify and adopt water quality standards. The corresponding federal water quality standards regulation at 40 CFR 131.6 describes the minimum requirements for water quality standards. The minimum requirements are use designations, water quality criteria to protect the designated uses and an anti-degradation policy. All of the citations mentioned describe mandates for water quality standards.

#### **IV. Definitions**

“Algaecides” means chemical substances, most commonly copper-based, used as a treatment method to control algal growth.

“Assessment period” refers to a “period of time (currently six years) for which data are used in a Water Quality Assessment.”

“Epilimnion” means the upper layer of nearly uniform temperature in a thermally stratified man-made lake or reservoir listed in 9 VAC 25-260-187.B.

“Lacustrine” means the zone within a lake or reservoir that corresponds to nonflowing lake-like conditions with areas that are deeper than 3m (10 feet). The other two zones within a reservoir are riverine (flowing, river-like conditions) and transitional (transition from river to lake conditions).

“Lake/Reservoir” means a constructed impoundment and refers to Virginia man-made lakes and reservoirs

“Monitoring period” refers to “April 1 through October 31.”

“Monitoring year” refers to “seven months from April 1 through October 31.”

“Natural Lake” means a lake that is natural in origin. There are two natural lakes in Virginia: Mountain Lake in Giles County and Lake Drummond located within the boundaries of Chesapeake and Suffolk in the Great Dismal Swamp.

“Publicly accessible” means any legal passage to any public waters of the state by way of contiguous designated public land.

“Strahler Order” is a simple method of classifying stream segments based on the number of tributaries upstream. A stream with no tributaries (headwater stream) is considered a first order stream. A segment downstream of the confluence of two first order streams is a second order stream. Thus, a  $n^{\text{th}}$  order stream is always located downstream of the confluence of two  $(n-1)^{\text{th}}$  order streams.

In addition, the following definitions of fishery type were used in making nutrient criteria assignments based on fishery type and nutrient ecoregion as described in section V. of this guidance document:

“Coldwater fishery” means a fishery in a man-made lake or reservoir for the year-round support of brook, brown, and rainbow trout.

“Coolwater fishery” means a fishery in a man-made lake or reservoir for the year-round support of game fish species such as striped bass, hybrid striped bass, or walleye.

“Fertilized fishery” means man-made lakes or reservoirs managed by the Virginia Department of Game and Inland Fisheries (DGIF) with fertilizers applied as a management input for centrarchid species (for example, sunfish, crappie, and black bass) or catfish species. These lakes are generally quite small, and fish production is the primary use.

“Warmwater fishery” means a fishery in a man-made lake or reservoir for the year-round support of warmwater fish such as largemouth and smallmouth bass, sunfish and catfish, and not explicitly classified as a coldwater, coolwater or fertilized fishery.

#### **V. Guidance**

##### **A. Sources for Lakes and Reservoirs Listed in the Table in 9 VAC 25-260-187**

*Current Listings:* The list of lakes and reservoirs in Section 187 was developed from three Virginia DEQ sources: 1) the significant lake list for the agency (2002 targeted lake monitoring guidance), 2) the revised significant lakes list for 2006, and 3) 59 lakes and reservoirs monitored by VA DEQ between 1990 and 2003, these were included in the Academic Advisory Committee (AAC) analysis for nutrient criteria development. These are the lakes and reservoirs that DEQ has monitored previously, currently is monitoring or will be monitoring in the upcoming assessment cycle.

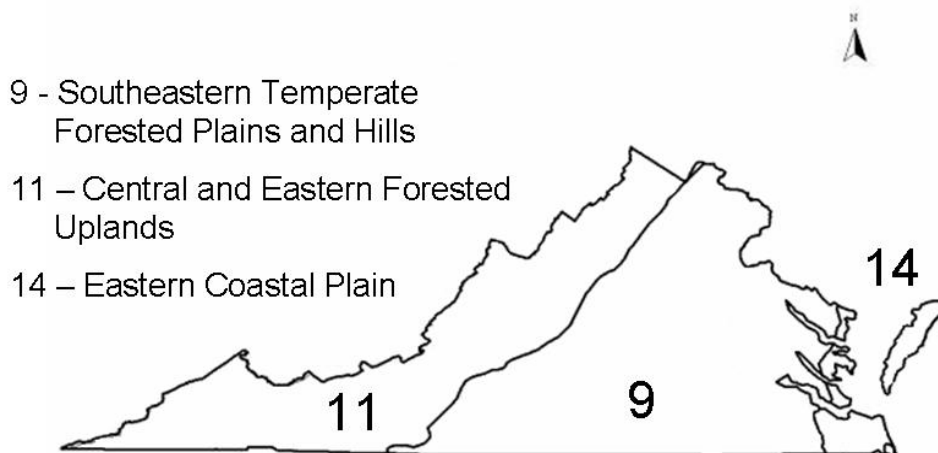
*Future Listings:* DEQ anticipates that additional lakes and reservoirs will be added to the regulation during triennial review and will propose adding to the list of Section 187.B additional lakes and reservoirs which the agency has recently monitored or included in the monitoring plan for future monitoring. Prior to the initiation of a rulemaking to add or modify a current listing in Section 187.B, staff from the Fish Division of the Virginia DGIF must be contacted to confirm the appropriate fishery type for that particular lake/reservoir.

*Removal from List:* In rare instances, DEQ may receive a request to remove a lake/reservoir from Section 187.B. Removal of a lake/reservoir would be subject to the DEQ Public Participation Guidelines, state Administration Process Act requirements and EPA approval.

## **B. Basis for Nutrient Criteria Assignment by Fishery Type and Nutrient Ecoregion in Section 187.B**

The table in Section 187.B of the amendments provides the numerical chlorophyll *a* and total phosphorus criterion applicable to that particular lake/reservoir. It is simplified in this guidance for reference (Table 1), but the actual Section 187.B table should be utilized for agency monitoring purposes to ensure that updated information is being used.

*Virginia Nutrient Ecoregions:* The following three aggregate nutrient ecoregions developed (see below Figure 1) by the Environmental Protection Agency (EPA) were used in development of the nutrient criteria.



**Figure 1 Virginia Nutrient Ecoregions**

*Listing of Fishery Type and Ecoregion for Each Man-made Lake/Reservoir:* Appendix I summarizes a known name applicable to a particular body of water, city or county location of the water body, fishery type, ecoregion and name of the USGS topographic map.

*Fishery Type Assignments:* Pages 10 - 11 and 16 - 33 of the AAC January 2005 Report <http://www.deq.virginia.gov/export/sites/default/wqs/pdf/AAC05report.pdf> discuss the use of fishery data by ecoregion and fishery type for setting criteria for chlorophyll *a* and total phosphorus.

*Applicable Criteria by Fishery Type and Ecoregion:* Table 1 (below) provides the candidate criteria recommended by the AAC July 2005 Addendum One to the January Report

[http://www.deq.virginia.gov/export/sites/default/wqs/documents/Nutrient\\_Criteria/AAC\\_Report\\_Addendum\\_5\\_26\\_05.doc](http://www.deq.virginia.gov/export/sites/default/wqs/documents/Nutrient_Criteria/AAC_Report_Addendum_5_26_05.doc) to accommodate fishery recreation and protect aquatic life.

**Table 1. Applicable Criteria by Fishery Type and Ecoregion in Virginia**

Fishery Type	Warm-water	Cool-water	Cold-water (trout)	Managed / Fertilized	Warm-water	Cool-water	Cold-water (trout)	Managed / Fertilized
Eco-region	----- chl-a (µg/L) <sup>a</sup> -----				----- TP (µg/L) <sup>b</sup> -----			
11	35	25	10		40	20	10	
9	35	25		60	40	30		40
14	60	25			40	20		

<sup>a</sup> Chl-a are 90<sup>th</sup> percentile values representative of the April – October period.

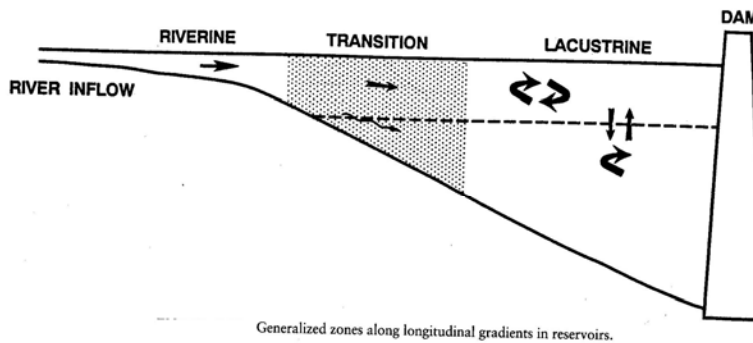
<sup>b</sup> TP is the median values representative of the April – October period.

**C. Monitoring**

**C.1. Determination of Section 187 Lake/Reservoir Boundaries**

*Description of Lake/Reservoir boundaries:* The nutrient criteria only apply in the lacustrine zone of the lakes/reservoirs listed in Section 187 i.e. “Water Quality Standards” 9-VAC 25-260-187. The other two zones within a lake/reservoir are riverine (flowing, river-like conditions) and transitional (transition from river to lake conditions). Lakes and reservoirs usually have these three zones along a longitudinal gradient (See Figure 2.). For assessment purposes, DEQ defines the lacustrine zone as the area of the lake where the depth is greater than 3 meters (10ft).

The littoral zone of a lake/reservoir is often described as the near shore area where sunlight penetrates all the way to the sediment and allows aquatic plants to grow. It is sometimes defined as a shallow area approximately three meters or less deep extending from the shoreline lake ward, but it depends on water clarity, light transmission and where rooted plants can grow. Therefore, no sampling should be done where there are rooted aquatic plants during the growing season. Chlorophyll *a* or total phosphorus data collected at less than 3 meters (10 ft.), e.g. within the littoral zone will not be used in the assessment for impairment due to nutrients.



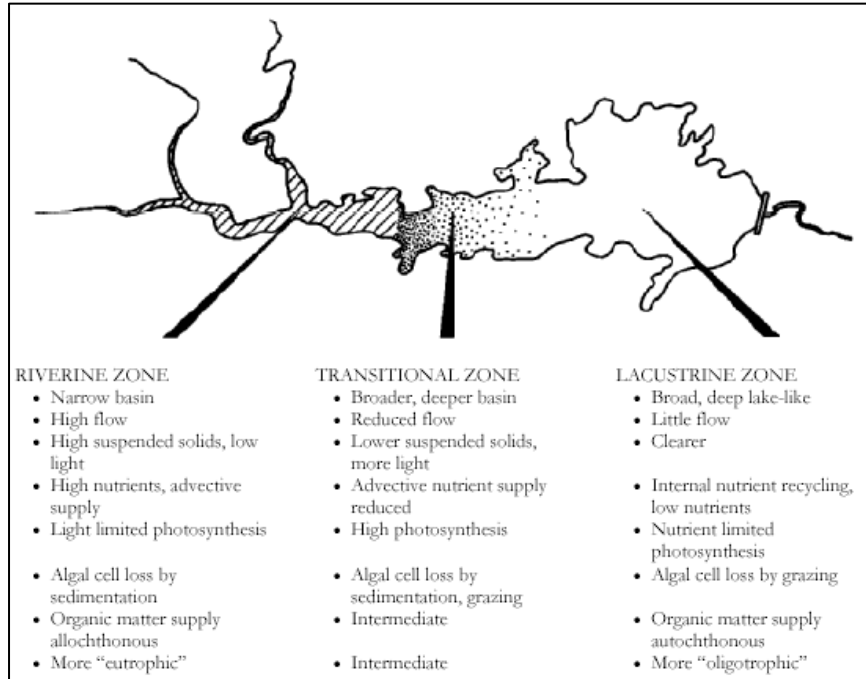
**Figure 2 Generalized Zones along Longitudinal Gradients in Reservoirs (Wetzel, 2001)**

The riverine zone is located at the most upstream sections (near the inlets) of lakes and reservoirs and displays “river-like” flow characteristics. At the riverine end of the lake/reservoir, thermal stratification tends to be unstable and turbidity and sedimentation rates are higher than downstream in the lacustrine zone. The transition zone is deeper than the riverine zone and flows are generally slower. The lacustrine zone behaves

most like a lake, where thermal stratification would most likely occur (from late spring to early fall.) There may be arms of the lake/reservoir that are considered lacustrine, exhibiting nonflowing, lake-like conditions. In this scenario, the lake monitoring team should use their best professional judgment in the assessment of arms, coves, etc.

In small, shallow (less than 3m in depth (10ft)) lakes and reservoirs where the classic lacustrine, transition and riverine zones are not pronounced, the lacustrine zone and nutrient criteria in Section 187 of the water quality standards regulation apply in a representative area of the water body.

Figure 3, taken from Kimmel and Groeger (1984), illustrates the transition from a riverine to lacustrine environment in lakes and reservoirs along a longitudinal gradient and describes the differences in the characteristics of these three zones.



**Figure 3 General Characteristics of the Riverine, Transitional and Lacustrine Zones in Reservoirs**

### C.2. Guidelines for identification of lake/reservoir zones for assessment

For the assessment of nutrients and dissolved oxygen for lakes and reservoirs sampled during the previous six years of targeted lake/reservoir monitoring, regional monitoring staff will:

- Identify lakes/reservoirs where algaecides are used during DEQ's monitoring period so assessment staff will know to use the total phosphorus criterion as well as chlorophyll *a*,
- All sample collections and field measurements should be made in the deepest mid-channel of any zone, cove or inlet within a lake/reservoir's boundary
- Identify station location (with all associated ID's i.e. CEDS) where:
  - chlorophyll *a* and total phosphorus (if documented use of algaecide) samples were collected in the lacustrine zone (greater than 3 meters (10ft)).
  - dissolved oxygen/temperature profile measurements were recorded anywhere in the lake/reservoir.



*Description of lacustrine boundaries:*

1. The lacustrine zone is the area that corresponds to nonflowing, lake-like conditions, which is usually the deepest part of the lake/reservoir, typically 3m (10ft) or deeper, where stratification normally occurs from spring through fall. (If a lake has a round shape, the lacustrine zone may be in the center of the lake. If the lake is shallow (less than 3m), without defined depths, sample in a representative portion of the lake/reservoir)
2. The upper boundary of the lacustrine zone is where a slope and broadening of the basin begins.

The other two zones of a lake include; *Transition*: The transition zone falls between the upper end of the lacustrine zone and the lower end of the riverine. *Riverine*: Depths less than one-third of the depth of the upper boundary of the lacustrine zone can be assumed to be located within the riverine zone at the upper end of the impoundment.

### **C. 3. Sampling littoral zone and coves and inlets.**

Sampling near-shore or littoral zones (depths less than 3 meters (10ft) ) should be avoided when sampling for nutrients in Section 187 waters; data collected from the littoral zone of a lake/reservoir by agency staff or outside groups will not be used for assessment of nutrients and possibly dissolved oxygen (DO) (see Section D.1). All other parameters apply throughout a lake/reservoir.

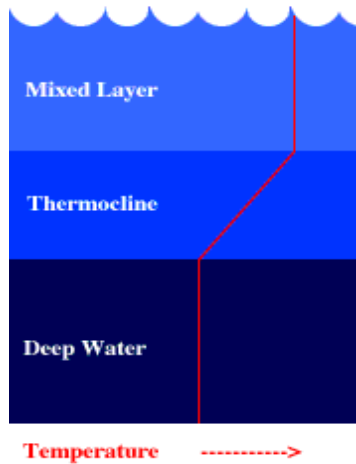
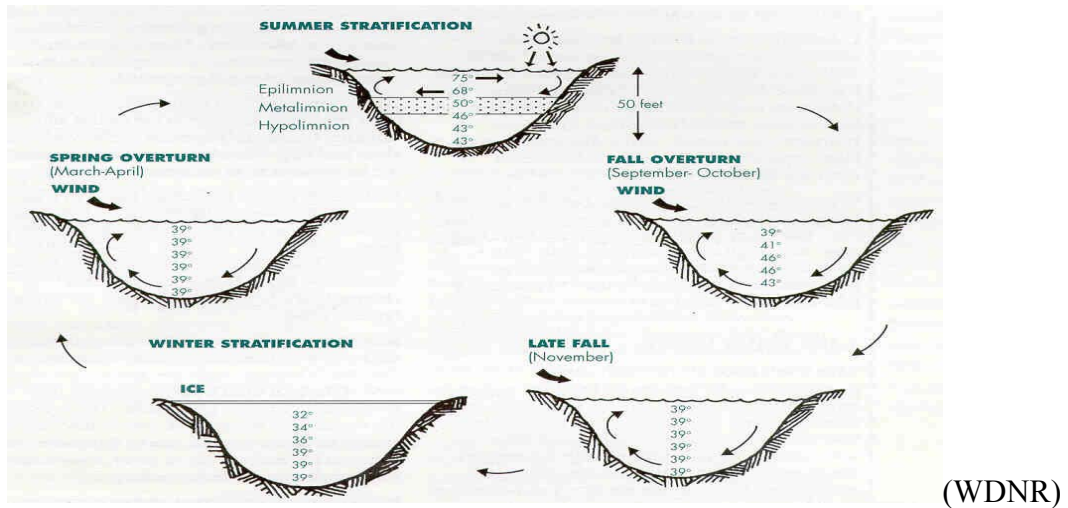
The perimeters of irregular lakes or reservoirs are often characterized by various types of inlets. For the purpose of this guidance, two types of inlets are differentiated:

- **Riverine** tributary inlets are defined as inlets with well-defined channels produced by the inflow of a tributary stream of 2<sup>nd</sup> or higher Strahler order. Waters in these inlets are likely to be more characteristic of the inflowing stream than of the receiving lake, and should not be sampled during monitoring events.
- **Coves (including arms and fingers)** are defined as inlets that are longer than they are broad. They should only be sampled from the center of their channel and only when their depth is greater than 3 meters (10 ft).

### **C. 4. Determination of stratification**

During periods of stratification of the lakes/reservoirs listed in Section 187, attainment of the minimum dissolved oxygen criterion is only assessed in the epilimnion at monitoring stations where stratification is observed. Dissolved oxygen criteria do not apply below the epilimnion during thermal stratification. The usual procedure is to plot temperature vs. depth to determine where a slope occurs in the temperature/dissolved oxygen profile measurement.

In deeper lakes or reservoirs, it may be possible to use the classical textbook definition of lake stratification developed for natural lakes if the temperature profile meets the following definition for a thermocline: the temperature decrease reaches 1 degree C or more per meter of descent. If the thermocline cannot be delineated (*i.e.*, the temperature decrease is less than 1°C for each meter of descent), then it is not considered to be thermally stratified. However, many lakes/reservoirs are shallow, often less than twenty feet deep, and exhibit stratification but do not meet the “classical” 1 degree C per meter of descent definition of stratification. In such situations, staff will need to use best professional judgment to determine whether a lake/reservoir is exhibiting stratification by sampling the entire water column to determine stratification or a measurable slope in temperature change. Examples of annual temperature cycles in stratified lakes are given in Figure 4.



(University of Illinois)

**Figure 4 Annual temperature cycles in stratified lakes, Wisconsin DNR (WDNR) and University of Illinois**

**C. 5. Monitoring period, frequency of sampling, and location of monitoring stations**

A monitoring year is considered to be April 1 through October 31 with a monthly sampling frequency during one calendar year. Man-made lakes/reservoirs listed in Section 187 must be sampled with one or more observations per month for at least six of the seven sampling months within the same calendar year. If the water body is sampled with one or more observations per month for less than six of the seven sampling months, the water body is considered to have insufficient data for assessment and sampling is required in a subsequent year, preferably the following year. Nutrient collections at the monitoring frequency of once per month during six of seven consecutive months (April 1 – October 31) within one calendar year during the Assessment Cycle (six years) will continue. However, there are two situations where additional sampling should be done in a subsequent year:

- If sampled for fewer than six of the seven sampling months within a calendar year, the lake or reservoir is placed in Category 3 (insufficient data) for assessment purposes and sampling is conducted in the next calendar year.

- Based on regional prioritization and available resources, each Section 187 listed lake/reservoir should have two monitoring years within the six year Assessment Cycle data window. The regional office should schedule a second year of monitoring for a lake/reservoir, within the same assessment window in order to verify the impairment. Assessment is based on the two most recent monitoring years that data are available within the assessment window

*Sampling location in lacustrine zone:* The number of monitoring stations within the lacustrine zone depends on the size and shape of the lake or reservoir. The 2001 edition of the North American Lake Association's "Managing Lakes and Reservoirs" is a good reference to use to determine location of monitoring stations. If it is a shallow (under 3meters (10ft.)) lake/reservoir, there might be only one station sampled per monthly visit. The monitoring station should be placed in the deepest part of the lake/reservoir either near the dam in reservoirs or in the deep center portion of natural lakes, with collections monthly over the seven month period of April through October.

Only data from the lacustrine portion of the lake/reservoir, down to a depth of one meter will be assessed for attainment of the chlorophyll *a* and total phosphorus criteria. That should not preclude regional sampling for nutrients in the riverine and transition zones or coves and arms or the littoral zone as new nutrient criteria are being developed for wadeable waters.

### **C. 6. Parameter Selection for Analysis**

Minimum parameter lists and monitoring frequency are identified by lake/reservoir monitoring assessment goal (Table 2). Regional offices may elect to have the laboratory analyze samples for additional parameters to meet other regional needs. For example, some regional offices with significant VPDES discharges to a lake/reservoir might elect to run biochemical oxygen demand and suspended solids. For 305(b) assessment purposes, the recommended minimum parameter list is dissolved oxygen, pH, Chlorophyll *a*, temperature, bacteria, nutrients, conductivity and salinity (where appropriate). To determine trophic status or potential need for regulatory designation as a nutrient enriched water, the following parameters need to be collected: conductivity, Secchi disk depth, chlorophyll *a*, dissolved oxygen/temperature depth profile, total nitrogen, total phosphorus and orthophosphorus. The recommended parametric coverage for toxicity assessment is: ammonia, pesticide/herbicide scan and metals scan in sediments. Table 3 lists lake/reservoir monitoring parameter group codes for samples submitted to the state laboratory (DCLS) for analysis.

**Table 2. Minimum Required Parameter List by Type of Assessment 305(b):**

- Dissolved Oxygen-Entire profile top to bottom (Epilimnion assessed only if stratified or 0.3 meter below surface if not stratified)
- pH
- Temperature
- E. coli (0.3 meters below surface)
- Conductivity
- Salinity (where appropriate) Trophic State/Nutrient Enrichment
- Secchi Disk Depth
- Chlorophyll *a* (0.3 meters below surface)
- Dissolved Oxygen/Temperature Depth Profile
- Total Phosphorous
- Total Orthophosphorous
- Total Nitrogen
- Nitrite (NO<sup>2</sup>)
- Nitrate (NO<sup>3</sup>)
- Ammonia Concentrations in water

**Table 3. Lake Monitoring Suggested Parameter Group Codes for Samples Submitted to DCLS for Analysis**

- **Field** - DO, pH, Conductivity, Temperature
- **INUTL**- Ammonia TKN, TP (0.01) which is low range and needs to be preserved
- **NUT4** - NO<sup>2</sup>, NO<sup>3</sup>, OP
- **FCHLR**-Chlorophyll a
- **EC4** – E.Coli
- **TPLL** – Total Phosphorus
- **LAKE** – Ammonia, Total Nitrogen, Orthophosphorus, Nitrite plus Nitrate

### **C. 7. Field Measurements**

Field measurements at each sampling station should include a temperature and dissolved oxygen profile (beginning at 0.3 meter below surface using a combined temperature- dissolved oxygen meter). Field measurements should also include pH, conductivity and Secchi depth. All of these field measurements, including the dissolved oxygen/temperature depth profile data, should be entered into the Water Quality Management database.

### **D. Assessment**

Two years of monitoring data must be used for assessment of nutrient criteria. If assessment results for two years conflict with each other, then that water body will be categorized as having insufficient data (Assessment Category 3) and a subsequent monitoring year will be required. In such cases, an assessment determination for nutrients will be based on the results of two out of the three monitoring years that are in agreement. If a third year of data is needed, monitoring should occur as soon as feasible but within one six-year assessment data window.

*Implement Amendments in 305(b)/303(d) integrated report:* This guidance explains how nutrients and dissolved oxygen data collected will be assessed. (If monitoring data are available for assessment of lakes and reservoirs not captured in recent amendments, the nutrient criteria would not be applicable to such a water body and the water body would not be assessed for nutrients. However, the methodology described in this section for assessment of dissolved oxygen criteria would be applicable.)

Both DO and nutrient data (chlorophyll *a* and also total phosphorus with documented use of algaecides at any time during the monitoring period of April to October) are assessed for aquatic life use. Bacterial data are used to assess recreational use. Observations regarding nuisance algal or plant growths or discolored water are assessed using the general standard as the basis; the recent criteria amendments for lakes/reservoirs did not modify these existing criteria.

*Trophic State Index (TSI) replaced by regulatory nutrient criteria in 2008 305(b) assessment report for Section 187 lakes:* The assessment guidance for 2006 reflected the combined TP (total phosphorus)/DO (dissolved oxygen) TSI approach of assessing non-187 lakes for nutrients which EPA found to be an acceptable method in lieu of regulatory nutrient criteria. Beginning with the 2008 assessment report, the regulatory nutrient criteria, to be determined for Section 187 waters only, replaced the TSI approach for Virginia Section 187 lakes/reservoirs. Since modifications were made to the dissolved oxygen criteria for lakes/reservoirs listed in Section 187, where nutrient criteria were developed, the use of TSI for determining natural dissolved oxygen impairment of the waters in Section 187 will no longer be applicable for future assessments in Section 187 waters. TSI will **ONLY** be used in non-187 lakes when related to DO exceedances.

*When to Apply TSI: (in non-Section 187 lakes **ONLY**)* Secchi Depths (SD), Chlorophyll *a* (CA), and Total Phosphorus (TP) will be calculated only on stratified lakes using aggregated station data in the epilimnion from mid-June through mid-September (at 0.3 m for TP and CA).

A trophic state index value of 60 or greater for any one of the 3 indices will indicate that nutrient enrichment

from anthropogenic sources are adversely interfering, directly or indirectly, with the designated uses. A TSI value of 60 corresponds to a CA concentration of 20 ug/l, a SD of 1 meter, and a TP concentration of 48 ug/l.

Following are the TSI equations:

$$\begin{aligned} \text{TSI(SD)} &= 10(6 - (\ln \text{SD} / \ln 2)) \\ \text{TSI(CA)} &= 10(6 - ((2.04 - 0.68 \ln \text{CA}) / (\ln 2))) \\ \text{TSI(TP)} &= 10(6 - ((\ln (48 / \text{TP})) / (\ln 2))) \end{aligned}$$

SD = meters

CA = ug/l

TP = ug/l

The following rules apply:

1. Do not calculate chlorophyll *a* in TSI lakes that are treated with algaecides.
2. The Chlorophyll *a* TSI will normally be the preferred indicator in un-treated lakes.
3. Assume that typical Virginia freshwater lakes and reservoirs are phosphorus limited.
4. Do not use the secchi depth index in the assessment if it is much larger than the CA and TP indices in the same assessment unit (prevalence of inorganic matter).
5. The appropriate TSIs should be calculated based on all summer sample data collected in the segment using the spreadsheet that has been developed for easier data processing.

For each monitoring station, if one or more of the TSIs  $\geq 60$ , the lake/reservoir will be assessed as impaired partially due to one or more pollutants from anthropogenic sources. The assessment unit or entire lake/reservoir will be placed in category 5A for TMDL development.

For each monitoring station, if each of the TSIs  $< 60$ , the lake/reservoir will be assessed as impaired due to pollution from natural sources and placed in category 4C. A TMDL is not needed for the assessment unit represented by the monitoring station(s) and appropriate DO criteria will be developed for the hypolimnion.

Based on the results of calculating TSI indices, the reservoir trophic status will be assigned in the Assessment Database (ADB) See Table 4.

**Table 4. Trophic Index and ADB Categories in Virginia**

<b>Trophic Index</b>		
<b>Trophic State</b>	<b>Carlson Trophic State Index</b>	<b>ADB Category</b>
Hypereutrophic	80 – 100	5A
Eutrophic	60 – Less than 80	5A
Mesotrophic	40 – Less than 60	4C
Oligotrophic	0 – Less than 40	4C
Unknown	Insufficient Data	3A

*Non agency data for non-187 lakes/reservoirs*

DEQ will potentially follow up with agency monitoring, however data that are older than the six year Assessment Cycle data window will not be considered for agency follow-up unless previously listed. Additionally, to be considered for follow up monitoring, water parameters associated with numeric standards must have observed effects and stratification must be determined and noted.

**D. 1. Assessment of nutrient criteria for aquatic life (fishery) use impairments**

*Assessment for aquatic life (fishery) use of Virginia man-made lakes and reservoirs for chlorophyll *a* and total phosphorus (if documented algaecide use):* The nutrient criteria only apply in the lacustrine zone of man-made lakes and reservoirs listed in Section 187 of the water quality standards regulation. If total phosphorus or chlorophyll *a* data are collected outside the lacustrine zone in the riverine or transitional zone, the data from these two zones cannot be used in the assessment for lake/reservoir impairment due to

nutrients. In addition, the nutrient criteria cannot be used for assessment of lakes and reservoirs that are not listed in Section 187 of the regulation.

The regional office staff will base their determination of algaecide use on discussions with the lake owner and/or DEQ monitoring staff observations of algaecide applications during their monitoring runs. (The intent is to use both chlorophyll *a* and total phosphorus when algaecides are applied within any zone of the reservoir.)

Section 187 of the water quality standards regulation specifically states that assessment of nutrient data is based on two monitoring years where data are available and that nutrient data from these two monitoring years are assessed separately. The aquatic life (fishery) use of the entire water body listed in Section 187 is considered impaired for nutrients if the criterion for either chlorophyll *a* or total phosphorus is exceeded in each of the two most recent monitoring years. (Note: total phosphorus data is used only if there is documentation of algaecide use during the monitoring period). **Chlorophyll *a* and total phosphorus observations will be pooled at one meter or less for all months and all stations between April and October of any given year.** (Note: Only observations collected at stations where depth is greater than 3 meters (10 ft) will be assessed.) The 90<sup>th</sup> percentile of pooled chlorophyll *a* data is the value used to compare to the criterion for a particular lake/reservoir. The calculated median value is used to assess against the criterion for pooled total phosphorus data.

*Assessment for aquatic life (fishery) use for nutrients in the two natural lakes:* Assessments of the two natural lakes in the special standards section will follow the guidelines above for chlorophyll *a* and total phosphorus for two monitoring years except that orthophosphate-P rather than total phosphorus applies to Mountain Lake.

*Use of citizen and other external data:* In order to use citizen data in assessments for nutrient impairments, the collector must provide documentation that the data meet QA/QC requirements for chlorophyll *a* and total phosphorus (orthophosphate-P for Mountain Lake) and that the location of the sampling was within the lacustrine portion of the lake/reservoir and outside the littoral (near shore) zone.

## **D. 2. Assessment of dissolved oxygen, temperature and pH criteria for aquatic life use impairments**

The dissolved oxygen, temperature and pH criteria are based on the appropriate criteria established for that class of waters in Section 9 VAC 25-260-50. This information is used for assessment of aquatic life use.

The 10.5% rule is applicable to assessments for the minimum criterion of dissolved oxygen, and criteria for temperature and pH at each station in all lakes/reservoirs in Section 187 and the two natural lakes in Section 310 “cc” and “dd” for which nutrient criteria have been adopted.

The minimum dissolved oxygen criterion will be assessed from all dissolved oxygen water monitoring observations at each station within the monitoring period. The assessment will be based on observations from the epilimnion if thermally stratified or throughout the water column if not stratified. Data from individual stations can be pooled and then assessed for the whole lake or individual stations can be assessed independently and the lake segmented for assessment, this will be a regional call. Two or more exceedances for data sets containing less than 10 samples or greater than 10.5% exceedances for larger data sets are required before a water body is listed as impaired for the minimum dissolved oxygen criterion (Figure 5) (generally 4 mg/l for most freshwater lakes and reservoirs) under §§ 62.1-44.19:5 and 7 of the Code of Virginia.

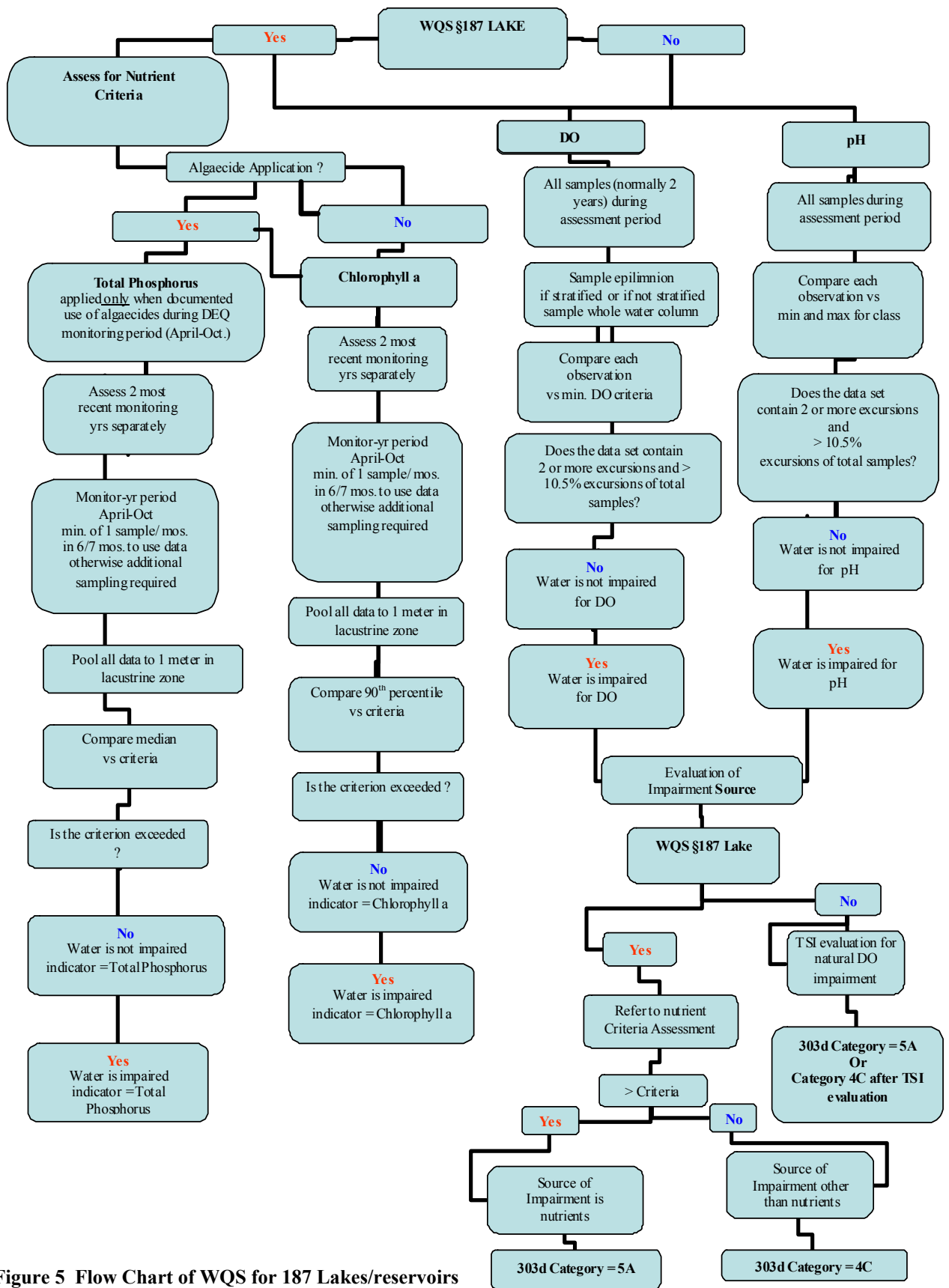


Figure 5 Flow Chart of WQS for 187 Lakes/reservoirs

## E. Process for confirmation of use impairments when nutrient criteria are exceeded

The amendments added a process for confirmation of the aquatic life (fishery) use impairments via a consultation with the Virginia Department of Game and Inland Fisheries (VDGIF) when the nutrient criteria in Section 187.B are exceeded. Where the nutrient criteria are exceeded but the designated uses of the water body are being attained, the water will still be considered impaired in accordance with § 62.1-44.19.5 of the Code of Virginia until site-specific criteria are adopted and become effective in order to remove the lake/reservoir from the impaired waters list.

*Consultation Process with VDGIF:* When DEQ determines that the applicable nutrient criteria in Section 187.B of the water quality standards regulation for a specific lake/reservoir are exceeded, the DEQ central office water quality standards program coordinator, or his/her designee, may contact the VDGIF Regional Fisheries Manager regarding the status of the fishery in determining whether or not the designated use for that water body is currently being attained. Since the nutrient criteria for lakes/reservoirs were developed using water chemistry data from those lakes/reservoirs where VDGIF biologists rated the fishery as good or excellent, documentation should support this level of fishery. Appropriate documentation for confirmation of maintenance of the designated fishery use would include the most recent information available on:

- catch per unit effort of specific size classes of managed fish populations
- population size structure
- observations or records regarding changes in fishing use or
- general trends in community structure.

*DEQ procedure for developing lake/ reservoir specific criteria:* The process for developing lake/reservoir specific chlorophyll *a* and/or total phosphorus criteria is as follows:

- For each parameter, pool (as described at <http://www.deq.virginia.gov/wqs/pdf/AAC05report.pdf> in the *AAC Report 2005*) all data taken down to one meter in the lacustrine portions of the lake/reservoir over all sampling observations made between April and October for two years or two of the three most recent years of monitoring data.
- For total phosphorus use the statistics (median values) described in the referenced AAC Report 2005 and for chlorophyll *a* use the statistics (90<sup>th</sup> percentile values) described at <http://www.deq.virginia.gov/wqs/AAC%20Report%20Addendum%205-26-05.doc> the AAC 2005 Report Addendum 1.
- Initiate a rulemaking to amend the water quality standards regulation to adjust an existing nutrient criterion in cases where the regulatory nutrient criterion is exceeded but the fishery is documented via consultation with VDGIF as good or excellent.

## F. Lake Selection

**Source List of Lakes:** The 2008 version of the significant lakes list serves as the source of lakes and reservoirs for prioritization and selection for monitoring by DEQ. This master list is attached in Part VII. A significant lake/reservoir is defined as: a publicly accessible lake/reservoir that is a public water supply and/or 100 acres or more in size and is included in Section 187 list of reservoirs with nutrient criteria. Publicly accessible is defined as: any *legal passage to any public waters of the state by way of contiguous designated public land*. Access by DEQ for sampling purposes involves safety and logistical issues. These issues are reviewed on a case by case basis. Publicly accessible lakes include the federally owned lakes/reservoirs that meet the above criteria, but all other federally owned lakes/reservoirs should be excluded from the agency lake monitoring program.

**Periodic Updates to the List:** It is the responsibility of each region to periodically (at least once every two years) update the master list by deleting lakes/reservoirs which have been drained or converted to private ownership and adding newly constructed lakes/reservoirs.



**Prioritization for Monitoring:** All lakes/reservoirs must be publicly accessible to be considered for monitoring by the agency. The uses and impairment prioritization matrix (below) of this document is an example of a way for each region to rank lakes/reservoirs within the regional boundaries for monitoring. After the lakes/reservoirs are prioritized, each region will determine how many lakes/reservoirs they have resources to monitor in any given year. Once prioritization is complete each Section 187 water body should have two monitoring years within a six year Assessment Cycle data window.

**Documentation of Alternative Basis for Selection for Monitoring:** The prioritization matrix is a starting point for prioritizing lakes/reservoirs in need of monitoring but it is not intended to prevent a region from using a different approach, if required by a unique circumstance or where follow up monitoring is necessary. If a region decides not to use the results of the matrix, regional staff should document the rationale for the deviations with the lake monitoring coordinator and describe the alternative approach used to prioritize lakes/reservoirs for monitoring.

### **G. Additional Information**

All Virginia DEQ and AAC referenced reports can be found at <http://www.deq.state.va.us/wqs/rule.html#NUT2>

APPENDIX I

Listing of Fishery Type and Ecoregion for Man-made Lakes and Reservoirs in Virginia

Man-made Lake/Reservoir Name	Location	Fishery Type	Ecoregion	USGS 1:24,000 Topo Map Name
Able Lake	Stafford County	Warmwater	9	Stafford
Airfield Pond	Sussex County	Warmwater	9	Manry
Amelia Lake	Amelia County	Warmwater	9	Chula
Aquia Reservoir (Smith Lake)	Stafford County	Warmwater	11	Stafford
Bark Camp Lake (Corder Bottom Lake, Lee/Scott/Wise Lake)	Scott County	Warmwater	11	Fort Blackmore
Beaver Creek Reservoir	Albemarle County	Warmwater	9	Crozet
Beaverdam Creek Reservoir (Beaverdam Reservoir)	Bedford County	Warmwater	11	Stewartsville
Beaverdam Reservoir	Loudoun County	Warmwater	9	Leesburg
Bedford Reservoir (Stony Creek Reservoir)	Bedford County	Warmwater	11	Peaks of Otter
Big Cherry Lake	Wise County	Warmwater	11	East Stone Gap
Breckenridge Reservoir	Prince William County	Warmwater	9	Joplin
Briery Creek Lake	Prince Edward County	Warmwater	9	Hampden Sydney
Brunswick Lake (County Pond)	Brunswick County	Warmwater	9	Smokey Ordinary
Burke Lake	Fairfax County	Fertilized	9	Fairfax
Carvin Cove Reservoir	Botetourt County	Warmwater	11	Daleville/Roanoke
Cherrystone Reservoir	Pittsylvania County	Warmwater	9	Chatham
Chickahominy Lake	Charles City County	Warmwater	9	Walkers
Chris Green Lake	Albemarle County	Warmwater	9	Luray
Claytor Lake	Pulaski County	Coolwater	11	Dublin/Radford South
Clifton Forge Reservoir (Smith Creek Reservoir)	Alleghany County	Warmwater	11	Clifton Forge
Coles Run Reservoir	Augusta County	Coldwater	11	Big Levels
Curtis Lake	Stafford County	Fertilized	9	Storck
Diascund Creek Reservoir	New Kent County	Warmwater	9	Walkers
Douthat Lake	Bath County	Coolwater	11	Healing Springs
Elkhorn Lake	Augusta County	Coldwater	11	Stokesville
Emporia Lake (Meherrin Reservoir)	Greensville County	Warmwater	9	Emporia
Fairystone Lake	Henry County	Warmwater	11	Philpott Lake
Falling Creek Reservoir	Chesterfield County	Warmwater	9	Drewrys Bluff
Fluvanna Ruritan Lake	Fluvanna County	Fertilized	9	Simon/Boyd Tavern
Fort Pickett Reservoir	Nottoway/Brunswick County	Warmwater	9	Danielstown/Blackstone East

Gatewood Reservoir	Pulaski County	Warmwater	11	Longspur/Pulaski
Georges Creek Reservoir (Gretna Lake)	Pittsylvania County	Warmwater	9	Gretna
Goose Creek Reservoir	Loudoun County	Warmwater	9	Leesburg
Graham Creek Reservoir (Elon Waterworks Reservoir)	Amherst County	Warmwater	9	Lynchburg
Great Creek Reservoir	Lawrenceville	Warmwater	9	Alberta
Harrison Lake	Charles City County	Warmwater	9	Westover
Harwoods Mill Reservoir	York County	Warmwater	14	Poquoson West
Hidden Valley Lake	Washington County	Warmwater	11	Brumley
Hogan Lake	Pulaski County	Warmwater	11	Pulaski
Holiday Lake	Appomattox County	Warmwater	9	Holiday Lake
Hungry Mother Lake	Smyth County	Warmwater	11	Chatam Hill/Marion
Hunting Run Reservoir	Spotsylvania County	Warmwater	9	Chancellorsville
J. W. Flannagan Reservoir	Dickenson County	Coolwater	11	Clintwood/Haysi
Kerr Reservoir, Virginia portion (Buggs Island Lake)	Halifax County,	Coolwater	9	John H. Kerr Dam/Tungsten/Clarksville South/Clarkesville North
Keysville Reservoir	Charlotte County	Warmwater	9	Eureka/Keysville
Lake Albemarle	Albemarle County	Warmwater	9	Crozet
Lake Anna	Louisa County	Coolwater	9	Lake Anna East/Lake Anna West/Mineral
Lake Arrowhead	Page County	Warmwater	11	Luray
Lake Burnt Mills	Isle of Wight County	Warmwater	14	Chuckatuck/Windsor
Lake Chesdin	Chesterfield County	Warmwater	9	Sutherland/Beach/Winterpock
Lake Cohoon	Suffolk City	Warmwater	14	Windsor
Lake Conner	Halifax County	Warmwater	9	Conner Lake
Lake Frederick	Frederick County	Warmwater	11	Stephens City
Lake Gaston, (Virginia portion)	Brunswick County	Coolwater	9	South Hill SE/Bracey
Lake Gordon	Mecklenburg County	Warmwater	9	South Hill
Lake Keokee	Lee County	Warmwater	11	Big Stone Gap
Lake Kilby	Suffolk City	Warmwater	14	Suffolk
Lake Lawson	Virginia Beach City	Warmwater	14	Little Creek
Lake Manassas	Prince William County	Warmwater	9	Thoroughfare Gap
Lake Meade	Suffolk City	Warmwater	14	Chucktuck/Suffolk
Lake Moomaw	Bath County,	Coldwater	11	Falling Spring/Mountain Grove
Lake Nelson (Nelson Lake)	Nelson County	Fertilized	9	Arrington
Lake Nottoway (Lee Lake, Nottoway Lake)	Nottoway County	Warmwater	9	Wellville
Lake Pelham	Culpeper County	Warmwater	9	Culpeper West

Lake Prince	Suffolk City	Warmwater	14	Windsor
Lake Robertson	Rockbridge County	Warmwater	11	Collierstown
Lake Smith	Virginia Beach City	Warmwater	14	Little Creek
Lake Whitehurst	Norfolk City	Warmwater	14	Little Creek
Lake Wright	Norfolk City	Warmwater	14	Little Creek
Lakeview Reservoir	Chesterfield County	Warmwater	9	Chester
Laurel Bed Lake	Russell County	Warmwater	11	Saltville
Lee Hall Reservoir (Newport News Reservoir) (City Reservoir)	Newport News	Warmwater	14	Yorktown
Leesville Reservoir (Leesville Lake)	Bedford County	Coolwater	9	Leesville
Little Creek Reservoir	Virginia Beach City	Warmwater	14	Little Creek
Little Creek Reservoir	James City County	Coolwater	9	Norge
Little River Reservoir	Montgomery County	Warmwater	11	Radford South
Lone Star Lake F (Crystal Lake)	Suffolk City	Warmwater	14	Chuckatuck
Lone Star Lake G (Crane Lake)	Suffolk City	Warmwater	14	Chuckatuck
Lone Star Lake I (Butler Lake)	Suffolk City	Warmwater	14	Chuckatuck
Lunga Reservoir	Prince William County	Warmwater	9	Joplin
Lunenburg Beach Lake (Victoria Lake)	Town of Victoria	Warmwater	9	Kenbridge West
Martinsville Reservoir (Beaver Creek Reservoir)	Henry County	Warmwater	9	Martinsville East/ Snow Creek
Mill Creek Reservoir	Amherst County	Warmwater	9	Piney River
Modest Creek Reservoir	Town of Victoria	Warmwater	9	Rubermont
Motts Run Reservoir	Spotsylvania County	Coolwater	9	Salem Church
Mount Jackson Reservoir	Shenandoah County	Warmwater	11	Hamburg
Mountain Run Lake	Culpeper County	Warmwater	9	Culpeper West
Ni Reservoir	Spotsylvania County	Warmwater	9	Salem Church/ Spotsylvania/Brokenburg/ Chancellorsville
North Fork Pound Reservoir (North Fork Pound River Lake)	Wise County	Warmwater	11	Flat Gap
Northeast Creek Reservoir	Louisa County	Warmwater	9	Pendleton
Occoquan Reservoir	Fairfax County	Warmwater	9	Occoquan
Pedlar Lake (Lynchburg Reservoir)	Amherst County	Warmwater	11	Buena Vista
Philpott Reservoir (Philpott Lake)	Henry County	Coolwater	9	Philpott Lake
Phelps Creek Reservoir (Brookneal Reservoir)	Campbell County	Warmwater	9	Brookneal
Ragged Mountain Reservoir (Charlottesville Reservoir)	Albemarle County	Warmwater	9	Charlottesville West

<b>Rivanna Reservoir (South Fork Rivanna Reservoir)</b>	<b>Albemarle County</b>	<b>Warmwater</b>	<b>9</b>	<b>Charlottesville East/ Charlottesville West</b>
<b>Roaring Fork</b>	<b>Pittsylvania County</b>	<b>Warmwater</b>	<b>9</b>	<b>Chatham</b>
<b>Rural Retreat Lake</b>	<b>Wythe County</b>	<b>Warmwater</b>	<b>11</b>	<b>Cedar Springs</b>
<b>Sandy River Reservoir</b>	<b>Prince Edward County</b>	<b>Warmwater</b>	<b>9</b>	<b>Rice</b>
<b>Shenandoah Lake (Lake Shenandoah)</b>	<b>Rockingham County</b>	<b>Warmwater</b>	<b>11</b>	<b>Harrisonburg</b>
<b>Silver Lake</b>	<b>Rockingham County</b>	<b>Warmwater</b>	<b>11</b>	<b>Bridgewater</b>
<b>Smith Mountain Lake</b>	<b>Bedford County</b>	<b>Coolwater</b>	<b>9</b>	<b>Goodview/Moneta SW/ Smith Mountain Dam</b>
<b>South Holston Reservoir</b>	<b>Washington County</b>	<b>Coolwater</b>	<b>11</b>	<b>Abingdon/Shady Valley/ Holston Valley</b>
<b>Speights Run Lake</b>	<b>Suffolk City</b>	<b>Warmwater</b>	<b>14</b>	<b>Buckhorn</b>
<b>Spring Hollow Reservoir</b>	<b>Roanoke County</b>	<b>Coolwater</b>	<b>11</b>	<b>Elliston</b>
<b>Staunton Dam Lake (Staunton Reservoir)</b>	<b>Augusta County</b>	<b>Warmwater</b>	<b>11</b>	<b>Stokesville</b>
<b>Stonehouse Creek Reservoir</b>	<b>Amherst County</b>	<b>Fertilized</b>	<b>9</b>	<b>Piney River</b>
<b>Strasburg Reservoir</b>	<b>Shenandoah County</b>	<b>Warmwater</b>	<b>11</b>	<b>Strasburg</b>
<b>Stumpy Lake</b>	<b>Virginia Beach</b>	<b>Warmwater</b>	<b>14</b>	<b>Kempsville</b>
<b>Sugar Hollow Reservoir (Charlottesville Reservoir)</b>	<b>Albemarle County</b>	<b>Coolwater</b>	<b>11</b>	<b>Browns Cove</b>
<b>Swift Creek Lake</b>	<b>Chesterfield County</b>	<b>Warmwater</b>	<b>9</b>	<b>Chesterfield</b>
<b>Swift Creek Reservoir</b>	<b>Chesterfield County</b>	<b>Warmwater</b>	<b>9</b>	<b>Hallsboro</b>
<b>Switzer Lake</b>	<b>Rockingham County</b>	<b>Coldwater</b>	<b>11</b>	<b>Brandywine</b>
<b>Talbott Reservoir</b>	<b>Patrick County</b>	<b>Warmwater</b>	<b>11</b>	<b>Meadows of Dan</b>
<b>Thrashers Creek Reservoir</b>	<b>Amherst County</b>	<b>Warmwater</b>	<b>9</b>	<b>Forks of Buffalo</b>
<b>Totier Creek Reservoir</b>	<b>Albemarle County</b>	<b>Warmwater</b>	<b>9</b>	<b>Esmont</b>
<b>Townes Reservoir</b>	<b>Patrick County</b>	<b>Coolwater</b>	<b>11</b>	<b>Meadows of Dan</b>
<b>Troublesome Creek Reservoir</b>	<b>Buckingham County</b>	<b>Warmwater</b>	<b>9</b>	<b>Buckingham</b>
<b>Waller Mill Reservoir</b>	<b>York County</b>	<b>Coolwater</b>	<b>9</b>	<b>Williamsburg</b>
<b>Western Branch Reservoir</b>	<b>Suffolk City</b>	<b>Coolwater</b>	<b>14</b>	<b>Chuckatuck</b>
<b>Wise Reservoir</b>	<b>Wise County</b>	<b>Coolwater</b>	<b>11</b>	<b>Wise</b>

**APPENDIX II**

**Lakes Prioritization Ranking Procedure**

	<b>RESOURCE VALUE IMPORTANCE</b>	<b>DEGREE of USE IMPAIRMENT</b>	<b>PROBLEM ID STATUS</b>	<b>PROBABILITY to CONTROL PROBLEM</b>	<b>URGENCY to ADDRESS PROBLEM</b>	<i>TOTALS</i>
<b>PUBLIC WATER SUPPLY</b>	5 x = A.1.	5 x = A.2.	2 x = A.3.	2 x = A.4.	5 x = A.5.	
<b>HUMAN CONSUMPTION FISH/BIOTA</b>	5 x = B.1.	2 x = B.2.	2 x = B.3.	2 x = B.4.	5 x = B.5.	
<b>PRIMARY CONTACT (Swimming)</b>	2 x = C.1.	2 x = C.2.	2 x = C.3.	2 x = C.4.	5 x = C.5.	
<b>AQUATIC LIFE PROTECTION</b>	2 x = D.1.	2 x = D.2.	2 x = D.3.	2 x = D.4.	2 x = D.5.	
<b>BOATING/ RECREATION ACTIVITY</b>	1 x = E.1.	1 x = E.2.	1 x = E.3.	1 x = E.4.	1 x = E.5.	

Priority Total =

***RANKING MULTIPLIER EXPLANATIONS***

**PUBLIC WATER SUPPLY**

**A.1. : PUBLIC WATER SUPPLY - RESOURCE VALUE IMPORTANCE**

- 0 = NOT APPLICABLE, No public water supply use.
- 1 = <10% of total supply and no other supplies impacted.
- 2 = >10%<30% of total supply or <10% & other supplies impacted.
- 3 = >30%<50% of total supply and no other supplies impacted.
- 4 = >30%<50% of total supply and other supplies impacted.
- 5 = ≥50% of total supply.

**A.2. : PUBLIC WATER SUPPLY - DEGREE of USE IMPAIRMENT**

- 0 = NOT APPLICABLE, No impairment.
- 1 = DEQ preliminary data indicates possible exceedance of human health criteria and/or degraded water quality impairs treatability.
- 2 = VDH warning issued to limit consumption and/or DEQ data confirmed exceeding human health criteria.
- 3 = Suspension of use as PWS ≥ 7<30 days during any 12 month period or Included on 303d listing as threatened for PWS use.
- 4 = VDH advisory issued limiting consumption, and/or suspension of use as PWS ≥ 30 days during any 12 month period.
- 5 = Suspension of use as PWS > 60 days during any 12 month period or Included on 303d listing as impaired.

**A.3. : PUBLIC WATER SUPPLY - PROBLEM IDENTIFICATION STATUS**

- 0 = NOT APPLICABLE, No water supply use impairment.
- 1 = No data collected to date but strong potential for impairment to water supply use.
- 2 = Complaint info. or minimal data collected indicating strong potential for impairment.
- 3 = Included on 303d listing as threatened or sufficient information indicating impairment.
- 4 = Included on 303d listing as impaired or sufficient data to confirm impairment.
- 5 = Criteria #4 and ID of cause of impairment.

**A.4. : PUBLIC WATER SUPPLY - PROBABILITY to CONTROL PROBLEM**

- 0 = NOT APPLICABLE, No water supply use impairment.
- 1 = Very low probability (considered none) to control problem.
- 2 = Low probability of control, technology does not exist, extremely difficult to apply existing technology, undefined NPS causes.
- 3 = Moderate probability of control, TMDL scheduled for development, technology exists, difficult/impractical to apply existing technology.
- 4 = High probability of control, TMDL scheduled within 5 yrs., technology applied successfully elsewhere.
- 5 = Control mechanism in development with high probability of control .

**A.5. : PUBLIC WATER SUPPLY - URGENCY to ADDRESS PROBLEM**

- 0 = NOT APPLICABLE, No water supply use impairment.
- 1 = Very low/no urgency, not listed as impaired (303d), no significant impacts of impairment, no outside motivation.
- 2 = Low urgency for control, listed as threatened (303d), possible significant impacts of impairment not yet experienced, no outside motivation.
- 3 = Moderate urgency for control, TMDL scheduled for development, significant impacts of impairment not yet experienced, outside motivation/public requests.
- 4 = High urgency for control, TMDL scheduled within 3 yrs., significant impacts of impairment infrequently experienced, outside motivation/public requests reaching executive mgmt. levels.
- 5 = Control needed  $\leq$  one year, significant health effects other significant impacts to community due to impairment.

**HUMAN CONSUMPTION of FISH/BIOTA**

**B.1. : HUMAN CONSUMPTION of FISH/BIOTA - RESOURCE VALUE IMPORTANCE**

- 0 = NOT APPLICABLE, No known human consumption of fish/biota from lake or human consumption of fish/biota prohibited and prohibition for human consumption of fish/biota not due to contamination.
- 1 = Minimal human consumption of fish/biota species.
- 2 = Moderate human consumption of fish/biota species.
- 3 = Significant human consumption of fish/biota species.
- 4 = Fish/biota comprise irreplaceable segment of communities food supply.

**B.2. : HUMAN CONSUMPTION of FISH/BIOTA - DEGREE of USE IMPAIRMENT**

- 0 = NOT APPLICABLE, No known impairment of human consumption of fish/biota from lake or human consumption of fish/biota prohibited not due to contamination.
- 1 = Infrequent and temporary loss of resource use primarily due to non-anthropogenic causes.
- 2 = DEQ preliminary data indicates possible exceedance of human health criteria.
- 3 = VDH advisory issued limiting consumption for portion of the population, or suspension of use <30 days during any 12 month period or DEQ data confirms exceedance of FDA criteria.
- 4 = VDH advisory issued limiting consumption for entirety of the population, suspension of use  $\geq$  30 days during any 12 month period or Included on 303d listing as impaired and cause due to presence of human health toxics.

- 5 = Suspension of primary contact use > 60 days during any 6 month period or data confirms persistent exceedances of human health toxics criteria.

**B.3. : HUMAN CONSUMPTION of FISH/BIOTA - PROBLEM IDENTIFICATION STATUS**

- 0 = NOT APPLICABLE, No impairment to human consumption of fish/biota.
- 1 = No data collected to date but strong potential for impairment to human consumption of fish/biota.
- 2 = Complaint info. or minimal data collected indicating strong potential for impairment to human consumption of fish/biota.
- 3 = Included on 303d listing as threatened or sufficient information indicating impairment.
- 4 = Included on 303d listing as impaired or sufficient data to confirm impairment.
- 5 = Criteria #4 and ID of cause of impairment.

**B.4. : HUMAN CONSUMPTION of FISH/BIOTA - PROBABILITY to CONTROL PROBLEM**

- 0 = NOT APPLICABLE, No impairment to human consumption of fish/biota.
- 1 = Very low probability (considered none) to control problem.
- 2 = Low probability of control, technology does not exist, extremely difficult to apply existing technology, undefined NPS causes.
- 3 = Moderate probability of control, TMDL scheduled for development, technology exists, difficult/impractical to apply existing technology.
- 4 = High probability of control, TMDL scheduled within 5 yrs., technology applied successfully elsewhere.
- 5 = Control mechanism in development with high probability of control .

**B.5. : HUMAN CONSUMPTION of FISH/BIOTA - URGENCY to ADDRESS PROBLEM**

- 0 = NOT APPLICABLE, No impairment to human consumption of fish/biota.
- 1 = Very low/no urgency, not listed as threatened (303d), no significant impacts of impairment, no outside motivation.
- 2 = Low urgency for control, listed as threatened (303d), possible significant impacts of impairment not yet experienced, no outside motivation.
- 3 = Moderate urgency for control, TMDL scheduled for development, significant impacts of impairment not yet experienced, outside motivation/public requests.
- 4 = High urgency for control, TMDL scheduled within 3 yrs., significant impacts of impairment infrequently experienced, outside motivation/public requests reaching executive mgmt. levels.
- 5 = Control needed  $\leq$  one year, significant health effects or other significant impacts to community due to impairment.

**PRIMARY CONTACT (Swimming)**

**C.1. : PRIMARY CONTACT (Swimming) - RESOURCE VALUE IMPORTANCE**

- 0 = NOT APPLICABLE, No known primary contact occurs or primary contact prohibited and is not due to contamination by indicators/pathogens.
- 1 = Primary contact not prohibited, no swimming areas designated, conditions not conducive to swimming, no data primary contact occurs.
- 2 = Minimal primary contact occurs, no swimming areas designated, conditions sporadically support swimming, information that primary contact occurs occasionally.
- 3 = Moderate primary contact occurs, few swimming areas designated, conditions usually support swimming, information that primary contact occurs seasonally.
- 4 = Significant primary contact occurs, multiple swimming areas designated, conditions support swimming, information that primary contact occurs regularly.
- 5 = Significant primary contact resource, area important recreational swimming resource, multiple swimming areas designated, loss of primary contact resource would be irreplaceable.



**C.2. : PRIMARY CONTACT (Swimming) - DEGREE of USE IMPAIRMENT**

- 0 = NOT APPLICABLE, No impairment or no known primary contact occurs.
- 1 = Infrequent and temporary loss of primary contact use primarily due to non-anthropogenic causes.
- 2 = VDH warning issued to limit primary contact during infrequent periods, suspension of use for primary contact  $\geq 7$  days during any 12 month period, or Included on 303d listing as threatened for fecal coliform contamination.
- 3 = VDH advisory issued limiting primary contact for portion of the population, suspension of primary contact use  $>7 < 30$  days during any 12 month period or Included on 303d listing as impaired.
- 4 = VDH advisory issued limiting primary contact for entirety of the population, suspension of primary contact use  $\geq 30$  days during any 12 month period or Included on 303d listing as impaired and cause due to presence of human pathogens.
- 5 = Suspension of primary contact use  $> 60$  days during any 6 month period or persistent source of human pathogens established.

**C.3. : PRIMARY CONTACT (Swimming) - PROBLEM IDENTIFICATION STATUS**

- 0 = NOT APPLICABLE, no impairment or no known primary contact occurs.
- 1 = No data collected to date but strong potential for impairment primary contact use.
- 2 = Complaint info. or minimal data collected indicating strong potential for impairment.
- 3 = Included on 303d listing as threatened or sufficient information indicating impairment, documented incidence of human illness due to primary contact .
- 4 = Included on 303d listing as impaired, sufficient data to confirm impairment, or multiple incidences of human illness due to primary contact.
- 5 = Criteria #4 and ID of cause of impairment.

**C.4. : PRIMARY CONTACT (Swimming) - PROBABILITY to CONTROL PROBLEM**

- 0 = NOT APPLICABLE, no impairment or no known primary contact occurs.
- 1 = Very low probability (considered none) to control problem.
- 2 = Low probability of control, technology does not exist, extremely difficult to apply existing technology, undefined NPS causes.
- 3 = Moderate probability of control, TMDL scheduled for development, technology exists, good potential to apply existing technology, defined NPS causes.
- 4 = High probability of control, TMDL scheduled within 5 yrs., technology applied successfully elsewhere.
- 5 = Control mechanism in development with high probability of control .

**C.5. : PRIMARY CONTACT (Swimming) - URGENCY to ADDRESS PROBLEM**

- 0 = NOT APPLICABLE, no impairment or no known primary contact occurs.
- 1 = Very low/no urgency, not listed as threatened (303d), no significant impacts of impairment, no outside motivation.
- 2 = Low urgency for control, listed as threatened (303d), possible significant impacts of impairment not yet experienced, no outside motivation.
- 3 = Moderate urgency for control, TMDL scheduled for development, significant impacts of impairment not yet experienced, outside motivation/public requests.
- 4 = High urgency for control, TMDL scheduled within 3 yrs., significant impacts of impairment infrequently experienced, outside motivation/public requests reaching executive mgmt. levels.
- 5 = Control needed  $\leq$  one year, significant health effects or other significant impacts to community due to impairment.

## **AQUATIC LIFE PROTECTION**

### **D.1. : AQUATIC LIFE PROTECTION - RESOURCE VALUE IMPORTANCE**

- 0 = NOT APPLICABLE, only where use has been removed in the Water Quality Standards.
- 1 = Small/shallow warm water areas with little fishing pressure, natural conditions not conducive to significant aquatic life populations.
- 2 = Minimally significant aquatic life populations, some mixed stream areas present, natural conditions do not support significant spawning/nursery, no significant commercial or recreational fishing, no endangered, threatened, or special interest species.
- 3 = Moderately significant aquatic life populations, natural conditions would support significant spawning/nursery, moderately significant commercial or recreational fishing, no endangered, threatened, or special interest species, information of significant aquatic populations occurs seasonally.
- 4 = Significant aquatic life populations, natural conditions have historically supported significant spawning/nursery, significant commercial or recreational fishing, few number or few members of endangered, threatened, or special interest species, cold water fishing Class V or VI waters.
- 5 = Significant aquatic life populations, established as a significant spawning/nursery, renowned commercial or recreational fishing, many number or many members of endangered, threatened, or special interest species, cold water fishing Class V or VI, or Tier 3 waters, loss of aquatic life populations resource would be irreplaceable.

### **D.2. : AQUATIC LIFE PROTECTION - DEGREE of USE IMPAIRMENT**

- 0 = NOT APPLICABLE (WHERE THIS USE HAS BEEN REMOVED IN THE WQS), or no known impairment.
- 1 = Impairment not due to anthropogenic causes, natural conditions not conducive to significant aquatic life populations.
- 2 = Minimally significant anthropogenic impairment, combination with #1, benthic monitoring rating Good-Fair (slight impairment), slight reductions in aquatic life population densities or diversity.
- 3 = Moderately significant anthropogenic impairment, benthic monitoring rating Fair or Fair-Poor (moderate impairment) but not identified on 303d listing, identifiable reductions in aquatic life population densities or diversity.
- 4 = Significant anthropogenic impairment, benthic monitoring rating Fair or Fair-Poor (moderate impairment) and IS identified on current 303d listing, identifiable reductions in aquatic life population densities or diversity which has effect on aquatic community.
- 5 = Severe anthropogenic impairment, benthic monitoring rating Poor (severe impairment) and IS identified on current 303d listing, identifiable reductions in aquatic life population densities or diversity which has irreplaceable/permanent effect on aquatic community.

### **D.3. : AQUATIC LIFE PROTECTION - PROBLEM IDENTIFICATION STATUS**

- 0 = NOT APPLICABLE, No impairment to fish/biota.
- 1 = No data collected to date but potential for impairment to aquatic community.
- 2 = Complaint info. or minimal data collected indicating potential for impairment to aquatic community.
- 3 = Included on 303d listing as threatened or sufficient information indicating impairment.
- 4 = Included on 303d listing as impaired or sufficient data to confirm impairment.
- 5 = Criteria #4 and ID of cause of impairment.

### **D.4. : AQUATIC LIFE PROTECTION - PROBABILITY to CONTROL PROBLEM**

- 0 = NOT APPLICABLE, no impairment.
- 1 = Very low probability (considered none) to control problem.
- 2 = Low probability of control, technology does not exist, extremely difficult to apply existing technology, undefined NPS causes.

- 3 = Moderate probability of control, TMDL scheduled for development, technology exists, good potential to apply existing technology, defined NPS causes.
- 4 = High probability of control, TMDL scheduled within 5 yrs., technology applied successfully elsewhere.
- 5 = Control mechanism in development with high probability of control .

**D.5. : AQUATIC LIFE PROTECTION - URGENCY to ADDRESS PROBLEM**

- 0 = NOT APPLICABLE, no impairment or aquatic life resource does not apply.
- 1 = Very low/no urgency, not listed as threatened (303d), no significant impacts of impairment, no outside motivation.
- 2 = Low urgency for control, listed as threatened (303d), possible significant impacts of impairment not yet experienced, no outside motivation.
- 3 = Moderate urgency for control, TMDL scheduled for development, significant impacts of impairment not yet experienced, outside motivation/public requests.
- 4 = High urgency for control, TMDL scheduled within 3 yrs., significant impacts of impairment infrequently experienced, outside motivation/public requests reaching executive mgmt. levels.
- 5 = Control needed  $\leq$  one year, significant health effects or other significant impacts to community due to impairment.

**BOATING/RECREATION ACTIVITY**

**E.1. : BOATING/RECREATION ACTIVITY - RESOURCE VALUE IMPORTANCE**

- 0 = NOT APPLICABLE, No known boating/recreation activity occurs due to no accessibility or activity is prohibited and is not due to anthropogenic activity.
- 1 = Small/shallow water areas with little boating/recreation activity , natural conditions not conducive to significant boating/recreation activity .
- 2 = Minimally significant boating/recreation activity, some mixed stream areas present, occasionally natural conditions do not support boating/recreation activity, waters not identified to support boating/recreation activity, minimal public access allowed.
- 3 = Moderately significant boating/recreation activity, natural conditions would usually support significant boating/recreation activity, moderate public access allowed, moderate boating/recreation activity occurs seasonally.
- 4 = Significant boating/recreation activity, natural conditions have historically supported significant boating/recreation activity, public access allowed at multiple locations and/or waterside parks provided, boating/recreation activity routinely scheduled for these waters, boating/recreation activity occurs > six months during a year.
- 5 = Significant boating/recreation activity, established as a significant/renowned area of boating/recreation activity, large scale boating/recreation activity routinely scheduled for these waters, loss of resource would be irreplaceable.

**E.2. : BOATING/RECREATION ACTIVITY - DEGREE of USE IMPAIRMENT**

- 0 = NOT APPLICABLE, no known impairment.
- 1 = Impairment not due to anthropogenic causes, natural conditions not conducive to boating/recreation activity.
- 2 = Minimally significant anthropogenic impairment to boating/recreation activity, combination with #1.
- 3 = Moderately significant anthropogenic impairment to boating/recreation activity, impairment to portion of the user community.
- 4 = Significant anthropogenic impairment to boating/recreation activity, impairment to majority of the user community, identifiable reductions in use by boating/recreation community.
- 5 = Severe anthropogenic impairment to boating/recreation activity, impairment to all but minority of the user community, identifiable reductions in use by boating/recreation community which has irreplaceable/permanent effect on user community.

**E.3. : BOATING/RECREATION ACTIVITY - PROBLEM IDENTIFICATION STATUS**

- 0 = NOT APPLICABLE, No impairment to boating/recreation activity.
- 1 = No data collected to date but strong potential for impairment to boating/recreation activity.
- 2 = Complaint info. or minimal data collected indicating strong potential for impairment to boating/recreation activity.
- 3 = Confirming studies completed or sufficient information indicating impairment to boating/recreation activity.
- 4 = Confirming studies completed indicating causes of impairment or sufficient data to confirm impairment boating/recreation activity.
- 5 = Criteria #4 and ID of remedial actions to remove impairment to boating/recreation activity.

**E.4. : BOATING/RECREATION ACTIVITY - PROBABILITY to CONTROL PROBLEM**

- 0 = NOT APPLICABLE, no impairment to boating/recreation activity.
- 1 = Very low probability (considered none) to control problem.
- 2 = Low probability of control, technology does not exist, extremely difficult to apply existing technology, undefined NPS causes.
- 3 = Moderate probability of control, TMDL scheduled for development, technology exists, good potential to apply existing technology, defined NPS causes.
- 4 = High probability of control, TMDL scheduled within 5 yrs., technology applied successfully elsewhere.
- 5 = Control mechanism in development with high probability of control .

**BOATING/RECREATION ACTIVITY**

**E.5. : BOATING/RECREATION ACTIVITY - URGENCY to ADDRESS PROBLEM**

- 0 = NOT APPLICABLE, no impairment to boating/recreation activity or resource does not apply.
- 1 = Very low/no urgency, no significant impacts of impairment, no outside motivation.
- 2 = Low urgency for control, possible significant impacts of impairment not yet experienced, no outside motivation.
- 3 = Moderate urgency for control, significant impacts of impairment not yet experienced, outside motivation/public requests.
- 4 = High urgency for control, remediation activities are scheduled within 3 yrs., significant impacts of impairment infrequently experienced, outside motivation/public requests for remediation reaching executive mgmt. levels.
- 5 = Control needed  $\leq$  one year, significant health effects or other significant impacts to community due to impairment.

I:\stephenc\assign\lakeprio.wpd

### APPENDIX III

#### Significant Lakes and Reservoirs by Region

##### ***Northern Regional Office – 18 Reservoirs/Lakes***

**Abel Lake** Stafford Co. 185 (Acres) PWS  
**Lake Anna** Louisa, Spotsylvania, Orange 9,600  
**Aquia Reservoir** Stafford Co. 219 PWS  
(Smith Lake)  
**Beaverdam Reservoir** Loudoun Co. 350 PWS  
**Breckenridge Reservoir** Prince William Co. 85 PWS  
**Burke Lake** Fairfax Co. 218 VDGIF  
**Curtis Lake** Stafford Co.  
**Goose Creek Reservoir** Loudoun Co. 140 PWS  
**Hunting Run Reservoir** Spotsylvania Co. 430 PWS  
Lake Orange Orange Co. 124 VDGIF  
**Lake Manassas** Prince William Co. 741 PWS  
**Lunga Reservoir** Prince William Co. 420 PWS  
**Motts Run Reservoir** Spotsylvania Co. 160 PWS  
**Mountain Run Lake** Culpeper Co. 75 PWS  
**Ni Reservoir** Spotsylvania Co. 400 PWS  
**Northeast Creek Res.** Louisa Co. 49 PWS  
**Occoquan Reservoir** Fairfax, Prince William Co. 1700 PWS  
**Lake Pelham** Culpeper Co. 253 PWS

##### ***Piedmont Regional Office – 12 Reservoirs/Lakes***

**Airfield Pond** Sussex Co. 105 VDGIF  
**Amelia Lake** Amelia Co. 110 VDGIF  
**Brunswick Lake** Brunswick Co. 150 VDGIF  
**Lake Chesdin** Chesterfield Co. 3196 PWS  
**Chickahominy Lake** Charles City Co. 1500 PWS  
**Diascund Reservoir** New Kent Co. 1700 PWS  
**Emporia Lake** Greensville Co. 210 PWS  
**Falling Creek Reservoir** Chesterfield Co. 110  
**Great Creek Reservoir** Lawrenceville 305  
**Harrison Lake** Charles City Co.  
**Lakeview Reservoir** Chesterfield Co.  
Swift Creek Lake Chesterfield Co. 156  
**Swift Creek Reservoir** Chesterfield Co. 1800 PWS

##### ***Blue Ridge Regional Office (BRRO) Lynchburg Office – 24 Reservoirs/Lakes***

**Briery Creek Lake** Pr. Edward Co. 845 VDGIF  
**Phelps Creek Reservoir** Campbell Co. 26 PWS  
**Cherrystone Reservoir** Pittsylvania Co. 118 PWS  
**Georges Creek Reservoir** Pittsylvania Co. 10 PWS  
**Lake Gordon** Mecklenburg Co. 112 VDGIF  
**Graham Creek Reservoir** Amherst Co. 48 PWS  
Banister Lake Halifax Co. 381 PWS  
**Holiday Lake** Appomattox Co. 115  
**Kerr Reservoir** (Va.'s portion) Halifax Co. 33251 ACOE/PWS  
**Keysville Reservoir** Charlotte Co. 42 PWS  
**Lake Conner** Halifax Co. 103 VDGIF  
**Lake Gaston** (Va.'s portion) Brunswick Co. 5530 PWS

**Lunenburg Beach Lake** Town of Victoria 12 PWS  
**Mill Creek Reservoir** Amherst Co. 189  
**Modest Creek Reservoir** Town of Victoria 21 PWS  
**Nottoway Falls Lake** Lunenburg Co. 32 PWS  
**Fort Pickett Reservoir** Nottoway Co. 198  
**Lake Nottoway** Nottoway Co. 55 PWS  
**Pedlar Lake** Amherst Co. 117 PWS  
**Roaring Fork** Pittsylvania Co. 25 PWS  
**Sandy River Reservoir** Prince Edward Co. 740  
**Stonehouse Creek Reservoir** Amherst Co. 125  
**Thrashers Creek Reservoir** Amherst Co. 110  
**Troublesome Creek Reservoir** Buckingham Co. 72 PWS  
(SCS Impoundment #2)

***Southwest Regional Office – 11 Reservoirs***

**Big Cherry Lake** Wise Co. 106 PWS  
**J. W. Flannagan Reservoir** Dickenson Co. 1143 ACOE/PWS  
**Hungry Mother Lake** Smyth Co. 108 DCR  
**Lake Keokee** Lee Co. 100 VDGIF  
**Laurel Bed Lake** Russell Co. 210 VDGIF  
**North Fork Pound Reservoir** Wise Co. 154 ACOE/PWS  
**South Holston Reservoir** Washington Co. 1810 TVA/PWS  
**Wise Reservoir** Wise Co. 30 WISE/PWS  
**Rural Retreat Lake** Wythe Co. 85 VDGIF  
**Hidden Valley Lake** Russell Co. 90 VDGIF  
**Bark Camp Lake** Scott Co. 47 USFS

***Tidewater Regional Office – 21 Reservoirs/Lakes***

**Lake Cahoon** Suffolk City 454 PWS  
**Lake Burnt Mills** Isle of Wight Co. 638 PWS  
**Harwood Mills Reservoir** York Co. 258 PWS  
**Lake Kilby** Suffolk City 200 PWS  
**Lake Lawson** Virginia Beach 75  
**Lee Hall Reservoir** Newport News 290 PWS  
**Little Creek Reservoir** Norfolk City 200 PWS  
**Little Creek Reservoir** James City Co. 926 PWS  
**Lone Star Lake F** Suffolk City 19 PWS  
**Lone Star Lake G** Suffolk City 90 PWS  
**Lone Star Lake I** Suffolk City 33 PWS  
**Lake Meade** Suffolk City 490 PWS  
**Lake Prince** Suffolk City 709 PWS  
**Lake Smith** Norfolk City 185 PWS  
**Speights Run Lake** Suffolk City 118 PWS  
**Stumpy Lake** Virginia Beach 263  
**Waller Mill Reservoir** York Co. 288 PWS  
**Lake Whitehurst** Norfolk City 495 PWS  
**Lake Wright** Norfolk City 12  
**Western Branch Reservoir** Norfolk City 1205 PWS  
**Lake Drummond** Suffolk City 3242

**Valley Regional Office – 18 Reservoirs/Lakes**

**Beaver Creek Reservoir** Albemarle Co. 104 PWS

**Douthat Lake** Bath Co. 35

**Coles Run Reservoir** Augusta Co. 7 USFS/PWS

**Elkhorn Lake** Augusta Co. 55 USFS/PWS

**Lake Albemarle** Albemarle Co.

**Lake Frederick** Frederick Co. 120 VDGIF

**Lake Nelson** Nelson Co.

**Lake Robertson** Rockbridge Co.

**Mount Jackson Reservoir** Shenandoah Co.

**Ragged Mount Reservoir** Albemarle Co. 54 PWS

**Rivanna Reservoir** Albemarle Co. 390 PWS

**Shenandoah Lake** Rockingham Co.

**Silver Lake** Rockingham Co. 10.9 PWS

**Staunton Dam Lake** Augusta Co. 30 PWS

**Strasburg Reservoir** Shenandoah Co.

**Switzer Lake** Rockingham Co. 110 USFS/PWS

**Sugar Hollow Reservoir** Albemarle Co. 47 PWS

**Totier Creek Reservoir** Albemarle Co. 66 PWS

**BRRO Roanoke Office – 18 Reservoirs/Lakes**

**Beaverdam Creek Reservoir** Bedford Co. 70 PWS

**Bedford (Stony Cr.) Reservoir** Bedford Co. 25 PWS

**Carvin Cove Reservoir** Botetourt Co. 668 PWS

**Claytor Lake** Pulaski Co. 4349 PWS

**Clifton Forge (Smith Cr.) Reservoir** Alleghany Co. 12 PWS

Falling Creek Reservoir Bedford Co. 18 PWS

**Fairystone Lake** Henry Co. 123

**Gatewood Reservoir** Pulaski Co. 182 PWS

**Hogan Lake** Pulaski Co. 43 PWS

**Leesville Reservoir** Bedford Co. 2728 PWS

**Little River Reservoir** Montgomery Co. 63 PWS

**Martinsville Reservoir** Henry Co. 192 PWS

**Lake Moomaw** Bath Co. 2303 ACOE

**Philpott Reservoir** Henry Co. 2893 ACOE

**Smith Mountain Lake** Bedford Co. 19994 PWS

**Spring Hollow Reservoir** Roanoke Co. 121 PWS

**Talbott Reservoir** Patrick Co. 125

**Townes Reservoir** Patrick Co. 21

**Total 122 Significant Reservoirs/Lakes statewide**

PWS = Public Water Supply

VDGIF = Virginia Department of Game and Inland Fisheries

ACOE = Army Corps of Engineers

TVA = Tennessee Valley Authority

**Bold** = Nutrient WQ Stand